Rural household response to labor supply shocks: Evidence from Ethiopia's travel ban on migrant workers

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Abstract

This paper estimates the impact of labor supply shocks on the production decisions of family farms. I exploit immigration policy changes in Ethiopia that prevented workers from traveling abroad and led to mass waves of returnee migrants. The empirical analysis focuses on two key migration-related channels. During the travel ban, I observe a significant increase in family labor availability (endowment effects) and a decline in remittances among households that had previously sent migrants abroad (income effects). Using this policy shift, I find an increase in farm labor demand but no significant changes in hired labor or farm intensification. Additionally, I find asymmetric labor endowment effects, with migrant-sending households experiencing greater labor rationing compared to non-migrant-sending counterparts. These results suggest that international migration is a mechanism that enables family farms to adjust to local labor market constraints. Once this mechanism is disrupted, migrant-sending farms fail to reallocate inputs to meet excess labor demand.

JEL classification: O13, O19, D1, J2, J6

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1 Introduction

Migration is a key economic strategy for development, especially in contexts where incomes and alternative labor opportunities are limited. According to the World Bank, remittances to low- and middle-income countries rose to over $650 billion in 2023, surpassing foreign direct investment and official development assistance (Seshan and Yameogo, 2020). This underscores the importance of migration for livelihoods, farm income diversification, and structural transformation processes in low-income countries (Barrett et al., 2001; Gollin, 2014).[1] The reallocation of resources from agriculture to higher-productivity sectors requires addressing barriers to the free mobility of labor and capital (Harris and Todaro, 1970; Lewis, 1954). In practice, however, economic constraints and restrictive migration policies often prevent workers from moving to where they could be more efficient and prosperous.

In this paper, I study how migration-related labor shocks impact rural households in Ethiopia. In the presence of incomplete input markets, the standard agricultural household model suggests that changes in household endowments, for example outmigration and remittances, affect the input allocation decisions of farmers (Singh et al., 1986). Based on this result, which reflects non-separation between consumption and production decisions of family farms, economists have developed several empirical tests to identify whether, and sometimes track how, market failure occurs (see for example, Dillon et al., 2019; LaFave and Thomas, 2016; Benjamin, 1992).[2]

In particular, I examine two potential channels through which underlying labor market failures affect the decisions of agricultural households regarding farming and input allocation. The first channel is changes in labor endowment. An exogenous restriction on labor migration increases the number of household members seeking jobs domestically. Under a non-separation framework, where migration decisions affect agricultural production due to market frictions, changes in household labor endowment impact farming intensity and input allocations between farming and non-farming activities. Separation failures reflect the inability of farmers and rural workers to efficiently reallocate inputs across activities. The second channel is via remittances. A decrease in remittances received due to reduced migration activities can also affect rural households' technology decisions by compounding the negative effects of liquidity and credit constraints.

[1] In sub-Saharan Africa, for instance, remittances averaged 2.6% of GDP in 2023 (The World Bank, 2023), and the region has one of the largest numbers of international migrant workers in the world, with over 24 million people (United Nations, 2019).

[2] Tracking the source of those market failures is fundamental to effectively target public policy and private investment. In rural markets in particular, understanding why markets fail to clear can be a difficult task due to the interrelated nature of consumption and production decisions of agricultural households, hence the need for separation assumptions in applied research.

An important challenge to the empirical analysis of migration is the complex relationship between households' technology and resource allocation decisions and their propensity to migrate. For example, households self-select into migration. To address this and other empirical issues, I exploit a policy change in Ethiopia's immigration law to identify the causal effects of changes in migration. In October 2013, the Ethiopian government imposed a travel ban on migrants moving overseas for work, which was later lifted in 2018 after a series of mass deportations of migrants from Gulf countries to Ethiopia.[3] The travel ban was intended to protect migrant workers who were often the targets of violence, human trafficking, and harsh labor conditions. However, the economic effects in domestic labor markets of the ban are yet to be fully understood, especially in the context of a primarily agrarian economy with high structural and youth unemployment (The World Bank, 2024).

I exploit the travel ban as a source of exogenous variation that affected labor endowment in rural Ethiopia. Given that the imposition of the ban is exogenous to local labor conditions within Ethiopia, this policy change offers an opportunity to estimate changes in input allocation among agricultural households. I use a nationally representative survey of rural households to compare households with migrant members who traveled abroad for work with their non-migrant-sending counterparts. In doing so, I can test if family farms are able to adjust in response to an increase in labor supply and untangle the role of international migration as an adjustment mechanism.

I begin by documenting the changes in endowments before and during the travel ban. I show that labor supply increased by 14% among migrant-sending households during the ban period. This change is particularly pronounced in the period immediately following the imposition of the travel ban. I also observe a significant reduction in the inflow of international remittances, halving every period over the three waves of data. This reduction is accompanied by a significant but small increase in domestic remittances from within Ethiopia.

Although there is no evidence that all these changes are a consequence of the travel ban, as those directly affected by the ban are not observable in the data, these results are compelling indicators of the potential changes in income and labor endowment. A clear example is the decline in remittances over time. The changes in remittances observed in the sample coincide with the rapid reduction in aggregate remittances indicators[4]. I observe the opposite in the case of domestic remittances for the period when the ban was implemented. It is likely that migrants and returnees transferred considerable amounts of money and labor

[3]Mass deportation events have continued after the travel ban was lifted and have increased in intensity and frequency as a result of the COVID-19 pandemic (UN-IMO, 2022).

[4]See section 2 for more details on migration indicators and background information.

back to Ethiopia in response or anticipation of stricter migration regulations; many such transfers would be unreported or not classified as domestic remittances in the data.

Using a simple difference-in-differences approach, I estimate second-order effects of the travel ban on labor and other farming inputs. I find significant effects on farm labor demand, which are mainly driven by changes in family labor and not by hired labor. There are no significant differences between migrant-sending and non-migrant-sending households regarding off-farm labor. Results also show no impact on other farming inputs, except livestock. During the ban period, migrant-sending households reduce their holdings of oxen, which is an important capital asset among agro-pastoral communities. A possible explanation for this result is that remittances that would have been used as a form of capital to purchase oxen was no longer available once the ban was imposed. This can also relate to the null effects on cultivated land, as oxen and land may be a more flexible substitute input. Land availability may be fix in the short term, so farmers adjust via more flexible inputs such as livestock holdings.

The empirical analysis results show asymmetric responses to changes in labor endowment, which vary across types of households. Using the same and additional data, I replicate and confirm the main results in Dillon et al. (2019). The estimated elasticities for non-migrant-sending households follow the same pattern of asymmetric non-separation, suggesting excess labor demand. However, for migrant-sending households, elasticities for both positive and negative changes in endowment are statistically significant. They also suggest a stronger degree of non-separation, as the magnitude is considerably larger than for non-migrant-sending households.

Related literature

This paper contributes to the literature in several ways. The main objective is to estimate the impact of labor supply shocks on rural markets and document what these effects can tell us about the economic behavior of agricultural households. Thus, my research contributes to development and agricultural economics, focusing on agricultural household models and separation failures (Dillon and Barrett, 2017; Benjamin, 1992; Singh et al., 1986). In particular, this paper is closely related to Dillon et al. (2019), where the authors propose a market clearing test based on asymmetric responses to changes in endowments. I follow their econometric approach to estimate these differential effects on changes in labor demand and remittances by type of household. Furthermore, I show that these asymmetries differ for migrant-sending households using the travel ban as credible exogenous variation, indicating that international migration serves as an adjustment mechanism to domestic labor market constraints.

In addition, I document positive changes in labor endowment caused by the travel ban

on rural households. This supply shock on rural labor markets is analogous to, but opposite in direction to, the experimental variation used by Breza et al. (2021) to measure labor rationing. Using a randomized negative hiring shock, these authors show that rural labor markets in India experience labor rationing during periods of labor slackness but not during peak periods. They show that in tight market conditions, rural employment adjusts freely due to corresponding changes in wages. Here, I find that, relative to non-migrant-sending households, migrant-sending households demanded more farm labor. Migrant-sending households also paid higher wages for hired farm work after the ban was imposed, but they did not reduce the amount of hired labor.

Finally, this paper also contributes to applied research in migration and development. Much effort has been placed among development economists on studying rural-to-urban migration. International migration, on the other hand, plays a critical role through remittances, but its effects among rural households are greatly understudied (Taylor, 2001). These remittances are crucial for poverty alleviation and improved health and education outcomes (Taylor, 1999; Adams and Page, 2005; Taylor and Lopez-Feldman, 2010; Kuschminder et al., 2018). My results are highly consistent with related literature on migration in Ethiopia, providing compelling evidence about the negative relationship between remittances and labor participation (Ademe Ayalew and Mohanty, 2022). Similarly, Redehegn et al. (2019) finds that migration is correlated with lower farm income due to reduced labor, although these effects are somewhat compensated by remittances increasing land and livestock holdings.

In the following section, I provide background information about the travel ban and aggregate migration indicators. In Section 3, I describe the theoretical framework I use to analyze agricultural households' input allocation. Section 4 describes the data and the estimation strategy I employ to estimate the causal effects of the ban and asymmetric responses to changes in endowment. Section 5 reports results on changes in endowments using descriptive and regression analysis. Section 6 includes the main effects on input allocation. In this section, I also explore further results on labor demand and labor rationing. The final section provides a short discussion of the results and proposes avenues for further research.

2 Ethiopia's travel ban on migrant workers

Agriculture is the backbone of Ethiopia's economy, employing a significant portion of the population and contributing substantially to the country's GDP. The agricultural sector accounts for about 34% of Ethiopia's GDP and employs over 70% of the workforce, emphasizing its vital role in sustaining livelihoods (The World Bank, 2024). While agriculture remains the primary employer, urbanization is gradually shifting the employment landscape

towards the service and industrial sectors, which has experienced growth, particularly in manufacturing and construction. Although internal migration in Ethiopia involves a limited flows of rural-to-urban movement of migrants and domestic remittances (Bundervoet, 2019; de Brauw et al., 2014, 2013), international migration has been become an important economic alternative, with many Ethiopians workers seeking employment abroad, specially out-migration into countries in the Persian Gulf (Tsegay, 2019; Cenfri, 2018; Fernandez, 2011).[5]

In late 2013, Ethiopia's migration policy changed drastically (Ashine, 2017). The Ethiopian government imposed a travel ban on its citizens seeking employment in the Persian Gulf. This decision by the government of Ethiopia was prompted by a wave of deportations in 2010 from the Gulf Countries, and as well as the continuous reports of human trafficking abuses, and exploitative working conditions faced by Ethiopian migrant workers in their destination countries (UN-IMO, 2022). While the intention was to safeguard the rights and well-being of Ethiopian migrants, it also had repercussions on the country's labor markets and remittance inflows. Remittances from Ethiopian migrants working abroad had been a crucial source of income, especially among the poorest households in the country (Cenfri, 2018).

The ban's impact on Ethiopia's international migration indicators was significant, yet difficult to untangle. Although reliable sources of migration information for Ethiopia are scarce, net migration data shows that a trend of immigrants outpacing emigrants for the entire period between 2009 to 2018. By 2014, migration level seems to reach a plateau and then decrease in 2017, coinciding with the phasing out of the travel ban. These changes coincide with the waves of returning migrant workers, and a rapid influx of a considerable number of refugees (panel B).[6]

The most direct impact seems to be in remittances inflows (panel C). The data suggests a drastic change in incomes received from abroad during the travel ban period. After the ban was imposed, fewer migrants overseas with fewer opportunities to travel, work and send money back home legally resulted into a sharp decline in the remittances arriving to Ethiopia, both in nominal value and as a percentage of Ethiopia's GDP. [7]

A migration policy like the one implemented in Ethiopia can have significant impacts in

[5]Most international work-related migration in Ethiopia is done by low-skilled workers who travel afoot, hitchhiking, and using transport to seaports in Eritrea, Somalia and Djibouti towards Yemen, which has become the main crossing point into Persian Gulf (see figure C1 in the appendix).

[6]Many of these refugees, which are counted as immigrants, enter Ethiopia due to major conflicts in neighboring countries, particularly Somalia and South Sudan.

[7]It is important to note that government sources have indicated that the inflow of remittances to Ethiopia has not decrease during this period and that, on the contrary, remittances continue to grow. This discrepancy between data sources reflects their ability to track formal and informal remittances, under-reporting, and misclassification, which also are relevant issues with survey data.

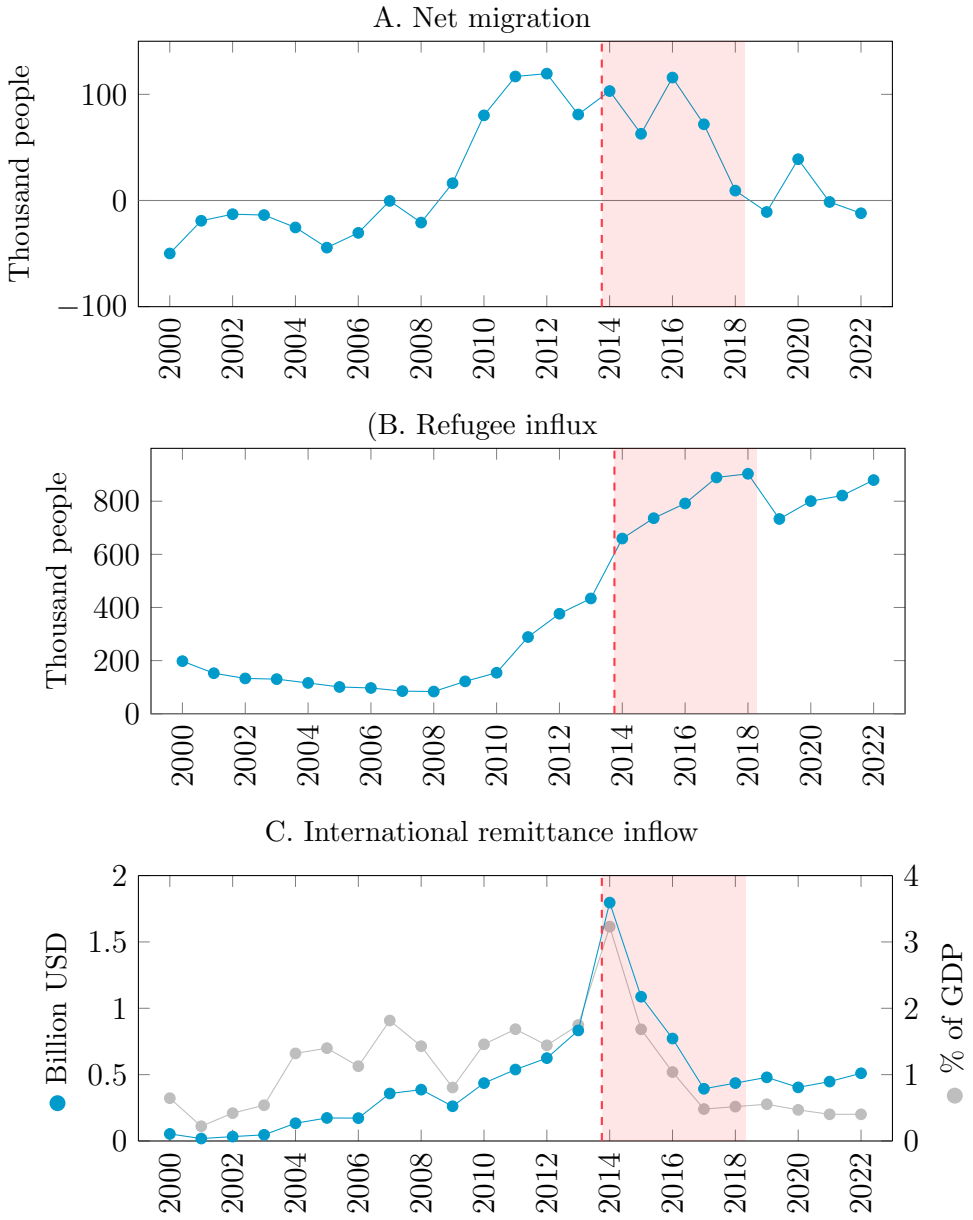

Figure 1: Ethiopia's migration indicators (2000-2022)
All figures created using information from the World Development Indicators databases from The World Bank. Panel A: Net migration is defined as the number of immigrants minus the number of emigrants each year. Panel B: Remittances received in current USD as a percentage of the GDP. Panel C: Refugee population. The shaded area shows the period in which the travel ban on international migrant workers took place.

labor markets. If the restriction is binding, effectively preventing the international outflow of workers, the ban can generate a shock on the labor supply by quickly increasing the number of people willing to work. This number is unknown but it may be similar in magnitude as those who wanted to leave before the ban was imposed. The vast majority of international travel out of Ethiopia is work-related, and many migrants cross borders illegally (Assefa Admassie,

2017). From 2008 to 2013, estimates indicate that nearly 200.000 Ethiopians migrated abroad annually, which represents about half of the individuals entering the domestic job market every year (Seid et al., 2015).

The travel ban may affect domestic labor markets even if the travel restriction did not prevent migrant workers from traveling abroad legally. During the same period, countries in the Persian Gulf also implemented policies to expatriate Ethiopians migrants. Specifically, Saudi Arabia, which receives half of all Ethiopian migrant workers, took drastic measures to curb illegal migration (Lecadet and Tafesse Melkamu, 2016). These included an amnesty period for migrants to leave the country without reprisal, mass deportations, and violent crackdowns that sounded the alarms of human rights organizations.

Most accounts indicate a large numbers of migrants that returned to Ethiopia in short waves during implementation of these restrictions. It has been reported more than 160,000 Ethiopians were deported from Saudi Arabia between late 2013 and early 2014 (Lecadet and Tafesse Melkamu, 2016), right after the travel ban was erected. Nearly 500,000 migrants returned to Ethiopia following the mass deportation and amnesty periods between 2013 and 2017 (UN-IOM, 2019). Therefore, the domestic effect of the ban in Ethiopia may be compounded by the increase in deported and returning workers coming from overseas.

Today, more there 30 million migrant workers reside in the Persian Gulf UN-IMO (2022). The expulsion and deportation of migrant workers continues to serve as an important policy tool in the region. This phenomenon has been greatly exacerbated by the COVID-19 pandemic, as United Arab Emirates and other countries in the region have taken actions to restrict international migration from Ethiopia (Getachew, 2020).

3 Theoretical framework

In this section, I present a simple agricultural household model following Benjamin (1992) and Dillon et al. (2019). I model household responses to changes in the labor endowment structure in the form of family size, and remittances. Comparative statics are reported to capture household asymmetric responses to labor rationing (Dillon et al., 2019), and specific effects on migrant-sending households. Below I analytically derive in detail the direction of the expected effects.

Setup

Following Benjamin (1992), let the household utility be denoted by u, which is a function of c is the household consumption and l is their total leisure time. The household maximizes its

utility subject to a total income constraint (1) and a time constraint (2). The main difference is the inclusion of L^M migrant labor (i.e. the amount of labor destined to outmigrate) and the corresponding value remittances per migrant worker r.

$$\begin{aligned} \max \quad & u(c,l) \quad \text{w.r.t.} \quad c, l, L^O, L^H, L^H, L^F, L^M \\ \text{subject to} \quad & c + wl = \pi(w;A) + wT(a) - L^M(r-w) \qquad (1) \\ \text{and} \quad & L = L^F + L^H \qquad (2) \end{aligned}$$

where π is the profit from agricultural production such that $\pi = F(L;A) - w(L^H + L^F)$, w is the wage rate, w is the value of remittances , T is the total available time endowment, F is a standard production function of farm activities such that $F_1 > 0$, $F_{11} < 0$ and $F_{12} > 0$, L^F is family labor, L^H is the hired labor, L^O is off-farm work, y and exogenous income, and A is farmland, which is assumed to be fixed for simplicity.

From an accounting perspective, the distribution of remittances between migrant member and those who stay is not relevant for the analysis, so assume that r captures a net transfer of income from migrants to the household. Assume further that in nominal terms $r > w$, meaning that remittances per worker are higher than the domestic market wage. This notion capture a fundamental wage-gap that promotes rural migration (Lewis, 1954). For any $r \leq w$ then $L^M = 0$, households have no incentive to migrate, and we woudl have with the same no migration setup as in Benjamin (1992).

Equilibrium conditions

The benchmark case is one in which the separation principle holds, such that consumption and production decisions are separable. In this case, the household maximizes utility given its maximized profits. The equilibrium input demand decisions do not depend only on input prices and other parameters, such that the farm labor demand $L^d = L^*(w, r; A)$.

The alternative scenario is one in which labor is rationed, either from the demand or supply side. In this scenario, the household is not able to work or hire labor as much it would like to, given the market-clearing wage w^*. In equilibrium, we have a situation where the optimal labor supply and demand are off by a fixed and exogenous quantity $\bar{L}$, such that

$$L^d = L^*(w^*, r; A) = L^s(w, r, M; a) + \bar{L}(a) \qquad (3)$$

If $\bar{L}(a) > 0$, we have a situation in which labor demand exceeds available hired labor and the marginal product of labor exceeds the market wage (i.e. excess demand). On the contrary, if $\bar{L}(a) < 0$ the household is not able to hire enough labor from the market to

work in the family farm, thus uses family labor despite the fact that the marginal product of labor is lower than w (i.e. excess supply). In either case, the optimal labor demand solution depends also depends on the underlying household preferences and production technology (Benjamin, 1992).

Comparative statics

I focus on how household labor demand changes in response to changes in the household structure, particularly an increase in labor endowment due to restricted labor migration and decreased remittances. The change in the optimal labor demand with respect to household characteristics a and remittances r are given by the following implicit derivatives where w^* is the shadow price of labor, and $\pi_{11} > 0$ is the second derivative of the profit function evaluated at the market wage.

$$\frac{dL^d}{da} = -\frac{d\pi^2(w^*; A)}{dw^* da} \tag{4}$$

$$\frac{dL^d}{dr} = -\frac{d\pi^2(w^*; A)}{dw^* dr} \tag{5}$$

The shadow wage is defined implicitly and refers to the wage level for which the household would have chosen an optimal amount of labor demand given the rationing constraint (Strauss, 1986). In other words, it is the wage level that satisfies the first order condition that $F_1\big(L^s(w^*, r, M, a) + \bar{L}(a); A\big) = w^*$ (Benjamin, 1992).

The sign of derivatives (4) and (5) depends on how the labor supply change with respect to the shadow wage. In equilibrium, $L^s(w, r, M; a) = T(a) - l(w, r, M; a)$ where l is the leisure demand, and $M = y + \pi + wT(a) + rL^M$. Therefore, the change of labor supply with respect to a is given by $\frac{dL^S}{da} = T'(a) - l'(a)$. Similarly, with respect to r we get $\frac{dL^S}{dr} = -l'(a)\frac{dM}{dr}$, which is negative because $\frac{dM}{dr} > 0$, meaning that farm labor supply decreases when remittances rise.

Collecting terms we get that the effect on labor demand is given by the following expressions, where $\epsilon_w = dL^{sc}/dw - dL^*/dw > 0$ is the net wage elasticity of labor, and L^{sc} is the compensated labor supply.

$$\frac{dL^d}{da} = \frac{\pi_{11}}{\epsilon_w}\Bigg(\underbrace{T'(a) - l'(a)}_{\substack{\text{endowment}\\ \text{effect}}} + \underbrace{\bar{L}'(a)}_{\substack{\text{ration}\\ \text{effect}}}\Bigg) \tag{6}$$

$$\frac{dL^d}{dr} = F_{11} l'(a) \frac{dM}{dr} \tag{7}$$

Assume that time endowment and leisure are increasing in a, such that $T'(a) > 0$ and $l'(a) > 0$ when changes in a represent a increase in working-age members of the household. In cases where the optimal labor demand exceeds the available supply in the market, it is fair to assume that the endowment effect is positive. This implies that the endowment effect (6) is expected to be positive, reflecting that the change in time endowment is greater than changes in leisure demand.

The direction of the effect in (6) indicates that labor demand decreases as a response to a positive change remittances. Some empirical evidence from Ethiopia support this theoretical result. Ademe Ayalew and Mohanty (2022) show that foreign remittances are negatively correlated with the number of worked hours and adult labor participation.

Labor rationing and asymmetric responses

The only partial effect left to be determined is how $\bar{L}'(a)$ affects labor demand. Contrary to (Benjamin, 1992), the way the ration $\bar{L}$ affect labor allocation is no longer exogenous. Instead, some households may be ration more often. Following (Dillon et al., 2019), I consider cases when households are rationed depending their responses to changes in a, which vary by the type of household.

I modeled the way ration $\bar{L}$ in equation (3) to capture the idea that changes in the household structure may induce different responses among migrant-sending households depending on the underlying type of labor rationing. Dillon et al. (2019) find evidence of excess labor demand during a similar period in Ethiopia.[8] This result suggests that household responses to labor rationing depend on whether there either an increase or decrease in labor endowment.

In the context of the model presented here, excess labor demand implies that $\bar{L}(a) > 0$. Furthermore, an increase in labor endowment, $\Delta^+ a$, is associated with $\bar{L}'(a) < 0$. For households in which an $\Delta^+ a$ relaxes labor constraints past the the rationing point, we get that $\bar{L}'(a) = -dL^s/da < 0$ such that $dL^d/da = 0$. This specific case is indistinguishable to the benchmark scenario and the separation result. The opposite is not true, however, as negative changes in endowment increase $\frac{dL^d}{da}$ because $\Delta^- a \to \bar{L}'(a) > 0$.

This notion of asymmetric responses is important because allow me to separate the effect of the ban between migrant and non-migrant workers. Changes in labor endowment caused

[8] In the next section, I replicate and confirm these authors' results using the sample and time period of this paper.

by the ban should only affect migrant and would-be migrant-sending households. Thus, for any household with a zero propensity for migration, we should observe the same pattern of non-separation as predicted by Dillon et al. (2019). The net effect on migrant-sending households depends on whether the changes in labor endowment, via reduced outmigration, enable these family farms to optimally adjust so that they are not longer rationed, or if the migration restriction imposed an additional type of constraint besides excess labor demand. In addition, only migrant-sending households would be affected by changes in a and r since by definition $L^M = 0$ for any non-migrant-sending household, hence $dM/dr = 0$.

Expected effects

Table 1 reports a summary of the expected effects given changes in labor endowment a and remittances r. The table assumes the case of of labor supply rationing and ignores potential null effects on migrant-sending households for simplicity in the comparison between types of households.

Table 1: Expected effects of the travel ban on labor on migrant-sending households

	Δ Labor demand		
	Migrant-sending	Non-migrant	Difference
Δ^+ Remittances	(–)	null	(–)
Δ^+ Labor endowment	(+)	null	(+)
Δ^- Labor endowment	(–)	(–)	null

Notes: This table reports the effects on migrant-sending households predicted by the model for the case of excess labor demand ($\bar{L} > 0$), and the specific changes in labor endowment and remittances expected from the travel ban.

4 Data and empirical strategy

4.1 Ethiopia Socioeconomic Survey

This paper uses data from three waves of the Ethiopia Socioeconomic Survey (ESS, henceforth). The ESS is a nationally representative survey of rural Ethiopia that collects socioeconomic information on agricultural households from rural areas and small towns. The ESS data includes individual-level data on employment and household members' demographics, farm- and plot-level production information, and community-level indicators for village-size enumeration areas. Using this information I constructed a balanced panel data set with

three ESS waves, two rounds each (post-planting and post-harvest), with information for 2937 households.[9]

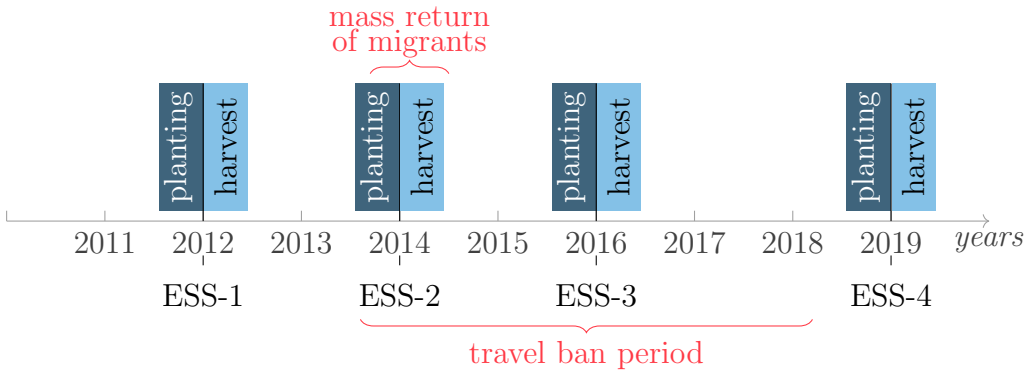

Figure 2: Socioeconomic Survey time-line
The figure shows the data collection waves and periods (planting and harvest) of the Ethiopia's Socioeconomic Survey (ESS). The travel ban was imposed in October 2013 and lasted until the first quarter of 2018. At least two mass waves of returning migrants were reported, one between in late 2013 and early 2014 (as reported in this figure), and a second the second quarter of 2017.

Socio-demographic information of the household was collected during the post-harvest data collection round. Appendix A describes the variable construction and measurement. See Table B1 in the appendix for summary statistics. Although ESS-2 and ESS-3 included new households from urban areas such as small towns, I use the sample that includes only households from rural communities initially surveyed in 2011-2012. These households are family farms dedicated to small-scale agriculture and livestock production. While most household labor is allocated to farm activities, a small fraction (9%) of households reports having members employed in non-farm activities.

The data also shows seasonal differences in labor allocation between the planting and harvesting periods. Figure 3 reports the average labor demand, own and hired, and hiring wages per period for all waves pooled together[10]. During the pre-planting and planting periods, significant more labor is demanded compared to the harvest and post-harvest, despite that both periods capture similar periods of time in the data (between 3 and 4 months). About half of the labor demanded in the planting is utilized during harvesting. Furthermore, wages vary in the opposite direction although the average change is small.

Seasonal dynamics are relevant to understand the ban's impact on rural labor markets. For instance, Breza et al. (2021) shows that negative labor supply shocks affect rural markets

[9]The balanced panel includes household information for all three waves of data collection is composed of 2781 households, which correspond to 95% of the unbalanced panel.) Moreover, there was an intermediate data collection round that focused entirely on livestock activities. This information is not used in this study.

[10]see figure C2 in the appendix for the same plots disaggregated per wave.

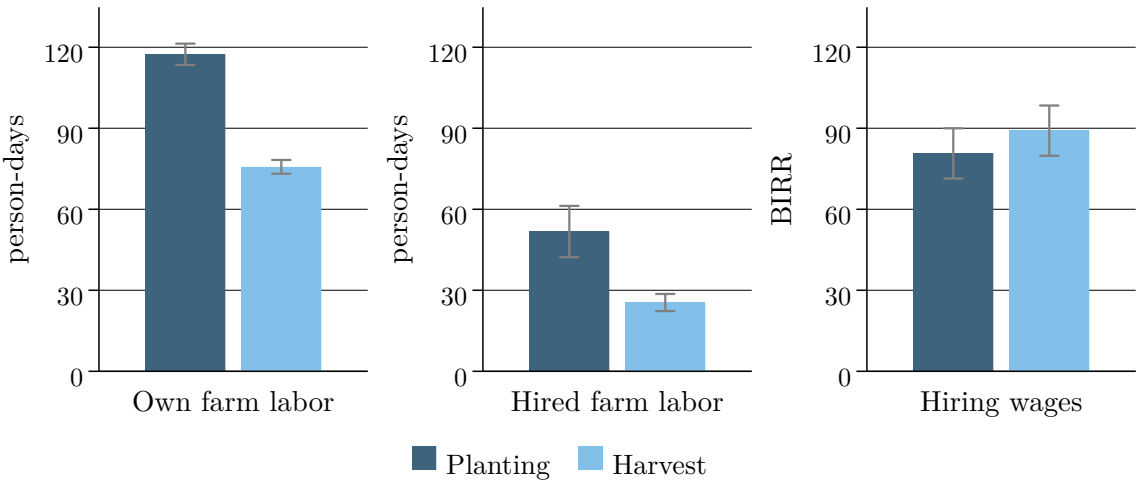

Figure 3: Seasonal dynamics in farm labor and wages
This figure shows the average labor demand per period for households with non-zero values for each variable. Each period includes several agricultural activities related to pre-planting and planting, and harvest and post-harvest. Labor demand measures the total number of days per person the household invested in each period, and it is disaggregated into own and hired labor demanded in each period. Wages are in Ethiopian BIRR (ETB) per day of work payed for work in the household's plots.

differently depending on seasonal labor slackness, and whether rural markets are able to adjust via changes in wage levels. I first aggregate labor demand, and then control for these activity-specific effects, to assess implication of the relative change labor slackness across activities on the main results.

4.2 Excess labor demand

Dillon et al. (2019) use the first two waves of the ESS (2011-2012 and 2013-2014) and show that labor supply is rationed in Ethiopia, which leads to an excess of labor demand in rural markets. These results are qualitatively replicated using the sample including all three panel-data waves. Replication results in table B2 with my sample from the first three ESS waves in the appendix in are within 5% of the estimates reported in Table 3 from Dillon et al. (2019). I also find similar results in significance and direction of these effects when using three-waves sample, although all coefficients are slightly smaller in magnitude. These results suggest that an increase on labor endowment due to the travel ban caused by the travel could potentially relax labor rationing for migrant-sending households.

4.3 Identification strategy

The causal relationship to be estimated are represented in the directed acyclic graph (DAG) shown in Figure 4.[11] For identification of these causal effect, I exploit the travel ban as a source of exogenous variation affecting households' labor and income endowments. Therefore, the travel ban exposure variable *Travel ban* is considered to be exogenous.

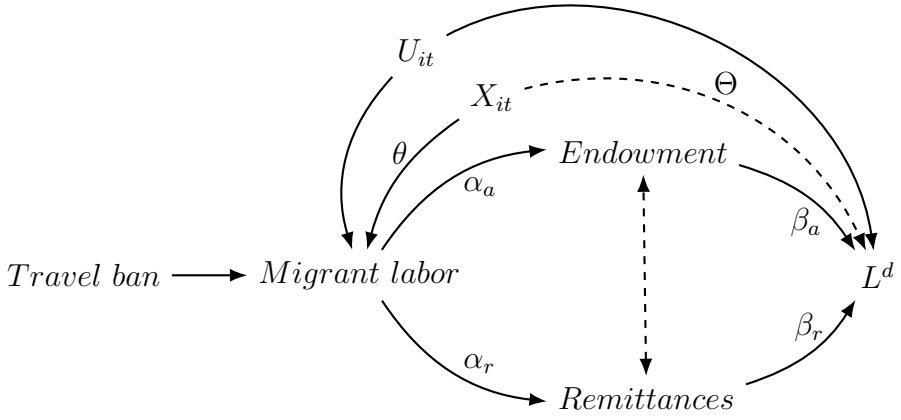

Figure 4: Modeled causal relationships
This Directed Acyclic Graph (DAG) reports the DAG describing the causal path between the travel ban exposure and labor demand as the outcome. The dashed lines describe the direct effects as defined by Textor (2015). Other lines show the indirect and mediation effects of each variable. The characters along each path correspond to the names that will be used for each effect used in the estimation equations.

In principle, the travel ban should impact the number of working-age adults of migrant-sending households, and foreign transfers from migrants working overseas. However, whether a household is directly affected by the travel ban is not observed in the data. The survey only identifies whether a member of the household is absent in the previous 12 months, the reason for their absence (e.g., studies or work), and for how long, which can be used to attribute the migration status.[12] An important challenge is then that the ban potentially impacted all Ethiopia at once, meaning that the travel ban's effect is confounded with household characteristics and the data collection waves.

The causal paths reported in Figure 4 are also sensitive to model selection. These causal paths only capture the effect of time-variant characteristics X_{it}. The reason is that time-invariant household characteristics and the passage of time can be conditioned using fixed effects, so these important effects are accounted for but there is no need to include them in the

[11] This figure was analyzed and created using the DAGitty software created by Textor (2015).
[12] Appendix B describes the variable construction and measurement

figure. Thus, the only direct effect (follow the solid arrows) affecting the causal path from observable characteristics goes to the *Migrant labor* indicator variable. The causal path towards L^d is closed after conditioning on X_{it}.[13] Therefore, as long the model is correctly specified, these relationships do not bias the causal path between the Ban and labor demand. Alternative specifications, with and without controls, are reported as robustness checks in appendix B.

The only biasing path open is caused by an omitted bias problem, represented by U_{it} affecting simultaneously the migration status and labor demand. Addressing this issue requires additional assumptions in order to be able to identify the causal effects of the travel ban via changes in endowment and remittances.

Identification Assumptions

A key identification assumption required here is the parallel trend assumption. I am interested in estimating the causal effects on migrant-sending households relative to their non-migrant counterparts. The parallel or common trend assumption implies that, in absence of the ban, outcomes for migrant and non-migrant-sending households would have followed the parallel paths over time.

Table 1 in the appendix reports differences in outcomes and other key characteristics between migrant and non-migrant-sending households in the pre-ban period (ESS-1). I find no significant differences in the main labor outcomes such as farm labor, family labor, or hired labor. No differences are found either in cultivated area or other farming practices. The main limitation here is that there are not enough pre-treatment periods to conduct a more robust analysis. Section 5 reports a detailed analysis comparing changes over time in endowments between migrant and non-migrant-sending households.

In addition, it is expected that the travel ban only affects migrant-sending households. Consequently, implies that the travel ban should not have a significant effect on non-migrant-sending households' endowment and technology decisions. The estimated effects may be biased downward but still valid in a causal sense, if the effect on non-migrants is in the same direction as the impact on migrant-sending households although lower in magnitude. If the effect on non-migrants goes in the opposite direction, the resulting effects will be overestimated. In subsection 5.1, I report differences before and after the travel ban was imposed, and provide some evidence showing both types of households exhibit a positive trend of labor endowment, while non-migrant-sending households experience no first order effects on remittances

Another assumption is that the travel ban has no direct effect on labor demand, but only

[13]Other indirect paths from X_{it} to endowments and remittances are ignored for simplicity as they also close once observable characteristics are controlled for in the econometric model.

through changes in endowments. For this reason, there is no path connecting the indicator variable Ban to L^d. This assumption is not fundamental to the estimation of the causal effects of the travel ban, as the indirect effect can be estimated econometrically. Later in the paper, I estimate this indirect effect as an additional robustness check.

If these assumptions hold, a difference-in-differences estimation approach allows me to identify the causal effects of changes in endowment caused by the travel ban on labor migration. These effects are captured by β_a and β_r. Unbiased estimates of these effects require that pre-ban households are indeed the appropriate counterfactual for migrant-sending households during the ban period. This is achieved if model selection and further assumptions close the remaining biasing path open by U_{it}.

4.4 Reduced-form estimation

First-order effects

I use a two-way fixed effect model to I study first-order effects of the travel ban on labor endowment and remittances. The purpose of this analysis is to determine how the labor migration restriction affected labor and income endowments, in the form of changes in working-age family members ($Endowment_{it}$) and foreign remittances inflows ($Remittances_{it}$) for household i and period t (i.e., data collection waves).

The main specification is described in equation 8. I include an interaction term capturing the potential exposure to the travel ban via the household migration status. The interaction $Migrant$ x Ban equals one for migrant-sending households during the ban period, zero otherwise. Under certain assumptions, this specification is equivalent to a generalized difference-in-differences estimation model (Wing et al., 2018). The model in 8 includes household's time-variant socioeconomic controls (X_{it}), household fixed effects (θ_i), wave-specific fixed effects (σ_t), and error term υ_{it}.

$$Endowment_{it} = \alpha_0 + \alpha_1 Migrant\ sending_{it} \text{x} Ban_t + \phi X_{it} + \theta_i + \sigma_t + \upsilon_{it} \tag{8}$$

The same estimation equation in 8 is used for the regression model for remittances. I use the value of cash and in-kind transfers from members who migrated abroad for work, as reported in the ESS. Moreover, I also use the value of domestic remittances (within Ethiopia), as a test to show that the travel ban effect on migrant-sending households affects endowments primarily through international migration.

Second-order effects

I first use the standard differences-in-difference approach to estimate the direct effect of the

travel ban on household input allocation. This reduce-form regression analysis include two sets of outcomes. I study effects on labor, including farm labor demand, as well as hired labor, off-farm labor supply, and their corresponding wage levels. The other set of outcomes includes non-labor inputs such as cultivated land, livestock, irrigation and fertilizer use.

I also follow the econometric approach in Dillon et al. (2019) to empirically estimate the expected effects suggested by the theoretical model. The estimating model in this specification relates indicator variables for positive and negative changes in labor endowment on changes in labor demand. I estimate differential effects by type of household to compare migrant-sending with non-migrant-sending households.

In addition, I estimate indirect effects on labor demand due to changes in labor endowment and remittances. Equation 9 describes the main specification, which relates an outcome variable y in household i, wave t, with household labor endowment, remittances and other characteristics. The main dependent variable is farm labor demand measured in person-days including all productive seasons (planting and harvesting). I also estimate models disaggregating the total labor demand into family labor and hired labor. Moreover, to study labor re-allocation between farming and non-farm labor labor, I also estimate effects on employment outside the farm during the last 12 months.

Similarly, I control for time-variant characteristics and household time-invariant unobservables using wave-specific (σ_t) and household-level (θ_i) fixed effects. I also include relevant time-variant household controls, X_{it}, including land and oxen herd size, and household composition (gender and elder shares). The error term, ϵ_{it}, is assumed to be i.i.d and not serially correlated over time.

$$\begin{aligned} L_{it}^{d} = \beta_0 &+ \beta_a \textit{Endowment}_{it} \times \textit{Migrant-sending}_{it} \times \textit{Ban}_t \\ &+ \beta_r \textit{Remittances}_{it} \times \textit{Migrant-sending}_{it} \times \textit{Ban}_t \\ &+ \Phi X_{it} + \Theta_i + \Sigma_t + \epsilon_{it} \end{aligned} \tag{9}$$

The parameters of interest are β_a and β_r. Each parameter capture four different effects on the outcome variable, one for each combination of indicator variables Ban and $Migrant-sending$, identifying the effects of labor endowment and remittances on migrant-sending households, before and after the travel ban was imposed.

5 Results: Change in endowments

In this section I document descriptive patterns in household socioeconomic characteristics, labor endowment and remittances. First, I report differences in socioeconomic and demo-

graphic characteristics between migrant and non-migrant-sending households. Given that migration decisions are endogenous, these characteristics are likely correlated with covariates and outcomes. Finally, I examine migration and labor dynamics over time, and comparing migrant and non-migrant-sending households. I then estimate reduced-form regression models to understand the relation of labor and migration decisions with the socioeconomic structure of the household.

In summary, descriptive results indicate that labor endowment increases while the inflow of foreign remittances decrease. These changes are particularly pronounced during the second wave, when the travel ban was imposed. However, not all these changes before and during the travel ban are statistically significant among migrant-sending households relative to non-migrant-sending counterpart.

5.1 Descriptive analysis

Table 2 reports the mean value for several household characteristics, and simple differences in means between migrant and non-migrant-sending households. Results show that these household are overall similar but differ in a few key characteristics. Migrant-sending households are larger and less educated. It is important to note that, while results show no mean differences in domestic remittances, migrant-sending households receive 40 times more foreign remittances than households with no migrant overseas.

I find no further differences in variables related to farming and assets used in production, such as land size, cultivated area, and herd size. Recent evidence in the literature suggests an important relationship between farming intensification and migration. Diop (2024) shows that an expansion of a input subsidy program in Zambia resulted in a combined effect of increased fertilizer use and higher internal migration. The differences in education levels may also reflect income differences, given that poorer households may be less able to afford schooling investments, which may drive out-migration.

Using the panel-structure of the data, I explore the dynamic household's migration and endowment over time. Figure 5 reports changes over time in household structure. Overall, 3.1% of all households report that at least a member traveled abroad for work. The percentage of migrant-sending households (Panel A) first decreases half percentage point from wave ESS1 and ESS2, to then return to similar levels at baseline during the last wave.

Changes in international migration are accompanied by an increase in labor endowment measured as the number of working-age household members net of migrants (Panel B). Migrant-sending households exhibit higher labor endowment out all waves, which coincides with mean differences in household size reported above. In the first two periods, both types

Table 2: Differences between migrant and non-migrant sending households

	Non-migrant (n=8334)	Migrant (n=270)	P-value
cultivated land (acres)	5.47	4.30	0.59
owned land (acres)	4.02	3.59	0.76
maize planted (acres)	0.61	0.64	0.30
number of oxen (#)	0.96	1.01	0.57
irrigated farm (yes=1)	0.11	0.10	0.80
fertilized farm (yes=1)	0.70	0.68	0.56
family size (#)	2.87	3.51	0.00
prime-age males (%)	0.22	0.21	0.48
eldery males (%)	0.08	0.09	0.12
education (HH head)	1.67	1.21	0.01
off-farm employment (yes=1)	0.10	0.11	0.42
domestic remittances (thsnd. ETB)	0.13	0.22	0.06
foreign remittances (thsnd. ETB)	0.12	4.80	0.00

Notes: This table was constructed using pooled data from the first three waves of the Ethiopia Socioeconomic Survey (ESS). The reported p-values are based on difference in mean tests comparing migrant-sending and non-migrant-sending households.

of households experience an increase in labor endowment, which includes phasing-in of 10 to 10 year old members into the household's labor endowment. Note that the increase in labor endowment is more pronounced for migrant-sending households. In the last wave, however, the migrant-sending households' trend flattens while for households with no migrants abroad the trend seems to increase at a similar pace. Non-migrant-sending households have half fewer members on average. By ESS-3, labor endowment seem to be converging between types of households but differences in endowment remain.

In addition, I observe changes in farm labor over time (Panel C). Migrant-sending household exhibit an increase in farm labor in ESS-2, followed by a decrease to slightly higher levels than at baseline. The trend for labor for non-migrant-sending households remains constant over time.[14] Overall, these results may suggest a differential responses to changes in endowment and labor endowment between these types of households. Some mechanisms for adjustment to these changes may include reallocating new members into off-farm labor. This reallocation is particularly relevant in ESS-2, when it is likely the most immediate and direct impact of the ban should have been experienced by households.

Figure 6 shows the changes of remittances inflows in Ethiopian BIRR over time and

[14]It is important to note that some of the data in ESS-2 is particularly noisy in this and other variables, which may reflect a greater dispersion in farming decisions as a consequence of the abrupt changes in household composition.

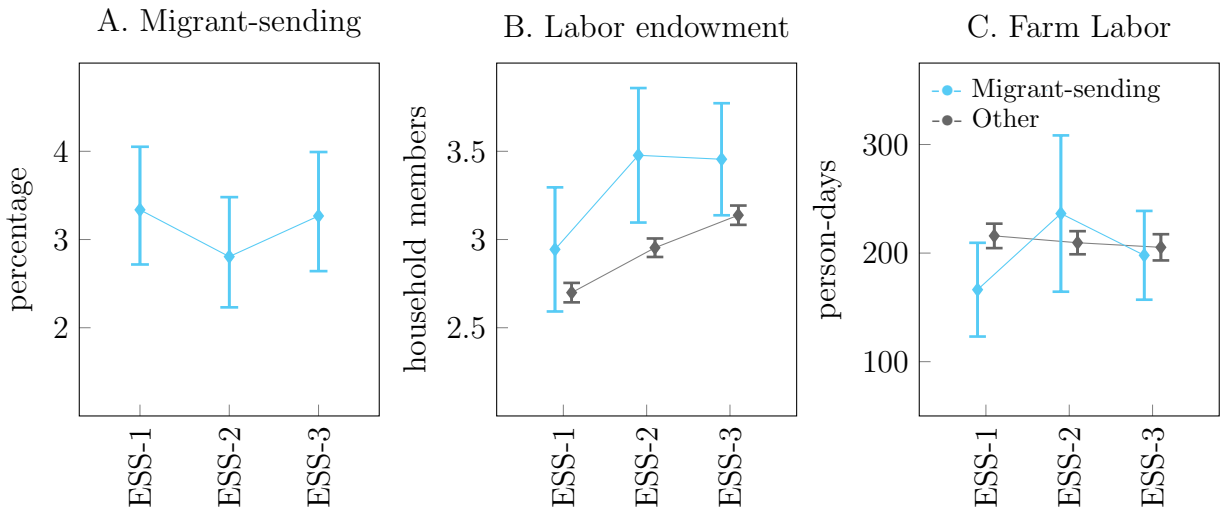

Figure 5: Migration and labor dynamics
Panel A reports the percentage of migrant-sending households across waves of data collection. Migrant-sending is defined a household having least a member who moved outside Ethiopia. Panel B shows the changes over time in household size defined as the number of working-age household members. Panel C reports the total farm labor in work-days in both production seasons (planting and harvesting).

by type of household. These descriptive statistics show that the mean value of domestic remittances (Panel A) is considerably lower than foreign remittances (Panel B). For reference, 1000 ETB (Ethiopian BIRR) roughly correspond to the average monthly wage of unskilled workers (Bachewe et al., 2020). While domestic remittances make a quarter of the average wage, foreign remittances can be equivalent to several months a worker's income.

In the case of domestic remittances, there is no statistical differences between migrant and non-migrant-sending households at baseline. In the second period, the value of domestic remittances sharply rise for migrant-sending households, which coincides with the implementation of the travel ban in 2013. Domestic remittances almost tripled in this wave for migrant-sending households, while remaining constant for non-migrant-sending households, making the difference between types of households statistically significant (t= -3.38, p<0.00). In last wave, the value of domestic remittances returns to similar levels to the baseline period and there is no longer significant differences between migrant-sending and other households.

On the other hand, foreign remittances tend to drastically decrease, halving each period over the three waves of data collection. This trend is consistent with the overall decline in aggregate remittances data reported earlier in the background section. At baseline, by definition, only migrant-sending households have foreign remittances. In subsequent periods, a small fraction of households report any foreign remittances. Some of these households reporting foreign remittances but no members working abroad may be households with

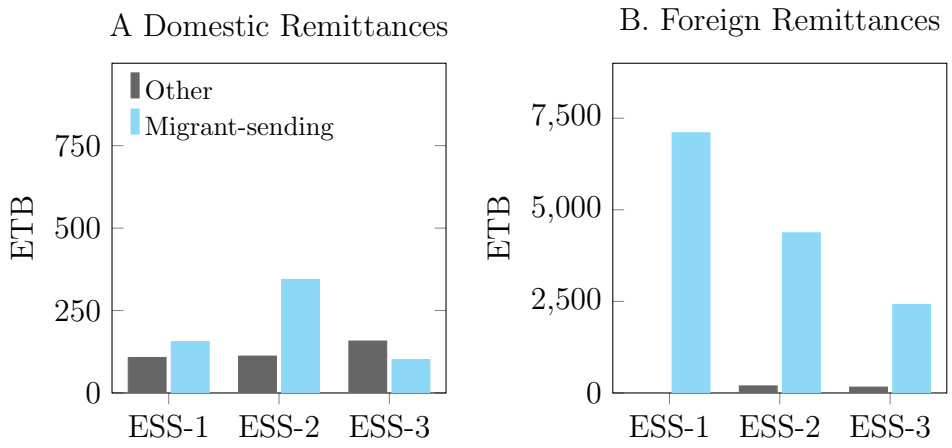

Figure 6: Remittances inflows over time
Remittances are defined as cash or in-kind transfers and gifts received during the previous 12 months. Panel A and B shows the average value of domestic remittances and those of foreign origin, respectively. Significance for difference in means tests between households with no members overseas and those that report at least one member traveling overseas: *** p<0.01, ** p<0.05, * p<0.1.

returnees that were expelled or voluntary returned to Ethiopia following the travel ban.

5.2 Reduce-form estimation

Table 3 reports coefficient estimates of the reduce-form regression model described in equation 8. This table include three separate specifications using labor endowment, foreign remittances and domestic remittances as dependent variables. All specifications include household-level controls controls such as farm size, oxen herd size, and household' gender and age composition. Similar results are obtained without controls (not reported here).

Table 3: Changes in labor endowment and remittances

	(1) Labor Endowment	(2) Foreign Remittances	(3) Domestic Remittances
Migrant-sending×Pre	0.21	6.27***	-0.04
	(0.15)	(1.95)	(0.07)
Migrant-sending×Post	0.62***	2.85***	0.09
	(0.14)	(0.63)	(0.10)
Post-Pre difference	0.41	-3.41	0.12
p-value	0.04	0.13	0.31
Non-migrant mean	2.92	0.235	125.78
Waves	3	3	3
Households	2937	2937	2937
Observations	8442	8442	8442
Adjusted R^2	0.29	0.10	0.05
Controls	yes	yes	yes
Wave fixed effects	yes	yes	yes
Household fixed effects	yes	yes	yes

Notes: Coefficients from linear regression models with household and wave-specific fixed effects. Controls include cultivated area, oxen herd size, share of male and female adults, and share of male elderly (>65 year old). Remittances vales are in thousands of Ethiopian BIRR. Clustered-robust standard errors at the household-wave level in parenthesis. Significance: *** p<0.01, ** p<0.05, * p<0.1.

Estimates in Table 3 confirm the descriptive results reported above. The coefficients for interaction variable *Migrant-sending* x *Ban* capture the difference between migrant-sending and non-migrant-sending households pre and post ban. In model 1, there is no difference in labor endowment at baseline between these types of households. This difference becomes significant in during the waves of data collection that coincide with the travel ban. Results suggest that labor endowment migrant-sending households rise an additional 0.41 members during the ban period relative to non-migrant-sending households. This pre to post ban difference among migrant-sending households is statistically different from zero (p=0.04).

In the case of remittances, regression estimates in column 2 show a reduction in more than half of foreign remittances. As expected, migrant-sending households exhibit 10 to 20 times higher foreign remittances than non-migrant-sending counterparts. Foreign remit-

tances decrease the equivalent of 3.5 monthly wages during the travel ban period (average wage of 1000 ETB). However, this pre-post difference in foreign remittances is again not statistically different form zero (p=0.13). Finally, coefficients in column 3 show that domestic remittances are no different between migrant and non-migrant-sending households in either period. These remittances increase during the ban period, but the difference is again not statistically significant.

Although there is no evidence that all these changes are consequence of the travel ban, as those directly affected by the ban is not observable in the data, these results are compelling indicators of the potential changes in income and labor endowment. A clear example is the decline in remittances over time. The changes in remittances observed in the sample coincide with the rapid reduction in aggregate remittances indicator mentioned earlier (see Panel C in Figure 1). We observe the opposite in the case of domestic remittances for the period when the ban was implemented. It is likely that migrants and returnees transferred considerable amounts of money and labor back to Ethiopia in response or anticipation of stricter migration regulations, many such transfers would be unreported or not classified as foreign remittances in the data.

6 Results: Input allocation

In this section, I report estimates for the overall direct effect of the travel ban on migrant-sending households. Using a simple difference in difference, I estimate how input allocation decisions of households with members working outside Ethiopia differ from non-migrant-sending households. Results show a clear positive effect on farm labor demand. To explain this result, I then estimate indirect effects via changes in labor endowment and remittances. Moreover, I investigate asymmetric responses to changes in endowments, exploring the differential impacts on migrant-sending households described in the theoretical model.

Table 4 reports coefficient estimates on farm labor demand and off-farm labor supply. Results shows that the travel ban had significant impacts on farm labor (column 1) but not in hired labor (column 2). This implies the ban affected the labor demand migrant-sending households via changes in family labor. The interaction for the total farm labor coefficient is 80.1 additional person-days of farm labor used by migrant-sending households relative to their non-migrant-sending counterparts. The coefficient for hired labor is negative, small and statistically insignificant, suggesting that both types of households hired relatively the same amount of labor during the travel ban period. Interestingly, I find a positive and significant effect on the wage level paid to hired labor used for farming (column 3).

Columns 4 and 5 in 4 show the estimated effects on off-farm labor and the corresponding

wage level. The interaction coefficient in both cases is negative and not statistically significant. Only 10% of households report off-farm employment of at least one member of the household, and the majority of those report non-farming employment.

Table 4: Travel Ban Impact: Labor

	(1) Farm Labor	(2) Hired Labor	(3) Hired Wage	(4) Off-farm Labor	(5) Off-farm Wage
Ban	-10.66	10.61***	-26.38***	-0.66**	1.90
	(8.06)	(4.03)	(7.09)	(0.33)	(0.87)
Migrant-sending	-66.67**	-1.96	-14.29	1.48	0.57
	(29.66)	(9.83)	(13.35)	(1.72)	(0.45)
Migrant-sending×Ban	80.68**	-0.24	54.26***	-0.47	-0.86
	(37.82)	(9.73)	(20.21)	(1.68)	(0.73)
Constant	184.93***	14.97**	71.67***	2.76***	5.38***
	(16.04)	(7.52)	(16.29)	(0.63)	(2.01)
Control mean at baseline	215.84	18.25	43.45	3.08	2.37
R^2	0.53	0.55	0.39	0.53	0.34
Waves	3	3	3	3	3
Households	2937	2937	2937	2937	2937
Observations	8442	8442	8442	8442	8442
Controls	yes	yes	yes	yes	yes
Wave fixed effects	yes	yes	yes	yes	yes
Household fixed effects	yes	yes	yes	yes	yes

Notes: Coefficients from linear regression models with household and wave-specific fixed effects. Controls include cultivated share of male and female adults, and share of male elderly (>65 year old). Clustered-robust standard errors at the household-wave level in parenthesis. Significance: *** p<0.01, ** p<0.05, * p<0.1.

Table 5: Travel Ban Impact: Other farming inputs

	(1) Cultivated Area	(2) Oxen	(3) Irrigated Farm	(4) Fertilized Farm
Ban	-0.16	0.05**	-0.00	0.03***
	(1.15)	(0.02)	(0.01)	(0.01)
Migrant-sending	0.68	0.04	-0.04	0.06*
	(1.30)	(0.08)	(0.03)	(0.04)
Migrant-sending×Ban	0.60	-0.18*	0.03	-0.07
	(1.96)	(0.10)	(0.03)	(0.04)
Constant	2.06	0.93***	0.09***	0.69***
	(2.31)	(0.05)	(0.01)	(0.02)
Control mean at baseline	6.08	0.95	0.11	0.67
R-squared	0.34	0.75	0.66	0.69
Waves	3	3	3	3
Households	2937	2937	2937	2937
Observations	8442	8442	8442	8442
Controls	yes	yes	yes	yes
Wave fixed effects	yes	yes	yes	yes
Household fixed effects	yes	yes	yes	yes

Notes: Coefficients from linear regression models with household and wave-specific fixed effects. Controls include cultivated share of male and female adults, and share of male elderly (>65 year old). Clustered-robust standard errors at the household-wave level in parenthesis. Significance: *** p<0.01, ** p<0.05, * p<0.1.

Estimates in 5 report the estimated effects on non-labor farming inputs. These estimates show null results in cultivated area and the extensive margin of irrigation and fertilizer use. The only significant effect is on oxen heard size, suggesting that in the ban period migrant-sending households reduce their holdings of oxen, which is an important capital asset among agro-pastoral communities. A possible explanation for this result is that remittances that would have been used as a form of capital to purchase oxen was no longer available once the ban was imposed. This can also relate to the null effects on cultivated land, as oxen and land may be a more flexible substitute input. Land availability may be fix in the short term, so farmers adjust via more flexible inputs such as livestock holdings.

6.1 Labor demand

I investigate further how changes in endowments and remittances affect farm labor demand. The subsection below reports second-order effects on farm labor demand. First, I focus on how the effect of endowments on labor demand varies between migrant-sending and non-migrant-sending households. I use the total labor demanded by the family farm measured in person-days. Other estimates dissagregated by family labor and hired labor are included in the appendix.

Results in 6 report elasticities of labor endowment and remittances. These elasticities capture changes in labor endowment affect labor demand. Results in column 1 show an labor endowment elasticity of 0.46, which is significant for all households pooled. I also find that the elasticizes for any type of remittances are virtually zero in all model specifications.

Results in columns 2 and 3 of table 6 reproduce the model specification in Dillon et al. (2019), which is employed here to estimate differential effects by type of household. Estimates in column 2 confirm the results in Dillon et al. (2019), showing a significant elasticity only for negative changes in labor endowment. This asymmetric response to changes in endowment indicate that households experience a rationed labor supply. As a result, the optimal labor demand is higher than what households are able to supply to the farm.

Table 6: Asymmetric responses to change in endowments

	(1) Δ Log of farm labor	(2) Δ Log of farm labor	(3) Δ Log of Farm labor
Δ Log of labor endowment	0.46**		
	(0.21)		
Δ^- Log of labor endowment		0.48**	
		(0.207)	
Δ^- Log of labor endowment×Non-migrant			0.42**
			(0.21)
Δ^- Log of labor endowment×Migrant-sending			2.90**
			(1.13)
Δ^+ Log of labor endowment		0.16	
		(0.17)	
Δ^+ Log of labor endowment×Non-migrant			0.12
			(0.17)
Δ^+ Log of labor endowment×Migrant-sending			2.50**
			(1.14)
Δ Log of foreign remittances	-0.01	0.00	0.00
	(0.05)	(0.06)	(0.06)
Δ Log of domestic remittances	-0.02	-0.02	-0.02
	(0.03)	(0.02)	(0.02)
Waves	2	2	2
Households	2758	2758	2758
Observations	5399	5399	5399
R^2	0.38	0.38	0.28
Controls	yes	yes	yes
Wave fixed effects	yes	yes	yes
Household fixed effects	yes	yes	yes

Notes: Coefficients from linear regression models with household and wave-specific fixed effects. Controls include cultivated area, oxen herd size, share of male and female adults, and share of male elderly (>65 year old). Remittances vales are in thousands of Ethiopian BIRR. Clustered-robust standard errors at the household-wave level in parenthesis. Significance: *** p<0.01, ** p<0.05, * p<0.1.

The estimated elasticites for non-migrant-sending follow the same pattern of asymmetric non-separation suggesting excess labor demand. However, for migrant-sending households both elasticizes, for positive and negative changes in endowment, are statistically significant.

They are also suggest a stronger degree of non-separation, as the magnitude is considerably larger than for non-migrant-sending households.

I further explore how changes in endowments caused by the travel ban relate to households technology decisions on labor allocation. Table 7 shows coefficient estimates of labor endowment on farm labor demand, as described by the model specification in equation (9). The first column shows a positive and significant overall effect of endowment on labor demand. An endowment increase of one worker is associated with an increase of 19 person-days in labor demand, or about 9% of the average labor demand. The model in the second column reports estimates by type of household, suggesting that the labor endowment effect on migrant-sending households is almost twice of that of non-sending-migrants, although this difference is not statistically significant (t=1.59, p=0.21).

Dissagreated results by family and hired labor in appendix table B4 suggest that these endowment effects are driven by family labor. Coefficients on family labor are slightly lower but qualitatively similar, in magnitude and direction, as for the total farm labor. On the contrary, there is no statistically significant estimates for hired labor, which represents about 1/9 of average labor demand.

The last two columns of table 7 reports the coefficient estimates of labor endowment by type of household before and during the travel ban periods. Although the magnitude of the endowment effect is slightly lower after the ban for households with no migrants abroad, coefficient estimates are statistically the same in pre and post ban period, both positive and significant. These effects are an indication that the separation principle fails.

Table 7: Endowment Effects on Labor Demand

	(1) Farm labor	(2) Farm labor	(3) Farm labor	(4) Farm labor
Labor Endowment	20.10***			
	(6.69)			
Labor Endowment×Non-migrant		19.01***		
		(6.78)		
Labor Endowment×Non-migrant×Pre			25.77***	
			(8.66)	
Labor Endowment×Non-migrant×Post			16.81**	
			(6.80)	
Labor Endowment×Non-migrant×Ban				-8.95
				(6.32)
Labor Endowment×Migrant-sending		34.65***		
		(12.98)		
Labor Endowment×Migrant-sending×Pre			-12.10	
			(20.05)	
Labor Endowment×Migrant-sending×Post			46.66***	
			(14.42)	
Labor Endowment×Migrant-sending×Ban				57.62**
				(24.98)
Dependent variable mean	209.91	209.91	209.91	209.91
Num. waves	3	3	3	3
Num. households	2937	2937	2937	2937
Num. observations	8442	8442	8442	8442
Adjusted R^2	0.28	0.28	0.28	0.28
Controls	yes	yes	yes	yes
Wave fixed effects	yes	yes	yes	yes
Household fixed effects	yes	yes	yes	yes

Notes: Coefficients from linear regression models with household and wave-specific fixed effects. Farm labor refers to the total person-day used in farming during the production season (planting and harvest). Controls include cultivated area, oxen herd size, share of male and female adults, and share of male elderly (>65 year old). Clustered-robust standard errors at the household-wave level in parenthesis. Significance: *** p<0.01, ** p<0.05, * p<0.1.

For migrant-sending households, conversely, the effect is negative and not statistically different from zero for the baseline period, suggesting that endowment had no effect on labor demand before the travel ban was imposed. After the ban, when there was a significant

increase in labor endowment as reported earlier, there is a strong and significant endowment effect. The travel ban could have caused migrant-sending households to experience a different type labor rationing, as they may have not been able to adjust to the labor endowment shock produced by the travel restriction on migrant workers.

Table B5 in the appendix reports the results of remittances on labor demand. In this case, I focus on foreign remittances and their effects on farm labor before and after the ban was imposed. I do not report estimates by type of household given there is no foreign remittances for non-migrant-sending households at baseline. Results show that overall effect reported in column 1 is not statistically different from zero. The coefficient estimate is significant for the pre travel ban period, indicating that, at baseline, an increase in one thousand ETB in foreign remittances is associated 0.7 percentage points lower labor demand. The interaction coefficient for remittances during the travel ban period is positive but not significant. Similarly, there is no effect of domestic remittances in any specification.

7 Discussion

Government policy has been identified as the main deterrent for international labor flows (Hanson, 2009; Mayda, 2009). Travel restrictions imposed by developed countries aim to reduce the inflow of workers from under-developed economies. These restrictions on international travel also reduce the flow of capital to the developing world in the form of remittances, which could otherwise increase consumption, provide a form of insurance to migrant-sending households, and raise investment in education (Yang, 2008; Taylor, 2001).

Using the case of the travel ban on migrant workers in Ethiopia, this study provides important insights into the effects of migration-related labor shocks on rural households in Ethiopia. By examining a policy change in Ethiopia, I am able to analyze how changes in labor endowments and remittances impact agricultural production decisions. The findings reveal significant adjustments in farm labor demand, particularly for family labor, among migrant-sending households following the ban. This suggests that international migration serves as an adjustment mechanism for agricultural households.

The asymmetric responses observed between migrant-sending and non-migrant-sending households highlight the complex dynamics at play in rural labor markets. While both groups exhibit signs of non-separation between production and consumption decisions, the stronger degree of non-separation among migrant-sending households points to the unique challenges they face in reallocating resources.

Together, these results show that restrictions on international migration can have substantial ripple effects on rural economies. However, further research is needed. Recent

reports highlight the negative impacts on returnee migrants to Ethiopia, as well as a disproportionate increase in female migrants after the ban (Ademe Ayalew and Mohanty, 2022). Additionally, some effects of the COVID-19 pandemic and government responses replicated the policy strategy of the travel ban: restrictions on migrant workers and deportations led to mass waves of returnee migrants. No systematic evaluation of these responses has been conducted, so this paper provides some of the first evidence of the impact of these types of restrictions on labor conditions using micro-level data.

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Appendix

A. Data and measurement

Survey data from the Ethiopia Socioeconomic Survey was used to create the following variables. This survey was conducted and implemented in partnership between the Ethiopian Statistical Service and Living Standards Measurement Study at the World Bank.

Outcome variables

- *Farm Labor Demand:* the total farm labor invested by a household and measured in person-day. Labor demand includes own family labor and hired farm labor individually. It is computed aggregating the the number days that each working-age member of the household works across all plots in the farm.
- *Family Labor:* Same as Farm Labor Demand but only including person-days of work of members of the household.
- *Hired Labor:* Same as Farm Labor Demand but only including person-days of work of hired workers who are not members of the household.
- *Hired wage:* amount of money paid in Ethiopian BIRR per person-day to hired labor.
- *Off-farm employment:* a binary variable to identify whether someone in the household is employed outside the family farm, as defined in the survey, in the past 12 months.
- *Off-farm labor:* the quantity of off-farm employment. This variable was computed calculating the average number of hours worked per worker-week in the past 12 months.
- *Off-farm wage:* the monthly wage paid for the reported off-farm labor.
- *Cultivated Land:* acres of land cultivated in the production season prior to the data collection.
- *Oxen:* number of oxen own by the household, as reported in the data.
- *Irrigated farm:* a binary variable indicating whether the farm has an irrigation system in place, as defined in the survey.
- *Fertilized farm:* a binary variable indicating whether the farm uses any type of fertilizer, as defined in the survey.

Explanatory variables

- *Migrant-Sending Household:* a household that report having at least one member who traveled outside Ethiopia to work in the past 12 months. Members who traveled for work is only reported in waves ESS2 and ESS3. For ESS1, migrant-sending households are defined as those who receive any positive amount of foreign remittances, regardless of the source.

- *Labor Endowment:* I follow Dillon et al. (2019) to calculate household' size as the total number of household members. Endowment includes the phasing-in of children coming to working age (older than 10 year), contributing 1/5 for each extra year from ages 11 to 15. So, teenagers 15 and older count the same as working adults. The endowment variable also takes into account whether a member has been absent in the previous 12 months prior the survey, such that persons is discounted 1/12 times the number of months not present in the household. Thus, a person absent for twelve months or more does not contribute to the labor endowment of the household. The average endowment in the sample is 2.6 persons, ranging from 0 (households where all members left in a given wave, about 2.2% of the sample) to 10 household members.

- *Foreign Remittances:* the value of cash and in-kind transfers from relative and friends outside Ethiopia to the household, as reported in the data.

- *Domestic Remittances:* the value of cash and in-kind transfers from relative and friends within Ethiopia to the household, as reported in the data.

B. Appendix Tables

Table B1: Summary Statistics

	Mean	S.D.	Min	Max	Obs.
Planting: Hired farm labor	15.97	138.46	0.0	2994.0	8343
Harvest: Hired farm labor	7.53	40.50	0.0	679.0	8343
Planting: Own farm labor	139.00	348.44	0.0	7170.0	8343
Harvest: Own farm labor	82.73	120.77	0.0	1469.0	8343
Planting: hiring wage (ETB)	23.64	120.28	0.0	1932.0	8343
Harvest: hiring wage (ETB)	26.13	120.36	0.0	1840.0	8343
Household labor endowment	2.66	1.33	0.0	10.0	8343
Distance to border crossing (kms)	252.45	107.92	13.0	500.8	8343
Farm size (acres)	5.32	31.79	0.0	981.0	8343
Herd size (# animals)	0.98	1.21	0.0	25.0	8343
Prime male share	0.23	0.17	0.0	1.0	8343
Prime female share	0.26	0.17	0.0	1.0	8343
Elderly male share	0.06	0.13	0.0	1.0	8343

Notes: The table reports summary statistics for the sample of 2871 households and three waves of data collection (N=8343). All farm labor variables (own/hired and planting/harvest) are measured in persons-days units. Hiring wage variables are in Ehiopian BIRR (ETB). Labor endowment is measured in number of household members, phasing in of persons away from home and children aging. Household gender and elder composition are in percentages out of the total of household members.

Table B2: Dillon *et al.* (2019) Replication results

	Farm labor (person-days)			
	(1)	(2)	(3)	(4)
Labor endowment (E)	0.575***	0.502***		
	(0.050)	(0.042)		
Change in endowment (ΔE)			0.600***	0.531***
			(0.150)	(0.099)
Observations	5535	8326	2767	5557
Planting x ΔE	0.459***	0.431***		
	(0.165)	(0.108)		
Planting x ΔE^+			0.152	0.236
			(0.243)	(0.170)
Planting x ΔE^-			0.702***	0.611***
			(0.256)	(0.166)
Harvest x ΔE	0.444***	0.253**		
	(0.009)	(0.026)		
Harvest x ΔE^+			0.212	0.070
			(0.416)	(0.704)
Harvest x ΔE^-			0.626**	0.422**
			(0.027)	(0.019)
Observations	5534	11116	5534	11116
ESS waves	2	3	2	3

Table B3: Pre-treatment period differences in outcomes

	Non-migrant (n=2939)	Migrant (n=98)	P-value
cultivated land (acres)	6.08	4.18	0.60
number of oxen (#)	0.95	0.90	0.68
fertilized farm (yes=1)	0.67	0.65	0.68
irrigated farm (yes=1)	0.11	0.08	0.36
labor (person-days)	215.84	166.30	0.11
family Labor (person-days)	197.58	159.06	0.17
hired labor (person-days)	18.25	7.24	0.33
non-farm employment (yes=1)	0.11	0.15	0.21
off-farm labor (yes=1)	3.08	5.09	0.16
hired wage	43.45	27.39	0.59
off-farm wage	2367.80	2690.86	0.74

Notes: This table reports differences between migrant-sending and non-migrant-sending households at baseline (ESS1). The estimated p-values are from differences in means.

Table B4: Effects on Family and Hired Labor

	(1) Family labor	(2) Family labor	(3) Hired labor	(4) Hired labor
Labor Endowment	16.94***		2.08	
	(0.62)		(3.38)	
Labor Endowment×Non-migrant		15.90***		2.00
		(5.35)		(3.46)
Labor Endowment×Migrant-sending		32.64		3.20
		(11.95)		(2.90)
Foreign Remittances	-1.18*		0.00	
	(0.62)		(0.10)	
Foreign Remittances×Non-migrant		-2.37**		-0.21
		(1.14)		(0.16)
Foreign Remittances×Migrant-sending		-0.737		0.08
		(0.75)		(0.90)
Domestic Remittances	6.08	6.00	2.75	2.75
	(3.85)	(3.86)	(4.23)	(4.23)
Dependent variable mean	186.70	186.70	23.21	23.21
Num. waves	3	3	3	3
Num. households	2937	2937	2937	2937
Num. observations	8604	8604	8604	8604
Adjusted R^2	0.28	0.28	0.32	0.32
Controls	yes	yes	yes	yes
Wave fixed effects	yes	yes	yes	yes
Household fixed effects	yes	yes	yes	yes

Notes: Coefficients from linear regression models with household and wave-specific fixed effects. Controls include cultivated area, oxen herd size, share of male and female adults, and share of male elderly (>65 year old). Clustered-robust standard errors at the household-wave level in parenthesis. Significance: *** p<0.01, ** p<0.05, * p<0.1.

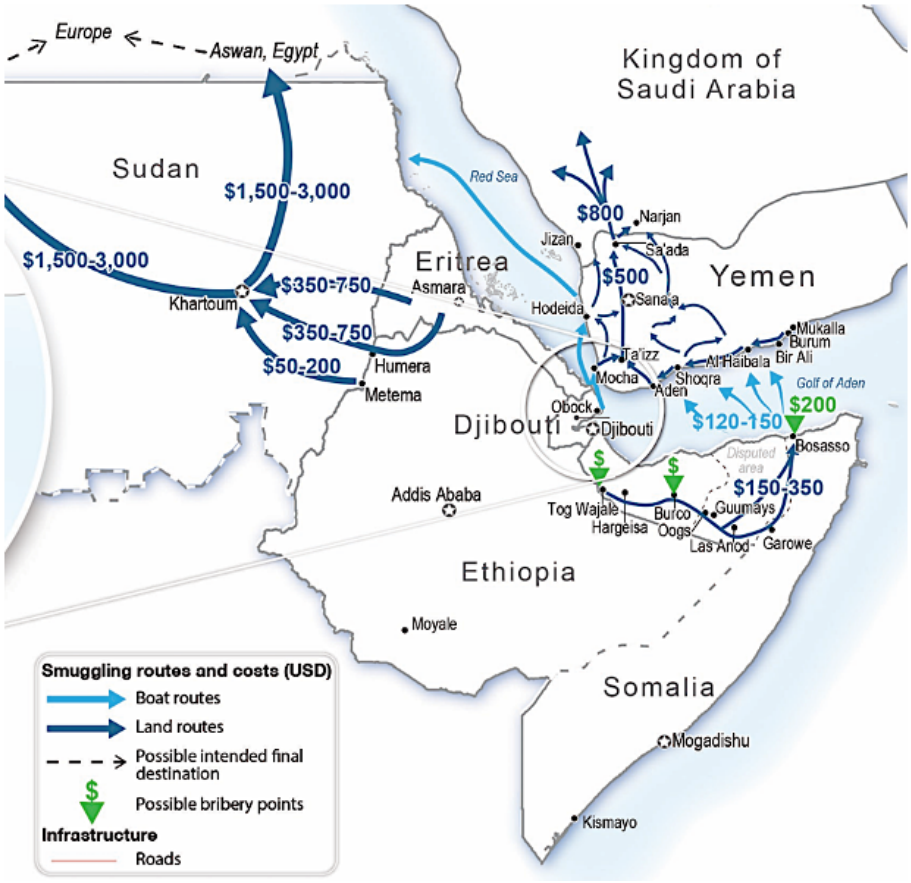
Table B5: Remittances Effects on Labor Demand

	(1) Farm labor	(2) Farm labor	(3) Farm labor
Foreign Remittances	-0.96		
	(0.73)		
Foreign Remittances×Pre		-1.38**	
		(0.57)	
Foreign Remittances×Post		1.34	
		(3.22)	
Foreign Remittances×Ban			2.72
			(3.27)
Domestic Remittances	9.54	8.94	8.94
	(5.89)	(5.90)	(5.90)
Dependent variable mean	209.91	209.91	209.91
Num. waves	3	3	3
Num. households	2937	2937	2937
Num. observations	8442	8442	8442
Adjusted R^2	0.28	0.28	0.28
Controls	yes	yes	yes
Wave fixed effects	yes	yes	yes
Household fixed effects	yes	yes	yes

Notes: Coefficients from linear regression models with household and wave-specific fixed effects. Remittances values in thousands of Ethiopian BIRR. Controls include cultivated area, oxen herd size, share of male and female adults, and share of male elderly (>65 year old). Clustered-robust standard errors at the household-wave level in parenthesis. Significance: *** p<0.01, ** p<0.05, * p<0.1.

C. Appendix Figures

Figure C1: Migration routes and journey costs



Notes: Figure from the UN Migration Agency – International Migration Organization. The figure report estimates based on 2017-2018 data on journey costs, corridors, and migration routes in Ethiopia.

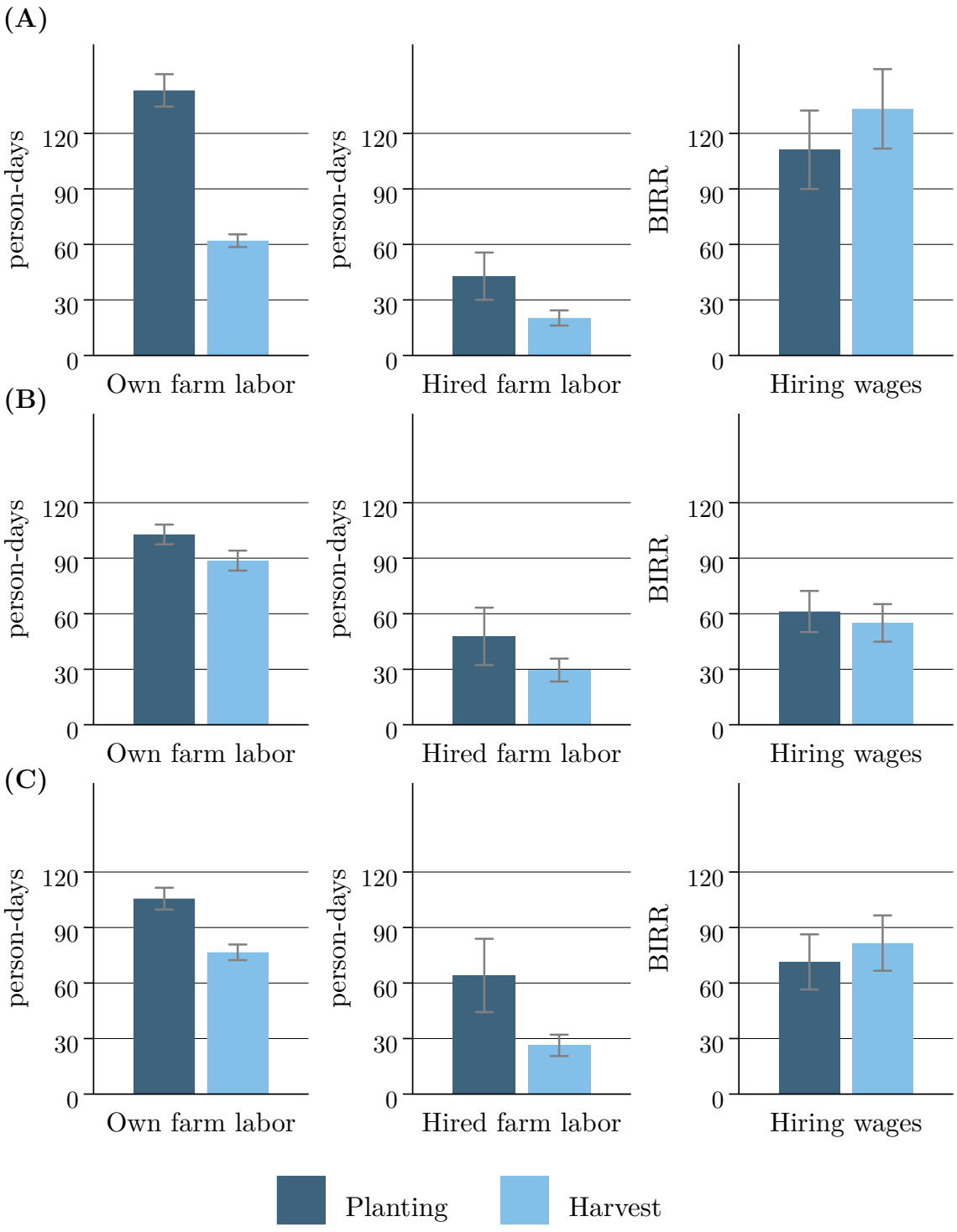


Figure C2: Seasonal dynamics in farm labor and wages per ESS wave
This figure shows the average labor demand per period for households with non-zero values for each variable. Panel (A) shows data from the first wave of the ESS data collection, ESS-1, (B) ESS-2, and (C) ESS-3.Each period includes several agricultural activities related to pre-planting and planting, and harvest and post-harvest. Labor demand measures the total number of days per person the household invested in each period, and it is disaggregated into own and hired labor demanded in each period. Wages are in Ethiopian BIRR (ETB) per day of work payed for work in the household's plots.