The Effects of Emigration and Remittances on Agriculture: Evidence from the Philippines*

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Abstract

The large increase in remittances from international migrants has generated optimism about the potential development benefits of these capital flows in migrant-sending economies, especially in rural communities where market failures are prevalent. There are, however, important concerns regarding the disruptive effect of a loss in the productive workforce to migration. While isolating the effects of remittances from the effects of migration is important in order to contrast these two mechanisms, empirical studies that separately identify the remittance and the emigration effects on the sending economies are rare. This paper provides separate estimates of the effect of remittances and the effect of emigration on agriculture in the Philippines, one of the largest exporters of migrants in the world.

I explore whether emigration and remittances have facilitated a transition out of the agricultural sector or caused changes in farming practices. To identify separately the causal effects of emigration and remittances, I use fixed effects and an instrumentation strategy that exploits macroeconomic shocks at the migrant's predicted destinations. The results show no evidence of effects migration and remittances on number of farms, farmed area and agricultural labor, suggesting that emigration and remittances do not promote a movement out of agriculture. Instead, there is evidence of remittance effects on farming practices. Remittances increase the fraction of farms that produce high-value commercial crops, decrease the fraction of farms that engage in crop diversification, and increase the adoption of mechanized technologies among rice farmers. Emigration, on the other hand, has little overall impact on the choice of crops and farming technologies. The asymmetric impacts of emigration and remittances are consistent with a local rural economy that has capital and insurance constraints, and an elastic supply of labor. To the extent that shortages of capital and insurance, but not of labor, usually limit agricultural production, remittances can be an important source of insurance and investment finance that fosters agricultural development.

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1 Introduction

Approximately 140 million people born in developing countries live outside their country of birth (World Bank, 2008). Reported remittances from these migrants have become the main source of private capital inflows in dozens of developing countries (World Bank, 2006). Many view with optimism the development gains that remittances may have, and argue that easing restrictions to the international mobility of labor is indispensable in an effective agenda to help poor countries (e.g., Birsdall et al. 2005, Pritchett 2006). However, large productivity costs might be involved in this process, since emigration can significantly reduce the size of the productive workforce and have disruptive effects on family members left behind. Thus, without a separate assessment of how the departure of workers and the inflow of remittances affect the sending economies, it seems difficult to make a proper appraisal of the development impacts of these phenomena. There are, however, very few empirical studies that estimate the causal impacts of remittances and emigration separately.

In this paper I derive separate estimates of the effects of emigration and remittances on Philippines' local agricultural economies. Given the high labor requirements of agricultural production and the credit and insurance shortages that typically affect rural economies, adjustments to the outflow of labor and the inflow of remittances in the agriculture sector are likely to be large. By increasing the availability of capital and reducing the supply of labor, remittances and emigration can generate shifts from agriculture towards more capital-intensive sectors and, in this way, promote a structural transformation that characterizes economic development. This shift in the relative endowment of capital and labor may also lead to the adoption of more mechanized farming practices. Moreover, if remittances to the sending economies are used as insurance, they may substitute for alternative risk-mitigating strategies used by farmers left behind. In this paper I investigate whether in local economies the inflow of capital from remittances and the outflow of workers from international migration have: i) led to a decline of the Philippines' agriculture sector; and ii) enabled the adoption of more mechanized and riskier farming practices in the Philippines' agricultural sector. I interpret the results in light of a conceptual framework that illustrates how the possible effects of migration

and remittances on agriculture depend on the existence of resource and insurance constraints and on the relative abundance of production inputs.

In this empirical exercise I face two important challenges. First, the observed relationships of agricultural outcomes with emigration and remittances cannot be interpreted as causal. Migration and remittances are not randomly allocated; they are selective processes that are likely to be based on unobservable characteristics. Reverse causality is also a big concern, since agricultural outcomes such as crop failures may induce migration outflows and generate a greater inflow of remittances from abroad. Second, due to the close linkages between emigration and remittance receipts, isolating their independent effects is a challenging task. The difficulty rests on the need to find suitable instruments that can separately predict the amount of remittances and the magnitude of migration outflows. In this paper I surmount these problems by exploiting variation in macroeconomic shocks faced by Filipino migrants at their country of destination. Specifically, I exploit arguably exogenous shocks that affect the employment opportunities of potential Filipino migrants and the purchasing power of migrants' earnings. Here I take advantage of the distinct features that characterize international migration patterns in the Philippines. Filipino migrants are widely dispersed overseas, making them susceptible to more varied shocks at the destination countries than, say, Mexican migrants who mostly go to the United States. Moreover, there is significant variation in the destination choice across Filipino provinces. I take advantage of this cross-province variation to construct two province-level instruments that measure demand and exchange rate shocks faced by potential Filipino migrants at the host countries.[1]

Thus, the Philippines' pattern of international migration has characteristic features that makes the identification strategy possible. In addition, there are several other reasons that make this country a good environment to study the effects of migration on agricultural production. The Philippines has a long tradition of international migration where the "overseas employment of Filipino workers"

[1]By exploiting the large variation in shocks faced by Filipino migrants at the destination, I follow Yang (2008) and Yang and Martinez (2005) who obtain reduced form estimates of the impact of exchange rate shocks on the sending economies. I extend their approach by deriving instrumental variable estimates of the effects of remittances and emigration.

has been actively encouraged by the government.[2] Currently, migrants from the Philippines amount to 10% of the country's workforce and remittances sent home are equivalent to 13% of the country's GDP (World Bank, 2008). Moreover, the agricultural sector is of vital importance, contributing one third of the country's total employment. Since forty percent of overseas migrants come from rural areas, there may be large adjustments to emigration and remittances in agricultural production.

I draw on data from the 1991 and 2002 agricultural censuses of the Philippines and a set of migration, income and labor force surveys administered by the National Statistics Office of the Philippines(NSO). In a first set of results I show that neither remittances nor migration modify the size of the agricultural sector as measured by labor inputs allocated to agriculture, farms and farmed area. However, because the estimates on farms and farmed area are somewhat imprecise, I am unable to rule out the possibility that the absence of effects along these two margins simply reflects lack of precision in the estimation. In a second set of results I find evidence of shifts in input and output mixes within agriculture production. Specifically, a 10% growth in remittances appear to increase the fraction of farms that produce high value commercial crops by 2% and the fraction of farms that specialize in the production of one crop by 1%. Remittances also increase the share of farms using mechanized farming methods in rice production by 2-4%. The effects are economically significant, especially given that the estimates are an average over the entire population, including non-remittance recipient households, and that agricultural responses are slow due to their seasonal nature. In contrast, there are no economically or statistically significant effects of emigration on the adoption of specialized or mechanized farming practices.

The results in this paper underscore the importance of assessing the impacts of emigration and remittances separately, to the extent that the effects on the sending economies depend on the characteristics of local labor, capital and insurance markets. The findings are consistent with a framework in which the capital inflow from remittances increases investments in agriculture by relaxing credit

[2]In the 1970s a policy aimed at promoting the overseas employment of Filipino workers was enacted. Agreements were made with oil-rich Gulf countries that had insufficient labor to complete ambitious infrastructure projects. In addition to making agreements with potential host countries, the Filipino government actively recruited migrants in the local market and secured their overseas employment. Nowadays the government has limited its role to the legal assistance of Filipino workers and the licensing and regulation of approximately 1000 private agencies in charge of all recruitment activities (Ruiz 2008, Asis 2006).

constraints and/or by reducing the cost of credit. Moreover, in the absence of complete insurance markets, remittances appear to be used as an insurance mechanism that can substitute for alternative risk-coping strategies such as crop diversification. Emigration, on the other hand, has no impact on production, consistent with a local economy that faces a highly elastic supply of labor. Given that shortages of capital and insurance, not of labor, usually constrain agricultural production in developing countries, results in this paper favor the view of remittances as an important source of investment finance and insurance that can promote agricultural development.

Most studies of the impact of migration on source economies do not isolate the estimates of the effect of the departure of workers from the effect of remittance receipts. In the literature that focuses on agricultural production outcomes the one exception, to my knowledge, is the study by Taylor et al (2003) that explores the links between migration, remittance and crop incomes in rural China. The authors find that the loss of labor to migration has a negative effect on household cropping income in source areas and that remittance receipts partially compensate for this lost-labor effect by increasing crop yields at the household level. My paper complements this result by directly observing positive effects of remittances on the adoption of mechanized technologies on local agricultural economies and by providing suggestive evidence of an insurance role of remittances.

In contrast to Taylor et al (2003), I use an identification strategy that exploits shocks experienced by migrants at the destination. This is a departure from the existing literature on the effects of migration and remittances on agriculture, where, in general, previous work dealt with the endogenous nature of the explanatory variables of interest by using as instrumental variables historical and village level migration rates or measures of mobility barriers.[3] The success of such identification strategies depends on the assumption that the instruments only affect agricultural outcomes through their impact on current migration or remittance levels. However, instruments that are constructed from mobility barriers, local migration prevalence and past migration patterns may have a direct impact on agriculture through other channels, such as commercial trade. Also, village and historic

[3]Some examples of studies that construct instruments with historic and/or village level migration measures are Taylor et al. (2003), Taylor and Lopez-Feldman (2010), Mendola (2008), de Braw (2010). Measures of mobility barriers such as language knowledge, education of household members and distance to border crossing are used by Mendola (2008) and Miluka et al. (2010).

migration patterns might be influenced by unobserved community characteristics - such as access to public services– that have an effect on agricultural outcomes. Finally, past migration patterns and mobility barriers can lead to increased economic opportunities, directly affecting agriculture. Thus, the exclusion restriction may fail in identification strategies that use measures of mobility barriers, historic migration and village migration prevalence as instrumental variables. I argue that the empirical approach I use in this paper requires a weaker identification assumption.

My results are consistent with recent studies showing that remittance inflows can increase productive investments in the sending communities (e.g. Dustmann and Kirchamp 2002, Woodruff and Zenteno 2006, Yang 2008). Thus, they contradict the literature showing that remittances are mainly used for leisure or current consumption with limited effects in the long-run[4]. Moreover this paper is one of the few studies that provides micro-data evidence indicating an insurance role of remittances in the sending economy. My findings are consistent with the results of Yang and Choi (2007), who provide evidence that remittances in the Philippines are used to buffer negative income weather-related shocks. In a related study, Mendola (2008) shows that farmers with international migrants in Bangladesh are more likely to adopt rice varieties with greater yield variability.

The rest of this paper is organized as follows. Section 2 reviews a simple conceptual framework that illustrates the potential effects of migration and remittances on agricultural production. Section 3 describes the empirical strategy and discusses the data sources employed. Section 4 presents the results of the main estimations. Section 5 discusses alternative explanations to the results and section 6 concludes.

2 Conceptual Framework

The goal of this section is to develop some intuition about how emigration and remittances can affect production decisions in local agricultural economies that will help frame the interpretation of the results. I start by likening emigration and remittances to shocks that alter the endowment of labor and working capital, respectively. I discuss how the effect on production via changes in

[4]Rapoport and Docquier (2005) provide a review

input endowment will depend on the characteristics of the credit and labor markets (adapting from Banerjee and Duflo 2008). I then consider the role of remittances as an insurance mechanism that, by smoothing consumption across states of nature, may alter the risk taking behavior of farmers. Finally, I discuss alternative channels through which remittances and migration may impact agricultural production (e.g. impact on prices of non-tradables).

Consider an economy in which output prices are determined competitively. Agricultural households weigh the profits of two alternative production methods or goods: "modern", which is indexed by subscript M, and "traditional", which is indexed by subscript T. Production technologies can be described by $Q_M = F_M(Z, K)$ and $Q_T = F_T(Z, L)$, where Z corresponds to a vector of fixed inputs and household characteristics. Thus, these alternative technologies differ in whether they use capital or labor.

I start by providing a graphical illustration of the impact of emigration on the farmer's production decisions. I consider two alternative scenarios: i) farmers are *constrained* in the labor market, and are therefore unable to invest in an efficient amount of labor in the production of Q_T, and ii) farmers are unconstrained. Both possibilities are shown in Figure 1, which depicts the marginal product of labor in the production of Q_T. Let w_1 denote the initial cost of labor. In the first scenario, the farmer faces a binding constraint in the hiring market and therefore invests a quantity of labor L_0, at which the marginal product exceeds the marginal cost, w_1. Emigration will increase labor shortages, reducing the quantity of labor invested to $L_0^{'}$. Thus, an outflow of workers will unambiguously reduce output level Q_T. Now assume that the farmer is unconstrained and can choose an efficient amount of labor, L_1 . Emigration will only affect production of Q_T if it increases the marginal wage faced by the farmer. An increase in wages to w_2 will reduce the quantity of labor to L_2 and, as a result, the output of the traditional technology will decline. However, the wage level will remain unaffected if the aggregate supply of labor faced by the farmer is elastic, as will be the case if there is a readily available pool of laborers that can easily substitute for the migrant workers. If this is the case, the production of Q_T will remain unaltered.

The analysis in the case of remittances is analogous. In an environment in which the farm is

bound by a credit market constraint, an inflow of capital from remittances will unambiguously have an impact on Q_M. In the absence of credit constraints, remittances will only affect production of Q_M if they reduce the marginal cost of capital faced by the farmer and this will depend on the elasticity of the supply of capital in the local market.

Thus far, I have interpreted remittances and migration as shocks to the availability of factor endowments in a local economy. An alternative channel through which remittances may affect agricultural production is by constituting a risk-mitigating device. . A body of empirical and theoretical literature has highlighted the insurance motives of migration among agricultural households (e.g. Stark 1993, Yang and Choi 2007, Mendola 2008, Rosenzweig and Stark, 1989). In the presence of imperfect insurance markets, agricultural households may use alternative mechanisms to cope with risk. One alternative is to diversify income sources by engaging in several economic activities. Another alternative is to diversify income sources via migration. As discussed by Morduch (1995) such smoothing mechanisms often substitute for each other, so if agricultural households use remittances to smooth consumption across states of nature, their need to diversify income sources by engaging in multiple farming activities will be reduced.

The empirical results in this paper are mainly interpreted in the light of the impact that remittances and emigration can have on production by changing the input endowments in the local market and the farmer's exposure to risk. Thus, I abstract from alternative mechanisms through which an impact on agriculture may occur. Admittedly, there are other causal channels that can be considered. Remittances can increase the demand of non-tradable goods and, to to the extent that the relative profitability of the non-tradable sector rises, lead to a decline in agricultural production. Remittances may also affect agricultural production by affecting the consumption of leisure of remittance-recipient households. Also, migration can alter farming practices if there is a transmission of agricultural technical knowledge from the country of destination to the community of origin. The possibility of alternative mechanisms will be taken into account in the interpretation of the empirical results.

3 Data and Empirical Strategy

3.1 Basic Specification and Identification Strategy

As described in the previous section, by changing the availability of labor and capital in local markets emigration and remittances may facilitate the transition out of agriculture towards more capital intensive sectors and/or increase the production of capital intensive outputs and the adoption of capital-intensive technologies. Moreover, by buffering income shocks, remittances may reduce the need of alternative mechanisms to diversify income sources. In this paper, I test for these adjustments and derive estimates of the effects of remittances and emigration on measures of: i) the size of the agriculture sector; ii) the adoption of capital-intensive technologies iii) crop choice; and iv) crop diversification. The basic regression model relates measures of migration and remittances in local markets to agricultural outcomes. The unit of analysis of the estimation is a city or municipality.[5] The variables measuring migration and remittances are defined at the more aggregate *province* level. A province is an administrative division equivalent to a US state and is the finest unit at which the migration and remittance data can be obtained. The estimating equation is as follows:

$$y_{ipt} = \alpha + \theta M_{pt} + \delta R_{pt} + \beta X_{ipt} + \gamma W_{pt} + \nu_{ip} + \mu_t + \epsilon_{ipt} \tag{1}$$

where y_{ipt} is an agricultural outcome for municipality i in province p and year t; M_{pt} and R_{pt} are respectively the log of the stock of migrants and the log of the total level of cash remittance receipts in province p and year t; X_{ipt} is a set of municipality-level time-varying controls; W_{pt} is a set of province level time-varying controls; ν_{ip} and μ_t are, respectively, municipality and year fixed effects. The equation is estimated for $t = 1991, 2002$ since these are the years for which the agricultural data is electronically available. All regressions are weighted by number of farms.[6]

[5] The local administrative units that provinces in the Philippines are subdivided into are defined as *cities* and *municipalities*. These two categories differ in terms of population size and tax revenue, with municipalities being smaller, more abundant, more likely rural, and analogous to "towns". For simplicity, in this paper I will use the term *municipality* as a general category that encompasses all local administration units, even though larger units are strictly defined as "cities".

[6] Since there are no farm-level covariates in the specification, estimates are equivalent to those obtained in farm-level regressions. Farm-level covariates had a negligible impact in the value and precision of the estimates of interest.

The coefficients of interest are θ and δ. Since the regressors of interest vary at a more aggregate level than the unit of analysis, within-province correlation of the error will cause a downward bias in conventional estimates of the standard errors. I therefore allow for an arbitrary variance-covariance structure by clustering standard errors at the province-by-year level.[7]

As discussed in the introduction, a causal interpretation of Ordinary Least Squares (OLS) estimates of θ and δ in equation (1) is inappropriate, since M_{pt} and R_{pt} may be endogenous. Migration outflows and remittance receipts are not random processes. They are based on unobserved characteristics of the local economy, such as productivity shocks or the quality of public services that may have an impact on agricultural practices. Reverse causality is also a big concern since agricultural shocks in source economies probably have an influence on migration and remittance decisions (e.g Munshi 2003 and Yang and Choi 2007). Moreover, migration, remittance and agriculture production decisions may be determined simultaneously if households jointly allocate labor and production resources on the sending community and abroad. To address these issues, I implement an identification strategy that uses municipality-level fixed effects in combination with instrumental variables.

Municipality-level fixed effects control for potentially confounding time-invariant characteristics. With two observations per municipality (1991 and 2002) a first differenced specification of equation (1) is equivalent to:

$$\Delta y_{ip} = \theta \Delta M_p + \delta \Delta R_p + \beta \Delta X_{ip} + \gamma \Delta W_p + \Delta \epsilon_{ip} \tag{2}$$

I deal with potential time-varying confounding factors by constructing instruments to estimate (2) in a just-identified 2SLS regression. This identification strategy takes advantage of the large variation in destination choices made by Filipino migrants, which makes them susceptible to very diverse shocks at the host countries. Column 1 in Table 1 shows the distribution of migrant workers across countries in 1991. Saudi Arabia was the preferred destination with 28% of the migrants, and the US was the second most preferred with 13% of the migrants. No other country hosted more than

[7]Serial correlation of the error terms is not a source of concern, as this is a model with fixed effects and two time periods (Wooldridge, 2002).

10% of the total stock of migrants. Columns 2 and 3 present the variation in the economic shocks experienced by migrants at these destinations. Such shocks are arguably exogenous to conditions of the Filipino agricultural economy as their variation is related to major economic events such as the introduction of the Euro, the Asian Financial Crisis and the Gulf War. Also importantly, the GDP and exchange rate shocks are not highly correlated.

Moreover, the probability of choosing a given destination country varies across provinces. I illustrate this feature in Table 2, which shows the 1991 distribution among the major destination countries of migrants from the 10 provinces with highest overall migration levels. Although there were 77 provinces in the Philippines in 1991, for simplicity I list the distribution for only the 10 provinces with highest migration. Clearly, the importance of each location varies across provinces. For example, Saudi Arabia hosted 70% of the migrants from Magindao but only 10% of the migrants from Negros Occidental. This leads to considerable variation across provinces in the shocks at the destination experienced by migrants.

In addition, there is historic persistence in the destination choices made by migrants. Migrants from given provinces persistently favor certain destinations. [8] This phenomenon probably reflects the important role that networks play in the distribution of information to prospective migrants of the opportunities abroad.[9] I exploit these characteristics of Filipino migration to construct instrumental variables that measure exogenous shocks faced by migrants at the destination.[10]

The instruments for ΔM_p (where M_p is the log of migration) and ΔR_p (where R_p is the log of remittances) are denoted by ΔZ_{1p} and ΔZ_{2p}, and described as follows:

$$\Delta Z_{1p} = \Delta log(\sum_d \pi_{pd} GDP_d) \tag{3}$$

[8] This is evident from the results of a simple OLS regression of the 2002 share of province-level migrants in each country on the 1991 share of province-level migrants in each country with province-level fixed effects. The estimated coefficient is 0.56 and significant at 1%.

[9] Recruitment agencies in the Philippines match migrant workers with employers abroad. An overwhelming majority of these agencies have headquarters in Manila, and a few have branches in major cities such as Davao or Cebu. Migrants from other areas learn about job opportunities abroad from informal brokers who are often part of the same social network (Agunias 2010).

[10] McKenzie and Rapaport (2004), Yang (2008), Yang and Martinez (2005) and Antman (2010) also exploit shocks at the migrants' destination in their empirical strategies.

$$\Delta Z_{2p} = \Delta log(\sum_{d} \pi_{pd} XR_d) \tag{4}$$

where π_{pd} is the share of migrants from province p going to country d in 1991; GDP_d is the GDP in country d, with a two year lag; XR_d is the exchange rate in Filipino pesos with respect to the currency in country d at time t[11]

The instrument described by (3) can be interpreted as a measure of proportionate changes in the size of the economy of the *expected* destination of migrants from province p. Weights are assigned in terms of the relative importance of each destination as measured by the 1991 distribution of migrants, π_{pd}. Given that migration from the Philippines is largely demand-driven, real shocks at the destination should impact migration and remittance patterns. I choose a lagged measure of GDP instead of a contemporaneous variable because the stock of migrants at time t likely migrated in response to a past demand shock at the destination. However, results presented in section 4 will show that very similar results are obtained in specifications that use contemporaneous measures and that the estimates are insensitive to the lag period. [12]

The instrument in (4) proxies a proportionate change in the exchange rate faced by migrants from province p at their "expected" destination. Shocks to the exchange rates have an impact on the purchasing power in Filipino pesos of the migrants' earnings and, therefore, may affect the volumes of migration and remittances.

Both instruments are constructed using the 1991 baseline distribution across countries of migrants from province p (i.e., π_{pd}). It is important to use a predetermined distribution across countries for the validity of the instrument, since the choice of the migrants' destination could respond to the agricultural outcomes. Details of the construction of the instrument are available in the Data Appendix.

[11] Exchange rate values are in 2002 Filipino pesos. Nominal exchange rates were obtained from the International Monetary Fund International Finance Statistics and converted to 2002 constant Filipino pesos using the consumer price index reported by NSO. GDP are reported at PPP and constant prices using data from the International Monetary Fund, World Economic Outlook Database.

[12] Of course, other proxy measures of the demand of migrants, such as per-capita GDP and unemployment rate, can be considered. In results not presented here, I explore such alternatives. I chose the GDP variables chosen based on a set of criteria that considered power, linear independence between the instruments and measurement error.

The use of time and level fixed effects in combination with instrumental variables will lead to a valid identification strategy as long as two conditions hold. First, the 1991 distribution of migrants across destinations is not correlated with changes in agricultural outcomes within municipalities between 1991 and 2002. Second, changes in GDP and exchange rates at the destination are exogenous to changes in agricultural outcomes within municipalities. In contrast, there will not be a threat to the identification strategy if the 1991 destination choice is determined by unobserved time-invariant province characteristics. Thus, the identification strategy is not violated even if wealthier provinces persistently send migrants to countries with the best economic opportunities, since time-invariant characteristics will be controlled for with the province-level fixed effects. The identification also will not be violated if the instruments capture external shocks that impact agricultural production in ways that are not differential across provinces. Thus, the identification assumption will hold even if the instruments capture national shocks to agricultural prices or exports, since common national shocks will be controlled for in the constant term.

The proposed identification strategy will be violated if the 1991 destination choice of migrants from a given province was based on province-specific productivity shocks that persisted through the decade and had a differential impact on agricultural outcomes in municipalities within that province. It will also be violated if, for example, the instruments proxy for external shocks to agricultural prices that differentially affect municipality-level agricultural outcomes. To control for possible confounding factors that may be correlated with changes in the agricultural outcomes of municipalities over the decade, I include a rich set of municipality and province level time-varying predetermined covariates. These variables are constructed by interacting year dummies with 1991 province and municipality level demographic, economic and agricultural characteristics.[13] In the results section, I evaluate the sensitivity of the first stage estimates to the inclusion of this set of control variables. A substantial change in the instrument coefficients suggests a threat to the validity of the identification assumption.

[13]The controls were constructed by interacting year dummies with 1991 province and municipality level measures of: i) demographic characteristics (i.e. share of household heads with no high school diploma, average age of household head, share of female adults, share of married adults, share of rural population); ii) economic conditions (i.e., unemployment rates and hours worked); iii) agriculture characteristics (farm area, area planted, area irrigated, livestock heads, rice farms)

3.2 Data

Agricultural Outcomes. To construct outcome variables that measure the size of the agricultural sector, crop mix and the use of capital intensive farming technologies, I use information from two sources: the Census of Agriculture and Fisheries of the Philippines (CAF) and the Labor Force Survey (LFS). I restrict the empirical analysis to 1991 and 2002 as these are the only years for which electronic data of the CAF is available

The CAF is administered approximately every ten years by the National Statistics Office of the Philippines (NSO) and enumerates all agricultural establishments in the country. Electronic data is only available for 1991 and 2002. The CAF collects information on area, crop choice and use of farming equipment. Since the CAF has no information on the value of agricultural production, agricultural income or quantities produced, I assess the scale of agricultural production with measures of the number of farms and area farmed. I complement the analysis using outcome measures of labor inputs allocated to agriculture that I gather from the LFS, a quarterly nationwide household survey designed to gather labor market information. Data in the CAF is not used to build labor input variables because only members of agricultural households are enumerated in this census. This is an important drawback given the important role hired labor plays in the Philippines' agriculture (Dawe et al. 2006).

To learn about the effects on crop mix and diversification, I use detailed data from the CAF on the different types of crops grown. To study the effects on mechanized technologies, I use data in the CAF that documents the use of equipment and machinery, owned and rented, and access to irrigation systems. As will be discussed in section 4.4, I restrict the study of capital-intensive technologies to farms that produce rice. Without such a restriction, observed changes in the method of production could be masking changes in the composition of crops. In section 4.3 I present evidence that ameliorates concern of endogenous selection from restricting the analysis to rice farms.

Data on the use of equipment in the CAF is finely disaggregated to 40 different types of machinery. To simplify the analysis, I build three categories that correspond to the use of mechanized technologies in the three main stages of the rice cultivation process: 1)tillage or land preparation

(plowing and ripping the soil); 2) cultivation (planting and weeding); and 3)post-harvesting (includes the process of *threshing* in which the harvested rice grain is separated from its the stalk). This classification is guided by the economics literature that studies agricultural mechanization patterns (Pingali, 2007).

1. The mechanization of land preparation typically involves the substitution of animal drawn plows to hand tractors. Also known as *power tillers*, these are two-wheeled machines that work the soil by means of rotating blades. The adoption of hand tractors can reduce labor input requirements per hectare in up to 75 percent (Pingali et al, 1997).[14] From data in the CAF I build measures of frequency in the use of hand tractors by rice farms.

2. The mechanization of the cultivation and harvesting operations in rice farms can occur through the adoption of mechanical cultivators, fertilizer distributors and weeders.[15] Using the CAF I build variables that indicate the frequency in the use of any of these machines among rice farms.

3. Finally, the mechanization of post-harvest activities typically involves the use of mechanical threshers to substitute manual labor. Generally, farmers use small axial threshers that are easily mobile and suited to be hired in contract operations.[16] Very rarely, farmers use combiners, which are large machines that combine into a single operation the process of reaping and threshing. Information on the use of these post-harvest technologies is available in the CAF.

The CAF also has information on the availability and type of irrigation systems, which can be public (built by the government) or private. In the Philippines in the 90s two out of three irrigated farms had private systems, mostly consisting of *communal* systems that are built and operated by

[14] In the absence of hand tractors, a rice farmer that plows 1 hectare with a water buffalo typically slogs 30 kilometers through a deeply muddy field and repeats this process several times (Dawe et al. 2006).

[15] The adoption of mechanical cultivators/transplanters can generate significant reductions in labor requirements. In the Philippines, rice seedlings are usually started in seedling beds and must be transplanted to flooded fields for cultivation. Transplanting seedlings by hand is a backbreaking work that requires bending over to place up to a quarter million separate seedlings per hectare (Dawe et al. 2006). Mechanical cultivators are designed to substitute labor in this process.

[16] In the absence of mechanical threshers, rice grains have to be separated from the stalks by treading or by beating the stalks against boards or racks; a very arduous task (Pignali et al, 1997).

farmer associations, sometimes with the support of government subsidized loans. Generally, these are simple gravity-type canal systems that divert river flows and are built with local materials (David, 1995). I use data in the CAF to build outcomes measuring access to private irrigation systems.

Table 3 presents summary statistics of 1991 agricultural characteristics for the 1210 municipalities used in the empirical analysis. In 1991 a typical municipality had 241 farms that had, on average, an area of 2.2 hectares. Statistics of farm production are reported in Panel B for the four most important crops in the country (i.e. rice, corn, coconut and banana) as well as for "high value commercial crops"[17]. The latter group consists of crops that are identified as most profitable by the Department of Agriculture of the Philippines.[18] In 1991 a typical municipality had approximately half of its farms producing rice, coconut and banana in at least one parcel. Corn production was less frequent. Half of the farms produced at least one high value commercial crop in at least one parcel. Raising livestock was common, with 60% of the farms being involved in this activity.

Panels C and D present statistics describing specialization and mechanization levels. Panel C shows that in a typical municipality 15% of the farms grew only one crop, 13% grew two crops and 58% grew three or more. Panel D shows the frequency in the use of different types of machinery among rice farms. Cultivation equipment, which consists of weeders, transplanters or sprayers, was the most frequent.

Migration and Remittance Variables. Data on migration and remittances are obtained from the Survey of Overseas Filipinos (SOF) and the Family Income and Expenditure Survey (FIES). Both surveys are conducted by the National Statistics Office of the Philippines (NSO). The SOF is a nationwide survey administered yearly through a rider questionnaire in the October Labor Force Survey. Information is collected for household members who were abroad within the last five years, whether they have returned or not. Crucially for my analysis, the SOF collects information on the countries visited by the migrants and the dates of their visits. The FIES is a nationwide

[17] Rice(palay), corn, coconut and banana account for 70% of the value of production in agriculture, at constant prices (Bureau of Agricultural Statistics, 2002).

[18] High value commercial crops are majorly composed by mango and also include tubers (i.e. camote (sweet potato), gabi (taro) and cassava) and vegetables (i.e. eggplant, tomatoes, stringbeans and alugbati (Malabar spinach)).

survey of households undertaken every three years by the NSO to collect data on family income and expenditures. The province is the finest administrative unit at which these surveys are representative. Provinces are the primary administrative division in the Philippines, and are further subdivided into more than a thousand cities and municipalities.

I use the SOF to construct province-level variables of migration for 1991 and 2002 and to build the 1991 distribution of migrants across destinations. Because the collection of the SOF started in 1993, retrospective histories on migration are used to build the 1991 variables, creating measurement error issues that are enhanced in first-differences equations like (2). Measurement error in remittances variables is also very likely. Remittances data is collected from the FIES, and can be easily mismeasured and misreported by survey respondents. Moreover, data for 2002 is not directly available and has to be proxied with information of 2003. [19]

The data appendix discusses the construction of the instruments in detail. It presents a list of provinces that were dropped from the sample. The provinces of the Metropolitan Manila are dropped due to the fact that they are completely urban. Provinces with very low migration levels are dropped because the accuracy of the distribution of migrants across countries will be unreliable. The remaining sample has 65 provinces, which are identified using the 1991 province boundaries.[20] Details of the threshold used to eliminate a province from the sample are also in the appendix.

4 Results

4.1 First Stage Regressions

Table 4 presents the results of the estimation of the first stage equations. Columns (1) and (6) show the results of a baseline specification, and the next columns add extra sets of controls. Estimated coefficients are interpreted as elasticities. All specifications include municipality level fixed effects

[19] These measurement issues, which are discussed in more detail in the data appendix, underscore the relevance of using instrumental variables. If measurement errors are classical, so the measurement error is independent of the true value of the mismeasured variable, the use of instrumental variables can lead to consistent estimates.

[20] During the 1990s, there were several changes to the Philippines' administrative divisions. All variables in this paper were constructed using the 1991 province divisions.

and standard errors are clustered by province and year.

The point estimates of the migration models in columns (1) through (4) indicate that a 10 percent increase in synthetic GDP is associated with an increase in the stock of migrants of 4.13-4.79 percent whereas the exchange rate coefficients are not statistically significant. The magnitude and significance of the elasticities of migration are generally invariant to the inclusion of additional controls. This suggests that the correlation between the instruments and the province level controls is small, a reassuring finding that favors the assumption of the instrumental variables being exogenous to unobserved characteristics determining migration.

Results from the remittances model, as shown in columns (6) to (10), indicate that a 10 percent increase in the exchange rate is associated with an increase in the stock of remittances of 4.83 -5.84 percent and this result also appears to be robust to the inclusion of additional controls. This estimate is similar to the estimation by Yang (2008), who finds an implied elasticity of remittances to exchange rate shocks of 0.60.[21] Finally, the results indicate that a 10 percent increase in the synthetic GDP is associated with an increase in remittances that ranges from 1.82 to 2.42 percent.

Table 4 also reports the F statistics of a joint significance test of the excluded instruments. The F-statistics in the migration models range from 16 to 22, while the F-statistics in the remittances model go from 10 to 12. As suggested in a weak instrument test by Stock and Yogo (2005), the fact that the F-statistics exceed the critical value of 7.03 indicates that, whenever I report a 5% significance, the true significance is not below 10%. However, in models with multiple endogenous variables, F statistics are not totally informative about instrument weakness. If instruments are highly collinear, they may lack linear independent relevance even when they are jointly significant, thereby making the model underidentified. Reassuringly, the first stage results show that each instrument provides independent variation to predict the endogenous variables: the stock of migrants depends only on GDP, while remittances are mostly predicted by the exchange rate.

The fact that the GDP shock has an impact on the growth of migrants can be explained by the fact that the decision to migrate in the Philippines is largely demand-driven. Recruitment agencies in

[21] However, it should be pointed out that Yang estimates elasticities at the level of remittance-receiving households, making his estimates not entirely comparable to those in my paper.

the Philippines operate as middlemen by matching potential migrants with employers abroad. Thus, the existence of job vacancies in host countries largely affects the magnitude of migration flows. Moreover the majority of Filipino migrants work in non-tradable sectors, such as domestic services, which are greatly affected by the host country's domestic conditions.[22] Changes in remittances are, on the other hand, largely affected by shocks to the exchange rate. Increases in exchange rate raise the value in Filipino pesos of the migrant's earnings and generate incentives to remit more.[23]

Very similar results from the first stage estimates are obtained when using alternative lags of the GDP instruments, as shown in columns (2), (3), (6) and (7) of Appendix Table 1. Columns (4) and (8) show the first stage estimates in models in which current and lagged values of GDP and exchange rates are used as instruments. The loss in statistical significance of the instruments reflects their high collinearity. In results not reported in this paper, I considered alternative instrumental variables, including further lags of economic shocks. There was generally a loss in instrument power, so I have opted for the more parsimonious specification above.

4.2 Impact of emigration and remittances on the agriculture sector

The framework developed in section 2 suggests several ways in which remittances and migration can affect the agricultural sector. A possible impact is the decline in the size of agriculture, to the extent that a loss in labor supply and a greater availability of capital enables a transition to more capital-intensive sectors such as manufacturing. I explore this hypothesis in this subsection.

Initially, I estimate the effects of migration and remittances on two measures of the size of the agriculture sector: the log number of farms and the log total area of farms in each municipality. Table 5 presents the estimated elasticities from OLS and IV regressions. There are some results that are worth highlighting. First, the IV estimates suggest the absence of significant effects of emigration and remittances on the farms or the farmed area. For all specifications, the IV estimated elasticities are not significantly different from zero, a result that is generally insensitive to the inclusion of additional

[22] Appendix Table 3 reports the 1991 distribution of Filipino migrants across occupations.

[23] However, as discussed by Yang (2008), there is no reason why the *whole* change in the Filipino value of migrants earnings appears as higher remittances sent home. Migrants may decide to increase their savings overseas and wait until their return date to accrue all the gains from the currency appreciation.

controls. All estimates are, however, large in magnitude and have relatively large standard errors, so I cannot rule out the possibility that the lack of statistically significant impacts is due to lack of precision in the estimation. Note that Hausman tests do not reject the null hypothesis that the OLS and IV coefficients are equal, a result that can be explained by the lack of precision.[24]

In the absence of precise estimates of the effects on the number of farms and area farmed, I look for additional evidence of the impact of remittances and emigration on the agricultural sector. Even with no adjustments in the number of farms or farmed area, remittances and migration may have an impact on the amount of labor in the agriculture sector. I therefore explore whether fewer labor inputs are allocated to the agriculture sector in response to emigration and remittances. As mentioned in section 3.2, I utilize data from the LFS to investigate this question.

To implement the analysis, the main estimating equation described in (1) is modified. The LFS is a survey of a smaller scale that is not designed to build variables at small geographic units like the municipality. The smallest geographic units at which the survey is representative is the province. This precludes me from building municipality level outcomes and estimating regressions from a balanced panel of municipalities, as in (1). Instead, I estimate the following person-level model :

$$y_{jpt} = \theta M_{pt} + \delta R_{pt} + \beta X_{jpt} + \gamma W_{pt} + \upsilon_p + \mu_t + \epsilon_{jt} \tag{5}$$

where y_{jpt} is a variable that measures employment and hours worked in the agriculture/production sector for individual j in province p and year t; M_{pt} and R_{pt} are respectively the log of the stock of migrants and the log of the total level of cash remittance receipts in province p and year t; X_{jpt} is a set of individual-level time-varying controls; W_{pt} is a set of province level time-varying controls; υ_p and μ_t are, respectively, province and year fixed effects. The equation is estimated for $t = 1991, 2002$. Standard errors are clustered at the province-by-year level to account for within-province correlation of the error terms.

[24] In regressions not presented here, I find that results using dependent variables in levels as opposed to logs are qualitatively similar.

The results presented in Table 6 consistently support the view that emigration and remittances have no impact on labor inputs allocated to the agriculture or the production sectors. The models in columns (1)-(2) are estimated for a sample of individuals aged 15 or more with the outcome variable being an indicator that takes the value of one if the individual's primary occupation is in agriculture. The coefficients measure the effect in percentage points of a 1% increase in remittances or emigration. Overall, the estimated coefficients are not significant and are very small in magnitude. Consider, for instance, the effect of a 10% growth in remittances, which is the two-year shock received by a typical province. The IV estimate with full controls indicates that a 10% growth in remittances decreases the probability an individual works in agriculture by 0.5%, and this effect is not statistically different from zero. Also, as shown in columns (3)-(4), emigration and remittance appear to have no significant impacts on the probability an individual works in the production sector.[25] As a specification check, I estimate the models in columns (1)-(4) using only a sample of individuals who are in the labor force. The results, which are reported in Appendix Table 2, are qualitatively and quantitatively similar.

Given the absence of effects on the probability that an individual works in the agriculture or production sectors, I investigate adjustments at the intensive margin. Columns (5)-(6) in Table 6 present estimates of models in which the dependent variable is the number of hours worked for individuals working in agriculture. Columns (7)-(8) show analogous estimates for individuals working in production. The coefficients measure the effect of a 1% increase in remittances or emigration in number of hours. Overall, the results consistently show the absence of effects of migration and remittances on the amount of hours devoted to either sector. In general, the magnitudes and standard errors of all estimates presented in Table 6 are small. Given that even impacts of a very small magnitude fall outside the regular confidence intervals, I interpret the results as tightly estimated zero effects.[26]

[25] The production sector, as defined by the NSO, comprises manufacturing, construction and transportation.

[26] For example, the effect in hours worked in agriculture of a 10 percent increase in remittances lies inside [-0.5, 0.2] with 95 percent probability.

4.3 Impact of emigration and remittances on crop choice and livestock

Having found little evidence of a shift away from agriculture, I now investigate possible adjustments to remittances and emigration within agriculture. In this subsection I explore the causal effects on crop choice and livestock accumulation. I estimate versions of equation (1) in which the outcome variables are the share of farms in a given town that produce a particular crop in at least one parcel of land. I focus on the production of rice, corn, coconut and banana, which, as was mentioned in section 3.2, are the most important crops in the country. I also build outcome variables measuring the probability that farms grow high value commercial crops and raise livestock.

Table 7 presents estimates from OLS and IV regressions. Each coefficient shows the effect in percentage points of a 1 percent increase in remittances or migration. There are several results that are worth highlighting. First, in all specifications, OLS and IV coefficients differ in terms of sign and significance. In all models the Hausman tests reject the null hypothesis that the OLS and IV coefficients are equal. OLS estimates of the effects of remittances appear to be downward biased in the rice, high-value crops and livestock models and positively biased in the corn, banana and coconut models. Interestingly, the direction of the bias in the case of migration runs in the opposite direction. This confirms the view that the distribution of migration and remittances across locations are not independent of determinants of agricultural production and, also, suggests that the unobserved factors determining the selection of remittances and migration are different.

Second, the estimated coefficients indicate that changes in remittances and migration have no effect on the probability that farms produce rice or own livestock. The lack of adjustments to emigration and remittances in the production of rice is not surprising. Rice is not only one of the most widely grown crops in the Philippines, it is also the dominant staple crop and is grown by many farmers in the Philippines for self consumption (Dawe et al.(eds), 2006). Moreover, since rice productivity largely depends on special topographic characteristics, shifts to alternative crops imply large adjustment costs.[27] This result has an important implication: lack of adjustments in rice production mitigates concerns of endogenous selection when I restrict the analysis of the use of

[27] Pingali et al (1997) discuss in detail the implications of climatic and topographic conditions on rice productivity.

capital-intensive technologies in section 4.4 to farms producing rice. The absence of an impact on livestock stands in contrast with earlier studies showing that remittances or emigration fuel a shift away from crop production into livestock (Miluka, 2010).

Third, I don't find evidence of a significant effect of emigration on the probability that farms produce any given crop or raise livestock. However, it should be noted even though the point estimates of the effect of emigration are not significant, the magnitudes of some of these estimates are similar to those on the remittances model. The absence of a significant emigration effect is consistent with the presence of a readily available pool of workers that can easily substitute for the labor lost to migration. This and other possible explanations are discussed in more detail in section 5. I do find, on the contrary, that remittances have a significant effect on crop choice. Remittances have a negative and statistically significant impact on the fraction of farms producing corn, coconut and banana. To assess the magnitudes of the estimates for remittances, consider again a 10 percent increase in the province-level remittance receipts, which is equivalent to the shock in a typical province within two years over the sample period. The results indicate that such a shock would reduce the fraction of farms that produce: corn, by 1.8-1.2 percentage points; coconut, by 2.8-2.9 percentage points; banana, by 3.0 -4.0 percentage points. High value crops, on the other hand, increase by 2.0-3.2 percent in response to a 10 percent growth in remittances. Unfortunately, I know of no other studies deriving similar estimations that can be used as a comparison benchmark. However, given that the estimates in this paper average over households that receive and don't receive remittances, and that crop mix adjustments are slow due to the seasonal nature of agricultural production, the magnitudes of these coefficients seem reasonable and of practical relevance.

These results suggest that remittances, perhaps by alleviating credit constraints or reducing the cost of capital, may be facilitating investments in the production of higher value crops. Indeed, high working capital requirements have been identified as a barrier that limits the possibilities that farmers in the Philippines can shift production from low-return crops, such as corn and coconut, to high-return crops, such as mango (Briones, 2008).[28] However, it is worth noting that the results can

[28]This interpretation of the results is in line with the ethnographic study by McKay (2005). Drawing on interviews from a case study undertaken during 1991-1992 and 1996-1997 in the Philippines' island of Northern Luzon, she finds

only be interpreted as suggestive evidence of shifts in the volume of production since the outcome variables measure crop choice and not output volumes. Changes in the intensity of production are, therefore, not measured.

The effects of remittances on crop choice could also be reflecting changes in patterns of specialization. The discussion presented in section 2 suggests that remittances may serve an insurance purpose, thereby altering the risk-mitigating devices used by farmers in the sending economies. Indeed, previous findings by Yang and Choi (2007) suggest that remittances may be used to buffer negative weather-related income shocks in the Philippines. If remittances are used to smooth consumption across states of nature, there may less need for the use of alternative risk-mitigating strategies, such as the diversification of income sources through diversified cropping. I test this hypothesis directly by determining whether remittances reduce the fraction of farmers that engage in crop diversification. I derive estimates of equation (1) using measures of crop diversification as outcome variables. The results are presented in Table 8. The IV estimates indicate that a 10 percent growth in the province-level remittances receipts reduce by 2.5-2.8 percent the fraction of farms that produce three or more crops and increase by 1.1-1.3 percent the fraction of farms that specialize in the production of one crop.

Note, however, that specialization in one crop does not always leads to greater risk exposure. Two such situations are considered. First, movement to a single, conservative activity from a mix of riskier activities may actually lead to a reduction in risk exposure. This may be particularly true if farmers move to specialization in rice production, since in the Philippines the price of rice is artificially stabilized by government buffer-stock operations.[29] To assess this possibility I replicate the estimates in Table 8 after excluding farms engaged in rice production. Table 9 shows the results, which are qualitatively and quantitatively similar to the results in Table 8, suggesting that the observed movements to a specialized cropping activity were not entirely driven by shifts to specialization in

that men whose spouses are overseas migrants use cash remittances from their absent wives as capital to produce new "modern commercial crops".

[29] For years the Philippines' government has implemented buffer-stock operations in the rice sector to stabilize prices paid to producers and guarantee supply for the consumers. The National Food Authority of the Philippines (NFA) procures rice from farmers during peak harvest seasons, stores it in rice mills and sells it in seasons in which prices are high. Such stabilization policies are exclusive to rice.

rice. Second, the underlying mechanism explaining the movements to crop specialization may be greater capital availability as opposed to a shift in a risk-coping mechanism. This will be the case if remittances are used by farmers to move from the production of several crops with low capital requirements to the specialization in a more capital intensive crop. I explore this issue by deriving estimates of equation (1) in which the dependent variables measure patterns of specialization in high-value commercial crops as well as patterns of specialization in traditional, non high-value crops. High-value commercial crops generally require greater upfront capital investments (Briones, 2008). The results are presented in Table 10. The IV estimates indicate that remittances increase the probability of specialization in both, high-value and traditional non high-value crops. A 10 percent growth in remittances increases the probability that farms specialize in the production of one high-value commercial crop by 2.9-3.9 percent, and in the production of one traditional non high-value commercial crop, by 4.6-8.4 percent. These additional results favor the view that the positive effect of remittances on crop specialization relates to the role of remittances as a risk-mitigating device.

4.4 Impact of emigration and remittances on the use of mechanized technologies

In this subsection I study if rice farms changed to more capital-intensive methods of production in response to increased emigration and remittances. Restricting the analysis to rice farms and rice-production machinery is crucial, since the production processes of different crops vary in terms of technology mix. Without such a restriction, observed changes in the method of production could be masking changes in the composition of crops. For example, if there is a shift in production from coconut to rice, increases in the fraction of farms using threshers may be observed, since the use of threshers is not required in coconut production. Restricting the sample of farms engaged in rice production allows me isolate technology effects that are not reflecting changes in crop choice. This restriction also facilitates to a large extent the definition of the mechanization variables. I draw on the large literature describing mechanization in rice production in the Philippines to guide the construction of the outcomes and the interpretation the results (e.g., Takahashi and Otsuka, 2009 ; Ahammed and Herdt, 1983; Dawe et al (eds.) 2006; IRRI, 1986). Of course, restricting the analysis

to rice production generates concerns about selection bias since the probability of producing rice could be a margin of adjustment to emigration and/or remittance shocks. However, the results in subsection 4.3 should ameliorate such concerns. As was shown in table 7, neither migration nor remittances have a statistically significant impact on the fraction of farms that produce rice; the estimated coefficients and standard errors are small in magnitude, a result that holds for OLS and IV regressions and is robust to the inclusion of controls.

In Table 11, I present estimates of the effects of remittances and emigration on the use of mechanized technologies in rice production. The outcome variables measure the share of rice farms that use hand tractors, cultivation and post-harvest equipment, as well as the share of rice farms that have access to private irrigation.[30] The coefficients in the table report the effect in the outcomes, measured in percentage points, of a 1 percent increase in remittances or migration.

The OLS estimates in Panel A suggest that remittances have small and insignificant effects on the percentage of farms that use mechanized technologies. In contrast, IV estimates are larger, positive and, with the exception of the cultivation model, statistically significant. The IV results imply that a 10 percent increase in remittances, which is equivalent to the shock received by a typical province within two years, led to an increase in the fraction of farms that use: handtractors (2.0-2.9 percentage points); post harvest equipment (4.2-5.3 percentage points) ; and post-harvest irrigation (2.1-2.2 percentage points). The difference between the OLS and IV estimates of the remittance effects suggests that remittances have been disproportionately allocated to locations where mechanized farming is less frequent, stressing the importance of the instrumental variable strategy.[31]

The positive impact of remittances in the access to irrigation and the use of hand-tractors and threshers are consistent with remittances facilitating the adoption of capital-intensive technologies among rice farmers by simply reducing the cost of working capital. They may also alleviate capital constraints that can arise in an environment in which credit markets do not operate smoothly, as is the case of the Philippines' rice sector. Indeed, as discussed in Floro and Ray (1997) credit markets

[30] As discussed in section 3, these systems mostly consist of simple gravity-type canal systems that divert river flows and are built by farmers' communities with local materials.

[31] Results of Hausman tests, presented in the table, reject the null of equality between OLS and IV coefficients with p-values of less than 0.01, except in the case of the cultivation equipment model.

in the Philippines' rice sector operate with imperfections.[32]

This result complements previous studies finding that remittances increase productive investments in the sending economies (e.g. Woodruff and Zenteno 2007, Yang 2008) and, more directly, studies showing that land productivity and productive investments can increase for migrant sending agricultural households (e.g., Taylor and Lopez-Feldman 2010, Mendola 2008). It is also in line with ethnographic evidence showing that remittance flows to the Philippines are used to finance investments in agricultural machinery.[33]

As opposed to remittances, emigration appears to have no causal effect on the adoption of capital-intensive technologies. This is in contrast with what is erroneously suggested by the OLS results, suggesting that, as opposed to remittances, emigration is disproportionately selected from locations with frequent mechanized farming. The absence of a causal impact of emigration on the use of mechanized farming technologies can be explained in terms of the framework in section 2. If the labor market is well functioning and the aggregate supply of labor is sufficiently elastic, emigration may not lead to adjustments in agricultural production. I analyze this issue in more detail in the next section.

5 Discussion

The results in section 4.2 suggest that remittances and emigration do not cause a relative decline in the size of the agriculture sector. In regressions not presented here, I find that these results are robust to removing one province at a time. A second set of results in sections 4.3 and 4.4 suggest that remittances have a positive impact on the choice of more specialized and capital-intensive crop

[32]Floro and Ray (1997)provide a detailed description of credit institutions in the Philippines rice economy. Rice farmers are rationed out by formal financial institutions and therefore resort to informal lending from marketing agents such as rice traders, millers and wholesalers. These agents engage in moneylending as a means to acquire claims over the produced output. They are better informed relative to formal lenders of the potential of morally hazardous behavior by borrowers and, unlike formal financial institutions, they are willing to accept agricultural production and labor as a collateral.

[33]The field work reports by United Nations-INSTRAW (2008) presents testimonies of Filipino farmers in Oriental Mindoro who used remittances from family members in Italy to buy land. Others invest in motor pumps, fertilizers, hand tractors and threshers. The ethnographic study by McKay (2003) in the Philippines provides anecdotal evidence of the use of remittances in agricultural productive investments by the husbands of female overseas domestic workers.

mixes and on the adoption of mechanized technologies whereas, in contrast, emigration has no effect on farming practices. Again, these results are found to be robust to the removal of one province at a time. A likely explanation of these findings is that remittances facilitate productive investments and change the risk-coping strategies of farmers in the sending economies. There is however, an alternative causal channel that could explain the results and deserves consideration.

Specifically, if the transfer of information on agricultural practices from migrants is in an unobserved way correlated with remittances, the results estimated in this paper require a different interpretation. International anecdotal evidence suggests that migration often leads to the flow of ideas and knowledge back to the sending countries (UNDP, 2009). Moreover, the transmission of farmer technical knowledge can be a major determinant in the choice of agricultural practices.[34] Therefore, the estimated effects of remittances on crop mix and farming technologies presented in this paper could be reflecting the impact of knowledge transmission on agricultural practices rather than the effect of a capital flow. However, I view the distribution of Filipino migrants across occupations in their destination countries as evidence against this alternative interpretation of the results. Most migrants work as production workers, household helpers or in other service sector occupations, whereas agricultural occupations are very infrequent. Only 3 percent of migrant workers in 1991 worked in agriculture.[35] Given that very few Filipino migrants work in the agriculture sector abroad, the role of migration as a transmission channel of farming knowledge is likely to be small.

The absence of effects from emigration on farming practices also merits further consideration. As discussed in section 2, in the absence of hiring constraints, the effects of emigration on agricultural production can be small if labor supply in the local markets is highly elastic. This very elastic labor supply might be reflecting the existence of "surplus labor", as presented in the seminal work by Lewis (1954). In an environment in which the abundance of labor relative to other inputs of production is so large that its marginal productivity is negligible, the withdrawal of workers will have a minimal impact on production. The high rural unemployment rates during the sample period

[34] For example, in a study of rice production patterns in South East Asia, Pingali et al. (1997) indicate that differences in farm productivity are more affected by farmer technical knowledge than by access to technology or inputs, making knowledge the "scarce resource".

[35] Appendix Table 3 shows the occupational distribution of Filipino workers for 1991.

and the importance of hired labor in the agricultural sector favor this interpretation.[36]

However, the absence of significant effects of emigration on farming practices in local markets does not imply that emigration has no effect on farming at the national level. If agricultural labor moves across provinces in response to the outflow of labor, the effects of emigration will spread across the national economy. To the extent that cross-province migration flows offset each other, net changes in province level relative endowments due to emigration may be very small. Thus, the full effects of emigration will not be captured by the province-level flow coefficients estimated in this paper.[37]

I assess this issue by studying the effects of emigration on the labor endowment of neighboring provinces. Specifically, I search for evidence of cross-province spillover effects within a given *region*. *Regions*, as defined by the NSO, consist of groups of contiguous provinces that have similar cultural and ethnic characteristics. In 1991 there were 16 regions. The map in figure 2 illustrates both the regional and province level divisions. Combining data from SOF and LSF and using the same instrumental variable described above, I estimate the following person-level equation:

$$y_{jprt} = \lambda_1 M_{p,t} + \lambda_2 M_{r-p,t} + \rho_1 R_{p,t} + \rho_2 R_{r-p,t} + \beta X_{jprt} + \gamma W_{prt} + \alpha_{pr} + \mu_t + \varepsilon_{jprt} \qquad (6)$$

y_{jprt} is a binary variable indicating whether individual j in province p, region r and year t was in the labor force; M_{r-pt} is the log of the stock of migrants in year t from all provinces in region r except for province p ; R_{r-pt} is the log stock of remittances in year t from all provinces in region r except for province p ; X_{jprt} is a set of individual level time-varying controls; W_{prt} is a set of province level time-varying controls; α_{pr} and μ_t are, respectively, province and time fixed effects. The equation is estimated for the sample of individuals aged 15 or more with $t = 1991, 2002$.

The coefficients λ_2 and ρ_2 capture the effects on the labor supply of province p of migration

[36] According to Dawe et al (2006)., approximately 70 percent of total labor used in rice production is hired. During the 1990s, rural unemployment rates reached 25 percent during the 1990s (Herrin and Pernia,2003).

[37] A similar methodological challenge has been faced by researchers using exogenous shocks at the regional level to identify the causal effects of immigration on the host countries. See, for instance, the discussions in Card (2001), Cortés (2008), Borjas (2008) and Friedberg (2001).

and remittance shocks in neighboring provinces. Results from these estimates are presented in Table 12. The coefficients measure the impact on labor force participation, in percentage points, of a 1 percent growth in remittances or in emigration. Overall, I fail to find statistically significant impacts of remittances and migration from neighboring provinces on the labor supply of province p, and these results are invariant to the inclusion of controls.[38]

Thus, the results suggest that labor force participation does not respond to remittance and migration shocks in neighboring provinces. This can be interpreted as suggestive evidence that favors the assumption of closed province-level factor markets. However, it is important to note a caveat to this conclusion: the evidence presented in Table 12 does not test for spillover effects of emigration and remittances across *regions* that would also lead to attenuation bias. The inability to account for intra-national factor mobility in response to emigration and remittances is a limitation of the identification strategy that cannot be ignored. Coefficients estimated in this study should then be interpreted as estimates of the causal effects of emigration and remittances on province level agriculture markets and as lower bounds of the overall impacts of emigration and remittances on the national economy.

6 Conclusion

This paper presents evidence suggesting that international migration and remittances from migrants are not leading to a relative decline in the size of agricultural sector. Instead, remittances seem to be transforming productive practices within agriculture. By increasing the availability of working capital and serving an insurance purpose, remittances appear to have a positive impact on the choice of more specialized crop mixes, the production of high value commercial crops and the adoption of mechanized technologies. A 10 percent increase in remittances, which is the typical two-year shocked received by a province, increases the probability that farms grow high value crops in 2-3 percent and specialize in one crop 1 percent. Moreover, the probability that rice farms adopt hand

[38]The first stage regressions of these estimations are shown in Appendix Table 4. Each instrument has independent predictive power in a respective first stage equation.

tractors increases by 2-3 percent and use threshers by 4-5 percent. Also, the fraction of rice farms with private irrigation systems grows by 2 percent. Considering that, due to the seasonal nature of agricultural production, adjustments in farming are slow and that the estimates in this paper average over the whole local agricultural economy and therefore include farms that are not direct recipients of remittances, the magnitudes of the effects are economically significant. In contrast, I find no evidence that emigration has an impact on farming practices, something that can be explained by the absence of hiring constraints and an elastic local labor supply.

The results in this paper contradict views that remittances primarily sustain current consumption with no impact in productive investments and also provide empirical evidence supporting the risk-mitigating role of remittance flows. Finally, the results do not support the view of a disruptive effect of the outflow of migrant workers on agricultural production. These findings underscore the importance of assessing separately the effect of emigration and the effect of remittances. To the extent that shortages of capital and insurance, and not of labor, constrain production in most agricultural economies in developing countries, emigration can have a minor disruptive effect while remittances facilitate agricultural development.

7 Data Appendix

7.1 Construction of migration and remittance variables

Migration stocks by province. Province level migration stocks were calculated using data from the Survey of Overseas Filipinos (SOF), which is a nationwide yearly survey conducted since 1993 by the National Statistics Office of the Philippines (NSO). The SOF collects information of all households reporting that any members were abroad in the last five years from a rider questionnaire in the October Labor Force Survey. The 2002 overseas migrants stocks was directly calculated by province using information on the number of household members abroad in 2002 SOF. The 1991 province stock of migrants was instead calculated using retrospective information of the 1993 survey. Adapting from Yang (2008) I use the following questions to identify whether a family member was overseas in 1991: (i) When did the family member last leave for overseas? ; (ii) When did the family member return from his/her last departure (if at all)?; (iii) How many months has the family member worked/been working abroad during the last five years? Questions (i) and (ii) can be used to identify migrants who were abroad in 1991 from *last* trip. In order to identify migrants who were abroad in 1991 from a trip previous to the last one I use question (iii) and assume that stays overseas were continues. If in October 1993 households report that a family members has spent two or more years abroad and has not returned, I infer that the migrant was abroad in 1991. Thus, the migration stock variables may be subject to measurement error issues that can be particularly severe in first difference estimations like the one conducted in this paper. If measurement error is uncorrelated with the unobserved explanatory variable, the estimated effects will be attenuated. This highlights the importance of the IV approach.

Remittance levels by province. Remittance levels by province can be obtained from two sources: the Survey of Overseas Filipinos (SOF) or the Family Income and Expenditure Survey (FIES). The FIES is a nationwide survey of households undertaken every three years by the NSO to collect data on family income and expenditures. Remittance measures from both data sources are imperfect. First, due to the definition of the survey universe, remittances in the SOF are only reported by households with a member who migrated in the last five years. Remittances to households that have no family members abroad are, therefore, not reported in the SOF. The FIES, on the other hand, provides information of remittances received by all households including those with no migrant members. However, the FIES is conducted every three years and its administration does not always coincide with that of the CAF. In 1991 both the FIES and the CAF were conducted, but this was not the case for 2002 as the FIES was administered only until 2003. Remittance data from the SOF is, on the contrary, available for 2002 but not for 1991 as the administration of this survey started in 1993.

In this study I use the deflated 2003 province-level stocks of remittances as a proxy for the 2002 stocks. The use of this proxy and the possibility of misreporting remittances by survey respondents creates concerns of measurement error. Moreover, as discussed before, the estimation in first differences implemented in this paper will make measurement error problems even more severe. The instrumental variable approach in this paper is used to address this problem.[39]

[39]Indeed, empirical results are not substantially affected when estimates are derived using the stocks of remittances

7.2 Construction of the instrumental variables

Shares of migrants across destinations (i.e. π_{pd}) I construct variables measuring the fraction of the province level stocks of migrants in each country of destination using data from the SOF. Provinces that have too few migrants are dropped from the sample, as the accuracy of the distribution is unreliable.[40] For the provinces remaining I identify the two more common destination countries and compute the distribution of migrants between these two destinations. If the number of migrants choosing the second destination is less than four, I only use the first destination. If two destinations host less than two thirds of the migrants and the third destination has less than four migrants, I compute the distribution among the top three destinations.[41]

Macroeconomic variables of destination countries Nominal exchange rates of the destination country currencies with respect to the Filipino peso were computed using the end-of-period USD exchange rates in the IMF International Finance Statistics database. I then converted the exchange rates to 2002 constant Filipino pesos using the consumer price index reported by NSO. The exchange rates in 2002 Filipino pesos were used to build the instruments.

GDP levels were collected from the International Monetary Fund World Economic Outlook Database. These variables were obtained at current PPP international dollars and then adjusted to constant prices. The adjustment to constant prices was done using the corresponding real GDP growth rates. These growth rates were calculated from the series of GDP in national currency constant prices in the World Economic Outlook database. After this adjustment, the GDP in constant PPP international dollars were used to build the instruments.

from the 2002 SOF instead of the 2003 FIES.

[40] The threshold used for being dropped out of the sample is less than four migrants reported in the survey. These provinces are Camiguin, Agusan Del Sur, Siquijor, Davao Oriental, Sulu, Bukidnon, Southern Leyte, Romblon, Misamis Occidental. The provinces of Metro Manila are also dropped from the sample in spite of them having high migration levels due to the fact that they are mainly urban.

[41] A similar approach is used by Antman (2010).

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Figure 1: Effects of a reduction in labor supply

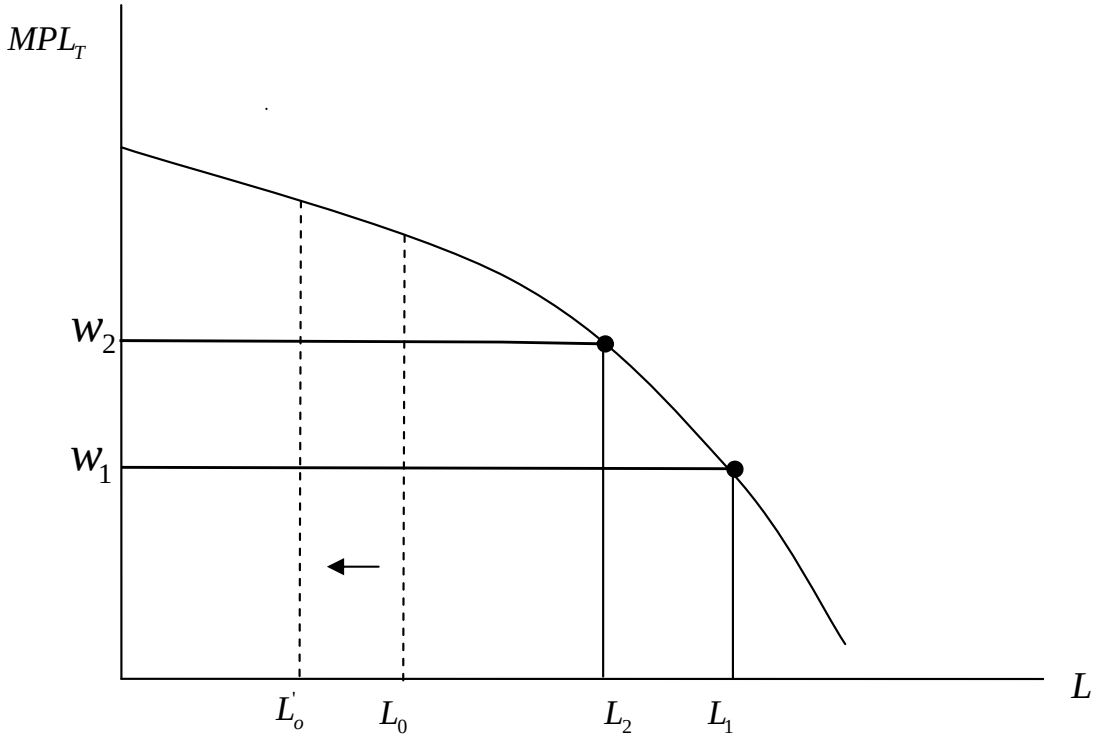
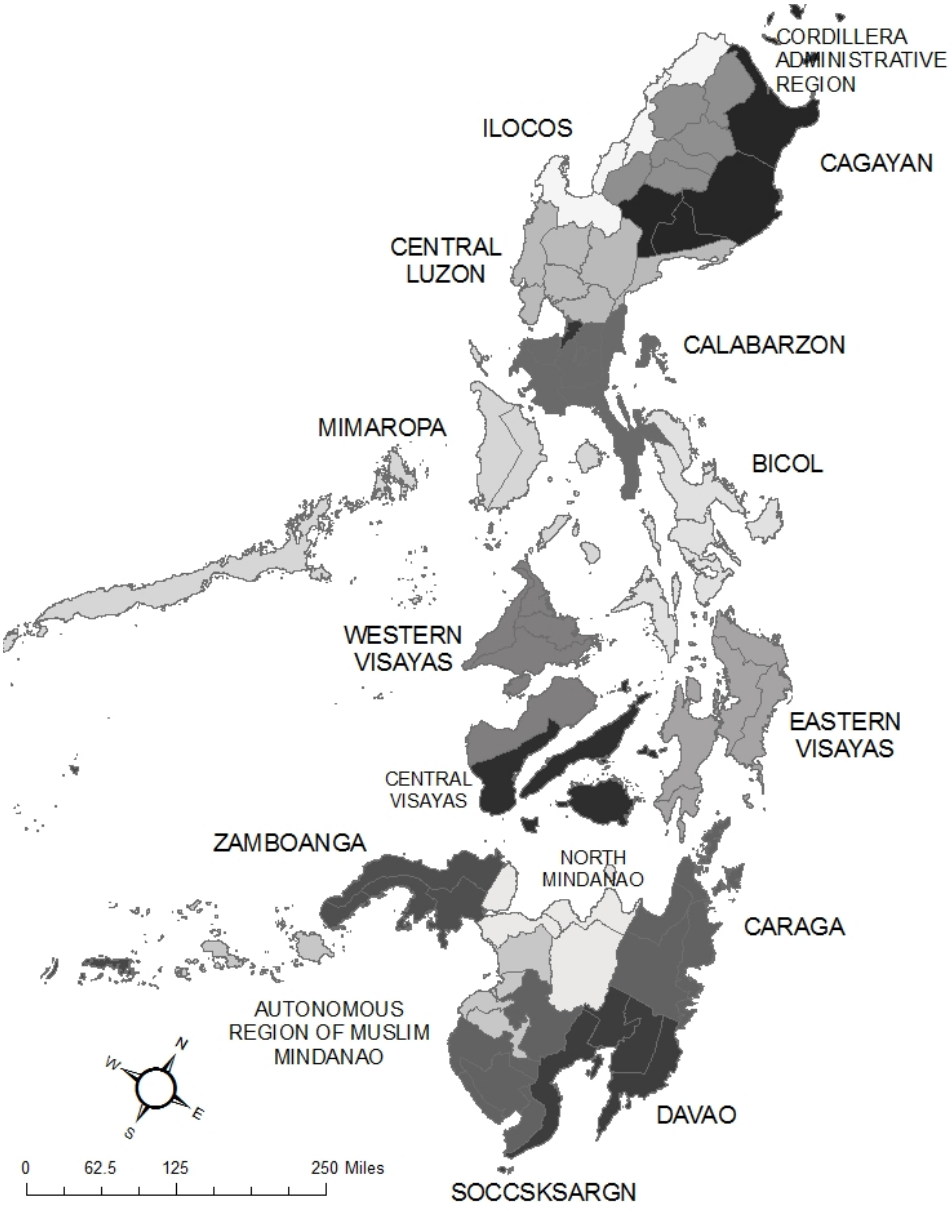


Figure 2: Regions and Provinces of the Philippines



Notes: Lines are used for province borders. Different colors are for different regions. Labels indicate the name of each region.

Table 1. Countries of destination of overseas workers in 1991

Country	% of total (1)	1991-2002 real GDP growth (2)	1991-2002 Exchange rate growth (3)
Kingdom of Saudi Arabia	28.4%	21%	-0.4%
United States of America	13.1%	42%	-0.4%
Italy	6.3%	18%	-37.9%
Japan	6.3%	10%	4.0%
Hong Kong	6.2%	42%	-0.6%
Greece	4.4%	33%	-46.3%
Singapore	4.1%	98%	-6.5%
United Arab Emirates	3.3%	57%	-0.4%
Kuwait	2.2%	152%	-5.5%
Malaysia	1.8%	92%	-28.6%
Taiwan	1.0%	79%	-22.8%
Other Countries	23.0%	N.A	N.A.

Notes: Column 1 reports the share of total filipino migrants in each country. Data is built using retrospective information of migration from the Surveys of Overseas Filipinos 1993-1996. See the data appendix for details

Column 2 reports the real change in GDP over the period. Changes are computed using GDP in constant prices. The change is calculated is the 2002 GDP minus the 1991 GDP divided by the latter. Column 3 reports the change in the real exchange rate: constant Filipino pesos per currency unit. The change is calculated as the 2002 exchange rate minus the 1991 exchange rate divided by the latter.

Exchange rate and GDP data are obtained from the IMF World Economic Outlook Database

Table 2. Province level distribution of migrants across destination countries.

Province(*)	Country of destination					
	Saudi Arabia	USA	Hong Kong	Italy	Other countries	Total
Maguindanao	71%	0%	0%	0%	29%	100%
Bulacan	49%	0%	20%	0%	31%	100%
Iloilo	46%	0%	0%	0%	54%	100%
Quezon	38%	0%	36%	13%	13%	100%
Pampanga	37%	13%	0%	12%	38%	100%
NCR-2nd Dist.	27%	9%	0%	9%	55%	100%
Cagayan	24%	22%	0%	22%	32%	100%
Ilocos Norte	19%	56%	0%	0%	26%	100%
Batangas	15%	11%	0%	48%	26%	100%
Negros Occidental	10%	19%	10%	0%	62%	100%

Note- (*) In 1991 there were 77 provinces in the Philippines. For simplicity, I list in this table the 10 provinces with highest migration levels. (**) NCR is the acronym for National Capital Region

Data is built using retrospective information of migration from the Surveys of Overseas Filipinos 1993-1996.

See the data appendix for details in which this variable was built.

Table 3. Municipality Agricultural Characteristics in 1991

	Mean (1)	Stdev (2)
Panel A:		
No of Farms	241	240
Area farms (Ha)	671	798
Average farm size (Ha.)	2.20	3.65
Panel B: Fraction of farms that produce/raise:		
Rice	0.47	0.30
Corn	0.31	0.26
Coconut	0.54	0.21
Banana	0.50	0.21
High valued crops	0.51	0.22
Livestock	0.60	0.29
Panel C: Fraction of farms that grow:		
One crop	0.15	0.11
Two crops	0.18	0.09
Three or more crops	0.58	0.24
Panel D: Fraction of rice farms that use:		
Private irrigation systems	0.31	0.28
Hand tractors	0.22	0.27
Cultivation equipment	0.57	0.31
Post harvest equipment	0.24	0.28
Number of municipalities	1210	

Source: 1991 CAF

Table 4. First Stage Regressions

Dependent variable:	Log (Stock of Migrants)					Log (Remittances)				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Log GDP - 2 years lag	0.441***	0.413***	0.413***	0.415***	0.479***	0.231*	0.198*	0.182*	0.242*	0.240**
	(0.130)	(0.117)	(0.113)	(0.131)	(0.112)	(0.124)	(0.119)	(0.103)	(0.128)	(0.112)
Log Exchange Rate -contemporaneous	0.289	0.267	0.256	0.284	0.195	0.483**	0.584***	0.530***	0.494**	0.578***
	(0.252)	(0.242)	(0.240)	(0.244)	(0.236)	(0.202)	(0.207)	(0.192)	(0.198)	(0.201)
Province level demographic controls	No	Yes	No	No	Yes	No	Yes	No	No	Yes
Province level agricultural controls	No	No	Yes	No	Yes	No	No	Yes	No	Yes
Province level economic controls	No	No	No	Yes	Yes	No	No	No	Yes	Yes
F excluded instruments	18.92	16.97	17.67	17.14	22.18	10.34	10.12	11.69	10.07	10.66
Observations	2420	2420	2420	2420	2420	2420	2420	2420	2420	2420

Note- Weighted Least Square estimates were the weights are the number of farms per municipality in 1991. Standard errors clustered by province and year.

All models include municipality and year fixed effects. Province level controls consist of interactions between 1991 means and decade dummies.

* Denotes statistical significance at the 10% level; ** at the 5 % level; *** at the 1% level

Table 5. Log area and log number of farms

	Log (No of farms)		Log (Area farm)	
	(1)	(2)	(3)	(4)
	Panel A: OLS estimates			
Log (remittances)	0.259***	0.081	-0.072	-0.168***
	(0.089)	(0.057)	(0.070)	(0.061)
Log (stock of migrants)	-0.019	0.088	0.102	0.190***
	(0.109)	(0.053)	(0.069)	(0.071)
	Panel B: IV estimates			
Log (remittances)	-0.080	-0.098	-0.442	-0.425
	(0.417)	(0.231)	(0.410)	(0.318)
Log (stock of migrants)	0.363	0.219	0.335	0.463
	(0.410)	(0.216)	(0.354)	(0.306)
Province level time varyng controls	No	Yes	No	Yes
Hausman p-value	0.60	0.72	0.42	0.66
Observations	2420	2420	2420	2420

Note-Municipality and year fixed effects included in all specifications. Province level controls consist of 1991 means of agricultural,demographic and economic characteristics. All regressions are weighted by the number of farms in 1991. Standard errors are clustered at the province x year level.

*Denotes statistical significance at the 10% level; ** at the 5 % level; *** at the 1% level

Table 6. Labor inputs in the agriculture and production sectors

	Works in agriculture sector (pct points)		Works in production sector (pct points)		Hours in agriculture sector (hours)		Hours in production sector (hours)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
				Panel A: OLS estimates				
Log (remittances)	-0.007	-0.017	0.006	0.007	-0.011***	-0.003	0.010***	0.005
	(0.011)	(0.012)	(0.008)	(0.008)	(0.004)	(0.002)	(0.003)	-0.003
Log (stock of migrants)	-0.017	0.004	0.009	0.004	0.007	0.003	0.004	0.002
	(0.018)	(0.019)	(0.009)	(0.009)	(0.005)	(0.004)	(0.004)	(0.004)
				Panel B: IV estimates				
Log (remittances)	-0.055	-0.049	0.055**	0.076*	-0.024	-0.019	0.004***	0.072
	(0.081)	(0.104)	(0.024)	(0.044)	(0.015)	(0.020)	(0.002)	-0.105
Log (stock of migrants)	-0.063	-0.058	0.022	0.077	-0.015	-0.014	0.004	(0.087)
	(0.132)	(0.173)	(0.034)	(0.060)	(0.097)	(0.098)	(0.002)	(0.151)
Province level controls	No	Yes	No	Yes	No	Yes	No	Yes
Mean dependent variable (% or hours)	25	25	17	17	33	33	44	44
Hausman p-value	0.36	0.70	0.04	0.06	0.13	0.00	0.00	0.52
Clusters	130	130	130	130	130	130	130	130
Observations	195,599	195,599	195,599	195,599	38,261	38,261	26,331	26,331

Columns (1)-(4) present estimates of the percentage point change in the probability of working in agriculture/production if the stock of remittances/migration increases in 1 percent. Columns (5)-(8) present estimates of the change in hours worked in agriculture/production if the stock of remittances/emigration increases in 1 percent.

All models include municipality and year fixed effects. Province level controls consist of interactions between 1991 means and decade dummies.

*Standard errors clustered by province and year. *Denotes statistical significance at the 10% level; ** at the 5 % level; *** at the 1% level*

Table 7. Effects of emigration and remittances on crop choice.

	Share of farms that grow:										Share of farms that raise livestock	
	Rice		Corn		Coconut		Banana		High Value Crops			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
					Panel A: OLS							
Log (remittances)	-0.104***	-0.100***	0.027	0.008	-0.007	-0.011	-0.051***	-0.021	-0.031**	-0.035**	-0.143***	-0.115***
	(0.023)	(0.014)	(0.020)	(0.011)	(0.015)	(0.012)	(0.017)	(0.015)	(0.014)	(0.015)	(0.028)	(0.018)
Log (stock of migrants)	0.079**	0.090***	-0.033**	-0.033***	-0.019	-0.022*	-0.001	-0.035**	0.007	0.001	0.134***	0.081***
	(0.033)	(0.020)	(0.016)	(0.010)	(0.015)	(0.012)	(0.018)	(0.015)	(0.016)	(0.017)	(0.035)	(0.020)
					Panel B: IV							
Log (remittances)	0.029	0.063	-0.187*	-0.124***	-0.289*	-0.278**	-0.398**	-0.304***	0.326**	0.200**	0.079	-0.044
	(0.075)	(0.087)	(0.113)	(0.044)	(0.159)	(0.138)	(0.157)	(0.083)	(0.163)	(0.094)	(0.254)	(0.088)
Log (stock of migrants)	-0.041	-0.068	0.160	0.165*	0.216	0.219	0.163	0.152	-0.181	-0.165	-0.131	-0.002
	(0.092)	(0.090)	(0.102)	(0.091)	(0.142)	(0.190)	(0.146)	(0.098)	(0.131)	(0.116)	(0.234)	(0.099)
Province level controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Mean dependent variable (%)	42	42	22	22	52	52	56	56	57	57	71	71
Hausman test p-value	0.05	0.03	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.03	0.04
Observations	2420	2420	2420	2420	2420	2420	2420	2420	2420	2420	2420	2420

All models include municipality and year fixed effects.

Province level controls consist of interactions between 1991 means and decade dummies.

*Standard errors clustered by province and year. *Denotes statistical significance at the 10% level; ** at the 5 % level; *** at the 1% level*

Table 8. Effects of emigration and remittances on crop diversification

	Share of farms that grow:					
	One crop		Two crops		Three or more crops	
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: OLS					
Log (remittances)	0.017**	0.014*	-0.003	-0.015*	-0.026	-0.022
	(0.008)	(0.007)	(0.008)	(0.008)	(0.020)	(0.018)
Log (stock of migrants)	0.010	0.013	0.015	0.013	-0.037	-0.019
	(0.009)	(0.008)	(0.009)	(0.009)	(0.023)	(0.019)
	Panel B: IV					
Log (remittances)	0.128**	0.114**	0.080	0.059	-0.275**	-0.251***
	(0.063)	(0.046)	(0.057)	(0.041)	(0.138)	(0.096)
Log (stock of migrants)	-0.074	0.052	-0.044	-0.035	0.158	0.158
	(0.056)	(0.041)	(0.048)	(0.037)	(0.120)	(0.120)
Province level controls	No	Yes	No	Yes	No	Yes
Mean dependent variable (%)	16	16	24	24	55	55
Hausman test p-value	0.01	0.08	0.15	0.27	0.02	0.05
Observations	2420	2420	2420	2420	2420	2420

All models include municipality and year fixed effects.

Province level controls consist of interactions between 1991 means and decade dummies.

*Standard errors clustered by province and year. *Denotes statistical significance at the 10% level; ** at the 5 % level; *** at the 1% level*

Table 9. Effects of emigration and remittances on crop diversification- excluding rice

	Share of farms that grow (excluding rice):					
	One crop		Two crops		Three or more crops	
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: OLS					
Log (remittances)	0.012	0.001	-0.004	-0.040***	-0.056	0.038
	(0.009)	(0.010)	(0.015)	(0.012)	(0.034)	(0.027)
Log (stock of migrants)	0.016	0.025**	0.008	0.029***	-0.027	-0.072***
	(0.010)	(0.011)	(0.012)	(0.010)	(0.029)	(0.024)
	Panel B: IV					
Log (remittances)	0.159**	0.146***	0.011	0.013	-0.283*	-0.270**
	(0.079)	(0.055)	(0.063)	(0.042)	(0.163)	(0.116)
Log (stock of migrants)	-0.094	-0.085	0.015	0.000	0.150	0.165
	(0.068)	(0.052)	(0.054)	(0.039)	(0.148)	(0.112)
Province level controls	No	Yes	No	Yes	No	Yes
Mean dependent variable (%)	18	18	23	23	47	47
Hausman test p-value	0.01	0.00	0.39	0.15	0.09	0.00
Observations	2420	2420	2420	2420	2420	2420

All models include municipality and year fixed effects.

Province level controls consist of interactions between 1991 means and decade dummies.

*Standard errors clustered by province and year. *Denotes statistical significance at the 10% level; ** at the 5 % level; *** at the 1% level*

Table 10. Effects of crop diversification- high value crops vs. non-high value crops

	Share of farms that grow:							
	One high value crop		Three or more high value crops		One non-high value crop		Three or more non high value crops	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
				Panel A: OLS				
Log (remittances)	0.005*	0.007**	-0.065***	-0.080***	0.003	0.015***	-0.016	-0.048***
	(0.003)	(0.003)	(0.018)	(0.013)	(0.007)	(0.005)	(0.018)	(0.012)
Log (stock of migrants)	-0.001	0.001	0.000	-0.021	0.016*	0.005	-0.023	-0.006
	(0.003)	(0.003)	(0.022)	(0.019)	(0.009)	(0.007)	(0.019)	(0.015)
				Panel B: IV				
Log (remittances)	0.039***	0.029***	-0.052	-0.086	0.084**	0.046*	-0.229***	-0.163***
	(0.014)	(0.010)	(0.092)	(0.061)	(0.036)	(0.027)	(0.084)	(0.059)
Log (stock of migrants)	-0.019	-0.017	0.025	0.020	-0.046	-0.020	0.142*	0.102*
	(0.019)	(0.018)	(0.085)	(0.059)	(0.034)	(0.026)	(0.080)	(0.060)
Province level controls	No	Yes	No	Yes	No	Yes	No	Yes
Mean dependent variable (%)	2.7	2.7	44.8	44.8	13.9	13.9	54.5	54.5
Hausman test p-value	0.00	0.02	0.21	0.04	0.07	0.12	0.00	0.02
Observations	2420	2420	2420	2420	2420	2420	2420	2420

All models include municipality and year fixed effects.

Province level controls consist of interactions between 1991 means and decade dummies.

*Standard errors clustered by province and year. *Denotes statistical significance at the 10% level; ** at the 5 % level; *** at the 1% level*

Table 11. Effects of emigration and remittances on the use of machinery in rice farms

	Share of rice farms that use:						Share of rice farms with private irrigation	
	Hand tractors		Cultivation equipment		Post harvest			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Panel A: OLS estimates							
Log (remittances)	0.007	0.018	0.002	0.000	-0.070	-0.051	-0.001	0.011
	(0.021)	(0.016)	(0.021)	(0.017)	(0.047)	(0.038)	(0.012)	(0.014)
Log (stock of migrants)	0.032	0.034	0.060**	0.088***	0.167**	0.166***	-0.004	-0.007
	(0.033)	(0.022)	(0.028)	(0.025)	(0.070)	(0.056)	(0.015)	(0.020)
	Panel B: IV estimates							
Log (remittances)	0.288*	0.203**	0.153	0.233	0.533*	0.420**	0.219**	0.212***
	(0.157)	(0.087)	(0.228)	(0.145)	(0.313)	(0.209)	(0.111)	(0.060)
Log (stock of migrants)	-0.134	-0.051	-0.104	-0.147	-0.381	-0.130	-0.167	-0.134
	(0.149)	(0.092)	(0.204)	(0.155)	(0.403)	(0.242)	(0.110)	(0.109)
Province level controls	No	Yes	No	Yes	No	Yes	No	Yes
Mean dependent variable (%)	36	36	65	65	38	38	36	36
Hausman test p-value	0.00	0.00	0.72	0.14	0.00	0.00	0.01	0.00
Observations	2420	2420	2420	2420	2420	2420	2420	2420

All models include municipality and year fixed effects. Province level controls consist of interactions between 1991 means and decade dummies.

*Standard errors clustered by province and year. *Denotes statistical significance at the 10% level; ** at the 5 % level; *** at the 1% level*

Table 12. Regional spillover effects on labor supply

	Labor Force Participation	
	(1)	(2)
Log (remittances in rest of region)	0.077	0.084
	(0.130)	(0.116)
Log (migration in rest of region)	-0.070	-0.085
	(0.214)	(0.204)
Log (remittances in own province)	-0.099	-0.108
	(0.085)	(0.096)
Log (migration in own province)	0.159	0.174
	(0.159)	(0.168)
Province controls	No	Yes
Clusters	130	130
Observations	196,599	196,599

All models include province and year fixed effects.

Province controls are interactions between 1991 means and decade dummies.

Statistical significance at the 10% level; ** at the 5 % level; * at the 1% level*

Standard errors clustered by province and year.

Appendix Table 1. First Stage- Alternative Specifications

Dependent variable:	Log Stock of Migrants				Log Stock of Remittances			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log GDP - contemporaneous	0.460***			1.428	0.225**			-3.750*
	(0.101)			(2.971)	(0.110)			(2.069)
Log Exchange Rate - contemporaneous	0.233			2.442	0.600***			5.082
	(0.225)			(10.071)	(0.197)			(8.333)
Log GDP - 1 year lagged		0.476***		-4.594		0.242**		7.272
		(0.109)		(6.174)		(0.112)		(4.441)
Log Exchange Rate - 1 year lagged		0.207		-1.472		0.573***		-2.198
		(0.233)		(10.653)		(0.200)		(9.005)
Log GDP - 2 year lagged			0.492***	0.618			0.255**	-7.729
			(0.109)	(6.535)			(0.127)	(4.902)
Log Exchange Rate - 2 year lagged			0.140	4.980			0.488**	3.961
			(0.230)	(6.012)			(0.195)	(5.655)
F excluded instruments	21.86	22.09	22.50	6.63	10.29	10.30	9.05	10.18
Observations	2420	2420	2420	2420	2420	2420	2420	2420

Note- Weighted Least Square estimates were the weights are the number of farms per municipality in 1991. Standard errors clustered by province and year.

All models include municipality and year fixed effects and province level controls.

* denotes statistical significance at the 10% level; ** at the 5 % level; *** at the 1% level

Appendix Table 2. Labor inputs in the agriculture and production sectors

	Works in agriculture		Works in production	
	(1)	(2)	(3)	(4)
	Panel A: OLS estimates			
Log (remittances)	-0.019	-0.018	0.006	0.007
	(0.015)	(0.018)	(0.008)	(0.008)
Log (stock of migrants)	-0.020	0.004	0.009	0.004
	(0.027)	(0.030)	(0.009)	(0.009)
	Panel B: IV estimates			
Log (remittances)	-0.079	-0.055	0.055*	0.073
	(0.086)	(0.114)	(0.028)	(0.045)
Log (stock of migrants)	0.022	-0.004	-0.028	-0.078
	(0.138)	(0.188)	(0.043)	(0.062)
Province level controls	No	Yes	No	Yes
Mean dependent variable (%)	35	35	20	20
Hausman p-value	0.70	0.72	0.04	0.07
Clusters	130	130	130	130
Observations	133,416	133,416	133,416	133,416

Columns (1)-(4) present estimates of the percentage point change in the probability of working in agriculture/production if the stock of remittances/migration increases in 1 percent.

All models include municipality and year fixed effects. Province level controls consist of interactions between 1991 means and decade dummies. Standard errors clustered by province and year.

Denotes statistical significance at the 10% level; ** at the 5 % level; * at the 1% level*

Appendix Table 3. Occupation of Filipino Migrants in 1991

Production workers and laborers	29%
Household helpers	27%
Professionals, technical workers and managers	18%
Service workers (excluding household helpers)	13%
Clerks and sales workers	7%
Agricultural workers	**3%**
Unknown	2%
Total	100%

Note: Data is built using retrospective information of migration from the Surveys of Overseas Filipinos 1993-1996. See the data appendix for details in which this variable was built.

Apppendix Table 4. First stage

Dependent variable	Log migration in own province		Log remittances in own province		Log migration in rest of region		Log remittances in rest of region	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log (GDP in province)	0.349*	0.465***	-0.109	0.252	0.172**	0.176*	-0.005	0.099
	(0.183)	(0.169)	(0.232)	(0.248)	(0.086)	(0.097)	(0.140)	(0.149)
Log (EXR in province)	0.156	0.130	0.453***	0.380***	-0.048	-0.050	-0.036	-0.061
	(0.102)	(0.079)	(0.114)	(0.114)	(0.034)	(0.035)	(0.068)	(0.066)
Log (GDP in rest of region)	-0.368	-0.251	-1.092*	-0.904	1.029***	1.069***	0.695*	0.648*
	(0.361)	(0.254)	(0.594)	(0.552)	(0.308)	(0.311)	(0.370)	(0.380)
Log (EXR in rest of region)	-0.189	0.066	-0.087	0.254	0.385***	0.383***	0.836***	0.891***
	(0.218)	(0.161)	(0.242)	(0.235)	(0.075)	(0.091)	(0.204)	(0.214)
Province level controls	No	Yes	No	Yes	No	Yes	No	Yes
Clusters	130	130	130	130	130	130	130	130
F- excluded instruments	4.54	6.28	6.16	5.83	10.29	7.50	7.35	7.03

All models include province and year fixed effects. Province controls are interactions between 1991 means and decade dummies.

Denotes statistical significance at the 10% level; ** at the 5 % level; * at the 1% level Standard errors clustered by province and year.*