Refugee Inflows, Surplus Farm Labor, and Crop Marketization in Rural Africa*

Shunsuke Tsuda†
Brown University

November 24, 2021

Abstract

This paper sheds light on the structure of factor and output market frictions to investigate long-term effects of refugee inflows on host farmers. Combining a canonical agricultural household model, the natural experimental setting of mass refugee inflows into Tanzania in the early 1990s, and longitudinal panel data from the host economy, I show that refugee inflows cause market-specific gains and losses. Refugee inflows tighten the off-farm labor market participation constraint, implying an increase in surplus farm labor and labor market inefficiency. On the other hand, I observe a positive impact on the transition from subsistence to crop marketization. This transition is revealed to be primarily due to a reduction in fixed transaction costs around refugee camps, not due to an increase in consumption demand by refugees. While the overall impact on agricultural labor productivity is negative, the "surplus farm labor effect" and the "crop marketization effect" act in opposite directions.

JEL Classification: O12, O15, Q12, R23
Keywords: Refugees, Host economies, Agricultural household models, Market transaction costs, Food aid, Sub-Saharan Africa

*I am grateful to the Corresponding Editor, Rema Hanna, and two anonymous referees for their detailed suggestions to improve the paper. For helpful comments, I thank Bryce Steinberg, Brian Dillon, Jo Fisher, Andrew Foster, Jamie Hansen-Lewis, Tomohiro Hara, Hidehiko Ichimura, Takashi Kurosaki, Ruchi Mahadeshwar, Daniel Marszalec, Patrick Mayer, Obie Porteous, Isabel Ruiz, Yasuyuki Sawada, Kelley Smith, Yoko Suzuki, Kenichi Ueda, Junichi Yamasaki, and participants of Research Conference on Forced Displacement at UN City (Copenhagen), Kobe-DEEH, NEUDC (Cornell), JEA meeting (Nagoya-U), and U-Tokyo Microeconomics Workshop. Financial support from Japan Society for the Promotion of Science (Grant No. 16J07869) and Japan Student Services Organization (Grant No. L16126010011) are acknowledged. All remaining errors are mine.

†Department of Economics. Contact: Shunsuke_Tsuda@brown.edu https://shunsuketsuda.com/

1 Introduction

Many developing countries face civil wars, which lead to refugee movements and impact local economic activities. UNHCR (2016) reports that 84% of the world's refugees (about 14.5 million people) were hosted by developing areas in 2016. The "refugee crisis" resulting from instability in the Middle East has caught the world's attention recently. Sub-Saharan Africa has also long faced this problem. A third of sub-Saharan African countries experienced civil wars during the mid-1990s (Blattman and Miguel 2010). There are also on-going civil conflicts and political violence in several regions in Africa. Impacts of refugee inflows in rural Africa are further complicated by the fact that a large share of the population in Sub-Saharan Africa lives in rural areas and engages in low productivity agriculture relative to the rest of the world (Udry 2010). Therefore, uncovering the linkage between refugee settlements, agricultural household behavior, and market efficiency in host economies is essential from the perspectives of both peacekeeping in conflict-prone society and promoting rural development.

Previous studies have documented little about how refugee inflows shape local market conditions and household behavior in rural developing economies where market imperfections are prevalent. For agricultural households, both selling crop harvests at a market and engaging in off-farm wage work are significant income sources. Crop market participation is, however, constrained by various kinds of transaction costs regarding market access (Barrett 2008; de Janvry and Sadoulet 2006). Factor markets such as the labor market also play significant roles in structural transformation, which is still underway in Africa (Barrett et al. 2018). These contexts stress the importance of taking both factor and output markets into account when analyzing the impact of refugee inflows on a host economy.

This paper attempts to answer the following questions: Do refugee inflows benefit or hurt host farmers in the long run? Is market efficiency improved or worsened? This paper empirically investigates the long-term effects of mass refugee inflows on agricultural household behavior through local factor and output markets. Specifically, I exploit the natural experiment that Tanzania experienced: there were sudden and unexpected (at least to local Tanzanian farmers) large-scale refugee inflows from Burundi and Rwanda, due to those countries' civil wars, into the northwest region of Tanzania in 1994. I then examine these questions by combining a canonical agricultural household model with longitudinal household-level panel data from the host economy. The effects of these refugee inflows are distinguishable from general migration due to the following two facts. First, areas surrounding refugee camps have experienced infrastructure development by aid agencies (Whitaker 1999; Maystadt and Duranton 2018). Second, food aid has significantly increased in response to these refugee inflows (Alix-Garcia and Saah 2010; World Food Program n.d.).

I hypothesize that refugee inflows primarily affect host farmers through the following three channels. First, through the labor market, because refugee inflows expand labor supply. Second, through the crop market, because refugee inflows increase local consumption demand of foods that are not externally sourced by food aid. Third, farmers are also affected through market transaction costs, because these costs could either decrease (due to, for example, the infrastructure development around refugee camps) or increase (due to, for example, a mix of different ethnicities in the labor market and security concerns).

The agricultural household model incorporating market imperfections helps to identify the shifts in labor and crop market conditions caused by the refugee inflows, in combination with the panel data.

The study area, the *Kagera* region of northwest Tanzania, is a remote agrarian economy that experienced mass refugee inflows from Burundi and Rwanda in the early 1990s. The main data is drawn from the Kagera Health and Development Survey (KHDS), a longitudinal household-level panel dataset collected in the region. I use two waves of this dataset—1993 (pre-shock: before the refugee inflows) and 2004 (post-shock: after the refugee inflows). The data show that market participation is low in both output and factor markets. Crop subsistence is prevalent over time. Hired farm labor and off-farm labor market participation are not very common.

I employ a difference-in-difference design to estimate the impacts of refugee inflows on labor market outcomes guided by the model, crop supply to markets, and agricultural labor productivity. I estimate gender-specific shadow wages (agricultural labor productivity) of household agricultural production by exploiting time allocation information in the data, following Jacoby (1993) and Skoufias (1994). The estimated shadow wages come into play for investigating labor market efficiency and the overall refugee impact on labor productivity. For the crop marketization, I focus on four main food crops produced in the study area. Two (maize and beans) are food aid crops. The other two (cooking bananas and cassava) are not included in the food aid.

For the labor market, the refugee inflows have tightened the off-farm labor market participation constraint for male labor. In other words, surplus farm labor is increased by the refugee inflows, implying the efficiency loss in labor market. This conclusion is derived, in conjunction with the model predictions, from the combination of the following three observations. First, the correlation between market and shadow wages is weak and insignificant, and its degree is not significantly altered by the refugee inflows. Second, the refugee inflows have widened the gap between market and shadow wages. Third, the refugee inflows have decreased off-farm labor market participation. The combination of these observations cannot be rationalized by other channels considered in the model such as an equilibrium market wage effect or a proportional labor market transaction cost. For female labor, on the other hand, these empirical tests revealed that the most consistent mechanism with the model is that a proportional transaction cost is increased by the refugee inflows in the environment where the participation constraint is kept binding.

For the crop market, the refugee inflows have positively affected the transition from subsistence to sellers of two of the four main food crops, maize and beans. This transition is revealed to be primarily due to a decrease in fixed market transaction costs, not due to a consumption demand shift by refugees, from the following six investigations in conjunction with the model predictions. First, this crop marketization is concentrated around Rwandan refugee camps where most Rwandan refugees have repatriated and thus the refugee food demand effect is not expected. Second, this crop marketization is only observed for major food aid crops. Refugee demand for these crops produced by local farmers is expected to be lower than that of the other food crops not included in the food aid.[1] Third, the crop supply response around the Rwandan refugee camps is observed only by initial subsistence households and not by initial sellers,

[1]Note that the WFP purchased food aid supplies not from Kagera but from other regions in Tanzania and from other countries (Whitaker 2002b).

which implies that fixed transaction costs play a more dominant role than other costs proportional to farm-gate prices. Fourth, marketization of coffee, a major export crop which would not be very responsive to local demand, also becomes concentrated around the Rwandan refugee camps. Fifth, there does not appear to be any other evidence that this marketization is explained by alternative mechanisms, such as a price effect, a technological change, or proximity to neighboring countries. Sixth, I find an increase in supplies of crops that were not included in food aid (cooking bananas and cassava) only around Burundian refugee camps where many refugees were considered to be still staying in 2004. These results suggest that investment in infrastructure around refugee camps also creates new opportunities for host populations and its impact lasts long even after refugees have left camps.

An overall impact of the refugee inflows on agricultural labor productivity is negative. In determining the impact, the "surplus farm labor effect" and the "crop marketization effect" act in opposite directions. Moreover, this overall impact also includes all other channels (other factor and output markets, in addition to the labor and crop markets analyzed in this paper) that contribute to the shadow wages. The key lesson is that market-specific tests help to understand the distributional impacts attributed to each market. In other words, looking only at the overall impact without conducting such market-specific tests would not lead to any meaningful interpretation. To summarize, the answer to the primary research question is that the refugee inflows have caused losses in the labor market and gains in the crop market for the host agricultural households. For other markets, this question is still unresolved.

This paper contributes to two strands of literature. The first set of literature is research on the economic effects of refugee inflows on host economies (e.g., Alix-Garcia et al. 2018; Card 1990; Fallah et al. 2019; Foged and Peri 2016; Morales 2018; Tumen 2016). Most prior studies have focused on labor market outcomes and are not set in the context of rural developing economies, with some exceptions (Alix-Garcia et al. 2018; Taylor et al. 2016). Of these, Alix-Garcia et al. (2018) is most closely related to my research. They investigate several channels based on different markets that drive increased economic activities around refugee camps in the context of rural Africa. My paper is distinct from their research in that I explicitly incorporate both output and factor market imperfections in host economies to examine a shift in each market condition and resulting household behavior.[2]

The second set of literature regards the empirical applications of agricultural household models with market imperfections. This paper's contribution to this literature responds to two aspects. The first aspect is labor market inefficiencies in rural developing areas (Jacoby 1993; Skoufias 1994; Barrett et al. 2008), analyzed by examining how the shadow and market wage gap is changed by an exogenous shock in the long run. More generally, this paper adds to the literature on the separation test (Benjamin 1992; Dillon et al. 2019; Jones et al. 2021; LaFave and Thomas 2016, and the references therein), which has recently received significant renewed attention. This study provides new evidence that a large-scale political shock shifts conditions that organize the non-separability of agricultural household decisions in the long

[2]There is also a few studies in the context of the refugees from Burundi and Rwanda in Tanzania (Baez 2011; Maystadt and Verwimp 2014; Maystadt and Duranton 2018; Ruiz and Vargas-Silva 2016; Ruiz and Vargas-Silva 2018). However, each of these studies focuses on one-sided outcomes (such as health, consumption, and employment) and internal mechanisms behind their results are not fully uncovered. Moreover, their results are somewhat inconsistent and do not conclude whether the refugee inflows have benefited or hurt host populations.

run.[3] The second aspect concerns the relationship between various transaction costs and crop market participation (e.g., Goetz 1992; Key et al. 2000; Renkow et al. 2004; Li 2021). A shift in a transaction cost in a particular market, say the crop market, may also simultaneously change a transaction cost in another market, say the labor market. Most existing studies look at only transaction costs of a single market. This paper contributes to the literature by investigating both crop and labor market transaction costs in a unified framework in combination with longitudinal panel data.

The rest of the paper proceeds as follows. Section 2 provides the agricultural household model with market transaction costs. Section 3 introduces the local context and the data. Section 4 describes the empirical strategy. Section 5 presents the main empirical results. Section 6 provides further discussion to improve the validity of the main results. Section 7 concludes the paper, discusses policy implications, and provides future research directions.

2 Conceptual Framework

I focus on labor and crop markets, the most fundamental factor and output markets, respectively, in rural Africa. The model analyzes how refugee inflows affect host farmers through the following three channels. First, through the labor market, because refugee inflows expand labor supply. Second, through the crop market, because refugee inflows increase local consumption demand for foods that are not externally sourced by the food aid. Third, refugee inflows also impact market transaction costs, as these costs could either decrease (due to, for example, infrastructure development around refugee camps) or increase (due to, for example, a mix of different ethnicities in the labor market and security concerns).

I provide the simplest theoretical framework that incorporates these three channels in line with the conventional agricultural household model (Benjamin 1992; de Janvry et al. 1991; Singh et al. 1986). As the data will show in the next section, households in the Kagera region, a remote rural region in Tanzania, are characterized as subsistence farmers in that many of them do not participate in labor and crop markets.[4] I thus focus on subsistence behavior, labor and crop market transaction costs and participations, and internal shadow wage responses. The model characterizes non-separability in which households make their production and consumption decisions simultaneously. Households take market conditions (market prices and transaction costs) as exogenously given. First, for ease of exposition, I illustrate the labor and crop market effects separately. A household's problem in each subsection is a part of the whole household's problem. Next, I discuss the overall impact of refugee inflows on agricultural labor productivity, which is a composite of the effects through labor and crop markets (and other markets).

[3]Related to this literature, this paper also speaks to classical arguments of surplus farm labor (Foster and Rosenzweig 2010; Foster and Rosenzweig 2017; Gollin 2014; Lewis 1954; Sen 1966). I add new evidence to this area that the surplus farm labor is increased by refugee inflows in the long run. This paper proposes that its underlying mechanism is primarily an increase in labor market transaction costs.

[4]This situation is also consistent with other settings of rural economies in Sub-Saharan Africa, where imperfect or missing markets are prevalent, as discussed in the previous literature (e.g., Binswanger and McIntire 1987; Binswanger and Townsend 2000; Fafchamps 1993; Platteau et al. 1998; Udry 1996). Throughout this section, I also postulate the missing land market, which is also consistent with the data in which land market transactions are not widely observed.

2.1 Labor Market Transaction Costs, Off-Farm Labor Supply, and Efficiency

The framework in this section is used to identify the presence of and shifts in different types of labor market transaction costs from data. A household solves the following utility maximization problem:

$$\begin{aligned} \max_{c,l,L,L_0} \quad & u(c,l;z_u) \\ \text{s.t.} \quad pc \le pq + [w(z_l,z_u) - t_l(z_l,z_u)]L_o + M & \\ q \le F(L,A;z_q) & \\ l + L + L_o \le T & \\ 0 \le L_o \le \bar{L}(z_l,z_u) & \end{aligned} \tag{1}$$

where c is the composite of food with its price p, l and L are leisure and family farm labor, L_o represents off-farm work with market wage w, M is non-labor income, and T is time endowment. The household produces q, the amount of family farm crop production, according to the production technology $F()$ with standard characteristics. Farm production uses labor input and other fixed inputs, A, such as land holdings and capital. z_u includes household-specific shifters of demand and transaction costs, z_l includes labor market-specific shifters of transaction costs, and z_q includes production shifters.[5] Note that all variables are household-specific, but the notation of household is omitted for simplicity of exposition.

There are two types of labor market transaction costs: a proportional transaction cost, $t_l(z_l,z_u)$,[6] and off-farm labor market participation constraint, $\bar{L}(z_l,z_u)$. The proportional transaction cost implies that the return to off-farm employment is proportionally subtracted by a certain amount. The clearest example of this is a commuting cost from a household location to a workplace. A worker gains a daily wage minus a commuting cost for each day he works outside his household. The participation constraint states that the amount that a household member can work outside his household is limited by a certain amount, possibly due to some institutional reasons. Market wages and these two types of transaction costs might conceptually depend on the labor market environment, z_l, and household-specific characteristics, z_u. For notational simplicity, z_l and z_u in brackets for market wages and transaction costs are omitted hereafter. The market wage and two types of transaction costs are taken as exogenous for each household.[7]

[5]These production shifters include all other endogenous inputs not explicitly modeled here (e.g., fertilizer, pesticides, or livestocks) as well as access to government-sponsored subsidy programs. A household jointly decides its labor allocation and amounts of other inputs in the real world, but I abstract from writing the household's decision of other inputs for simplicity. The shadow wage (marginal product of labor) in the internal equilibrium indeed reflects all the other optimal input decisions, but its relationship with the market wage, on which empirical tests are based, can be simply expressed even if I explicitly incorporate such other inputs. Notably, in the estimation of shadow wages for my empirical analysis, I take into account inputs other than labor.

[6]This proportional transaction cost is defined in a general form. It includes the well-known iceberg form of transaction cost where a household member obtains τw by supplying one unit of labor to an off-farm employment. In this case, $t_l(z_l,z_u) = 1 - \tau w$. Therefore, I allow the proportional transaction cost to depend on other labor market conditions (z_l) including w. Indeed, the log-linear form of the empirical specification implicity assumes this iceberg form.

[7]Another possibility for why refugee inflows affect agricultural households in a host economy is via hiring refugees as farm labor, which is not incorporated in the model for the following two reasons. First, my empirical analysis implies that hiring labor is not affected by the refugee inflows among the sample households. Second, having both off-farm wage employment and hired farm labor by the same household is uncommon in the data, which suggests that there would not be a significant

The shadow wage of family farm labor can be expressed as:

$$w^* \Big(\equiv p \frac{\partial F(L, A; z_q)}{\partial L} \Big) = \begin{cases} w - t_l + \frac{\eta}{\lambda} & \text{if } L_o = 0 \\ w - t_l & \text{if } 0 < L_o < \bar{L} \\ w - t_l - \frac{\mu}{\lambda} & \text{if } L_o = \bar{L} \end{cases} \tag{2}$$

where λ, η, and μ represent Lagrange multipliers of the budget constraint, the non-negativity constraint of off-farm work, and the off-farm labor market participation constraint, respectively. Using the shadow wage, the household's full income constraint is expressed as:

$$pc + w^* l = pq + w\bar{L} + w^*(T - \bar{L} - L) + M \equiv y^*$$

I focus on the situation where off-farm market wage is higher than family farm shadow wages, which is consistent with the data. The (household-specific) measure of labor market inefficiency is characterized by the gap between market and shadow wages, $w - w^* (> 0)$. Aggregation of each household-specific wage gap into a region can convey information on the overall labor market inefficiency in that regon. In the situation with off-farm employment, there are two cases to consider.

Case (I) The off-farm employment constraint ($L_o \leq \bar{L}$) is not binding.

In this case, only the proportional transaction cost (t_l) constitutes the wage gap: $w - w^* = t_l$. In other words, as long as the constraint is unbinding, shifts in the market wage and $\bar{L}$ have no effects on the wage gap. Market and shadow wages correlate perfectly. An increase of market wage increases off-farm labor market participation.

Case (II) The off-farm employment constraint ($L_o \leq \bar{L}$) is binding.

In this case, on the other hand, a shift of the constraint affects the household's wage gap as follows:

$$\frac{\partial (w - w^*)}{\partial \bar{L}} = \frac{\frac{\partial l}{\partial y^*}(w - w^*)}{\frac{\partial L}{\partial w^*} + \frac{\partial l}{\partial w^*} + \frac{\partial l}{\partial y^*}(T - \bar{L} - L)} < 0$$

if the substitution effect of wage on leisure is sufficiently large relative to the income effect on leisure, which is likely to hold in a rural developing economy. That is, when the off-farm labor market participation constraint is binding, tightening the constraint is likely to increase the wage gap. Given the similar condition of leisure demand, an increase in market wage can also drive up the wage gap:

$$\frac{\partial (w - w^*)}{\partial w} = \frac{\frac{\partial L}{\partial w^*} + \frac{\partial l}{\partial w^*} + \frac{\partial l}{\partial y^*}(T - L)}{\frac{\partial L}{\partial w^*} + \frac{\partial l}{\partial w^*} + \frac{\partial l}{\partial y^*}(T - \bar{L} - L)} > 0$$

heterogeneity in skills or roles between family labor and hired labor in the study area. See Sadoulet et al. (1998) for an agricultural household model that incorporates a skill heterogeneity across workers and considers a household that both sells and hires labor.

In contrast to the unbinding case, market and shadow wages do not correlate perfectly when the constraint is binding. The model still predicts the positive correlation, but the correlation becomes minimal if the income effect on leisure is small or the participation constraint is tight (i.e., $\bar{L}$ is small).[8] Given that the participation constraint is binding, an increase in market wage keeps off-farm labor market participation at the same level ($\bar{L}$). If the income effect on leisure arising from the increased off-farm wage income is large, then the household reallocates its family farm labor to leisure. This family labor reallocation drives up the shadow wage. If the income effect is substantially small, on the other hand, shadow wages are not highly responsive to market wages. As a result, if these forces (i.e., the binding off-farm labor market participation constraint and the weak income effect) dominate in a region, then it is possible that the positive correlation between market and shadow wages is not observed.

Summary

Table 1 summarizes this discussion. This table shows the effects of labor market conditions on three observable variables under two scenarios. The labor market conditions include the market wage, the proportional transaction cost, and the labor market participation constraint. The three observable variables are (a) a correlation between market and shadow wages, (b) a wage gap between market and shadow wages, and (c) the off-farm labor supply. The two scenarios are (I) the off-farm employment constraint ($L_o \leq \bar{L}$) is initially (before the refugee inflows) unbinding and (II) the off-farm employment constraint ($L_o \leq \bar{L}$) is initially binding. Both the proportional transaction cost ($t_l(z_l, z_u)$) and the off-farm labor market participation constraint ($\bar{L}$) are not directly observable. Therefore, in order to understand how the refugee inflows affect labor market transaction costs, my empirical tests rely on the combination of these three observable measures.

Intuitive illustration

The intuitive reasoning is as follows. Consider the situation where the gap between market and shadow wages is increased by the refugee inflows. The following two cases are consistent with this observation: market wage is increased or labor market transaction cost is increased by the refugee inflows.

First, looking at off-farm labor market participation offers guidance in judging which case explains the increased wage gap, since market wage and transaction cost have opposite effects on labor market participation. Suppose that off-farm labor market participation is decreased by the refugee inflows. This observation is consistent with the case where labor market transaction cost is increased by the refugee inflows. There are still following two cases that are consistent with this observation: the proportional transaction cost (t_l) is increased or the off-farm labor market participation constraint ($\bar{L}$) is tightened by the refugee inflows.

[8]This argument can also be checked by looking at the response of shadow wage to the market wage: $\frac{\partial w^*}{\partial w} = -\frac{\frac{\partial l}{\partial y^*}\bar{L}}{\frac{\partial L}{\partial w^*}+\frac{\partial l}{\partial w^*}+\frac{\partial l}{\partial y^*}(T-\bar{L}-L)} > 0$ if the substitution effect of wage on leisure is sufficiently large relative to the income effect. Obviously, $\frac{\partial w^*}{\partial w} \to 0$ as $\bar{L} \to 0$ or $\frac{\partial l}{\partial y^*} \to 0$.

Next, looking at the correlation between market and shadow wages helps to distinguish between these two cases. If a strong correlation is observed, then it is most consistent with the scenario where the off-farm employment constraint ($L_o \leq \bar{L}$) is not binding. In this scenario, *as long as the unbinding status of the constraint is maintained*, the increased wage gap is most consistent with the mechanism that the proportional transaction cost (t_l) is increased by the refugee inflows. On the other hand, if a weak correlation or even no correlation is observed, then it is most consistent with the scenario where the off-farm employment constraint ($L_o \leq \bar{L}$) is binding. In this scenario, the increased wage gap is most plausibly explained by the mechanism that the off-farm labor market participation constraint ($\bar{L}$) is tightened by the refugee inflows.

In Figure 1, the left panel illustrates the latter mechanism. That is, the refugee inflows have tightened the off-farm employment constraint, i.e., $\bar{L}$ is decreased, in an environment where the constraint was initially binding. $\tilde{L}$ is the profit-maximizing level of family labor in which the marginal product of labor is equal to the market wage rate (net of the proportional labor transaction cost). The binding off-farm employment constraint makes the household problem non-separable between consumption and production. With the non-separation, the optimal farm labor supply, L^*, would differ from $\tilde{L}$. w^* is the household's initial shadow wage. After the refugee inflows, the resulting shadow wage becomes $w^{*\prime}$, the wage gap increases, and the off-farm labor supply decreases.

Asymmetric non-separation

Finally, note that the comparative statics so far are derived *conditional on maintaining the (un)binding status of the labor market participation constraint*. In reality, however, this (un)binding status can also be altered by the shifts in labor market conditions caused by the refugee inflows. For example, suppose that a household's constraint is initially unbinding and that the refugee inflows decrease $\bar{L}$. Due to this decrease, the household's new constraint after the refugee inflow may become binding. Alternatively, suppose that the refugee inflows increase the market wage. Then, even if $\bar{L}$ is unchanged, the household's new constraint after the refugee inflows may become binding. By similar logic, it is also possible that an initially binding constraint becomes unbinding after the refugee inflows.

An empirical implication of this asymmetric non-sepration is that the predictions on the observable variables depend on whether the binding status is being kept or altered by shifting a labor market condition. For example, suppose that the labor market participation constraint is tightened in the environment where (I) $L_o \leq \bar{L}$ is initially unbinding. As long as the decrease in $\bar{L}$ is small so that $L_o \leq \bar{L}$ is kept unbinding, there are no effects on the observable variables. On the other hand, only if the decrease in $\bar{L}$ is high so that $L_o \leq \bar{L}$ becomes binding, the correlation becomes weak, the wage gap widens, and the off-farm labor supply decreases. This reasoning has a close motivation to the asymmetric non-separation test by Dillon et al. (2019). Table 1 also summarizes these empirical predictions.[9]

[9] This table shows the empirical predictions with the data that contains many observations of households. In reality, all the labor market conditions could be household-specific. Therefore, this table shows empirical predictions when the binding status of the constraint and changes in the labor market conditions specified in the leftmost column become the dominant force among the sample households. For example, if $\bar{L}$ is decreased as the dominant force, some households may face $\bar{L}$ approaching zero. Note also that, in (II)-(a), the empirical predictions are regarded as negligible in the case where the constraint is kept binding,

Table 1: Responses of Observables to the Shifts in Labor Market Conditions

	(a) Correlation between wages	**(b) Wage gap**	**(c) Off-farm labor supply**	Possibility of altering the binding status
(I) $L_o \leq \bar{L}$ **is not binding**	$+$			
$w \uparrow \vert t_l, \bar{L}$	$(\downarrow)$	$(\uparrow)$	$\uparrow$	Yes
$t_l \uparrow \vert w, \bar{L}$	$\sim$	$\uparrow$	$\downarrow$	No
$\bar{L} \downarrow \vert w, t_l$	$(\downarrow)$	$(\uparrow)$	$(\downarrow)$	Yes
(II) $L_o \leq \bar{L}$ **is binding**	$(+)$			
$w \uparrow \vert t_l, \bar{L}$	$\sim$	$\uparrow$	$\sim$	No
$t_l \uparrow \vert w, \bar{L}$	$(\uparrow)$	$\uparrow$	$(\downarrow)$	Yes
$\bar{L} \downarrow \vert w, t_l$	$\sim$	$\uparrow$	$\downarrow$	No

Notes: Panel (I) and (II) correspond to the scenarios where the labor market participation constraint ($L_o \leq \bar{L}$) is initially (before the refugee inflows) unbinding and binding, respectively. $\sim$ means no effect or negligible effect. **With (↑) and (↓), the direction inside the bracket is predicted if and only if the initial binding status is altered by shifting a labor market condition, while there are no effects if the initial binding status is maintained.** For example, suppose that market wage is increased in the environment where (I) $L_o \leq \bar{L}$ is initially unbinding. As long as $L_o \leq \bar{L}$ is kept unbinding, there is no effect on (b) wage gap ($= t_l$). On the other hand, only if the increase in market wage is high so that $L_o \leq \bar{L}$ becomes binding, the wage gap will be increased.

2.2 Crop Market Transaction Costs and Supply Response

Following Key et al. (2000), consider two types of crop market transaction costs: (I) proportional transaction costs (PTC) and (II) fixed transaction costs (FTCs). I postulate the missing labor market environment as this subsection focuses on crop market. A household's problem is characterized as follows:

$$
\begin{aligned}
& \max_{\{c_j\}, l, \{L_j\}, \delta_j^s, \delta_j^b} \quad u(\mathrm{c}, l; z_u) \\
\text{s.t.} \quad & \sum_j [p_j m_j - FTC_j^s \cdot \delta_j^s - FTC_j^b \cdot \delta_j^b] + M = 0 \\
& c_j \leq q_j - m_j \quad \forall j \\
& q_j \leq F^j(L^j, A^j; z_q^j) \quad \forall j \\
& l + \sum_j L^j \leq T
\end{aligned} \tag{3}
$$

where j represents crop and m_j represents net sales of crop j (i.e., it becomes negative if the household is a buyer of crop j). FTC_j^s and FTC_j^b are income equivalents of fixed transaction costs of selling and buying crop j, respectively. δ_j^s and δ_j^b are indicator functions which take on the value 1 if a household is a net seller and a net buyer of crop j, respectively. Note that $\delta_j^s \cdot \delta_j^b = 0$ by construction. Households allocate the total time endowment T into leisure (l) and labor inputs ($\{L^j\}$) for crop productions. I also introduce proportional transaction costs of selling and buying crop j, denoted by PTC_j^s and PTC_j^b. Then, denoting market price of crop j by p_j^m, $p_j = p_j^m - PTC_j^s$ if a household is a net seller of crop j and $p_j = p_j^m + PTC_j^b$ if a household is a net buyer of crop j.

although there may be trivial responses. This is because the change in the wage correlation is expected to be significantly larger when the binding status changes to unbinding than when it is kept binding.

The household solves this problem through the following two-step procedure. First, the household derives its optimal allocation based on each crop market participation regime. Next, the household chooses its optimal market participation regime for each crop j. Letting λ and μ_j be Lagrange multipliers of the first and second constraints, the household's decision price of crop j can be expressed as:

$$p_j^* = \begin{cases} p_j = p_j^m - PTC_j^s & \text{if } m_j > 0 \text{ (seller)} \\ \tilde{p_j} = \frac{\mu_j}{\lambda} & \text{if } m_j = 0 \text{ (autarky)} \\ p_j = p_j^m + PTC_j^b & \text{if } m_j < 0 \text{ (buyer)} \end{cases} \tag{4}$$

where $\tilde{p_j}$ is the household-specific (unobservable) shadow price of crop j in the subsistence regime.[10]

Given each crop market participation regime, using the resulting crop decision prices and the shadow wage, the household's problem can then be expressed as the following two-step problem in which production and consumption decisions are separable:

Step 1 Solve the profit maximization problem with the crop decision prices and the shadow wage subject to the technology constraint (the third constraint in (3)). This derives the system of crop supplies and farm labor demand functions: $q^{j*} = q^j(p_j^*, w^*; z_q^j)$, $L^{j*} = L^j(p_j^*, w^*; z_q^j)$.

Step 2 Solve the utility maximization problem subject to the full income constraint measured at the decision prices, the output supplies, and the factor demand functions:

$$\begin{aligned} \sum_j [p_j^* c_j] + w^* l &= \sum_j [p_j^* q^j(p_j^*, w^*; z_q^j) - w^* L^j(p_j^*, w^*; z_q^j)] + w^* T + M - \sum_j [FTC_j^s \cdot \delta_j^s + FTC_j^b \cdot \delta_j^b] \\ &\equiv y^* \end{aligned}$$

This step derives the system of consumption demand functions: $c^{j*} = c_j(\mathrm{p}^*, w^*, y^*)$ (and $l^* = l(\mathrm{p}^*, w^*, y^*) = T - \sum_j L^{j*}$)

Next, consider crop k's regime choice. Denote the full income before incurring the fixed market transaction cost of crop k by:

$$y_k^*(\mathrm{p}^*, w^*) \equiv \sum_j [p_j^* q^j(p_j^*, w^*; z_q^j) - w^* L^j(p_j^*, w^*; z_q^j)] + w^* T + M - \sum_{j \neq k} [FTC_j^s \cdot \delta_j^s + FTC_j^b \cdot \delta_j^b]$$

Then, letting $V(\mathrm{p}^*, w^*, y^*, z_u)$ be the indirect utility function, the maximum utility attained by each regime of crop k is expressed as:

$$\begin{aligned} V_k^s &= V(p_k, p_{-k}^*, w^{s*}, y_k^*(p_k, p_{-k}^*, w^{s*}) - FTC_k^s; z_u) \quad \text{if net seller of crop } k \\ V_k^b &= V(p_k, p_{-k}^*, w^{b*}, y_k^*(p_k, p_{-k}^*, w^{b*}) - FTC_k^b; z_u) \quad \text{if net buyer of crop } k \\ V_k^a &= V(\tilde{p}_k, p_{-k}^*, w^*, y_k^*(\tilde{p}_k, p_{-k}^*, w^*); z_u) \quad \text{if subsistence for crop } k \end{aligned}$$

[10]This shadow price captures the marginal utility of the consumption of crop j in cash equivalents. That is, the shadow price is equal to the price that the farmer is willing to pay to relax the resource constraint of crop j by one unit.

Note that shadow wages in different crop market participation regimes (w^{s*}, w^{b*}, w^*) might also differ. Define $\bar{p_k^s}$ and $\bar{p_k^b}$ as:

$$
\begin{aligned}
V(\bar{p_k^s}, p^*_{-k}, w^*, y^*_k(\bar{p_k^s}, p^*_{-k}, w^*) - FTC^s_k; z_u) &= V(\tilde{p_k}, p^*_{-k}, w^*, y^*_k(\tilde{p_k}, p^*_{-k}, w^*); z_u) \\
V(\bar{p_k^b}, p^*_{-k}, w^*, y^*_k(\bar{p_k^b}, p^*_{-k}, w^*) - FTC^b_k; z_u) &= V(\tilde{p_k}, p^*_{-k}, w^*, y^*_k(\tilde{p_k}, p^*_{-k}, w^*); z_u)
\end{aligned}
$$

In other words, $\bar{p_k^s} - \tilde{p_k}(> 0)$ measures the ad valorem amount that a household needs to cover the fixed cost of entry into the market of crop k as a seller, keeping the internal price of labor at the same value. The indirect utility is increasing in crop k's price for its net sellers:

$$
\begin{aligned}
\frac{dV}{dp_k} &= \frac{\partial V}{\partial y^*}\Big\{\big(\frac{\partial V/\partial p_k}{\partial V/\partial y^*} + q^{k*}\big) + \big(\frac{\partial V/\partial w^{s*}}{\partial V/\partial y^*} + T - \sum_j L^{*j}\big)\Big\} \\
&= \frac{\partial V}{\partial y^*} \underbrace{(q^{k*} - c^{k*})}_{\text{market surplus}} > 0
\end{aligned}
$$

where the second equality follows from the Roy's identity and the time constraint. Similarly, the indirect utility is decreasing in crop k's price for its net buyers. Therefore, the household's regime choice of crop k becomes:

$$
\begin{aligned}
\text{Net seller of crop } k \text{ if} \quad & p^m_k - PTC^s_k > \bar{p_k^s} \Leftrightarrow p^m_k > \bar{p_k^s} + PTC^s_k \\
\text{Net buyer of crop } k \text{ if} \quad & p^m_k + PTC^b_k < \bar{p_k^b} \Leftrightarrow p^m_k < \bar{p_k^b} - PTC^b_k \\
\text{Subsistence for crop } k \text{ if} \quad & \bar{p_k^b} - PTC^b_k < p^m_k < \bar{p_k^s} + PTC^s_k
\end{aligned}
\tag{5}
$$

The primary interest lies on transition from subsistence to sellers of crops as a way of raising income sources. Since $\frac{\partial \bar{p_k^s}}{\partial FTC^s_k} = \frac{1}{q^{k*} - c^{k*}} > 0$, as the fixed market transaction cost decreases, the first inequality in (5) is ceteris paribus more likely to hold. Obviously, the same inequality is also more likely to hold as the proportional market transaction cost decreases. It is not possible to directly observe which types of transaction costs have been shifted due to the refugee camp constructions and the resulting infrastructure development around them. The notable difference is that, *conditional on* being net sellers, a shift in the fixed market transaction cost does not affect crop supply, while the proportional transaction cost does.

Summary

This simple framework generates the empirical predictions summarized in Table 2. If either proportional or fixed crop market transaction cost is decreased by the refugee inflows, among crop subsistence households before the refugee inflows, those located in the refugee-hosting areas will be ceteris paribus more likely to become crop sellers after the refugee inflows. If the proportional transaction cost is reduced in the refugee-hosting areas, then initial crop sellers will also increase crop supplies in those areas. On the other hand, a decrease in the fixed transaction cost will not affect crop supplies by initial crop sellers.

Table 2: Crop Supply Responses to the Shifts in Crop Market Conditions

Initial market participation status	Crop sellers	Crop subsistence households
Consumption demand by refugees ↑	↑	↑
Proportional transaction cost ↓	↑	↑
Fixed transaction cost ↓	∼	↑

Implication for shadow wage

Finally, I describe the shift in crop k's decision price and resulting shadow wage response faced by a household if it transitions from crop k subsistence to a seller due to a decrease in the fixed transaction cost.[11] Suppose that initially (before the refugee inflows) the fixed transaction cost of selling crop k was FTC_k^s and a household selected into subsistence for crop k. Suppose also that after the refugee inflows the fixed transaction cost was reduced to $FTC_k^{\prime s}$ and the household selected into a crop k seller. Note that given other conditions are fixed, the shift in the fixed transaction cost does not change the household's internal price of crop k and indirect utility if it continues to stay subsistence. Then, defining $\bar{p_k^{\prime s}}(< \bar{p_k^s})$ similarly as before, the indirect utility level of subsistence is written as:

$$\begin{aligned} V(\tilde{p_k}, p_{-k}^*, w^*, y_k^*(\tilde{p_k}, p_{-k}^*, w^*); z_u) &= V(\bar{p_k^s}, p_{-k}^*, w^*, y_k^*(\bar{p_k^s}, p_{-k}^*, w^*) - FTC_k^s; z_u) \\ &= V(\bar{p_k^{\prime s}}, p_{-k}^*, w^*, y_k^*(\bar{p_k^{\prime s}}, p_{-k}^*, w^*) - FTC_k^{\prime s}; z_u) \\ &< V(p_k, p_{-k}^*, w^{s*}, y_k^*(p_k, p_{-k}^*, w^{s*}) - FTC_k^{\prime s}; z_u) \end{aligned} \tag{6}$$

Therefore, given other conditions are fixed (including $FTC_k^{\prime s}$), it can be restated that crop k's *decision price* faced by the household as a market seller increases from $\bar{p_k^{\prime s}}$ to p_k from before to after the refugee inflows. The shadow wage response to the increased crop decision price can be expressed as:

$$\frac{dw^*}{dp^k} = -\frac{\frac{\partial L^k}{\partial p_k} + \frac{\partial l}{\partial p_k} + \frac{\partial l}{\partial y^*} q_k^*}{\sum_j \frac{\partial L^j}{\partial w^*} + \frac{\partial l}{\partial w^*} + \frac{\partial l}{\partial y^*}(T - \sum_j L^{j*})} > 0 \tag{7}$$

if, again, the substitution effect of wage on leisure is sufficiently large relative to the income effect on leisure.

2.3 Overall Impact of Refugee Inflows on Agricultural Labor Productivity

The overall impact of refugee inflows on agricultural labor productivity of the host farmers indeed contains both the labor and crop market effects (as well as other market effects, which are abstracted here) described so far. The shadow wage w^*, the marginal product of labor, is a straightforward measure of agricultural labor productivity. Therefore, recalling that z_l is an exogenous variable (from the perspective of local farmers) regarding labor market conditions and p^* is the (household-specific) decision price of a

[11] In case of a shift of the proportional transaction cost or the market price, the argument is similar and even simpler.

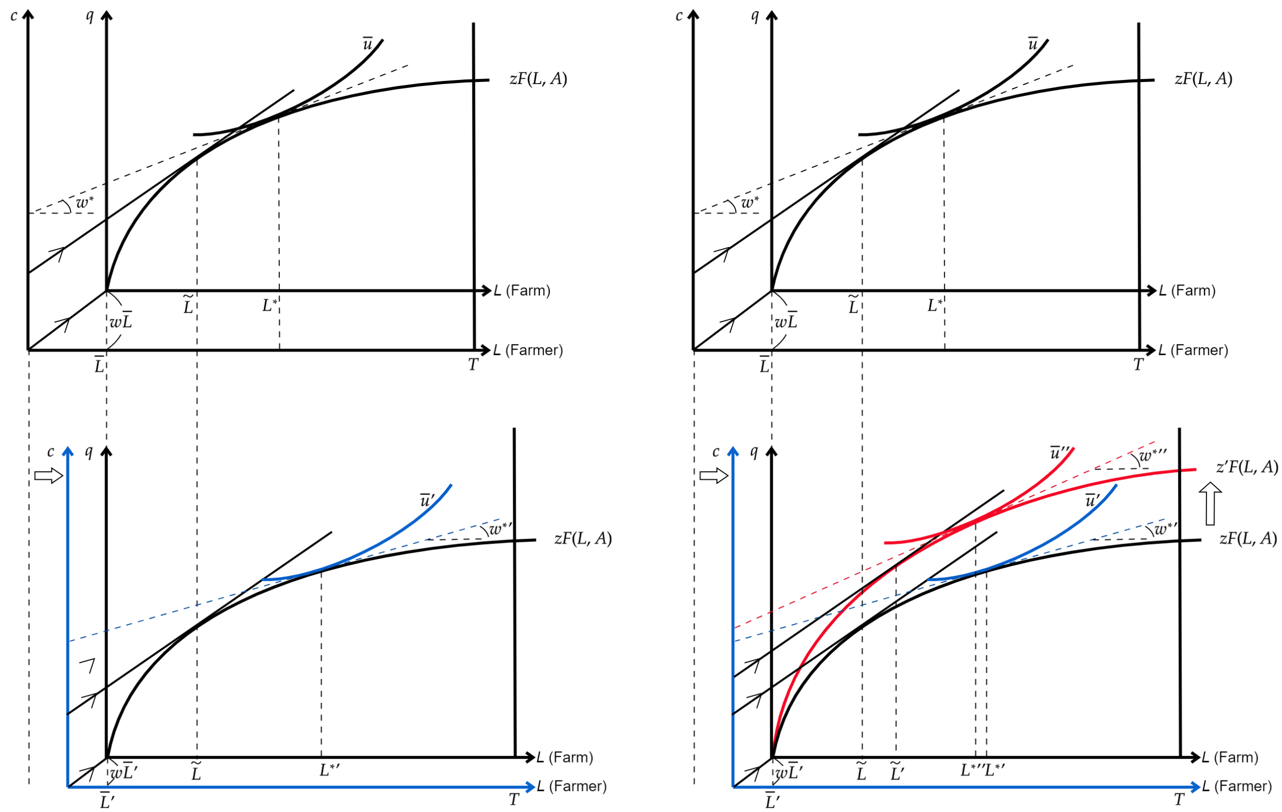


Figure 1: Intuitive Illustration of the Impact of Refugee Inflows

main crop, the total effect of the refugee inflows is approximated as:

$$\frac{dw^*}{drefugee} \approx \underbrace{\frac{dz_l}{drefugee}\frac{\partial w^*}{\partial z_l}}_{\text{Labor market effect}} + \underbrace{\frac{dp^*}{drefugee}\frac{\partial w^*}{\partial p^*}}_{\text{Crop market effect}} \tag{8}$$

where the labor market condition z_l could include the market wage (w), the proportional transaction cost of labor (t_l), or the off-farm labor market participation constraint $(\bar{L})$. Note that the second term, the crop market effect on shadow wage, vanishes if the off-farm labor market participation constraint $(L \leq \bar{L})$ is not binding. The model in the previous subsection with missing labor market corresponds to the special case where $\bar{L}$=0. The same analysis of the crop price effect on shadow wage can apply as long as the constraint $(L \leq \bar{L})$ is binding.[12]

An intuitive illustration of adding the crop market effect to the labor market effect is shown in the right panel of Figure 1. As a clear example, suppose that the refugee inflows (A) tighten the off-farm employment constraint (again, as I have already illustrated in the left panel) and (B) decrease crop market transaction cost. Note that the agricultural output is treated as the numeraire in this simple figure. The

[12]If a household stays subsistence in some crops, then the term $\frac{\partial w^*}{\partial z_l}$ in the labor market effect includes the feedback effect from the shadow crop prices. In that case, the sign of $\frac{\partial w^*}{\partial z_l}$ is likely to be kept unchanged under standard assumptions. See Sonoda (2004) for a detail discussion.

decrease in crop market transaction cost is thus equivalently expressed as the increase in Hicks-neutral technological change from z to z', instead of changing the crop decision price.

After the refugee inflows, the resulting internal wage with the effects of (A) and (B) is $w^{*\prime\prime}$. This total effect can be decomposed as follows. The effect of (A) on the internal wage is $w^{*\prime} - w^*$ and the additional effect of (B) is $w^{*\prime\prime} - w^{*\prime}$. In this case, it is expected that $w^* > w^{*\prime} < w^{*\prime\prime}$. That is, the "surplus farm labor effect" and the "crop marketization effect" caused by the refugee inflows can shift the internal wage in opposite directions. Therefore, attributing the effect of the refugee inflow solely to labor market mechanisms would miss an essential element in a rural developing area.

3 Institutional Setting and Data

3.1 Civil Wars, Refugee Inflows into Tanzania, and Food Aid

In the early 1990s, Tanzania and the Democratic Republic of Congo experienced large-scale refugee inflows from two neighboring countries, Burundi and Rwanda, due to those countries' civil wars (UNHCR 2000). These civil wars are classified as ethnic conflicts, between Hutu and Tutsi ethnicities. In Tanzania, the two western areas near the borders with Rwanda and Burundi—the Kagera and Kigoma regions—received a mass exodus of refugees. The Kagera region, my study area, is located in the northwestern part in Tanzania, between Lake Victoria, Uganda, Rwanda and Burundi. The Kagera region is characterized as one of the poorest and most remote areas in Tanzania (de Weerdt 2010). The population is mostly involved in agricultural activity. The Kagera region is shown in the left panel in Figure A.1 in Appendix A.

There were two main refugee inflows in the early 1990s. The first wave was when between 250,000 and 300,000 Burundian Hutu refugees came into Tanzania after October 21, 1993. This wave was triggered by the assassination of Burundi's democratically elected president Mekchior Ndadaye. Ndadaye was of Hutu ethnicity and killed by Tutsi extremists. This assassination also triggered the Hutu genocide of the Tutsi people resulting in the long-term Burundian civil war, which lasted until 2005.

The second wave was when about 250,000 Rwandan refugees fled into Tanzania within 24 hours on April 28, 1994 (Rutinwa 2002). This influx was the largest and fastest exodus ever observed by the UNHCR. This sudden refugee inflow was closely related to the start of the Rwandan genocide, which was triggered by the assassination of the presidents of Rwanda and Burundi, Juvénal Habyarimana and Cyprien Ntaryamira, whose plane was shut down as it prepared to land in Kigali. The Tutsi Rwandan Patriotic Front (RPF) eventually gained control of the country and established the new government led by Paul Kagame at the end of the genocide on July 1994. In the aftermath of the genocide, between 1-2 million Hutu ethnic refugees fled Rwanda to escape the revenge of the Tutsi ethnics, an exodus that became known as the "Great Lakes Refugee Crisis."

As a result, about 700,000 refugees remained in Kagera in 1995. In Figure A.1, the right panel shows the locations of refugee camps constructed by the UNHCR in response to these inflows. The local population size at that time was about 1.5 million, which means that nearly half of the region's population were refugees at the peak of the influx (Maystadt and Verwimp 2014).

Figure 2 (and Table A.1 for precise numbers) show the number of refugees from Burundi and Rwanda over time in Tanzania. Although official information on the number of these refugees in the Kagera region is not available, the drastic increases of Burundian and Rwandan refugees in 1993 and 1994 mostly correspond to the inflows into Kagera described above.[13] A number of Rwandan refugees were repatriated in 1996 (Whitaker 2002a). However, about 500,000 Rwandan and Burundian refugees have remained in Tanzania (UNHCR 2000). While there is no official information on the size of the populations in each refugee camp over time, this figure implies that Burundian refugee camps have much higher populations than Rwandan ones 10 years after the large-scale refugee inflows.

Food aid into Tanzania drastically increased since 1994, in response to these refugee inflows. The total amount of food aid into Tanzania and its crop composition are shown in Figure 3 (and Table A.2 for precise numbers), obtained from Food Aid Information System, World Food Programme (WFP). As is apparent from Figure 3, maize represents a significant share of food aid delivered to Tanzania in any period. Maize is also one of the main crops produced by local farmers in the Kagera region as shown in a later subsection. Therefore, the dominance of maize in the crop composition of food aid has an important implication, namely that the increase in demand of maize produced by local farmers would be relatively low compared to other main food crops. Note that the WFP purchased supplies for food aid not from Kagera but from other regions in Tanzania and from other countries (Whitaker 2002b).

3.2 Data: Kagera Health and Development Survey (KHDS)

Main data is drawn from the Kagera Health and Development Survey (KHDS) collected by Economic Development Initiatives (EDI) and the World Bank. This dataset is well-known as one of the longest-running panel datasets in Africa. Within this span, the baseline survey at wave 1 was conducted for 919 households and 6353 individuals in 1991. Two-step stratified random sampling was conducted. In the first step, 49 village clusters from four agronomic zones were selected. The sampled villages are shown in Figure A.2. In the second step, the stratified random sampling of households according to health status was conducted in each village cluster. In this stratification, the survey over-sampled households with a higher risk of adult illness and mortality.[14]

One unique feature of this data is a very high tracking rate. In the 2004 follow up survey, 832 households out of the original 919 households were re-interviewed ($\sim 90\%$) and there became 2719 households, mainly due to the splits of the original households when children became adults and formed new households after their marriages. In terms of individuals, 88 percent of the original respondents were tracked. This KHDS dataset is based on the World Bank's Living Standards Measurement Survey (LSMS), which collects data on household education, health, migration, fertility, farming, non-farm household business, and consumption.

[13] In Figure 2, more than 100,000 Burundian refugees were reported before 1993. These refugees were considered to be settled not in Kagera, but primarily in the regions of Tabora and Rukwa (Thomson 2009).

[14] A detailed explanation of this dataset and the stratified sampling strategy is found in Ainsworth et al. (2004) and Beegle et al. (2006).

This paper relies on the following information from this dataset. First, information on household-level agricultural activity plays a central role in my empirical analysis. This information includes family farm crop production, inputs, and crop market transactions. Second, information on individual-level time allocation is used to capture labor allocation between family farm work and off-farm family wage employment. Combined with the information on crop production, this time allocation data is also used to estimate shadow wages of family farm labor.

Finally, the information on refugee camps is obtained from two sources. One source is geographic information collected by another researcher, which is publicly available on the EDI website.[15] This information measures the distance between the center of each village and each refugee camp. Another source is the community survey of KHDS, which collects community-level information on whether there are any refugee settlements in a village, in a ward, or in a neighboring ward.

My empirical analyses use two waves of the panel data: 1993 (the pre-shock period) and 2004 (the post-shock period) data. Note that each of waves 2 and 3 contains the half-year information. Combining these two waves, I constructed the annual data in 1993. The annual data from wave 5 is used as the post-shock data in 2004. The quasi-balanced panel data is constructed by choosing households in 1993 and their related households, located in the same area as the initial households, in 2004. I focus on households with agricultural production in the Kagera region. For some of the main empirical analyses, I drop households that were only observed in one wave and whose related households in the other year were not found. As is shown in the next subsection, households in the quasi-balanced panel and in the whole sample share common characteristics in crop and labor market transaction patterns. Throughout the analyses, all quantitative measures are transformed into real values in 1991 TSHS (Tanzanian Shillings) using the Laspeyres index.

3.3 Geographical and Agricultural Conditions in the Study Area

Table A.3 summarizes the basic geographic information. According to the 1988 Tanzanian census data, the total population size of the Kagera region was about 1.4 million in 1988. This region consists of 4 geographic zones (tree crop zone, riverine zone, annual crop zone, and urban zone), 6 districts (Karagwe, Bukoba Rural, Bukoba Urban, Muleba, Biharamu and Ngara), and about 550 villages with each village having about 500 households. The tree crop zone is located in the northern part of Kagera and the main crops produced there are coffee and bananas. The annual crop zone is located in the southern part of Kagera and the main crops produced there are beans, cassava, and maize. The riverine zone is located between these two zones and the main crops produced there are a mixture of the main crops in these two zones.

The variation in the intensity of refugee settlements is mostly across longitudes and it is balanced in terms of natural conditions. The refugee inflows were concentrated in the western part of Kagera where the borders with Rwanda and Burundi are relatively close. On the other hand, the refugee inflows were

[15] This geographic information is provided by Jean-Francois Maystadt and used in his papers (Maystadt and Verwimp 2014; Maystadt and Duranton 2018). I appreciate his generosity for making it publicly available.

not concentrated only in either northern or southern region. Geographic and agricultural characteristics do not significantly differ across longitudes within the same latitude. Therefore, geographic zones that produce any of the main crops produced in the Kagera region (coffee, bananas, beans, cassava, and maize) have both refugee areas and non-refugee areas.

Table A.4 summarizes the production of main crops by the sample households in three periods. In all the periods, it is apparent that coffee, bananas, beans, cassava, and maize are common crops produced in this region, in terms of both the number of households and the mean of harvest values among producers. Moreover, comparing the total sample size and the number of observations of each crop production, it is apparent that a significant portion of the sample households engages in joint production of multiple main crops.

3.4 Labor and Crop Market Transactions of Sample Households

Labor market transactions

Table 3 summarizes labor market participation patterns of the sample agricultural households, following Benjamin (1992). Almost all the households use family labor for their family farms. Having both off-farm wage employment and hired farm labor is uncommon. In the quasi-panel data, only 5.39% of the households that supply off-farm labor in 2004 also hire labor for family farms. This observation suggests that there would not be a significant heterogeneity in skills between family labor and hired labor. From 1993 (pre-shock) to 2004 (post-shock), the share of households that use hired labor for family farms decreased and the share of households that supply labor for off-farm wage employment increased.

Table B.2 summarizes gender-specific hourly wages of the sample agricultural households. Figure 4 shows their distributions before and after the refugee inflows. This information consists of two sources. The first source is the observed hourly wages of off-farm wage employment. The second part is the estimated shadow wages of family farm labor.[16] From this table and figure, it is clear that the off-farm market wages are substantially higher than the shadow wages of family farms.

Off-farm labor market participation is low. Off-farm labor market participation was very low in 1991 (baseline) and 1993 (pre-shock) but increased after 10 years in 2004 (post-shock). Female off-farm labor market participation is much lower than male (less than half) in both periods, and the market wage of male labor is much higher than that of female in the post-shock period. On the other hand, female labor engages in farm production more than male labor and the female shadow wage is on average higher than the male shadow wage in both 1993 and 2004.

Figure 5 shows the cumulative distributions of gender-specific shadow wages in the pre-shock (1993) and post-shock (2004) periods in the refugee areas and non-refugee areas. In the pre-shock period (1993), the shadow wage distributions appear almost identical. On the other hand, only in the post-shock period (2004), the shadow wages (for both males and females) are shifted towards right among households in

[16] The estimation procedure of the shadow wages simply follows the pioneer literature Jacoby (1993) and Skoufias (1994) for meaningful comparisons. The estimation procedure is described in Appendix B. The validity of using these wage variables in the difference-in-difference framework is discussed in section 6.1.

non-refugee areas relative to those in refugee areas.

Crop market transactions

Table 4 summarizes market transaction patterns of main crops by the sample agricultural households. In both periods, the market transaction of the main cash crop, coffee, is most frequently observed. Market transaction rates for the main food crops (maize, beans, cooking bananas, and cassava) are low. The share of maize sellers increased from 1993 to 2004. The other food crops also have low rates of market transaction, while no significant time trends are observed for the other food crops.

Figure 6 shows the distributions of net sales for each crop in the post-shock period (2004) in the refugee areas and non-refugee areas. These are the distributions among households whose related households in the pre-shock period were subsistence farmers for each crop, since my primary interest is the transition from subsistence to crop sellers. The net sales measure is the value of crop sales minus the value of crop purchased for each crop. A subsistence household for each crop is defined as one whose net sales of that crop is zero.[17] A high share of subsistence households is observed in the figure. This figure also shows that there are fewer numbers of subsistence farmers and more sellers of maize and beans in the refugee areas in 2004. By contrast, there are more subsistence farmers for cooking bananas in the refugee areas and there are no visible distributional differences for cassava.

Crop market participation status is also jointly determined by and associated with the marginal product of labor. Figure 7 shows distributions of gender-specific shadow wages for crop sellers and households that do not sell any crops in the post-shock period. The distribution is shifted towards right among crop sellers relative to non-sellers.

4 Empirical Strategy

I emphasize the exogeneity of refugee camp locations by exploiting the natural experimental setting of the refugee inflows. The following arguments support this assumption. First, the massive exoduses from Burundi and Rwanda were triggered by sudden political events, which were unrelated to and unexpected by local Tanzanian agricultural households in the Kagera region. Second, the very large scale refugee inflows happened in a very short span (e.g., the influx of 250,000 Rwandan refugees within 24 hours in April 1994), which made it difficult for the UNHCR to search for refugee camp locations where surrounding economic conditions are favorable. Moreover, these refugees from Burundi and Rwanda travelled on foot, meaning that they were concentrated near the borders with Burundi and Rwanda (Ruiz and Vargas-Silva 2018). Third, the plausibility of this exogeneity is also discussed and agreed upon by the previous research from the same context (Baez 2011; Maystadt and Verwimp 2014; Maystadt and Duranton 2018; Ruiz and Vargas-Silva 2018). Therefore, the empirical analyses exploit the variation in the proximity to refugee camps within similar natural conditions.

[17]The share of households that both sell and buy the same crop is extremely low. Therefore, the definition of subsistence is indeed almost identical to the households that neither sell nor buy each crop. This observation implies that there does not exist a significant heterogeneity (across varieties) within each classified crop.

As the main treatment variable, I use a dummy variable which takes 1 if one of the refugee camps is located within 50 km from the center of the village where each household lives. Out of the 49 village clusters, there are 14 treatment villages with this treatment variable. I report results with this treatment variable in the next section. Results with several alternative treatment variables are also shown as robustness checks in a later section.

My primary interest is in testing for the consequences of hosting refugees on agricultural markets. Even though this is a natural experimental setting, there still remains a concern with any cross-sectional analysis that locations where refugee camps are placed may be different from other areas in terms of unobservable land quality, productivity, or other market environments. By differencing I focus on the same area before and after the placement of the camps and control for fixed unobservable characteristics, and then I compare changes in outcomes of interest between the treatment and control areas. A difference-in-difference design is thus employed as a main empirical specification. Therefore, the coefficient of interest is not on the refugee treatment variable itself but on the interaction term between the refugee treatment and the post-shock period dummy. For some specifications where there is no variation in the dependent variable in 1993, I also use a cross-sectional specification that controls for district fixed effects. Since the treatment unit is at the village level, following the essence of Abadie et al. (2017), robust standard errors clustered at the village level are obtained in all the specifications.

Table 5 reports summary statistics of the main outcome and control variables used in the empirical analyses. This table also shows the balancing test results for differences in these main variables between the treatment and control villages. For the wage variables, any statistically significant difference between the treatment and control villages is not found even unconditionally. For the shadow wages, beyond the insignificant mean difference, any significant differences in the distribution in 1993 are not found (Figure 5). On the other hand, there are statistically significant differences in some of the key crop-related variables. However, once I control for the district fixed effects (as I do in the cross-sectional specification), statistically significant differences below the 10% level are found only in religious and tribal variables. Moreover, there was no significant pre-trend in the outcome variables around the refugee area before the refugee inflows, further justifying the difference-in-difference framework. Results of the pre-trend analysis using data from 1991 and 1993 are reported in section 6.2.

4.1 Labor Market Efficiency and Off-Farm Employment

The tests of labor market efficiency consist of the following three observations, in conjunction with the theoretical predictions summarized in Table 1: (a) the correlation between market and shadow wages, (b) the impact of refugee inflows on the gap between market and shadow wages, and (c) the impact of refugee inflows on labor market participation for each gender. Note that the above model abstracts from gender. In reality, however, the heterogeneity by gender in various dimensions of African agriculture is widely discussed (e.g., Udry 1996; Doss et al. 2015) and significant gender-specific labor market effects are reported in this setting of western Tanzania (Whitaker 2002b; Ruiz and Vargas-Silva 2018). Therefore, I empirically investigate gender-specific labor market effects.

The first test examines the correlation between market and shadow wages among households that have both own-farm family labor and off-farm employment. In addition to looking at the simple correlation, the first test is augmented by estimating the following regression:

$$\begin{aligned} \log ShadowWage_{chjt} = \alpha_{0j} + \alpha_{1j}X_{cht} + \alpha_{2j}Year2004_t + \alpha_{3j}\log MarketWage_{cht} \\ +\alpha_{4j}(\log MarketWage_{cht} \times Year2004_t) + \alpha_{5j}(Refugee_c \times Year2004_t) \\ +\alpha_{6j}(Refugee_c \times \log MarketWage_{cht} \times Year2004_t) + \phi_c + \epsilon_{chjt} \end{aligned} \quad (9)$$

where c (cluster) represents villages, h represents households, $j = m, f$ represents gender, and t represents time periods (1993 or 2004). $Refugee_c$ is the village-level treatment variable regarding refugee location, ϕ_c represents village fixed effects, and X_{cht} includes additional control variables, which include demographic information (household size, number of adult household members; religion dummies; tribe dummies). An indication of an efficiently functioning labor market is that $\alpha_{3j} > 0$ (wage equalization motive across multiple labor opportunities). Note that this coefficient captures correlation. The correlation itself, rather than causality, is indeed of interest in this test. α_{4j} looks at whether such equalization is promoted over time and α_{5j} looks at the impact of refugee inflows on shadow wages. α_{6j} looks at how the wage equalization process over time is changed by the refugee inflows, which corresponds to the asymmetric non-separation test.

The second and third tests are conducted by estimating the impacts of refugee inflows on the gap between market and shadow wages and the off-farm labor market participation. I estimate these impacts by the following difference-in-difference specification:

$$Y_{chjt} = \beta_{0j} + \beta_{1j}X_{cht} + \beta_{2j}Year2004_t + \beta_{3j}(Refugee_c \times Year2004_t) + \phi_{c(/h)} + \epsilon_{chjt} \quad (10)$$

where Y_{chjt} takes $|\log MarketWage_{cht} - \log ShadowWage_{chjt}|$[18] and the labor market participation dummy for each gender. For the second test, I use the subsample of households that supply labor to both family farm and off-farm wage employment for estimation (which is the same subsample used for the first test). $\phi_{c(/h)}$ represents village fixed effects for the second test. For the third test, I include all agricultural households in both periods before and after the refugee inflows in the sample (the unbalanced panel data). $\phi_{c(/h)}$ thus represents village fixed effects or initial household fixed effects for the third test.[19]

Guided by Table 1, combining estimates of β_{3j} for the two specifications in (10) with α_{3j} and α_{6j} in (9) help to identify the presence of labor market transaction cost and the direction of its change caused

[18] This variable defines the degree of labor market inefficiency. Taking the absolute value is to obtain the size of labor market inefficiency, whichever wage is larger than the other. The market wage is indeed higher than shadow wages for most households, and restricting the sample to such households does not influence the result qualitatively (i.e., the coefficient sign and its statistical significance). Note also that the market wage is defined at the household level in empirical specifications. If multiple members in the same household work outside the household, the household-level market wage is obtained by taking the mean of their wages.

[19] For the second test (the wage gap), the same set of additional controls (household demographic information) as the first test is used. For the third test (labor market participation), land size is also added to the set of controls because the scale of a family farm would also be an important determinant of labor market participation apart from the transaction costs. The empirical results are nonetheless robust regardless of whether land size is included in the controls.

by the refugee inflows.

4.2 Food Crop Marketization

In order to understand the underlying mechanism behind crop marketization, guided by Table 2, I examine the impact of refugee inflows on crop supply among initial subsistence households and among initial sellers of each crop.

First, in order to investigate the transition from subsistence to crop sellers, I first select the subsample of each crop's subsistence households in 1993 (pre-shock) and then use their related households in 2004 (post-shock) to conduct a cross-sectional analysis. The following regression specification is estimated:

$$Y_{chj2004} = \beta_{0j} + \beta_{1j} X_{ch2004} + \beta_{2j} Refugee_c + \phi_d + \epsilon_{chj2004} \tag{11}$$

where Y_{chjt} is the seller dummy of each food crop $j \in$ {maize, beans, cooking bananas, cassava} and ϕ_d represents district fixed effects. Since the village fixed effects cannot be controlled for (because the treatment is at the village level), X_{ch2004} also contains village-level geographical characteristics, in addition to household-level characteristics, in this cross-sectional analysis.[20]

Second, with the subsample of sellers of each food crop in 1993 and their related households in 2004 (post-shock) (the quasi-balanced panel data), I estimate the following difference-in-difference regression specification:

$$Y_{chjt} = \beta_{0j} + \beta_{1j} X_{cht} + \beta_{2j} Year2004_t + \beta_{3j}(Year2004_t \times Refugee_c) + \phi_{c/h} + \epsilon_{chjt} \tag{12}$$

where Y_{chjt} is the value of sales for each crop $j \in$ {maize, beans, cooking bananas, cassava} and $\phi_{c/h}$ represents village fixed effects or initial household fixed effects.

The impact of refugee inflows, β_{3j}, captures two components: the food demand effect (due to the increased food demand by refugees interacted with the crop composition of food aid) and the transaction cost effect (due to the infrastructure development around refugee camps[21]). If the former effect domi-

[20] Specifically, village-level geographic controls include log of elevation and the road distance to borders of Burundi, Rwanda, and Uganda (at/from the village center). These data are publicly available and organized by Joachim De Weerdt (https://www.uantwerpen.be/en/staff/joachim-deweerdt/public-data-sets/khds/). I appreciate the researchers listed in this web site for making the data readily accessible. Household-level controls include land size and the same demographic information listed in the empirical strategy for labor market. Land size is added to the controls for the same reason as in the empirical specification of labor market participation. The empirical results are nonetheless robust regardless of whether land size is included in the controls. Moreover, in order to control for the change in household-level covariates over time, I also report the result of the difference-in-difference version in Appendix, although $Y_{chj1993} = 0$ for all the households in this subsample.

[21] For example, major roads around the refugee camps did not exist when the refugees first moved into the Kagera region. Afterward, constructions of new major roads in Kagera have been concentrated around the refugee camps. See Figure 5 of Maystadt and Duranton (2018). However, infrastructure development is not limited to the road expansion. Maystadt and Verwimp (2014), Whitaker (1999), and Whitaker (2002b) describe several potential channels along with the entry of international aid agencies, NGOs, and entrepreneurs. Disentangling each channel is beyond the scope of this paper. My focus is, rather, whether such infrastructure development translates into transaction costs that local farmers face and whether that story is supported by empirical tests derived from a canonical household model.

nates, crop-specific heterogeneous effects are expected, partly driven by the food aid crop composition and the consumption tastes of the refugees. In particular, crop marketization of hosting farmers will be increased for crops that refugees demanded but that are not included in the food aid. On the other hand, if the latter effect dominates, $\beta_{3j} > 0$ is possible for all market-oriented food crops, including the food aid crops (maize and beans).

In order to further investigate the food demand effect, I also prepare additional refugee treatment variables, corresponding to Rwandan refugee camps and Burundian ones.[22] Recall that most Rwandan refugees repatriated before 2004 while a significant number of Burundian refugees still remained in Tanzania in 2004.

5 Results

I first report labor market results, and then crop market results follow. Finally, I discuss the overall impact of the refugee inflows on shadow wages.

5.1 The Increase in Surplus Farm Labor and Labor Market Inefficiency

I report impacts of the refugee inflows on the three observable outcomes outlined in Table 1. Given the three outcomes, I then argue that the explanation most consistent with the model is that the labor market participation constraint is tightened by the refugee inflows.

(a) Weak correlation between market and shadow wages

Figure 8 visualizes the correlations between market and shadow wages by scatter plots and their linear fits. In a perfectly efficient labor market where households equalize marginal products of their own farms and market wages, the linear fit would coincide with the 45-degree line. With a constant transaction cost without a binding participation constraint, it would appear parallel to the 45-degree line. The upper two panels show the correlation for each gender in each year. The lower two panels show the correlations in refugee hosting areas and in non-refugee areas for each gender in 2004 (the post-shock period). In all cases, the linear fits are far from the 45-degree line and their slopes appear to be far from one.

In Table 6, panel (A) reports statistical significance of the correlation between log market and shadow wages after controlling for the time effect. For both male and female, the correlation is around 0.1, which is far from 1. This correlation is statistically significant only for female wages, regardless of controlling for household demographic information and village fixed effects. Panel (B) of the same table shows how the correlation is shifted over time in refugee areas and non-refugee areas, but no significant interaction effects are found. I also checked this weak correlation between market and shadow wages with many other sets of controls in addition to those reported in the table. This result implies the presence of labor

[22] All the Burundian refugee camps are located in the Ngara district and all the KHDS sample villages in Ngara are within 50km from one of the Burundian refugee camps. Therefore, the district fixed effects are not included in the estimation of (11) using the Burundian treatment.

market inefficiency because the shadow and market wages do not have a tendency to move in tandem. The presence of labor market inefficiency itself is not a surprising result. On the other hand, the statistical insignificance is a notable difference from the previous literature.[23] This result is plausible if there is a ceiling on off-farm labor market participation. A household's shadow wage can be much less sensitive to the level of market wage when its labor market participation constraint is binding than when the constraint is not binding.

(b) The gap between market wages and shadow wages has widened

More importantly, I consider how the degree of labor market constraint is affected by the refugee inflows. I address this question by first looking at how they affect labor market efficiency. Again, the labor market efficiency is defined as the gap between market and shadow wages. Table 7 reports the impact of the refugee inflows on the wage gap among agricultural households that supply their labor to both their own farm work and off-farm wage work. The result indicates the negative effect of refugee inflows on labor market efficiency. The increase in the wage gap around refugee camps from before to after the refugee inflows is statistically significantly higher than other areas for both male and female labor. The impact also appears economically significant. Controlling for household demographic information and village fixed effects, the point estimate is around 0.9 for male and exceeds 1 for female. This result implies that the magnitude of the widening wage gap over time (as a percentage of shadow wages) in refugee areas is roughly more than twice as large as that in non-refugee areas. More detailed quantification of the refugee-inflow impact is left for future research, since the precise information on refugee population size in each refugee camp in 2004 is not available in this context.[24]

In order to understand what is driving the increased wage gap, Table A.5 reports results of the same regression with the same sample of households only by changing the dependent variable to log market and shadow wages. The refugee impact on market wage is both statistically and economically insignificant. Interestingly, the refugee impact on male shadow wage is also statistically insignificant. These results emphasize the importance of investigating the wage gap as simply looking at market wages and shadow wages separately may miss an important underlying mechanism.

(c) Male off-farm labor market participation has decreased

Panel (A) of Table 8 shows that off-farm labor market participation is significantly decreased by the refugee inflows. The increase in the probability of engaging in off-farm employment after the refugee

[23] Jacoby (1993) and Skoufias (1994) also found the coefficient (corresponding to α_{3j} here) significantly smaller than 1, in Peru and India, respectively. While they found statistically significant positive coefficients, I do not observe any statistically significant positive correlations at all even after controlling for various controls and village- or household-specific fixed components in my Sub-Saharan African context.

[24] This limitation applies to all the subsequent results reported in this paper. This paper rather focuses on a qualitative finding, that is, the direction of each effect and its statistical significance. Note also that the market wage variable has a high variance, especially in 2004 (Table B.2). On the other hand, the shadow wage variable has a smaller variance in both 1993 and 2004. The present result is qualitatively robust for dropping outliers of the dependent variable in different ways. This robustness suggests that the higher variance in the market wage is not the factor influencing the main result.

inflows is 14% and 12.4% lower in the refugee-hosting areas than other areas, controlling for village fixed effects and initial household fixed effects, respectively. On the other hand, the refugee impact on hired farm labor is insignificant both statistically and economically.

Decomposing this result by gender, panel (B) of the same table shows that the negative effect mostly stems from a decrease in male labor market participation. The corresponding point estimate is about 13% whether I control for village fixed effects or initial household fixed effects. The refugee impact on female labor participation is insignificant both statistically and economically. Note also that female labor market participation itself is much lower than male labor market participation as the mean of the dependent variable in the same table shows. This result is consistent with anecdotal evidence that male refugees tended to travel around refugee camps for their work, while female refugees tended to spend most of their time in refugee camps (Whitaker 1999; Whitaker 2002b).

Decomposing this result further by sectors, panel (C) of the same table shows that the negative refugee impacts on male off-farm employment are statistically significant for both agricultural and non-agricultural wage work. The economic significance is stronger for non-agricultural work (the point estimate is about 10%) than for agricultural work (the point estimate is about 5%). Note also that male labor market participation for the non-agricultural sector is much higher than for the agricultural sector as the mean of the dependent variable in the same table shows. This result is consistent with anecdotal evidence that refugees were engaging in both agricultural and non-agricultural work (Whitaker 1999; Whitaker 2002b). Note that this result is not inconsistent with the insignificant refugee impact on hired farm labor shown in panel (A) of the same table. Recall from section 3.2 that households with higher health risks are over-sampled in the KHDS dataset. Simply assuming that wealth and health are positively correlated, the households with hired farm labor are likely to be under-sampled in the KHDS. In other words, the results shown in this paper would represent the refugee impact on relatively poor agricultural households in the Kagera region.

Primary mechanisms: The labor market participation constraint has tightened for male labor, while the proportional transaction cost has increased for female labor

The refugee inflows have increased the gap between market and shadow wages for both male and female workers (Table 7), and decreased male off-farm labor market participation (Table 8).

Male labor. According to Table 1, there are two likely explanations for the increased wage gap and decreased labor market participation. The first explanation is that the proportional transaction cost (t_l) has increased in the environment where the labor market participation constraint ($L_o \leq \bar{L}$) is not binding. The second explanation is that the labor market participation constraint ($L_o \leq \bar{L}$) has tightened in the environment where the constraint is binding.[25] If the former is the case, a strong correlation between shadow and market wages would be observed. If the latter is the case, on the other hand, observing a much weaker correlation would be plausible. Given that the weak and insignificant correlation is observed in Table 6, the second explanation is more consistent with the model. Moreover, the estimate of α_{6j} is

[25]It is also obvious that the market wage movement caused by the refugee inflows (even if we had this effect, in contrast to the insignificant results reported in columns (2) in Table A.5) cannot alone explain the series of empirical results.

statistically insignificant. The degree of the wage correlation is not significantly altered by the refugee inflow (from the insignificant estimate of α_{6j} in Table 6). This result does not reject the hypothesis that the status of labor market participation constraint is not altered by the refugee inflows. Therefore, the most consistent mechanism with the model is that the labor market participation constraint is tightened by the refugee inflows in the environment where the constraint continues to be binding. This mechanism corresponds to the third row in panel (II) in Table 1.

Female labor. By similar reasoning according to Table 1, the only reasonable explanation for the widening wage gap while labor market participation remains unchanged is as follows: the proportional transaction cost is increased by the refugee inflows in the environment where the constraint continues to be binding. This mechanism corresponds to the second row in panel (II) in Table 1. The weak correlation between market and shadow wages and the insignificant estimate of α_{6j} from Table 6 are also consistent with this mechanism.[26]

Summary. Given that the empirical results aggregate impacts from different households, it is reasonable to conclude that these mechanisms for male and female labor are the dominant forces relative to other potential forces. In summary, these results can be viewed as an increase in surplus farm labor and thus labor market inefficiency caused by the refugee inflows.

5.2 The Transition from Subsistence to Food Crop Sellers

Significant impacts of the refugee inflows on the transition from subsistence to food crop marketization are found both statistically and economically. Table 9 presents results of the estimation of (11) for food crop market participation (seller dummies), focusing on the four major crops: maize, beans, cooking bananas, and cassava.[27]

As columns (1)–(4) of panel (A) in this table report, the most significant effect both statistically and economically is found in the transition from subsistence to bean sellers. Among households related to bean subsistence households in the pre-shock period, the probability of transforming to a bean seller in the post-shock period is 26.3% higher in the refugee area than in other areas, controlling for the district fixed effects and the village-level geographical controls[28] as well as the household-level demographics. As observed in the same column of panel (B) of the same table, I also find a significant effect for maize marketization. Among households related to maize subsistence households in the pre-shock period, the probability of transforming to a maize seller in the post-shock period is 12.7% higher in the refugee

[26] The presence of the binding constraint is also empirically supported by Dillon et al. (2019) in Tanzania, employing a different empirical approach with a different dataset (LSMS-ISA). Ito (2009) incorporated two types of labor market transactions with a similar motivation as mine but with a different empirical approach, and also found a significant labor market entry cost in India.

[27] The difference-in-difference version is presented in Table A.7 and the qualitative interpretation of the results is same as that described in this section.

[28] In fact, the point estimates are very similar regardless of controlling for the geographic controls. Moreover, most of the coefficients on these geographic controls are statistically insignificant, and this holds even if I remove the refugee treatment variable from the regression. This observation suggests that proximity to neighboring countries is not strongly associated with crop market conditions faced by local farmers. In all the other results from the difference-in-difference specifications both for the labor and crop markets, I have also checked the robustness of the results for adding the interaction term between the distance to a neighboring country and the year-2004 dummy, and I found the similar pattern again.

area than in other areas. On the other hand, panels (C) and (D) of Table 9 report insignificant (both statistically and economically) effects of the refugee inflows for marketization of the other food crops (cooking bananas and cassaava).

Mechanisms behind crop marketization—Transaction costs and refugee food demand

Recall from Table 2 that the impact of refugee inflows on crop marketization captures two components: the food demand effect (due to the increased food demand by refugees interacted with the crop composition of food aid) and the market transaction cost effect (due to the infrastructure development around refugee camps). Subsequently, I provide additional investigations to distinguish between these components. These investigations are based primarily on stratification of treatment variables by refugee presence, comparison of effects between crops with different levels of dependence on food aid, and comparison of crop supply responses between initial subsistence households and initial crop sellers, as well as basic mechanisms such as a price effect and a technological change.

First, I argue that the reduction in fixed market transaction costs would plausibly be the primary mechanism behind crop marketization. Next, I provide suggestive evidence that the refugee food demand effect also exists.

I. The reduction in fixed market transaction costs as a primary mechanism

The combination of the following six arguments implies that the reduction in fixed market transaction costs is the mechanism behind the marketization of maize and beans (especially for maize) most consistent with the model predictions.

(i) Insignificant price effect. Figure A.3 and Table A.8 report the market prices that farmers received by selling maize and beans. In the long run, there is no evidence that the refugee inflows have positive effects on food crop prices, unlike those in the short run as Alix-Garcia and Saah (2010) shown. This result would be consistent with the view that the marketization of maize and beans is not due to the higher farm-gate price in response to the higher consumption demand around refugee camps. However, this price observation alone may not be as informative as one might expect for the following two reasons. First, the number of observations is very small. Second, and more importantly, an increase in the farm-gate price may also be observed due to the reduction in transaction costs without the refugee food demand effect. For example, if the search cost for avoiding intermediaries who pay little for farmers is reduced due to social infrastructure development around the refugee camps, then an increase in the farm-gate price could also be possible. Imperfect competition among intermediaries is indeed widely observed in rural Africa (Bergquist and Dinerstein 2020). Therefore, the subsequent arguments are still needed to justify the primary mechanism.

(ii) Concentration of the marketization effect around refugee camps where most refugees have left. In order to investigate impacts of refugee camps with and without refugee presence, I stratify treatment variables by the nationality of the refugee camp.[29] Recall from Figure 2, Table A.1, and Whitaker (2002a) that most Rwandan refugees had repatriated before 2004 but that there were still many Burundian refugees staying in Tanzania in 2004. Around Rwandan refugee camps, the food demand effect is thus expected to be low but infrastructure (inclusive of acquired links to supply chains) are likely still present. Conversely, around Burundian refugee camps, the food demand effect is expected to be high especially among crops that are not an important part of food aid. Columns (5)–(10) of Table 9 report the results from the same regression specification, but with the treatment variables for Burundian and Rwandan refugee camps used separately. These columns report that the impact of refugee camps on marketization of maize and beans is concentrated only around Rwandan refugee camps.[30] This evidence is also contrary to the scenario that the refugee food demand effect primarily drives the crop marketization by host farmers, given that most Rwandan refugees had left the camps. Moreover, even though most Rwandan refugees had repatriated, the possibility that there were still some Rwandan refugees staying in Kagera cannot be completely ruled out. In order to infer the food consumption preferences of Rwandan refugees, Table A.9 reports calorie share of food available for human consumption in Rwanda. This table illustrates that banana and cassava consumption is much higher than maize consumption in Rwanda. Assuming that the tastes of Rwandan refugees are more similar to ordinary Rwandans than to Tanzanians, the positive impact of refugee camps on the marketization of maize instead of bananas or cassava would also be against the refugee food demand mechanism.

On the other hand, given the available data, it is not feasible to identify why no positive effects are observed for the same outcomes around Burundian refugee camps. It is not obvious that the continued presence of refugees would negate the transaction cost effect. One possibility is that the transaction cost around refugee camps is context-specific. The transaction cost may be lower around Rwandan refugee camps than around Burundian ones for various possible reasons. Even if infrastructure development around refugee camps decreases the transaction cost around Burundian refugee camps as well, the presence of refugees may increase the crop market transaction cost for similar reasons as suggested by the earlier labor market results.[31] In this case, the positive and negative effects on transaction costs can be canceled out. Another possibility is that the continued provision of food aid crowds out the entry of local farmers into the market for crops that are being supplied by the aid (maize and beans). Identifying the exact mechanism is left for future research.

(iii) Maize is the major food aid crop. Recall from Figure 3 and Table A.2 that maize accounts for the disproportional share of food aid. Recall too that the food aid also includes beans. On the other hand, bananas and cassava are not food aid crops. Refugee demand for food produced by local farmers would

[29] There are six Rwandan refugee camps (Mwisa, Burigi, Chabalisa, Rubwera, Kagenyi, and Omukariro) and seven Burundian refugee camps (Musuhura, Lukole A, Lukole B, Kitalli, Benako, Keza, and Mbuba). Although Rwandan refugee camps and Brundian refugee camps might have other unobservable different characteristics, a major factor that promoted the repatriation of Rwandan refugees was the political situation that the Rwandan Patriotic Front (RPF) government was facing (Whitaker 2002a).

[30] Recall that the district fixed effects cannot be included in the estimations with the Burundian treatment for the reason described in the previous footnote.

[31] There is suggestive evidence that the transaction cost impact in the labor market is stronger around Burundian refugee camps where refugees were still staying in 2004. Table A.6 reports that the negative impact on labor market participation (Table 8) is stronger around Burundian camps both statistically and economically than around Rwandan camps.

thus increase more for bananas and cassava than for maize and beans. Therefore, the strong positive impact of refugee camps on marketization of only food aid crops also goes against the refugee food demand mechanism.[32]

(iv) Crop supply response only from initial subsistence farmers. According to the previous arguments, the most reasonable mechanism behind the marketization of maize and beans would be the decrease in market transaction cost. The following argument helps to further identify which type of crop market transaction costs plays a key role. Table 10 reports the estimation results of (12). Columns (4)–(6) and (10)–(12) of this table report the impact of Rwandan refugee camps on the supply of maize and beans to markets among initial sellers. For both maize and beans, in contrast to a significant crop marketization by initial subsistence households around the refugee camps (relative to that in other areas), no statistically significant supply response was observed among initial sellers. Guided by the model predictions outlined in Table 2, this result suggests that the dominant force behind crop marketization is the reduction in fixed crop market transaction costs rather than proportional transaction costs.

(v) No significant technological change is observed. Another possibility would be that a technological improvement raised productivity and led to the observed marketization around refugee camps. Infrastructure development around refugee camps may have improved access to regionally tradable inputs such as fertilizers or pesticides. Table A.10 reports the impact of the Rwandan treatment on these inputs and others. No significant evidence of the Rwandan treatment effect on these inputs is found. Strong negative impacts on child labor (both statistically and economically) and on livestock use (economically) are found, but it is difficult to connect these observations to the crop marketization. Moreover, if these technological changes (child labor and/or livestock) had been dominant forces driving the crop marketization, the initial crop sellers would have also increased their crop supply.

(vi) Marketization of an export crop. Coffee, the main cash crop in Tanzania, is produced primarily for exporting out of the Kagera region. This means that its production is less responsive to the effects of local food demand and food aid. Therefore, an investigation into coffee marketization is also useful in supporting the idea that crop market transaction costs have declined around Rwandan refugee camps. Table A.11 reports the results on coffee production and marketization among all initial producers in panel (A) and among initial non-sellers[33] in panel (B). Panel (B) reports that, among initial coffee non-sellers, the refugee inflows have significant positive impacts on being coffee producers and sellers in the post-shock period. This coffee marketization also supports the view of the reduction in fixed crop market transaction cost around the refugee camps.

[32] My argument so far is also bolstered by the qualitative findings of the short-term impact of refugee inflows reported by Whitaker (1999). She summarizes the short-term impacts as follows. Refugees preferred their own staples including cooking bananas and cassava. Since the food aid mainly consisted of maize and beans, they were seeking other varieties of food from local farmers. Consequently, the prices of cassava and cooking bananas rose sharply. Alix-Garcia and Saah (2010) also found similar short-term price effects. On the other hand, the observations so far imply that the long-term impacts are entirely different from the short-term ones and thus against the refugee food demand mechanism.

[33] Coffee non-sellers within coffee producers may not seem like a realistic classification because coffee is an export crop. However, as Table A.4 and Table 4 show, a non-trivial number of households in the pre-shock period produce coffee without market sales. I interpret such coffee non-sellers as initial-stage or small-scale coffee farmers, analogous to subsistence farmers of food crops. See Adhvaryu et al. (2019) for more detailed information of the coffee sector in Tanzania and the characteristics of coffee farmers in Kagera.

II. Suggestive evidence of the refugee food demand effect

Columns (1)–(3) and (7)–(9) of Table 10 report that increases in food crop supplies to markets by initial sellers are significantly higher around Burundian refugee camps than in other areas. Controlling for the initial household fixed effects, the statistical significance holds for beans, cooking bananas, and cassava, while it does not for maize. These supply shifts could be plausibly regarded as suggestive evidence of the refugee food demand effect, from the following four ingredients. First, many Burundian refugees were considered to be still in Kagera in 2004 (while Rwandan ones were not). Second, maize is the major food aid crop, while cooking bananas and cassava are not food aid crops. The share of beans in food aid is also very low compared to maize. Third, beans, cooking bananas, and cassava are likely to be preferred by Burundians.[34] According to these three facts, the increase in crop supply would be consistent with the potential increase in food demand produced by local farmers. Finally, the model predictions outlined in Table 2 suggest that these observations are consistent with the refugee food demand effect. Although the degrees of statistical significance are weaker than the other results reported in this section, the set of these results of the Burundian treatment effect is indeed entirely opposite of the Rwandan treatment effect discussed above and cannot be rationalized by the fixed transaction cost mechanism. Moreover, these heterogeneous impacts across crops can be explained not by the proportional transaction cost but by the crop composition of the food aid.

5.3 The Overall Negative Impact on Shadow Wages

Table 11 reports the overall negative impact of the refugee inflows on shadow wages for both male and female, restricting the sample to the quasi-panel data. In this regression, I am not controlling for agricultural input variables, including land, that were used to estimate the shadow wage in Appendix B. Recall from section 2.3 that the two main results of this paper, the "surplus farm labor" effect and the "crop marketization effect" affect agricultural labor productivity in opposite directions theoretically. Indeed, among off-farm labor market participants, the degree of the negative impact on shadow wage is larger (recall Table 6 and Table A.5) than the overall impact. On the other hand, Figure 7 reports that being a crop seller in the post-shock period is positively associated with a higher female shadow wage, which is consistent with the theoretical prediction (7). Moreover, this overall impact of the refugee inflows reflects responses in all other agricultural output and factor markets, in addition to the labor and crop markets analysed in this paper, that contribute to the estimated shadow wages. Therefore, looking only at this overall impact would not lead to any meaningful interpretation. The key lesson is that, rather,

[34]Unfortunately, the information on calorie share of food consumption in Burundi is missing in the FAOSTAT, although data on aggregate crop production in Burundi are available. According to the FAOSTAT, the shares of production values of cooking bananas (4.03%) and cassava (6.23%) are much higher than beans (0.7%) and maize (0.82%) in Burundi in 2004 and these relative differences are similar in 1993 as well. Note that these absolute values are small because the share of sugar cane production value is disproportionately high (41.5% in 2004). Therefore, it is reasonable to presume that cooking bananas and cassava are major staples in Burundi. Whitaker (1999) also anecdotally argues that the refugees preferred cooking bananas and cassava. I have less confidence in beans, but Table 1 of Alix-Garcia and Saah (2010) (from the FAOSTAT when the data was probably available) reports that the calorie share of beans (legumes) in Burundian food consumption is about twice that of maize.

market-specific tests help to understand the distributional impacts attributed to each market. To conclude, the answer to the primary research question is that the refugee inflows hurt hosting farmers in terms of the labor market environment and benefited them in terms of the crop market environment. While the answer is not determined yet for other markets, overall the negative impact outweighs the positive one.

6 Discussion

I provide discussions to improve the plausibility of causality of my empirical results. First, I argue the validity of the wage variables used throughout my empirical analyses. Second, I report the placebo test results which show that any pre-trend that has the same direction and mechanism as the main results above does not exist. Third, I show the robustness of the results with alternative definitions of the treatment variable.

6.1 Validity of the Wage Variables

The use of reported market wages and estimated shadow wages always raises the concern of measurement error. Given this possibility, *absolute* values of the market wage, the shadow wage, or the wage gap themselves may not capture their true values and may not be meaningful indicators. However, this concern is not a problem in the difference-in-difference framework adopted in my empirical analyses. My primary interest is the difference in wage gap between the refugee areas and other areas in a *relative* sense. Therefore, as long as the measurement error is systematic and not correlated with the refugee treatment, the difference-in-difference estimator conveys meaningful information. That is, if the observed or estimated wage is systematically underestimating or overestimating the true wage for reasons unrelated to the refugee treatment, then the average relative difference in outcome variables between the refugee and non-refugee areas could be validly used for examining the impact of refugee inflows.

The potential measurement error in the reported market wage would depend mainly on the questionnaire structure or the survey interview protocol. There would be no reason for either to be associated with the refugee treatment.

The shadow wage used in my empirical analysis may not be an unbiased estimate of the marginal product of labor because of the potential endogeneity of the agricultural input variables used in its estimation. The potential measurement error in the estimated shadow wage may also depend on the functional form of the production function, the choice of agricultural input variables, or the measurement error of the input variables used for estimation. There would be no reason for either of them to be associated with the refugee treatment.

Furthermore, the Cobb-Douglas specification of the agricultural production function is useful for the purpose of this paper. As (B.1) in Appendix B shows, the estimated shadow wage is also a proxy of the average product of labor up to a constant. The estimated shadow wage is also the average product of labor multiplied by a constant ($\hat{\beta}_{L_j} APL_j$). The "constant" $\hat{\beta}_{L_j}$ is the estimated coefficient on labor time by each gender from the Cobb-Douglas production function. Because of the endogeneity issue, $\hat{\beta}_{L_j}$

might not be an unbiased estimate of the elasticity of agricultural output value with respect to labor (β_{L_j}). Developing a methodology to obtain its unbiased estimate is obviously an important research agenda. However, for the purpose of this paper, the biased estimate of β_{L_j} does not violate the validity of my empirical results. If I take the difference in log of the estimated shadow wage between the refugee and non-refugee areas, then $\log \hat{\beta}_{L_j}$ disappears.

6.2 Placebo Tests

A potential problem is that the main empirical results may just capture pre-existing time trends between the refugee and non-refugee areas that cannot be controlled for by geographical fixed effects. In order to check underlying time trends, I exploit another two-period (1991 & 1993) panel data. Both of these two periods are before the major refugee inflows. I investigate the "treatment effect" of the refugee inflows in the same difference-in-difference framework as the main framework except for the time periods. The following results support the point that the market environment around refugee camps reflects the entry (and exit) of refugees rather than other attributes of camp locations.

Table A.12 presents the placebo test for labor market efficiency, which corresponds to Table 7 in the main analysis. Recall that Table 7 reports the positive impact of the refugee inflows on the gap between market and shadow wages for both male and female labor. On the other hand, any statistically significant time trend in this direction is not found in Table A.12. In terms of the economic significance, the point estimate in the placebo test (0.141) is also much smaller than that in the main result (0.893) for male labor. For female labor, the sign of the point estimate in the placebo test is opposite to the main result.

Table A.13 presents the placebo test for labor market participation, which corresponds to Table 8 in the main analysis. Recall that Table 8 reports the negative impact of the refugee inflows on labor market participation for male labor. On the other hand, any statistically significant time trend in this direction is not found in Table A.13. The sign of the point estimate in the placebo test is even opposite to the main result, especially for the agricultural sector.

Table A.14 presents the placebo test for the transition from crop subsistence to sellers, which corresponds to Table 9 in the main analysis. Recall that Table 9 reports the positive impact on households' transitions from subsistence to sellers for the aid crops, maize and beans, only around Rwandan refugee camps. In Table A.14, any statistically significant time trend in this direction is not found for maize and beans. In terms of the economic significance, the size of the coefficient is not trivial for beans (0.117), but the following paragraph argues that this is not likely to be due to the reduction in fixed transaction costs.

Table A.15 presents the placebo test for the food crop sales to markets by initial sellers, which corresponds to Table 10 in the main analysis. Recall that Table 10 reports the positive impact on crop supply among initial sellers only around Burundian refugee camps. In Table A.14, any statistically significant time trend in this direction around Burundian refugee camps is not detected for any crops. Moreover, the coefficient of the Rwandan impact for beans is positive and significant (statistically and economically). According to the model prediction outlined in Table 2, this supply shift of beans cannot be interpretable as the reduction of fixed transaction costs, since the fixed transaction costs would only affect crop sales by initial subsistence farmers. Instead, this is most likely to be driven by other temporal market forces. Therefore, the non-trivial size of the coefficient for beans marketization in A.14 would not be regarded as the similar pre-trend to the main result.

6.3 Robustness Checks

In order to check the robustness of the main results, I prepare the following four additional treatment variables: (A) a dummy, which takes 1 if one of the refugee camps is located within its own ward or the neighborhood wards of the village where each household lives; (B) log of the distance between the center of the village where each household lives and the nearest refugee camp; (C) a dummy, which takes 1 if one of the refugee camps is located within 60km from the center of the village where each household lives; (D) a dummy, which takes 1 if one of the refugee camps is located within 40km from the center of the village where each household lives. (A) checks the robustness of the results for a treatment variable that does not rely on the distance. This measure is obtained from the KHDS questionnaire. (B) checks the linear impact of the degree of proximity to a refugee camp, instead of a dummy treatment variable based on a distance threshold. (C) and (D) check the sensitivity of the main results to changing the distance threshold for classifying the treatment status.[35] In all the appendix tables shown in this section, panels (A), (B), (C), and (D) report results using the alternative treatment variables (A), (B), (C), and (D) defined here, respectively.

Table A.16, the gap between market and shadow wage gaps, corresponds to Table 7 in the main results. The economic significance is consistent across all the specifications, although the statistical significance holds in only two of the four panels. The difference in statistical significance across different treatment variables is understandable given the large variance in wages. Table A.17, labor market participation, corresponds to Table 8 in the main results, focusing on the off-farm labor supply of male members. The economic and statistical significance holds in three of the four panels, especially for the non-agricultural work. Notably, in both the wage gap and the labor market participation, the statistical significance remains with the 40 km threshold in panel (B) while it is lost with the 60 km threshold in panel (A).

Table A.18, transition from subsistence to food crop sellers, corresponds to Table 9 in the main results. I focus on Rwandan refugee camps, as this impact was concentrated around there in the main result. Note that (D) is omitted from this table, because there are only three villages, all in the same district, whose value of this treatment variable is 1 and thus the power is significantly lost in my preferred specification with the district fixed effects. The less significant result with (A) is understandable because (A) does not distinguish between Burundian and Rwandan refugee camps. The statistical and economic significance is retained in both of the alternative Rwandan treatment variables, (C) and (D), for both maize and beans, although its degree is slightly weaker for maize than that in the main result.

[35] Out of the 49 village clusters, there are 22 and 9 treatment villages with (C) and (D), respectively.

7 Concluding Remarks

This paper investigates long-term effects of refugee inflows on host farmers through labor and crop markets. I exploit a natural experiment Tanzania faced when it experienced mass refugee inflows from Burundi and Rwanda in the early 1990s. Combining a canonical agricultural household model with a longitudinal panel data from the host economy, I show that the refugee inflows cause market-specific gains and losses for agricultural households. The results imply that, in the long run, the refugee inflows have increased labor market transaction costs and decreased crop market transaction costs. In both markets, fixed transaction costs play a dominant role. This paper demonstrates that looking only at consumption or wage levels is insufficient to uncover important underlying mechanisms behind the impact of refugee inflows in rural developing areas where factor and output market imperfections are prevalent.

The following policy implications are derived from the empirical results of this paper. First, facilitating market transactions in an environment with a mix of different ethnic groups (by, for example, promoting intergroup contacts to improve mutual understanding) is a key policy issue. In the context of this study, facilitating the entry of host populations into labor markets where refugees are present (by, for example, reducing search costs and eliminating security concerns) would also be important to achieve this agenda. The empirical results imply that surplus farm labor is increased by refugee inflows, which is against this direction. Second, investments in physical and social infrastructure around refugee camps can also create new opportunities for host populations. Moreover, such a development impact could last long even after refugees have left refugee camps. The shift from crop subsistence to marketization around the Rwandan refugee camps where most Rwandan refugees have repatriated is one indication of this direction implied by the empirical results. Governments, practitioners, and donor and development agencies should envision what types of long-lasting impacts their investments might have on the host economy after refugees leave. It would also be important for these actors to have foresight in envisioning several scenarios, since it may not be possible to predict how long the refugee presence will last at the time of their arrival.

Several limitations remain due to the lack of detailed data. Additional information on household behavior in host economies with more frequent time periods will assist in understanding short-, medium-, and long-term impacts of refugee inflows. Information on the number of refugees in each camp, which is not still available in most settings in developing countries, would facilitate examination of the economic significance of the impact of refugee inflows. Similarly, information on detailed activities of refugees would be helpful to better understand why labor market frictions in host economies are increased by refugee inflows. Future research on these questions is needed.

External validity is also an important agenda. This study focuses on the largest scale refugee movement in recent African history. Refugee movements are still observed in many regions in Sub-Saharan Africa and around the world. Many aspects, such as ethnic compositions, agricultural and technological conditions, and refugee camp and aid policies, have different faces across regions. Moreover, this paper is silent on general equilibrium implications across households and villages as well as total welfare implications including out-migration from the region. Further research is warranted to incorporate new data collection in post-conflict and refugee inflow areas and generalize the linkage between conflicts, refugees, and rural economic mobility.

References

Abadie, Alberto, Susan Athey, Guido W Imbens, and Jeffrey Wooldridge, "When Should You Adjust Standard Errors for Clustering?," Technical Report, National Bureau of Economic Research 2017.

Adhvaryu, Achyuta, Namrata Kala, and Anant Nyshadham, "Booms, busts, and household enterprise: Evidence from coffee farmers in Tanzania," *The World Bank Economic Review*, 2019.

Ainsworth, Martha, P Bhatt, and J Shafer, "User's Guide to the Kagera Health and Development Survey Datasets," *Development Research Group. The World Bank*, 2004.

Alix-Garcia, Jennifer and David Saah, "The effect of refugee inflows on host communities: Evidence from tanzania," *The World Bank Economic Review*, 2010, *24* (1), 148–170.

_ , Sarah Walker, Anne Bartlett, Harun Onder, and Apurva Sanghi, "Do refugee camps help or hurt hosts? The case of Kakuma, Kenya," *Journal of Development Economics*, 2018, *130*, 66–83.

Baez, Javier E, "Civil wars beyond their borders: The human capital and health consequences of hosting refugees," *Journal of Development Economics*, 2011, *96* (2), 391–408.

Barrett, Christopher B, "Smallholder market participation: Concepts and evidence from eastern and southern Africa," *Food Policy*, 2008, *33* (4), 299–317.

_ , Paul Christian, and Bekele A Shiferaw, "The processes of structural transformation of African agriculture and rural spaces," *World Development*, 2018, *105*, 283–285.

_ , Shane M Sherlund, and Akinwumi A Adesina, "Shadow wages, allocative inefficiency, and labor supply in smallholder agriculture," *Agricultural Economics*, 2008, *38* (1), 21–34.

Beegle, Kathleen, Joachim De Weerdt, and Stefan Dercon, "Kagera health and development survey 2004 basic information document," 2006. The World Bank.

Benjamin, Dwayne, "Household composition, labor markets, and labor demand: testing for separation in agricultural household models," *Econometrica: Journal of the Econometric Society*, 1992, pp. 287–322.

Bergquist, Lauren Falcao and Michael Dinerstein, "Competition and entry in agricultural markets: Experimental evidence from Kenya," *American Economic Review*, 2020, *110* (12), 3705–47.

Binswanger, Hans P and John McIntire, "Behavioral and material determinants of production relations in land-abundant tropical agriculture," *Economic Development and Cultural Change*, 1987, pp. 73–99.

_ and Robert F Townsend, "The growth performance of agriculture in Subsaharan Africa," *American Journal of Agricultural Economics*, 2000, pp. 1075–1086.

Blattman, Christopher and Edward Miguel, "Civil war," *Journal of Economic literature*, 2010, *48* (1), 3–57.

Card, David, "The impact of the Mariel boatlift on the Miami labor market," *Industrial & Labor Relations Review*, 1990, *43* (2), 245–257.

de Janvry, Alain and Elisabeth Sadoulet, "Progress in the modeling of rural households' behavior under market failures," in "Poverty, inequality and development," Springer, 2006, pp. 155–181.

— **, Marcel Fafchamps, and Elisabeth Sadoulet**, "Peasant household behaviour with missing markets: some paradoxes explained," *The Economic Journal*, 1991, pp. 1400–1417.

de Weerdt, Joachim, "Moving out of poverty in Tanzania: Evidence from Kagera," *The Journal of Development Studies*, 2010, *46* (2), 331–349.

Dillon, Brian, Peter Brummund, and Germano Mwabu, "Asymmetric non-separation and rural labor markets," *Journal of Development Economics*, 2019, *139*, 78–96.

Doss, Cheryl, Chiara Kovarik, Amber Peterman, Agnes Quisumbing, and Mara Van den Bold, "Gender inequalities in ownership and control of land in Africa: myth and reality," *Agricultural Economics*, 2015, *46* (3), 403–434.

Fafchamps, Marcel, "Sequential labor decisions under uncertainty: An estimable household model of West-African farmers," *Econometrica: Journal of the Econometric Society*, 1993, pp. 1173–1197.

Fallah, Belal, Caroline Krafft, and Jackline Wahba, "The impact of refugees on employment and wages in Jordan," *Journal of Development Economics*, 2019, *139*, 203–216.

Foged, Mette and Giovanni Peri, "Immigrants' effect on native workers: New analysis on longitudinal data," *American Economic Journal: Applied Economics*, 2016, *8* (2), 1–34.

Foster, Andrew D and Mark R Rosenzweig, "Is there surplus labor in rural India?," 2010.

— **and** — , "Are there too many farms in the world? Labor-market transaction costs, machine capacities and optimal farm size," Technical Report, National Bureau of Economic Research 2017.

Goetz, Stephan J, "A selectivity model of household food marketing behavior in sub-Saharan Africa," *American Journal of Agricultural Economics*, 1992, *74* (2), 444–452.

Gollin, Douglas, "The Lewis model: A 60-year retrospective," *Journal of Economic Perspectives*, 2014, *28* (3), 71–88.

Ikegami, Munenobu, "Household Investment, Heterogeneous Productivity, and Poverty Dynamics: Theory and Evidence from Kagera, Tanzania," 2008.

Ito, Takahiro, "Caste discrimination and transaction costs in the labor market: Evidence from rural North India," *Journal of development Economics*, 2009, *88* (2), 292–300.

Jacoby, Hanan G, "Shadow wages and peasant family labour supply: an econometric application to the Peruvian Sierra," *The Review of Economic Studies*, 1993, pp. 903–921.

Jones, Maria, Florence Kondylis, John Ashton Loeser, and Jeremy Magruder, "Factor Market Failures and the Adoption of Irrigation in Rwanda," 2021.

Key, Nigel, Elisabeth Sadoulet, and Alain De Janvry, "Transactions costs and agricultural household supply response," *American journal of agricultural economics*, 2000, *82* (2), 245–259.

LaFave, Daniel and Duncan Thomas, "Farms, families, and markets: New evidence on completeness of markets in agricultural settings," *Econometrica*, 2016, *84* (5), 1917–1960.

Lewis, W Arthur, "Economic development with unlimited supplies of labour," *The manchester school*, 1954, *22* (2), 139–191.

Li, Nicholas, "In-kind transfers, marketization costs and household specialization: Evidence from Indian farmers," 2021.

Maystadt, Jean-François and Gilles Duranton, "The development push of refugees: Evidence from Tanzania," *Journal of Economic Geography*, 2018, *19* (2), 299–334.

_ **and Philip Verwimp**, "Winners and losers among a refugee-hosting population," *Economic development and cultural change*, 2014, *62* (4), 769–809.

Morales, Juan S, "The impact of internal displacement on destination communities: Evidence from the colombian conflict," *Journal of Development Economics*, 2018, *131*, 132–150.

Platteau, Jean-Philippe, Yujiro Hayami, and Partha Dasgupta, "Resource endowments and agricultural development: Africa versus Asia," *The Institutional Foundations of East Asian Economic Development*, 1998. in Y. Hayami and M. Aoki eds., London: Macmillan, 357-410.

Renkow, Mitch, Daniel G Hallstrom, and Daniel D Karanja, "Rural infrastructure, transactions costs and market participation in Kenya," *Journal of development economics*, 2004, *73* (1), 349–367.

Ruiz, Isabel and Carlos Vargas-Silva, "The labour market consequences of hosting refugees," *Journal of Economic Geography*, 2016, *16* (3), 667–694.

_ **and** _ , "The impact of hosting refugees on the intra-household allocation of tasks: A gender perspective," *Review of Development Economics*, 2018, *22* (4), 1461–1488.

Rutinwa, Bonaventure, "The end of asylum? The changing nature of refugee policies in Africa," *Refugee survey quarterly*, 2002, *21* (1 and 2), 12–41.

Sadoulet, Elisabeth, Alain de Janvry, and Catherine Benjamin, "Household behavior with imperfect labor markets," *Industrial Relations: A Journal of Economy and Society*, 1998, *37* (1), 85–108.

Sen, Amartya K, "Peasants and Dualism with or without Surplus Labor," *Journal of political Economy*, 1966, *74* (5), 425–450.

Singh, Inderjit, Lyn Squire, and John Strauss, *Agricultural household models: Extensions, applications, and policy*, Johns Hopkins University Press Baltimore, 1986.

Skoufias, Emmanuel, "Using shadow wages to estimate labor supply of agricultural households," *American Journal of Agricultural Economics*, 1994, *76* (2), 215–227.

Sonoda, Tadashi, ""Internal Instability" of Peasant Households: A Further Analysis of the de Janvry, Fafchamps, and Sadoulet Model," *The Japanese Journal of Rural Economics*, 2004, *6*, 1–12.

Taylor, J Edward, Mateusz J Filipski, Mohamad Alloush, Anubhab Gupta, Ruben Irvin Rojas Valdes, and Ernesto Gonzalez-Estrada, "Economic impact of refugees," *Proceedings of the National Academy of Sciences*, 2016, *113* (27), 7449–7453.

Thomson, Jessie, "Durable solutions for Burundian refugees in Tanzania," *Forced Migration Review*, 2009, *33*, 35–37.

Tumen, Semih, "The economic impact of Syrian Refugees on host countries: Quasi-Experimental evidence from Turkey," *American Economic Review*, 2016, *106* (5), 456–60.

Udry, Christopher, "Gender, agricultural production, and the theory of the household," *Journal of political Economy*, 1996, *104* (5), 1010–1046.

—, "The economics of agriculture in Africa: Notes toward a research program," *African Journal of Agricultural and Resource Economics*, 2010, *5* (1), 284–299.

UNHCR, "The Rwandan genocide and its aftermath," *The State of the World's Refugees*, 2000. Chapter 10.

—, "Global Trends – Forced Displacement in 2016," 2016.

Whitaker, Beth Elise, "Changing Opportunities: Refugees and Host Communities in Western Tanzania," *New Issues in Refugee Research*, 1999.

—, "Document. Changing priorities in refugee protection: the Rwandan repatriation from Tanzania," *Refugee Survey Quarterly*, 2002, *21* (1_and_2), 328–344.

—, "Refugees in Western Tanzania: The distribution of burdens and benefits among local hosts," *Journal of Refugee Studies*, 2002, *15* (4), 339–358.

World Food Program, *Food Aid Information System (FAIS).* (www.wfp.org/fais/, Access: April 2018).

Figures

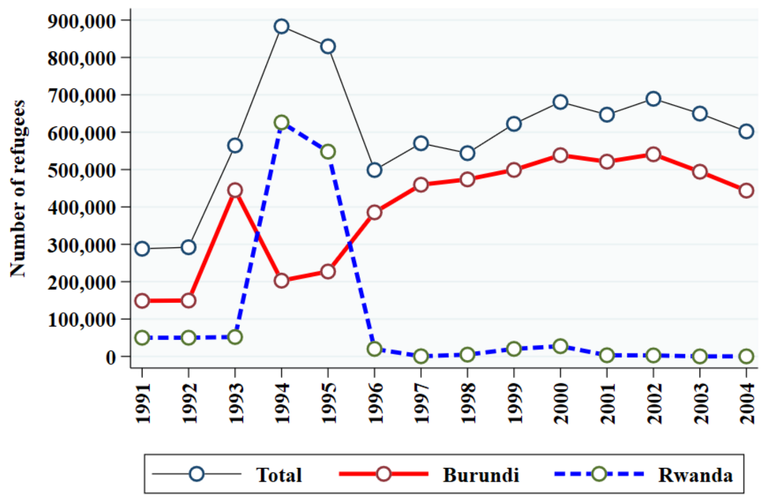


Figure 2: Refugees in Tanzania

Source: UNHCR Population Statistics (http://popstats.unhcr.org/en/overview).

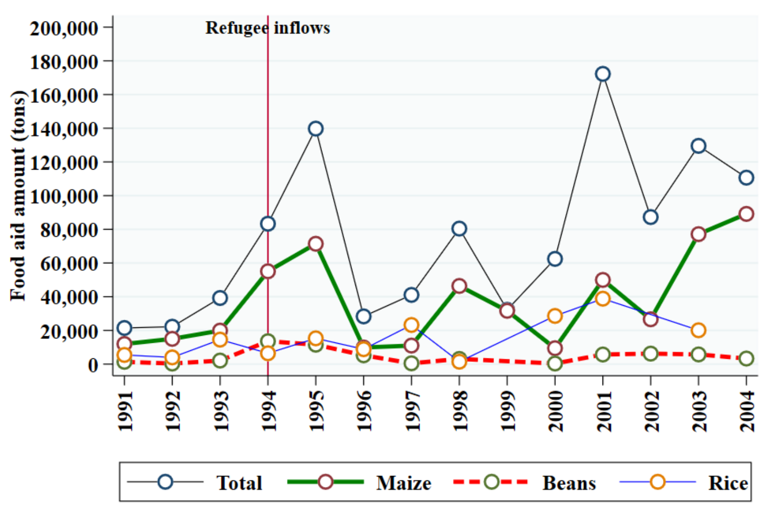


Figure 3: Food Aid Delivered to Tanzania

Source: WFP *Food Aid Information System* (www.wfp.org/fais/).

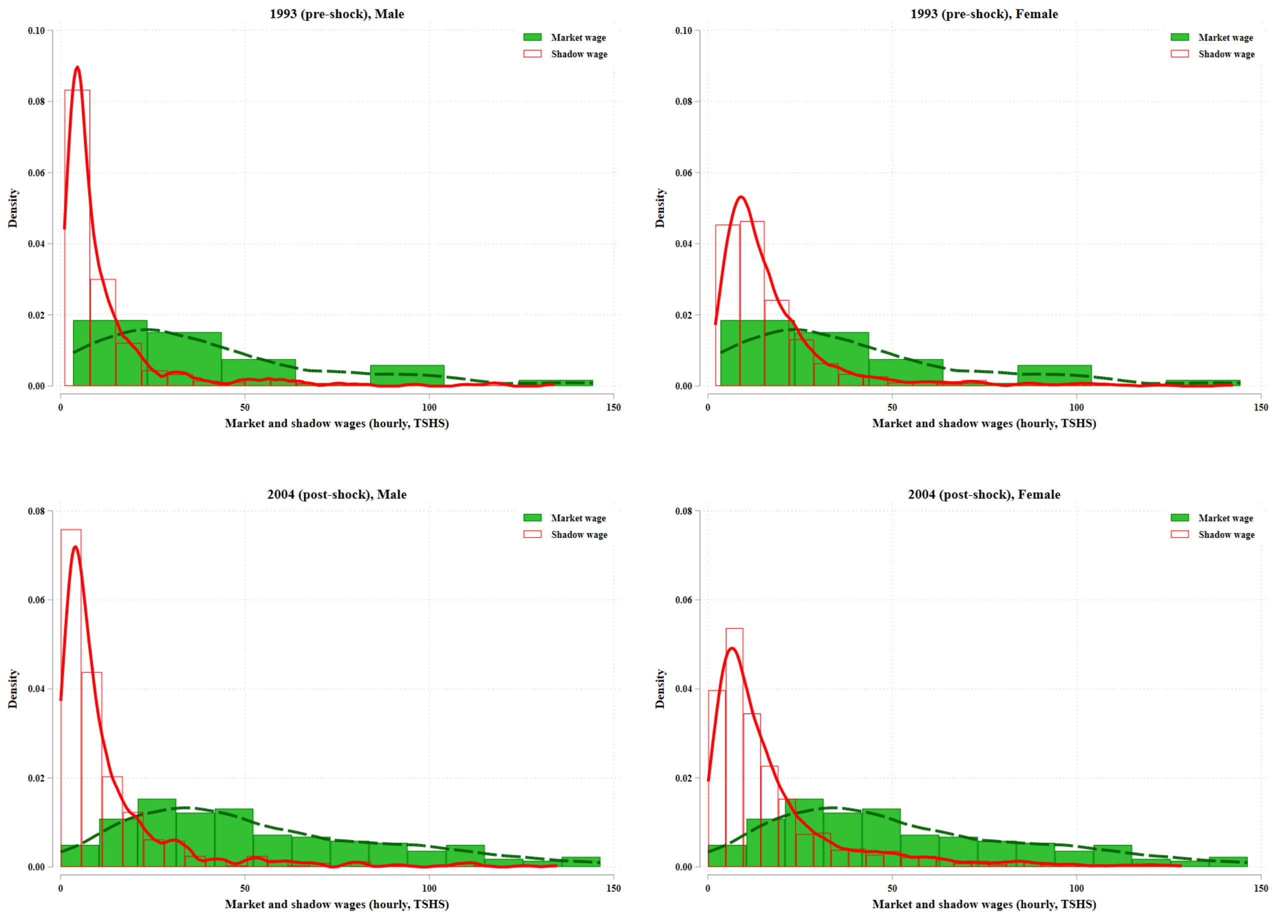


Figure 4: Distributions of Market and Shadow Wages

Notes: The estimation procedure of shadow wages is described in Appendix B. The reported wages are in hourly basis and the real values in 1991.

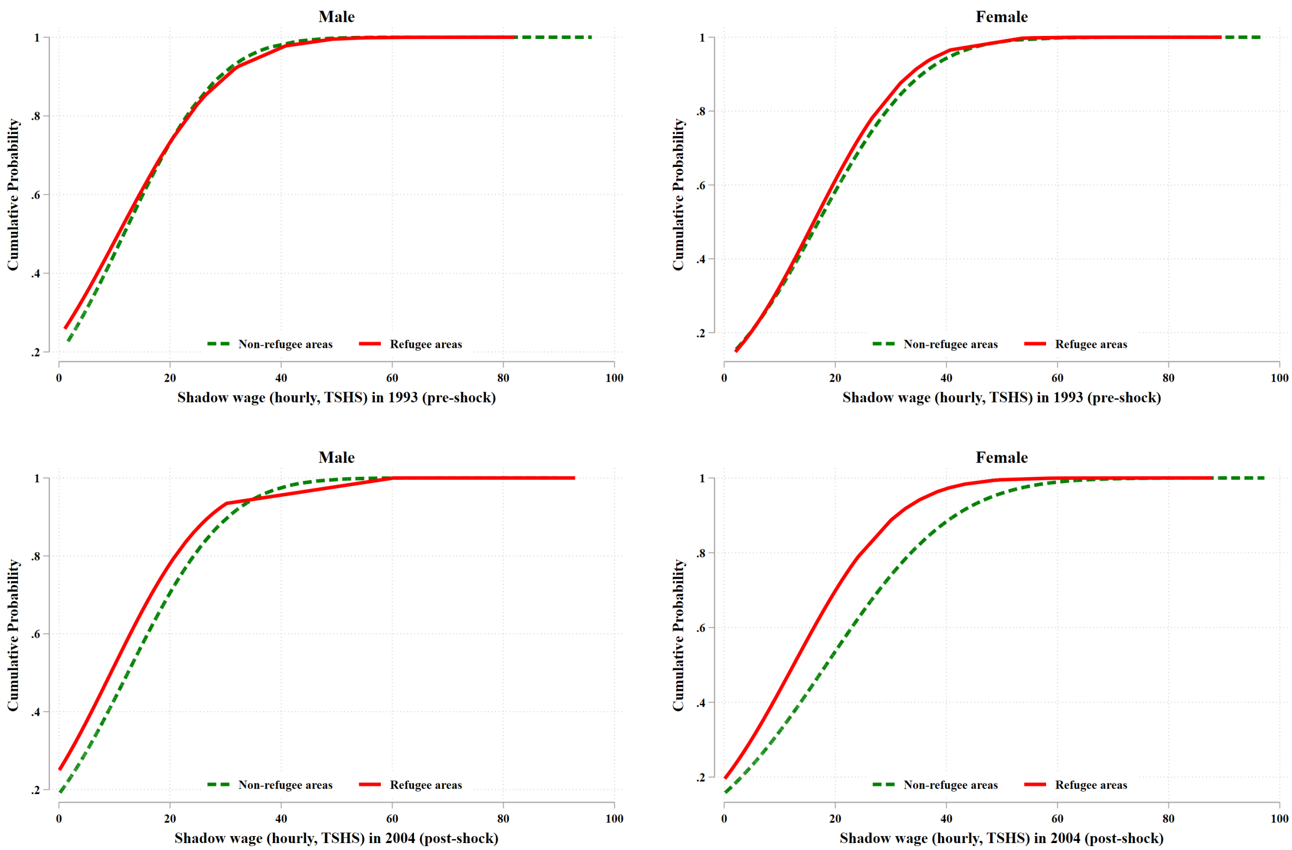


Figure 5: Distributions of Shadow Wages in Refugee and Non-Refugee Areas

Notes: The estimation procedure of shadow wages is described in Appendix B. The estimated shadow wages are in hourly basis and the real values in 1991. A household's location is defined as in the refugee area if one of the refugee camps is located within 50km from center of the village where each household lives.

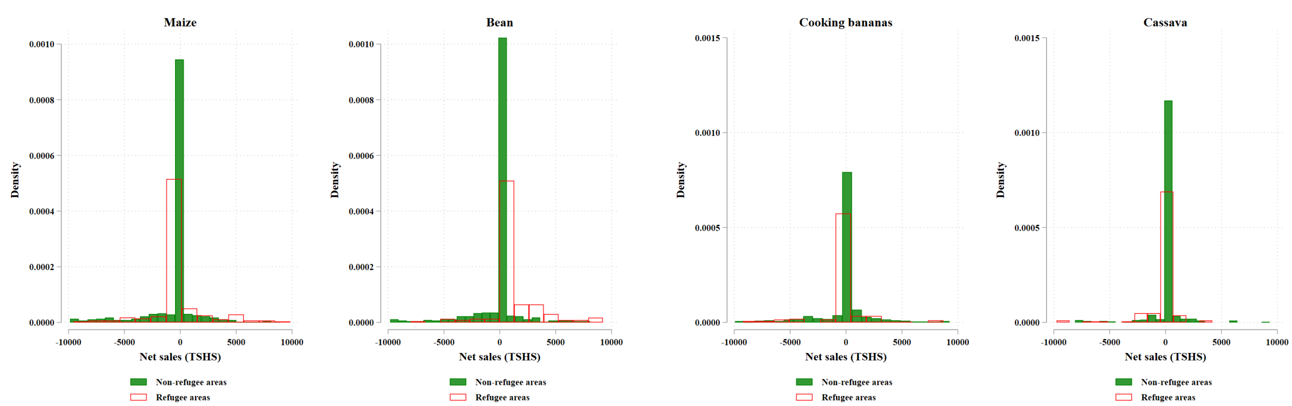


Figure 6: Post-Shock (2004) Net Sales of Food Crops by Initial Subsistence Households

Notes: Net sales of each crop is defined as the amount sold minus the amount purchased in the real values in 1991. A negative value means that a household is a (net) buyer of a crop. A household's location is defined as in the refugee area if one of the refugee camps is located within 50km from center of the village where each household lives.

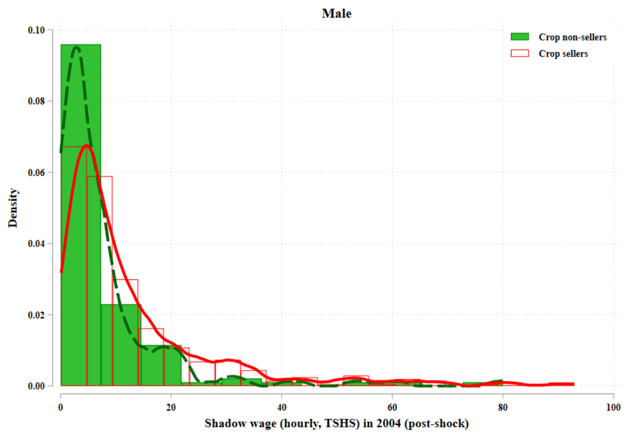


Figure 7: Distributions of Shadow Wages by Crop Market Participation Status

Notes: The estimation procedure of shadow wages follows the conventional literature (Jacoby 1993; Skoufias 1994) and is described in Appendix B. The estimated shadow wages are in hourly basis and the real values in 1991.

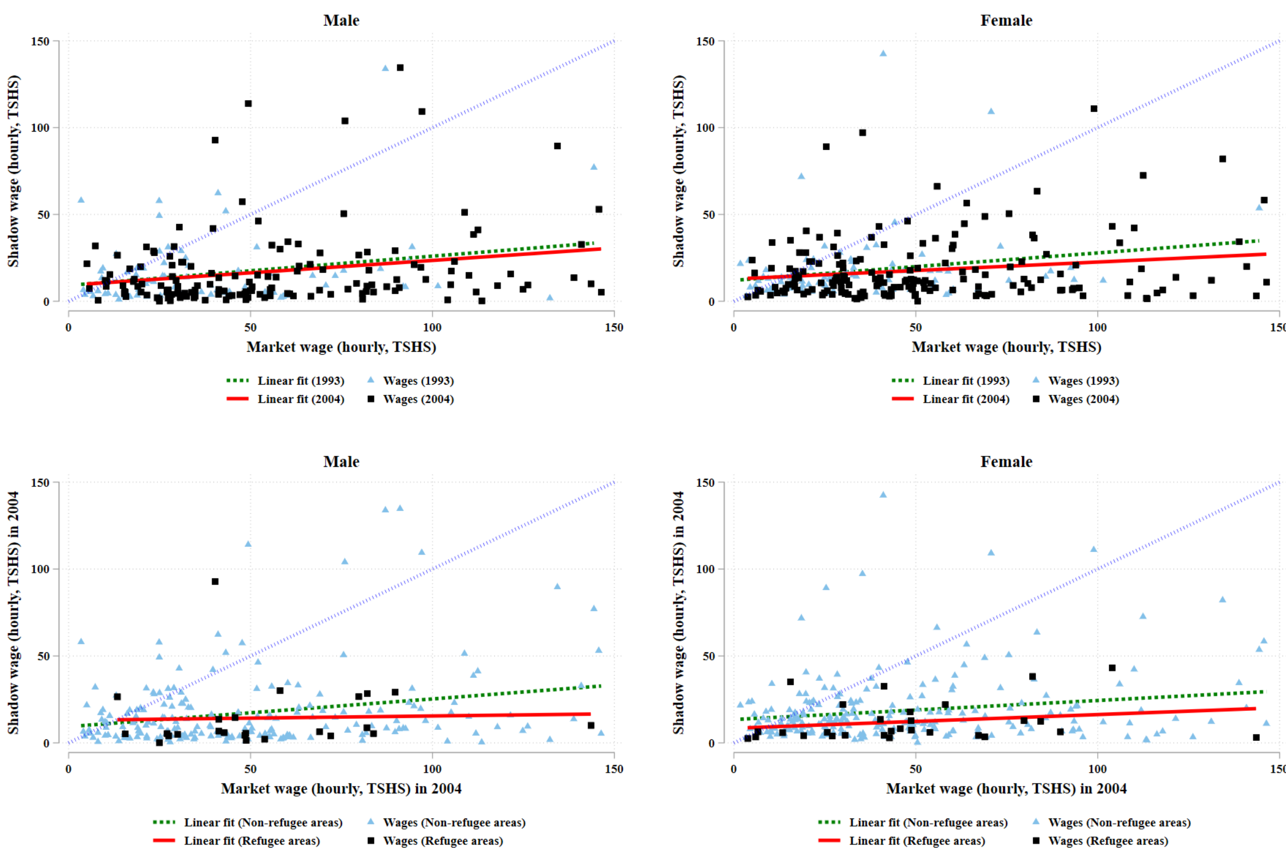


Figure 8: Correlation between Market and Shadow Wages

Notes: The estimation procedure of shadow wages follows the conventional literature (Jacoby 1993; Skoufias 1994) and is described in Appendix B. The reported wages are in hourly basis and the real values in 1991.

Tables

Table 3: Off-Farm Employment and Hired Labor Use by Sample Agricultural Households

		1993 (Pre-Shock) Hired harvest labor (past 12 months)		2004 (Post-Shock) Hired harvest labor (past 12 months)	
		No	Yes	No	Yes
(A) The quasi-panel sample		(n=485)		(n=928)	
Use family harvest labor	No	0.206	0.206	1.078	0.216
(past 12 months)	Yes	55.670	43.918	77.694	21.012
Off-farm wage employment	No	49.072	38.557	57.112	15.841
(past 12 months)	Yes	6.804	5.567	21.659	5.388
Off-farm agricultural wage employment	No	54.021	43.093	68.750	19.396
(past 12 months)	Yes	1.856	1.030	10.022	1.832
Off-farm non-agricultural wage employment	No	50.515	39.588	66.379	17.349
(past 12 months)	Yes	5.361	4.536	12.392	3.880
(B) The whole sample		(n=805)		(n=955)	
Use family harvest labor	No	0.124	0.373	1.033	0.207
(past 12 months)	Yes	54.907	44.596	78.202	21.798
Off-farm wage employment	No	48.447	39.130	57.955	15.496
(past 12 months)	Yes	6.584	5.839	21.281	5.268
Off-farm agricultural wage employment	No	52.671	43.975	69.421	19.008
(past 12 months)	Yes	2.360	0.994	9.814	1.757
Off-farm non-agricultural wage employment	No	50.186	40.000	67.045	16.942
(past 12 months)	Yes	4.845	4.969	12.190	3.823

Table 4: Crop Market Participation Regimes of Sample Agricultural Households

	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
(A) The quasi-panel sample	**1993 (Pre-Shock, n=485)**					**2004 (Post-shock, n=928)**				
(1) Coffee seller	307					357				
(2) Maize seller	33	47				51	120			
(3) Beans seller	66	32	108			78	59	154		
(4) Cooking banana seller	88	20	41	123		110	37	55	164	
(5) Cassava seller	54	14	21	30	75	48	33	24	35	79
(B) The whole sample	**1993 (Pre-Shock, n=805)**					**2004 (Post-shock, n=958)**				
(1) Coffee seller	481					360				
(2) Maize seller	53	84				51	122			
(3) Beans seller	114	52	176			79	59	157		
(4) Cooking banana seller	151	34	71	207		112	37	56	166	
(5) Cassava seller	82	24	40	49	119	48	33	24	35	79

Table 5: Summary Statistics and Balancing Test

	Treatment villages				Control villages				*p*-values	
	N	Mean	Min	Max	N	Mean	Min	Max	Unconditional	With district FE
Household size	215	6.158	1	22	565	5.618	1	25	0.036	0.816
Number of adults	215	2.982	1	12	565	2.996	1	15	0.478	0.716
Number of children	215	3.256	0	15	565	2.621	0	14	0	0.55
Dummy: Muslim	216	0.088	0	1	566	0.129	0	1	0.112	0.045
Dummy: Protestant	216	0.278	0	1	566	0.204	0	1	0.029	0.035
Dummy: Catholic	216	0.523	0	1	566	0.62	0	1	0.014	0.427
Dummy: Mhaya (tribe)	216	0.19	0	1	566	0.802	0	1	0	0.033
Dummy: Mnyambo (tribe)	216	0.31	0	1	566	0.011	0	1	0	0.379
Dummy: Mhangaza (tribe)	216	0.426	0	1	566	0.014	0	1	0	0.279
Land area (acre)	216	13.53	1.5	73.8	565	9.07	0.7	55	0.691	0.871
Market wage	30	37.15	5.911	168.1	67	58.377	1.773	451.1	0.217	0.776
Shadow wage (male)	187	11.17	1.049	118.8	435	14.05	0.896	324.3	0.148	0.623
Shadow wage (female)	201	20.38	2.013	541	516	22.225	2.169	515.4	0.579	0.956
Dummy: Off-farm employment	216	0.139	0	1	566	0.118	0	1	0.437	0.447
Dummy: Off-farm employment (male)	216	0.125	0	1	566	0.078	0	1	0.04	0.887
Dummy: Off-farm employment (female)	216	0.019	0	1	566	0.044	0	1	0.09	0.214
Dummy: Maize seller	216	0.13	0	1	566	0.099	0	1	0.216	0.343
Dummy: Beans seller	216	0.421	0	1	566	0.147	0	1	0	0.183
Dummy: Cooking banana seller	216	0.241	0	1	566	0.272	0	1	0.374	0.463
Dummy: Cassava seller	216	0.134	0	1	566	0.155	0	1	0.458	0.887
Dummy: Coffee producer	216	0.731	0	1	566	0.834	0	1	0.001	0.465
Dummy: Coffee seller	216	0.597	0	1	566	0.613	0	1	0.685	0.709

Table 6: Refugee Inflows, Market Wages, and Shadow Wages

(A) Wage correlation	**log (shadow wage of own farm work)**							
	Male				Female			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dummy: Year2004	-0.146	-0.114	-0.126	-0.0749	-0.130	-0.155	-0.0439	-0.0301
	(0.140)	(0.148)	(0.204)	(0.212)	(0.151)	(0.151)	(0.175)	(0.165)
log (wage of off-farm job)	0.0804	0.0682	0.104	0.0928	0.120***	0.101**	0.106**	0.0959**
	(0.0827)	(0.0787)	(0.0913)	(0.0897)	(0.0423)	(0.0422)	(0.0434)	(0.0434)
Observations	267	267	267	267	301	301	301	301
R-squared	0.006	0.082	0.009	0.065	0.017	0.070	0.017	0.046
Mean (Dep. Var.)	2.260	2.260	2.260	2.260	2.567	2.567	2.567	2.567
SD (Dep. Var.)	1.191	1.191	1.191	1.191	0.932	0.932	0.932	0.932

(B) Asymmetric non-separation	**log (shadow wage of own farm work)**							
	Male				Female			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dummy: Year2004	0.177	0.146	0.143	-0.108	-0.0792	0.0532	0.421	0.315
	(0.550)	(0.585)	(0.630)	(0.652)	(0.472)	(0.460)	(0.442)	(0.419)
Dummy: *Refugee1* (50km)	-0.280	-0.146			0.0365	0.408		
	(0.259)	(0.329)			(0.193)	(0.344)		
log (wage of off-farm job)	0.117	0.110	0.124	0.0350	0.0713	0.0875	0.131	0.107
	(0.118)	(0.132)	(0.174)	(0.174)	(0.0999)	(0.106)	(0.108)	(0.108)
log (wage) × Year2004	-0.0954	-0.0706	-0.0412	0.0536	0.0302	-0.00377	-0.0533	-0.0258
	(0.158)	(0.164)	(0.188)	(0.190)	(0.131)	(0.135)	(0.131)	(0.131)
Refugee1 (50km) × Year2004	-1.054	-0.473	-0.854	-1.394	-0.768**	-0.649*	-1.473***	-1.315***
	(1.280)	(1.203)	(1.572)	(1.460)	(0.336)	(0.365)	(0.412)	(0.438)
Refugee1 (50km) × log (wage) × Year2004	0.270	0.120	0.0868	0.174	0.0744	0.0242	0.103	0.0602
	(0.307)	(0.309)	(0.372)	(0.338)	(0.0815)	(0.0755)	(0.109)	(0.116)
Observations	261	261	261	261	296	296	296	296
R-squared	0.016	0.080	0.016	0.078	0.037	0.086	0.064	0.095
Mean (Dep. Var.)	2.275	2.275	2.275	2.275	2.560	2.560	2.560	2.560
SD (Dep. Var.)	1.193	1.193	1.193	1.193	0.911	0.911	0.911	0.911
Other controls	No	Yes	No	Yes	No	Yes	No	Yes
Village FE	No	No	Yes	Yes	No	No	Yes	Yes

Notes: Robust standard errors clustered at the village level in parentheses. The sample consists of households in 1993 (pre-shock) and 2004 (post-shock) which have both own-farm family labor and a member engaging in an outside job. I consider only adult labor (age$\geq$15) for wages. Other controls include household demographic information (household size, number of adult household members; religion dummies; tribe dummies). *Refugee1* (Xkm) is a dummy which takes 1 if one of the refugee camps is located within Xkm from the center of the village where each household lives.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 7: Refugee Inflows and Labor Market Efficiency

	Gap between log market and shadow wages							
	Male				Female			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dummy: Year2004	0.441**	0.349*	0.228	0.116	0.391**	0.387**	0.354**	0.346**
	(0.212)	(0.194)	(0.186)	(0.193)	(0.189)	(0.185)	(0.170)	(0.162)
Dummy: *Refugee1* (50km)	-0.137	0.196			-0.237	-0.473		
	(0.246)	(0.298)			(0.235)	(0.377)		
Refugee1 (50km) $\times$ Year2004	0.348	0.271	0.739**	0.893**	0.537	0.586	1.075***	1.127***
	(0.296)	(0.371)	(0.320)	(0.355)	(0.327)	(0.351)	(0.298)	(0.335)
Observations	261	261	261	261	296	296	296	296
R-squared	0.039	0.110	0.034	0.083	0.057	0.063	0.075	0.101
Mean (Dep. Var.)	1.824	1.824	1.824	1.824	1.436	1.436	1.436	1.436
SD (Dep. Var.)	1.296	1.296	1.296	1.296	1.094	1.094	1.094	1.094
Other controls	No	Yes	No	Yes	No	Yes	No	Yes
Village FE	No	No	Yes	Yes	No	No	Yes	Yes

Notes: Robust standard errors clustered at the village level in parentheses. The sample consists of households in 1993 (pre-shock) and 2004 (post-shock) which have both own-farm family labor and a member engaging in an outside job. I consider only adult labor (age$\geq$15) for wages. Other controls include household demographic information (household size, number of adult household members; religion dummies; tribe dummies). *Refugee1* (Xkm) is a dummy which takes 1 if one of the refugee camps is located within Xkm from the center of the village where each household lives.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 8: Refugee Inflows and Labor Market Participation

(A)	**Dummy: Labor market participation**					
	Off-farm employment			Hired farm labor		
	(1)	(2)	(3)	(4)	(5)	(6)
Dummy: Year2004	0.176***	0.181***	0.194***	-0.240***	-0.238***	-0.173***
	(0.0291)	(0.0299)	(0.0396)	(0.0280)	(0.0287)	(0.0319)
Dummy: *Refugee1* (50km)	0.0145			0.0159		
	(0.0444)			(0.0654)		
Refugee1 (50km) $\times$ Year2004	-0.149***	-0.140***	-0.124**	0.0293	0.0182	0.0417
	(0.0530)	(0.0468)	(0.0546)	(0.0853)	(0.0830)	(0.0922)
Observations	1727	1727	1727	1727	1727	1727
R-squared	0.048	0.043	0.047	0.088	0.081	0.131
Mean (Dep. Var.)	0.202	0.202	0.202	0.318	0.318	0.318
SD (Dep. Var.)	0.401	0.401	0.401	0.466	0.466	0.466
(B)	**Dummy: Off-farm employment by gender**					
	Male			Female		
	(1)	(2)	(3)	(4)	(5)	(6)
Dummy: Year2004	0.135***	0.148***	0.168***	0.0651***	0.0586***	0.0586**
	(0.0242)	(0.0245)	(0.0306)	(0.0196)	(0.0192)	(0.0250)
Dummy: *Refugee1* (50km)	0.0528			-0.0290*		
	(0.0376)			(0.0171)		
Refugee1 (50km) $\times$ Year2004	-0.132***	-0.131***	-0.136***	-0.0332	-0.0269	-0.00217
	(0.0440)	(0.0393)	(0.0485)	(0.0250)	(0.0251)	(0.0269)
Observations	1727	1727	1727	1727	1727	1727
R-squared	0.038	0.038	0.045	0.023	0.014	0.021
Mean (Dep. Var.)	0.148	0.148	0.148	0.068	0.068	0.068
SD (Dep. Var.)	0.355	0.355	0.355	0.252	0.252	0.252
(C)	**Dummy: Male off-farm employment by sector**					
	Agricultural work			Non-agricultural work		
	(1)	(2)	(3)	(4)	(5)	(6)
Dummy: Year2004	0.0529***	0.0557***	0.0632***	0.0935***	0.105***	0.120***
	(0.0103)	(0.0107)	(0.0127)	(0.0213)	(0.0219)	(0.0279)
Dummy: *Refugee1* (50km)	0.0223			0.0415		
	(0.0156)			(0.0317)		
Refugee1 (50km) $\times$ Year2004	-0.0564***	-0.0507***	-0.0459**	-0.0952**	-0.100***	-0.112**
	(0.0145)	(0.0143)	(0.0220)	(0.0392)	(0.0352)	(0.0433)
Observations	1727	1727	1727	1727	1727	1727
R-squared	0.021	0.025	0.023	0.031	0.025	0.030
Mean (Dep. Var.)	0.041	0.041	0.041	0.114	0.114	0.114
SD (Dep. Var.)	0.197	0.197	0.197	0.318	0.318	0.318
Village FE	No	Yes	No	No	Yes	No
Initial household FE	No	No	Yes	No	No	Yes

Notes: Robust standard errors clustered at the village level in parentheses. Size of land area and household demographic information (household size, number of adult household members; religion dummies; tribe dummies) are controlled in all the specifications presented here. *Refugee1* (Xkm) is a dummy which takes 1 if one of the refugee camps is located within Xkm from the center of the village where each household lives.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 9: Refugee Inflows and Transition from Subsistence to Sellers of Food Crops

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(A) Dummy: Maize seller										
Dummy: *Refugee1* (50km)	0.0872**	0.128***	0.121***	0.127***						
	(0.0330)	(0.0306)	(0.0322)	(0.0348)						
Dummy: *Refugee1* (Burundi)					-0.0916	-0.573***				
					(0.0846)	(0.175)				
Dummy: *Refugee1* (Rwanda)							0.112***	0.157***	0.130***	0.134***
							(0.0272)	(0.0305)	(0.0311)	(0.0347)
Observations	860	860	860	860	860	860	860	860	860	860
R-squared	0.046	0.056	0.078	0.079	0.042	0.053	0.049	0.060	0.079	0.080
Mean (Dep. Var.)	0.129	0.129	0.129	0.129	0.129	0.129	0.129	0.129	0.129	0.129
SD (Dep. Var.)	0.335	0.335	0.335	0.335	0.335	0.335	0.335	0.335	0.335	0.335
(B) Dummy: Beans seller										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dummy: *Refugee1* (50km)	0.263***	0.287***	0.267***	0.263***						
	(0.0552)	(0.0502)	(0.0614)	(0.0535)						
Dummy: *Refugee1* (Burundi)					-0.0645	0.286				
					(0.0937)	(0.380)				
Dummy: *Refugee1* (Rwanda)							0.293***	0.299***	0.285***	0.264***
							(0.0543)	(0.0535)	(0.0604)	(0.0561)
Observations	834	834	834	834	834	834	834	834	834	834
R-squared	0.115	0.127	0.127	0.140	0.078	0.089	0.121	0.127	0.131	0.139
Mean (Dep. Var.)	0.164	0.164	0.164	0.164	0.164	0.164	0.164	0.164	0.164	0.164
SD (Dep. Var.)	0.371	0.371	0.371	0.371	0.371	0.371	0.371	0.371	0.371	0.371
(C) Dummy: Cooking banana seller										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dummy: *Refugee1* (50km)	0.0112	0.0336	0.0188	0.0312						
	(0.0525)	(0.0520)	(0.0585)	(0.0549)						
Dummy: *Refugee1* (Burundi)					-0.203	0.130				
					(0.143)	(0.296)				
Dummy: *Refugee1* (Rwanda)							0.0505	0.0318	0.0298	0.0359
							(0.0508)	(0.0556)	(0.0597)	(0.0566)
Observations	818	818	818	818	818	818	818	818	818	818
R-squared	0.022	0.029	0.033	0.041	0.025	0.029	0.023	0.029	0.033	0.042
Mean (Dep. Var.)	0.178	0.178	0.178	0.178	0.178	0.178	0.178	0.178	0.178	0.178
SD (Dep. Var.)	0.383	0.383	0.383	0.383	0.383	0.383	0.383	0.383	0.383	0.383
(D) Dummy: Cassava seller										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dummy: *Refugee1* (50km)	-0.0195	-0.0110	-0.0390	-0.0273						
	(0.0275)	(0.0230)	(0.0234)	(0.0220)						
Dummy: *Refugee1* (Burundi)					0.00492	0.0256				
					(0.0967)	(0.206)				
Dummy: *Refugee1* (Rwanda)							-0.0223	-0.0127	-0.0285	-0.0191
							(0.0215)	(0.0234)	(0.0238)	(0.0226)
Observations	855	855	855	855	855	855	855	855	855	855
R-squared	0.027	0.031	0.030	0.034	0.027	0.031	0.028	0.031	0.029	0.034
Mean (Dep. Var.)	0.084	0.084	0.084	0.084	0.084	0.084	0.084	0.084	0.084	0.084
SD (Dep. Var.)	0.278	0.278	0.278	0.278	0.278	0.278	0.278	0.278	0.278	0.278
Geographic controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
District FE	No	No	Yes	Yes	No	No	No	No	Yes	Yes

Notes: Robust standard errors clustered at the village level in parentheses. For each crop-level estimation, I first pick the subsample of that crop's subsistence households in 1993 (pre-shock) and then use their related households in 2004 (post-shock) in the estimation. Size of land area and household demographic information (household size, number of adult household members; religion dummies; tribe dummies) are controlled in all the specifications presented here. Geographic controls include log of elevation and road distance to the borders of Burundi, Rwanda, and Uganda. *Refugee1* (Xkm) is a dummy which takes 1 if one of the refugee camps is located within Xkm from the center of the village where each household lives. *Refugee1* (Burundi)/*Refugee1* (Rwanda) are dummies which take 1 if one of the Burundian/Rwandan refugee camps is located within 50km from the center of the village where each household lives.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 10: Refugee Inflows and Food Crop Sales to Markets by Initial Sellers

(A) Food-aid crops	Value of crop sales (z-score)											
	Maize						Beans					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dummy: Year2004	-0.825**	-0.888**	-0.599	-0.769*	-0.811**	-0.622	-0.668***	-0.579***	-0.645***	-0.432***	-0.363**	-0.341**
	(0.400)	(0.396)	(0.494)	(0.388)	(0.394)	(0.495)	(0.137)	(0.129)	(0.214)	(0.143)	(0.139)	(0.166)
Dummy: *Refugee1* (Burundi)	-1.021***						-0.648***					
	(0.282)						(0.197)					
Refugee1 (Burundi) × Year2004	1.030***	0.965***	0.461				0.710***	0.595**	0.693**			
	(0.290)	(0.287)	(0.372)				(0.226)	(0.227)	(0.271)			
Dummy: *Refugee1* (Rwanda)				-0.0805						0.582		
				(0.743)						(0.349)		
Refugee1 (Rwanda) × Year2004				0.342	0.149	0.321				-0.352	-0.417	-0.634
				(0.713)	(0.687)	(0.726)				(0.433)	(0.392)	(0.466)
Observations	748	748	748	748	748	748	840	840	840	840	840	840
R-squared	0.146	0.131	0.122	0.145	0.126	0.122	0.177	0.098	0.128	0.179	0.097	0.130
(B) Non-food-aid crops	**Value of crop sales (z-score)**											
	Cooking bananas						Cassava					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dummy: Year2004	-0.142	-0.0881	-0.0178	-0.0615	0.00829	0.0742	-0.331***	-0.332***	-0.287***	-0.394***	-0.386***	-0.352***
	(0.126)	(0.134)	(0.165)	(0.187)	(0.200)	(0.242)	(0.109)	(0.0993)	(0.0916)	(0.126)	(0.121)	(0.107)
Dummy: *Refugee1* (Burundi)	-0.625*						-0.467*					
	(0.321)						(0.269)					
Refugee1 (Burundi) × Year2004	0.537	0.568	0.716*				0.542*	0.479*	0.424*			
	(0.327)	(0.341)	(0.412)				(0.290)	(0.268)	(0.244)			
Dummy: *Refugee1* (Rwanda)				0.229						-0.526		
				(0.432)						(0.313)		
Refugee1 (Rwanda) × Year2004				-0.320	-0.426	-0.360				0.516*	0.427	0.561*
				(0.495)	(0.556)	(0.588)				(0.307)	(0.265)	(0.301)
Observations	853	853	853	853	853	853	780	780	780	780	780	780
R-squared	0.099	0.106	0.156	0.097	0.106	0.153	0.115	0.109	0.112	0.125	0.115	0.124
Village FE	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes	No
Initial household FE	No	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes

Notes: Robust standard errors clustered at the village level in parentheses. For each crop-level estimation, I use the subsample of sellers of that crop in 1993 (pre-shock) and their related households in 2004 (post-shock). Size of land area and household demographic information (household size, number of adult household members; religion dummies; tribe dummies) are controlled in all the specifications presented here. *Refugee1* (Burundi)/*Refugee1* (Rwanda) are dummies which take 1 if one of the Burundian/Rwandan refugee camps is located within 50km from the center of the village where each household lives.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 11: Refugee Inflows and Shadow Wages: The Overall Impact

	log (shadow wage of own farm work)					
	Male			Female		
	(1)	(2)	(3)	(4)	(5)	(6)
Dummy: Year2004	0.0435	0.0586	0.148	-0.0768	-0.0455	-0.0366
	(0.115)	(0.115)	(0.113)	(0.105)	(0.103)	(0.105)
Dummy: *Refugee1* (50km)	-0.0181			0.0653		
	(0.156)			(0.199)		
Refugee1 (50km) $\times$ Year2004	-0.322	-0.397*	-0.488**	-0.412**	-0.474**	-0.497**
	(0.208)	(0.221)	(0.213)	(0.204)	(0.215)	(0.227)
Observations	956	956	956	1205	1205	1205
R-squared	0.086	0.058	0.072	0.058	0.039	0.048
Mean (Dep. Var.)	1.965	1.965	1.965	2.501	2.501	2.501
SD (Dep. Var.)	1.095	1.095	1.095	0.970	0.970	0.970
Village FE	No	Yes	No	No	Yes	No
Initial household FE	No	No	Yes	No	No	Yes

Notes: Robust standard errors clustered at the village level in parentheses. Household demographic information (household size, number of adult household members; religion dummies; tribe dummies) is controlled in all the specifications presented here. *Refugee1* (Xkm) is a dummy which takes 1 if one of the refugee camps is located within Xkm from the center of the village where each household lives.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

— Appendix —

“Refugee Inflows, Surplus Farm Labor, and Crop Marketization in Rural Africa”

Shunsuke Tsuda

A Additional Figures and Tables

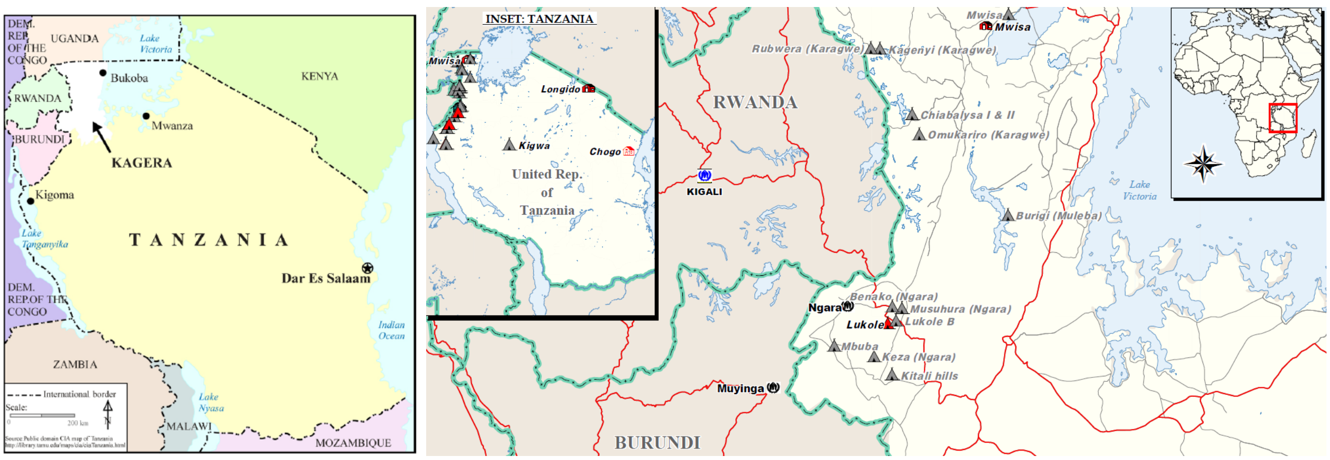


Figure A.1: The Kagera Region and Refugee Camps in Tanzania

Sources: Ainsworth et al. (2004) (left); UNHCR (right).

Table A.1: Refugees in Tanzania

Year	Burundi	Burundi share (%)	Rwanda	Rwanda share (%)	Total
1991	148703	51.61453	50000	17.3549	288103
1992	149500	51.17269	50012	17.11872	292148
1993	444867	78.80447	51942	9.201091	564520
1994	202738	22.95364	626196	70.8968	883250
1995	227216	27.38628	547976	66.04739	829671
1996	385452	77.2864	20020	4.01418	498732
1997	459420	80.54814	410	0.071884	570367
1998	473768	87.10876	4760	0.875191	543881
1999	498982	80.19601	20098	3.230136	622203
2000	538448	79.08328	27372	4.020198	680862
2001	521180	80.56578	3034	0.469006	646900
2002	540861	78.45695	2717	0.394126	689373
2003	494209	76.05907	24	0.003694	649770
2004	443706	73.69454	188	0.031225	602088

Source: UNHCR Population Statistics (http://popstats.unhcr.org/en/overview)

Table A.2: Food Aid Delivered to Tanzania (Tons)

Year	Maize	Maize share (%)	Beans	Beans share (%)	Rice	Rice share (%)	Total
1991	11938.5	55.71	1366.0	6.37	5446.3	25.41	21430.9
1992	14989.8	67.52	334.0	1.50	3985.0	17.95	22200.5
1993	19893.6	50.69	2122.8	5.41	14536.0	37.04	39245.5
1994	55089.4	66.11	13596.2	16.32	6436.1	7.72	83326.9
1995	71434.0	51.11	11519.8	8.24	15299.8	10.95	139767.2
1996	9852.2	34.77	5224.0	18.44	8858.0	31.26	28336.1
1997	11000.0	26.78	480.0	1.17	23236.0	56.56	41082.9
1998	46398.3	57.69	3086.9	3.84	1440.0	1.79	80428.5
1999	31640.5	98.09					32256.8
2000	9443.0	15.12	364.5	0.58	28597.2	45.79	62451.7
2001	49964.9	29.01	5699.8	3.31	38838.4	22.55	172259.1
2002	26607.9	30.48	6221.0	7.13			87289.8
2003	77153.0	59.56	5735.9	4.43	20097.0	15.51	129547.8
2004	89152.6	80.56	3306.2	2.99			110669.6
1994-2004	477735.8	49.38	55234.3	5.71	142802.5	14.76	967416.4

Source: WFP *Food Aid Information System* (`www.wfp.org/fais/`)
Notes: Missing information in the blanc places.

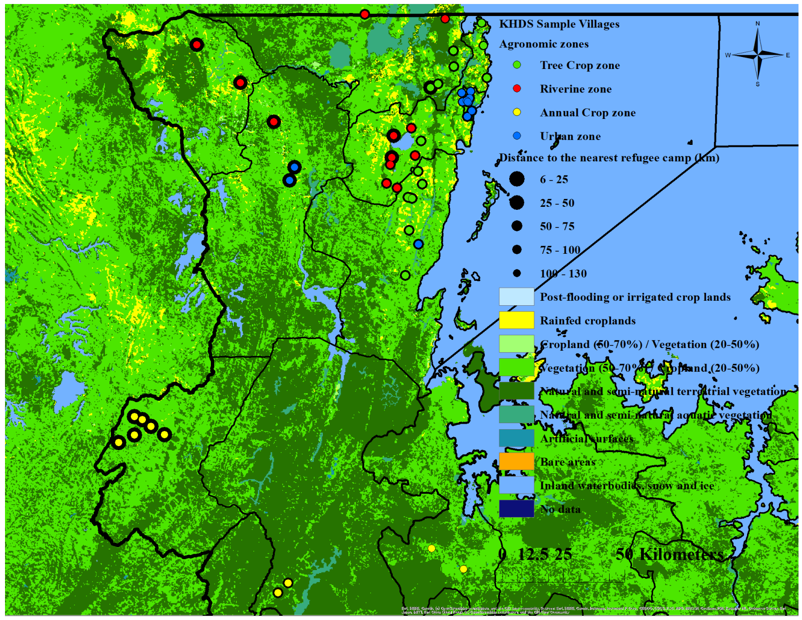


Figure A.2: The KHDS Sample Villages and Geography

Sources: *Globcover 2009*; *GADM ver 3.6*.

Notes: The thickest lines represent country borders, the second thickest line represents the border between Kagera and other regions in Tanzania, and the thin lines represent district borders.

Table A.3: Characteristics of the Sample Villages by Agronomic Zones

Agronomic Zones	Tree Crop zone	Riverine zone	Annual Crop zone	Urban zone
Number of the sample villages	15	12	10	12
Area	Northern part	Middle part	Southern part	The town of Bukoba
Soil characteristics	Low Fertility soils	Alluvial and colluvial soils	Low to Medium Fertility soils	
Rainfall patterns	High	Require Flood Control	Low	
Main crops	Bananas, Coffee	Mixed	Bean, Cassava, Maize	
Mean population (1988)	2066.8	2449.4	2980.3	3125.9
Mean adult population (1988)	811.1	981.3	1245	1461.1
Mean of number of households (1988)	411	481.5	612.6	695.6
Number of villages within 50km from a refugee camp	1	5	6	2
Number of villages with a refugee camp within own or neighborhood ward	2	3	6	1
Mean distance to the nearest refugee camp from Village centers (km)	65.5	52	44.5	68

Source: Beegle et al. (2006) and the 1988 census.
Notes: No information regarding agriculture on urban areas.

Table A.4: Value of Crop Harvests of Sample Households

Crops	N	Mean	SD	Min	Max
1991 (Baseline: Wave 1) (n=893)					
Coffee	603	108292	1220771	40	2.84e+07
Cooking bananas	790	179127	2689130	100	7.50e+07
Sweet bananas	677	48480	924866	50	2.40e+07
Other bananas	469	143382	2027173	30	4.32e+07
Cassava (row)	760	16881	25987	50	377300
Yams, Cocoyams or Sweet potatoes	732	15099	26713	20	319500
Maize	809	38948	62589	100	1013000
Millet or Sorgum	193	11174	17801	100	106500
Rice	13	45060	42109	1200	126000
Beans	855	33435	33534	200	415100
Groundnuts	293	14957	19436	150	123620
Oil palm/Palm oil	146	13404	22920	20	170500
Sugar, Candy, Honey or Sweet potatoes	350	4967	11540	40	126570
1993 (Pre-shock: Waves 2 & 3) (n=863)					
Coffee	669	23128	63931	80	1113600
Cooking bananas	804	55098	60054	160	577900
Sweet bananas	763	5584	10477	100	124200
Other bananas	669	6693	26510	50	501750
Cassava (row)	807	16015	21916	100	224000
Yams, Cocoyams or Sweet potatoes	795	13143	16764	30	152100
Maize	800	24180	30400	50	346500
Millet or Sorgum	269	9074	19686	20	197440
Rice	13	48632	145370	500	531500
Beans	840	29144	22154	70	186700
Groundnuts	357	10563	12840	100	125320
Oil palm/Palm oil	221	5365	6399	20	49440
Sugar, Candy, Honey or Sweet potatoes	552	2926	9802	40	210320
2004 (Post-shock: Wave 5) (n=1222)					
Coffee	501	140250	2348523	12	5.26e+07
Cooking bananas	1032	131663	161005	300	1490000
Sweet bananas	543	17934	49862	100	720000
Other bananas	469	20761	42830	2	504000
Cassava (row)	967	51381	95470	200	2195000
Yams, Cocoyams or Sweet potatoes	1009	55252	75672	300	773000
Maize	1103	68080	78584	100	625900
Millet or Sorgum	87	30640	35007	250	180000
Rice	18	82806	57504	1000	177000
Beans	1114	63847	70147	200	1260000
Groundnuts	375	24954	26377	1200	216000
Oil palm/Palm oil	102	37181	51304	50	303200
Sugar, Candy, Honey or Sweet potatoes	309	11115	18823	100	144000

Notes: All values represented here are nominal values in TSHS in corresponding years. Value of crop harvests include (i) values of products sold, (ii) value of products lost, (iii) value of products given to other people, (iii) value of products kept as stock, and (iv) value of products consumed by own household members. n represents the corresponding sample size. In 1991 and 1993, this corresponds to households which engage in agriculture. In 2004, this corresponds to households which engage in agriculture, live within Kagera region, and whose information on agricultural production are available.

Table A.5: Refugee Inflows and Wages among Households Supplying Labor to Off-Farm Employment

	log wages					
	Market		Shadow (male)		Shadow (female)	
	(1)	(2)	(3)	(4)	(5)	(6)
Dummy: Year2004	0.565***	0.612***	-0.0885	0.122	0.0882	0.280*
	(0.161)	(0.142)	(0.188)	(0.226)	(0.142)	(0.161)
Dummy: *Refugee1* (50km)	0.256		-0.126		0.412	
	(0.253)		(0.303)		(0.330)	
Refugee1 (50km) × Year2004	0.0250	-0.0415	0.0380	-0.687	-0.544**	-1.042***
	(0.275)	(0.266)	(0.397)	(0.506)	(0.270)	(0.244)
Observations	345	345	261	261	296	296
R-squared	0.096	0.079	0.076	0.070	0.077	0.080
Mean (Dep. Var.)	3.897	3.897	2.275	2.275	2.560	2.560
SD (Dep. Var.)	1.040	1.040	1.193	1.193	0.911	0.911
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
Village FE	No	Yes	No	Yes	No	Yes

Notes: Robust standard errors clustered at the village level in parentheses. The sample consists of households in 1993 (pre-shock) and 2004 (post-shock) which have both own-farm family labor and a member engaging in an outside job. I consider only adult labor (age≥15) for wages. Other controls include household demographic information (household size, number of adult household members; religion dummies; tribe dummies). *Refugee1* (Xkm) is a dummy which takes 1 if one of the refugee camps is located within Xkm from the center of the village where each household lives.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A.6: Refugee Inflows by Nationality and Labor Market Participation

(A)	Dummy: Labor market participation											
	Off-farm employment						Hired farm labor					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dummy: Year2004	0.156***	0.163***	0.184***	0.152***	0.160***	0.178***	-0.241***	-0.236***	-0.170***	-0.230***	-0.236***	-0.168***
	(0.0268)	(0.0269)	(0.0358)	(0.0274)	(0.0277)	(0.0384)	(0.0321)	(0.0322)	(0.0405)	(0.0267)	(0.0264)	(0.0312)
Dummy: *Refugee1* (Burundi)	-0.101						0.0463					
	(0.0781)						(0.115)					
Refugee1 (Burundi) × Year2004	-0.182***	-0.169***	-0.175**				0.0811	0.0199	0.0561			
	(0.0550)	(0.0534)	(0.0757)				(0.0765)	(0.0611)	(0.0604)			
Dummy: *Refugee1* (Rwanda)				0.0184						0.0219		
				(0.0579)						(0.0868)		
Refugee1 (Rwanda) × Year2004				-0.0936	-0.0890	-0.0608				-0.0102	0.0128	0.0223
				(0.0661)	(0.0563)	(0.0530)				(0.125)	(0.126)	(0.138)
Observations	1727	1727	1727	1727	1727	1727	1727	1727	1727	1727	1727	1727
R-squared	0.048	0.041	0.047	0.042	0.039	0.043	0.088	0.081	0.131	0.087	0.081	0.130
Mean (Dep. Var.)	0.202	0.202	0.202	0.202	0.202	0.202	0.318	0.318	0.318	0.318	0.318	0.318
SD (Dep. Var.)	0.401	0.401	0.401	0.401	0.401	0.401	0.466	0.466	0.466	0.466	0.466	0.466
(B)	**Dummy: Off-farm employment by gender**											
	Male						Female					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dummy: Year2004	0.117***	0.130***	0.156***	0.114***	0.128***	0.150***	0.0622***	0.0570***	0.0599**	0.0580***	0.0525***	0.0567**
	(0.0226)	(0.0225)	(0.0276)	(0.0230)	(0.0230)	(0.0306)	(0.0163)	(0.0163)	(0.0227)	(0.0176)	(0.0172)	(0.0235)
Dummy: *Refugee1* (Burundi)	-0.0494						-0.0365					
	(0.0738)						(0.0366)					
Refugee1 (Burundi) × Year2004	-0.162***	-0.155***	-0.192**				-0.0562*	-0.0524*	-0.0246			
	(0.0454)	(0.0443)	(0.0729)				(0.0288)	(0.0295)	(0.0329)			
Dummy: *Refugee1* (Rwanda)				0.0519						-0.0319*		
				(0.0468)						(0.0180)		
Refugee1 (Rwanda) × Year2004				-0.0819	-0.0840*	-0.0672				-0.0112	-0.00371	0.0127
				(0.0555)	(0.0486)	(0.0466)				(0.0242)	(0.0248)	(0.0259)
Observations	1727	1727	1727	1727	1727	1727	1727	1727	1727	1727	1727	1727
R-squared	0.038	0.036	0.044	0.033	0.034	0.039	0.022	0.015	0.021	0.021	0.014	0.021
Mean (Dep. Var.)	0.148	0.148	0.148	0.148	0.148	0.148	0.068	0.068	0.068	0.068	0.068	0.068
SD (Dep. Var.)	0.355	0.355	0.355	0.355	0.355	0.355	0.252	0.252	0.252	0.252	0.252	0.252
(C)	**Dummy: Male off-farm employment by sector**											
	Agricultural work						Non-agricultural work					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dummy: Year2004	0.0449***	0.0480***	0.0584***	0.0447***	0.0492***	0.0581***	0.0807***	0.0922***	0.110***	0.0784***	0.0896***	0.106***
	(0.00906)	(0.00987)	(0.0129)	(0.00989)	(0.00999)	(0.0128)	(0.0200)	(0.0199)	(0.0252)	(0.0198)	(0.0203)	(0.0273)
Dummy: *Refugee1* (Burundi)	-0.0490						0.0122					
	(0.0621)						(0.0432)					
Refugee1 (Burundi) × Year2004	-0.0624**	-0.0494**	-0.0526				-0.119***	-0.123***	-0.148**			
	(0.0277)	(0.0226)	(0.0369)				(0.0333)	(0.0339)	(0.0566)			
Dummy: *Refugee1* (Rwanda)				0.0291*						0.0311		
				(0.0146)						(0.0386)		
Refugee1 (Rwanda) × Year2004				-0.0391***	-0.0398***	-0.0305				-0.0582	-0.0618	-0.0617
				(0.0113)	(0.0141)	(0.0247)				(0.0522)	(0.0449)	(0.0420)
Observations	1727	1727	1727	1727	1727	1727	1727	1727	1727	1727	1727	1727
R-squared	0.021	0.023	0.022	0.018	0.023	0.022	0.031	0.024	0.029	0.028	0.022	0.025
Mean (Dep. Var.)	0.041	0.041	0.041	0.041	0.041	0.041	0.114	0.114	0.114	0.114	0.114	0.114
SD (Dep. Var.)	0.197	0.197	0.197	0.197	0.197	0.197	0.318	0.318	0.318	0.318	0.318	0.318
Village FE	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes	No
Initial household FE	No	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes

Notes: Robust standard errors clustered at the village level in parentheses. Size of land area and household demographic information (household size, number of adult household members; religion dummies; tribe dummies) are controlled in all the specifications presented here. *Refugee1* (Burundi)/*Refugee1* (Rwanda) are dummies which take 1 if one of the Burundian/Rwandan refugee camps is located within 50km from the center of the village where each household lives.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A.7: Refugee Inflows and Transition from Subsistence to Sellers of Food Crops (DID)

(A) Any refugee camp	**Dummy: Crop seller**											
	Maize			Beans			Cooking bananas			Cassava		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dummy: Year2004	0.124***	0.122***	0.118***	0.119***	0.110***	0.0900***	0.208***	0.208***	0.208***	0.105***	0.0998***	0.101***
	(0.0241)	(0.0243)	(0.0271)	(0.0250)	(0.0240)	(0.0246)	(0.0319)	(0.0301)	(0.0316)	(0.0176)	(0.0177)	(0.0196)
Dummy: *Refugee1* (50km)	-0.00864			0.0176			0.0326			-0.0150		
	(0.0172)			(0.0271)			(0.0251)			(0.0146)		
Refugee1 (50km) × Year2004	0.101***	0.0864***	0.0781**	0.237***	0.224***	0.200***	-0.0301	-0.0256	-0.0388	0.00444	0.00801	0.0300
	(0.0277)	(0.0304)	(0.0329)	(0.0483)	(0.0510)	(0.0526)	(0.0361)	(0.0374)	(0.0417)	(0.0218)	(0.0226)	(0.0242)
Observations	1235	1235	1235	1169	1169	1169	1100	1100	1100	1213	1213	1213
R-squared	0.073	0.059	0.064	0.149	0.070	0.078	0.068	0.063	0.068	0.041	0.039	0.045
Mean (Dep. Var.)	0.090	0.090	0.090	0.117	0.117	0.117	0.133	0.133	0.133	0.059	0.059	0.059
SD (Dep. Var.)	0.286	0.286	0.286	0.322	0.322	0.322	0.339	0.339	0.339	0.236	0.236	0.236
(B) Burundian refugee camps	**Dummy: Crop seller**											
	Maize			Beans			Cooking bananas			Cassava		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dummy: Year2004	0.143***	0.136***	0.130***	0.162***	0.142***	0.114***	0.208***	0.207***	0.203***	0.101***	0.0963***	0.101***
	(0.0227)	(0.0223)	(0.0259)	(0.0280)	(0.0261)	(0.0250)	(0.0282)	(0.0275)	(0.0294)	(0.0167)	(0.0167)	(0.0189)
Dummy: *Refugee1* (Burundi)	-0.109*			-0.0808			-0.108			-0.0394		
	(0.0581)			(0.0694)			(0.109)			(0.0716)		
Refugee1 (Burundi) × Year2004	0.0679	0.0534	0.0490	0.0598	0.0707	0.0774	-0.0610*	-0.0566	-0.0391	0.0528*	0.0580*	0.0791**
	(0.0428)	(0.0461)	(0.0463)	(0.0540)	(0.0636)	(0.0764)	(0.0356)	(0.0399)	(0.0521)	(0.0292)	(0.0297)	(0.0363)
Observations	1235	1235	1235	1169	1169	1169	1100	1100	1100	1213	1213	1213
R-squared	0.066	0.056	0.061	0.107	0.054	0.062	0.070	0.064	0.067	0.042	0.040	0.047
(C) Rwandan refugee camps	**Dummy: Crop seller**											
	Maize			Beans			Cooking bananas			Cassava		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dummy: Year2004	0.133***	0.129***	0.124***	0.129***	0.118***	0.0967***	0.201***	0.202***	0.203***	0.110***	0.106***	0.109***
	(0.0235)	(0.0234)	(0.0268)	(0.0241)	(0.0232)	(0.0237)	(0.0294)	(0.0277)	(0.0293)	(0.0169)	(0.0171)	(0.0193)
Dummy: *Refugee1* (Rwanda)	0.00770			-0.00977			0.0385			0.00784		
	(0.0153)			(0.0130)			(0.0234)			(0.00862)		
Refugee1 (Rwanda) × Year2004	0.101***	0.0872***	0.0779**	0.304***	0.282***	0.245***	0.000812	0.000154	-0.0293	-0.0308	-0.0301	-0.0135
	(0.0266)	(0.0309)	(0.0386)	(0.0452)	(0.0532)	(0.0636)	(0.0390)	(0.0412)	(0.0479)	(0.0190)	(0.0205)	(0.0207)
Observations	1235	1235	1235	1169	1169	1169	1100	1100	1100	1213	1213	1213
R-squared	0.074	0.058	0.063	0.155	0.072	0.078	0.068	0.063	0.067	0.042	0.039	0.044
Village FE	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes	No
Initial household FE	No	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes

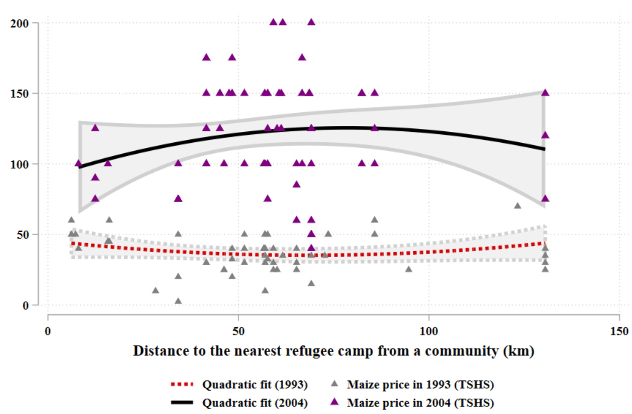
Notes: Robust standard errors clustered at the village level in parentheses. For each crop-level estimation, I use the subsample of that crop's subsistence households in 1993 (pre-shock) and their related households in 2004 (post-shock). Size of land area and household demographic information (household size, number of adult household members; religion dummies; tribe dummies) are controlled in all the specifications presented here. *Refugee1* (Xkm) is a dummy which takes 1 if one of the refugee camps is located within Xkm from the center of the village where each household lives. *Refugee1* (Burundi)/*Refugee1* (Rwanda) are dummies which take 1 if one of the Burundian/Rwandan refugee camps is located within 50km from the center of the village where each household lives.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A.8: Refugee Inflows and Food Crop Market Prices

	log (crop price per kilogram)							
	Maize				Beans			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dummy: Year2004	1.142***	1.141***	0.683*	0.667	1.430***	1.419***	0.310	0.345
	(0.0844)	(0.0747)	(0.386)	(0.494)	(0.124)	(0.122)	(0.480)	(0.453)
Dummy: *Refugee1* (50km)	-0.179	-0.171			0.0823	0.191		
	(0.197)	(0.134)			(0.122)	(0.141)		
Refugee1 (50km) × Year2004	0.182	0.257			-0.196	-0.206		
	(0.183)	(0.186)			(0.184)	(0.184)		
Refugee3 (log distance)			-0.0624	0.250			-0.0478	-0.0346
			(0.0913)	(0.154)			(0.0889)	(0.183)
Refugee3 × Year2004			0.133	0.144			0.271**	0.260**
			(0.101)	(0.121)			(0.127)	(0.119)
District FE	N	Y	N	Y	N	Y	N	Y
Observations	120	120	120	120	204	204	204	204
R-squared	0.654	0.710	0.651	0.714	0.526	0.552	0.532	0.557

Notes: Robust standard errors clustered at the village level in parentheses. The price observations are from the household-level information of crop sales at markets. *Refugee1* (Xkm) is a dummy which takes 1 if one of the refugee camps is located within Xkm from the center of the village where each household lives. *Refugee3* is log of the distance between the center of the village each household lives and its nearest refugee camp.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.



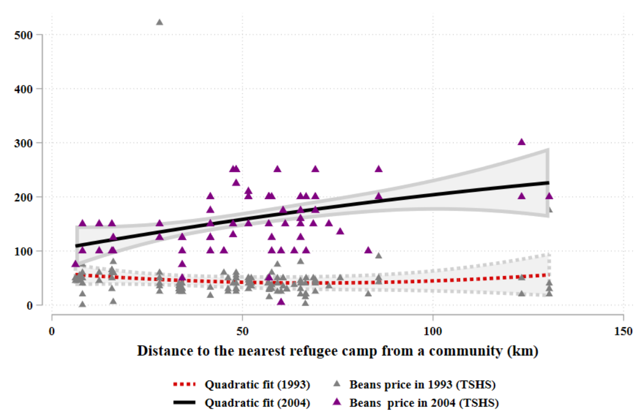


Figure A.3: Refugee Camp Proximity and Food Crop Prices
Notes: Quadratic fits and their 95% intervals are shown. The price observations are from the household-level information of crop sales at markets. The unit of each crop price is per kilogram.

Table A.9: Percentage of Calories from Food Supply Available for Human Consumption

	Maize	Beans	Bananas	Cassava
Tanzania				
1993	31.67	5.04	2.23	20.73
2004	27.24	4.39	4.53	8.78
Rwanda				
1993	8.26	11.26	26.39	5.89
2004	5.49	11.28	22.31	12.35

Source: FAOSTAT, Food Balances (http://www.fao.org/faostat)

Notes: The supply available during each period is obtained from production and trade information, adjusted to any change in stocks. The detailed description is found in the above link. Burundian information is missing in the FAOSTAT.

Table A.10: Rwandan Refugee Camps and Agricultural Inputs (Controlling for Land Size)

(A)	**Labor hours (log)**											
	Adult family labor (male)			Adult family labor (female)			Child family labor (male)			Child family labor (female)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dummy: Year2004	-0.00338	-0.109	-0.198	-0.0353	-0.157	-0.290	-1.476***	-1.494***	-1.967***	-1.609***	-1.623***	-1.751***
	(0.228)	(0.234)	(0.277)	(0.184)	(0.167)	(0.215)	(0.168)	(0.164)	(0.166)	(0.155)	(0.166)	(0.232)
Dummy: *Refugee1* (Rwanda)	0.558**			-0.115			0.599**			0.327		
	(0.256)			(0.194)			(0.232)			(0.268)		
Refugee1 (Rwanda) × Year2004	0.133	-0.0841	-0.141	-0.382	-0.550	-0.556	-0.693***	-0.852***	-0.778***	-0.131	-0.169	0.0100
	(0.364)	(0.309)	(0.301)	(0.357)	(0.462)	(0.463)	(0.232)	(0.215)	(0.278)	(0.358)	(0.413)	(0.439)
Observations	1727	1727	1727	1727	1727	1727	1727	1727	1727	1727	1727	1727
R-squared	0.119	0.109	0.121	0.066	0.071	0.076	0.263	0.257	0.337	0.266	0.270	0.328
Mean (Dep. Var.)	4.700	4.700	4.700	6.002	6.002	6.002	1.958	1.958	1.958	1.788	1.788	1.788
SD (Dep. Var.)	3.184	3.184	3.184	2.448	2.448	2.448	2.933	2.933	2.933	2.833	2.833	2.833
(B)	**Other agricultural inputs (log)**											
	Manure			Fertilizer			Pesticide			Livestock		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dummy: Year2004	1.401***	1.493***	1.434***	0.0419	0.0230	-0.0247	0.114	0.115	-0.154	0.251	0.447**	0.281
	(0.190)	(0.196)	(0.243)	(0.0856)	(0.0924)	(0.125)	(0.145)	(0.143)	(0.167)	(0.218)	(0.210)	(0.213)
Dummy: *Refugee1* (Rwanda)	-0.533***			-0.271**			-0.00659			-0.0284		
	(0.179)			(0.120)			(0.241)			(0.440)		
Refugee1 (Rwanda) × Year2004	0.0588	0.0544	0.152	0.204	0.112	0.0420	-0.448	-0.379	-0.288	-0.502	-0.721	-1.345
	(0.259)	(0.210)	(0.284)	(0.150)	(0.120)	(0.143)	(0.385)	(0.349)	(0.338)	(0.554)	(0.581)	(0.863)
Observations	1727	1727	1727	1727	1727	1727	1727	1727	1727	1727	1727	1727
R-squared	0.067	0.067	0.072	0.036	0.027	0.036	0.074	0.054	0.043	0.132	0.120	0.109
Mean (Dep. Var.)	1.016	1.016	1.016	0.246	0.246	0.246	0.566	0.566	0.566	2.290	2.290	2.290
SD (Dep. Var.)	2.665	2.665	2.665	1.336	1.336	1.336	1.924	1.924	1.924	3.562	3.562	3.562
Village FE	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes	No
Initial household FE	No	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes

Notes: Robust standard errors clustered at the village level in parentheses. Size of land area and household demographic information (household size, number of adult household members; religion dummies; tribe dummies) are controlled in all the specifications presented here. *Refugee1* (Rwanda) is a dummy which takes 1 if one of the Rwandan refugee camps is located within 50km from the center of the village where each household lives.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A.11: Refugee Inflows, Cash Crop Production, and Cash Crop Market Participation

	Coffee producer dummy			Coffee seller dummy		
(A) Initial coffee producers	(1)	(2)	(3)	(4)	(5)	(6)
Dummy: Year2004	-0.465***	-0.447***	-0.406***	-0.308***	-0.299***	-0.270***
	(0.0351)	(0.0337)	(0.0322)	(0.0509)	(0.0479)	(0.0467)
Dummy: *Refugee1* (Rwanda)	0.0284			0.114		
	(0.0180)			(0.0681)		
Refugee1 (Rwanda) × Year2004	0.0925**	0.102**	0.105**	-0.00473	-0.00112	0.00593
	(0.0428)	(0.0425)	(0.0515)	(0.0908)	(0.0873)	(0.0859)
Observations	1251	1251	1251	1251	1251	1251
R-squared	0.258	0.250	0.299	0.141	0.144	0.180
Mean (Dep. Var.)	0.661	0.661	0.661	0.514	0.514	0.514
SD (Dep. Var.)	0.474	0.474	0.474	0.500	0.500	0.500
(B) Initial coffee non-sellers						
	Coffee producer dummy			Coffee seller dummy		
	(1)	(2)	(3)	(4)	(5)	(6)
Dummy: Year2004	-0.435***	-0.473***	-0.468***	0.454***	0.404***	0.407***
	(0.0467)	(0.0468)	(0.0521)	(0.0502)	(0.0489)	(0.0486)
Dummy: *Refugee1* (Rwanda)	0.0141			0.00550		
	(0.0303)			(0.0309)		
Refugee1 (Rwanda) × Year2004	0.118**	0.274***	0.456***	0.129**	0.264***	0.474***
	(0.0477)	(0.0461)	(0.0972)	(0.0553)	(0.0745)	(0.133)
Observations	811	811	811	811	811	811
R-squared	0.145	0.142	0.169	0.104	0.077	0.113
Mean (Dep. Var.)	0.551	0.551	0.551	0.348	0.348	0.348
SD (Dep. Var.)	0.498	0.498	0.498	0.477	0.477	0.477
Village FE	No	Yes	No	No	Yes	No
Initial household FE	No	No	Yes	No	No	Yes

Notes: Robust standard errors clustered at the village level in parentheses. In panel (A) I use the subsample consisting of coffee producer households in the pre-shock period (1993) and their related households in the post-shock period (2004). In panel (B), I use the subsample consisting of coffee producer without market participations in the pre-shock period (1993) and their related households in the post-shock period (2004). Size of land area and household demographic information (household size, number of adult household members; religion dummies; tribe dummies) are controlled in all the specifications presented here. *Refugee1* (Rwanda) is a dummy which takes 1 if one of the Rwandan refugee camps is located within 50km from the center of the village where each household lives.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A.12: Placebo Test for the Labor Market Efficiency

	Gap between log market and shadow wages							
	Male				Female			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dummy: Year1993	0.127	0.136	0.122	0.203	-0.482*	-0.482*	-0.400	-0.403
	(0.254)	(0.261)	(0.328)	(0.345)	(0.282)	(0.287)	(0.411)	(0.424)
Dummy: *Refugee1* (50km)	-0.381	-0.101			-0.0633	0.0193		
	(0.273)	(0.447)			(0.217)	(0.296)		
Refugee1 (50km) $\times$ Year1993	0.244	0.287	0.220	0.141	-0.173	-0.149	-0.253	-0.262
	(0.332)	(0.345)	(0.362)	(0.388)	(0.375)	(0.385)	(0.485)	(0.491)
Observations	142	142	142	142	157	157	157	157
R-squared	0.020	0.088	0.011	0.077	0.086	0.102	0.060	0.074
Mean (Dep. Var.)	1.402	1.402	1.402	1.402	1.308	1.308	1.308	1.308
SD (Dep. Var.)	1.028	1.028	1.028	1.028	0.953	0.953	0.953	0.953
Other controls	No	Yes	No	Yes	No	Yes	No	Yes
Village FE	No	No	Yes	Yes	No	No	Yes	Yes

Notes: Robust standard errors clustered at the village level in parentheses. The sample consists of households in 1991 and 1993 which have both own-farm family labor and a member engaging in an outside job. I consider only adult labor (age$\geq$15) for wages. Other controls include household demographic information (household size, number of adult household members; religion dummies; tribe dummies). *Refugee1* (Xkm) is a dummy which takes 1 if one of the refugee camps is located within Xkm from the center of the village where each household lives.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A.13: Placebo Test for the Labor Market Participation

(A)	**Dummy: Labor market participation**					
	Off-farm employment			Hired farm labor		
	(1)	(2)	(3)	(4)	(5)	(6)
Dummy: Year1993	0.0161	0.0151	0.0281	0.208***	0.208***	0.212***
	(0.0204)	(0.0199)	(0.0200)	(0.0255)	(0.0261)	(0.0266)
Dummy: *Refugee1* (50km)	-0.0459*			0.0344		
	(0.0266)			(0.0571)		
Refugee1 (50km) × Year1993	0.0475	0.0487	0.0264	-0.0280	-0.0224	-0.0342
	(0.0373)	(0.0362)	(0.0339)	(0.0586)	(0.0575)	(0.0577)
Observations	1584	1584	1584	1584	1584	1584
R-squared	0.018	0.018	0.016	0.084	0.062	0.139
Mean (Dep. Var.)	0.109	0.109	0.109	0.349	0.349	0.349
SD (Dep. Var.)	0.312	0.312	0.312	0.477	0.477	0.477
(B)	**Dummy: Off-farm employment by gender**					
	Male			Female		
	(1)	(2)	(3)	(4)	(5)	(6)
Dummy: Year1993	0.000198	-0.000383	0.0113	0.0159	0.0152	0.0165
	(0.0160)	(0.0153)	(0.0151)	(0.0153)	(0.0154)	(0.0145)
Dummy: *Refugee1* (50km)	-0.0337			-0.0171		
	(0.0216)			(0.0148)		
Refugee1 (50km) × Year1993	0.0632**	0.0640**	0.0481*	-0.0112	-0.0103	-0.0163
	(0.0282)	(0.0268)	(0.0264)	(0.0184)	(0.0187)	(0.0177)
Observations	1584	1584	1584	1584	1584	1584
R-squared	0.012	0.011	0.019	0.016	0.017	0.005
Mean (Dep. Var.)	0.082	0.082	0.082	0.030	0.030	0.030
SD (Dep. Var.)	0.275	0.275	0.275	0.171	0.171	0.171
(C)	**Dummy: Male off-farm employment by sector**					
	Agricultural work			Non-agricultural work		
	(1)	(2)	(3)	(4)	(5)	(6)
Dummy: Year1993	-0.00506	-0.00540	-0.00583	0.00524	0.00488	0.0171
	(0.00522)	(0.00506)	(0.00554)	(0.0148)	(0.0143)	(0.0141)
Dummy: *Refugee1* (50km)	-0.0101			-0.0211		
	(0.00915)			(0.0207)		
Refugee1 (50km) × Year1993	0.0432***	0.0448***	0.0399***	0.0293	0.0289	0.0130
	(0.0132)	(0.0134)	(0.0107)	(0.0225)	(0.0216)	(0.0224)
Observations	1584	1584	1584	1584	1584	1584
R-squared	0.017	0.011	0.021	0.015	0.011	0.009
Mean (Dep. Var.)	0.016	0.016	0.016	0.069	0.069	0.069
SD (Dep. Var.)	0.125	0.125	0.125	0.253	0.253	0.253
Village FE	No	Yes	No	No	Yes	No
Initial household FE	No	No	Yes	No	No	Yes

Notes: Robust standard errors clustered at the village level in parentheses. Size of land area and household demographic information (household size, number of adult household members; religion dummies; tribe dummies) are controlled in all the specifications presented here. *Refugee1* (Xkm) is a dummy which takes 1 if one of the refugee camps is located within Xkm from the center of the village where each household lives.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A.14: Placebo Test for the Transition from Subsistence to Sellers of Food Crops

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(A) Dummy: Maize seller										
Dummy: *Refugee1* (50km)	-0.0127	0.0124	0.0525	0.0504						
	(0.0478)	(0.0478)	(0.0750)	(0.0715)						
Dummy: *Refugee1* (Burundi)					-0.0865	-0.147				
					(0.108)	(0.265)				
Dummy: *Refugee1* (Rwanda)							0.000129	0.0181	0.0525	0.0504
							(0.0473)	(0.0530)	(0.0750)	(0.0715)
Observations	432	432	432	432	432	432	432	432	432	432
R-squared	0.028	0.043	0.057	0.067	0.029	0.044	0.027	0.043	0.057	0.067
Mean (Dep. Var.)	0.081	0.081	0.081	0.081	0.081	0.081	0.081	0.081	0.081	0.081
SD (Dep. Var.)	0.273	0.273	0.273	0.273	0.273	0.273	0.273	0.273	0.273	0.273
(B) Dummy: Beans seller										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dummy: *Refugee1* (50km)	0.203	0.219	0.128	0.117						
	(0.151)	(0.166)	(0.192)	(0.181)						
Dummy: *Refugee1* (Burundi)					0.00412	0.981***				
					(0.140)	(0.310)				
Dummy: *Refugee1* (Rwanda)							0.221	0.212	0.128	0.117
							(0.163)	(0.177)	(0.192)	(0.181)
Observations	456	456	456	456	456	456	456	456	456	456
R-squared	0.148	0.175	0.177	0.210	0.123	0.163	0.150	0.172	0.177	0.210
Mean (Dep. Var.)	0.169	0.169	0.169	0.169	0.169	0.169	0.169	0.169	0.169	0.169
SD (Dep. Var.)	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375
(C) Dummy: Cooking banana seller										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dummy: *Refugee1* (50km)	-0.00691	-0.0242	0.0813	0.0749						
	(0.0871)	(0.101)	(0.118)	(0.125)						
Dummy: *Refugee1* (Burundi)					0.108*	0.190				
					(0.0619)	(0.367)				
Dummy: *Refugee1* (Rwanda)							-0.0198	-0.0332	0.0813	0.0749
							(0.0918)	(0.111)	(0.118)	(0.125)
Observations	406	406	406	406	406	406	406	406	406	406
R-squared	0.044	0.052	0.058	0.070	0.045	0.052	0.044	0.052	0.058	0.070
Mean (Dep. Var.)	0.222	0.222	0.222	0.222	0.222	0.222	0.222	0.222	0.222	0.222
SD (Dep. Var.)	0.416	0.416	0.416	0.416	0.416	0.416	0.416	0.416	0.416	0.416
(D) Dummy: Cassava seller										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dummy: *Refugee1* (50km)	-0.0587	-0.0511	-0.0444	-0.0423						
	(0.0546)	(0.0577)	(0.0799)	(0.0654)						
Dummy: *Refugee1* (Burundi)					-0.162	-0.750**				
					(0.156)	(0.328)				
Dummy: *Refugee1* (Rwanda)							-0.0405	-0.0333	-0.0444	-0.0423
							(0.0702)	(0.0659)	(0.0799)	(0.0654)
Observations	529	529	529	529	529	529	529	529	529	529
R-squared	0.017	0.019	0.025	0.044	0.017	0.027	0.016	0.018	0.025	0.044
Mean (Dep. Var.)	0.147	0.147	0.147	0.147	0.147	0.147	0.147	0.147	0.147	0.147
SD (Dep. Var.)	0.355	0.355	0.355	0.355	0.355	0.355	0.355	0.355	0.355	0.355
Geographic controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
District FE	No	No	Yes	Yes	No	No	No	No	Yes	Yes

Notes: Robust standard errors clustered at the village level in parentheses. For each crop-level estimation, I first pick the subsample of that crop's subsistence households in 1991 and then use their related households in 1993 in the estimation. Size of land area and household demographic information (household size, number of adult household members; religion dummies; tribe dummies) are controlled in all the specifications presented here. Geographic controls include log of elevation and road distance to the borders of Burundi, Rwanda, and Uganda. *Refugee1* (Xkm) is a dummy which takes 1 if one of the refugee camps is located within Xkm from the center of the village where each household lives. *Refugee1* (Burundi)/*Refugee1* (Rwanda) are dummies which take 1 if one of the Burundian/Rwandan refugee camps is located within 50km from the center of the village where each household lives.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A.15: Placebo Test for the Food Crop Sales to Markets by Initial Sellers

(A) Food-aid crops	**Value of crop sales (z-score)**											
	Maize						Beans					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dummy: Year1993	-0.534***	-0.568**	-0.577*	-0.612***	-0.644***	-0.641**	-0.488***	-0.494***	-0.575**	-0.608***	-0.612***	-0.640***
	(0.195)	(0.211)	(0.293)	(0.219)	(0.235)	(0.308)	(0.162)	(0.158)	(0.219)	(0.172)	(0.168)	(0.218)
Dummy: *Refugee1* (Burundi)	0.164						-0.0205					
	(0.234)						(0.338)					
Refugee1 (Burundi) × Year1993	0.0209	-0.0164	0.0120				-0.0907	-0.0899	0.115			
	(0.217)	(0.235)	(0.354)				(0.287)	(0.289)	(0.262)			
Dummy: *Refugee1* (Rwanda)				-0.331						-0.159		
				(0.201)						(0.213)		
Refugee1 (Rwanda) × Year1993				0.360*	0.350*	0.349				0.447***	0.453***	0.458***
				(0.204)	(0.207)	(0.214)				(0.136)	(0.135)	(0.162)
Observations	190	190	190	190	190	190	290	290	290	290	290	290
R-squared	0.154	0.122	0.095	0.161	0.129	0.105	0.130	0.105	0.216	0.139	0.117	0.235
(B) Non-food-aid crops	**Value of crop sales (z-score)**											
	Cooking bananas						Cassava					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dummy: Year1993	-0.542**	-0.574**	-0.394***	-0.596**	-0.626**	-0.437***	-0.406**	-0.381*	-0.386*	-0.449**	-0.424**	-0.421*
	(0.233)	(0.249)	(0.104)	(0.242)	(0.260)	(0.123)	(0.190)	(0.195)	(0.204)	(0.198)	(0.202)	(0.215)
Dummy: *Refugee1* (Burundi)	-0.121						-0.486					
	(0.282)						(0.293)					
Refugee1 (Burundi) × Year1993	-0.0813	-0.124	0.240				0.0945	0.197	0.171			
	(0.173)	(0.173)	(0.340)				(0.217)	(0.247)	(0.245)			
Dummy: *Refugee1* (Rwanda)				-0.266						-0.336		
				(0.216)						(0.240)		
Refugee1 (Rwanda) × Year1993				0.354	0.335	0.570*				0.471	0.452	0.461
				(0.216)	(0.210)	(0.306)				(0.373)	(0.373)	(0.337)
Observations	228	228	228	228	228	228	156	156	156	156	156	156
R-squared	0.094	0.107	0.184	0.098	0.111	0.202	0.071	0.091	0.054	0.075	0.096	0.064
Village FE	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes	No
Initial household FE	No	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes

Notes: Robust standard errors clustered at the village level in parentheses. For each crop-level estimation, I use the subsample of sellers of that crop in 1991 and their related households in 1993. Size of land area and household demographic information (household size, number of adult household members; religion dummies; tribe dummies) are controlled in all the specifications presented here. *Refugee1* (Xkm) is a dummy which takes 1 if one of the refugee camps is located within Xkm from the center of the village where each household lives. *Refugee1* (Burundi)/*Refugee1* (Rwanda) are dummies which take 1 if one of the Burundian/Rwandan refugee camps is located within 50km from the center of the village where each household lives.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A.16: Refugee Inflows and Labor Market Efficiency with Alternative Treatment Variables

(A)	**Gap between log market and shadow wages**							
	Male				Female			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dummy: *Refugee2*	-0.121	0.00706			-0.209	-0.298		
	(0.277)	(0.247)			(0.249)	(0.291)		
Refugee2 × Year2004	0.211	0.166	0.683**	0.689**	0.422	0.421	0.792**	0.829**
	(0.255)	(0.300)	(0.268)	(0.300)	(0.334)	(0.363)	(0.314)	(0.351)
Observations	267	267	267	267	301	301	301	301
R-squared	0.037	0.106	0.033	0.079	0.058	0.063	0.075	0.095
(B)	**Gap between log market and shadow wages**							
	Male				Female			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Refugee3 (log distance)	-0.0357	-0.180			0.0490	0.431		
	(0.181)	(0.283)			(0.191)	(0.368)		
Refugee3 × Year2004	-0.0677	-0.0370	-0.459	-0.456	0.172	0.170	-0.516	-0.543
	(0.292)	(0.336)	(0.341)	(0.362)	(0.337)	(0.332)	(0.374)	(0.393)
Observations	261	261	261	261	296	296	296	296
R-squared	0.036	0.105	0.029	0.074	0.051	0.072	0.056	0.082
(C)	**Gap between log market and shadow wages**							
	Male				Female			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dummy: *Refugee1* (60km)	-0.103	0.0157			-0.160	-0.279		
	(0.239)	(0.260)			(0.242)	(0.283)		
Refugee1 (60km) × Year2004	0.259	0.191	0.435	0.503	0.306	0.375	0.502	0.465
	(0.326)	(0.345)	(0.314)	(0.328)	(0.318)	(0.317)	(0.355)	(0.357)
Observations	261	261	261	261	296	296	296	296
R-squared	0.038	0.107	0.027	0.074	0.051	0.058	0.057	0.081
(D)	**Gap between log market and shadow wages**							
	Male				Female			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dummy: *Refugee1* (40km)	0.0670	0.371			-0.0850	-0.328		
	(0.280)	(0.320)			(0.263)	(0.450)		
Refugee1 (40km) × Year2004	-0.0504	-0.236	0.454	0.510	0.241	0.262	0.823*	1.035**
	(0.323)	(0.420)	(0.446)	(0.531)	(0.529)	(0.552)	(0.434)	(0.510)
Observations	261	261	261	261	296	296	296	296
R-squared	0.036	0.105	0.024	0.070	0.048	0.055	0.057	0.087
Other controls	No	Yes	No	Yes	No	Yes	No	Yes
Village FE	No	No	Yes	Yes	No	No	Yes	Yes

Notes: Robust standard errors clustered at the village level in parentheses. The sample consists of households in 1993 (pre-shock) and 2004 (post-shock) which have both own-farm family labor and a member engaging in an outside job. I consider only adult labor (age$\geq$15) for wages. Other controls include household demographic information (household size, number of adult household members; religion dummies; tribe dummies). *Refugee1* (Xkm) is a dummy which takes 1 if one of the refugee camps is located within Xkm from the center of the village where each household lives. *Refugee2* is a dummy which takes 1 if one of the refugee camps is located within own ward or a neighborhood ward of the village where each household lives. *Refugee3* is log of the distance between the center of the village each household lives and its nearest refugee camp.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A.17: Refugee Inflows and Labor Market Participation with Alternative Treatment Variables

(A)	**Dummy: Off-farm employment of male**								
	Total			Agricultural work			Non-agricultural work		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dummy: *Refugee2*	0.00945			0.00388			-0.00195		
	(0.0273)			(0.0167)			(0.0227)		
Refugee2 × Year2004	-0.124***	-0.132***	-0.124***	-0.0265*	-0.0326**	-0.0166	-0.104***	-0.108***	-0.116***
	(0.0359)	(0.0324)	(0.0415)	(0.0149)	(0.0138)	(0.0187)	(0.0318)	(0.0299)	(0.0373)
Observations	1768	1768	1768	1768	1768	1768	1768	1768	1768
R-squared	0.041	0.040	0.046	0.019	0.023	0.021	0.035	0.026	0.031
(B)	**Dummy: Off-farm employment of male**								
	Total			Agricultural work			Non-agricultural work		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Refugee3 (log distance)	-0.0111			0.0108			-0.00497		
	(0.0305)			(0.0140)			(0.0209)		
Refugee3 × Year2004	0.103***	0.0929***	0.114***	0.0200	0.0178	-0.00829	0.0778***	0.0738***	0.0861***
	(0.0224)	(0.0210)	(0.0356)	(0.0159)	(0.0154)	(0.0187)	(0.0185)	(0.0180)	(0.0310)
Observations	1727	1727	1727	1727	1727	1727	1727	1727	1727
R-squared	0.040	0.038	0.046	0.021	0.014	0.021	0.033	0.025	0.030
(C)	**Dummy: Off-farm employment of male**								
	Total			Agricultural work			Non-agricultural work		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dummy: *Refugee1* (60km)	0.0351			0.0247**			0.0241		
	(0.0265)			(0.0110)			(0.0240)		
Refugee1 (60km) × Year2004	-0.0394	-0.0371	-0.0188	-0.0176	-0.0211	0.00187	-0.0291	-0.0267	-0.0218
	(0.0453)	(0.0438)	(0.0508)	(0.0181)	(0.0184)	(0.0231)	(0.0387)	(0.0376)	(0.0432)
Observations	1727	1727	1727	1727	1727	1727	1727	1727	1727
R-squared	0.033	0.033	0.038	0.018	0.023	0.021	0.028	0.021	0.024
(D)	**Dummy: Off-farm employment of male**								
	Total			Agricultural work			Non-agricultural work		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dummy: *Refugee1* (40km)	0.0120			-0.0115			0.0110		
	(0.0423)			(0.0211)			(0.0241)		
Refugee1 (40km) × Year2004	-0.157***	-0.161***	-0.199***	-0.0450*	-0.0457*	-0.0102	-0.121***	-0.122***	-0.151***
	(0.0409)	(0.0417)	(0.0582)	(0.0237)	(0.0254)	(0.0286)	(0.0363)	(0.0377)	(0.0495)
Observations	1727	1727	1727	1727	1727	1727	1727	1727	1727
R-squared	0.040	0.038	0.048	0.021	0.015	0.021	0.033	0.025	0.032
Village FE	No	Yes	No	No	Yes	No	No	Yes	No
Initial household FE	No	No	Yes	No	No	Yes	No	No	Yes

Notes: Robust standard errors clustered at the village level in parentheses. Size of land area and household demographic information (household size, number of adult household members; religion dummies; tribe dummies) are controlled in all the specifications presented here. *Refugee1* (Xkm) is a dummy which takes 1 if one of the refugee camps is located within Xkm from the center of the village where each household lives. *Refugee2* is a dummy which takes 1 if one of the refugee camps is located within own ward or a neighborhood ward of the village where each household lives. *Refugee3* is log of the distance between the center of the village each household lives and its nearest refugee camp.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A.18: Refugee Inflows and Transition from Subsistence to Sellers of Food Crops with Alternative Treatment Variables

(A)	**Dummy: Crop seller**							
	Maize		Beans		Cooking bananas		Cassava	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dummy: *Refugee2*	0.0815**	0.0684*	0.137**	0.0992	-0.107**	-0.0988**	0.0100	0.0106
	(0.0344)	(0.0347)	(0.0605)	(0.0639)	(0.0466)	(0.0478)	(0.0402)	(0.0399)
Observations	860	860	834	834	818	818	855	855
R-squared	0.052	0.075	0.100	0.119	0.036	0.047	0.031	0.034
(B)	**Dummy: Crop seller**							
	Maize		Beans		Cooking bananas		Cassava	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Refugee3 (Rwanda)	-0.0150	-0.157**	-0.349***	-0.492***	-0.0162	0.00230	0.0536	0.150**
	(0.0696)	(0.0767)	(0.0831)	(0.0865)	(0.0759)	(0.103)	(0.0553)	(0.0680)
Observations	860	860	834	834	818	818	855	855
R-squared	0.047	0.076	0.118	0.149	0.028	0.041	0.032	0.040
(C)	**Dummy: Crop seller**							
	Maize		Beans		Cooking bananas		Cassava	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dummy: *Refugee1* (Rwanda, 60km)	0.0845**	0.0782*	0.200***	0.178***	0.0626	0.0626	-0.0338	-0.0386
	(0.0387)	(0.0394)	(0.0438)	(0.0439)	(0.0528)	(0.0530)	(0.0213)	(0.0238)
Observations	860	860	834	834	818	818	855	855
R-squared	0.057	0.079	0.134	0.146	0.032	0.045	0.033	0.036
Geographic controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District FE	No	Yes	No	Yes	No	Yes	No	Yes

Notes: Robust standard errors clustered at the village level in parentheses. For each crop-level estimation, I first pick the subsample of that crop's subsistence households in 1993 (pre-shock) and then use their related households in 2004 (post-shock) in the estimation. Size of land area and household demographic information (household size, number of adult household members; religion dummies; tribe dummies) are controlled in all the specifications presented here. *Refugee2* is a dummy which takes 1 if one of the refugee camps is located within own ward or a neighborhood ward of the village where each household lives. *Refugee3* (Rwanda) is log of the distance between the center of the village each household lives and its nearest Rwandan refugee camp. *Refugee1* (Rwanda, Xkm) is a dummy which takes 1 if one of the Rwandan refugee camps is located within Xkm from the center of the village where each household lives.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A.19: Refugee Inflows and Food Crop Sales to Markets by Initial Sellers with Alternative Treatment Variables

(A)	Value of crop sales (z-score)											
	Maize			Beans			Cooking bananas			Cassava		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dummy: *Refugee2*	-0.921**			0.454			0.350			0.339		
	(0.413)			(0.339)			(0.351)			(0.647)		
Refugee2 × Year2004	1.029**	0.821**	0.605	-0.327	-0.356	-0.697*	-0.398	-0.406	-0.356	-0.190	-0.228	-0.0254
	(0.400)	(0.390)	(0.505)	(0.344)	(0.329)	(0.391)	(0.342)	(0.341)	(0.369)	(0.557)	(0.509)	(0.445)
Observations	759	759	759	853	853	853	864	864	864	791	791	791
R-squared	0.154	0.133	0.124	0.175	0.095	0.132	0.085	0.094	0.137	0.125	0.110	0.111
(B)	Value of crop sales (z-score)											
	Maize			Beans			Cooking bananas			Cassava		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Refugee3 (Burundi)	0.00644			0.264***			0.256			-0.143		
	(0.203)			(0.0945)			(0.188)			(0.342)		
Refugee3 (Burundi) × Year2004	-0.376***	-0.297**	-0.311*	-0.293***	-0.232**	-0.297**	-0.242*	-0.264*	-0.330*	0.106	0.177	0.166
	(0.139)	(0.144)	(0.185)	(0.0969)	(0.101)	(0.117)	(0.138)	(0.149)	(0.178)	(0.293)	(0.292)	(0.300)
Observations	748	748	748	840	840	840	853	853	853	780	780	780
R-squared	0.155	0.129	0.124	0.177	0.098	0.129	0.100	0.107	0.158	0.115	0.109	0.112
(C)	Value of crop sales (z-score)											
	Maize			Beans			Cooking bananas			Cassava		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dummy: *Refugee1* (Burundi, 60km)	-1.021***			-0.648***			-0.625*			-0.467*		
	(0.282)			(0.197)			(0.321)			(0.269)		
Refugee1 (Burundi, 60km) × Year2004	1.030***	0.965***	0.461	0.710***	0.595**	0.693**	0.537	0.568	0.716*	0.542*	0.479*	0.424*
	(0.290)	(0.287)	(0.372)	(0.226)	(0.227)	(0.271)	(0.327)	(0.341)	(0.412)	(0.290)	(0.268)	(0.244)
Observations	748	748	748	840	840	840	853	853	853	780	780	780
R-squared	0.146	0.131	0.122	0.177	0.098	0.128	0.099	0.106	0.156	0.115	0.109	0.112
(D)	Value of crop sales (z-score)											
	Maize			Beans			Cooking bananas			Cassava		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dummy: *Refugee1* (Burundi, 40km)	-1.021***			-0.648***			-0.625*			-0.467*		
	(0.282)			(0.197)			(0.321)			(0.269)		
Refugee1 (Burundi, 40km) × Year2004	1.030***	0.965***	0.461	0.710***	0.595**	0.693**	0.537	0.568	0.716*	0.542*	0.479*	0.424*
	(0.290)	(0.287)	(0.372)	(0.226)	(0.227)	(0.271)	(0.327)	(0.341)	(0.412)	(0.290)	(0.268)	(0.244)
Observations	748	748	748	840	840	840	853	853	853	780	780	780
R-squared	0.146	0.131	0.122	0.177	0.098	0.128	0.099	0.106	0.156	0.115	0.109	0.112
Village FE	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes	No
Initial household FE	No	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes

Notes: Robust standard errors clustered at the village level in parentheses. Size of land area and household demographic information (household size, number of adult household members; religion dummies; tribe dummies) are controlled in all the specifications presented here. *Refugee2* is a dummy which takes 1 if one of the refugee camps is located within own ward or a neighborhood ward of the village where each household lives. *Refugee3* (Burundi) is log of the distance between the center of the village each household lives and its nearest Burundian refugee camp. *Refugee1* (Burundi, Xkm) is a dummy which takes 1 if one of the Burundian refugee camps is located within Xkm from the center of the village where each household lives.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

B Procedure for Estimating Shadow Wages

This appendix section describes the procedure of estimating shadow wages. I follow Jacoby (1993) and Skoufias (1994). I use annual data for getting information on agricultural production. In wave 5 (2004), we have annual production data. In wave 2 (1992) and wave 3 (1993), we have only retrospective data for 6 months. Thus, for the period before the refugee inflows, I use the annual data of 1992-1993, which is a combined data between wave 2 (1992) and wave 3 (1993). The interviews for the wave3 data collection were taken after 6 months from the wave 2 interviews[36]. For the period after refugee inflows, we use the annual data from 2004 (wave 5). As a benchmark reference, the annual data from wave 1 (1991) is also used to estimate shadow wages in 1991.

B.1 Construction of the Subsamples in 1993 and 2004

1993: the pre-shock period

The original sample size of wave 2 (1992) households is 876. Out of the 876 households, 863 households have at least one individual who has owned or worked on a shamba/garden, and 643 households have at least one individual who has raised or owned livestock or animals. Out of the 876 households, I kept 865 households by dropping 11 households which have no members who either owned or worked on a shamba/garden, or who raised or owned livestock/animals.

The original sample size of wave 3 (1993) households is 829. Out of the 829 households, 820 households have at least one individual who has owned or worked on a shamba/garden, and 611 households have at least one individual who has raised or owned livestock or animals. Out of the 829 households, I kept 820 households by dropping 9 households which have no members who either owned or worked on a shamba/garden, or who raised or owned livestock/animals.

Finally, I combine these two production datasets. After dropping attrition households, we got 817 households,

2004: the post-shock period

The number of households interviewed in 2004 is 2774. The increase of the sample size from the early 90's is because we have splitting households in 2004 from the original 919 households in 1991. Out of this overall sample, I make a subsample for the agricultural production function estimation by applying the following three restrictions.

1. Detailed questions in the section of agricultural production such as farm inputs and sales of crop products are dropped for tracked households. In order to keep the consistency in the estimation of agricultural production function, we drop such households. We have 1659 untracked households.
2. Out of the 2774 households, 266 households migrated to elsewhere in Tanzania and 52 households migrated to neighboring countries. Since our focus is within the Kagera region, we drop such households for the shadow wage estimation. We have 1361 households in the same cluster as 10 years ago, 536 households in nearby villages, and 559 households which moved to elsewhere in Kagera. I first start my analysis by using these three types of households. In total, there are 2456 households.
3. Out of the 2774 households, 2280 households have at least one individual who has owned or worked on a shamba/garden, and 1514 households have at least one individual who has raised or owned livestock or animals. I choose the households which have at least one individual who owned or worked on a

[36] Ikegami (2008) adopted the same way to construct annual data sets.

shamba/garden, or who raised or owned livestock/animals.

By restricting the sample following these three procedures, I got 1265 households. Finally, by dropping 35 households which have outliers values in agricultural outputs, I got 1230 households for the production function estimation.

B.2 Outputs and Inputs Variables for the Estimation of Shadow Wages

Following the similar way as Jacoby (1993) and Skoufias (1994), the total value of agricultural output is defined as the sum of the followings:

{Value of harvest of crops sold; Value of crops lost; Value of crops kept for seed or given to laborers or landowner, or as gifts in ceremonies; Value of crops in stock; Value of crop products sold; Value of food consumption of home products; 0.2×Value of Livestock owned; Value of (animal) meat consumed; Value of animal products sold}

The value of harvest crops sold, crop products sold, and animal products sold are actual monetary revenue of these products sales. Other variables are monetary values evaluated by each household. For example, the value of crops lost (due to insects, rodents, fire, rotting, etc) is asked by the following question: "If you had sold the lost quantity at the time you lost it, what is the most monetary amount you have gotten (TSHS)?" Similar questions are asked for other variables as well.

B.3 Estimation of Cobb-Douglas Production Function and Shadow Wages

This subsection briefly reports the estimation of the Cobb-Douglas production function of the composite agricultural product[37] and the shadow wages of agricultural households in the Kagera region. Assume that the production function $F()$ in (1) has the Cobb-Douglas form. We follow the same procedure as Jacoby (1993) and Skoufias (1994) for the shadow wage estimation. The definition of the shadow wage is in (2). The estimated shadow wage for each gender j is defined as

$$w_j^* \equiv MPL_j = \hat{\beta}_{L_j} \frac{p_f^* \hat{q_f}}{L_j} = \hat{\beta}_{L_j} APL_j \tag{B.1}$$

where $\hat{\beta}_{L_j}$ is the estimated coefficient of labor time by each sex in the estimation of Cobb-Douglas production function (taking logs in all the variables) and $p^* \hat{q_f}$ is the predicted output value of the composite agricultural product from the estimated coefficients. Note that we have the data of the agricultural product represented by the value of products, regarding it as the proxy for $p_f^* q_f$. Table B.1 presents the OLS estimation results of the Cobb-Douglas agricultural production function. Table B.2 shows the estimated shadow wages, adopting the specifications with the village fixed effects, and the reported market wages of agricultural households members.

[37] Although we have the agricultural product data by crops as shown in the last subsection, we aggregate the agricultural products for the production function estimation, since we could not distinguish the inputs data for each crop production.

Table B.1: Cobb-Douglas Agricultural Production Function Estimation

	Total value of agricultural outputs					
	1991		1993		2004	
	(1)	(2)	(3)	(4)	(5)	(6)
Land area (acres)	0.333***	0.350***	0.306***	0.306***	0.633***	0.629***
	(0.0662)	(0.0659)	(0.0440)	(0.0474)	(0.0744)	(0.0792)
Adult male labor (hours)	0.0469***	0.0357***	0.0313***	0.0331***	0.0532***	0.0512***
	(0.0141)	(0.0122)	(0.00689)	(0.00721)	(0.0157)	(0.0166)
Adult female labor (hours)	0.0558**	0.0455**	0.0813***	0.0756***	0.116***	0.113***
	(0.0227)	(0.0198)	(0.0101)	(0.0112)	(0.0201)	(0.0205)
Child male labor (hours)	0.0188**	0.0155*	0.0310***	0.0308***	0.0451***	0.0474***
	(0.00813)	(0.00914)	(0.00459)	(0.00482)	(0.0157)	(0.0171)
Child female labor (hours)	0.0424***	0.0398***	0.0190***	0.0171***	-0.00779	-0.0129
	(0.00884)	(0.00942)	(0.00560)	(0.00521)	(0.0248)	(0.0251)
Hired labor	0.0150	0.0113	0.0135***	0.0140***	0.0379***	0.0426***
	(0.0113)	(0.0115)	(0.00441)	(0.00444)	(0.0108)	(0.0109)
Manure	0.0131	0.0276*	0.0116	0.0101	0.00708	0.00689
	(0.0139)	(0.0153)	(0.00764)	(0.00777)	(0.0107)	(0.0120)
Fertilizer	0.0121	0.0226	0.00264	0.000434	-0.0545***	-0.0470*
	(0.0237)	(0.0211)	(0.0115)	(0.0138)	(0.0190)	(0.0254)
Pesticide	0.0122	0.0187	0.0212*	0.0280**	0.0303	0.0424**
	(0.0139)	(0.0145)	(0.0117)	(0.0122)	(0.0184)	(0.0198)
Transportation costs	0.0469***	0.0507***	0.0202**	0.0284***	0.00902	0.0145
	(0.0136)	(0.0126)	(0.00857)	(0.00780)	(0.0271)	(0.0286)
Other inputs	0.0212*	0.0183	0.0242***	0.0172***	0.0219	0.00711
	(0.0115)	(0.0112)	(0.00643)	(0.00619)	(0.0150)	(0.0175)
Livestock inputs	0.0308***	0.0253**	0.0269***	0.0261***	0.0307***	0.0247*
	(0.0110)	(0.0102)	(0.00421)	(0.00516)	(0.0114)	(0.0132)
Kiangaza dummy	-0.305**	0.0881	-0.153	-0.0765	-0.639***	-0.837***
	(0.119)	(0.113)	(0.141)	(0.162)	(0.217)	(0.304)
Masika dummy	0.101	-0.0231	-0.0680	-0.360***	-0.218	-0.452
	(0.153)	(0.269)	(0.0502)	(0.131)	(0.131)	(0.380)
Constant	10.75***	10.80***	10.39***	10.43***	9.229***	10.65***
	(0.255)	(0.149)	(0.110)	(0.0819)	(0.598)	(0.181)
District FE	Y	N	Y	N	Y	N
Village FE	N	Y	N	Y	N	Y
Observations	888	891	817	817	1,222	1,222
R-squared	0.239	0.361	0.569	0.627	0.233	0.270

Notes: Robust standard errors clustered at the village level in parentheses. I am taking log of all the variables. Input variables other than land and family labor (hired labor, manure, fertilizer, pesticide, transportation costs, livestock inputs, and other inputs) are expenditures spent in last 12 months. *Kiangaza* dummy and *Masika* dummy are the dummies which take one if the survey interview was taken during a dry season and a rainy season, respectively.
* $p<0.1$, ** $p<0.05$, *** $p<0.01$.

Table B.2: Shadow and Market Wages of Agricultural Household Members

	N	Mean	SD	Min	Max
1991 (Baseline: Wave 1)					
Adult male shadow wage	587	13.867	20.448	.784	248.018
Adult female shadow wage	712	13.772	26.576	.449	473.893
Adult market wage	87	59.637	102.105	1.397	712.251
Adult male market wage	67	54.596	80.756	1.397	507.246
Adult female market wage	22	76.633	148.187	9.804	712.251
1993 (Pre-shock: Waves 2 & 3)					
Adult male shadow wage	635	13.355	22.874	.896	324.253
Adult female shadow wage	736	22.218	40.716	2.013	541.02
Adult market wage	100	51.802	76.848	1.773	451.128
Adult male market wage	73	51.659	74.532	2.325	451.128
Adult female market wage	30	50.509	80.197	1.773	451.128
2004 (Post-shock: Wave 5)					
Adult male shadow wage	599	14.142	24.241	.066	267.568
Adult female shadow wage	799	19.835	28.313	.09	347.941
Adult market wage	256	102.854	153.416	3.778	1196.072
Adult male market wage	189	110.589	160.223	3.778	1196.072
Adult female market wage	90	80.88	122.976	10.439	1097.738

Notes: All values are the real values in 1991. Wages are estimated and calculated in hourly basis. The estimation procedure of shadow wages follows the conventional literature (Jacoby 1993; Skoufias 1994) and is described in Appendix B. If multiple members in a household engage in outside wage works, then I take the average wage across them to obtain household-level market wages.