Effect of Price Risk on Migration: Evidence from Ethiopian Rural Households

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(Preliminary and incomplete—Please do not cite without author's permission.)

Selected Paper prepared for presentation at the 2015 Agricultural & Applied Economics Association and Western Agricultural Economics Association Annual Meeting, San Francisco, CA, July 26-28

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Abstract:
This paper examines the relationship between household risk preferences towards agricultural commodity prices and out-migration from rural households using the Ethiopian Rural Households Survey (ERHS). Based on panel regression results with district fixed effects, household willingness-to-pay (WTP) to stabilize the prices of seven major agricultural commodities has a significant and positive impact on out-migration in Ethiopian rural households. The paper also finds that higher volatility of coffee and maize prices have a significant relationship with out-migration of net sellers selling coffee and maize.

Keywords: price risk, risk and uncertainty, development, migration
JEL code: O1, D1, D8, Q12

1. Introduction and Background

"*The effects of price risk may be severe enough to induce farmers to quit the farm and to look for alternative income sources. For example, peasants might choose to migrate from rural areas to urban areas to sell their labor services*."

- Finkenshtain and Chalfant (1991), pp. 564

The percentage of population living in urban areas has shown a steady increase in developing countries from 17% in 1950 to 45% in 2000 (Lucas, 1997). Rural-to-urban migration is an important phenomenon in understanding a number of policy issues such as food security, poverty, and unemployment. Determinants of internal migration from rural to urban areas have long been studied. Harris and Todaro (1970) established a model which shows that higher expected income in urban areas explains the accelerating rural-to-urban migration in spite of high unemployment rate in urban areas. According to Katz and Stark (1986), even though expected income is not larger in urban areas than in rural areas, income risk aversion can explain the rural-to-urban labor migration. After Katz and Stark (1986), the relationship between the income risk attitudes and migration has been explored by a number of studies. Recently, Jaeger *et al*. (2010) found that individuals who are willing to take risks tend to migrate between labor markets in Germany. Caruthers (2013) found that household risk attitude affect migration destination decisions. These studies indicate that migration is taken as a risk management strategy to manage risk towards income.

Note that an individual's welfare could be expressed in terms of an indirect utility function $V(p, y)$, where the individual's maximized utility depends on both price (p) as well as income (y). Most of the economic studies on risk and uncertainty – including the ones focusing on the relationship between risk and migration – have focused on the welfare impacts of volatility in income, and relatively fewer studies have focused on the welfare impacts of volatility in price. Especially, to fully understand the rural-to-urban labor migration in developing countries, it is important to understand the impact of *agricultural commodity price risk* as well as income risk given the following two reasons: First, agriculture constitutes to a substantial part of economic activities in developing countries. On the production side, shares of agriculture in GDP in developing countries

are more than a double of the shares in developed countries (World Bank, 2014) and especially in Africa, a higher share of population depends on agriculture for its living than in any other region (Minot, 2011). On the consumption side, the budget share of food is much higher in developing countries than in developed countries.[1] Second, the issue of food price volatility and policies to decrease food price volatility[2] have been important topics for policy discussions in a number of developing countries,[3] especially after the global food crisis of 2007-08 and the sharp increase of food prices in 2010. Recent papers by Bellemare *et al.* (2013) and Bellemare (2014) empirically studies the welfare impacts of food price stabilization policies. However, the relationship between the food price volatility and migration behavior remains unexplored.

Given the importance of understanding the issue of food price volatility in developing countries, a prediction on peasant behavior in Finkelshtain and Chalfant (1991) provides a starting point of the investigation done in this paper: They established a theory on peasant's attitudes towards price risk which induces long-run exit decisions from agriculture. According to their theory, when commodity price risk is so severe, farmers may quit farming and migrate from rural to urban areas. To the best of my knowledge, no study has addressed the relationship between the commodity price volatility and rural-to-urban migration behavior.

This paper aims to provide an empirical study that addresses the role of individual attitudes towards commodity price risk that have been ignored by previous literature on determinants of rural-to-urban migration. The main research questions to be addressed in this study are the following: (i) Do household risk attitudes towards commodity prices affect migration decision? (ii) Does high degree of commodity price risk drive migration out of the rural areas? The former question focuses on the role of individual price risk preferences, whereas the latter focuses on the impact of overall degree of price risk in the

[1] In countries such as Egypt, Malawi, Mozambique, Peru, and Nepal, shares of household expenditure on food in urban areas range from 37% to 69%. For all these countries the shares are even higher in rural areas (Table 3 on Page 39. FAO, 2004). However, the share is around 10% in the U.S. (USDA ERS, 2014), and ranges from 13% to 20% in OECD countries (OECD-FAO, 2008) for the similar time period.

[2] For convenience, hereafter I will use the terms "volatility," "fluctuation," "risk," and "uncertainty" interchangeably for variability of prices over time. Also, I will use "price" to mean either producer, wholesale, or consumer price. Also, I focus mainly on staple food prices.

[3] In Southeast Asia, Bangladesh, India, Afghanistan, and Sri Lanka used economic measures such as price control or trade policy (World Bank, 2010). In Africa where food price fluctuation is more severe, Zambia and Malawi have taken the most aggressive measure to stabilize food prices (Chapoto and Jayne, 2009).

aggregate level (In this paper, commodity prices are defined in district-level), which will serve as two different ways of examining the relationship between commodity price risk and migration.

In order to answer these research questions, I focus on rural households of Ethiopia by looking at the Ethiopian Rural Households Survey (ERHS). Ethiopia is an interesting and important country to study, because Ethiopia is one of the lowest urbanized countries worldwide, with about 15% of the population living in urban areas in 2000 (Rahmato et al., 2013). There has been a consistent increase in the proportion of population living in urban areas, and the rate of urbanization is expected to increase further in the future. Given the low fertility rate in urban areas, migration has been a major factor explaining urbanization in Ethiopia. Therefore, understanding what drives out-migration from rural areas in Ethiopia could shed a light on developing the future policies on rural and urban development in Ethiopia. This is also important to the issue of food security. Economic activities in Ethiopia, as in the cases of other developing countries in Africa, largely depends upon agriculture – agriculture accounts for 41% of the GDP and 80% of labor force employment – and agriculture in rural Ethiopia is mostly subsistence farming (Brown, 2008). Also, high price volatility for cash crops and staple grains has been difficult for poor farmers. If farmers migrate from rural areas due to high commodity price volatility, its impact on the supply and demand of crops may worsen the food security in rural areas.

The paper proceeds as follows: The next section explains the theoretical framework, followed by a description of data. Then, the empirical framework is laid out and the results from analysis are presented and discussed.

2. Theoretical Framework

2.1 Theory on Welfare Impacts of Price Risk

Earlier economic studies on the welfare impacts of price risk developed theories on the behavior of (income) risk-averse producers and consumers facing price uncertainty. Sandmo (1971), assuming income risk averse producers, predicted that producers would produce less than the optimal output under price certainty. Turnovsky et al. (1980) looked

at the behavior of income risk-averse consumers. More recently, studies on price risk and uncertainty have combined both approaches to develop the agricultural households model, which assumes that a producer of agricultural commodities can be both producers and consumers of the same commodity. Finkelshtain and Chalfant (1991) assume that an agricultural household faces uncertainty about both income and the prices of the commodities, and suggest a measure of risk premium which combines the Pratt's traditional measure of income risk premium (Pratt, 1964) and an additional term associated with the stochastic interaction between income and the prices. The proposition 3 of their paper predicts that, if a farmer is risk-averse in terms of this alternative measure of risk-aversion (which incorporates the impacts of both the income uncertainty and price uncertainty), then he may exit from farming even if the average cost is smaller than expected price (p. 564, Finkelshtain and Chalfant, 1991) – i.e., *producer's high risk aversion towards prices may cause migration out of rural area*. Katz and Stark (1996) suggested that income risk aversion in the Arrow-Pratt sense can serve as an explanation for migration from rural to urban areas that are occurring in developing countries even when the expected income is lower in the urban than in rural areas. If the prediction by Finkelshtain and Chalfant (1991) is correct, then farmers' *price risk preference* could serve as an alternative explanation to the rural-to-urban migration in developing countries that we observe.

2.2 Willingness-to-Pay for Price Stabilization

This section borrows heavily from the theory developed in Barrett (1996) and Bellemare et al. (2013). Recent studies have focused on connecting the classical theories on attitudes towards price risk into the empirics. Barrett (1996), based on the agricultural household framework, developed an estimable coefficient of price risk aversion for a single commodity. The theory starts from assuming that household maximizes utility over consumption subject to a budget constraint an uncertain price that will be realized in the next time period. Thus, the expected indirect utility function can be expressed as *EV (p, y)*, where *E* and *p* are the expectation operator and a vector of uncertain prices, respectively. In the standard theory on income risk and uncertainty, $-\frac{V_{yy}}{V_y}$ is the Arrow-

Pratt coefficient of absolute income risk aversion, where V_y and $V_{yy}$are the first and the second derivatives, respectively, of the indirect utility function with respect to income. This is widely used as a measure of the welfare impact of income risk, or the risk attitudes towards income. Likewise, $-\frac{V_{pp}}{V_y}$, where V_{pp} is the second derivative of the indirect utility function with respect to the price can serve as a measure of the welfare impact of price risk. This is the coefficient of absolute price risk aversion developed by Barrett (1996).

Bellemare et al. (2013) extended this framework into a case of multiple commodities. Instead of facing an uncertain price for a single commodity, an agricultural household now faces a vector of *k* uncertain prices with respect to *k* agricultural commodities. Extending this concept of the coefficient of absolute price risk aversion into *k*-commodities yields a matrix A of price risk aversion coefficients, defined as:

$$A = -\frac{V_{pp}}{V_y} = -\frac{V_{pp}}{V_y} \cdot \begin{bmatrix} V_{p_1 p_1} & \cdots & V_{p_1 p_k} \\ \vdots & \ddots & \vdots \\ V_{p_k p_1} & \cdots & V_{p_k p_k} \end{bmatrix}$$

$$= \begin{bmatrix} A_{11} & \cdots & A_{1k} \\ \vdots & \ddots & \vdots \\ A_{k1} & \cdots & A_{kk} \end{bmatrix} \qquad (1)$$

And, each *ij*-element of this matrix can be estimated based on the following form:

$$A_{ij} = -\frac{M_i}{P_j}[\beta_j(\eta_j - R) + \varepsilon_{ij}] \qquad (2)$$

Where M_i is the marketable surplus of commodity *i*, which is equal to the amount of commodity *i* sold minus the amount of commodity *i* consumed. P_j is the price of commodity *j*, β_j is the share of the marketable surplus of commodity *j*, therefore, is equal to $\frac{P_j M_j}{y}$. η_j is the income elasticity of marketable surplus of commodity *j*, *R* is the Arrow-

Pratt coefficient of relative risk aversion of the household, and ε_{ij} is the cross-price elasticity of the marketable surplus of commodity i with respect to the price of commodity j. The diagonal elements A_{ii}> (=, or <) 0 means that the household's welfare is decreasing (unaffected by, or increasing) in the volatility of the price of i. Bellemare et al. (2013) then estimated the matrix A_{ij} for the seven major commodities in rural Ethiopia – coffee, maize, beans, barley, wheat, teff, and sorghum. In order to make the estimation feasible, they assumed that R is equal to 2 for all the households.

In order to conveniently measure the welfare impacts of stabilizing the prices of several commodities, Bellemare et al. (2013) developed and estimated the willingness-to-pay (WTP) to stabilize commodity prices, which is defined as follows:

$$[\mathrm{V}(\mathrm{E}(\mathrm{p}), \mathrm{y} - \mathrm{WTP})] = E[V(p, y)] \quad (3)$$

I.e., WTP is the amount that a household is willing to pay in order to eliminate all price risk so that all the prices of the seven major commodities are set to be equal to their expected values. Using a second-order Taylor series expansions, they show that:

$$WTP = \frac{1}{2}[\sum_{j=1}^{k} \sum_{i=1}^{k} A_{ij}] \quad (4)$$

Where A_{ij} are defined in equation (2). As we are concerned with seven commodities, k = 7 in this case. We divide this measure by income y, and call it as the willingness-to-pay (WTP) from now on. Thus, WTP is the amount that households are willing to sacrifice in order to eliminate all price risk, expressed in terms of the proportion of income. A higher WTP of a household means that the household is more risk-averse towards price risk.

Given the discussions so far, the household migration behavior can be expressed as follows:

$$Mig_{ijt} = f(WTP_{it}, X_{it}, \gamma_i, \delta_j) \quad (5)$$

Where Mig_{ijt} indicates migration decision to send a household member out of the rural

household, which is 1 when migration happens, and 0 otherwise. WTP_{it} is the household WTP for price stabilization of household *i* in district *j* in time *t*, X_{it} is a household control variable that varies over time, γ_i is a household-specific time-invariant characteristics, and δ_j is a region-specific time-invariance characteristics. Recall the prediction by Finkelshtain and Chalfant (1991) that agricultural producer's high risk aversion towards prices may cause migration out of rural area. Applying this prediction to the framework in expression (5), I expect that, the higher the WTP, the higher the chances that Mig_{ijt} is equal to 1.

3. Data & Descriptive Statistics

3.1 Ethiopian Rural Household Survey

The Ethiopian Rural Household Survey (ERHS) is unique household panel data set that covers villages in rural Ethiopia. The survey started from the data collection in 1989 covering seven peasant associations (PAs), or natural villages in Ethiopia. In 1994, the project was extended to cover 15 woredas (or districts) and 18 PA's. Additional rounds of surveys were then collected in late 1994, 1995, 1997, 1999, 2004, and 2009.

This study uses the 1994a, 1994b, 1995, and 1997 rounds of the ERHS based on the following reasons: First, the data set contains information on household consumption and production of agricultural commodities, prices of agricultural commodities, and household migration behavior, which are essential to answer the two research questions of this paper. Also, Bellemare et al. (2013) has estimated household-level WTP for price stabilization using the same rounds of survey. Second, during the period, the questionnaires were not changed, which makes the surveys more comparable across time. Lastly, household-level attrition is particularly low during this period, and is just under 8 percent between 1994 and 1999. According to the tracing rule used in this survey, "a household was kept in the sample even if the head of the household had left or died. About 8 percent of the households had a different head, in most cases the spouse of the earlier head. … The fact that households cannot obtain land when moving to other areas is clearly part of the explanation of the low attrition rate." (Dercon and Hoddinott, 2011).

3.2 Descriptive Statistics

Table 1 displays variables used in this study. The main dependent variable in this study is *leave*, which is a binary variable that indicates whether there is a household member who has left the household during last 5 years, which is a measure of long-term out-migration from the household. There are three alternative dependent variables constructed from the questionnaire that reflect alternative definitions of migration in the context of this study considering the purpose and destinations of migration – leave household for work purposes (*leave for work*), leave household for urban areas (*leave for urban*), and leave household for urban areas for work purposes, which is the interaction between the last two variables (*leave for urban for work*). Independent variables include the following: Household WTP for price stabilization is a measure of household-level price risk preference estimated by Bellemare et al. (2013) and is expressed as a proportion of household income. A positive (negative) WTP indicates that the household is risk-averse (risk-loving) towards price risk. A higher WTP means that the household is more risk-averse towards price risk. Household income, and some of its sub-categories – farm income, nonfarm income, and remittances – all vary over time for each household, and are included as controls. Marketable surplus for commodity k (MS_k) is the difference of household production and demand for commodity k. Thus, a household is a net supplier (net buyer) of commodity k if the marketable surplus is positive (negative). Price of commodity k varies for each region called woreda and each season.

Table 2 presents descriptive statistics for 8,296 households in the data. On average, households are willing to give up 9.6% of their income to stabilize the prices of the seven major commodities. 29.8% of the households had a member (or more) who migrated out of the household during last 5 years, and 20% of the households had a migrant to left home for work purposes. Also, 20% of the households had a migrant who left for urban areas. Household average income during the last four months as of the date of survey was 890 Birr, from which 498 Birr comes from selling crops, and 91 Birr comes from nonfarm labor. Average amount of remittances and transfers received during past four months is 125 Birr. Note that the standard deviations are very high for all the variables. The table also presents descriptive statistics for the prices of seven major commodities. Mean and standard deviation are highest for coffee prices. Given that coffee is the most

important cash crop for Ethiopian farmers, high volatility of coffee prices may pose a threat to the welfare of coffee producing farmers.

Table 3 displays statistics on household marketable surpluses of the seven most important commodities in terms of production and consumption. On average, households are net buyers of all seven commodities in terms of the amount (kg) of production and consumption. For all commodities, there are more net buyers than net sellers. Also, for each given commodity, there are a number of households that do not produce or consume the commodity (autarkic households). However, there are only 282 out of the 8,296 households in the data set that do not produce or consume *any* of these seven commodities. The average amount of net sales is highest for wheat, sorghum, barley, and teff among the net sellers of the respective commodities. The average amount of net purchase is lowest for teff, barley, maize, and wheat among the net buyers of these commodities.

4. Empirical Framework

4.1 Household price risk preference and migration

To address the first research question that concerns the impact of household-level price risk preference on migration, the main equation to be estimated is the following simple linear probability model (LPM) using the household panel data:

$$Mig_{ijt} = \beta_0 + \beta_1 WTP_{ijt} + \beta_2 X_{ijt} + \delta_j + \varepsilon_{ijt} \qquad (6)$$

Where Mig_{ijt} is a binary variable that measures whether, during last five years, there is a household member who migrated from household i in woreda[4] j in year t. WTP_{ijt} is the household-level WTP to stabilize the prices of all seven major commodities (coffee, maize, barley, beans, wheat, teff, and sorghum) expressed as a fraction of income, estimated by Bellemare et al. (2013). X_{ijt} is a vector of household-level control variables that vary over time, such as non-farm income or amount of remittances. δ_j is the woreda fixed effect and ε_{ijt} is the error term. The main coefficient of interest is β_1. The expected

[4] Woreda (districts) are the third-level administrative division in Ethiopia. There are 15 Woredas in the data set.

sign of β_1 is positive according to the prediction of Finkelshtain and Chalfant (1991). Robustness checks will be conducted using the household fixed effects instead of woreda fixed effects and applying alternative definitions of migration.

4.2 Price risk and migration

The second research question addresses the relationship between the overall price volatility of agricultural commodities and household migration decision. The purpose of this analysis is to examine a more direct relationship between the price volatility and migration without having to make parametrical assumptions made in order to estimate the WTP. The equation to be estimated is the following:

$$\overline{Mig}_i = \gamma_0 + \sum_{k=1}^{7} \gamma_{1k} \overline{P}_k + \sum_{k=1}^{7} \gamma_{1k} SD_k + u_i \qquad (7)$$

Where $\overline{Mig}_i$ is a household-level average (over the four survey round) of a binary variable that measures whether, during last five years, there is a household member who migrated from household *i*. $\overline{P}_k$ and SD_k are the mean value and the standard deviation of the price of crop *k*, respectively. Mean and standard deviations are both included in order to capture the impacts of the price level and price volatility separately. The same equation will be estimated by including CV_k's, the coefficient of variation of the price of crop *k*, in place of $\overline{P}_k$ and SD_k, to make the level of price volatility comparable across different commodities. Price of each crop varies over survey rounds and woredas. Therefore, the $\overline{P}_k$, SD_k, and CV_k vary for each woreda. u_i is an error term. The model will be estimated for net producers and net buyers of each of the seven commodities separately.

5. Results and Discussions

5.1 Household price risk preference and migration

Table 4 displays simple OLS results with robust standard errors. Column (1) is the result from the most parsimonious model. The positive and significant coefficient on WTP

implies that, as a household's WTP for price stabilization increases, the probability that the household has a member who migrated out from the household during the past five years increases, and the relationship is statistically significant. In other words, households that prefer more stable commodity prices tend to have higher probability of sending family member(s) out of the household. Columns (2) and (3) include time-varying household-specific variables related to income. In column (2) where household income is included, the coefficient on the WTP remains the same, and income is not statistically significant. Column (3) includes sub-categories of household income (Due to data availability, including the sub-categories shrinks the number of observations significantly). Among the different sources of household income, farm income which is household income from selling crops has a positive and significant relationship with migration. Columns (4) through (6) include woreda and round dummies. The magnitude of the coefficient on the WTP is smaller than the models in columns (1) through (3), but the positive and significant relationship between the WTP and migration is preserved. Household income becomes significant at 10% level of significance, with a negative sign, indicating that poorer households tend to have migrant member(s). This is not inconsistent with de Braw (2014) who finds using the 2004 ERHS round that households that migrants would later leave tend to be poorer, having less consumption expenditure and less land.

Table 5 presents the results from panel regressions with fixed effects. Columns (1) through (3) include woreda fixed effects and round dummies. The robust results indicate that, controlling for unobserved heterogeneity among 15 different regions, household's WTP for price stabilization has a positive and significant relationship with migration. With household fixed effects (presented in columns (4) – (6)), however, the impact of WTP becomes insignificant. This means that the unobserved individual household-level time-invariant factor (such as income risk aversion) plays a large role in explaining the migration behavior. One possible explanation is the assumption made in Bellemare et al. (2013) on the household coefficient of relative risk aversion towards income. Note that the expression for the household price risk aversion and in turn the WTP for price stabilization includes the coefficient relative risk aversion towards income. In Bellemare et al. (2013) and therefore in the data, the coefficient of relative risk aversion towards

income was assumed to be 2 for all the households in the data in order to make the estimation tractable. If household income risk preferences are unique to each household and do not change much over time in the time horizon of the data which seems plausible, it is possible that the income risk preference (and its corresponding portion in the WTP in the data) is captured by the household fixed effects. Another possible explanation is not enough variation across time in the WTP in the data set that might have caused the impact of WTP infused into the household fixed effects. In any case, these possible reasons indicate limitation of the data, and should not lead to mistakenly conclude that income risk preference or some other omitted factors explain the migration behavior whereas price risk preference does not.

The results are robust when using the alternative dependent variables using alternative definitions of migration: Table 6 presents estimation results under three alternative definitions of migration – (i) leave for work; (ii) leave for urban area; and (iii) leave for urban area for work purposes. According to the simple OLS regressions results with round and woreda dummies presented in columns (1) through (3), there still is a positive and significant relationship between the WTP and household migration behavior. With woreda fixed effects (presented in columns (4) through (6)), the results are almost identical with slight difference in standard errors. As in the case of the original definition of migration, the significance of WTP goes away with household fixed effects (columns (7) through (9)).

5.2 Price risk and migration

The second research question addresses the direct relationship between the price risk and migration. For analysis, I keep focusing on the seven most important crops (i.e., coffee, maize, beans, barley, wheat, teff, and sorghum) in terms of consumption and production, but examine the cases of net sellers and net buyers of each crop separately.

Table 7 shows the results for net sellers of the seven commodities. The top panel contains the regression results from including the means and standard deviations of all seven commodities as regressors, but the results on the mean and standard deviation of own prices are reported for the sake of brevity. For coffee, maize, and beans, lower

average prices are significantly related with higher occurrences of out-migration by net-sellers of respective commodities, which seems to makes sense intuitively. However, there is a significant and opposite relationship for teff. Also, higher volatility of coffee, maize, and wheat prices are significantly related to higher occurrences of out-migration of net sellers. In case of sorghum, the opposite relationship is observed. The bottom panel displays the regression results from including the coefficient of variation – a standardized measure of volatility – of the prices of seven commodities, instead of the means and standard deviations. As in the top panel, a positive and significant relationship between the price volatility of coffee and maize and out-migration of net sellers selling the respective commodities. We see an opposite such relationships for barley and sorghum.

Results from both the top and the bottom panels indicate that higher price volatility of coffee and maize are related to higher occurrences of out-migration of net sellers selling coffee and maize, respectively. This is not inconsistent with the observation in Bellemare et al. (2013) that "stabilizing coffee prices is more likely generate welfare gains than stabilizing other commodity prices," if the positive relationship (between coffee price volatility and out-migration) observed here is an indication of a negative welfare effect of high coffee price volatility. Given that coffee is Ethiopia's major cash crop accounting for 3.8% of Ethiopia's GDP (Taffessse et al., 2011), this significant relationship might also have an important implication on the farm economy. Also, given that maize is one of the five major cereals cultivated in Ethiopia (Taffessse et al., 2011), losing the farmers producing maize due to high price volatility may pose a threat to food security.

Table 8 displays results for net buyers of the seven commodities. According to the top panel, lower maize price and higher barley price are related to out-migration of net consumers of maize and barley, respectively. The result on barley is intuitive, whereas the result on maize is not. Higher standard deviation of bean and teff prices are significantly related to out-migration of the net buyers of beans and teff, respectively. The lower panel indicates that higher price volatility of beans and lower price volatility of wheat are significantly correlated with out-migration of the respective net buyers.

6. Conclusion

This paper provides an empirical investigation into the role of price risk on migration out of rural households, a topic that has important implications on food security and urban development yet has been ignored so far in the literature. Specifically, the paper examines the two aspects of price risk – individual household's preference towards price risk, and the district-level volatility in prices of agricultural commodities – and their role in explaining the out-migration from rural households in Ethiopia that are mostly both producers and consumers of agricultural commodities. I use four rounds of the ERHS, a publicly available longitudinal data set that contains detailed information on household production, consumption, health and demographics in rural Ethiopia. Specifically, I use the 1994a, 1994b, 1995, and 1997 survey rounds, for which data on commodity prices, marketable surpluses, and migration are available. Bellemare et al. (2013) has estimated the household WTP for price stabilization using the same rounds of survey. I use these estimates and the ERHS data on migration out of rural households as main independent and dependent variables, respectively, for panel regressions to investigate my first research question.

Results indicate that aversion to commodity price risk significantly increases incidences of migration out of rural households in Ethiopia when we exclude the outliers. The results are robust to controlling for district fixed effects and time dummies, and also to alternative definitions of migration concerning purposes and destinations. Also, I find that higher degree of volatility in coffee and maize prices are significantly related to out-migration of the net sellers of coffee and maize, respectively.

Although statistically significant relationships are found between price risk preference and migration and also between the degree of price volatility and migration, I refrain from claiming that such relationships are causal, due to the following reasons: First, there is a high degree of autocorrelation in the measure of migration– the main the dependent variable – in this paper. I.e., a household that has a migrant over the past 5 years in 1994 survey are very likely to have a migrant in 1995 survey. Also, estimation of the household WTP by Bellemare et al. (2013) relies upon the assumptions of expected utility and also the assumptions on functional forms, and noisy empirical data. It is

therefore a measure of household risk preferences suboptimal to actual elicitation from the households (which, if any, must be well-designed and implemented). So far, however, to my best of knowledge, there is no empirical study that directly elicits household risk preferences. These limitations directs us to the next steps in the investigation of price risk and migration – better identification, using a cleaner, richer data set that includes more recent years.

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Tables

*Table **Error! No sequence specified.**. Variable Descriptions*

Variable	Descriptions
Leave	1 if there is anyone who has left the household during last 5 years, 0 otherwise.
Leave for work	1 if there is anyone who has left the household to look for work, to take up job, to be near to their place of work, to run own farm or enterprise, or migration with unknown intention, 0 otherwise.
Leave for urban	1 if there is anyone who has left the household and whose current residence is: (i) urban area in this woreda; or (ii) Addis Ababa; or (iii) other urban area. 0 otherwise.
Leave for urban for work	Interaction of "Leave for work" and "Leave for urban."
WTP	Household-level willingness-to-pay to stabilize prices of the seven most important commodities (coffee, maize, beans, barley, wheat, teff, sorghum) at their means, expressed as a proportion of household income, estimated by Bellemare et al. (2013).
Income	Household income (in Birr, including in-kind) during the last four months as of the date of survey
Farm income	Amount of income (in Birr) earned by selling crops
Nonfarm income	Amount of income (in Birr) from household work off the household's land (either on someone else's land or in some other employment) received during the last four months as of the date of survey
Remittances	Amount of remittances (in Birr) received during the last four months as of the date of survey
MS_k	Household marketable surplus (in kg) of commodity *k*, which is also a household net supply of commodity *k*, or quantity supplied minus quantity demanded of commodity *k*.
P_k	Price (in Birr/kg) of commodity *k*

Table 2. Descriptive Statistics

	Unit	Mean	Std. Dev.	Min.	Max.
WTP	From -1 to 1	0.096	0.173	-1	1
Leave	0 or 1	0.298	0.458	0	1
Leave for work	0 or 1	0.203	0.402	0	1
Leave for urban	0 or 1	0.199	0.399	0	1
Leave for urban for work	0 or 1	0.183	0.387	0	1
Income	Birr	890.506	10,019.944	0	820,626
Farm income	Birr	498.209	9,947.643	0	820,145
Nonfarm income	Birr	90.790	295.142	0	5,421
Remittances	Birr	125.070	1,551.334	0	70,884
Coffee Prices	Birr/kg	13.356	5.202	3.584	26.685
Maize Prices	Birr/kg	1.293	0.383	0.658	2.859
Beans Prices	Birr/kg	1.876	0.431	1.035	3.153
Barley Prices	Birr/kg	1.505	0.411	0.658	2.532
Wheat Prices	Birr/kg	1.737	0.330	0.921	2.481
Teff Prices	Birr/kg	2.279	0.404	1.035	3.261
Sorghum Prices	Birr/kg	1.525	0.415	0.720	2.609
N=8,296					

Table 3. Marketable Surpluses of Households (unit: kg)

	All (N = 8,296)		Net Sellers			Net Buyers		
	Mean	Std. Dev.	Mean	Std. Dev.	*N*	Mean	Std. Dev.	*N*
Coffee	-10.14	60.01	54.50	80.71	509	-18.56	62.88	6,026
Maize	-112.15	335.92	230.23	384.32	825	-374.95	390.21	2,988
Beans	-40.47	95.50	89.75	89.06	170	-127.29	123.23	2,757
Barley	-87.66	360.13	282.39	330.20	699	-454.14	537.45	2,036
Wheat	-64.08	275.26	436.90	623.73	366	-292.28	324.18	2,366
Teff	-96.14	319.64	273.58	436.32	513	-454.19	418.96	2,065
Sorghum	-39.05	203.11	315.72	283.87	386	-346.98	318.98	1,285

Table 4. OLS Results with Robust S.E.

Dep. Variable: Leave	(1)	(2)	(3)	(4)	(5)	(6)
WTP	0.145***	0.145***	0.184***	0.0974***	0.0974***	0.0963*
	(0.0302)	(0.0302)	(0.0551)	(0.0311)	(0.0311)	(0.0571)
Income		-2.72e-08			-3.32e-07*	
		(3.09e-07)			(1.82e-07)	
Farm income			3.52e-05***			2.50e-05***
			(8.80e-06)			(9.22e-06)
Nonfarm income			5.14e-05			4.18e-05
			(3.59e-05)			(3.69e-05)
Remittances			6.32e-07			2.33e-06
			(4.60e-06)			(5.06e-06)
Woreda dummy	No	No	No	Yes	Yes	Yes
Round dummy	No	No	No	Yes	Yes	Yes
N	8,296	8,296	2,676	8,296	8,296	2,676
R^2	0.003	0.003	0.014	0.033	0.033	0.048

Robust standard errors in parentheses.
*: p-value < 0.1, **: p-value < 0.05, ***: p-value < 0.001.

Table 5. Fixed Effects Regression Results

Dep. Variable: Leave	Woreda Fixed Effects			Household Fixed Effects		
	(1)	(2)	(3)	(4)	(5)	(6)
WTP	0.0974***	0.0974***	0.0963*	0.0257	0.0257	-0.0640
	(0.0301)	(0.0301)	(0.0552)	(0.0317)	(0.0317)	(0.0828)
Income		-3.32e-07			-7.36e-07	
		(4.95e-07)			(4.74e-07)	
Farm income			2.50e-05***			-6.36e-06
			(8.35e-06)			(1.23e-05)
Nonfarm income			4.18e-05			-3.18e-05
			(3.56e-05)			(6.05e-05)
Remittances			2.33e-06			-1.05e-05
			(5.24e-06)			(1.17e-05)
Woreda FE	Yes	Yes	Yes	No	No	No
Household FE	No	No	No	Yes	Yes	Yes
Round dummy	Yes	Yes	Yes	Yes	Yes	Yes
# Groups	15	15	15	1,494	1,494	1,470
N	8,296	8,296	2,676	8,296	8,296	2,676
R^2	0.004	0.004	0.011	0.004	0.005	0.009

Robust standard errors in parentheses.
*: p-value < 0.1, **: p-value < 0.05, ***: p-value < 0.001.
Number of groups for Woreda FE = 15. Number of groups for Household FE = 15.

Table 6. Results with Alternative Definitions of Migration

Model	OLS			Woreda Fixed Effects			Household Fixed Effects		
Dependent Variable	(1) Leave for work	(2) Leave for urban	(3) Leave for urban for work	(4) Leave for work	(5) Leave for urban	(6) Leave for urban for work	(7) Leave for work	(8) Leave for urban	(9) Leave for urban for work
WTP	0.057*	0.085**	0.064**	0.057*	0.085**	0.064*	-0.022	0.004	-0.014
	(0.033)	(0.034)	(0.032)	(0.034)	(0.034)	(0.033)	(0.039)	(0.039)	(0.038)
Round dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Woreda dummy	Yes	Yes	Yes	No	No	No	No	No	No
Woreda FE	No	No	No	Yes	Yes	Yes	No	No	No
Household FE	No	No	No	No	No	No	Yes	Yes	Yes
# Groups	-	-	-	15	15	15	1,494	1,494	1,494
N	5,621	5,621	5,621	5,621	5,621	5,621	5,621	5,621	5,621
R^2	0.0405	0.0449	0.0603	0.0240	0.0283	0.0439	0.0221	0.0265	0.0422

Standard errors in parentheses.
*: p-value < 0.1, **: p-value < 0.05, ***: p-value < 0.001.

Table 7. Price Level, Standard Deviation, Coefficient of Variation and Migration – Net Seller

Dep. Variable: Leave	(1) Coffee	(2) Maize	(3) Beans	(4) Barley	(5) Wheat	(6) Teff	(7) Sorghum
Mean	-0.075***	-0.941***	-0.295***	0.640	-0.501	0.146**	0.113
	(0.021)	(-0.218)	(0.095)	(0.476)	(0.128)	(0.059)	(0.160)
Standard Deviation	0.032**	2.845**	0.041	-0.846	0.466***	0.123	-0.487***
	(0.013)	(1.244)	(0.408)	(0.596)	(0.145)	(0.109)	(0.172)
Adj. R^2	0.1276	0.0799	0.0573	0.0973	0.0225	0.0090	0.0152
CV	0.364**	0.437***	4.725	-0.544*	0.399	-0.887	-0.761***
	(0.182)	0.169	(5.737)	(0.291)	(0.495)	(0.863)	(0.277)
Adj. R^2	0.1276	0.0258	0.0445	0.0930	0.0627	0.0081	0.0162
N	531	847	179	719	375	526	398

Robust standard errors in parentheses.

*: p-value < 0.1, **: p-value < 0.05, ***: p-value < 0.001.

(1) Top panel: In case of beans, wheat, teff, and sorghum, only the mean and standard devations of their own prices are included, because the variables of interest are dropped due to collinearity when all the commodities are included.

(2) Bottom panel: In case of teff, only the coefficient of variation of the own price was included.

Table 8. Price Level, Standard Deviation, Coefficient of Variation and Migration – Net Buyer

Dep. Variable: Leave	(1) Coffee	(2) Maize	(3) Beans	(4) Barley	(5) Wheat	(6) Teff	(7) Sorghum
Mean	0.012	-0.669***	-0.308	0.634**	-0.132	-0.276	0.316
	(0.024)	(0.089)	(0.675)	(0.278)	(0.233)	(0.406)	(0.455)
Standard Dev.	-0.017	0.677	1.214*	-0.193	-0.102	2.200***	-0.459
	(0.011)	(0.414)	(0.707)	(0.343)	(0.257)	(0.780)	(0.573)
Adj. R^2	0.0766	0.0820	0.0511	0.0795	0.0585	0.0555	0.0637
CV	-0.013	-0.012	0.589***	0.265	-0.234**	0.265	0.052
	(0.031)	(0.068)	(0.192)	(0.254)	(0.107)	(0.254)	(0.363)
Adj. R^2	0.0321	0.0443	0.0116	0.0151	0.0310	0.0151	0.0384
N	6212	3111	2856	2105	2433	2143	1318

Robust standard errors in parentheses.

*: p-value < 0.1, **: p-value < 0.05, ***: p-value < 0.001.