REMITTANCES, HOUSEHOLD DECISIONS AND MICROENTERPRISES: EMPIRICAL EVIDENCE FROM ECUADOR AND PERU

Dissertation

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Introduction

The main focus of this thesis lies on the impacts of migrant's remittances and women's empowerment on economic development. It contains four empirical studies from two Latin American countries, Ecuador and Peru.

Although migration is highly restricted, the number of migrants is increasing continually. More than 215 million people - or 3 percent of the world population - live outside their home countries.[1] Migrant's remittances sent to family members in the home country are not only a visible consequence of migration. Migration is often motivated at least partly by the desire for sending remittances to family members. The amounts are large. In 2009, remittances sum up to 416 billion US Dollar (USD) worldwide and the major part goes to developing countries (310 billion USD). The inflows are an important source of income for developing countries that is slightly lower than foreign direct investment (360 billion USD) and almost three times as high as official development aid (120 billion USD). With 60 billion USD, Latin America and the Caribbean has been the main remittance receiving region until 2007 in the developing world (before remittances to South Asia and East Asia and Pacific started to increase heavily in these regions). Hence, migration and migrants' remittances take an important position in the economy of Latin America, and considerably affect migrant households and the dynamics of the whole economy. In contrast to other main international inflows, remittances are private transfers that directly increase household income. Improving our understanding about their impacts on development is crucial. The impact on the recipient households is generally positive. Remittances decrease poverty, income volatility, liquidity constraints and vulnerability. Moreover, they can increase household expenditures on education and health, categories which are considered as especially important for economic development. On the other hand, the transfers can undermine the incentives to work according to the neoclassical model of labor-choice by increasing the recipients' income. While an increase in leisure should increase the recipients' utility, it also reduces output and may create dependency.

Promoting gender equality and empowering women is the third goal of the UN millennium development goals. Equality between both genders is not only a desirable aim in itself and addresses the most vulnerable, but the potential implications of women's empowerment on development have long been recognized. Household members have distinct preferences that are widely assumed to be gender-specific. If a household contains more than one individual, a household decision depends on these

[1] All data in this paragraph are taken from World Bank (2011).

distinct preferences and on the power distribution among household members. Several development approaches such as microcredit programs and conditional cash transfers focus on transferring income to women. The aim, among others, is to improve their economic status and consequently their intra-household bargaining power. The main reason is a broad consensus in the literature: women's empowerment seems to enhance expenditures on household well-being, and in particular those on children and food. Among factors such as individual income, migration and remittances may change the power distribution. Women form an increasing part of the migratory movement, whether as migrants, who send remittances, or as head of the households, who receive international transfers. While male migration often leaves women in charge of the household, female migrants send remittances, which may be a higher income contribution than that before migration.

The first chapter estimates the impact of workers' remittances on households' spending decisions in Ecuador under gender-specific aspects. As remittance receipt is endogenous, we adopt an instrumental variable approach. Applying both parametric and semiparametric techniques, we provide evidence that remittances strongly enhance expenditures on education, health, and housing, and decrease expenditures on food. Remittances might hence result in a stronger human capital accumulation with positive external effects for the rest of the economy as well. Gender-specific impacts are rather modest. No relevant differences in the expenditure patterns of male and female household heads can be detected, and the impact of remittance receipt is quite similar. The sex of the remitter and the receiver affects the expenditure behavior slightly.

Chapter two focuses on gendered bargaining power in Peru. In contrast to the first chapter, we use two more differentiated measures of female bargaining power, the relative resource position of women and their relative number. Applying both fixed effects estimations and the inclusion of lagged dependent variables to identify causal effects, we find that women's empowerment increases expenditures on food, education and health. Higher food expenses are particularly relevant in the case of Peru where child malnutrition is high. The findings provide a rationale for strengthening women's negotiation position, which would improve human capital accumulation, and therefore may foster the long-run production possibilities in Peru.

The third chapter analyzes the potentially negative impact of remittances on labor supply in Peru. The inflows can undermine the incentives to work by increasing the recipients' income. On the other hand, the transfers may alleviate credit constraints for poor households which may spur productive investment and hence self-employment.

The findings are another piece of evidence that once endogeneity is appropriately addressed, remittances have only a minor and insignificant impact on labor supply on average. However, the type of work may change. Remittances are associated with a lower likelihood of wage-employment and a higher likelihood of self-employment. The latter is driven by poor individuals who are much more likely to be self-employed. Moreover, capital stock and profits of poor entrepreneurs increase, and their implicit self-employment wage rises. The evidence suggests that remittances indeed provide access to capital, and allow poor individuals to start and expand small businesses. From a policy perspective, our results suggest that remittances alleviate credit constraints that leave the entrepreneurial potential of poor individuals unexploited. This finding provides a rationale for microcredit programs, which would support poor households with no otherwise access to credit markets.

To deepen these insights, chapter four provides a more detailed analysis of the microenterprise behavior in Peru. Following the indirect evidence of credit constraints provided in chapter three, this chapter analyzes these constraints in more detail. In cooperation with Michael Grimm and Jann Lay, we investigate the size of returns to capital in Peruvian microenterprises in a first step. The observed high returns hint at credit constraints as one major obstacle to firm growth. Otherwise, a profit-maximizing entrepreneur would increase the capital stock until marginal returns equal the market interest rate. Risk, however, may be another possible explanation. Risk-averse entrepreneurs demand a risk premium on their invested capital stock. This drives a wedge between market interest rates and marginal returns and reduces the optimal capital stock. The dynamic analysis shows that credit constraints and risk are indeed key factors for explaining low initial capital stocks and slow capital accumulation. From a policy perspective, these results imply that credit constraints and risk leave the potential of many small-scale entrepreneurs unexploited.

1 Remittances, Expenditure Patterns, and Gender: Parametric and Semiparametric Evidence from Ecuador[2]

1.1 Introduction

Ecuador has experienced a massive emigration which is mainly motivated by economic factors. After several crises, and therefore high poverty, unemployment, and few economic prospects, the emigration rate increased strongly since the end of the 1980s. Destination countries are the United States and Europe, especially Spain. Current emigration from Ecuador is mostly illegal and therefore expensive and permanent. A migrant has to pay to a facilitator between 10000 US Dollar (USD) and 14000 USD to travel to the United States (Soruco et al. (2008)). Often the whole family takes a loan to finance migration, and first remittances are often used for repaying these loans. Main motivation for most of the Ecuadorian migrants is thus not the prospect of a better life in another country, but the possibility to provide financial support for relatives in the home country (Pew Hispanic Center and Benedixen and Associates (2003)).

Migration and migrants' remittances take an important position in the economy of Ecuador. In 2006, remittances account for 7 percent of GDP. The inflows have the potential to reduce poverty, liquidity constraints, and income volatility. Moreover, they can increase household expenditures on education and health, categories which are considered as especially important for economic development. Women form an increasing part of the migratory movement, whether as migrants, who send remittances, or as head of the households, who receive international transfers. The impact of remittances depends mainly on their use, and the literature suggests gender-specific preferences in the use of income. The aim of this study is to examine, whether remittances-receiving households have higher expenditures on education and health, and how this relationship is affected by female bargaining power. To this end, we evaluate the impact of (i) remittances on households' expenditure patterns, (ii) the gender of the household head who receives remittances, and (iii) the gender of the individual who sends and who receives remittances.

The remainder of this study is organized as follows. The next section briefly summarizes the impact of remittances on development. It also examines the most salient

[2]This chapter is published in Göbel (2013).

results from the intra-household expenditure literature. Section 1.3 presents the data. Section 1.4 describes the empirical approach, and the parametric and semiparametric estimation procedures in particular. Moreover, the econometric strategies to identify the impacts of remittances and gender are explained. Section 1.5 discusses the results and relates them to the literature. The final section concludes.

1.2 Remittances and Gender

International migrants moving from developing to developed countries get acquainted with a different society, other social norms, and new markets in the destination countries. Their preference on the use of income may change, and so may the expenditure behavior of the households in the home country. Several studies indeed find that remittance receipt increases household expenditures on education and health (a detailed review will be given in section 1.5.1), categories which are considered as especially important for economic development. On the one hand, remittances decrease liquidity constraints, and therefore allow households to invest more in the education of their children, as well as they reduce the need for child labor (McKenzie and Rapoport (2011)). Due to their counter-cyclical nature the international transfers reduce income risk and smooth consumption. Especially when capital markets are weak this is important to allow investments in human capital (Calero et al. (2009)). An additional important factor influencing the labor force is health. Empirical evidence suggests an increase due to remittance receipt which is partly explained by an increased knowledge about health related issues (Hildebrandt and McKenzie (2005); López-Córdova et al. (2005)).

Migration and remittances are expected to change the bargaining power within the family which may affect the allocation of household expenditures. In the traditional unitary-household theory, households are units that have a sole preference and pool all resources (Samuelson (1956), Becker (1974)). However, every member of the household has own preferences. If a household contains more than one individual, the individual consumption depends on the bargaining power. Several empirical studies have tested the unitary household theory. Although the impact differs between countries, there is still a common structure: more resources controlled by women enhance expenses on household wellbeing, especially those on children and on education increase (Mason and King (2001); Quisumbing and Maluccio (2000)). Using data from Cote d'Ivoire, Hoddinott and Haddad (1995) find evidence that a greater share of household' income controlled by women results in more expenditures on food, and

less on alcohol and cigarettes. These results are in line with the findings from a study of Doss (2006). Moreover, not only the share of expenditures devoted to food or education increases with a higher female bargaining power, but also the corresponding outcomes improve such as infant mortality, schooling or nutrition (Thomas (1990)). In a nutshell, a strong female intra-household bargaining power seems to increase expenses on education, health, and food. This is one reason for development approaches to focus on transferring income to women. Women marry at an earlier age, have a higher life-expectancy, and therefore outlive their husbands. As they have to rely on their children for old-age support during a longer period, this behavior is rational (Quisumbing and Maluccio (2000)).

Summing up the literature that focuses on gender-specific motivations for remittances, women seem to function as insurers for their families and tend to prefer their remittances to be spent on education and health, while male remitters prefer investments in housing and other assets (see for a review Guzmán et al. (2008)). Though the migrant may intend his/her remittances to be spent in a certain way, he/she is not physically present in the origin household and cannot fully monitor the behavior of household members (a typical principal-agent problem). Hence, the use of remittances reflects the preferences of the remitter and the receiving household. In a Mexican case study, for example, Pfeiffer and Taylor (2008) reveal that households with a female remitter invest a smaller share of total expenditures on education than households with a male remitter. This stands in contrast to the assumption that female remitters prefer their remittances to be spent on education. The authors conclude that this result may be due to the intra-household bargaining power: since women cannot monitor the education of their children, female migration leads to smaller expenses on education, in spite of remittances.

1.3 Data

This study uses data from the Living Standards Survey round five in Ecuador *Encuesta Condiciones de Vida - Quinta Ronda* (ECV-5), collected by the National Statistic and Census Institute (INEC) in 2005/2006. The data set comprises 13581 households. In the following analysis, households from the Amazonas region are excluded which reduces the sample slightly to 12491 households.[3] Incomes and ex-

[3]In the subsequent empirical analysis, we construct an instrument on the basis of past remittance receipt within the community. Information from the previous round, ECV-4, are used which does not contain data from the Amazonas region.

Table 1: Dependent Variables

Variable	Definition	Examples	Mean	= 0*
Food	Purchases and non-purchased food	Bread, milk, gifts	0.50	0.00
Housing	Real estates, rent with related costs	Rent expenses, water, gas	0.18	0.00
Education	Educational expenses	Registration fees, books	0.03	0.10
Health	Health expenses	Doctor fees, medicine	0.05	0.34
Other	Miscellaneous	Durable goods, luxuries	0.24	0.00

Note: * Percentage of households that have zero expenditure in this category.

penditures have been collected in annual, monthly, weekly, and daily values, and we convert all amounts to an annual level. Several households receive numerous products for free, which is especially true for food products and poor households. Due to poverty, food is often grown in private gardens or received from the employer as remuneration. Consequently, these households have small expenditures on food. Yet, monetary values for these costless products are available. In the estimation sample, we count them twice, once as income and at the same time as expenditure.[4] We aggregate expenditure data from the survey into two consumption categories (food and housing), two types of human capital investment (education and health) and one other (miscellaneous) category (see Table 1 for more details on the categories). We restrict the empirical analysis to households with positive expenditures on food and housing (which reduces the sample size very slightly to 12488 observations).

Although the survey provides detailed data on socio-demographic characteristics, it is not a specialized survey of remittances or migration. Therefore, it does not contain comprehensive data on migrants. Only migrants that have left the country after 2000 are captured by the survey, and basic data such as age, gender, education, and destination country are available. These migrants (560 men and 470 women) tend to be more educated than the Ecuadorian average, and female migrants have a higher educational level than their male counterparts. Spain is the main migration destination, accounting for 47 (58) percent of all male (female) migrants. The United States attract 40 percent of all male, but only 24 percent of all female migrants. These gender-specific migration flows result from a gender-specific demand in the destination countries.[5] Almost half (45 percent) of the migrants (of both genders) leave minor

[4]A household with an income of 300 USD which spends USD 50 on food, but receives costless food for 200 USD is counted as a household with an income of 500 USD spending 250 USD on food.

[5]Some destination countries like the United States have a strong demand for less qualified labor in the construction or agriculture sector, and therefore attract male migrants. In contrast, the need for workers in areas such as care, gastronomy or cleaning in countries like Spain favors female migration

Table 2: Descriptive Statistics

	All households		Male-headed hh.		Female-headed hh.	
Remittance receipt	No	Yes	No	Yes	No	Yes
Per-capita expenditures	1517	1695	1517	1641	1517	1803
Household size	4.06	4.20	4.24	4.45	3.27	3.71
No. females >= 15	1.34	1.56	1.29	1.48	1.58	1.72
No. males >= 15	1.28	1.26	1.44	1.58	0.62	0.61
No. children < 15	1.43	1.38	1.52	1.39	1.06	1.38
No. adults >= 15 with prim. educ.	1.22	1.14	1.27	1.23	0.99	0.94
No. adults >= 15 with sec. educ.	0.73	0.91	0.77	1.00	0.59	0.72
No. adults >= 15 with tert. educ.	0.40	0.57	0.42	0.63	0.34	0.46
Household head married (%)	72.78	65.79	87.97	87.03	7.93	24.03
Partner of hh. head absent (%)*	1.26	12.54	0.73	2.01	25.95	87.58
Observations	10503	1988	8510	1318	1993	670

Note: * given that the head is married.

children in the responsibility of the households in Ecuador. This may partly explain the high incidence of remittances: 76 (74) percent of the households with a male (female) migrant receive the inflows. International transfers to households with a male migrant are substantially higher (2040 USD) than those towards households with a female migrant (1500 USD).[6] Yet, households do not explicitly indicate the remitter. If a male household member has migrated after 2000, one may assume the remitter to be male. Conversely, it may be that not the male migrant is the remitter, but is in fact another person who migrated before 2000.

The effect of migration on expenditure patterns cannot be observed due to the lack of data on migrants. However, the impact of remittances can be evaluated, since the data set contains comprehensive information on remittances, including the amount remitted, the frequency in which remittances are received, as well as the source country. An additional analysis of the impact of the gender of the migrant on expenditure patterns can be drawn on a subsample of 616 households. These households receive remittances and have household members who migrated after 2000.

Table 2 shows descriptive statistics from the ECV-5, disaggregated by gender and remittance receipt. Of the 12491 households included in the sample, 16 percent receive remittances. In terms of gender, 21 percent of the households in the sample are female

(Pfeiffer and Taylor (2008)).

[6]Female migrants are more often employed in the informal sector, and therefore receive less income than their male counterparts.

headed, and differences in comparison with male headed households are present; while per-capita expenditures are similar in non-receiving households (1520 USD), women have a higher expenditure level in remittance receiving households (1640 USD and 1800 USD, respectively). Female headed households have one family member less, the head is rarely married, and if she is, the partner is absent in most cases. The incidence of female household heads is about twice as high in remittance-receiving household. Women seem to be head of the household only if there has never been a husband, if he died, or if he migrated and sends remittances.

1.4 Econometric Analysis

1.4.1 Empirical Approach

How remittances affect development depends mainly on their use. The aim of this study is to examine whether remittances-receiving households have higher expenditures on education and health, and how this relationship is affected by female bargaining power. Several previous studies have contributed to a pessimistic perception by observing that the inflows are mainly used for food and current expenses (for a review, see Chami et al. (2003)). Yet, remittances - like any other source of income - are fungible and increase total income. Even if they are not directly invested in human capital, they can lower liquidity constraints, and hence other sources of income may be invested. Thus, the whole expenditure pattern of the households has to be examined. Recent studies include a remittances variable as a regressor in a system of household demand equations (e.g. Zarate-Hoyos (2004), Taylor and Mora (2006) and Adams and Cuecuecha (2010)). An advantage of this approach is its consistency with consumer demand models which assume that income from diverse sources is pooled. One disadvantage is the potential endogeneity of remittances, which has to be addressed. Migration (and consequently remittance receipt) selects on both, observable and unobservable characteristics. To address the endogeneity of remittances, an instrumental variable (IV) approach is applied.

After analyzing the impact of remittances on household's budget allocation, a gender-dimension is taken into account. The first challenge is to find a variable that measures intra-household bargaining power. Exogenous variables typically used to measure female bargaining power, like wealth upon marriage, are not stated in the ECV-5. Following Guzmán et al. (2008), the best proxy available is the sex of the household head. However, the gender of the household head is correlated with explanatory variables which implies that gender (as remittances) is endogenous. As

no reasonable instrument for gender exists, we apply a matching procedure to make male and female headed households comparable, and run separate regressions.

In the third part of the analysis, the impact of the gender of the migrant and the receiver is evaluated. To this end, we focus on a subsample of 616 remittance-receiving households with migrants. Here, the mentioned principal-agent problem can arise as the household in the home country is in fact spending the transfer. In spite of possibly gender-specific preferences of the migrants, these may not be reflected in the use of remittances.

1.4.2 Econometric Model

In the empirical analysis, a proper functional form for the econometric model has to be chosen. A popular form is the Working-Leser curve which relates budget shares linearly to the logarithm of total household expenditures and additional variables (Working (1943), Leser (1963)). In this study, the model is specified as follows:

$$w_{ij} = \alpha_i + \beta_i log\frac{x_j}{n_j} + \psi_i log(n_j) + \eta_i \Pi_j + \theta_i R_j + \epsilon_{ij}, \tag{1}$$

or in a shorter notation

$$w_{ij} = \mu_i X_j + \epsilon_{ij}, \tag{2}$$

where w_{ij} is the budget share of expenditure category i by household j, x_j is total household expenditures, n_j is household size (thus $\frac{x_j}{n_j}$ is per-capita expenditures). The term Π_j is a vector of household characteristics that may affect expenditure behavior, R_j captures whether the household receives remittances, and ϵ_{ij} is an error term. In the short notation X_j represents all right hand side variables of the model including the intercept. The dependent variables reflect the categories of household expenditures, namely "food", "housing", "education", and "health". Not every household has expenditures on each category which implies censored dependent variables. Expenditure on a category is observed only if the household's desired expenditure exceeds some threshold which depends on the lumpiness of the goods as well as the opportunity cost. Estimation techniques that fail to consider the censoring of the dependent variables give rise to biased parameter estimates. Thus, the following participation equation is added to equation (2):

$$w_{ij}^* = \gamma_i Z_j + u_{ij}. \tag{3}$$

The dependent variable w_{ij}^* is unobservable, but has an observable realization of one if w_{ij} takes on a positive value and zero otherwise. The term Z_j is a vector that contains

all explanatory variables included in equation (2), and some additional variables which allow for identification, and u_{ij} is an error term.[7] In addition, the budget shares are not independent of each other. A positive shock in the budget share "food", for example, results in higher expenses on "food" which leads to smaller expenses in at least one other budget share. The error terms across equations are correlated. The model is an equation system with dependent variables censored by latent variables.

Estimating a censored system of equations is no easy task. Until 1999, the popular Heien and Wessells (1990) two-step estimation procedure was considered the standard approach. Yet, Shonkwiler and Yen (1999) (henceforth SY) point out an inconsistency and show that this estimator performs poorly in Monte Carlo simulations. They hence suggest an alternative, consistent two-step estimator which has found wide applicability in empirical work as it has a solid theoretical foundation and is easy to implement. In the first step, the probability of participation in each expenditure category is estimated using a probit regression. The results are then used in the second step, to weight the expenditure equations in the system, and to construct a selection term. Despite its popularity, this method has been criticized, since it relies on the assumption that the residuals follow a normal distribution, and are homoscedastic in the participation equation. Sam and Zheng (2010) (henceforth SZ) hence propose a two-step estimator similar in spirit to SY that uses Klein and Spady (1993) (hereafter denoted by KS) semiparametric single-index model instead of a probit regression in the first step. The semiparametric KS estimator makes no distributional assumptions, but it assumes a linear index function to avoid the curse of dimensionality. Being asymptotically efficient in the sense that it attains the semiparametric efficiency bound, it is the most efficient two-step estimator compared to other semiparametric estimators. Moreover, KS perform Monte Carlo simulations which indicate that their estimator is considerably more accurate than a probit estimation when the errors are not normally distributed. In contrast, the efficiency losses are modest when the error distribution is standard normal.

Both methods start with an estimation of the participation equations:

$$P(w_{ij}^* = 1|Z_j) = F_i(\gamma_i Z_j). \tag{4}$$

Whereas the probit model assumes $F_i(\cdot)$ being the normal cumulative distribution

[7] Following Taylor and Mora (2006), regional dummies as well as the variable "access to the house" are included. It indicates the main access to the house, ranging from "sea/ river" and "trail" to "highway". If households are poorly connected to markets that may explain whether they spend on a specific good/ category. Yet, once they do spend, this should not affect the amount spent.

function (cdf), the semiparametric method estimates the coefficients $\hat{\gamma}_i$ and the unknown continuous distribution function $\hat{F}_i(\cdot)$.[8] The estimate of γ_i is obtained by maximizing the quasi-loglikelihood function:

$$l(\gamma_i) = \sum_{n=1}^{N} \Big(w_{ij}^* log(\hat{F}_i(\gamma_i Z_j)) + (1 - w_{ij}^*) log(1 - \hat{F}_i(\gamma_i Z_j)) \Big). \tag{5}$$

In the second step, the following system of equations is estimated:

$$w_{ij} = \hat{F}(\hat{\gamma}_i Z_j)\big(\mu_i X_j + \lambda_i(\hat{\gamma}_i Z_j)\big) + \varepsilon_{ij}, \tag{6}$$

where all variables are defined as before, and $\lambda_i(\cdot)$ is a selection control function. If the error term is normally distributed (SY), $\lambda_i(\cdot)$ is simply the Heckman (1979) control term $\theta_i \frac{\phi(\hat{\gamma}_i Z_j)}{\Phi(\hat{\gamma}_i Z_j)}$, where $\Phi(\cdot)$ denotes the cdf, $\phi(\cdot)$ is the normal probability density function (pdf), and θ_i are coefficients to be estimated.

Applying the SZ method, $\lambda_i(\cdot)$ is unknown because the distribution of the error terms is not specified. To estimate the control term, Newey (1999) approximates $\lambda_i(\cdot)$ with a power series expansion of the transformed index $\tau_{ij} = f(\hat{\gamma}_i Z_j)$. That is

$$\lambda_i(\cdot) = \sum\nolimits_{k=1}^{K} \theta_{ik} \tau_{ij}^{k-1} = (1, \theta_{i2}\tau_{ij}, \theta_{i3}\tau_{ij}^2, \ldots, \theta_{iK}\tau_{ij}^{K-1}), \tag{7}$$

where the first term cannot be identified separately from the constant term. Here, the order K is chosen such as to minimize the mean squared error for each equation.

We use a power series of inverse Mill's ratio of the normalized estimated index.[9] The semiparamteric estimator imposes a scale and location normalization for identification. To reverse it, we use the constant and slope coefficients, π_0 and π_1, respectively, that we obtain from a probit estimation of w_{ij}^* on the index $(\hat{\gamma}_i Z_j)$. The inverse Mill's ratio of the normalized estimated index is then:

$$\tau_{ij} = \phi(\hat{\pi}_0 + \hat{\pi}_1(\hat{\gamma}_i Z_j)/\Phi(\hat{\pi}_0 + \hat{\pi}_1(\hat{\gamma}_i Z_j)). \tag{8}$$

The first order term is hence the Heckman correction, and will be sufficient if the error term is normally distributed.

[8] An estimate for $F_i(\cdot)$ can be obtained nonparametrically, using the kernel method: $F_i(\vartheta_{ij}) = \frac{\sum_{n=1}^{N} w_{ij}^* K[(\vartheta_{ij} - \vartheta_{in})/h]}{\sum_{n=1}^{N} K[(\vartheta_{ij} - \vartheta_{in})/h]}$, where $\vartheta_{ij} = \gamma_i Z_j$ and the bandwidth h is a non-stochastic window. Estimates are obtained using the R np package developed by Hayfield and Racine (2008) that employs automatic (data-driven) bandwidth selection via cross validation. To ensure identification, the intercept is constrained to zero and the coefficient of one continuous regressor to one.

[9] Other power series that we consider include: (i) the index $\hat{\gamma}_i Z_j$ itself, and (ii) the normal cdf Φ. Estimates are robust to the exact form of the approximation.

The SZ method assumes a more general form of equation (4). Therefore, it has the advantages of generating consistent and efficient estimates without relying on distribution assumptions, and accommodating a certain form of heteroscedasticity. Since semiparametric methods are extremely computationally demanding, the SY method is preferred if its assumptions are not violated. To exploit the information contained in the cross equation error correlations, the system of equations is estimated jointly for the full household sample using iterative nonlinear SUR (with both methods).[10]

1.4.3 Endogeneity of Remittances

In a thought experiment whereby a number of households are randomly drawn from the population, and subsequently "treated" with remittance receipt, the impact of remittances on household expenditure patterns could be examined. As such an experiment is not possible, the problem of endogeneity arises, i.e. the variable remittance receipt is correlated with the residual. Migration of one household member is a precondition for the receipt of remittances. The occurrence of one member migrating depends heavily on household characteristics. Variables that may "explain" migration may also be correlated with household expenditure patterns. These variables may include observable characteristics, such as household income and the educational level, as well as unobservable characteristics like the degree of risk aversion or ambition. In the absence of random assignment, an estimation strategy that allows for identification of the treatment effect has to be employed, such as a matching procedure, difference-in-difference estimation or an instrumental variable (IV) approach. McKenzie et al. (2010) use a natural experiment to compare different methods in estimating the income gains from migration. Their findings suggest that migration selects on both, observable and unobservable characteristics, and that an IV approach with good instruments works best among the non-experimental methods.

Although an IV approach is preferable, it relies heavily on the exogeneity assumption. Variables which explain remittance receipt but are uncorrelated with the expenditure patterns have to be employed. In this study, identification of the causal effect (the local average treatment effect LATE) relies on instruments that exploit

[10]Due to the criterion of additivity, the variance-covariance matrix of error terms for a complete equation demand system will be singular. With the SY correction method, the error terms do not sum up to zero by construction. Consequently, the budget shares do only almost equal one. Nevertheless, this makes convergence difficult. The normal procedure is to delete one of the equations, here the miscellaneous category "other", from the system. As no censoring is present in the categories "food" and "housing", both enter the system as in equation (22).

information on former remittance receipt within the community. From the ECV-4, the previous round of the survey, we construct the variable "Remittances in the community in 1999" which is the proportion of remittance receiving households in the community in the year 1999. This variable is interacted with the proportion of household members with secondary and tertiary education, respectively, to allow for the variability of the instrument at the household level (Amuedo-Dorantes and Pozo (2006); Hanson and Woodruff (2003)). Justification lies in the fact that historical migration developed networks which can promote future migration. On the other hand, historical migration rates are exogenous as they occurred in the past, and are hence not affecting current consumption.

1.4.4 Endogeneity of Gender

Next, we turn to the gender-dimension of our analysis. Table 2 has already shown that household characteristics differ substantially for female and male headed households. The gender of the household head is likely to be correlated with the residual, i.e. gender is endogenous. The impact of remittances will be different even in the absence of gender-specific preferences. To make female and male headed households comparable, this study uses a matching procedure.[11] The idea behind matching is to find for each "treated" observation (i.e. female headed household) its "non treated" or "control" counterpart (i.e. male headed household) with equal characteristics. If the number of variables is large or variables take on many values (like total per-capita expenditures here), exact matching becomes impossible. Common practice is then to use some form of inexact matching that balances the covariates as well as possible. The idea of coarsened exact matching (CEM) developed by Blackwell et al. (2009) is to coarsen each variable into groups, for example, we split total household expenditures by quartile. Subsequently, a set of strata is created which contain all observations with the same values of the coarsened data. One possible stratum hence may contain all individuals from the first expenditure quartile, which live in an urban area, have no children, etc.. Observations in strata that contain at least one treated and one control unit are retained, and units in the remaining strata are removed from

[11] Note, that to control for the endogeneity of remittances and genderm, different methods are used. Matching is a procedure that eliminates endogeneity insofar as that afterwards both groups have exactly the same characteristics, i.e. observables. Thus, gender is not correlated anymore with the residual. However, matching does not eliminate any bias due to unobservables which is essential in the analysis of remittances. Yet, it would be very difficult to find a reasonable instrument for gender, and therefore matching is the chosen technique here.

the sample. If a stratum does not contain the same number of treated and control units, observations are randomly dropped to obtain the same number.

1.5 Results

1.5.1 Impact of Remittance Receipt

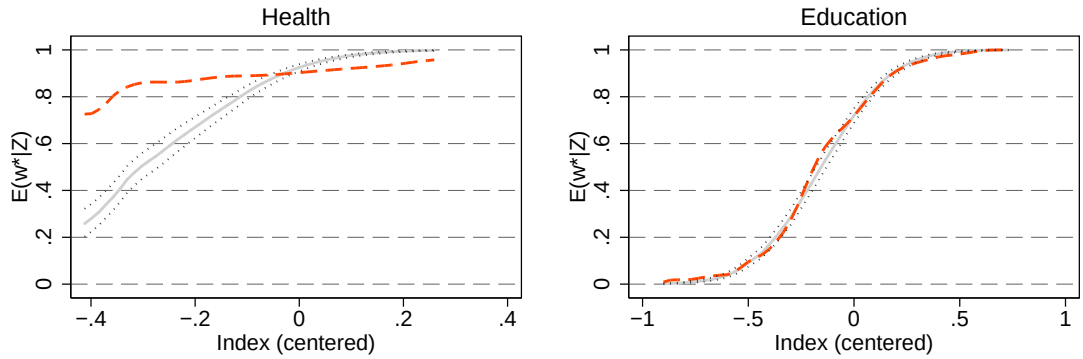
To address the possible problem of endogeneity, the probability of remittance receipt is estimated in the first stage (see the first column of Table 3). The probability increases with per-capita expenditures; migration is very expensive, only wealthier

Table 3: First Stage Estimates of the Instruments

Dependent variable: Remittance receipt			
Gender of the household head	Both	Male	Female
Log(per-capita expenditures)	0.035***	0.073***	0.071***
	(0.004)	(0.011)	(0.011)
Log(household size)	0.050***	0.098***	0.102***
	(0.007)	(0.018)	(0.018)
Prop. of children < 15	-0.032	0.119*	0.087
	(0.017)	(0.050)	(0.044)
Prop. of adults >= 15 with prim. educ.	-0.012	0.018	0.002
	(0.015)	(0.034)	(0.033)
Prop. of adults >= 15 with sec. educ.	0.064***	0.110*	-0.023
	(0.019)	(0.047)	(0.047)
Prop. of adults >= 15 with ter. educ.	0.090***	0.089	0.052
	(0.022)	(0.053)	(0.056)
Rural area	-0.033***	-0.006	-0.039
	(0.007)	(0.020)	(0.020)
Remittances in the community in 1999	2.069***	2.080***	1.721***
	(0.106)	(0.285)	(0.239)
-sec. educ.	-0.900***	-0.950	1.342*
	(0.227)	(0.596)	(0.571)
-ter. educ.	-2.031***	-1.426*	-0.922
	(0.256)	(0.642)	(0.713)
Constant	-0.183***	-0.540***	-0.460***
	(0.037)	(0.089)	(0.091)
R-squared	0.057	0.094	0.113
Observations	12488	2211	2210
F-statistic of the instruments F(3,N-k-1)	165	23	42

Note: Bootstrapped standard errors in parentheses (with 500 reps.): * significant at 5%; ** at 1%; *** at 0.1%.

Figure 1: Distribution of KS and Probit Estimate



Solid line: Probit estimate; dashed line: KS estimate; dotted lines: 95 % confidence interval (Probit)

households can afford it, and consequently receive remittances. The positive impact of secondary and tertiary education, respectively, detects that migration selects positively on education. Households in rural areas are less likely to receive the inflows. The key instruments, "Remittances in the community in 1999" and its interaction with the proportion of household members with secondary and tertiary education, respectively, are significant at the 0.1 percent level. This suggests that the instruments provide strong support for identification. A higher incidence of prior remittances in the community increases the likelihood of remittance receipt. This effect vanishes, however, with the educational level.

A range of Wu-Hausman tests confirm the necessity to identify causal effects: remittances are highly correlated with the error term in each expenditure category (see Table A.1 in the appendix). Performed Sargan tests do not reject that the error term is uncorrelated with the instruments which suggests that our instruments are valid. Moreover, the first stage F-statistic of the instruments (F-test = 165) is well above the critical values outlined by Stock and Yogo (2002) to detect weak instruments.

To test, whether the assumption of normally distributed errors (probit model) is consistent with the data, Figure 1 presents the estimates from both the probit and the KS method as well as the 95 percent confidence interval of the probit estimate. The more sophisticated semiparametric method makes no distributional assumptions, and is therefore able to reveal a distribution structure that may differ from the Gaussian normal distribution. The left graph presents the estimates for the category health. The KS estimate hardly ever lies within the 95 percent confidence interval of the probit estimate. The assumption of normally distributed error terms has to be rejected. In the right graph, the estimates differ only little, but significantly, for some

Table 4: Average Budget Shares: Full Sample

	Parametric SY method				Semiparametric KS method			
	Food	Housing	Health	Education	Food	Housing	Health	Education
NR	53.52%	13.70%	1.88%	3.80%	53.54%	13.70%	1.93%	3.72%
RR	31.16%	41.33%	9.97%	8.18%	31.15%	41.32%	9.81%	8.43%
AT	-22.36%	27.63%	8.09%	4.38%	-22.39%	27.63%	7.87%	4.71%

Notes: All average budget shares are estimated for household with mean values. NR = non remittance receiving households, RR = remittance receiving households, AT = average treatment effect.

probability values. It seems crucial to apply both the consistent semiparametric and the commonly used and easy to implement SY method to get consistent estimates, and to analyze how much the results from both methods differ.

Table A.3 in the appendix presents the results of the nonlinear SUR estimations of the equation system. To account for the additional variability introduced by the two-step nature of the estimation process and by estimating the IV, the estimates are bootstrapped (with 500 replications). Most household characteristics are highly significant which is also true for the IV of remittance receipt. From the equation system (6) counterfactual average budget shares can be predicted which are shown in Table 4. These are the average budget shares of hypothetical households with mean X_j that differ in no characteristic but in the probability of remittance receipt. The method allows comparing a remittance-receiving household with its non-receiving counterpart, and the difference is the impact of remittance receipt, the average treatment effect (AT).

The effects are large, and the results are robust with respect to the estimation method applied; both methods yield almost identical results. Remittance receiving households spend 8 percentage points more on health, 4-5 percentage points more on education, and 28 percentage points more on housing when compared to what they would spend without the transfers. Food expenses decrease by 22 percentage points. These results are in line with findings from Adams and Cuecuecha (2010): remittance receiving households spend more at the margin on housing, education, and health in Guatemala. Although the authors evaluate the effects on the marginal budget shares based on a different modeling approach, they find a similar relative increase of 80-200 percent. Using Mexican data, Amuedo-Dorantes and Pozo (2011) find that international remittances raise health care expenditures. Calero et al. (2009) who use the same data as this study also detect a positive impact of remittances on schooling in Ecuador. The increase in housing expenses is in line with the findings of Soruco et al.

(2008) who analyze remittances in Ecuador; after the loans for transportation costs are repaid, the first investment financed by remittances is usually directed towards housing. Taylor and Mora (2006) as well as Zarate-Hoyos (2004) provide evidence that remittances result in lower expenditures on food, and substantially higher expenditures on housing.

1.5.2 Impact of Gender

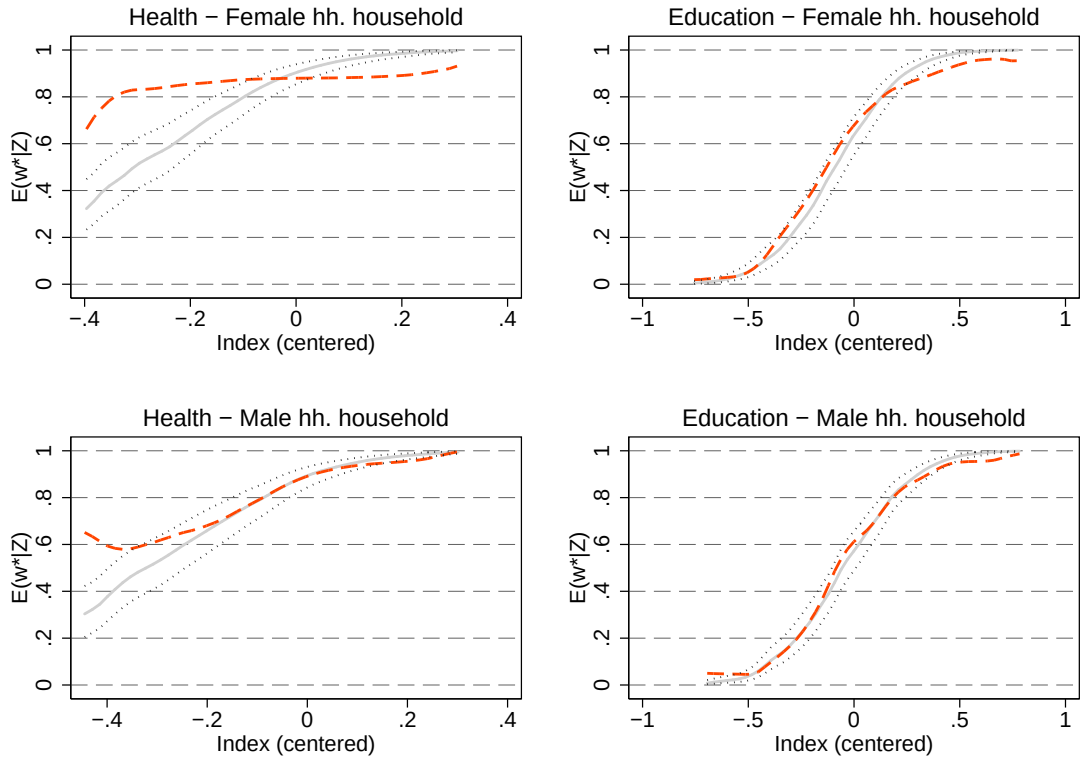
We match female and male headed households to make both household types comparable. In Table A.2 in the appendix all explanatory variables used in the estimations are listed. A t-test is performed to analyze whether significant differences in means are prevalent between the treated and control group. While the hypothesis of "no difference in means" can be rejected for most variables at the 5 percent level in the full sample, it cannot be rejected in the matched subsample. However, the matching procedure reduces the number of observations considerably. Female headed households are very different from their male counterparts, and 300 of them were in a stratum without any control observation. Consequently, they are excluded which leaves 2210 female headed households for which a similar male headed household can be identified.

Table 3 and Table A.1 present the first-stage results as well as tests of the instruments, respectively, for both household types. The gender-specific first-stage results are rather similar. Remittance receipt is more likely the higher the incidence of prior remittances within the community is. Yet, while this effect is decreasing with the educational level in male headed households, it is even increasing with the proportion of household members with secondary education in female headed households. Sargan-tests as well as F-tests of the instruments suggest that the instruments are valid. Wu-Hausman tests indicate that at least in the categories housing and education remittances are highly endogenous for both household types. When estimating a system of equations, remittance receipt should either enter each equation as a variable, or should be instrumented in each equation, which is done here.

To determine, whether the distributional assumptions made by the probit model are consistent with the data, the participation equations are estimated by both methods. Similar to the findings from the full sample, Figure 2 reveals that the assumptions are partly violated. In the category education, the KS estimate lies within the 95 percent confidence interval of the probit estimate. In contrast, the probit estimate is significantly lower for low probability values in the category health.

The results from the iterative nonlinear SUR estimations are shown in Table A.4 in the appendix. The remittance instrument is significant and has the same sign for

Figure 2: Distribution of KS and Probit Estimate: Gender-Specific



Solid line: Probit estimate; dashed line: KS estimate; dotted lines: 95 % confidence interval (Probit)

both genders. Table 5 presents the estimated average budget shares. Although the distributional assumption of the SY method is violated in the category health, both

Table 5: Average Budget Shares: Gender-Specific

	Parametric SY method				Semiparametric KS method			
	Food	Housing	Health	Education	Food	Housing	Health	Education
Female headed households								
NR	60.93%	12.43%	1.71%	3.51%	61.02%	12.43%	1.51%	3.82%
RR	28.64%	43.95%	9.30%	7.95%	28.34%	43.94%	10.36%	6.99%
AT	-32.28%	31.53%	7.59%	4.44%	-32.68%	31.51%	8.85%	3.16%
Male headed households								
NR	52.47%	11.23%	1.13%	3.34%	52.28%	11.22%	1.41%	3.08%
RR	43.92%	39.90%	10.88%	5.41%	44.45%	39.91%	9.99%	6.41%
AT	-8.55%	28.67%	9.75%	2.07%	-7.83%	28.69%	8.58%	3.33%

Notes: All average budget shares are estimated for household with mean values. NR = non remittance receiving households, RR = remittance receiving households, AT = average treatment effect.

methods yield very similar results. Without remittances both household types show a rather similar expenditure behavior. Yet, female headed households spend slightly more on food, education, and health than their male counterparts. The impact of remittances is also not substantially different. Remittances decrease expenditures on food by 32 percentage points, while those on housing, health, and education increase by 32, 8, and 4 percentage points, respectively, in female headed households. In male headed households, remittances results in a 9 percentage points lower food share, and housing, health, and education increase by 29, 10, and 2 percentage points, respectively.

In a third step, the impact of the gender of the remitter and the receiver is analyzed

Table 6: Full Estimates for the Sample Selection Model: Migrants

	Parametric SY method			
	Food	Housing	Health	Education
Log(per-capita expenditures)	-0.123***	0.054***	-0.015***	-0.028***
	(0.011)	(0.014)	(0.003)	(0.010)
Log(household size)	-0.130***	0.042**	0.002	0.010
	(0.019)	(0.017)	(0.007)	(0.029)
Prop. of children < 15	0.064	-0.028	-0.023*	0.037
	(0.040)	(0.036)	(0.012)	(0.040)
Prop. of adults >= 15 with prim. educ.	-0.059	0.040	0.037***	-0.007
	(0.057)	(0.040)	(0.013)	(0.015)
Prop. of adults >= 15 with sec. educ.	-0.089	0.007	0.025*	-0.005
	(0.058)	(0.039)	(0.014)	(0.015)
Prop. of adults >= 15 with ter. educ.	-0.118*	-0.058	0.024*	0.083***
	(0.061)	(0.045)	(0.013)	(0.029)
Rural area	-0.131***	0.060***	-0.001	-0.004
	(0.019)	(0.019)	(0.006)	(0.006)
Male receiver	-0.010	-0.026	-0.001	-0.020**
	(0.022)	(0.020)	(0.009)	(0.008)
Male migrant	-0.002	-0.002	0.004	-0.014*
	(0.018)	(0.017)	(0.007)	(0.008)
Selection term I			0.072	0.034
			(0.051)	(0.052)
Constant	1.681***	-0.270**	0.115***	0.236*
	(0.103)	(0.120)	(0.032)	(0.136)
R-squared	0.245	0.070	0.273	0.463
N	616	616	616	616

Note: Bootstrapped standard errors in parentheses (with 500 reps.): * significant at 10%; ** significant at 5%; *** significant at 1%.

using a subsample of 616 remittance-receiving households. Additional covariates are "Male migrant" and "Male receiver" which are both defined as proportional values. The former is the proportion of male migrants, whereas the latter is the proportion of male receivers.[12] The validity of the distributional assumption made using the SY method cannot be rejected, and hence only the SY method is performed in the following (see Figure A.1 in the appendix). Covariates such as total per-capita expenditures and household size are with the same sign as in the previous estimation, but overall less significant due to the much smaller sample size (see Table 6). If the remitter is female, expenditures on education increase by one percentage point (weakly significant). Similarly, the female sex of the receiver results in a significant increase in education expenses by 2 percentage points.

1.6 Conclusion

Migration and remittances take an important position in the economy of Ecuador which considerably affects the remaining households and the dynamics of the whole economy. The effect on development mainly depends on the use of the international transfers, and the literature suggests gender-specific preferences in the use of income. This study analyzes the impact of remittances and gender on household expenditure patterns by employing both parametric and semiparametric techniques. The results are very robust with respect to the estimation method applied and illustrate that remittance receipt enhances expenditures on education and health. The effects are large. Remittances might hence result in a stronger human capital accumulation with positive external effects for the rest of the economy as well. Moreover, remittances increase expenditures on housing. While for the economy this is consumption, from the part of the migrant it is an investment and results in future savings. In addition, investment in housing may spur the local construction sector and has a positive impact on families' health. In order to evaluate the overall impact on development, a well-specified growth model has to be employed which could be a promising approach for future research.

The literature on remittances suggests that including a gender perspective is crucial. Our findings, however, contradict this perception: the gender-specific impacts concerning expenditure patterns in Ecuador are rather small. In the absence of remittances, female household heads spend slightly more on food, education, and housing

[12] In 70 percent of all households, only one person receives remittances, and 77 percent of all households have only one migrant. The results are robust to restricting the analysis to those observations.

than their male counterparts. In consequence, the family well-being and human-capital formation might improve with a female head of the households, but the effects are small. The impact of remittance receipt is similar for both genders: the inflows are associated with higher expenditures on education, health, and housing and smaller food expenses. Only the reduction in food expenses is much stronger for female headed households. In addition, the evidence suggests that the sex of the remitter and the receiver affects the expenditure behavior, at which the impact of the sex of the receiver seems to be more important. Both a female migrant and a female receiver increase expenditures on education. Due to data restrictions these aspects are rather weak and not estimated further, and more research seems to be warranted that addresses this question in particular.

2 Female Intra-Household Bargaining Power and Household Expenditures: Evidence from Peruvian Panel Data

2.1 Introduction

Recently, several development approaches such as microcredit programs and conditional cash transfers focus on transferring income to women. The aim, among others, is to improve their economic status and consequently their intra-household bargaining power which may foster development. The main reason is a broad consensus in the literature: women's empowerment seems to enhance expenditures on household well-being, in particular those on children and food.

We evaluate the impact of female intra-household bargaining power on household expenditures in Peru using a five-year panel data set. To this end, we estimate a complete demand system. The main categories of interest are food, education, and health. Whereas the latter two categories are crucial for human capital formation and hence may impact long term development, the former category improves overall household well-being. More importantly, sufficient food provision is an important determinant of child health and well-being in Peru. In 2005 Peru had one of the highest rates of chronic child malnutrition in Latin America with a prevalence of 30 percent (World Bank (2012)).[13] Long-term malnutrition influence child health negatively and hinders child development. It may result in poor cognitive ability and may have severe adverse effects on adult health and economic outcomes. Current malnutrition implies that adults may be less able to do work for longer periods of time or to conduct strenuous tasks.

Our contribution to the gendered intra-household bargaining in developing countries is twofold. (1) Our data set allows us to employ fixed effects as well as to include a lagged dependent variable to identify causal effects. (2) The data set stems from Peru, a country which has not been analyzed in these regards so far.

The remainder of the paper is organized as follows. In the next section, we review the relevant literature. Section 2.3 presents the data. In section 2.4, we explain the econometric framework and describe our two measures of bargaining power. Moreover, the results are presented and their robustness is discussed. The final part concludes.

[13]This number refers to stunting (low height for age) which is the principal issue in Peru. Stunting is an indicator of chronic malnutrition that measures the retardation of growth among children younger than five.

2.2 Literature Review

In the traditional unitary-household theory, households are units that pool all resources and have a single utility function (Samuelson (1956), Becker (1974)). According to the income pooling property, the distribution of income within the household should not affect allocations once the total expenditure level is controlled for. Household members are assumed to have the same preferences, or alternatively they have an altruistic or dictatorial household head who takes all decisions. Although the unitary model is appealing due to its simplicity, the income pooling property is widely rejected by data while a single utility function seems not to be a reasonable assumption. These weaknesses gave rise to alternative intra-household models with various specifications that model the interaction between household members (see Xu (2007) and Vermeulen (2002) for comprehensive reviews). The major categories are cooperative bargaining models and collective models. In these models, every household member is assumed to have an own utility function. Household demand depends on them and on the power distribution among household members.

Cooperative Nash bargaining models are the earliest contribution to the intra-household bargaining literature (Manser and Brown (1980), McElroy and Horney (1981)).[14] These models incorporate elements of cooperative game theory. Household members bargain on the utility gains of living together as compared with utility at the threat point, the higher the utility at the threat point the larger the individual bargaining power. The threat point determines how well-off an individual would be if marriage dissolves.[15] It is a function of individual income and extra-household environmental parameters (EEPs). EEPs can be demographic, legal, or macroeconomic conditions (McElroy (1990)). These includes alimony rights, custody and child support standards, divorce law, access to employment and other income-earning means - for example, the rights of running a business or owning land - as well as social and religious norms and traditions (Agarwal (1997)). Depending on the power distribution among household members, a specific allocation is chosen which is Pareto efficient.

Collective models are a generalization of cooperative bargaining model (Chiappori (1988, 1992)). Bargaining is not explicitly addressed and no a priori predictions are made about which allocation will be chosen by the household. These models only

[14] In the sociological literature, the relevance of intra-household bargaining power is early acknowledged by Blood and Wolfe (1960).

[15] Non-cooperative models, such as the "separate spheres" bargaining model of Lundberg and Pollak (1993), take non-cooperative behavior as the threat point instead which allows for inefficient outcomes.

make the very weak and general assumption that intra-household decisions are Pareto efficient. With these models only few assumptions allow some testable implications to be derived. The household is assumed to maximize a weighted sum of the utility functions of the members subject to the pooled budget constraint. The weights reflect the intra-household bargaining power of members, which depends on income and EEPs.

In both model types, household demand depends on heterogeneous preferences and on the power distribution among household members. As preferences are rarely observed in the data, they are often assumed to be gender-specific. To derive testable implications, factors which influence the bargaining power but not preferences have to be identified. Potential candidates are individual income and EEPs. They can be used to test the income pooling assumption and hence to reject the unitary model.

Bobonis (2009), for example, identifies changes in women's negotiation position by the randomized variation in women's income from the Mexican conditional cash transfer program PROGRESA. Women's empowerment is associated with higher expenditures on female clothing and especially on child clothing and lower expenditures on alcohol and tobacco. In Côte d'Ivoire, both genders cultivate different crops and rainfall affects their yields differently. Duflo and Udry (2004) find that rainfall shocks, which increase the income of women, result in higher food expenses. These results are in line with the findings from a study of Doss (2006). A higher share of assets owned by women in rural Ghanaian households is associated with higher expenditures on food and education, and lower expenditures on health and alcohol and tobacco.[16] Moreover, not only the share of expenditures devoted to food, health, or education increases with a higher female bargaining power, but also the corresponding outcomes improve such as infant mortality, schooling or nutrition.[17]

In sum, the assumptions of the unitary household theory are widely rejected in empirical studies. Although the impacts differ between countries, there appears to be a common structure. A higher female bargaining power seems to enhance expenditures on household well-being, especially on children and food, while expenses on alcohol and cigarettes decrease. This study follows the same approach, in testing the income pooling property of the unitary model and in analyzing the impact

[16]Further evidence of higher food expenses as a result of a stronger female resource position is provided by Hoddinott and Haddad (1995), Schmeer (2005), and Gummerson and Schneider (2012). See also Duflo (2012) for a review.

[17]Refer to the work of Luke and Munshi (2011), Thomas (1990), Duflo (2003), and Rangel (2006), among others.

of power distribution among household members. Any observed changes due to an altered power distribution are then due to shifts in the bargaining power and heterogeneous preferences. Explanations for gender-specific preferences range from cultural and social norms to economic considerations. The traditional division of labor, for example, leaves women in charge of child care and home duties. Women may hence have stronger preferences for expenditures on children as they are more directly concerned. In addition, women marry at an earlier age, have a higher life-expectancy, and therefore outlive their husbands. As they have to rely on their children for old-age support during a longer period, this behavior is rational (Quisumbing and Maluccio (2000)).

2.3 Data

We use data from the nationally representative Peruvian household survey *Encuesta Nacional de Hogares* (ENAHO) collected by the National Institute of Statistics and Informatics (INEI for its Spanish initials) between 2002 and 2006. The ENAHO entails a panel sub-sample of about 5000 to 6000 households each year of which 55 to 80 percent are re-visited in the following year (see Table B.1 in the appendix).[18] We keep only households with at least one man, one woman, and one child. The head of the household has to be between 18 and 66 years old. Furthermore, we restrict the analysis to observations with non-missing values. We exclude households with a total food consumption share of less than 10 percent and those that we observe in less than two periods.[19] The final dataset is an unbalanced panel with 13132 observations of 1087, 816, 950, and 942 households which we observe in two, three, four and five years, respectively.

The survey provides detailed information on socio-demographic and employment characteristics at the individual and household level. The average household in our

[18]In 2002 the survey took place during the 4th quarter (Oct-Dec). Starting from May 2003 the survey is permanent (the whole sample is distributed monthly along the year). Around 18 percent of the visited households are not interviewed as the household refuses, is absent, the house is unoccupied or there are other reasons (miscellaneous category). This leads to an unbalanced panel with 719, 1435, 1153, 1870 and 2096 households being observed in one, two, three, four and five years, respectively. The fact that this number is increasing reflects the effort by INEI to create a large panel dataset. Quite a number of panel households were not interviewed in consecutive years.

[19]Total food consumption includes all food consumed inside or outside the home (the budget categories food and restaurants) that are either compensated by monetary or non-monetary means (see Table 8 for more information).

Table 7: Individual Characteristics

	Women	Men
Age	34.57	34.90
Primary education (%)	0.324	0.371
Secondary education (%)	0.293	0.352
Tertiary education (%)	0.097	0.107
Self-employment (%)	0.235	0.377
Wage employment (%)	0.174	0.377
Unpaid family work (%)	0.229	0.088
Unemployed (%)	0.068	0.048
Out of workforce (%)	0.300	0.112
Receiver labor income (%)	0.421	0.767
Receiver non-labor income (%)	0.185	0.142
Observations	20206	20661

Note: A range of t-tests indicate that all stated variables are significantly different among men and women (at the 5 percent level).

sample contains 3.1 adults and 2.3 children. Hence, in addition to the couple, 1.1 adults are part of the household who are often adult children of the couple. More than 50 percent of all households are classified as being poor according to the national definition.[20] Table 7 highlights some basic characteristics of adult men and women. The educational level in Peru is rather high with 70 percent of women and 80 percent of men having at least primary education (at least 7 years of schooling). Women appear to be economically dependent on men. While 80 percent of male adults earn labor income, this is only true for 40 percent of female adults. Women take time off from the workforce more than twice as often as men and are also more than twice as often employed as unpaid family aid. Hence, they are much less likely to be wage-employed or self-employed. Receiving non-labor income is more likely for women.

We aggregate expenditure data from the survey into seven categories: food, restaurants, health, education, clothing, housing, and other (miscellaneous). Table 8 presents their definitions with some examples. The biggest expenditure share is food (42 percent) followed by housing (14 percent) and restaurants (11 percent). Yet, in a developing country like Peru not only the monetary expenditure level is important. Several households receive numerous products for free, which is especially true for food, health, and housing goods. Due to poverty, food is often grown in private gardens or received from the employer as remuneration. Sometimes the employer offers

[20]The INEI classifies households as poor if the total monthly expenditure level is too low to buy the basic food basket plus basic transportation, utilities, and other home goods and services.

Table 8: Dependent Variables

			Monetary Expendit.			Total Consumption		
Variable	Definition	Example	Mean	Share	= 0*	Mean	Share	= 0*
Food	Food cons. inside	Bread, milk, cereals, meat	1184	41.62	1.12	1654	43.69	0.78
Restaurants	Food cons. outside	Restaurant meals, snacks on the way	364	10.70	21.96	487	10.82	16.45
Health	Health expenses	Consultation, vaccination, medicine	162	4.67	22.76	297	6.15	7.36
Education	Educational expenses	Supplies, fees, travel costs, internet	244	5.67	6.97	278	4.75	6.61
Clothing	Clothing expenses	Clothing, footwear, fabric	172	6.40	6.03	182	4.32	4.68
Housing	Rent & related costs	Rent, renovation	437	13.68	0.09	827	17.51	0.00
Other	Miscellaneous	Transport costs, celebrations	626	17.26	0.47	657	12.75	0.33

Notes: Total consumption includes monetary and non-monetary expenditures (in kind payments, public/ private donation, and self-consumption). Expenditures are measured annually. All stated values are in constant Dec. 2001 USD (Nuevo Sols values were deflated using the INEI Consumer Price Index, and converted into USD using the Dec. 2001 nominal exchange rate). * Percentage of observations that have zero expenditures in this category.

free accommodation, renovations of a house can be done by the household members themselves, and some basic health goods are costless. Consequently, some households have small expenditures on these categories. Yet, monetary values for these costless products are available. This allows us to calculate total household consumption regardless of whether the household has actually paid for these goods.[21] Columns seven and eight display the means and shares of each consumption category. The last column indicates the level of censoring, which is the proportion of observations that have zero consumption in the specific category.

Furthermore, the survey provides valuable information on individual income, including labor income as well as non-labor income (see Table 9). Labor income is obtained from dependent and independent employment and includes any form of monetary labor income including salary, profits, Christmas bonus, gratifications, etc.. It is fairly low with a mean annual value of 3400 US Dollar (USD) and more than 70 percent is received by men. Non-labor income is even smaller and sums up to 400 USD

[21] Although total consumption is about one third higher than monetary expenditures, the shares are rather similar.

Table 9: Household Income

	All	Women	Men	Children	= 0*
Labor income	3391	848	2530	14	1.13
Non-labor income	363	166	191	6	60.27
Non-monetary income	313	129	179	4	28.11

Notes: Incomes are measured annually. Due to rounding, numbers presented may not add up. All values are in constant Dec. 2001 USD. * Percentage of observations have zero income in this category.

on average. It is composed of property rents, special incomes and transfers, whereby the latter contribute the major part (77 percent).[22] Receiving non-labor income is quite rare, and more than 60 percent of all observations have zero non-labor income. Non-monetary income received from employment (either non-monetary remuneration from the employer or consumption from self-employment) amounts to 300 USD on average.

2.4 Econometric Analysis

2.4.1 Model and Estimation Method

In the empirical analysis, we have to choose a proper functional form of the econometric model. A popular form is the Working-Leser curve, which relates budget shares linearly to the logarithm of household expenditures *log(exp)* (Working (1943), Leser (1963)).[23] In this study, the basic model is specified as follows:

$$p_{ijt} = \alpha_j + \beta_{1j} B_{it} + \beta_{2j} H_{it} + \beta_{3j} T_t + \epsilon_{ijt}, \tag{9}$$

where the dependent variable p_{ijt} is the total consumption share of category j by household i in the survey period t. The term B_{it} measures gendered bargaining power, and ϵ_{ijt} is an error term. Common time effects for period t - which may include changes in relative prices or macroeconomic shocks - are captured by year dummies T_t. The term H_{it} refers to household characteristics that may affect expenditure behavior

[22] Special income includes lottery wins, inheritance, and accident insurance. The highest transfer stems from remittances (50 percent) followed by retirement pensions (31 percent), while the remaining categories - alimony, pension for food, widow's pension, and others - sum up to 19 percent.

[23] Recent studies using this model include Adams and Cuecuecha (2010) and Guzmán et al. (2008). If prices were available, the model could easily be extended to the widely applied Almost Ideal Demand System (AIDS) of Deaton and Muellbauer (1980).

including *log(exp)*.[24] On a cautionary note, however, we have to admit that we might omit relevant variables. The appropriate estimation technique depends upon whether a potential omitted variable bias is due to unobserved household specific effects or habit persistence. In case of the former, the longitudinal nature of the data offers a direct estimation method. The error term ϵ_{ijt} from equation (9) may be decomposed into:

$$\epsilon_{ijt} = \omega_i + u_{ijt}. \tag{10}$$

The term ω_i is a time-invariant effect unique to household i which includes observable and unobservable characteristics that do not change over time such as income determining human capital factors as well as tastes and consumption preferences. u_{ijt} is an error term. The household specific effects may either be random or fixed. The random effects (RE) assumption requires ω_i to be uncorrelated with H_{it} and the household specific effects are then parameterized as additional random disturbance. This assumption is rather strong as consumption preferences are likely to be correlated with factors such as education or age.[25] Hence, the household specific effects have to be assumed to be fixed effects (FE), which allows for a correlation between ω_i and H_{it}. The estimation strategy is then to treat them as parameters and modify equation (9) to:

$$p_{ijt} = \alpha_j + \beta_{1j} B_{it} + \beta_{2j} H_{it} + \beta_{3j} T_t + \omega_i + u_{ijt}. \tag{11}$$

All household-specific determinants of expenditure behavior are absorbed, and the estimates are unbiased under the assumption of the household-specific effects being time-invariant. The impact of variables that are (quasi-) constant over time, such as education, cannot be estimated, and thus they are not included in H_{it}. However, the within-variation tends to be much lower than the cross-sectional variation and hence FE-coefficients may be weakly identified. This problem is aggravated by measurement error in the independent variables whose relative importance becomes exaggerated in the within estimation.[26] This may result in a downward bias and low significance of the estimates, a feature which is well known in the literature (Angrist and Pischke (2009)).

On the other hand, economists have long recognized the habit concept in consumer choice.[27] Habit persistence refers to the situation where consumption in one period

[24] See Table B.2 in the appendix for means and standard deviations of H_{it}.

[25] A Hausman test rejects the validity of a random effects model.

[26] See, for example, Griliches and Hausman (1986) and Freeman (1984).

[27] The habit persistence concept comes from a macroeconomic perspective (e.g. Brown (1952))

may depend on past consumption. Customs, routines, standards, and levels of past consumption lead to an inertia in consumer behavior. The annual rent in one year, for example, is highly correlated with the rent in the previous year due to long-term contracts. For this case, we employ a dynamic version of equation (9):

$$p_{ijt} = \alpha_j + \gamma_j p_{ijt-1} + \beta_{1j} B_{it} + \beta_{2j} H_{it} + \beta_{3j} T_t + \epsilon_{ijt}, \tag{12}$$

where p_{ijt-1}, the lagged dependent variable (LDV), is included as a regressor to capture habit formation. It might seem appealing at first glance to include both a LDV and household FE. However, this reduces the number of observations as only those households observed in at least three periods are considered and the problem of weakly identified FE coefficients in short panels is exacerbated. Moreover, the within estimator of a LDV is correlated with the error term by construction, a problem pointed out by Nickell (1981). If the potential omitted variable bias is only due to habit persistence, however, the inclusion of FE is not necessary, and OLS is the appropriate estimation method. Otherwise, the inclusion of a LDV circumvents the problem of weakly identified FE coefficients while still controlling for a form of household-specific effects (although admittedly not as well as the FE model). Given the drawbacks of each estimation method and their complementarity, it seems useful to implement both approaches.

Estimation of a system of equations is complicated by the correlation of the error terms across equations. A positive shock in the budget share food, for example, results in higher expenses on food which implies a reduction of at least one other budget share. To deal with this problem, we estimate a seemingly-unrelated regression (SUR) model. Economic theory imposes several constraints on the parameters as the additivity criterion requires that all budget shares sum up to unity, $\sum_j p_{ijt} = 1$. In the FE-model, each equation contains exactly the same set of explanatory variables. In this case, the estimation of a SUR-model is equivalent to estimating each equation separately and the adding-up conditions are automatically satisfied.[28] In the LDV-model, the LDVs differ across equations. The adding-up conditions are:

$$\sum\nolimits_j \gamma_j = c \qquad \sum\nolimits_j \alpha_j = 1 - c \quad \text{and} \quad \sum\nolimits_j \beta_{nj} = 0 \quad \forall n, \tag{13}$$

where c is an unknown constant (Berndt and Savin (1975) and Anderson (1980)). The additivity criterion implies that the covariance matrix is singular. Hence, one

and has been adopted in micro-models. For example, the almost ideal demand system is recently extended by including habit persistence (e.g. Alessie and Kapteyn (1991), Blanciforti and Green (1983), and Zhen et al. (2011)).

[28] The adding-up conditions are $\sum_j \alpha_j = 1 \quad \text{and} \quad \sum_j \beta_{nj} = 0 \quad \forall n$.

equation has to be dropped from the system for estimation. If the constraints are imposed on the system, equations are invariant to the choice of equation which is to be deleted. The parameters of the deleted equation can then be recovered using these constraints. Constraining all γ_j's to be identical and estimating the system via iterative SUR is sufficient to impose the additivity criterion, and the remaining constraints are automatically satisfied.

The main remaining challenge is to find a variable that measures gendered intra-household bargaining power B_{it}. Fully exogenous variables such as wealth upon marriage or shocks in income or the outside option, for example, are not present in our data. The best proxy available is gender-specific income. The more one contributes to household income, the greater should be the say in decision-making regarding household expenditures. In developing countries such as Peru, multiperson households are common. We take account of this demographic reality and analyze the bargaining process within all adult household members. In presence of gender-specific preferences, both genders may form coalitions. Accordingly, we use the relative income shares held by coalitions of men and women, respectively. Following Sørensen and McLanahan (1987), our bargaining index B_{it} is defined as the female income share minus the male income share:

$$B_{it} = \frac{Y^{\text{female}}}{Y^{\text{total}}} - \frac{Y^{\text{male}}}{Y^{\text{total}}}, \tag{14}$$

where Y is total income (monetary and non-monetary). Obviously, the value of B_{it} lies between -1 (only men receive income) and 1 (only women receive income). Furthermore, a value of 0 refers to the case of equally distributed income shares across genders. For positive (negative) values, women contribute more (less) to total income.

As an additional measure, we use the gender composition of adult household members:

$$B_{it}^{N} = \frac{N^{\text{female}}}{N^{\text{total}}}, \tag{15}$$

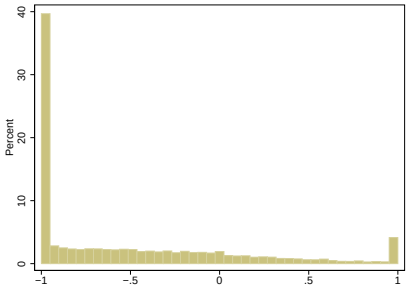
where N is the number of household members. The psychology literature suggests that the size of each coalition might affect outcomes independently of the resource position of each group (see for a review Gummerson and Schneider (2012)). If women outnumber men, female bargaining power may be high only because of their superior number.

2.4.2 Results

Distributions as well as means and standard deviations of our key variables B_{it} and B_{it}^{N} are presented in Figure 3 and 4. The left figure reveals that in 40 percent of all

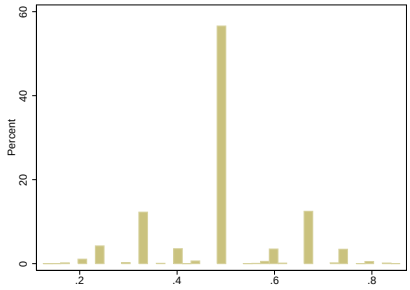
households only men contribute to household income whereas in only 5 percent of all households women are the sole contributors. In the remaining households, both genders receive some income. A mean of -0.52 indicates the men's income contribution is considerably higher than women's, and hence women are economically dependent on men. The gender composition is highly balanced with a mean of 0.5 and a symmetric distribution.

Figure 3: Bargaining Index B_{it}



Mean: -0.515 Sd: 0.581

Figure 4: Gender Composition B_{it}^{N}



Mean: 0.496 Sd: 0.121

The main categories of interest are food, education, and health. Education and health are crucial for human capital formation and hence foster long-run production possibilities. Sufficient food provision is an important determinant of child health and well-being in Peru. The categories food and restaurants are close substitutes and both counteract malnutrition. This is particularly relevant in the case of Peru where child malnutrition is high. However, a dollar spend on restaurant meals translates in relatively low nutrition compared to a dollar spend on home prepared food. Restaurants may hence be considered a luxury/leisure category.

Table 10 presents the estimation results from both estimation methods. For reasons of clarity, the dependent variables are given in percentage (i.e. the shares are multiplied with 100). As both bargaining measures are correlated (=0.25), we only include one at a time. Although the impacts are more pronounced when using a lagged dependent variable, we concentrate on the results that are robust with respect to the estimation method applied. A stronger resource position of women, B_{it}, is associated with higher expenditures on health and education while expenses on clothing decrease. A higher number of women, B_{it}^{N}, appears to decrease restaurant meals. Furthermore, more female bargaining power seems to be associated with higher expenditures on housing. Yet, this is only significant in the LDV-SUR model and may be considered suggestive. The signs of the coefficients of both bargaining measures largely coincide in most categories, suggesting overall robust findings.

Table 10: Key Regression Results

	Food	Restaur.	Health	Educ.	Clothing	Housing	Other
FE - Regressions: equation (11)							
B_{it}	0.007	-0.084	0.324^{b}	0.284^{a}	-0.197^{b}	0.001	-0.336^{b}
	(0.286)	(0.240)	(0.159)	(0.099)	(0.092)	(0.161)	(0.167)
B_{it}^{N}	2.692	-2.963^{b}	2.076^{b}	-0.218	-1.024^{c}	1.104	-1.668^{c}
	(1.669)	(1.404)	(0.928)	(0.576)	(0.537)	(0.942)	(0.973)
LDV - SUR: equation (12)							
B_{it}	-0.829^{a}	-0.075	0.315^{b}	0.442^{a}	-0.145^{c}	0.328^{b}	-0.036
	(0.264)	(0.225)	(0.135)	(0.095)	(0.077)	(0.151)	(0.146)
B_{it}^{N}	0.795	-4.520^{a}	0.970	1.480^{a}	-0.251	1.238^{c}	0.288
	(1.199)	(1.022)	(0.614)	(0.430)	(0.352)	(0.688)	(0.663)

Notes: Regressions include a constant and all additional variables stated in Table B.2 in the appendix. Full regression results are presented in Table B.3 - B.6 in the appendix. The number of observations is 13132 in the FE-regressions and 7981 in the LDV-SUR regression. Standard errors in parentheses: ^{c} significant at 10%; ^{b} at 5%; ^{a} at 1%.

As expected, the LDV-results are not only more significant but also more pronounced. If only women receive income, expenditures on health and education are 0.6 to 0.9 and 0.5 to 1.2 percentage points higher, respectively, in comparison to the situation when only men receive income.[29] This is a relative increase of 10 to 15 and 11 to 26 percent, respectively. Yet, these numbers can only be taken as an upper bound. A hypothetical government transfer of 1000 USD to women residing in households with a median expenditure level of 3560 USD would increase expenditures on health and education only by 1.5 to 2 and 2 to 4 percent, respectively. If an adult woman joins a married couple household, for example, restaurant meals decrease by up to 9 percent (or 1 percentage point).[30]

2.4.3 Robustness

Women's negotiation position is measured by an index based on income shares, B_{it}. As total income is largely composed of labor income, this measure may suffer from endogeneity issues. Labor income is typically correlated with characteristics such as

[29] This implies a shift in B_{it} from -1 to 1 and hence an increase of 2. In the LDV-regressions, the coefficients display short-run effects. The impacts stated in the text refer to the long-run effects, which are the coefficients multiplied by $\frac{1}{1-\gamma} = \frac{1}{1-0.29} = 1.4$.

[30] In this situation, B_{it}^{N} moves from $\frac{1}{2}$ to $\frac{2}{3}$ implying a change by a factor of $\frac{1}{6}$.

ambition, motivation, self-esteem and/or education, which may be positively associated with bargaining power. If these factors are constant over time, they are absorbed in the FE. However, time-varying factors cannot be accounted for by using FE. The main concern is that a higher labor income is often due to an increase in the number of hours worked in paid employment. Hence, fewer hours are available for home duties, which may alter shadow prices. As Doss (2006) has persuasively argued, more purchases of prepared food or more restaurant meals in response to a higher female income, for example, may not reflect gender-specific preferences and a higher female bargaining power, but that women have less time for cooking. We do control for the total amount of hours worked by all household members. Nevertheless, this is a relevant concern in particular in the categories food and restaurants, especially as other studies detect a positive impact of women's empowerment on food expenditures, that we do not observe.[31] One way to circumvent this problem is to use non-labor income as a measure of bargaining power. As non-labor income is not related to current labor supply, shadow prices stay unaffected.

Accordingly, we use the relative non-labor income (NL) shares held by coalitions of men and women. We use all types of NL except pensions for food.[32] To account for the fact that the contribution of non-labor income to total income is rather small, we weight the gendered income shares. Our non-labor bargaining index B_{it}^{*} is then:

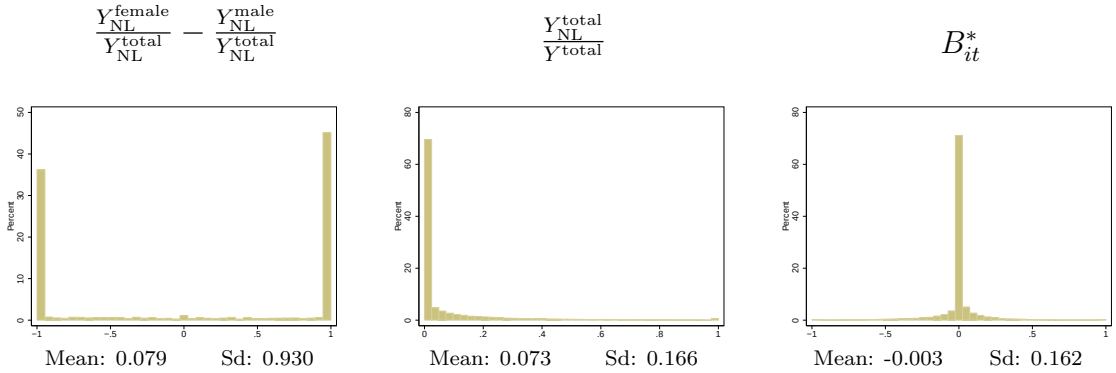
$$B_{it}^{*} = \underbrace{\left(\frac{Y_{\text{NL}}^{\text{female}}}{Y_{\text{NL}}^{\text{total}}} - \frac{Y_{\text{NL}}^{\text{male}}}{Y_{\text{NL}}^{\text{total}}} \right)}_{\text{Control over non-labor income (NL)}} \times \underbrace{\frac{Y_{\text{NL}}^{\text{total}}}{Y^{\text{total}}}}_{\text{Relevance of NL}} , \tag{16}$$

where Y_{NL} is non-labor income (NL). Receiving the major part of household NL should not increase the bargaining power if the income share of NL is very low. The second expression, therefore, measures the contribution of NL to total income. If it is very low, the expression is close to zero and hence B_{it}^{*} is close to zero. A high NL share implies that the second expression is close to one, and thus the gendered NL distribution matters.

[31] Evidence of higher food expenses as a result of a stronger female resource position is provided by Duflo and Udry (2004), Doss (2006), Hoddinott and Haddad (1995), Schmeer (2005), and Gummerson and Schneider (2012). See also Duflo (2012) for a review.

[32] Given the low incidence of each component of NL, we opt for using the sum of property rents, special income, and transfers other than pension for food (composed of alimony, remittances, retirement pension, widow's pension, and others). The finding that more NL in the hands of women increases food expenditures may be arbitrary if this is driven by pensions for food, which are almost exclusively received by women. Thus, we only consider NL other than pensions for food.

Figure 5: Non-labor Bargaining Index



Distributions as well as means and standard deviations of the two parts of the non-labor bargaining power index and the index itself are presented in Figure 5. The left part shows that NL is almost exclusively received by men or by women, but not by both genders (this figure only considers households with NL income different from zero). The graph in the middle reveals that almost 70 percent of all households receive zero or close to zero NL, and if households receive NL, its contribution to total income is rather low. Thus, the index B_{it}^{*} has a very high incidence of zero values. This makes estimations sensitive to outliers.

Table 11 presents the estimation results from the FE regressions and from the LDV-SUR regression. Once the resource position is measured by an index based on NL, an increase is associated with higher food expenditures and lower expenditures on restaurants. The signs of both bargaining measures, B_{it}^{*} and B_{it}^{N}, coincide. While the altered index appears to do a good job in the food and restaurant regressions, it is insignificant in all other expenditure categories. We believe that this is due to the very low variance of this variable in combination with the rather small budget shares of the other categories. As shadow prices in the other key categories education and health are unlikely to be affected by an altered gender-specific work load, the appropriateness of B_{it} is not of a concern here.

Additional biases may arise from the use of linear models. Not every household has expenditures in each category, which means that the dependent variables are censored. Consumption is observed only if the household's desired consumption exceeds some threshold, which depends on the lumpiness of the goods as well as the opportunity cost. The model can be expressed in terms of a latent variable with

$$q_{ijt} = \begin{cases} q_{ijt}^{*} & \text{if } q_{ijt}^{*} > 0 \\ 0 & \text{if } q_{ijt}^{*} \leq 0. \end{cases} \tag{17}$$

Table 11: Alternative Measures of B_{it}

	Food	Restaur.	Health	Educ.	Clothing	Housing	Other
FE-Model: equation (11)							
B_{it}	2.492^a	-1.977^a	0.219	0.127	0.230	-0.737	-0.353
	(0.884)	(0.743)	(0.492)	(0.305)	(0.285)	(0.499)	(0.515)
LDV-Model: equation (12)							
B_{it}	1.700^c	-1.953^b	0.379	0.248	0.025	-0.094	-0.305
	(0.956)	(0.816)	(0.490)	(0.343)	(0.281)	(0.549)	(0.529)

Notes: Additional variable included as described below Table 10. The number of observations is 13132 in the FE-regressions and 7981 in the LDV-SUR regression. Standard errors in parentheses: ^{c} significant at 10%; ^{b} at 5%; ^{a} at 1%.

A tobit model accounts for the censored nature of the dependent variables. However, no consistent FE-tobit procedure exists to estimate equation (11).[33] The difficulty in nonlinear panel models is that estimators can be severely biased due to the individual effect α_i which, in contrast to linear models, cannot be overcome by differencing. The most widely used solution to address this problem was proposed by Mundlak (1978):

$$\omega_i = \tau_i + \lambda_j \overline{Z_{it}}. \tag{18}$$

The idea is to parameterize the FE using the household mean of all right-hand side variables Z_{it} that are included in equation (9). The term τ_i is an error term. In order to incorporate the parameterization of the FE, and with $\xi_{ijt} = \tau_i + u_{ijt}$, we rewrite equation (11):

$$q_{ijt} = \alpha_j + \beta_{1j} B_{it} + \beta_{2j} H_{it} + \beta_{3j} T_t + \lambda_j \overline{Z_{it}} + \xi_{ijt}. \tag{19}$$

Although the model is estimated using a RE procedure, the results display (quasi) FE coefficients due to the Mundlak-type specification.

Estimating a censored SUR is not an easy task. The two-step procedure of Shonkwiler and Yen (1999) has found wide applicability in empirical work as it has a solid theoretical foundation and is easy to implement.[34] In the first step, the probability

[33] No sufficient statistic exists that would allow the fixed effects to be conditioned out of the likelihood. Hence, a fixed effects conditional tobit estimation is not feasible. The estimation of an unconditional tobit fixed effects model by including dummy variables suffers from the incidental parameter problem and is not consistent.

[34] The method has been highly debated in the literature. Although statistically inefficient, the SY-procedure is consistent and avoids the computational complexity of alternative maximum-likelihood estimators in large systems and hence remains an attractive option.

of participation in each expenditure category is estimated using a probit regression:

$$P(\widetilde{q_{ijt}}) = F(\omega_j \Pi_{it}). \tag{20}$$

The dependent variable in each probit is equal to 1 if $q_{ijt} > 0$ and zero otherwise. Π_{it} is a vector that contains the LDV, $\widetilde{q_{ijt-1}}$, and the right-hand side variables Z_{it}. The results are then used in the second step to weight the expenditure equations in the system and to construct a selection control term. The equation system takes the following form:

$$q_{ijt} = \Phi(\hat{\omega}_j \Pi_{it}) \left(\beta_j \Omega_{it} + \delta \frac{\phi(\hat{\omega}_j \Pi_{it})}{\Phi(\hat{\omega}_j \Pi_{it})} \right) + e_{ijt}, \tag{21}$$

where Ω_{it} is a vector that contains the LDV, q_{ijt-1}, and the right-hand side variables Z_{it}. $\phi()$ denotes the normal probability density function (pdf), and $\Phi()$ is the normal cumulative distribution function (cdf).

Unlike the case without censoring, it is a problem to ensure adding-up of the observed budget shares. The deterministic components on the right-hand side of equation (21) do not sum to unity across equations in general, and hence the error terms do not add up to zero (Yen et al. (2002)). Thus, a (nonlinear) SUR estimation of the system can be based on the entire set of equations, and no equation has to be dropped as in a singular equation system.[35] Parametric restrictions only ensure adding-up of the latent variables, but not of the observed expenditure shares. The upper part of Table B.7 in the appendix highlights the results from the FE-Tobit estimations and the nonlinear SUR regressions. The FE-regressions in the categories food, housing, and others are estimated via OLS given that (almost) no censoring occurs in these categories. The results are robust both in terms of magnitude and significance. Moreover, both bargaining measures show a positive and significant impact on health expenditures in this specification.

The inclusion of both a LDV and fixed effects reduces the number of observations as only households that are observed in at least three periods are considered. More importantly, the problem of weakly identified FE coefficients in short panels is exacerbated. Moreover, the within estimator of a LDV is correlated with the error term by construction, a problem pointed out by Nickell (1981). Nevertheless, it is reasonable robustness check. We use the corrected Least Squares Dummy Variables (LSDVC) approach developed by Bruno (2005). This LSDVC approach adjusts the within estimates using an approximation of the bias term and is feasible for unbal-

[35] Alternatively, one can drop one arbitrary equation and use the estimated parameters to recover the deleted equation.

anced panels.[36] A SUR estimation is not possible and the equations are estimated separately. Although the estimated coefficients are less significant (as predicted), the impact coincides with previous estimations (see Table B.7 in the appendix).

Another concern might be the use of total income and total consumption regardless of whether the household has actually paid for a specific good or has received it for free. We hence additionally measure B_{it} and the expenditure shares based only on monetary values. To check the sensitivity of the results with respect to our index, we use the female income share as an alternative measure, $B_{it}^{**} = Y^{\text{female}}/Y^{\text{total}}$. The results appear to be overall robust to both alternative measurements (see Table B.8 in the appendix). A stronger women's negotiation position increases expenditures on education and health, and decreases expenditures on restaurant meals. The effects appear to be more pronounced, when using monetary values, but the impact on health and clothing expenditures looses significance.[37]

2.5 Conclusion

This study investigates the impact of female intra-household bargaining power on household expenditures using a five-year panel data set. We apply both fixed effects estimations as well as the inclusion of a lagged dependent variable to identify causal effects. Although the impacts are more pronounced when using a lagged dependent variable, we concentrate on the results that are robust with respect to the estimation method applied. The empirical findings contradict predictions based on the unitary household model. Household expenditure patterns depend on the power distribution among household members. In particular, we find that more resources in the hands of women increase expenditures on education and health and decrease clothing expenses. An increase in non-labor income received by women is associated with higher food expenditures and lower expenditures on restaurants. Moreover, a higher relative number of women results in lower expenditures on restaurants. Although more female bargaining power seems to be associated with higher expenditures on housing, this evidence is not robust.

[36] Alternatively, GMM and system estimators can be adopted to address the Nickell bias. Yet, direct bias corrected methods have been shown to outperform GMM and system estimators in case of exogenous regressors (Behr (2003), Bruno (2005)). The Arellano and Bond (1991) estimator is chosen as initial estimator. Standard errors are bootstrapped with 250 repetitions.

[37] Although the results appear to be more pronounced using income shares at first glance, this is due to a different scaling. Using shares, the index ranges from zero to one and not from minus one to one.

The effects of a stronger women's resource position appear to be large at first glance. Comparing situations where men or women have exclusive decision-making power, expenditures on education would be 11 to 26 percent higher, and those on health would rise with 10 to 15 percent if women are those to decide. Yet, a large hypothetical government transfer of 1000 USD to women would increase expenditures on health and education only by 1.5 to 2 and 2 to 4 percent, respectively.

Although a perception of women being always a more altruistic decision-maker is somewhat exaggerated, women's empowerment seems to improve nutrition and human capital formation at least in Peru. This may have a positive impact on long-term development. From a policy perspective, our results hence suggest that policy can affect production possibilities without altering the resources available to the households by taking gender-specific preferences into account. This finding provides a rationale for improving women's status. Although measures such as microcredit programs and conditional cash transfers that focus on transferring income to women should have a positive impact, our findings suggest that it is rather small. Facilitating women's access to paid employment as well as the introduction of fixed quotas for women in the formal sector might be a possible solution. Improving women's legal outside options in case of divorce should also increase their bargaining power. In this regard, alimony rights, custody and child support standards or the division of goods upon divorce are important.

3 Remittances and Labor Supply in Peru: Do the Poor Respond Differently?

3.1 Introduction

Emigration from Peru is a relatively recent phenomenon, and it hardly existed prior to 1970. After several crises beginning in the 1980s and therefore high poverty and few economic prospects, the emigration rate increased strongly (see for a comprehensive review Takenaka and Pren (2010)). Peruvians emigrated to whatever countries they could enter, which resulted in a dispersed migration pattern. In general, they come from urban areas, and in particular Lima, as it has the only international airport. Rural migrants typically migrate first to Lima, where they work for several years to save money. Peruvian migrants are of both genders, diverse ages and varying motivations. They have a very high education level (52 percent in the United States have some college education) that stands in sharp contrast to the highly researched migrants from Mexico. Though the educational level in Peru is very high, this is not matched with adequate employment opportunities hence resulting in low returns to schooling and a high incentive for the educated to migrate. As a consequence of the rising emigration flows, remittances have more than tripled in Peru since 2000. In 2010, they sum up to 2.5 bn USD. This accounts for 2 percent of GDP, thus resulting in a relevant impact on the local economy.

Although remittances have generally a positive impact on the recipient households, they can undermine the incentives to work according to the neoclassical model of labor-choice. While an increase in leisure should increase the recipients' utility, it also reduces output and may create dependency. In a context of financial markets imperfections, however, remittances may alleviate credit constraints for poor households, which may foster productive investment and hence self-employment. Remittance flows are - in contrast to other sources of non-labor income - explained as part of familial contracts between the migrant and the remittance receiver. In face of poorly developed credit markets in developing countries, sending a family member abroad and receiving remittances may be a possibility to alleviate credit constraints for poor households. The financial transfers can allow the start-up or expansion of firms up to a level which is optimal under complete markets. Several empirical studies indeed find migration and remittance receipts to be positively correlated with the likelihood of self-employment (e.g. Yang (2008), Binzel and Assaad (2011)), and a different strand of literature finds a positive impact on productive asset accumulation

(e.g. Chiodi et al. (2012), Woodruff and Zenteno (2007)). Investment in productive assets is particularly relevant in the case of Peru. The informal sector constituting of mainly self-employment and microenterprises (MEs) accounts for about 75 percent of employment, and a major part operates under severe credit constraints (Göbel et al. (2012)). Remittance receipt may hence not only influence the decisions of whether to work and how much to work (the extensive and intensive margin of labor supply, respectively), but also the type of work performed. These considerations lead to the following hypotheses to be tested subsequently: (1) Remittances decrease labor supply in each occupation except self-employment. (2) Self-employment increases if remittance income is used to overcome credit constraints. (3) In this case, remittances increase the capital stock, profits, and the self-employment wage. (4) Credit constraints, and consequently the impact of alleviation via remittances is stronger for poor individuals.

This study examine the association between remittance receipt and employment, looking at how this association differs with household poverty level. We take an additional step further and examine if the capital stock and consequently profits and the (implicit) self-employment wage increases as hypothesized. The remainder of the study is organized as follows. Next, we provide an overview of the corresponding literature, and highlight econometric difficulties. Section 3.3 illustrates the data. In section 3.4 the econometric framework is developed, and the results are presented. The final part concludes.

3.2 Previous Evidence and Empirical Issues

There is a growing literature on the impacts of migration and remittances on employment outcomes. Funkhouser (1992) finds in his early empirical study in Nicaragua that labor supply responds negatively to remittances, although self-employment increases. The main difficulty in measuring impacts of migration or remittances on a certain outcome is endogeneity. Migration of one household member is a precondition for the inflows. The occurrence of one member migrating depends heavily on household characteristics, and consequently variables that may "explain" migration may also be correlated with the dependent variable. These variables may include observable characteristics such as the educational level, as well as unobservable characteristics like the degree of risk aversion or ambition. In the absence of random assignment, an estimation strategy that allows for identification of the treatment effect has to be employed.

Gibson et al. (2011), for instance, use a quasi natural experiment - a migration lottery program - to estimate the impacts of international migration and remittances on several outcomes of remaining household members. The authors find labor supply to be unaffected. In his Philippines case study, Yang (2008) exploits information from favorable exchange rate shocks that increase income in remittance receiving households. While the number of total hours worked seems to remain unaffected, the author provides evidence of increasing hours in self-employment. In addition, households become more likely to start relatively capital-intensive enterprises after a positive shock, which is consistent with alleviation of credit constraints.[38] Studies that analyze the behavior of men and women separately find gender-specific effects. After using propensity score matching as well as networks as instruments to correct for selection, Acosta (2006) observes a significant decline in women's labor supply whereas men's labor force participation remains unaffected. Amuedo-Dorantes and Pozo (2006) address the endogeneity concern by instrumenting remittances with information on Western Union offices in the state. They find no effect on the overall labor supply of men, but the type of work is altered by remittance receipt. While formal sector work and urban self-employment decrease, informal sector employment increases. Female labor supply decreases slightly, but only in rural areas. A study of Binzel and Assaad (2011) uses both an instrumental variable approach as well as a matching procedure to identify the effects of migration and remittances on the labor supply of women. Their findings suggest that women in migration households decrease wage work whereas female self-employment increases.

Once endogeneity is appropriately addressed, (gender-specific) labor supply seems to respond (negatively) marginally to remittance receipt on average. The type of work, however, appears to be affected, and self-employment tends to increase. The latter may follow from the fact that remittances foster productive investments, which hence has a positive effect on self-employment. The second literature which relates to the issues addressed in this study examines the impact of migration/ remittances on asset accumulation.[39] Using a survey of more than 6000 self-employed workers and

[38]Further evidence is provided by Cox-Edwards and Rodríguez-Oreggia (2009). Applying propensity score matching, no significant effect of remittance receipt on labor force participation in Mexico is detected. The authors explain their findings with remittances being the income contribution of the migrant abroad thus leaving total household income unchanged.

[39]Further indirect evidence is derived from the behavior of returning migrants. Dustmann and Kirchkamp (2002), Mesnard (2004) and Mesnard and Ravallion (2006), for example, find immigrants relatively likely to start self-employment activities upon return due to an alleviation of credit constraints.

small firm owners in Mexico, Woodruff and Zenteno (2007) analyze the impacts of attachment to migration networks. They identify the causal effect by exploiting variation in the degree of connection to historical migration networks (distance from rail lines). Migration networks are hypothesized to be associated with lower capital costs and/ or the alleviation of capital constraints. Their findings suggest that investment, and profits increase with attachment to the migration networks. Sales increase only in firms in high-capital sectors. The authors argue that the first results hint at lower capital costs while the latter provides evidence of alleviation of credit constraints in those sectors.[40] Chiodi et al. (2012) evaluate the link between migration and asset dynamics for a panel of poor rural households in Mexico by exploiting variation in aggregate migration across time and space. The provided evidence suggests that migration may be used to foster accumulation of productive asset. In the same vein, a study by Adams (1998) shows that remittances tend to increase investment in rural Pakistan by raising the marginal propensity to invest for migrant households.[41]

3.3 Data

We use data from the nationally representative Peruvian household survey *Encuesta Nacional de Hogares* (ENAHO) collected by the National Institute of Statistics and Informatics (INEI for its Spanish initials) between 2002 and 2006. The ENAHO entails a panel sub-sample of about 5000 to 6000 households each year of which 55 to 80 percent are re-visited in the following year (see Table B.1 in the appendix).[42] The survey provides detailed information on socio-demographic and employment characteristics at the individual level, including whether an individual is working, unemployed or out of the labor force (i.e. neither working nor searching for a job). For individuals that are working, we have information on the number of hours worked

[40] In a first step, Woodruff and Zenteno (2007) also estimate the relationship between migration networks and labor force participation or entry into self-employment, but they do not find a robust relationship.

[41] In contrast, Miluka et al. (2010) provide evidence that migrant households appear to invest less in farm technologies in crop production in Albania.

[42] In 2002 the survey took place during the 4th quarter (Oct-Dec). Starting from May 2003 the survey is permanent (the whole sample is distributed monthly along the year). Around 18 percent of the visited households are not interviewed as the household refuses, is absent, the house is unoccupied or there are other reasons (miscellaneous category). This leads to an unbalanced panel with 719, 1435, 1153, 1870 and 2096 households being observed in one, two, three, four and five years, respectively. The fact that this number is increasing reflects the effort by INEI to create a large panel dataset. Quite a number of panel households were not interviewed in consecutive years.

and the type of employment. Individuals are either working in dependent paid employment, named "wage-employment" in the following, they are independent workers or employers, named "self-employment" in the following, or they are helping in a household firm without getting paid, named "unpaid family aid" in the following. We restrict our analysis to individuals aged 18 to 70 that are not currently studying. Individuals that are not interviewed in consecutive years are excluded. In addition, we exclude those that are never in the labor force. In rural registration area ("Área de Empadronamiento Rural"), defined as villages with less than 500 inhabitants, only 0.5 percent of all households receive remittances. Therefore, and because of probably different employment behavior, we exclude them as well. The final dataset is an unbalanced panel with 27333 observations of 3304, 2898, 619, and 1911 working-age individuals that we observe in two, three, four and five years, respectively.

Self-employed individuals who are not working in agriculture, livestock production, or forestry are interviewed in an Informal Sector Module. This module captures the characteristics of the entrepreneurs and their production unit in microenterprises (MEs) with up to ten employees. It contains detailed information on investment, input use, and sales. We exclude observations from villages with less than 400 dwellings as these are only observed since 2004 due to a change in the survey design. Moreover, we restrict the analysis to MEs which seem to be operated with the main aim to earn income. This excludes firms without profits, in which less than 20 hours monthly are worked (from the owner and staff members), and those in which the owner is not working at all.[43] The final ME dataset is an unbalanced panel with 6889 observations of 1395, 1003, 549, 219, and 193 MEs, which we observe in one, two, three, four and five years, respectively.

Unfortunately, the ENAHO is not a specialized survey of remittances or migration. Therefore, it does not contain any information on household members that migrated which would allow for an estimation of the effect of migration on labor supply. However, the impact of remittances can be evaluated, since the data set contains comprehensive information on remittances, including the amount remitted, and the frequency in which remittances are received. Roughly 8 percent of the households included in the sample receive remittances at least in some years. Table 12 summarizes some household and individual characteristics separately according to the remittance

[43]Excluding observations from villages with less than 400 dwellings and without the main aim to earn income reduces the sample by 3 and 5 percent, respectively. Moreover, 19 percent of self-employed individuals work in agriculture, livestock production, or forestry, and are consequently not included in the Informal Sector Module (in villages with at least 400 dwellings).

Table 12: Household and Individual Characteristics

Remittance receipt	Never	Always	Some periods
Household characteristics			
No. hh. mem.	4.55	4.66	4.83*
No. hh. mem. aged 0-5	0.46	0.46	0.40*
No. hh. mem. aged +65	0.20	0.34*	0.41*
Total labor income (wage-employed)	2036	2091	2574*
Total labor income (self-employed)	1621	1404	1834
Total non-labor income (excl. rem.)	832	1337*	1892*
Total remittances (if > 0)	.	2156	1267
Poor (%)	0.41	0.11*	0.23*
Observations	11932	110	907
Individual characteristics			
Male	0.51	0.50	0.49
Years of education	10.00	11.45*	11.35*
Employed	0.80	0.70*	0.71*
Employed if in labor force	0.92	0.86*	0.90*
Hours worked (if > 0)	182	168	186
Observations	25104	206	2023

Notes: Income and remittances are measured annually. All monetary values are in constant Dec. 2001 USD (Nuevo Sols values were deflated using the INEI Consumer Price Index, and converted into USD using the Dec. 2001 nominal exchange rate). The difference between the households or individuals that never receive remittances and other types of households are significant * at 5%.

receipt status. The INEI classifies households as poor if the total expenditure level is below the poverty line i.e. too low to buy the basic food basket plus basic clothing, transportation, utilities, and other home goods and services.[44] Households that receive remittances at least in some periods are significantly less likely to be poor than those that never receive remittances.

The survey provides valuable information on household incomes, including labor income from each type of employment as well as non-labor income. Whereas households that always receive remittances have a similar wage-employment income as non-remittance receiving households, those that either gain or lose remittances earn significantly more (Table 12). In contrast, there is no significant difference in self-

[44]The expenditure level includes self-produced goods as well as public and private donations. The measure is not equivalent to the World Bank's definition of poverty (1.25 USD per day). The INEI poverty line is constructed for each region separately, according to local prices and available goods. On average, households are classified as poor if the daily expenditure level is below 2 USD.

Table 13: Employment Pattern

	Women	Men
Wage employment	0.333	0.496
of which: Informal sector	0.139	0.221
Self-employment	0.442	0.400
Unpaid family aid	0.117	0.040
Unemployed	0.104	0.062
Observations	10577	12819

employment income. Yet, the non-labor income of households which receive remittances at least once is about twice as high as that of non-receivers. Individuals who live in remittance receiving households have a significantly higher educational level. They are less likely to be employed, although the impact is more nuanced when only individuals in the labor force are considered. For individuals that are working, there is no difference in the number of hours worked.

Table 13 illustrates the employment structure of those that are in the labor force.[45] The importance of the informal sector - constituting of mainly self-employment and MEs - is remarkable, even compared to Latin American averages. More than 40 percent of the Peruvian labor force is self-employed. Another fourth part work as paid worker in informal firms, defined as firms without registration or written accounts, or as unpaid family workers. Compared to men, women are less likely to be wage-employed and are more often engaged as unpaid family aid.

Some basic characteristics of Peruvian MEs from the Informal Sector Module are highlighted in Table 14. Monthly incomes from self-employment are with a median of 94 USD fairly low, especially in respect to the high labor input of more than 200 hours monthly.[46] A median capital stock of 55 USD suggests that most activities operate with a very low capital stock, but the level of capital stock is very different across industries. About half of the entrepreneurs are female, and gender-specific preferences in the sector choice become obvious. While firms in the industries "hotels and restaurants" and "petty trading" are mostly owned by women (89 and 70 percent, respectively), firms operating in the "construction" or "transport" sector are almost

[45] In our sample, 14 percent of the individuals are out of the labor force. They are included in the empirical analysis, but not in this table.

[46] Capital stock is the replacement value of the sum of investment in machinery, furniture, vehicles, utilities, and other investment, excluding property investment. Profits is defined as the monthly owner's income.

Table 14: Descriptive Statistics of Firms by Industry

Industries	All	Prim.	M.&F.	C.	W./R.	P.T.	H.&R.	T.	Serv.
Capital stock	55	163	115	27	158	28	60	1206	15
Labor (owner)	205	205	167	205	240	227	180	274	116
Labor (owner& staff)	248	210	205	231	325	270	235	282	128
Profits	94	157	87	139	197	75	77	140	85
Zero capital (%)	0.15	0.06	0.03	0.03	0.04	0.20	0.05	0.12	0.34
Gender: Male (%)	0.47	0.97	0.54	1.00	0.80	0.30	0.11	0.99	0.50
Observations	6889	93	850	333	209	2,916	932	893	663

Notes: All monetary values are in constant Dec. 2001 USD. Industries are: primary sector, other manufacturing & food, construction, wholesale/retail shops, petty trading, hotels and restaurants, transport, and other services. The median is shown, except for the variables presented in percentage. Labor and profits are measured in monthly hours and USD, respectively.

always headed by a man (100 and 99 percent, respectively). Comparing the male and female dominated sectors, incomes appear to be higher in male dominated sectors.

3.4 Econometric Analysis

3.4.1 Remittances and Labor Supply

Labor supply depends on the real wage and real non-labor income including remittances given the attributes of the individual which involves the following empirical specification:

$$y_{iwt}^{o*} = X_{it}\gamma + R_{it}\beta + \epsilon_{iwt}, \tag{22}$$

where the dependent variable measures participation (y_{iwt}^{p*}) or hours of work (y_{iwt}^{h*}) of individual i in period t in employment type w. We focus on the impact on overall employment (i.e. any type of employment), wage-employment, and self-employment, as the employment types unpaid family aid and unemployment have a rather low incidence. The wage rate is typically highly endogenous, moreover we do not observe it directly in our data. The vector X_{it} contains variables that serve as proxies for the wage rate as well as for the employment behavior. The variable R_{it} is a dichotomous indicator of remittance receipt. It is equal to one if the household receives remittances.

We estimate equation (22) for the full sample, as well as for poor and non poor individuals separately.[47] To get a first idea about the potential impacts of remittances, Table 15 summarizes the naive OLS results. On average, labor supply at the intensive

[47]To reduce possible reverse causality problems, we classify the households in the first observed period. See also section 3.4.3.

Table 15: Labor Supply: First OLS Regressions

		Employment		Self-employment		Wage-employment	
Sample		Likelihood	Hours	Likelihood	Hours	Likelihood	Hours
All	R	-0.049[a]	-13.226[a]	0.011	-3.234	-0.061[a]	-8.523[b]
	SE	(0.015)	(3.906)	(0.015)	(3.387)	(0.015)	(3.432)
Non poor	R	-0.066[a]	-13.877[a]	-0.006	-5.196	-0.054[a]	-6.149
	SE	(0.017)	(4.372)	(0.016)	(3.704)	(0.017)	(3.915)
Poor	R	0.017	-6.207	0.079[b]	8.696	-0.080[b]	-16.756[b]
	SE	(0.031)	(8.771)	(0.035)	(8.174)	(0.033)	(7.099)

Notes: Regressions include: a constant, age and its square, years of education and its square, family size, number of household members younger than five and 65 years and older, log household non-labor income, per-capita income and unemployment rate within the province, dummies indicating Lima, urban areas, whether the household is poor, and whether the individual is the head of the household, and year dummies. Robust standard errors in parentheses: [c] significant at 10%; [b] at 5%; [a] at 1%.

and extensive margin seems to respond negatively to remittances. This effect is driven by a drop in wage-employment. The self-employment sector seems to react more heterogeneously. While poor individuals appear to be more likely to work self-employed, non poor individuals do not adjust their labor supply in self-employment.

So far, we have left endogeneity issues aside, although remittance receipt is very likely to be endogenous. In the analysis of the impacts of migration and remittances, an instrumental variable (IV) approach is generally expected to perform best among the non-experimental methods (McKenzie et al. (2010)). This method relies heavily on the exogeneity assumption. Thus, variables that explain remittance receipt but are uncorrelated with labor supply have to be employed. Unfortunately, we lack of such an exogenous instrument and an IV approach is not feasible.[48]

[48]In the absence of short-term shocks, identification of the causal effect often relies on historical migration. Historical migration developed networks which can promote future migration. As it has been in the past, it is not affecting current outcomes. Unlike in the prominent Mexican case, however, migration is a rather recent phenomenon in Peru, which cast some doubt on the validity of this instrument. Nevertheless, we have tried to use the percentage of remittance receiving households at the community level in the year 1998 as well as internal migration experience of the head of the household. The latter is defined as the head of the household living in a community other than the community of birth, and may serve as a proxy for migration will. The potential instruments were additionally interacted with the number of household members with secondary and with tertiary education, respectively, to allow for the variability of the instruments at the household level (Amuedo-

The longitudinal nature of the data, however, allows us to address the endogeneity concern in a direct way. The error term ϵ_{iwt} from equation (22) may be decomposed into

$$\epsilon_{iwt} = \alpha_i + u_{iwt}, \tag{23}$$

where α_i is a time-invariant effect unique to individual i which includes both observable and unobservable characteristics that do not change over time, such as human capital and taste factors. u_{iwt} is an i.i.d. error term. Treating α_i as a parameter is known as the fixed effects (FE) model.[49] In this study, we use the within variation which overcomes the incidental parameter problem, and is equivalent to the inclusion of individual fixed effects. All individual-specific determinants of labor supply are absorbed, and the estimates are unbiased under the assumption of the individual-specific effects being time-invariant. The impact of variables that are (quasi-) constant over time, such as gender or education, cannot be estimated, so they are not included in X_{it}. With fixed effect estimation, only individuals who receive remittances in some but not all periods contribute information for the estimate of R_{it}. The effects for individuals who always or never receive remittances are absorbed in those individual fixed effects. The estimator treats remittance receipt gain and loss symmetrically. Thus, the employment effect upon remittance receipt is assumed to be equal and opposite to that of losing remittances. Yet, the gain of remittances may have an effect on employment which persists in subsequent periods due to a potentially positive effect on investments. In the panel analysis, we therefore measure the impact of remittances by two dummies R_{it} and $R^{\text{before}_{it}}$. The latter is equal to one from the period onwards the household does not receive remittances anymore.[50] This yields:

$$y^{o*}_{iwt} = X_{it}\gamma + R_{it}\beta + R^{\text{before}}_{it}\beta_1 + \alpha_i + u_{iwt}, \tag{24}$$

Table 16 summarizes the main results of interest, pertaining to the effects of remittance receipt. Overall, the standard errors are quite large and the impact is rather modest. For the full sample, remittances appear not to alter the average labor supply, but the type of work changes. Whereas the likelihood of wage-employment decreases by 4 percentage points, it increases in self-employment by 4 percentage points (weakly significant). Although the effects on self- and wage-employment seem to persist in

Dorantes and Pozo (2006), Hanson and Woodruff (2003)). Unfortunately, in any specification and with or without community dummies to control for effects at the community level, the instrument(s) never passed an exogeneity test.

[49] A Hausman test rejects the validity of a random effects model.

[50] Consequently, the baseline category is the period before remittances.

Table 16: Labor Supply: FE Regressions

		Employment		Self-employment		Wage-employment	
Sample		Likelihood	Hours	Likelihood	Hours	Likelihood	Hours
All	R	0.000	0.610	0.036^{c}	1.772	-0.037^{c}	-0.504
	SE	(0.022)	(6.006)	(0.022)	(4.952)	(0.022)	(4.894)
	R^{before}	-0.036	-6.912	0.002	-2.909	-0.041	-2.465
	SE	(0.032)	(8.356)	(0.030)	(6.518)	(0.030)	(6.934)
Non Poor	R	-0.032	-2.304	-0.010	-5.379	-0.023	2.919
	SE	(0.025)	(6.174)	(0.024)	(5.282)	(0.025)	(5.387)
	R^{before}	-0.065^{c}	-12.456	-0.044	-10.599	-0.012	0.171
	SE	(0.036)	(8.978)	(0.034)	(7.157)	(0.035)	(7.717)
Poor	R	0.099^{b}	8.935	0.163^{a}	21.770^{c}	-0.058	-9.012
	SE	(0.047)	(15.041)	(0.045)	(11.532)	(0.045)	(10.865)
	R^{before}	0.056	10.689	0.124^{b}	18.034	-0.101^{c}	-6.774
	SE	(0.067)	(19.483)	(0.058)	(14.364)	(0.061)	(15.113)

Notes: Regressions include: a constant, age and its square, log household non-labor income, and a dummy indicating whether the individual is the head of the household. Robust standard errors in parentheses: ^{c} significant at 10%; ^{b} at 5%; ^{a} at 1%.

subsequent periods without the transfers, this is not statistically significant (which might be attributed to the lower incidence). The rise in self-employment is driven by poor individuals who are 16 percentage points more likely to be self-employed upon remittance receipt. The effect appears to be permanent: even in subsequent periods without remittances, poor individuals are 12 percentage points more likely to be self-employed. An insignificant drop in the likelihood of wage-employment - which is even stronger after remittance receipt - suggests that some of these new entrepreneurs move out of wage-employment. Overall, the employment likelihood of poor individuals increases by 10 percentage points. In contrast, non poor individuals seem less likely to be either self- or wage-employed, but this effect is small and insignificant. The amount of hours worked appears to be rather unaffected in the full sample and in the subsamples. The only, weakly significant, effect is an increase in the number of hours worked in self-employment by the poor.

In addition, we estimate separate regressions for men and women (see Table 17). Both genders appear to react similarly. If they are poor, remittance receipt is associated with a higher likelihood of self-employment by 15 to 17 percentage points. This effect appears to be permanent for men. Yet, although the sign suggests a similar

Table 17: Labor Supply: Gender-Specific Effects

		Employment		Self-employment		Wage-employment	
Sample		Likelihood	Hours	Likelihood	Hours	Likelihood	Hours
Women							
All	R	0.013	5.003	0.046	7.532	-0.024	2.238
	SE	(0.034)	(7.895)	(0.029)	(6.548)	(0.029)	(5.504)
	R^{before}	-0.072	-13.783	-0.063	-9.900	-0.012	-0.351
	SE	(0.048)	(11.024)	(0.040)	(7.978)	(0.038)	(8.808)
Non Poor	R	-0.022	2.630	0.016	2.281	-0.027	5.703
	SE	(0.038)	(8.141)	(0.034)	(7.054)	(0.034)	(6.235)
	R^{before}	-0.115^b	-18.669	-0.106^b	-17.950^b	0.007	3.508
	SE	(0.055)	(12.404)	(0.048)	(9.148)	(0.047)	(10.755)
Poor	R	0.146^b	18.315	0.145^a	26.067^c	0.009	-4.859
	SE	(0.071)	(20.407)	(0.051)	(15.459)	(0.053)	(12.052)
	R^{before}	0.107	13.219	0.081	20.860	-0.040	-6.268
	SE	(0.096)	(23.384)	(0.067)	(15.829)	(0.054)	(12.698)
Men							
All	R	-0.016	-4.779	0.024	-4.430	-0.052	-3.971
	SE	(0.030)	(9.019)	(0.032)	(7.367)	(0.034)	(8.138)
	R^{before}	0.004	0.629	0.070	4.400	-0.070	-4.369
	SE	(0.042)	(12.529)	(0.043)	(10.316)	(0.047)	(10.722)
Non Poor	R	-0.043	-7.915	-0.036	-13.520^c	-0.022	-0.647
	SE	(0.033)	(9.348)	(0.033)	(7.819)	(0.038)	(8.969)
	R^{before}	-0.006	-4.676	0.022	-2.745	-0.028	-2.791
	SE	(0.046)	(12.882)	(0.048)	(11.006)	(0.051)	(11.031)
Poor	R	0.057	-0.284	0.173^b	17.533	-0.115^c	-13.216
	SE	(0.061)	(21.238)	(0.070)	(16.546)	(0.068)	(17.186)
	R^{before}	0.014	9.774	0.163^c	16.637	-0.153	-7.086
	SE	(0.094)	(30.001)	(0.091)	(23.035)	(0.103)	(25.894)

Notes: Regressions include: a constant, age and its square, log household non-labor income, and a dummy indicating whether the individual is the head of the household. Robust standard errors in parentheses: ^{c} significant at 10%; ^{b} at 5%; ^{a} at 1%.

behavior for women, this is not significant. The likelihood of wage-employment decreases for poor men (by weakly significant 12 percentage points), but not for poor women. While some of the male poor new entrepreneurs seem to come from wage-

employment, their female counterpart appears to come from unemployment, out of the labor force or unpaid family work (the miscellaneous categories), and consequently their total employment probability rises by 15 percentage points. The non poor seem to reduce their labor supply in self-employment. However, this is only significant for poor women in the periods after remittances.

3.4.2 Remittances and Firms

Our results suggest that self-employment activities respond positively to remittance receipt. A logical next step is then to determine if the capital stock, profits, sales, and the self-employment wage is altered as hypothesized. Our empirical analysis departs from the following functional form:

$$y_{it} = X_{it}\gamma + R_{it}\beta + R_{it}^{\text{before}}\beta_1 + \alpha_i + \xi_{iwt}, \tag{25}$$

where all variables are defined as before, and ξ_{iwt} is an i.i.d. error term. The dependent variable y_{it} measured the key input and performance variables: capital, labor, profits, sales, and wage, all measured in logs. Capital stock is the replacement value of the sum of investment in machinery, furniture, vehicles, utilities, and other investment, excluding property investment. Labor includes the labor inputs of the firm owner and his/her staff members. Profits is defined as the monthly owner's income. Sales are the value of monthly sales of goods and services. Wage is defined as owner's income divided by owner's labor input. All monetary values are in constant Dec. 2001 USD.

Table 18 presents the key results of FE regressions of equation (25). The evidence for the full sample is rather weak. Only the self-employment wage increases significantly by more than 30 percent, and the effect seems to be permanent. Again, poor and non-poor individuals appear to react differently. The non poor seem not to respond much to remittances, only labor input is reduced (weakly significant). In contrast, poor entrepreneurs tend to increase their capital stock upon remittance receipt (insignificant), and in subsequent periods it is 200 percent higher than before remittances (significant). Labor input is not adjusted, and consequently profits grow significantly by 100 percent. The effect on profits is rather insensitive to the inclusion of log(capital) in the regression (Column 4). This suggest that remittances affect profits not only through the higher capital stock, but have an additional positive effect. Due to higher profits, the implicit wage is 120 percent higher (significant). The effects on profits and wage seems to persist in subsequent periods, but the coefficients are not significant. Sales seem to respond positively, but this is only weakly significant. These relative numbers would correspond to an increase in capital stock from 28 to

Table 18: Firm Performance

		(1) Capital	(2) Labor	(3) Profits	(4) Profits	(5) Sales	(6) Sales	(7) Wage
All	R	0.354	-0.110	0.155	0.143	0.058	0.042	0.266^{b}
	SE	(0.288)	(0.075)	(0.131)	(0.130)	(0.095)	(0.093)	(0.130)
	R$^{\text{bef.}}$	0.629	-0.059	0.314	0.293	0.091	0.062	0.374^{c}
	SE	(0.390)	(0.085)	(0.210)	(0.210)	(0.119)	(0.117)	(0.213)
Non P.	R	0.333	-0.169^{c}	-0.048	-0.058	-0.010	-0.022	0.068
	SE	(0.384)	(0.090)	(0.130)	(0.129)	(0.113)	(0.112)	(0.133)
	R$^{\text{bef.}}$	0.504	-0.122	0.130	0.115	0.013	-0.005	0.234
	SE	(0.510)	(0.106)	(0.171)	(0.171)	(0.140)	(0.136)	(0.179)
Poor	R	0.457	0.025	0.680^{b}	0.662^{b}	0.260	0.231	0.803^{a}
	SE	(0.319)	(0.133)	(0.301)	(0.301)	(0.175)	(0.172)	(0.283)
	R$^{\text{bef.}}$	1.093^{b}	0.061	0.754	0.712	0.335^{c}	0.267	0.725
	SE	(0.546)	(0.144)	(0.500)	(0.503)	(0.202)	(0.206)	(0.510)
Log(capital) incl.		No	No	No	Yes	No	Yes	No

Notes: All dependent variables are measured in logs. Regressions include: a constant, age and its square, log household non-labor income, and a dummy indicating whether the individual is the head of the household. Robust standard errors in parentheses: ^{c} significant at 10%; ^{b} at 5%; ^{a} at 1%.

43 USD (80 USD), in profits from 65 to 129 USD (139 USD) monthly, and a rise in wage from 0.38 to 0.83 USD (0.77 USD) hourly for poor entrepreneurs with mean X_{it} upon remittances (in subsequent periods).

3.4.3 Robustness

Changes in migration may affect directly both remittances and employment. For example, if migrants were working in self-employment and leave to migrate, then other family members may have to take over the business. Additionally, if migrants were performing household tasks (e.g. looking after elderly family members or children), then other household members may have to cut back on their wage work hours to take over these tasks, and may choose self-employment for the greater flexibility in hours. Unfortunately, the data contain no information about migration which would allow for an estimation of the effect of migration on labor supply. We attempt to address the first concern by analyzing how the number of household businesses is affected by remittances. The evidence provided in Table C.1 suggests that the number of household businesses increases upon remittance receipt and in subsequent periods.

This weakly significant result is again driven by poor household that own significantly more firms upon remittance receipt and in subsequent periods.[51] The second issue is well known in the literature and indeed may be more prevalent in poorer households. Although it is rather difficult to address this concern empirically with our data, we have already provided suggestive evidence that this should not be driving our results. Taking care of relatives is a task which is almost exclusively performed by women. However, in contrast to men, poor new female entrepreneurs appear do come from unemployment, unpaid family aid, or out of the labor force and hence their likelihood of employment increases upon remittance receipt (see Table 17).[52]

An additional concern might be the use of linear models. In the first specification, participation y_{ijt}^{p*} is an unobservable latent continuous variable which has an observable realization of one if y_{ijt}^{p} takes on a positive value, and zero otherwise. When the dependent variable y_{ijt}^{h*} reflects the hours worked in one employment category, these are all either positive or zero if the individual is not working in the specified employment category. Logit and tobit models, respectively, account for the censored nature of the dependent variables. However, Angrist and Pischke (2009) pointed out that although a nonlinear model may provide a better fit than a linear model, the issue may matter little when the interest lies in marginal effects. On the other hand, no standard procedures for non-linear fixed effects estimations exists which allows to construct marginal effects.

The difficulty in nonlinear panel models is that estimators can be severely biased due to the incidental parameters problem and the individual effect α_i which, in contrast to linear models, cannot be overcome by differencing. The most widely used solution to address this problem was proposed by Mundlak (1978):

$$\alpha_i = \omega_i + \overline{Z_i}\lambda. \tag{26}$$

The idea is to parameterize the individual effect using the individual mean of all regressors Z_{it}. The term ω_i is an i.i.d. error term. Rewriting (24) by incorporating the individual fixed effects and with $e_{iwt} = \omega_i + u_{iwt}$ yields:

$$y_{iwt}^{o*} = X_{it}\gamma + R_{it}\beta + R_{it}^{\text{before}}\beta_1 + \overline{Z_i}\lambda + e_{iwt}. \tag{27}$$

[51] Using household level business ownership as an outcome yields similar but less significant results.

[52] Migrants also may have been helping in an agricultural household firm, which is a task likely to be taken over by the remaining male household members. As this is an income-generating task (at least for the household), it is not plausible why this should result in considerably more self-employment. Moreover, agricultural household firms are almost exclusively found in rural areas. Restricting the estimation sample to urban areas does not change the results.

We examine the probability of participation by employing a logit model conditional on the Mundlak-terms. Although the model is estimated using a random effects procedure, the results display (quasi) fixed effects coefficients, as we utilize a Mundlak-type specification.[53] To account for the censored nature of the number of hours worked, a (quasi) fixed effects tobit conditional on Mundlak-terms is applied.[54]

Table 19 highlights the estimation results from this specification (for full results, see Table C.2 and Table C.3 in the appendix). All findings from the linear models are confirmed, and the effects are even stronger and more significant. The largest impact of remittances is a permanent increase in the likelihood of self-employment for poor individuals by at least 24 percentage points. In addition, their monthly number of hours in self-employment increases permanently by at least 18 hours (significant only after remittance lost), while their likelihood of wage-employment decreases by at least 7 percentage points.

In the analysis above, we distinguish poor and non poor individuals according to the definition of the INEI (see section 3.3 for a detailed description). However, remittances are likely to allow households to move out of poverty which may bias our results. To reduce possible reverse causality problems, we have classified the households in the first observed period.[55] To check the sensitivity of the results to the

[53]In linear models, this is equivalent to using the within variation or the inclusion of individual fixed effects. This does not hold for non-linear models. For comparison, we have additionally estimated a fixed effects logit model (Chamberlain (1980)). Yet, this procedure comes at the cost of only considering individuals with a change in participation status, and, in particular, no marginal effects can be estimated. Both regression results appear to be almost equal (see C.2 and Table C.3 in the appendix).

[54]A fixed effects conditional tobit estimation is not feasible as no sufficient statistic exists that would allow the fixed effects to be conditioned out of the likelihood. The estimation of an unconditional tobit fixed effects model by including dummy variables suffers from the incidental parameter problem and is not consistent. Using Monte-Carlo methods, Greene (2004) finds that the slope estimators for the fixed effects tobit models seem not to be biased beyond five time periods. However, the dispersion is underestimated, which results in an upward bias in the marginal effects.

[55]Given that we include dummies indicating periods with remittances and afterwards, the baseline category is the period before remittances. Accordingly, the remittance coefficient for poor individuals is estimated for those residing in households that have been poor in the first observed period (and before remittances), which does not give rise to concerns. Similarly, the remittance coefficient for non poor individuals is estimated for those residing in households that have been non poor in a period before remittances. One may argue that some of these households may have received remittances in an earlier period which made them move out of poverty. Indeed, it is possible that some households observed and classified as non poor have been poor at some point in the past. Nevertheless, this does not give rise to major concerns as we estimate the impact for non poor individuals without

Table 19: Labor Supply: non-linear Specification

		Employment		Self-employment		Wage-employment	
Sample		Likelihood	Hours	Likelihood	Hours	Likelihood	Hours
All	R	0.000	1.623	0.063	3.119	-0.052^{c}	-0.673
	SE	(0.017)	(4.780)	(0.042)	(4.345)	(0.030)	(3.689)
	R^{before}	-0.030	-5.818	0.005	-1.779	-0.057	-2.777
	SE	(0.029)	(6.549)	(0.047)	(5.768)	(0.040)	(5.507)
Non Poor	R	-0.024	-1.444	-0.015	-4.344	-0.036	2.052
	SE	(0.021)	(4.969)	(0.035)	(4.457)	(0.044)	(4.295)
	R^{before}	-0.054	-11.104	-0.060	-9.662^{c}	-0.015	-0.410
	SE	(0.035)	(7.028)	(0.041)	(5.764)	(0.063)	(6.499)
Poor	R	0.058^{a}	10.536	0.312^{a}	22.643^{b}	-0.068	-7.805
	SE	(0.021)	(12.442)	(0.090)	(9.575)	(0.042)	(8.317)
	R^{before}	0.034	11.443	0.236^{b}	17.773	-0.103^{b}	-8.055
	SE	(0.041)	(16.191)	(0.120)	(11.244)	(0.041)	(11.704)

Notes: Regressions include: a constant, age and its square, log household non-labor income, a dummy indicating whether the individual is the head of the household, and mundlak-terms. Coefficients display marginal effects. For the tobit model, the marginal effects for the expected value of y conditional on being uncensored ($y = E(hours_w|hours_w > 0)$) are shown. Standard errors in parenthesis: ^{c} significant at 10%; ^{b} at 5%; ^{a} at 1%.

poverty measure, we split the sample into two groups according to a household wealth index.[56] The household wealth index is derived from the first principal component of a set of indicators of ownership of household assets. Only non-business assets, such as color televisions and the condition of the house (for example, the state of the walls and the quality of sanitary facilities) are included. Possible problems of reverse causality are addressed by using the wealth index from the first observed period. We choose a threshold such that the ratio of poor and non poor individuals remains constant. Estimation results provided in Table C.4 and C.5 support our previous findings: remittances increase self-employment at the intensive and extensive margin, and decrease the likelihood of wage-employment of poor individuals, while the non poor do not change their labor supply. Yet, the decrease in the likelihood of wage-employment becomes stronger, and the increase in the likelihood of self-employment

questioning the reason for being non poor.

[56]Moreover, it would be interesting to see how the results change with the World Bank's poverty definition (1.25 USD). According to this definition, however, only 10 percent of all households are classified as poor which results in a too low sample size.

becomes smaller. Regarding firm performance, remittances are associated with a higher capital stock, profits level, and wage for poor entrepreneurs, although the estimates are only significant at the 10 percent level.

One source of potential concern is that we measure remittance receipt by a dummy. As a robustness check we substitute the dichotomous variable by the log of total amount of remittances. Our results appear to be very robust regarding the measurement of remittance receipt (see Table C.6 and C.7 in the appendix). A rise in the amount of remittance has a rather moderate effect. If yearly remittances increase from 160 USD (the first quartile for poor individuals) to 1600 USD (the last quartile) the likelihood of self-employment for poor individuals increases from 9 to 13 additional percentage points. In this situation, capital stock, profits, and wage increase by 45 instead of 31 percent, by 53 instead of 37 percent, and by 61 instead of 43 percent, respectively.

Remittances appear to provide access to capital, and consequently capital stock, profits and the self-employment wage of poor entrepreneurs increase. Nevertheless, the finding that sales remain constant casts some doubt on whether remittances truly alleviate credit constraints as already pointed out by Woodruff and Zenteno (2007). The increase in profits and wage may also be associated with lower capital costs. However, our finding that remittances are associated with higher capital stock, profits and wage only for poor entrepreneurs hints at alleviation of credit constraints. Furthermore, sales respond positively to remittances in our study, although this is only significant in subsequent periods and only at the 10 percent level.[57]

In addition, the new poor entrepreneurs may run firms that are irrelevant in economic terms. Yet, the number of hours worked in self-employment increases by 22 hours - from 68 to 90 hours monthly per individual - implying an increase by 32 percent, which suggests that the new firms are relevant.[58] Nevertheless, we have ad-

[57]Somehow related, there is an ongoing debate whether a greater cash flow sensitivity of investment is a reliable indicator for credit constraints. Given that most firms may be classified as constrained and therefore respond to internal cash flows, Kaplan and Zingales (1997) argue that the sensitivity has to increase monotonically with the degree of credit constraints. The empirical evidence indeed is mixed. Cash flow, however, is also a good indicator for investment opportunities. In contrast, remittance income is additional liquidity, and constrained firms should be sensitive to additional liquidity while unconstrained firms should not. Indeed, we only observe firms of poor entrepreneurs investing which hints at credit constraints.

[58]The total number of hours worked is constructed for all individuals including, for example, those in wage-employment and the unemployed. Self-employed individuals have an average work load of 180 hours monthly.

dressed this concern further by estimating the impact of remittances on households' total self-employed income and the self-employed income share. Whereas households' total self-employed income increases significantly by 1400 USD (380 USD) annually for the poor (for the full sample), the self-employed income share rises significantly by 8 percentage points (no effect is present for the full sample).[59]

Finally, we have checked the robustness of our results to minor changes in the specification. We additionally include time dummies to estimate a two-way FE model. The time dummies appear to be significant only in some regressions, and do not change the results, but increase the standard errors due to less degrees of freedom (see Table C.8 and C.9 in the appendix). Moreover, we have included individuals aged at least 15 years, as well as excluded individuals younger than 25 years or older than 60 years. The estimates are very robust to these changes, only the significant level is in some regressions slightly lower when we use a smaller sample (not shown). In addition, empirical evidence suggests that employment decisions exhibit serial persistence (Hyslop (1999)).

3.5 Conclusion

This paper uses Peruvian panel data to examine the association between remittance receipt and employment, looking at how this association differs with household poverty level. Remittances can undermine the incentives to work by increasing the recipients' income. On the other hand, the inflows may alleviate credit constraints for poor households, which may foster productive investment and hence self-employment. Individual fixed effects estimations are applied to estimate the effect of remittances on both the decision whether to work and how much to work. All results are very robust, as shown by the estimation of a number of alternative specifications. The findings are another piece of evidence that once endogeneity is appropriately addressed, remittances have only a minor and insignificant impact on labor supply on average. However, the type of work is altered. Remittances are associated with a lower likelihood of wage-employment and a higher likelihood of self-employment. The impacts differ among poor and non poor individuals. Whereas the non poor appear to react little, the poor are 16 percentage points more likely to be self-employed. Overall, the employment likelihood of poor individuals increases by 10 percentage points.

Some of these poor new entrepreneurs seem to come from wage-employment if they are male. In contrast, female poor new entrepreneurs appear to come from unem-

[59] Results are available from the authors upon request.

ployment, out of the labor force, or unpaid family work, and consequently their total employment probability rises. It is difficult to judge, however, whether these results are driven by gender-specific preferences. Men are much more likely to be wage-employed. This may be due to social norms that impede female wage-employment or that put pressure on men to take any available wage-employment (even if it is poorly paid). While both genders react to profitable earning opportunities, men are much more likely to come from wage-employment than women.

In a second step, we examine the impacts of remittances on firm performance. The effects are large: capital stock, profits, and the self-employment wage of poor entrepreneurs increase by 58 to 123 percent upon remittances. In contrast, non poor entrepreneurs seem to reduce labor input. The evidence suggests that remittances indeed provide access to capital, and allow poor individuals to start and expand firms. Self-employment activities become more profitable, and the poor are thus more likely to be self-employed. Whether this implies an additional positive effect on total employment (as some of the entrepreneurs may wish to hire employees) is beyond the scope of this paper, but could be a promising approach for future research. Moreover, this study has little to say about how sustainable the effects are.

From a policy perspective, our results suggest that remittances alleviate credit constraints that leave the entrepreneurial potential of poor individuals unexploited. This finding provides a rationale for microcredit programs which would benefit especially the poor. However, the purpose of this document is not to go into detail about a potentially successful program design. Furthermore, remittances appear to be pro poor at least with respect to self-employment opportunities. Policy makers might hence be encouraged to think about policies to promote remittance flows. A reduction in transfer costs, for example, could increase remittances sent through formal channels. Improved and low-cost access to banking services, such as savings accounts, might be a possible solution. Savings accounts may also mitigate the credit constraints that we have identified.

4 Constrained Firms, not Subsistence Activities: Evidence on Capital Returns and Accumulation in Peruvian Microenterprises[60]

4.1 Introduction

Income from microenterprises (MEs) constitutes the main source of income of the growing number of poor urban dwellers in developing countries. Due to their low productivity, however, these firms contribute little to GDP. The evidence presented in the previous chapter suggests, that insufficient access to credit markets can be one reason for those firms not to exploit their full potential. This provides a rationale for policy interventions like the expansion of microcredit programs. This chapter sheds more light on this finding by providing a more detailed analysis of Peruvian MEs. Several empirical studies indeed have found very high marginal returns to capital in MEs in poor countries - typically well above market interest rates, and in some studies highest at very low levels of capital stock (Fafchamps et al. (2011), McKenzie and Woodruff (2006), Udry and Anagol (2006)). This finding hints at credit constraints as one major obstacle to firm growth. Under complete credit markets, a profit-maximizing entrepreneur would otherwise increase the capital stock until marginal returns equal the market interest rate. Empirical work that explicitly addresses credit constraints also confirms their importance (de Mel et al. (2008, 2012), McKenzie and Woodruff (2008)). Yet, credit constraints may only partly explain the observed high returns to capital. In fact, the persistence of small-scale activities in many poor countries is difficult to reconcile with very high returns to capital only caused by credit constraints. Successful entrepreneurs should be able and willing to re-invest a part of their high returns into their MEs, thereby overcoming credit constraints and accumulating capital (as shown, for example, by Tybout (1983)). Risk may be an additional reason why this is not the case, as optimal capital stocks may be much lower than in less risky environments. The empirical literature generally has difficulties in the operationalization of risk and risk attitudes, which may explain why empirical research on the role of risk for ME performance is scarce. A notable exception is de Mel et al. (2008) who do, however, not find any sizeable effect of risk on returns to capital. Nevertheless, there is indirect evidence of the role of risk, such as the high rates of churning among informal MEs in developing countries (Mead and Liedholm

[60] This chapter is based on Göbel et al. (2012).

(1998)).

This paper aims at providing new insights on the returns to capital, and the dynamics of small-scale activities in developing countries. To test whether we can confirm previous findings of high returns for MEs, we first estimate production functions. In addition, we use this step to compute total factor productivities and an idiosyncratic risk proxy. We then examine capital accumulation. Our main contribution is hence to complement the static investigation of high returns to capital by a dynamic analysis of the determinants of capital accumulation. The focus will be on two fundamental constraints to capital growth in MEs, credit constraints and risk.

We use a panel dataset of Peruvian MEs covering the period 2002 to 2006. The analysis of the ME sector is particularly relevant in the case of Peru where these firms account for about 75 percent of employment. Even during the impressive growth period covered by our panel, with growth averaging 5.7 percent per annum, there has been no decline in employment in MEs. According to OECD/ Economic Commission for Latin America and the Caribbean (2013), 98 percent of all firms in Peru are MEs. This is very high even for a Latin America country, where small and microenterprises have lower access to finance than large firms.

The remainder of the paper is organized as follows. In Section 4.2 we present some theoretical considerations. Next, we provide a brief overview of previous evidence on ME performance and on the constraints they face. The subsequent section describes the dataset and the basic characteristics of Peruvian micro-entrepreneurs and their enterprises, before section 4.5 presents our empirical setup and discusses the results. The final section summarizes our main findings and concludes.

4.2 Theoretical Considerations

In a simple neoclassical model without any frictions, the optimal capital stock in equilibrium equates the market interest rate with the marginal returns to capital. Yet, under credit constraints and in the presence of risk, the start-up capital of firms may be far from the optimum. Information asymmetries and moral hazard that cause credit market failure are typically exacerbated in developing economies, and more so for MEs.[61] Informal entrepreneurs with different capacity to provide collateral may therefore face different costs of capital. This in turn implies that some entrepreneurs

[61] In Latin America, small and microenterprises have indeed poorer access to finance and less favorable conditions compared to large firms (OECD/ Economic Commission for Latin America and the Caribbean (2013)).

are not able to realize the desired (initial) capital stock. Similar to credit constraints, risk drives a wedge between market interest rates and marginal returns, as risk-averse entrepreneurs demand a risk premium on their invested capital stock.[62]

Entrepreneurs adjust their capital stock over time. Very importantly, firms can overcome credit constraints by retaining earnings (Evans and Jovanovic (1989), Cabral and Mata (2003)). Capital stocks would then be increasing with enterprise age. Due to decreasing returns to capital, the incentives to invest are higher for firms with a sub-optimal low capital stock. In addition, the incentives to retain earnings are higher for more productive firms. This implies that younger and more productive firms should accumulate capital faster. The dynamic implications of risk are complex. In risky environments, risk-averse entrepreneurs require a risk premium on additional investment and may postpone it. In this case, risk should have a negative impact on capital accumulation. Yet, new information or learning may decrease uncertainty (Jovanovic (1982)). The risk premium will then decrease over time and accumulation will (ceteris paribus) be faster in older firms.

In addition, risk and credit constraints interact. One important interaction may be that less wealthy and hence credit-constrained entrepreneurs may be more risk averse and consequently exhibit a lower propensity to invest. Their incentives for additional investment out of withheld profits are lower, and, ceteris paribus, their pace of capital accumulation is slower. Furthermore, if firm owners face credit constraints and investments are partly irreversible, they may have strong motives for precautionary savings. Only when the level of precautionary savings is deemed comfortable enough, risky investments will be undertaken (Fafchamps and Pender (1997), Fafchamps (1999)). Interaction between wealth and risk may also manifest themselves in (endogenous) time-inconsistent preferences. Very high discount rates are typically observed for low-wealth individuals in high-risk environments (Pender (1996), Yesuf and Bluffstone (2008)).[63]

[62] Fafchamps (1999) notes that in such a risky environment without appropriate contract-enforcing formal institutions, true business risk is likely to be compounded by opportunistic and contractual risk. The argument is that high exposure to risk makes it easy to falsely claim inability to comply with contractual obligations towards a business counterpart. The World Bank's Doing Business dataset provides some information on credit availability as well as on the efficiency of contract enforcement (http://www.doingbusiness.org). Whereas the percentage of individuals and firms listed by a private credit bureau amounts to 43 percent in Peru, it is 67 percent in OECD countries (World Bank (2013)). The cost of contract enforcement amounts to 36 percent of a claim in Peru, compared to 31 percent in OECD countries.

[63] A related explanation for low accumulation is the lack of self-control, another behavioral patterns

The considerations above lead to the following hypotheses to be tested subsequently: (i) returns to capital are high in MEs if these firms operate under credit constraints and risk; (ii) credit constraints and risk reduce initial capital stocks and result in a slower pace of capital accumulation; (iii) the impact of both risk and credit constraints on accumulation decreases with higher enterprise age.

4.3 Previous Evidence

A vast of studies find evidence of very high returns to capital in small-scale activities in developing countries (de Mel et al. (2008), Fafchamps et al. (2011), McKenzie and Woodruff (2006, 2008), Udry and Anagol (2006)). De Mel et al. (2008), for instance, perform an experiment in which they randomly provide cash or in-kind transfers to Sri Lankan MEs. The authors find, at least for male entrepreneurs, marginal returns to capital in a range from 55 to 70 percent per year. Consistent with credit market constraints, the marginal returns to capital are lower (higher) for wealthier (poorer) entrepreneurs. No significant differences in marginal returns between risk-averse and less risk-averse entrepreneurs can be detected. In a similar experiment in Mexico, McKenzie and Woodruff (2008) also provide evidence of very high returns of at least 20 to 33 percent a month. Returns are - with up to 100 percent monthly - highest among firms with capital stocks near 200 US Dollar (USD) that report being financially constrained. At least for this selected group, there is hence a strong indication for credit market imperfections causing high returns at low levels of capital.[64]

Whereas these fairly recent empirical studies focus on returns to capital and their causes, there is a separate strand of the literature that examines the patterns of entry, exit, and growth of MEs. Mead and Liedholm (1998) summarize the findings of a research project on ME behavior that draws (partly) on panel datasets from a number of developing countries. The authors typically find high rates of churning among MEs, with survival being positively associated with firm age, smaller initial size and past growth. The analysis of firm growth shows that MEs, which were smaller at start-up, tend to grow more rapidly than their larger counterparts. Also young firms grow faster.[65] These results are similar to those obtained by Fajnzylber

that has been observed in low income countries (Fafchamps et al. (2011), de Mel et al. (2012)).

[64]Similar evidence (for selected groups of entrepreneurs) is provided by Fafchamps et al. (2011).

[65]McPherson (1996) and Coad and Tamvada (2012), for example, show similar patterns for southern African and Indian firms, respectively.

et al. (2006) using Mexican data. These authors find that size and time in business are negatively related to exit and growth. They conclude that MEs in Mexico show dynamic patterns consistent with a number of standard results from the theoretical literature on firm dynamics.

While Mead and Liedholm (1998) and Fajnzylber et al. (2006) describe quite well some dynamic features of MEs in developing countries, they have little to say on the causes of differences in behavior.[66] So for, few studies explicitly show the impact of capital constraints on accumulation. One exception is a study about the garment industry in Tirupur in Southern India by Banerjee and Munshi (2004). The authors find large and systematic differences in the levels of capital stocks in firms owned by people from two different community groups. This finding may be attributed to differences in access to capital between the groups. One of them, the Gounders, comes from a relatively wealthy agricultural community that was the first to move into the garment industry in Tirupur. Banerjee and Munshi (2004) argue that the incumbent Gounders start their businesses with much higher levels of capital stock than comparable outsiders because of their stronger ties to the local community, and the associated better access to finance. Both groups accumulate capital over time, but the outsiders do so much faster and catch up with the Gounders after approximately seven years.[67]

Recent work by de Mel et al. (2012) examines the long-term effects of a randomly assigned transfer of cash or capital (again based on the sample of Sri Lankan MEs). Tracking MEs over a period of 4.5 to 5.5 years, they show that these transfers lead to permanently higher capital stocks and, accordingly, higher profits in treated MEs.

[66] Fajnzylber et al. (2006) do present some suggestive evidence in favor of credit constraints. The authors regress employment growth on dummies for credit at start-up, and dummies for subsequent credit (and a set of other controls). Firms with start-up credit appear to grow slower given that they reach their optimal capital stocks more rapidly. In contrast, MEs with subsequent access to credit grow faster, as they can quickly adjust to their optimal capital stock. Yet, the authors acknowledge that this result might be driven by simultaneity.

[67] Further evidence for credit constraints is derived from exogenous shocks (liquidity or credit availability) on firm performance. Tybout (1983), for example, uses industry level data from Colombia. While favorable earnings shocks appear to be of little relevance for large firms, these additional internal funds are used for investment by smaller firms. Banerjee and Duflo (2008) take advantage of a policy change in India that affected the flow of directed credit to estimate the effect of a favorable credit shock on investment and productivity of medium-sized firms. Their results show a large acceleration in the rate of growth of sales and profits due to the shock. In contrast, Akoten et al. (2006) cannot find a positive impact of credit access on the performance of small garment producers in Kenya.

The authors interpret these findings as an indication of tight credit constraints. Yet, the lack of re-investment of profits by the control group suggests that other factors must be at work as well. De Mel et al. (2012) point at behavioral factors, in particular the lack of self-control and time-inconsistent preferences, as a possible explanation why MEs do not accumulate capital, despite possibly high returns to investment.

4.4 Data and ME Characteristics

We use data from the nationally representative Peruvian household survey *Encuesta Nacional de Hogares* (ENAHO) collected by the National Institute of Statistics and Informatics (INEI for its Spanish initials) between 2002 and 2006. The ENAHO entails a panel sub-sample of about 5000 to 6000 households each year of which 55 to 80 percent are re-visited in the following year (see Table B.1 in the appendix).[68] The survey provides detailed information on individual socio-demographic and employment characteristics. Individuals who are identified as independent workers or as employers (in principal or secondary employment), and who are not working in agriculture, livestock production, or forestry, are interviewed in an Informal Sector Module.[69] This module captures the characteristics of the entrepreneurs and their production unit in MEs with up to ten employees. It also contains detailed information on input use and sales and the legal status of the firm as well as characteristics of employed workers. We restrict our analysis to individuals in urban areas, i.e. in cities with at least 4000 inhabitants. Furthermore, we exclude ME observations with either missing or non-positive values for the variables used (value-added, labor and capital), as well as MEs in the primary sector. The final dataset for estimation is an unbalanced panel of MEs with 2825, 1006, 439, 283, and 135 MEs, which we observe in one, two, three, four and five years, respectively.

Table 20 illustrates the employment structure of the labor force. The importance of the informal sector is remarkable, even compared to Latin American averages. More

[68] In 2002 the survey took place during the 4th quarter (Oct-Dec). Starting from May 2003 the survey is permanent (the whole sample is distributed monthly along the year). Around 18 percent of the visited households are not interviewed as the household refuses, is absent, the house is unoccupied or there are other reasons (miscellaneous category). This leads to an unbalanced panel with 719, 1435, 1153, 1870 and 2096 households being observed in one, two, three, four and five years, respectively. The fact that this number is increasing reflects the effort by INEI to create a large panel dataset. Quite a number of panel households were not interviewed in consecutive years.

[69] In urban areas, 10 percent of self-employed individuals work in agriculture, livestock production, or forestry, and are consequently not included in the Informal Sector Module.

Table 20: Structure of Employment (in Percent)

	Total	Men	Women
Wage employment	48.70	53.25	43.05
of which in informal firms (%)	39.96	41.56	36.27
Self-employment or Employer	36.16	34.28	38.49
Unpaid family work	7.99	5.54	11.04
Unemployed	7.15	6.99	7.36
Total	100	100	100

than a third of the Peruvian workforce is self-employed. Another almost 30 percent work as paid worker in informal firms, defined as firms without registration or written accounts, or as unpaid family workers. Compared to men, women are less likely to be wage-employed and more often engaged as unpaid family worker.

Some basic characteristics of Peruvian MEs from the Informal Sector Module are highlighted in Table 21. MEs are typically very small with a mean firm size of 1.6 including the owner. Almost one third of the firms operate with the help of unpaid family members and only 12 percent employ paid staff. The average enterprise age of about 8 years is higher than one might probably expect. The ME owner is, on average, 42 years old and has been to school for 11 years. Almost half of the owners are female. Incomes from MEs are fairly low, with mean and median monthly value-added of about 150 and 90 USD. The median capital stock of 80 USD suggests that most activities do not require much investment.[70] On the other hand, a mean capital stock of 700 USD implies that some firms have relatively high capital stocks. Most MEs can be found in *petty trading* (38 percent) followed by *transport* (15 percent), *hotels and restaurants* (13 percent), and *other manufacturing & food* (13 percent). The different industries are very heterogeneous in many characteristics, for example in capital stocks, gender-composition, or number of employees.

Data presented in Table 21 show that MEs are being established and closed at a substantial rate. Depending on the industry, new starts during the year account for 24 to 38 percent of all existing firms. Similarly, of all observed firms between 26 and 42 percent close every year.[71] Entry (as well as exit) rates are higher in sectors that

[70] All monetary values are converted into 2001 USD. See the information under Table 21 for details. Value-added is the value of monthly sales plus self-consumed production minus expenses other than on labor and capital (i.e. expenses for intermediate inputs and electricity). Capital stock is the replacement value of the sum of investment in machinery, furniture, vehicles, utilities, and other investment, excluding property investment.

[71] We identify the firms by their owner. If a business is handed over from the owner to his wife,

Table 21: Descriptive Statistics of MEs by Industry

Industries	All	M.& food	Constr.	W./R. shops	Petty trad.	H.& R.	Tran.	Oth. serv.
ME characteristics								
Employees	0.63	0.82	0.65	1.12	0.68	0.91	0.13	0.45
Self-employed (%)	63.2	59.8	64.5	45.2	55.9	46.2	91.0	78.3
With paid employees (%)	12.1	21.3	31.5	36.7	5.8	12.2	7.7	11.1
With unpaid employees (%)	31.4	32.7	20.5	39.5	41.2	49.7	4.1	16.4
Monthly value-added (mean)	153	148	166	305	134	135	165	168
Monthly value-added (median)	90	81	129	190	72	74	133	76
Capital (mean)	697	823	127	962	217	192	2396	691
Capital (median)	83	115	23	153	41	65	1610	111
Capital (median) (new MEs)	58	65	26	227	29	46	1251	37
Enterprise age	7.9	11.7	11.6	9.7	7.8	6.0	5.7	6.4
Entry rate (%)	29.4	30.4	37.9	24.0	25.4	33.8	26.9	39.0
Exit rate (%)	32.0	34.1	41.6	25.8	26.6	33.0	31.9	46.0
Owner's characteristics								
Gender: Male (%)	52.1	55.5	99.8	84.0	31.7	12.3	99.8	64.6
Owner's age	41.9	44.7	42.5	40.0	43.3	43.9	37.2	38.2
Owner's years of schooling	10.5	10.5	10.4	11.3	9.8	9.1	11.2	12.7
Observations	7960	1026	454	281	2995	1051	1194	959

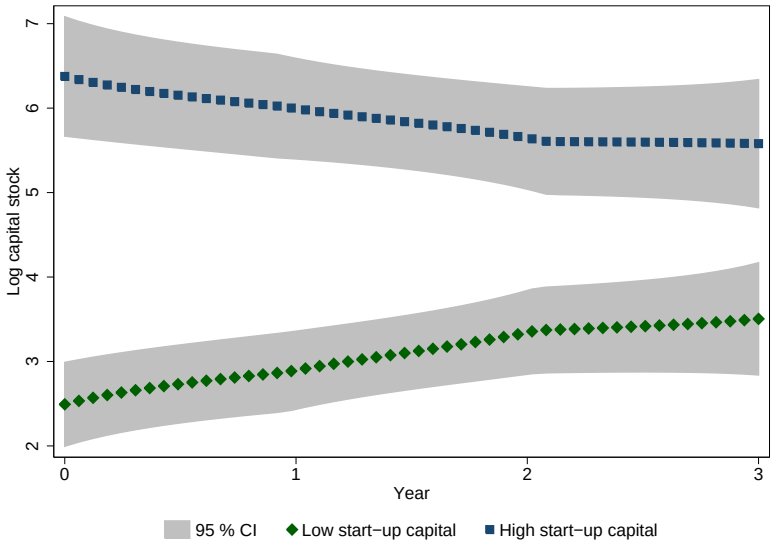
Notes: Industries are other manufacturing & food, construction, wholesale/retail shops, petty trading, hotels and restaurants, transport, and other services. Monetary values are in constant Dec. 2001 Nuevo Sols (using the INEI Consumer Price Index) and converted into USD using the Dec. 2001 nominal exchange rate.

require less capital. New firms start with a 30 percent lower median capital stock on average. Capital accumulation is quite heterogeneous as well; for example, MEs in *wholesale/ retail shops* even reduce their capital stock on average.

Figure 6 provides another indication that Peruvian MEs tend to adjust their capital stocks over time. Based on a sample of firms with a maximum age of three years when first observed, this figure shows the capital stock (year effects controlled for) of MEs that can be found in the first and fourth quartile of the distribution of initial capital

for example, this will be counted as business closure and opening. Consequently, our entry and exit rates may only be taken as an upper bound. However, these numbers are similar to those in Mead and Liedholm (1998), who find entry and exit rates in Sub-Sahara Africa ranging from 20 to 32 percent. Entry rates in their study are computed by dividing all new firms appearing in a given year by the number of firms in existence at the beginning of that year. Exit rates rely on retrospective information regarding business closure in the past year.

Figure 6: Capital Accumulation and Reduction of Young Firms (Sub-sample)



Note: The figure is based on a sub-sample including only young firms with a maximum age of three years old when first observed and that are observed in at least four periods.

stocks, respectively.[72] The initial difference in capital stocks between these two groups is very large. Firms in the fourth quartile start with a log capital stock that is higher by a factor of four. This implies that the capital stock is more than 50 times higher in this group. Yet, MEs that start with lower capital stocks accumulate, while those with a high capital stock even tend to reduce their capital stocks. After 3 years, capital stocks in the two groups still differ significantly. Nevertheless, the log difference has reduced to about 2.5 implying that capital stocks in firms with high initial capital stocks are only about ten times larger than in the group that starts with low levels.

4.5 Econometric Analysis

4.5.1 Capital Returns

We first estimate a production function to test whether we can find high returns to capital in Peruvian MEs. For estimation purposes we take a log-linear transformation of a neoclassical production function:

$$y_{it}=\alpha_i+\beta l_{it}+\gamma k_{it}+u_{it}, \tag{28}$$

[72]More precisely, we follow Banerjee and Munshi (2004) by regressing the logarithm of capital on a full set of year dummies. We then plot the residual of this regression plus the mean value against time using local polynomial smoothing based on an Epanechnikov kernel.

where y_{it} is log value-added, l_{it} is log labor, and k_{it} is log capital of firm i at time t, respectively.[73] The error term u_{it} may be decomposed into two components: an i.i.d. error term ε_{it}, and $\omega_i = \ln(\Omega_{\mathrm{i}})$, where Ω_t is the efficiency level or total factor productivity (TFP). To estimate the production function for each industry, a random effects (RE) panel model is employed. A RE regression gives unbiased estimates only if the firm specific productivity ω_i influences the value-added directly. However, it may also simultaneously determine the input factor use which may bias our coefficients.[74] Multiple ways to address the simultaneity problem have been proposed, including a fixed effects (FE) estimator and the semiparametric proxy estimator of Levinsohn and Petrin (2003) (henceforth LP).[75] The FE estimator uses only the variation within firms over time. It is unbiased under the assumption of the unobserved firm-specific productivity being time-invariant. However, the within-variation tends to be much lower than the cross-sectional variation and hence FE-coefficients may be weakly identified. This problem is aggravated by measurement error in the independent variables whose relative importance becomes exaggerated in the within estimation.[76] This may result in a strong downward bias and low significance of the estimates, a feature which is well known in the literature (Angrist and Pischke (2009)). The semiparametric LP estimator uses within-plant changes in intermediate/electricity inputs as a proxy for productivity shocks. Thus, it is confronted with the same problems of low within-variation in combination with measurement errors. In additon, about 15 percent (66 percent) of all MEs in our sample do not use intermediate (electricity) inputs, and would be excluded from the analysis. Hence, we opt for applying the FE and LP estimators only as a robustness check.

Table 22 presents the production function estimates as well as the implied marginal returns to capital. The estimated coefficients are very much in line with previous studies with a log labor coefficient in the range between 0.5 and 0.7, and a log capital

[73] See footnote (70) for definitions.

[74] Profit-maximizing MEs observe at least partly their current productivity level and may increase the use of inputs as a result of positive productivity shocks. If labor inputs can immediately be adjusted, the labor coefficient will be upward-biased. Capital, however, is quasi-fixed and the capital coefficient will be underestimated in most cases (Levinsohn and Petrin (2003).

[75] The alternative semi-parametric method of Olley and Pakes (1996) is not feasible as it uses information on investment which is not present in our data. GMM system estimation requires at least three time periods. As explained below, the FE estimator is already problematic and hence GMM is not feasible as it would additionally reduce our sample by more than 60 percent.

[76] See, for example, Griliches and Hausman (1986) and Freeman (1984) as well as footnote (77).

coefficient between 0.1 and 0.2.[77] There is quite some sectoral variation, in particular in the capital coefficient. The differences in the sector specific R2s also suggest that there is a lot of heterogeneity in the within sector variance of returns, probably partly driven by differences in the extent of reporting errors. The output-capital elasticity is highest in manufacturing (0.22) and lowest in petty trading (0.08). With an average of 14 percent, monthly returns to capital are very high, but also very heterogeneous. In the most capital intensive sector *transport* the returns are rather low with only 2 percent while they amount to 80 percent in the least capital intensive sector *construction*. If an entrepreneur invests additional 10 USD into his/her ME, monthly income increases by 6.8 USD in *construction*, and only by 0.2 USD in *transport*. This would correspond to a permanent income gain of 6 percent in *construction*, but only 0.1 percent in *transport* (evaluated at mean value-added and capital stock).

Figure 7 presents the returns to capital as a function of the capital stock based on the estimates presented in Table 22 (for all industries). We take mean values of all variables except the capital stock. As previous studies, our analysis of returns to capital in Peruvian MEs shows very high marginal returns to capital that decline rapidly as firms accumulate capital. Yet, in a range up to 130 USD of capital stock marginal returns are well above 10 percent monthly. More than 57 percent of MEs can be found in this range and may hence be able to realize these returns if provided the necessary capital. As laid out above, the lack of credit may, however, not be the only reason for low capital stocks and unexploited opportunities. Risk may also cause lower investment and hence lower capital stocks.

4.5.2 Capital Accumulation

In this section, we attempt to identify the factors that restrict capital accumulation. In accordance with our theoretical considerations, we first examine the determinants of the start-up capital stock. The investment equation then takes the following func-

[77] Westbrook and Tybout (1993), for example, analyze returns to scale in firms that are observed in up to 8 years and have at least 10 employees in Chile. They find OLS log labor and log capital coefficients in most industries to be in the range between 0.7 and 0.9, and 0.2 and 0.3, respectively. Their within-plant estimates are in the range between 0.4 and 0.6, and 0.1 and 0.3, respectively. The authors argue that their OLS estimates appear to suffer from an upward bias while their within-plant estimates are likely to be downward biased, and identify measurement error in capital stocks to drive the latter result. This problem is certainly acerbated in our dataset covering MEs with fewer periods and up to 10 employees.

Table 22: Production Function Estimates for Peruvian Industries

Industries	All	M.& food	Constr.	W./R. shops	Petty trad.	H.& R.	Tran.	Oth. serv.
Log labor	0.605***	0.619***	0.642***	0.697***	0.582***	0.690***	0.486***	0.558***
SE	(0.015)	(0.036)	(0.045)	(0.066)	(0.028)	(0.041)	(0.040)	(0.040)
Log capital	0.118***	0.220***	0.141***	0.104***	0.080***	0.076***	0.139***	0.142***
SE	(0.005)	(0.015)	(0.026)	(0.029)	(0.011)	(0.020)	(0.014)	(0.016)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Outlier^{+}	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Average K	84	87	23	150	39	57	1115	83
Average Y	101	78	127	228	93	101	150	76
Average Y/K	8.8	7.2	16.1	6.2	12.2	5.3	1.7	10.1
M. returns	0.143	0.198	0.774	0.159	0.191	0.136	0.019	0.131
R2 overall	0.39	0.57	0.47	0.49	0.25	0.45	0.34	0.38
N	7857	1012	444	274	2952	1039	1170	944

Notes: Robust standard errors in parenthesis * p<0.10, ** p<0.05, *** p<0.01. $^{+}$ In all regressions, we drop influential outliers from our sample (and sub-samples) that we identify by the DFITS-statistic obtained from a precedent OLS regression (see Belsley and Welsch (1980)). We use a cut-off-value $|DFITS|= 3\sqrt{\mathrm{k/N}}$, with k, the degrees of freedom (plus 1) and N, the number of observations. This reduces the sample by 1 to 2 percent. (Monthly) marginal returns to capital $\frac{dY}{dK} = \gamma * \frac{Y}{K}$ are evaluated at $Y = exp(mean(logY))$ and $K = exp(mean(logK))$.

tional form:

$$k_{\mathrm{i0}}=\mu_1+\mu_2\Omega^e_{it} + \mu_3 W_{\mathrm{i0}}+\mu_4 R_{\mathrm{i0}}+\mu_5 R_{\mathrm{i0}} W_{\mathrm{i0}}+e_{\mathrm{i0}}, \tag{29}$$

In a second step, we analyze the accumulation behavior:

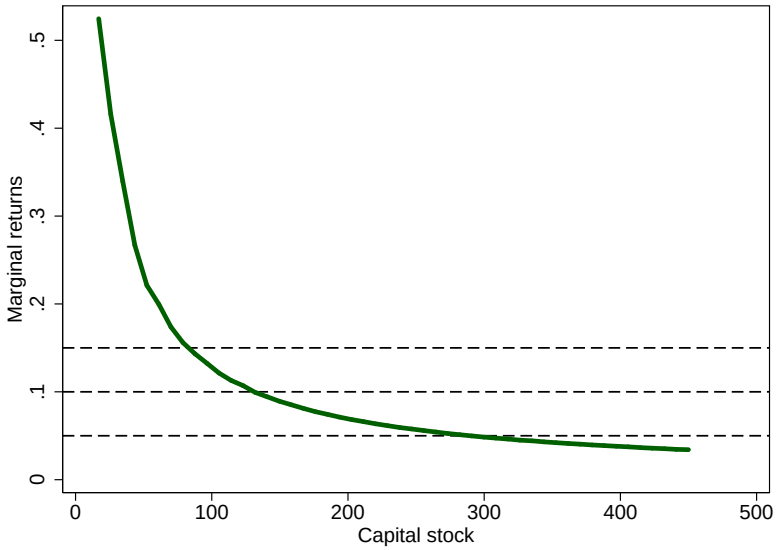
$$\Delta k_{it} = \rho_0 k_{it} + \rho_1 + \rho_2 \Omega_{it} + \rho_3 W_{if} + \rho_4 R_{it} + \rho_5 R_{it} W_{if} + u_{it}. \tag{30}$$

All variables are defined as before, e_{i0} is an error term, and u_{it} is the combined error term. Capital growth Δk_{it} is measured as the change in log capital $(k_{it+1} - k_{it})$. The term $R_{it}W_{if}$ is the interaction between risk and wealth (from the first observed period in business). We now briefly discuss the key right-hand-side variables and how we proxy them: credit constraints, productivity, and risk. Their distributions as well as means and standard deviations are presented in Figure D.1 - D.4 in the appendix.

The *expected productivity* is proxied by owner's age and its square, years of education, and a dummy for male entrepreneurs. In equation (30), *productivity* Ω_{it} is measured as the time invariant residual ω_i obtained by a RE estimation of the production function (28).

Credit constraints are proxied by the wealth level W_{if} of the household, as household assets may serve as collateral for credit. The household wealth index is derived

Figure 7: Marginal Returns for Firms with an Interquartile Capital Stock



Notes: For a better graphical understanding, we choose to display only the interquartile range. In the first quartile of capital stock, marginal returns are very high, which would imply a wide y-axis scaling. In contrast, they are close to zero for higher capital stocks, and a maximum value of 32000 USD would imply a wide x-axis scaling. We predict the profit level given the capital stock and mean values in all other variables. Whereas the mean log labor is 5.34 for the whole sample, it is only 4.94 for firms with a capital stock in the first quartile. This results in a slight overestimation of the returns to capital at low levels. Returns to capital are proxied by (ΔY/ΔK) with $\Delta X = X_i - X_{i-5}$. Results are robust to an extension of the lag length to 10 or 20.

from the first principal component of a set of indicators of ownership of household assets. Only non-business assets, such as color televisions and the condition of the house (for example, the state of the walls and the quality of sanitary facilities) are included. Household wealth, however, may be correlated with unobservable characteristics, such as entrepreneurial ability or motivation, which also affect the start-up capital stock and growth. This correlation is likely to be positive, implying an upward bias of the estimated coefficient. This potential bias should be somewhat reduced by including the above proxies (age, education, gender) for *expected productivity* in equation (29) and the productivity measure in equation (30). Possible problems of reverse causality are addressed in equation (30) by using for the wealth index the information on asset ownership provided in the first observed period in business (W_{if}).

Risk is difficult to operationalize. Yet, we propose to construct a series of proxies. First, we measure risk by the variation of sales, a "classical" proxy for risk. We compute this variation at the sector level with sectors being disaggregated as finely as possible while keeping the number of observations in each sector cell at least at

30. To this end, we use the pooled cross-sectional sample with almost four times as many observations that allows for a finer disaggregation. Such a procedure yields 85 sector cells, for which we compute the coefficients of variation in sales.

Second, we propose to measure idiosyncratic risk using the time-variant component from the FE estimation of equation (28). More specifically, we construct a measure of exposure to risk RES_i from the residual ε_{it}:

$$RES_i = \sum_{t=1}^{T} |\varepsilon_{it}| / T_i, \tag{31}$$

where T_i refers to the number of periods, in which we observe the ME i.[78] This measure, based on average absolute time-variant FE residuals, reflects only firm-specific volatility in value-added observed over the lifespan of the ME.[79] It captures the ex-ante effects of anticipated shocks and cyclical effects as well as possibly non-anticipated ex-post effects of shocks. We argue above that we prefer RE over FE since the latter performs poorly in short panels and the coefficients are downward biased. This implies an overestimation of the productivity level ω_i and, more importantly, a strong correlation with the input factors. Yet, it is difficult to say whether and how this bias affects the time-variant residuals. These residuals sum up to zero for each firm by definition. Their estimated variance may, however, be overestimated, for example if too much of possible anticipated cyclical effects now enter ε_{it}, in particular since labor coefficients are underestimated. To guard against the importance of such effects we test whether ε_{it} is correlated with input use; and it turns out that this correlation is very low (<0.05).

Third, we can average RES_i at the sector-level (49 sector cells as only the panel data is used). Fourth, we use the share of entrepreneurs that are found to be unemployed, helping as unpaid family worker, or even leaving the labor force in the subsequent period to construct a sector-specific involuntary exit rate (45 sector cells).[80] Except RES_i all risk proxies are measured at the sector level, and are constant over time. We opt for using sector-cells rather than sector-year cells to measure sector-specific risk. This permanent risk measure is constant over time, and it is likely to be more relevant than temporary risk shocks for investment decisions. Moreover, it allows a finer sector disaggregation.

[78] The average T_i is 3.3.

[79] Using instead the time-variant residual from a RE model does not change the results.

[80] Only entrepreneurs that are observed in the subsequent period can be classified as exiting or surviving, i.e. we do not have this information for the last round of the survey and for entrepreneurs in households that were dropped from the panel.

We report the pairwise correlations of these risk proxies in Table D.1 in the appendix. In line with expectations, all correlations are positive. It is difficult to judge which of these imperfect proxies is most adequate. Moreover, they may be capturing different dimensions of business risk. Due to the correlation between the single proxies they cannot be included jointly in a regression. From a combination of these proxies, we therefore propose to construct a risk proxy using principal components analysis (see Table D.1 in the appendix). The first principal component that we will use as risk proxy in the subsequent analysis explains about 38 percent of the "total variance" in the four variables.

With our right-hand side variables specified, we now analyze the determinants of the start-up capital stock. The first column of Table 23 presents the OLS estimation results of equation (29). The sample is restricted to start-up MEs defined as being owned by entrepreneurs who did not have a firm in the previous year. In line with the theoretical considerations, asset-rich entrepreneurs start with a considerably higher capital stock. An increase in the wealth level by 1 standard deviation raises the capital stock by 46 percent from 60 to 88 USD for a hypothetical ME with mean values. Risk is associated with a lower initial capital stock.[81] If the risk exposure of our hypothetical firm decreases by 1 standard deviation, its capital stock is 90 percent higher and amounts to 114 USD. Furthermore, the interaction term of wealth and the risk proxy has a positive coefficient as predicted, at higher levels of wealth the negative effects of risk are mitigated. In other words, the impacts of risk and credit constraints reinforce each other.

The second and third columns present the results from the OLS accumulation regression. The most important factor appears to be the pre-investment capital stock, i.e. small MEs grow considerably faster. An increase in the capital stock by 1 percent leads to an approximate decrease of the growth rate of 0.3 percentage points. As expected, productivity also fosters accumulation, an increase by 1 standard deviation results in an increase of the growth rate by 9 percentage points. Young firms appear to grow faster with a turning point at a relatively high enterprise age of 43 years. This is in line with previous evidence and may be partly due to depreciation of a capital stock that is not being renewed or replaced (Mead and Liedholm (1998), Fajnzylber et al. (2006)). These (pure) age effects are rather small. The growth rate of an ME

[81] Here, the risk index does not contain the idiosyncratic measure as it is only available for new firms that are observed in at least two periods. This would reflect a strong selection and reduce our sample by two thirds. The first principal component explains about 53 percent of the "total variance" in the three variables.

Table 23: Estimates of Start-up Capital and Accumulation

Dependent variable:	start-up k		Δk
Log capital		-0.324***	-0.330***
		(0.015)	(0.015)
Wealth index	0.184***	0.092***	0.121***
	(0.031)	(0.013)	(0.018)
Risk index	-0.507***	-0.215***	-0.251***
	(0.052)	(0.022)	(0.029)
Wealth * Risk	0.043**	0.023***	0.022**
	(0.020)	(0.009)	(0.009)
Enterprise age		-0.024***	-0.023***
		(0.008)	(0.008)
Enterprise ageˆ2		0.001**	(5.0 * 10ˆ(-4))**
		(2.2 * 10ˆ(-4))	(2.2 * 10ˆ(-4))
TFP		0.149***	0.152***
		(0.052)	(0.052)
Enterprise age * risk			0.004*
			(0.052)
Enterprise age * wealth			-0.003**
			(0.001)
Year dummies	Yes	Yes	Yes
Outlier controlled^{+}	Yes	Yes	Yes
R2	0.234	0.197	0.204
N	1170	2431	2422

Notes: Regression of equation (29) include: a constant, age and its square, years of education, and a dummy indicating male entrepreneurs. In the estimation presented in the first column, the risk index does not contain the idiosyncratic measure as it is only available for new firms that are observed in at least two periods. This would result in a strong selection and reduce our sample by two thirds. Robust standard errors in parenthesis * p<0.10, ** p<0.05, *** p<0.01. $^{+}$ In all regressions, we drop influential outliers according to the procedure explained under Table 22.

declines by about 2 percentage points with one additional year of existence.

In contrast, the effects of credit constraints and risk on investment tend to be very large. Both coefficients are highly significant and the implied effects sizable: An increase in the wealth level by 1 standard deviation raises the growth rate by 21 percentage points. If risk decreases by 1 standard deviation, the growth rate is 24 percentage points higher, ceteris paribus.[82] The interaction term between risk and wealth has the expected positive sign. Comparing an entrepreneur with average

[82]These numbers hold for firms with mean values. As wealth and risk are normalized, the interaction term rules out.

wealth to a wealthy (average plus 1 standard deviation) entrepreneur, the fall in the growth rate due to a risk increase is one-fifth lower.

Finally, we include interactions between enterprise age and the constraint proxies (last column of Table 23). The effects are in line with our predictions. The coefficient of the risk index increases and we find evidence of this effect being reduced slowly over time (after 62 years it reduces to zero). Similarly, the impact of wealth is stronger and we find a negative wealth age interaction (after 42 years the wealth effect reduces to zero).

Summing up, both risk and credit constraints are key factors for explaining low initial capital stocks and slow capital accumulation in MEs. This suggests that these factors are behind the high returns to capital that we observe at low levels of capital.

4.5.3 Robustness

We first provide some robustness checks for our production function estimates and the corresponding estimated returns to capital. Then, we examine the robustness of the results on accumulation with a focus on the effects of risk.

Table 24 presents the LP and FE estimates of the above production function. The LP coefficients on capital are very similar to the RE coefficients, but the labor coefficients are significantly lower. This gives us some confidence that the RE estimates on the capital coefficients are not upward biased, and the returns to capital stated in Table 22 are reliable. Both the FE coefficients on labor and capital are very low, probably reflecting their downward bias due to weak identification and measurement error.

Table 24: LP and FE Estimates of the Production Function

	Log labor		Log capital		
Method	Coefficient	SE	Coefficient	SE	N
LP	0.386***	(0.013)	0.109***	(0.013)	6610
FE	0.386***	(0.021)	0.042***	(0.010)	7857

Notes: LP estimates are obtained using the Stata procedure developed by Petrin et al. (2004). LP standard errors (SE) are bootstrapped with 250 repl.; * p<0.10, ** p<0.05, *** p<0.01. In all regressions, we drop influential outliers according to the procedure explained under Table 22.

In general, measurement error of both profits and capital tends to bias the estimated coefficients towards zero. Thus, this source of bias does not give rise to major concerns in light of the significant strong effects. Moreover, we dropped influential outliers, as explained above. It is very unlikely that measurement error is less pro-

nounced at lower levels of capital stocks, which would then partly explain higher returns at lower levels of capital.

Additional biases may arise from systematic firm exit. ME activities with low levels of capital stock are likely to be more vulnerable to shocks.[83] This bias should be less pronounced in our estimates, as we use an unbalanced panel. Nevertheless, we test for selection effects by first estimating the following equation for firm survival:

$$P\left(\text{Survival}_{it} = 1\right) = \text{F}(\theta k_{it} + \eta Z_{it} + \tau IS_{it}), \tag{32}$$

where Z_{it} is a vector of variables that proxy productivity (owner's age and its square, years of education, a dummy indicating male entrepreneurs) and year dummies. The term IS_{it} is a vector of variables that identify survival (see below). We estimate this equation as a simple probit. To correct for the selection problem, we then include the inverse of the mill's ratio in the augmented production function:

$$y_{it} = \alpha_i + \beta l_{it} + \gamma k_{it} + \rho Z_{it} + \frac{\phi(\widehat{\theta} k_{it} + \widehat{\eta} Z_{it} + \widehat{\tau} IS_{it})}{\Phi(\widehat{\theta} k_{it} + \widehat{\eta} Z_{it} + \widehat{\tau} IS_{it})} + u_{it}, \tag{33}$$

where ϕ denotes the standard normal pdf, and Φ is the standard normal cdf. The difficulty is to find variables that explain survival/exit, but are not correlated with value-added. We use a dummy indicating whether the entrepreneur is 60 years or older, and the number of small children in a household (less than one year old). That both variables may indeed be associated with involuntary business closure is supported by both instruments being jointly significant at the 10 percent level (not shown).[84] In the production function estimates, the inverse of the mill's ratios are not significant. Although the capital coefficient is slightly higher once we control for selection, the difference is not significant (not shown). In contrast, the inverse of the mill's ratios are significant in the growth equation. Once we control for selection,

[83] If MEs with a high capital stock are more likely to tolerate productivity shocks and remain in business, the capital coefficient would be biased downwards. Firms with a low capital stock that experience an adverse shock may move out of business while those with a higher capital stock react by reducing capital. This would imply an upward bias in the growth rate of small firms as only surviving firms are considered.

[84] Without IS_{it}, identification relies on the nonlinearity of the inverse of the mill's ratio. We have used a number of alternative instruments (including the number of household members, number of wage earners, transfer incomes, household composition variables, loss of employment, severe illness, criminal act or natural disaster). However, all of these variables are either not significant in the selection equation, or highly significant in the production function regression (after including the inverse of the mill's ratio).

small firms still grow considerably faster. However, the coefficient is slightly smaller, but not significantly different from the results presented above (not shown).

Another potential concern may be the validity of our risk measure that we construct from a combination of imperfect proxies (variation of sales, involuntary exit rate, idiosyncratic risk, and the latter aggregated at the sector level). As robustness check we therefore include each proxy separately and all proxies jointly in the estimations. In equations (29) and (30) all proxies - when included one by one - enter with the expected negative sign and are highly significant (Table D.2 in the appendix). Once they are jointly included, the idiosyncratic risk measure becomes insignificant in equation (30). One proxy, idiosyncratic risk within the sector, changes the sign in the estimation of equation (29), but is insignificant. These tests give us quite some confidence that our risk measure indeed provides an adequate summary measure of business risks. The inclusion of six industry dummies into equations (29) and (30) provides an important additional robustness check, as most risk proxies are constructed at the sector level and may therefore also capture other sectoral effects.[85] Not surprisingly, the effects of risk are being reduced and may be considered a lower bound estimate (see Table D.3 in the appendix). This estimate still implies that a one standard deviation increase in the risk measure leads to a reduction of start-up capital and the growth rate by a factor of three and 60 percentage points, respectively. The coefficient and its interaction with wealth remain highly significant whereas the interaction with enterprise age becomes insignificant.[86]

4.6 Conclusion

In this paper, we analyze returns to capital and capital stock dynamics of MEs using a panel dataset from Peru. We first compute marginal returns to capital based on random effects estimations of ME production functions. As many previous studies, we find very high marginal returns - on average about 14 percent monthly - at low levels of capital, but these marginal returns decrease rapidly at higher levels. Yet, in a range up to 130 USD of capital stock marginal returns are well above 10 percent monthly. More than 57 percent of MEs can be found in this range and may hence be able to realize these returns if provided the necessary capital. This result is very robust, as shown by the estimation of a number of alternative specifications. The

[85] Sectors are disaggregated as finely as possible which means that they are not equivalent to common industry definitions (see Table 22).

[86] Other coefficients are not affected by the inclusion of sector dummies.

main empirical part of the paper then examines why capital stocks remain low and why MEs do not accumulate, for example by re-investing those high returns. Our analysis of the determinants of start-up capital and subsequent capital accumulation confirms the well-established finding in the literature that credit constraints explain a major part of the variation in firm growth. We find a very large effect of household non-business wealth on capital stocks of MEs. An increase in the wealth level by one standard deviation raises the growth rate of MEs by 21 percentage points. While the positive effect of wealth is a standard finding, it provides an interesting benchmark for the effects of risk that the present study - in our view - can show more convincingly than previous studies. We find risk to lead to considerably lower capital stocks and a slow process of capital accumulation. The effect is again sizable with a lower bound estimate that corresponds to 15 percentage points reduction in the growth rate for a one standard deviation increase in our preferred risk proxy. That MEs' investment decisions are heavily influenced by considering risks, is supported by pronounced interactions between wealth and risk. The presented evidence is consistent with poorly endowed entrepreneurs who operate in imperfect capital markets and a very risky environment. These entrepreneurs forego profitable investments as they have to withhold liquidity and/or have very high discount rates. The "pure" risk effects may be efficient individual responses to prevailing business risks when insurance markets fail. However, the significant interaction between wealth and risk shows that capital market imperfections reinforce the negative effect of risk on accumulation. This is an indication of important inefficiencies and unexploited potential in MEs, caused by risk and credit constraints. However, this paper has little to say on how precisely this mechanism works and more research seems to be warranted that addresses these behavioral questions.

In general, the findings once again illustrate the great heterogeneity of informal activities (Cunningham and Maloney (2001)). While these activities may appear residual activities pursued for subsistence at first sight, the dynamics of an important part - if not the majority of the entrepreneurs in the Peruvian context - can be better described by theories of the firm. Yet, of firms that operate under severe constraints. From a policy perspective, these results imply that credit constraints and risk leave the potential of many small-scale entrepreneurs unexploited. How these constraints can be overcome is difficult to say on the basis of our results. Of course, the strong effects of wealth provide a rationale for microcredit, but it is beyond the scope of this paper to judge whether efficient modes can be found to allocate capital to MEs in these small quantities. Access to simple savings accounts with light credit lines might be a

possible solution. Savings accounts may also mitigate the effects of risk that we have identified. Whether such a measure will be effective in reducing the adverse effects of risk, however, depends on the precise nature of risks. In this regard, it is worth stressing that some risk is inherent to any business activity. This is also why more research into how - possibly excessive - risk leads to sub-optimal investment decisions. Moreover, there is scope to analyze how household-related risks, for example health shocks, affect investment decisions. If these risks mattered, providing corresponding insurance, for example health and life insurance, may enhance capital accumulation in MEs. Both the determinants of ME investment behavior and the effectiveness and efficiency of specific policies are hence pertinent research questions since small-scale activities are likely to remain the main income source of the world's poor in decades to come.

Appendix A to Chapter 2

Table A.1: Tests of the Instruments

	Food	Housing	Education	Health
All households				
Wu-Hausman F(1, N)	42.691	121.622	67.865	14.400
p-value	0.000	0.000	0.000	0.000
Sargan score $\chi^2(2)$	4.052	0.557	4.904	4.087
p-value	0.132	0.757	0.086	0.130
Female headed households				
Wu-Hausman F(1, N)	21.663	48.129	20.729	3.322
p-value	0.000	0.000	0.000	0.068
Sargan score $\chi^2(2)$	1.524	1.789	3.439	0.524
p-value	0.467	0.409	0.179	0.770
Male headed households				
Wu-Hausman F(1, N)	2.037	11.991	7.540	0.077
p-value	0.154	0.001	0.006	0.781
Sargan score $\chi^2(2)$	0.013	1.802	3.562	2.221
p-value	0.994	0.406	0.168	0.329

Table A.2: Balancing

	Full sample		Matched sample	
Gender of the household head	Male	Female	Male	Female
Log(per-capita expenditures)	6.753	6.831*	6.863	6.815
Log(household size)	1.322	1.037*	1.064	1.064
Prop. of children < 15	0.287	0.261*	0.207	0.218
Prop. of adults >= 15 with prim. educ.	0.454	0.433*	0.427	0.449
Prop. of adults >= 15 with sec. educ.	0.294	0.271*	0.275	0.262
Prop. of adults >= 15 with ter. educ.	0.162	0.162	0.173	0.156
Rural area	1.450	1.365*	1.367	1.367
Remittance receipt (%)	0.134	0.252*	0.207	0.207

Notes: The difference between male and female headed households is significant * at 5%.

Table A.3: Full Estimates for the Sample Selection Models: Full Sample

	Parametric SY method				Semiparametric KS method			
	Food	Housing	Health	Education	Food	Housing	Health	Education
Log(exp)	-0.080***	0.010**	-0.013***	-0.029***	-0.080***	0.010**	-0.022*	-0.029***
	(0.004)	(0.003)	(0.001)	(0.004)	(0.004)	(0.003)	(0.010)	(0.004)
Log(hh)	-0.108***	0.014***	-0.011***	0.000	-0.108***	0.014***	-0.007*	-0.001
	(0.006)	(0.004)	(0.003)	(0.007)	(0.006)	(0.004)	(0.003)	(0.007)
Child.	0.091***	-0.062***	-0.025***	-0.018	0.090***	-0.062***	-0.024***	-0.021*
	(0.011)	(0.008)	(0.003)	(0.009)	(0.011)	(0.008)	(0.004)	(0.009)
Prim.	-0.119***	0.039***	0.009*	-0.004	-0.116***	0.039***	0.013***	0.008
	(0.011)	(0.007)	(0.004)	(0.008)	(0.011)	(0.007)	(0.003)	(0.007)
Sec.	-0.203***	0.045***	0.004	0.008	-0.200***	0.045***	0.006	0.019*
	(0.012)	(0.008)	(0.004)	(0.009)	(0.012)	(0.008)	(0.005)	(0.008)
Ter.	-0.320***	0.088***	0.013**	0.057***	-0.317***	0.088***	0.018***	0.066***
	(0.012)	(0.009)	(0.005)	(0.011)	(0.012)	(0.009)	(0.004)	(0.010)
Rural	-0.044***	0.011**	0.009***	-0.005*	-0.044***	0.011**	0.008***	-0.005*
	(0.006)	(0.004)	(0.002)	(0.002)	(0.006)	(0.004)	(0.002)	(0.002)
IV	-0.224***	0.276***	0.089***	0.066***	-0.224***	0.276***	0.087***	0.071***
	(0.032)	(0.025)	(0.013)	(0.012)	(0.032)	(0.025)	(0.013)	(0.012)
S I			-0.006	0.006			-0.092	-0.001
			(0.012)	(0.010)			(0.424)	(0.010)
S II							-0.488	
							(1.152)	
S III							0.956	
							(1.464)	
C	1.416***	0.011	0.112***	0.253***	1.416***	0.011	0.191	0.250***
	(0.032)	(0.026)	(0.012)	(0.034)	(0.033)	(0.026)	(0.119)	(0.033)
R2	0.259	0.054	0.209	0.396	0.259	0.054	0.209	0.396
N	12488	12488	12488	12488	12488	12488	12488	12488

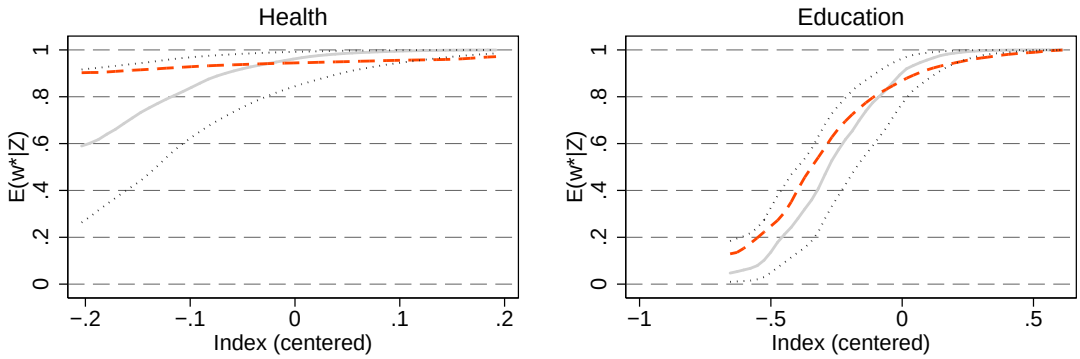
Note: Bootstrapped standard errors in parentheses (with 500 reps.): * significant at 5%; ** significant at 1%; *** significant at 0.1%.

Table A.4: Full Estimates for the Sample Selection Models: Gender-Specific

	Parametric SY method				Semiparametric KS method			
	Food	Housing	Health	Education	Food	Housing	Health	Education
Female headed households								
Log(exp)	-0.024*	-0.023**	-0.020***	-0.036***	-0.022*	-0.022**	-0.057***	-0.035***
	(0.010)	(0.008)	(0.003)	(0.011)	(0.010)	(0.008)	(0.017)	(0.009)
Log(hh)	-0.070***	-0.041***	-0.021**	-0.019	-0.069***	-0.041***	-0.015**	-0.028*
	(0.012)	(0.010)	(0.007)	(0.020)	(0.012)	(0.010)	(0.005)	(0.014)
Child.	0.121***	-0.065***	-0.027***	0.010	0.123***	-0.065***	-0.030***	0.020
	(0.026)	(0.019)	(0.008)	(0.023)	(0.026)	(0.019)	(0.008)	(0.014)
Prim.	-0.119***	0.060***	0.016*	0.007	-0.119***	0.061***	0.017**	0.013
	(0.021)	(0.014)	(0.007)	(0.013)	(0.021)	(0.014)	(0.006)	(0.012)
Sec.	-0.217***	0.088***	0.010	0.016	-0.218***	0.087***	0.011	0.023
	(0.025)	(0.017)	(0.008)	(0.013)	(0.025)	(0.017)	(0.008)	(0.013)
Ter.	-0.386***	0.139***	0.021*	0.085***	-0.386***	0.139***	0.025**	0.111***
	(0.026)	(0.018)	(0.009)	(0.018)	(0.026)	(0.018)	(0.008)	(0.016)
Rural	-0.023	-0.006	0.006	-0.007	-0.022	-0.006	0.008	0.004
	(0.013)	(0.010)	(0.004)	(0.005)	(0.013)	(0.010)	(0.004)	(0.007)
IV	-0.323***	0.315***	0.087***	0.076**	-0.327***	0.315***	0.101***	0.054*
	(0.054)	(0.043)	(0.020)	(0.028)	(0.054)	(0.043)	(0.021)	(0.027)
S I			-0.005	0.017			-1.772	-0.004
			(0.022)	(0.024)			(1.186)	(0.023)
S II							3.233	
							(3.967)	
S III							-3.257	
							(5.265)	
C	1.021***	0.271***	0.163***	0.305**	1.007***	0.271***	0.678**	0.297***
	(0.080)	(0.064)	(0.028)	(0.102)	(0.081)	(0.064)	(0.245)	(0.074)
R2	0.259	0.084	0.214	0.398	0.259	0.084	0.216	0.406
N	2210	2210	2210	2210	2210	2210	2210	2210
Male headed households								
Log(exp)	-0.061***	-0.017*	-0.016***	-0.033***	-0.061***	-0.017*	-0.012**	-0.033***
	(0.010)	(0.008)	(0.004)	(0.009)	(0.010)	(0.008)	(0.004)	(0.010)
Log(hh)	-0.073***	0.002	-0.015*	-0.003	-0.073***	0.002	-0.007	0.009
	(0.015)	(0.011)	(0.008)	(0.015)	(0.015)	(0.011)	(0.009)	(0.018)
Child.	0.078*	-0.135***	-0.044***	-0.030	0.079*	-0.135***	-0.042***	0.001
	(0.031)	(0.024)	(0.010)	(0.032)	(0.031)	(0.024)	(0.010)	(0.027)
Prim.	-0.136***	0.018	0.008	-0.014	-0.135***	0.018	0.018*	-0.014
	(0.023)	(0.014)	(0.009)	(0.011)	(0.023)	(0.014)	(0.007)	(0.011)
Sec.	-0.214***	0.023	0.002	0.012	-0.212***	0.023	0.015	0.018
	(0.027)	(0.017)	(0.011)	(0.012)	(0.027)	(0.017)	(0.008)	(0.011)
Ter.	-0.347***	0.076***	0.012	0.043**	-0.345***	0.076***	0.023**	0.056***
	(0.029)	(0.021)	(0.012)	(0.014)	(0.029)	(0.021)	(0.009)	(0.015)
Rural	0.011	-0.021*	0.012*	-0.023***	0.012	-0.021*	0.009	-0.024***
	(0.014)	(0.009)	(0.005)	(0.005)	(0.014)	(0.009)	(0.007)	(0.005)
IV	-0.086	0.287***	0.113**	0.038	-0.078	0.287***	0.099**	0.061
	(0.085)	(0.068)	(0.042)	(0.040)	(0.085)	(0.068)	(0.038)	(0.053)
S I			0.000	0.004			0.011	0.038
			(0.023)	(0.023)			(0.063)	(0.023)
S II							0.052	
							(0.051)	
C	1.163***	0.259***	0.128***	0.315***	1.163***	0.259***	0.085*	0.273**
	(0.079)	(0.062)	(0.035)	(0.088)	(0.079)	(0.062)	(0.040)	(0.091)
R2	0.258	0.059	0.203	0.383	0.258	0.059	0.207	0.386
N	2211	2211	2211	2211	2211	2211	2211	2211

Note: Bootstrapped standard errors in parentheses (with 500 reps.): * significant at 5%; ** significant at 1%; *** significant at 0.1%.

Figure A.1: Distribution of KS and Probit Estimate: Migrant Subsample



Solid line: Probit estimate; dashed line: KS estimate; dotted lines: 95 % confidence interval (Probit)

Appendix B to Chapter 3

Table B.1: Panel Survey

Year	Hh. visited	Hh. not interviewed	Hh. observed in prev. period	Hh. interviewed
2002	6257	847	.	5410
2003	4217	688	3068	3529
2004	6490	1141	2787	5349
2005	6778	1469	4146	5309
2006	6593	1182	4496	5411

Table B.2: Explanatory Variables H_{it}

	Mean	Standard deviation
In each regression		
Age	42.698	10.474
Age^2	1932.792	927.183
Log(exp)	8.179	0.636
Household size	5.449	1.850
Work load (No. hours worked)	398.168	251.764
No. $<$ 6 years	0.755	0.805
No. $>=$ 65 years	0.071	0.282
Additionally in the LDV-SUR regressions		
Education	9.104	4.250
Education^2	100.946	76.913
Dummy: Poor	0.531	0.499
Dummy: Urban area	0.494	0.500
Dummy: Lima	0.181	0.385

Notes: The additional explanatory variables are: age of the household head (measured in years) and its square, household size, number of children younger than six and of elderly older than 64 years, log total expenditures and its square, number of hours worked (by all household members) as well as year dummies. In the FE-regression the impact of variables that are (quasi-) constant over time cannot be estimated, and thus they are not included in H_{it}. These variables (only in the LDV-SUR regressions) are: years of education of the household head and its square, and dummies indicating whether the household is poor, lives in an urban area, and in Lima.

Table B.3: Full Regression Estimates: FE - Regressions, B_{it}

	Food	Restaur.	Health	Educ.	Clothing	Housing	Other
B_{it}	0.007	-0.084	0.324^{b}	0.284^{a}	-0.197^{b}	0.001	-0.336^{b}
	(0.286)	(0.240)	(0.159)	(0.099)	(0.092)	(0.161)	(0.167)
Age	0.684^{a}	-0.676^{a}	-0.146	0.227^{a}	-0.075	0.167	-0.181
	(0.216)	(0.182)	(0.120)	(0.074)	(0.070)	(0.122)	(0.126)
Age^2	-0.008^{a}	0.008^{a}	0.002	-0.002^{a}	0.000	-0.002	0.002
	(0.003)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Log(exp)	-5.875^{a}	5.717^{a}	2.664^{a}	-0.266^{b}	0.135	-6.085^{a}	3.709^{a}
	(0.393)	(0.331)	(0.219)	(0.135)	(0.127)	(0.222)	(0.229)
Hh. size	-0.088	0.220	0.171^{c}	0.427^{a}	0.027	-0.347^{a}	-0.410^{a}
	(0.167)	(0.140)	(0.093)	(0.058)	(0.054)	(0.094)	(0.097)
Work load	-0.001	0.006^{a}	-0.004^{a}	-0.001^{a}	0.001^{a}	-0.002^{a}	0.002^{a}
	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
No. < 6	0.340	-0.640^{a}	0.778^{a}	-0.691^{a}	-0.012	0.115	0.110
	(0.282)	(0.237)	(0.157)	(0.097)	(0.091)	(0.159)	(0.164)
No. 65+	0.505	-1.261^{b}	0.926^{b}	-0.300	0.142	0.522	-0.533
	(0.698)	(0.587)	(0.388)	(0.240)	(0.225)	(0.394)	(0.407)
D: 2003	0.325	0.453	-1.362^{a}	0.354^{a}	0.070	0.027	0.133
	(0.355)	(0.299)	(0.197)	(0.122)	(0.114)	(0.200)	(0.207)
D: 2004	0.357	0.861^{a}	-1.346^{a}	0.925^{a}	-0.105	0.080	-0.772^{a}
	(0.326)	(0.274)	(0.181)	(0.112)	(0.105)	(0.184)	(0.190)
D: 2005	1.278^{a}	0.720^{b}	-1.610^{a}	1.203^{a}	-0.260^{b}	-0.227	-1.105^{a}
	(0.345)	(0.290)	(0.192)	(0.119)	(0.111)	(0.194)	(0.201)
D: 2006	-0.905^{b}	1.428^{a}	-1.332^{a}	1.890^{a}	-0.262^{b}	-0.051	-0.767^{a}
	(0.361)	(0.304)	(0.201)	(0.125)	(0.116)	(0.204)	(0.211)
Cons.	77.468^{a}	-26.854^{a}	-11.360^{a}	0.086	5.222^{a}	67.007^{a}	-11.558^{a}
	(5.236)	(4.403)	(2.911)	(1.805)	(1.685)	(2.954)	(3.052)
R2-within	0.0346	0.0665	0.0366	0.0440	0.0055	0.1065	0.0364

Notes: Regressions include a constant and all additional variables stated below Table B.2. The R-squared values are for the "within" fixed-effect estimator which differences out mean household specific values. Hence, the R-squared values do not take into account the explanatory power of the fixed effects. If we include fixed effects instead of differencing them out, the measured R-squared values are 0.6855, 0.5102, 0.4391, 0.6541, 0.4382, 0.6627 and 0.5573. Standard errors in parentheses: ^{c} significant at 10%; ^{b} at 5%; ^{a} at 1%.

Table B.4: Full Regression Estimates: FE - Regressions, B_{it}^N

	Food	Restaur.	Health	Educ.	Clothing	Housing	Other
B_{it}^N	2.692	-2.963^b	2.076^b	-0.218	-1.024^c	1.104	-1.668^c
	(1.669)	(1.404)	(0.928)	(0.576)	(0.537)	(0.942)	(0.973)
Age	0.686^a	-0.677^a	-0.146	0.225^a	-0.074	0.167	-0.180
	(0.216)	(0.182)	(0.120)	(0.074)	(0.070)	(0.122)	(0.126)
Age^2	-0.008^a	0.008^a	0.002	-0.002^a	0.000	-0.002	0.002
	(0.003)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Log(exp)	-5.867^a	5.706^a	2.680^a	-0.258^c	0.126	-6.082^a	3.694^a
	(0.393)	(0.330)	(0.219)	(0.136)	(0.127)	(0.222)	(0.229)
Hh. size	-0.088	0.220	0.171^c	0.426^a	0.027	-0.346^a	-0.409^a
	(0.167)	(0.140)	(0.093)	(0.058)	(0.054)	(0.094)	(0.097)
Work load	-0.001	0.006^a	-0.004^a	-0.001^a	0.001^a	-0.002^a	0.002^a
	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
No. < 6	0.309	-0.604^b	0.746^a	-0.696^a	0.005	0.102	0.137
	(0.283)	(0.238)	(0.157)	(0.097)	(0.091)	(0.159)	(0.165)
No. 65+	0.456	-1.209^b	0.897^b	-0.287	0.155	0.502	-0.513
	(0.698)	(0.587)	(0.388)	(0.241)	(0.225)	(0.394)	(0.407)
D: 2003	0.319	0.460	-1.367^a	0.354^a	0.073	0.025	0.137
	(0.355)	(0.299)	(0.197)	(0.122)	(0.114)	(0.200)	(0.207)
D: 2004	0.352	0.866^a	-1.349^a	0.927^a	-0.103	0.078	-0.770^a
	(0.326)	(0.274)	(0.181)	(0.112)	(0.105)	(0.184)	(0.190)
D: 2005	1.272^a	0.728^b	-1.618^a	1.201^a	-0.256^b	-0.229	-1.098^a
	(0.345)	(0.290)	(0.192)	(0.119)	(0.111)	(0.194)	(0.201)
D: 2006	-0.913^b	1.436^a	-1.336^a	1.893^a	-0.261^b	-0.055	-0.765^a
	(0.361)	(0.304)	(0.201)	(0.125)	(0.116)	(0.204)	(0.211)
Cons.	76.013^a	-25.199^a	-12.706^a	0.003	5.912^a	66.412^a	-10.424^a
	(5.308)	(4.464)	(2.951)	(1.831)	(1.709)	(2.995)	(3.094)
R2-within	0.0349	0.0669	0.0367	0.0431	0.0054	0.1067	0.0363

Notes: Regressions include a constant and all additional variables stated below Table B.2. Standard errors in parentheses: ^{c} significant at 10%; ^{b} at 5%; ^{a} at 1%.

Table B.5: Full Regression Estimates: LDV - SUR, B_{it}

	Food	Restaur.	Health	Educ.	Clothing	Housing	Other
LDV	0.286^a	0.286^a	0.286^a	0.286^a	0.286^a	0.286^a	0.286^a
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
B_{it}	-0.829^a	-0.075	0.315^b	0.442^a	-0.145^c	0.328^b	-0.036
	(0.264)	(0.225)	(0.135)	(0.095)	(0.077)	(0.151)	(0.146)
Age	0.175	-0.365^a	-0.100^c	0.243^a	-0.027	0.098	-0.022
	(0.116)	(0.099)	(0.059)	(0.042)	(0.034)	(0.067)	(0.064)
Age^2	-0.003^b	0.004^a	0.001^b	-0.003^a	0.000	-0.000	0.000
	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.001)	(0.001)
Log(exp)	-7.295^a	1.470^a	1.316^a	1.292^a	0.264^b	-0.946^a	3.899^a
	(0.433)	(0.368)	(0.221)	(0.155)	(0.127)	(0.248)	(0.239)
Hh. size	0.377^a	0.388^a	0.020	0.319^a	-0.026	-0.658^a	-0.420^a
	(0.120)	(0.102)	(0.061)	(0.043)	(0.035)	(0.069)	(0.066)
Work load	-0.001	0.006^a	-0.003^a	-0.002^a	0.001^a	-0.002^a	0.002^a
	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
No. < 6	1.473^a	-0.910^a	0.482^a	-0.910^a	0.022	-0.043	-0.114
	(0.214)	(0.183)	(0.110)	(0.077)	(0.063)	(0.123)	(0.118)
No. 65+	-0.193	-0.453	1.061^a	-0.572^a	0.069	0.301	-0.213
	(0.532)	(0.454)	(0.273)	(0.191)	(0.156)	(0.305)	(0.294)
Education	-0.392^a	0.301^b	0.299^a	-0.165^a	-0.074^c	-0.064	0.096
	(0.146)	(0.124)	(0.075)	(0.052)	(0.043)	(0.084)	(0.080)
Education^2	0.000	-0.026^a	-0.016^a	0.019^a	0.005^b	0.016^a	0.001
	(0.008)	(0.007)	(0.004)	(0.003)	(0.002)	(0.005)	(0.004)
D: Poor	0.798^c	-0.547	-0.231	0.268^c	-0.198	0.545^b	-0.635^b
	(0.450)	(0.384)	(0.231)	(0.162)	(0.132)	(0.259)	(0.249)
D: Urban	-5.642^a	0.958^a	0.055	0.657^a	-0.644^a	4.358^a	0.257
	(0.362)	(0.307)	(0.184)	(0.129)	(0.106)	(0.208)	(0.199)
D: Lima	1.422^a	-2.342^a	-0.094	0.076	-1.096^a	2.716^a	-0.682^a
	(0.428)	(0.365)	(0.219)	(0.154)	(0.126)	(0.246)	(0.237)
D: 2004	1.021^b	0.309	0.085	0.385^b	-0.213	-0.098	-1.489^a
	(0.445)	(0.380)	(0.228)	(0.160)	(0.131)	(0.256)	(0.246)
D: 2005	1.258^a	-0.146	0.110	0.354^b	-0.004	-0.421^c	-1.151^a
	(0.408)	(0.349)	(0.209)	(0.146)	(0.120)	(0.234)	(0.226)
D: 2006	-0.792^c	0.767^b	0.407^c	0.732^a	0.104	-0.420^c	-0.799^a
	(0.406)	(0.347)	(0.208)	(0.146)	(0.119)	(0.233)	(0.225)
Cons.	91.113^a	0.418	-5.687^a	-13.343^a	2.230^c	17.433^a	-20.802^a
	(4.019)	(3.404)	(2.044)	(1.433)	(1.172)	(2.290)	(2.207)
R2	0.4544	0.1451	0.0708	0.3379	0.0824	0.3496	0.2797

Notes: Regressions include a constant and all additional variables stated below Table B.2. The R-squared values are for the "within" fixed-effect estimator which differences out mean household specific values. Hence, the R-squared values do not take into account the explanatory power of the fixed effects. If we include fixed effects instead of differencing them out, the measured R-squared values are 0.6855, 0.5104, 0.4392, 0.6538, 0.4381, 0.6628 and 0.5573. Standard errors in parentheses: ^{c} significant at 10%; ^{b} at 5%; ^{a} at 1%.

Table B.6: Full Regression Estimates: LDV - SUR, B_{it}^N

	Food	Restaur.	Health	Educ.	Clothing	Housing	Other
LDV	0.287^a	0.287^a	0.287^a	0.287^a	0.287^a	0.287^a	0.287^a
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
B_{it}^N	0.795	-4.520^a	0.970	1.480^a	-0.251	1.238^c	0.288
	(1.199)	(1.022)	(0.614)	(0.430)	(0.352)	(0.688)	(0.663)
Age	0.157	-0.363^a	-0.095	0.250^a	-0.030	0.103	-0.023
	(0.116)	(0.099)	(0.059)	(0.042)	(0.034)	(0.066)	(0.064)
Age^2	-0.003^b	0.004^a	0.001^b	-0.003^a	0.000	-0.000	0.000
	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.001)	(0.001)
Log(exp)	-7.378^a	1.461^a	1.349^a	1.338^a	0.249^b	-0.913^a	3.894^a
	(0.432)	(0.367)	(0.221)	(0.155)	(0.126)	(0.247)	(0.239)
Hh. size	0.400^a	0.371^a	0.016	0.314^a	-0.023	-0.660^a	-0.418^a
	(0.120)	(0.102)	(0.061)	(0.043)	(0.035)	(0.069)	(0.066)
Work load	-0.001^c	0.006^a	-0.002^a	-0.002^a	0.001^a	-0.002^a	0.002^a
	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
No. < 6	1.467^a	-0.818^a	0.458^a	-0.945^a	0.029	-0.072	-0.119
	(0.215)	(0.184)	(0.110)	(0.077)	(0.063)	(0.124)	(0.119)
No. 65+	-0.270	-0.322	1.052^a	-0.587^a	0.067	0.284	-0.224
	(0.533)	(0.454)	(0.273)	(0.191)	(0.157)	(0.306)	(0.295)
Education	-0.377^a	0.295^b	0.295^a	-0.170^a	-0.072^c	-0.068	0.097
	(0.146)	(0.124)	(0.075)	(0.052)	(0.043)	(0.084)	(0.080)
Education^2	-0.000	-0.026^a	-0.016^a	0.019^a	0.005^b	0.017^a	0.001
	(0.008)	(0.007)	(0.004)	(0.003)	(0.002)	(0.005)	(0.004)
D: Poor	0.833^c	-0.563	-0.239	0.258	-0.193	0.538^b	-0.633^b
	(0.450)	(0.384)	(0.231)	(0.162)	(0.132)	(0.259)	(0.249)
D: Urban	-5.758^a	1.028^a	0.077	0.686^a	-0.657^a	4.376^a	0.247
	(0.361)	(0.306)	(0.184)	(0.129)	(0.106)	(0.208)	(0.199)
D: Lima	1.431^a	-2.322^a	-0.103	0.063	-1.092^a	2.705^a	-0.682^a
	(0.428)	(0.365)	(0.219)	(0.154)	(0.126)	(0.246)	(0.237)
D: 2004	1.021^b	0.289	0.091	0.393^b	-0.215	-0.091	-1.488^a
	(0.446)	(0.380)	(0.228)	(0.160)	(0.131)	(0.256)	(0.246)
D: 2005	1.268^a	-0.154	0.109	0.352^b	-0.003	-0.422^c	-1.150^a
	(0.409)	(0.348)	(0.209)	(0.147)	(0.120)	(0.234)	(0.226)
D: 2006	-0.778^c	0.755^b	0.406^c	0.730^a	0.106	-0.421^c	-0.797^a
	(0.407)	(0.346)	(0.208)	(0.146)	(0.119)	(0.233)	(0.225)
Cons.	92.221^a	2.739	-6.734^a	-14.864^a	2.615^b	16.234^a	-20.872^a
	(4.036)	(3.411)	(2.051)	(1.439)	(1.176)	(2.298)	(2.214)
R2	0.4538	0.1472	0.0704	0.3371	0.0820	0.3495	0.2797

Notes: Regressions include a constant and all additional variables stated below Table B.2. Standard errors in parentheses: ^{c} significant at 10%; ^{b} at 5%; ^{a} at 1%.

Table B.7: Alternative Specifications

	Food	Restaur.	Health	Educ.	Clothing	Housing	Other
Accounting for Censoring							
FE - Regressions: equation (19)							
B_{it}	0.007	-0.160	0.322^{c}	0.297^{a}	-0.206^{b}	0.001	-0.336^{b}
	(0.286)	(0.282)	(0.170)	(0.104)	(0.096)	(0.161)	(0.167)
		[-0.089]	[0.182]	[0.173]	[-0.128]		
B_{it}^{N}	2.692	-4.352^{a}	2.357^{b}	-0.262	-1.095^{b}	1.104	-1.668^{c}
	(1.669)	(1.630)	(0.992)	(0.606)	(0.558)	(0.942)	(0.973)
		[-2.407]	[1.328]	[-0.152]	[-0.680]		
LDV - SUR: equation (21)							
B_{it}	-0.791^{a}	-0.243^{b}	0.304^{b}	0.465^{a}	-0.134^{c}	0.375^{b}	-0.007
	(0.230)	(0.123)	(0.148)	(0.103)	(0.077)	(0.157)	(0.147)
B_{it}^{N}	-1.140	-2.702^{a}	1.214^{b}	1.683^{a}	-0.363	0.923	0.217
	(0.993)	(0.606)	(0.589)	(0.469)	(0.345)	(0.682)	(0.655)
FE-LDV Regressions							
B_{it}	0.226	-0.054	0.354^{c}	0.300^{b}	-0.270^{b}	-0.362^{c}	-0.208
	(0.395)	(0.340)	(0.207)	(0.139)	(0.117)	(0.216)	(0.224)
B_{it}^{N}	0.912	0.082	2.227^{c}	-0.972	-0.948	-0.503	-0.811
	(2.317)	(1.989)	(1.208)	(0.816)	(0.684)	(1.261)	(1.310)

Notes: Regressions include a constant and all additional variables stated below Table B.2. The FE-regressions of equation (19) in the categories food, housing, and others are estimated via OLS given that (almost) no censoring occurs in these categories. Marginal effects in square brackets. The number of observations is 13132 in the FE-regressions, 7981 in the LDV-SUR regression, and 6954 in the FE-LDV regression. Standard errors in parentheses: ^{c} significant at 10%; ^{b} at 5%; ^{a} at 1%.

Table B.8: Alternative Measures

	Food	Restaur.	Health	Educ.	Clothing	Housing	Other
Alternative Measures of B_{it}: Monetary Values							
FE - Regressions: equation (11)							
B_{it}	-0.442	-0.530^{b}	0.420^{a}	0.393^{a}	-0.182	0.215	0.125
	(0.310)	(0.253)	(0.160)	(0.121)	(0.143)	(0.168)	(0.223)
B_{it}^{N}	3.534^{c}	-3.145^{b}	1.260	0.336	-0.883	-0.000	-1.101
	(1.861)	(1.518)	(0.964)	(0.729)	(0.857)	(1.010)	(1.340)
LDV - SUR: equation (12)							
B_{it}	-0.262	-0.471^{c}	0.171	0.629^{a}	-0.358^{a}	0.122	0.170
	(0.296)	(0.247)	(0.140)	(0.119)	(0.127)	(0.157)	(0.198)
B_{it}^{N}	2.249^{a}	-5.746^{a}	0.680	2.220^{a}	-0.477	0.178	-0.068
	(0.480)	(1.130)	(0.639)	(0.546)	(0.581)	(0.719)	(0.904)
Alternative Measures of B_{it}: Income Share							
FE-Model: equation (11)							
B_{it}	0.081	-0.097	0.554^{c}	0.611^{a}	-0.372^{b}	-0.166	-0.611^{c}
	(0.574)	(0.483)	(0.319)	(0.198)	(0.185)	(0.324)	(0.334)
LDV-Model: equation (12)							
B_{it}	-1.661^{a}	-0.046	0.611^{b}	0.894^{a}	-0.265^{c}	0.529^{c}	-0.062
	(0.528)	(0.450)	(0.270)	(0.189)	(0.155)	(0.303)	(0.292)

Notes: Regressions include a constant and all additional variables stated below Table B.2. The number of observations is 13132 in the FE-regressions and 7981 in the LDV-SUR regression. Standard errors in parentheses: ^{c} significant at 10%; ^{b} at 5%; ^{a} at 1%.

Appendix C to Chapter 4

Table C.1: Number of Household Businesses

	All	Non poor	Poor
R	0.088^{c}	-0.041	0.488^{a}
SE	(0.051)	(0.050)	(0.114)
R_{before}	0.040	-0.119^{c}	0.466^{a}
SE	(0.064)	(0.062)	(0.145)

Notes: Regressions include: a constant, log household non-labor income and household fixed effects. Robust standard errors in parentheses: ^{c} significant at 10%; ^{b} at 5%; ^{a} at 1%.

Table C.2: Non-linear Specification: Full Results I

	Employed			Self-employed			Wage-employed		
	Logit	FE-Logit	Tobit	Logit	FE-Logit	Tobit	Logit	FE-Logit	Tobit
R	-0.001	-0.011	2.735	0.331	0.323^{c}	10.849	-0.318	-0.327^{c}	-2.388
	(0.182)	(0.179)	(8.018)	(0.206)	(0.192)	(14.930)	(0.201)	(0.178)	(13.119)
R^{before}	-0.290	-0.294	-10.012	0.026	0.017	-6.313	-0.359	-0.348	-9.937
	(0.251)	(0.277)	(11.465)	(0.266)	(0.276)	(20.625)	(0.278)	(0.263)	(19.946)
Log(NL)	0.004	0.003	1.179^{a}	-0.022^{a}	-0.021^{a}	-0.608	0.031^{a}	0.028^{a}	3.553^{a}
	(0.009)	(0.007)	(0.305)	(0.008)	(0.007)	(0.477)	(0.009)	(0.007)	(0.613)
Age	0.280^{a}	0.275^{a}	8.129^{a}	0.241^{a}	0.232^{a}	13.720^{a}	0.157^{a}	0.154^{a}	9.093^{b}
	(0.057)	(0.058)	(2.415)	(0.064)	(0.059)	(4.588)	(0.057)	(0.056)	(4.204)
Age^2	-0.003^{a}	-0.003^{a}	-0.096^{a}	-0.002^{a}	-0.002^{a}	-0.137^{a}	-0.002^{a}	-0.002^{a}	-0.127^{a}
	(0.001)	(0.001)	(0.026)	(0.001)	(0.001)	(0.047)	(0.001)	(0.001)	(0.049)
Head$^{\circ}$	0.585^{a}	0.630^{a}	17.610^{b}	0.463^{b}	0.448^{b}	30.825^{b}	0.404^{b}	0.420^{b}	28.605^{b}
	(0.176)	(0.199)	(7.041)	(0.197)	(0.186)	(12.326)	(0.188)	(0.204)	(13.264)
Mundlak	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes
N. obs.	27333	9530	27333	27333	9912	27333	27333	9157	27333
N. indiv.	8732	2861	8732	8732	2840	8732	8732	2751	8732
Log l.	-12119	-3483	-136303	-14039	-3654	-71439	-13748	-3378	-69754

Notes: Regressions include: a constant, and mundlak-terms where indicated. $^{\circ}$ *Head* is a dummy variable which is equal to one if the individual is the head of the household. Bootstrapped standard errors (with 500 reps.) in parentheses: ^{c} significant at 10%; ^{b} at 5%; ^{a} at 1%.

Table C.3: Non-linear Specification: Full Results II

	Employed			Self-employed			Wage-employed		
	Logit	FE-Logit	Tobit	Logit	FE-Logit	Tobit	Logit	FE-Logit	Tobit
Non Poor									
R	-0.247	-0.255	-2.443	-0.099	-0.081	-16.060	-0.190	-0.197	6.871
	(0.198)	(0.216)	(8.439)	(0.243)	(0.230)	(16.750)	(0.244)	(0.196)	(14.278)
R^{before}	-0.507^{c}	-0.488	-19.321	-0.445	-0.438	-36.571	-0.079	-0.054	-1.385
	(0.279)	(0.300)	(12.643)	(0.358)	(0.337)	(22.706)	(0.329)	(0.281)	(22.017)
Log(NL)	0.023^{c}	0.019^{c}	2.095^{a}	-0.031^{a}	-0.029^{a}	-0.900	0.056^{a}	0.048^{a}	5.443^{a}
	(0.012)	(0.011)	(0.449)	(0.011)	(0.011)	(0.684)	(0.012)	(0.010)	(0.797)
Age	0.229^{a}	0.234^{a}	7.946^{a}	0.216^{b}	0.209^{b}	14.383^{b}	0.126	0.139^{c}	7.204
	(0.073)	(0.080)	(2.916)	(0.089)	(0.087)	(6.181)	(0.087)	(0.080)	(5.490)
Age^2	-0.002^{a}	-0.003^{a}	-0.100^{a}	-0.002^{b}	-0.002^{c}	-0.148^{b}	-0.002^{b}	-0.002^{b}	-0.121^{c}
	(0.001)	(0.001)	(0.032)	(0.001)	(0.001)	(0.064)	(0.001)	(0.001)	(0.063)
Head°	0.792^{a}	0.853^{a}	33.346^{a}	0.901^{a}	0.860^{a}	73.905^{a}	0.116	0.136	12.601
	(0.239)	(0.264)	(9.092)	(0.253)	(0.240)	(17.839)	(0.235)	(0.275)	(14.401)
Mundlak	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes
N. obs.	15756	5168	15756	15756	5135	15756	15756	4846	15756
N. indiv.	5246	1622	5246	5246	1559	5246	5246	1523	5246
Log l.	-6856	-1870	-78528	-7849	-1879	-39412	-7860	-1762	-42847
Poor									
R	0.773^{b}	0.713^{c}	17.361	1.324^{a}	1.350^{a}	69.858^{a}	-0.537	-0.517	-30.551
	(0.391)	(0.398)	(19.917)	(0.371)	(0.423)	(27.109)	(0.396)	(0.401)	(33.737)
R^{before}	0.395	0.336	18.802	1.014^{b}	1.026^{b}	55.800^{c}	-0.930^{c}	-0.981	-31.580
	(0.557)	(0.569)	(25.776)	(0.480)	(0.471)	(32.948)	(0.533)	(0.617)	(47.616)
Log(NL)	-0.013	-0.012	0.209	-0.016	-0.015	-0.421	0.008	0.008	1.536
	(0.011)	(0.011)	(0.446)	(0.011)	(0.010)	(0.707)	(0.011)	(0.010)	(0.934)
Age	0.318^{a}	0.311^{a}	8.301^{b}	0.274^{a}	0.268^{a}	13.376^{b}	0.173^{b}	0.166^{c}	11.255
	(0.077)	(0.082)	(3.264)	(0.088)	(0.083)	(5.670)	(0.083)	(0.087)	(7.117)
Age^2	-0.003^{a}	-0.003^{a}	-0.091^{b}	-0.003^{a}	-0.003^{a}	-0.128^{b}	-0.001	-0.001	-0.130
	(0.001)	(0.001)	(0.036)	(0.001)	(0.001)	(0.059)	(0.001)	(0.001)	(0.084)
Head°	0.285	0.293	-6.485	-0.090	-0.096	-23.986	0.756^{b}	0.708^{b}	57.663^{b}
	(0.294)	(0.308)	(9.744)	(0.323)	(0.302)	(17.052)	(0.327)	(0.299)	(25.292)
Mundlak	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes
N. obs.	11577	4362	11577	11577	4777	11577	11577	4311	11577
N. indiv.	3486	1239	3486	3486	1281	3486	3486	1228	3486
Log l.	-5222	-1604	-57710	-6132	-1765	-31955	-5826	-1604	-26850

Notes: Regressions include: a constant, and mundlak-terms where indicated. ° *Head* is a dummy variable which is equal to one if the individual is the head of the household. Bootstrapped standard errors (with 500 reps.) in parentheses: ^{c} significant at 10%; ^{b} at 5%; ^{a} at 1%.

Table C.4: Poverty Measure = Wealth Index: Labor Supply

		Employment		Self-employment		Wage-employment	
		Likelihood	Hours	Likelihood	Hours	Likelihood	Hours
Non Poor	R	0.002	-4.450	0.017	-6.326	-0.013	2.118
	SE	(0.024)	(6.485)	(0.025)	(5.445)	(0.024)	(5.417)
	R^{before}	-0.033	-14.648	-0.007	-8.292	-0.009	-3.369
	SE	(0.035)	(9.520)	(0.035)	(7.612)	(0.034)	(8.051)
Poor	R	-0.001	22.647	0.113^{b}	34.667^{a}	-0.115^{b}	-9.555
	SE	(0.058)	(14.520)	(0.046)	(11.169)	(0.052)	(11.472)
	R^{before}	-0.042	23.412	0.034	16.661	-0.139^{b}	2.935
	SE	(0.072)	(16.624)	(0.056)	(11.966)	(0.061)	(13.512)

Notes: Regressions include: a constant, age and its square, log household non-labor income, and a dummy indicating whether the individual is the head of the household. Robust standard errors in parentheses: ^{c} significant at 10%; ^{b} at 5%; ^{a} at 1%.

Table C.5: Poverty Measure = Wealth Index: Firm Performance

		(1)	(2)	(3)	(4)	(5)	(6)	(7)
		Capital	Labor	Profits	Profits	Sales	Sales	Wage
Non Poor	R	0.241	-0.155^{c}	0.058	0.052	0.035	0.025	0.192
	SE	(0.335)	(0.081)	(0.113)	(0.112)	(0.103)	(0.101)	(0.118)
	R^{before}	0.364	-0.101	0.275	0.266	0.196	0.181	0.357^{c}
	SE	(0.466)	(0.096)	(0.182)	(0.181)	(0.137)	(0.131)	(0.195)
Poor	R	0.983^{c}	0.071	0.773^{c}	0.729	0.295	0.240	0.809^{c}
	SE	(0.505)	(0.186)	(0.460)	(0.469)	(0.232)	(0.236)	(0.445)
	R^{before}	1.723^{a}	0.081	0.665	0.587	-0.116	-0.212	0.664
	SE	(0.646)	(0.188)	(0.654)	(0.666)	(0.225)	(0.236)	(0.629)
Log(capital) incl.		No	No	No	Yes	No	Yes	No

Notes: All dependent variables are measured in logs. Regressions include: a constant, age and its square, log household non-labor income, and a dummy indicating whether the individual is the head of the household. Robust standard errors in parentheses: ^{c} significant at 10%; ^{b} at 5%; ^{a} at 1%.

Table C.6: Remittances = Log(Total Amount): Labor Supply

		Employment		Self-employment		Wage-employment	
Sample		Likelihood	Hours	Likelihood	Hours	Likelihood	Hours
All	R	-0.000	0.130	0.004	0.156	-0.004	0.046
	SE	(0.003)	(0.675)	(0.002)	(0.567)	(0.003)	(0.560)
	R^{before}	-0.039	-6.502	-0.001	-3.211	-0.040	-1.770
	SE	(0.032)	(8.323)	(0.030)	(6.550)	(0.031)	(6.975)
Non Poor	R	-0.004	-0.241	-0.001	-0.629	-0.002	0.410
	SE	(0.003)	(0.692)	(0.003)	(0.608)	(0.003)	(0.609)
	R^{before}	-0.065^{c}	-12.337	-0.043	-10.786	-0.011	0.758
	SE	(0.036)	(8.890)	(0.034)	(7.196)	(0.035)	(7.745)
Poor	R	0.011^{c}	1.319	0.018^{a}	2.654^{c}	-0.007	-0.975
	SE	(0.006)	(1.776)	(0.005)	(1.358)	(0.006)	(1.315)
	R^{before}	0.051	12.252	0.117^{c}	18.589	-0.102	-6.285
	SE	(0.068)	(19.820)	(0.060)	(14.563)	(0.063)	(15.433)

Notes: Regressions include: a constant, age and its square, log household non-labor income, and a dummy indicating whether the individual is the head of the household. Robust standard errors in parentheses: ^{c} significant at 10%; ^{b} at 5%; ^{a} at 1%.

Table C.7: Remittances = Log(Total Amount): Firm Performance

		(1) Capital	(2) Labor	(3) Profits	(4) Profits	(5) Sales	(6) Sales	(7) Wage
All	R	0.044	-0.012	0.015	0.014	0.004	0.002	0.026^{c}
	SE	(0.033)	(0.009)	(0.015)	(0.015)	(0.011)	(0.011)	(0.015)
	R^{before}	0.644^{c}	-0.050	0.294	0.273	0.071	0.041	0.341
	SE	(0.391)	(0.085)	(0.213)	(0.212)	(0.119)	(0.117)	(0.216)
Non Poor	R	0.041	-0.018	-0.003	-0.004	0.001	-0.001	0.009
	SE	(0.043)	(0.011)	(0.015)	(0.015)	(0.013)	(0.013)	(0.015)
	R^{before}	0.518	-0.106	0.149	0.134	0.028	0.009	0.245
	SE	(0.507)	(0.107)	(0.169)	(0.169)	(0.139)	(0.136)	(0.176)
Poor	R	0.059	0.003	0.070^{c}	0.067^{c}	0.017	0.013	0.081^{b}
	SE	(0.036)	(0.016)	(0.036)	(0.036)	(0.022)	(0.021)	(0.034)
	R^{before}	1.108^{b}	0.061	0.678	0.635	0.254	0.184	0.627
	SE	(0.554)	(0.140)	(0.524)	(0.527)	(0.216)	(0.221)	(0.535)
Log(capital) incl.		No	No	No	Yes	No	Yes	No

Notes: All dependent variables are measured in logs. Regressions include: a constant, age and its square, log household non-labor income, and a dummy indicating whether the individual is the head of the household. Robust standard errors in parentheses: ^{c} significant at 10%; ^{b} at 5%; ^{a} at 1%.

Table C.8: Inclusion of Year Dummies: Labor Supply

		Employment		Self-employment		Wage-employment	
Sample		Likelihood	Hours	Likelihood	Hours	Likelihood	Hours
All	R	-0.004	0.646	0.033	1.554	-0.037^{c}	-0.176
	SE	(0.022)	(5.991)	(0.022)	(4.953)	(0.022)	(4.898)
	R^{before}	-0.041	-6.097	-0.002	-3.136	-0.040	-1.363
	SE	(0.032)	(8.358)	(0.030)	(6.534)	(0.030)	(6.975)
	F-test(4,N)	20.29	23.11	1.83	3.05	13.52	16.71
Non P.	R	-0.030	-2.015	-0.012	-6.302	-0.019	4.105
	SE	(0.025)	(6.194)	(0.024)	(5.297)	(0.025)	(5.415)
	R^{before}	-0.060^{c}	-11.091	-0.047	-11.779	-0.004	2.620
	SE	(0.036)	(8.999)	(0.034)	(7.213)	(0.035)	(7.791)
	F-test(4,N)	13.27	13.76	0.93	3.11	10.61	11.17
Poor	R	0.090^{c}	9.179	0.160^{a}	22.479^{c}	-0.064	-9.520
	SE	(0.047)	(14.932)	(0.045)	(11.523)	(0.045)	(10.825)
	R^{before}	0.038	11.004	0.118^{b}	19.029	-0.111^{c}	-7.298
	SE	(0.068)	(19.545)	(0.058)	(14.349)	(0.062)	(15.224)
	F-test(4,N)	10.78	10.03	1.11	0.87	4.86	6.73

Notes: Regressions include: a constant, age and its square, log household non-labor income, and a dummy indicating whether the individual is the head of the household, and year dummies. The F-test tests for the joint significance of the year dummies. Robust standard errors in parentheses: ^{c} significant at 10%; ^{b} at 5%; ^{a} at 1%.

Table C.9: Inclusion of Year Dummies: Firm Performance

		(1) Capital	(2) Labor	(3) Profits	(4) Profits	(5) Sales	(6) Sales	(7) Wage
All	R	0.281	-0.113	0.126	0.117	0.032	0.019	0.231^{c}
	SE	(0.288)	(0.075)	(0.133)	(0.132)	(0.095)	(0.094)	(0.131)
	R^{before}	0.552	-0.061	0.259	0.241	0.051	0.025	0.307
	SE	(0.391)	(0.087)	(0.214)	(0.213)	(0.119)	(0.117)	(0.218)
	F-t.(4,N)	12.10	2.34	5.36	5.38	2.69	3.13	7.46
Non P.	R	0.313	-0.181^{b}	-0.071	-0.080	-0.016	-0.028	0.046
	SE	(0.386)	(0.091)	(0.133)	(0.133)	(0.114)	(0.113)	(0.137)
	R^{before}	0.464	-0.128	0.060	0.046	-0.005	-0.023	0.154
	SE	(0.510)	(0.109)	(0.176)	(0.176)	(0.140)	(0.137)	(0.187)
	F-t.(4,N)	5.59	3.20	4.20	4.27	1.47	1.94	6.07
Poor	R	0.259	0.026	0.644^{b}	0.634^{b}	0.197	0.181	0.758^{a}
	SE	(0.312)	(0.134)	(0.304)	(0.303)	(0.171)	(0.169)	(0.284)
	R^{before}	0.962^{c}	0.057	0.723	0.687	0.257	0.198	0.679
	SE	(0.554)	(0.145)	(0.507)	(0.509)	(0.199)	(0.202)	(0.517)
	F-t.(4,N)	8.14	0.48	1.46	1.38	3.54	3.34	2.19

Notes: All dependent variables are measured in logs. Regressions include: a constant, age and its square, log household non-labor income, and a dummy indicating whether the individual is the head of the household, and year dummies. The F-test tests for the joint significance of the year dummies. Robust standard errors in parentheses: ^{c} significant at 10%; ^{b} at 5%; ^{a} at 1%.

Appendix D to Chapter 5

Table D.1: Risk Proxies, Correlation Matrix

	Sales variation°	exit rate°	RES°	RES	Component 1	Component 1
Sales variation°	1.000				0.548	0.540
exit rate°	0.290***	1.000			0.595	0.552
RES°	0.311***	0.330***	1.000		0.588	0.590
RES	0.051***	0.054***	0.165***	1.000	-	0.235

Notes: * p<0.10, ** p<0.05, *** p<0.01. ° Variable is measured at the sector level. The last columns on the right show the eigenvector associated to the first component (without and with the idiosyncratic risk.)

Table D.2: Risk Proxies, Regressions

	start-up k					Δ k			
Sales var.°	-0.549*** (0.056)			-0.490*** (0.058)	-0.182*** (0.030)				-0.129*** (0.030)
exit rate°		-7.589*** (0.874)		-6.364*** (0.878)		-2.762*** (0.412)			-2.134*** (0.445)
RES°			-2.549** (1.062)	1.238 (1.087)			-3.047*** (0.513)		-1.651*** (0.556)
RES								-0.194** (0.082)	-0.113 (0.083)
R2	0.228	0.214	0.173	0.253	0.178	0.179	0.173	0.170	0.198
N	1171	1173	1174	1173	2446	2447	2450	2436	2435

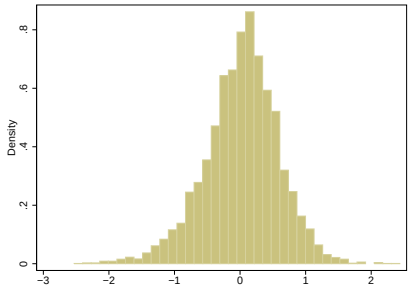
Notes: Regressions include all additional explanatory variables which are contained in the main regressions of equation (29) and (30). In all regressions, we drop influential outliers according to the procedure explained in the note to Table 22. ° Variable is measured at the sector level. Robust standard errors in parenthesis * p<0.10, ** p<0.05, *** p<0.01.

Table D.3: Start-up Capital and Accumulation with Industry Dummies

Dependent variable:	start-up k		Δ k
Log capital		-0.401***	-0.404***
		(0.017)	(0.017)
Wealth index	0.199***	0.109***	0.136***
	(0.028)	(0.013)	(0.018)
Risk index	-0.140**	-0.131***	-0.112***
	(0.065)	(0.029)	(0.035)
Wealth * Risk	0.045**	0.016*	0.018**
	(0.018)	(0.009)	(0.009)
Enterprise age		-0.022***	-0.020***
		(0.008)	(0.008)
Enterprise ageˆ2		(4.9 * 10ˆ(-4))**	(4.1 * 10ˆ(-4))*
		(2.2 * 10ˆ(-4))	(2.2 * 10ˆ(-4))
TFP		0.187***	0.192***
		(0.052)	(0.052)
Enterprise age * risk			-0.002
			(0.002)
Enterprise age * wealth			-0.003**
			(0.001)
Year dummies	Yes	Yes	Yes
Outlier controlled^{+}	Yes	Yes	Yes
R2	0.382	0.239	0.244
N	1170	2432	2426

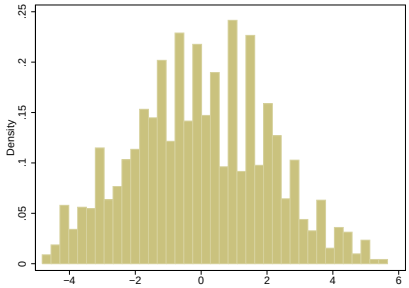
Notes: Regressions include all variables stated under Table 23. $^{+}$ In all regressions, we drop influential outliers according to the procedure explained in a note to Table 22. Industry dummies represent all industries as in Table 22 with petty trading as baseline. Robust standard errors in parenthesis * p<0.10, ** p<0.05, *** p<0.01

Figure D.1: Productivity



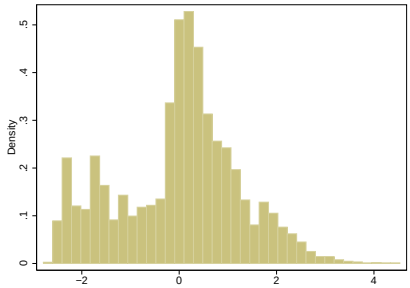
mean: 0 sd: 0.56

Figure D.2: Wealth



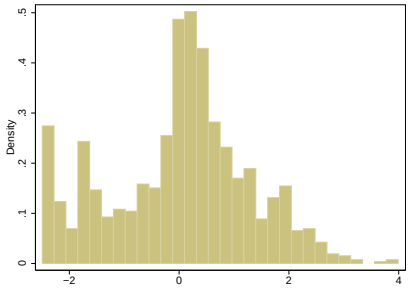
mean: 0 sd: 2.06

Figure D.3: Risk



mean: 0 sd: 1.29

Figure D.4: Initial risk



mean: 0 sd: 1.27

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