Three Essays on Decision-Making under Uncertainty in Developing Countries

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To my father and mother in heaven,

thinking of their sacrifice.

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CHAPTER 1

Introduction of the Three Essays

1.1. Motivation

People face substantial risk and uncertainty throughout most developing countries. Economists have provided an array of economic theories to explain how decision agents make choices under uncertainty. Decision theory distinguishes between risky prospects and uncertain prospects. Under the classical theory of decision under risk, the utility of each outcome is weighted by its probability of occurrence. Expected utility theory was developed to explain attitudes toward risk, namely risk aversion and risk loving. Experimental studies of decision under risk have shown that people often violate the expected utility model. The findings of their studies are often more consistent with alternative models that incorporate a nonlinear transformation of the probability scale that allocates higher weights to low probability events and lower weights to high probability events. In the real world, furthermore, decisions are often made without definite knowledge of their consequences and the probability distribution of the consequences.

This study has been prompted by two questions about decision making under uncertainty: (1) Do agents in developing countries conceptualize the uncertainty in a way that is consistent with expected utility theory? (2) How do agents cope with uncertainty that lasts a long period of time? The first question is motivated by a notion that studies in the field of development economics often confound the two concepts of risk and uncertainty under the paradigm of expected utility theory. The second question is motivated by another notion, which is that there are a limited number of studies that investigate coping strategies of households during a prolonged period of uncertainty, such as morbidity shocks.

To address these two questions, the first essay revisits the neoclassical theory of migration. Since the pioneering work of Sjaastad (1962) and a subsequent work of Harris and Todaro (1970), most economists have viewed migration as a human capital investment decision. In this framework, migration is viewed as an investment that accrues returns over time but also has moving costs that decrease income initially. The potential migrant compares the discounted present value of expected income gains with the mobility costs required to move to a potential destination and decides to go to the destination if the expected net gain is greater than the costs. This model has been very useful in describing some of the stylized facts in the migration literature. Nonetheless, the assumptions it is based on appear to be quite strong. Studies that test the validity of those assumptions are rare, and yet many studies are still based on human capital theory of migration. The first essay in this thesis revisits and empirically tests neoclassical assumptions and claims regarding the stylized facts in the migration literature. It also tests whether the rationality of decision makers defined by the simple migration model is compatible with rich household survey data.

The second and the third essays examine the impact of prime-age adult morbidity on intrahousehold resource allocation. While migration decisions are associated with uncertainty that is somewhat avoidable, in daily life agents may face a very different type of uncertainty due to shocks such as illnesses among prime-age adults. Morbidity is distinct from other types of shocks that households in developing countries experience. It involves more uncertainty in that the duration, and even the possibility of recovery, are generally difficult to anticipate. This is of special interest because people in developing countries often have very limited access to health insurance and medical facilities. The second and third essays attempt to provide answers to the question (2). In particular, the second essay investigates whether households employ intrahousehold labor substitution as a coping strategy in response to morbidity shocks. It also tests whether family farm production is affected by prime-age adult morbidity. The third essay explores the extent to which households are able to smooth consumption in response to the chronic illness or acute morbidity of a prime-age adult. Controlling for duration as well as severity of illness, the second and the third essays present a comprehensive picture of intrahousehold coping strategy under uncertainty.

1.2. Literature Review

1.2.1. Risk and Uncertainty

There is an extensive literature in both psychology and behavioral economics which suggests that individuals use heuristics or "rules of thumb" to form expectations (Kahneman et al., 1982; Rabin, 1998; DellaVigna, 2007). Yet, there are only a few empirical studies that examine whether agents conceptualize uncertainty in a way that is consistent with expected utility theory, especially in the field of development economics. Moreover, there are few studies that investigate whether subjective expectations predict choice behavior that is consistent with the expected utility theory.

Delavande et al (2011) argue that subjective expectations can predict economic behavior in developing countries. In particular, they find that people in developing countries generally can understand and answer probabilistic questions, and subjective expectations are useful predictors of future behavior and economic decisions. The empirical studies cited in their study, however, do not in general present a causal link between subjective expectations and economic behavior. One exception is a study by Jensen (2010), who finds a discrepancy between the measured returns to schooling in the Dominican Republic and the returns perceived by students. He shows that students at randomly selected schools, given information on the higher measured returns, had higher perceived returns when re-interviewed 4 to 6 months later. Furthermore they complete on average 0.20–0.35 more years of school over the next four years than those who were not given this information. One can view the results as evidence that a change in subjective expectations causally affects schooling behavior. Yet, the causal link does not appear to be strong, as the findings of his study do not rule out that such a differential effect is due to other factors. For instance, there are likely to be roles of pure information, rather than the effect of subjective expectation, in encouraging students to remain in school or in reducing the uncertainty in students' estimates about returns to schooling.

Using data from Ethiopia, India, and Uganda, Harrison et al (2010) estimate that just over 50% of their sample behaves in accordance with expected utility theory and that the rest subjectively weight probability according to prospect theory. They find that risk aversion behavior of poor subjects in those countries is more consistent with expected utility theory and risk-seeking behavior is better explained by prospect theory.

On the other hand, expected utility theory implies that there is no difference between risk and ambiguity, and some scholars interpret probability as a numerical expression of beliefs, thereby furnishing Bayesian statistics with its behavioral foundations. On the contrary, Ellsberg (1961) suggested that people often prefer to bet on risky prospects instead of ambiguous prospects, which is not consistent with expected utility theory. Confirming Ellsberg's conjecture, ambiguity aversion has been found in a number of empirical studies in the field of development economics. Henrich and McElreath (2002) studied risk and ambiguity attitudes among small scale farmers in Chile and found no evidence for ambiguity aversion. In contrast, Akay et al. (2009) experimentally tested whether ambiguity aversion is prevalent among small scale farmers. They measured risk and ambiguity attitudes among small scale farmers in rural Ethiopia using an experiment with real monetary incentives, and compared the results to data from university students in the Netherlands facing the same decision tasks. They found clear evidence for ambiguity aversion for both the Ethiopian farmers and the Dutch students. Engle-Warnick et al. (2009) also argue that both ambiguity and risk aversion are important in understanding farmers' decision-making under uncertainty. They adapted a standard model of diversification to a setting where the probability of good yield is unknown, and showed that ignoring ambiguity aversion can overstate risk aversion's effect on diversification.

The vast literature on rural-to-urban migration, influenced by Sjaastad (1962) and Harris and Todaro (1970), assumes that expectations of incomes and employment probabilities in the migrant destination are important determinants of the migration decision. When subjected to empirical testing, however, the hypothesis of earning-enhancing benefits of migration does not support the rationality of a substantial portion of migrants (Banerjee and Kanbur,1981; Salvatore, 1981; Garrison, 1982: Katz and Stark, 1986; Tunali, 2000; Gibson and Mckenzie, 2011). Moreover, although migration research often emphasizes the importance of risk, there are few formal theoretical models that attempt to identify the role of risk. In the neoclassical theory of migration, risk is either simply acknowledged or assumed to be implicit in wage levels.

1.2.2. Coping Strategies under Uncertainty

Households in developing counties suffer from income uncertainty. They are vulnerable to agricultural income shocks and demographic shocks such as morbidity, loss of family members, or dissolution of the family. There are a number of studies that examine the effectiveness of formal and informal risk-sharing and consumption-smoothing arrangements at the village level (e.g. Fafchamps and Lund, 2003; Jalan and Ravallion, 1999; Alderman and Paxson, 1994; Townsend, 1994). The overall conclusion of this research is that most households to some extent succeed in protecting their consumption from the full effects of the income shocks to which they are subject, but the full risk-sharing hypothesis is generally rejected.

In addition, there have been a good deal of studies that examine the strategies households employ to cope with those shocks (for surveys see Alderman and Paxson, 1992; Morduch, 1995, 1999; Deaton, 1997). A particular strand of literature investigates the overall efficacy of strategies employed by households by testing the full-risk sharing hypothesis (Deaton, 1992;Townsend, 1994; Ligon, 2000; Ligon, Thomas and Worall, 2002; Gertler and Gruber, 2002; Dercon and Weerdt, 2006).

It is commonly assumed that farm households, lacking other alternatives, are forced to protect consumption from idiosyncratic income shocks through relatively costly methods (Kochar 1995). For instance, households may use their productive assets as a buffer stock when there are credit constraints (Deaton, 1991, 1992; Banks et al., 2001; Carroll and Kimball, 2001; Carroll, 1997). However, households may use less costly coping strategies under uncertainty. For instance, if households lack access to alternative means of protecting consumption, income uncertainty may generate precautionary savings. Poor households in developing countries are known to hold significant amounts of extra saving in a wide variety of forms such as stored grain, cash holdings, jewelry, and livestock (Lee and Sawada 2010; Alderman, 1996; Fafchamps et al., 1998; Park, 2006; Rosenzweig and Wolpin, 1993; Townsend, 1994). Alternatively, households may use labor as self-insurance to demographic shocks. For instance, well functioning labor markets allow households subject to idiosyncratic shocks to shift from own-farm cultivation to the labor market. Or there may be intrahousehold labor substitution within households. In fact, there is some evidence that time allocation in rural households is responsive to income shocks (Fafchamps, 1993; Jacoby and Skoufias, 1997; Kochar, 1999; Rose, 2000; Beegle, 2005).

The use of labor as self-insurance may be more important in cases of morbidity shocks (Pitt, Rosenzweig, and Hassan, 1990; Kochar, 1995). Unlike other shocks, morbidity not only diminishes labor capacity but also increases the expenditure for the family of the sick person over the duration of the illness. It is even distinguished from mortality in that households may not be able to adopt ex ante strategies to cope with an impending adult death since the possibility of recovery is generally difficult to anticipate. While the resolution of uncertainty for other shocks occurs in a short period of time, morbidity shocks may involve uncertainty that lasts for a longer period of time. Furthermore, analyzing the effect of prime-age adult morbidity is of special interest for understanding risk coping mechanisms of households with limited access to credit markets, health insurance, and medical facilities

1.3. Objectives and Contribution of the Three Essays

Arguably, the subject of migration is one of the most fertile areas in economics for doing research concerning decision making under uncertainty.[1] It is, of course, difficult to investigate empirically the role and effects of uncertainty on migration decisions. For instance, unlike risk, ambiguity is by definition not quantifiable and

[1] Throughout my dissertation, the term uncertainty is used to include the concepts of both risk and ambiguity.

tests of ambiguity effects are likely to be better performed in the context of experimental economics. The first essay of this dissertation instead revisits and tests the assumptions and explanations about some of stylized facts found in the migration literature. The distinction between risk and ambiguity may be irrelevant if the test results still favor the neoclassical migration models, and the rationality defined by the simple neoclassical migration may not need to be refined. If neoclassical explanations are not compatible with the data, more elaborated migration models would need to be developed.

More specifically the objectives of this essay are

- To review neoclassical explanations of stylized facts concerning rural-urban migration
- To test and evaluate empirically the validity of the proposed mechanisms underlying the stylized facts in rural-urban migration.

The first essay uses three waves of data from the Indonesian Family Life Survey (IFLS) (1993, 2000, 2007), an unusually rich data set that can be used to test the validity of the neoclassical migration model. In addition to these data, this essay also uses geographic information obtained from Google Maps. The analysis of this essay also attempts to bridge the gap between the migration literature and modern decision theory, which acknowledges the role of both ambiguity and risk in decision-making.

The second and third essays focus on intrahousehold time reallocation under uncertainty and its implications for household welfare. In particular, the essays study the effects of prime-age adult morbidity on intrahousehold labor substitution, household farm production and profits, and the extent to which households are able to smooth consumption. While there are many papers examining coping strategies of households and risk-sharing mechanisms in response to income shocks, only a few examine the effects of morbidity that lasts a long period of time on households with limited access to conventional coping strategies during the prolonged period of uncertainty. Moreover, studies testing the health shock effects are limited in that they do not control for the duration and severity of illnesses.

The second and the third essays attempt to bridge the gaps in the literature that analyzes the coping strategies used and their welfare implications, for households under uncertainty.

More specifically the objectives of these essays are:

- To estimate the effects of prime age adults' morbidity on intrahousehold labor substitution
- To estimate the effects of prime age adults' morbidity on family farm profits.
- To estimate the effects of prime age adults' morbidity on household consumption.

These two studies may be of special interest to policy makers who need to identify households, and individuals within households, who are more vulnerable to morbidity shocks. Overall, these studies present a more comprehensive picture than the previous literature of the impacts of morbidity shocks on household welfare and the way households cope with such uncertainty.

CHAPTER 2

Essay 1: On the Robustness of the Neoclassical Theory of Migration

2.1. Introduction

Spawned from the pioneering work of Sjaastad (1962), most economists have viewed migration as a human capital investment decision. In this neoclassical framework, migration is viewed as an investment that incurs costs and decreases income initially, followed by returns that accrue over time. This theory posits that the individual compares the present discounted value of income gains (subtracting transportation costs for each potential destination) and decides to go to the destination with the highest net gain. Todaro (1969) and Harris and Todaro (1970) extended the basic human capital model by introducing the probability of finding a job in the urban sector in the context of developing countries. They proposed that expected income rather than a certain income is the driving force in motivating people to move. Since then, economic models of migration have extended neoclassical models of lifetime migration to different (and more realistic) contexts, such as family migration models, dynamic migration models and incomplete information models. Yet, the vast literature on rural-to-urban migration in developing countries is still grounded in the economic theory that individuals behave in ways that maximize their expected gain or expected utility. The significance and the essence of the neoclassical migration model are succinctly described by Stark (2003) as follows. *"Almost every scholar who has written on migration has noted that the migration tale is fairly straightforward: anticipate the individual to migrate if his expected earnings in the city net of his expected earnings in the village and net of the direct costs of migration are strictly positive*."

On the empirical side, studies have shifted from the use of aggregate data to the use of microdata. The availability of more microdata has enabled scholars to study the determinants and selectivity of migration for many countries in the world. In fact, there are many more migration studies in the context of developing countries these days than decades ago. Most, if not all, of these migration studies, whether they are on developing countries or developed countries, have provided a number of stylized facts on the migration process. For instance, migration is found to be negatively associated with distance and age while education is known to have positive effects on migration propensities. Yet, people rarely explore deeper than the first level of interpretation of these stylized facts derived from the simple neoclassical theory of migration.

This study revisits some of the assumptions and implications of the neoclassical model of migration, and evaluates the plausibility of the proposed mechanisms that underlie those stylized facts. To this end, the paradigm that a rational individual acts as an expected utility maximizer, is subjected to empirical scrutiny using a rich data set, the Indonesian Family Life Survey, and information on geographic proximity to larger urban centers collected from Google Maps. The central idea is that rationality of decision makers defined by the neoclassical theory of migration needs to be consistent with the migration patterns described by the rich household survey data, if the validity of neoclassical explanations of the stylized facts holds.

The main contributions of this study are twofold. First, it presents detailed pictures of underlying mechanisms beyond the general neoclassical explanations of some of the stylized acts in migration. While there are numerous studies investigating determinants of migration, most empirical migration studies have been largely descriptive in nature, often relying on ad hoc explanations and lacking a rigorous theoretical model. This study presents empirical tests of hypotheses derived from general explanations of the neoclassical human capital theory of migration. These tests are important for making real progress in the understanding of the factors determining the fundamental heterogeneity of migration. Such deeper investigations of neoclassical explanations of stylized facts are essential to get better insight into a question of selectivity in migration: why do some people migrate while others stay among people who otherwise look the same and face similar conditions? Second, this study tests the rationality of decision makers defined by the neoclassical theory of migration. While there are papers that test the hypothesis in terms of earning-enhancing benefits of migration (Banerjee and Kanbur,1981; Salvatore, 1981; Garrison, 1982: Tunali, 2000; Gibson and Mckenzie, 2011), this study instead examines and tests the rationality assumption by investigating the underlying mechanisms of two stylized facts widely accepted in the migration literature. Such a test is important in developing new migration models that can better explain some of the migration patterns that are not well portrayed by conventional migration theories. For instance, this study shows that the magnitude of distance effects is not explained by any of conventional neoclassical explanations. For a better model, one needs to know exactly which migration patterns described by rich microdata deviate from the premise of existing migration theories. This study attempts to show the extent to which the neoclassical assumption of rationality in migration decision making is compatible with microdata.

The plan of this paper is as follows. Sections 2.2 and 2.3 review the simple neoclassical human capital model of migration and revisit two stylized facts found in the literature: 1) distance has a negative effect on migration; and 2) education will tend to increase migration. In particular, section 2.2 presents a generalized neoclassical framework of migration, and section 2.3 reviews its implications for these two stylized facts. In addition, alternative perspectives are proposed to explain some nonlinear aspects of distance effects in migration decisions, which are not well explained by the conventional neoclassical theory of migration. Section 2.4 describes the IFLS data, the characteristics of the sample, and the explanatory variables used in this study. It also presents regression results based on the conventional neoclassical model. An empirical model is then used to estimate the propensity to migrate to urban areas between 2000 and 2007. In section 2.5, the validity of neoclassical explanations of the two stylized facts is empirically tested. In particular, I derive some testable hypotheses from three general explanations of distance effects. I also present three possible explanations of education effects and derive testable hypotheses from them. To test these hypotheses, I use three waves of the IFLS data (1993, 2000, and 2007). Distance data were also collected using Google Maps and used for this study.

2.2. The Neoclassical Human Capital Model of Migration

2.2.1. Other Paradigms in Migration Studies

The first scholarly work of migration was introduced by Ravenstein (1885, 1889), who formulated his "laws of migration" after an exhaustive descriptive analysis of the U.K. census data.[2] His perspective has later become the underlying assumption of the push-pull model introduced by Lee (1966).[3] According to the push-pull model, mainly developed by demographers and geographers, the migration decision is determined by factors associated with the area of origin and factors associated with the area of destination which may either "push" or "pull" to migrate. For instance, push factors include rural environmental degradation, political problems, or population growth causing a Malthusian pressure on natural and agricultural resources, whereas pull factors include economic conditions that lure people into cities and industrial countries (Skeldon 1997; King and Schneider 1991; Schwartz and Notini 1994; Zachariah et al 2001).

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[2] He listed seven conclusions that he called "laws" (1) Most migrants move only short distance and then typically to major cities, (2) Rapidly growing cities are destinations of migrants from nearby rural areas, (3) The process of dispersion is the inverse of the process of absorption, (4) Each main current of migration produces a compensating countercurrent, (5) Migrants from long distance tend to move to major cities, (6) Rural residents have higher propensities to migrate than urban people, (7) Women have a higher propensity to migrate than men.

[3] The push-pull terminology was not invented or employed by Lee, but he is the first one who proposed the new analytical framework in migration studies.

Selectivity of migration may be explained by the model because people respond differently to “plus” and “minus” factors at origins and destinations and have different abilities to cope with the intervening variables (Reniers 1999). This is consistent with the neo-classical perspective which explains migration selectivity by individual differences in human capital endowments, which lead to diverging returns on migration investment. For instance, individuals are different in terms of personal skills, knowledge, physical abilities, age, sex, and so on, and hence there will also be differences in the extent to which people are expected to gain from migrating.

While the push-pull model seems quite attractive for its ability to integrate other theoretical insights, it is doubtful that the framework is of much analytical use. Rather than a theory, it is a descriptive model in which various migration factors play some role in a relatively inconsistent manner. Push-pull models applied in practice tend to present ad-hoc explanations forming a rather ambiguous collection of migration determinants (For more criticisms, see De Haas 2010).

An alternative and radically different view on migration was proposed in the 1960s by the historical-structural paradigm, which has its intellectual roots in Marxist political economy and in world systems theory (Castles & Miller 2003). Contrary to neoclassical migration theory, this historical-structural view asserts that individuals do not have a free choice in migration decisions. Historical structuralists perceive migration as one of many manifestations of capitalist penetration. According to their view, rural populations become increasingly deprived of their traditional livelihoods, and they are incorporated into the global political economy system (Massey et al

1998). However, their perspective has been criticized for treating individuals as victims who have no choice but to adapt to macro-forces. Moreover, their rigid forms of historical structuralism have been found to be invalid in many countries (Papademetriou, 1985; Sen, 1999).

2.2.2. Theoretical Framework of Neoclassical Migration Model

This section presents a generalized neoclassical human capital model of migration. The model is intended to be abstract, yet simple enough to characterize the general rural-urban migration models in the literature.

To begin, one can think of migration as an investment decision, where the agent tries to maximize expected life cycle utility. Each potential migration destination can be thought as a security, and the agent can invest in only one security. Each security can be defined as a production technology, which in turn is a *cumulative* density function for returns as a function of the life cycle stock of nonleisure time (T) invested in the security.[4] In this model there are two types of mutually exclusive securities, denoted by M and N. Agents are assumed to make irreversible choice between two securities at time zero. This analogy attempts to describe the general migration model, which compares the lifetime expected discounted utility in urban (M) and rural areas (N). For instance, in the simple neoclassical migration model, migration occurs if

$$(2.0) \qquad M(T) = \int_0^T [pw_u + (1-p)w_i]e^{-rt}dt - C > \int_0^T e^{-rt}w_r dt = N(T),$$

[4] Treating migration decision as a choice of security or a choice of technique is not a new idea. In Sen's (1968) model, migration may be viewed as a choice of techniques associated with higher returns. Extending his model, Stark (1981) presented the intuition that viewed migration as a choice of security. In his model, migration is viewed as a risk coping strategy of rural households.

where p denotes the probability of employment in an urban formal sector job, w_r denotes the wage rate of a rural area, C denotes a fixed cost of migration, and the wage rates of formal and informal jobs in urban areas are denoted by w_u and w_i, respectively.

To begin, assume a deterministic world, so that the time investment of each agent is transformed by the technology of securities into nonstochastic returns. For the technology in the deterministic world, we make the following assumptions, some of which will be relaxed in a risky world:

a) M(T) and N(T) are continuous and nondecreasing functions such that $M : R^+ \rightarrow R$, and $N : R^+ \rightarrow R$

b) $\frac{\partial M(T)}{\partial T} \geq \frac{\partial N(T)}{\partial T} \geq 0,\ \frac{\partial N^2(T)}{\partial T^2} < 0, and\ \frac{\partial M^2(T)}{\partial T^2} < 0$

c) $u\big(M(T)\big) \geq u\big(N(T)\big)$ for $\infty > T \geq T^*$, otherwise $u\big(M(T)\big) < u(N(T))$, where u(.) is a nondecreasing concave utility function satisfying other standard assumptions[5]

d) The entity that engages in choice-making is an individual.

e) There exist complete capital markets.

Assumptions a) and b) are needed to eliminate some trivial states. In assumption c), a value of T greater than T^* guarantees "a period of recovery" so that the amount of return lost at an early period (i.e., nonleisure time smaller than T^*) by choosing security M is recovered by the excess of return in terms of the total labor force time before retirement. In migration decisions, T^* is equivalent to the threshold

[5] Additional assumptions include continuity and local nonsatiation.

of duration, from which migrants begin to recover from all the initial costs of migration. Thus, in a deterministic world, rural-urban migration is rational as long as total nonleisure time available in urban areas is greater than the breakeven point of T^*. **Figure 2.1** (a) shows that returns from migration (M(T)) are greater than staying (N(T)) if an agent's total labor force time before retirement (T) is greater than T*. In contrast, the agent is better off in rural areas when her total labor force time is smaller than T*. Hence, T* is the minimum duration in urban areas, at which initial costs of migration are paid off by higher returns in urban areas. Assumption e) is needed to assure that there are no liquidity constraints.

In a risky world, on the other hand, the two securities yield stochastic returns that depend on total time stocks and objective probability distributions. Let θ_N, θ_M be vectors consisting of some parameters by which the probability distributions and returns of N and M are determined, respectively.[6] The information on θ_N and θ_M is assumed to be available at the time the migration is made. Then, an expected utility maximizer prefers M to N if the former yields unambiguously higher expected utility than the latter such that:

(2.1) $$E_{F_N}[u(N(T)|\theta_N)] < E_{F_M}[u(M(T)|\theta_M)],$$

where E_{F_N} and E_{F_M} are mathematical expectation operators for the cumulative probability distribution F_N and F_M, respectively.[7] The inequality (2.1) can be stated more generally: an agent with θ_M and θ_N prefers M to N if F_M *first-order*

[6] In the Harris and Todaro's migration model, θ_M is a function of migration flows. This parameter is an essential part in their model to derive an equilibrium condition.

[7] More formally, $E_{F_K}[u(K(T)|\theta_K)] = \int_F u\big(K(T)\big)dp(\theta_K)\,, (K = M, N)$, where *F* is a state space and *p* is a probability measure on *F*.

stochastically dominates F_N. Consistent with assumption c), in a stochastic world, it is assumed that the distribution F_M *first-order stochastically dominates* F_N for T > T* and the opposite is true for T < T*. The agent is indifferent between two securities when T = T*, in which case neither F_N nor F_M stochastically dominates the other. In this risky world, assumption c) is equivalent to the single-crossing condition assuming that there exists T^* such that for all T (∞>T>T*), M(T) yields unambiguously higher returns than N(T).[8] One advantage of the exposition of stochastic dominance is that the inequality holds regardless of the utility function as long as it is weakly increasing.[9] **Figure 2.1** (b) depicts the two cases of a stochastic world. In the first case, F_N first order stochastically dominates F_M and agents are better off in rural areas. As in the deterministic world, on the other hand, rural-urban migration can be justified as long as an agent can invest his or her stock of time that is greater than T*.

In this risky world, two important factors that determine the choice between the two alternative securities are risk and expected returns. The higher risk entailed in choosing M must be rewarded by higher expected return in order for the agent to choose M over N. Consider the risk premium that is equivalent to the amount by which the expected return of a risky asset must exceed the risk-free return in order to make the risky and risk-free assets equally attractive. Denote the risk premia for N

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[8] The cumulative function M and N satisfy the single crossing condition if there exists a y such that for all x, x ≥ y→M(x)≥N(y) and x≤y → M(x)≤N(y)

[9] This will become more useful when we focus on the effect of economic environment on migration decisions as will be shown in Proposition 2.

and M by ρ_{r^N} and ρ_{r^M}, respectively. Then we can formally state the criteria for choosing between alternative securities in the presence of risk:

Proposition 1. A risk averse agent is indifferent between M and N if and only if $E_{F_M}(M(T)|\theta_M) - E_{F_N}(N(T)|\theta_N)$ is equal to $\rho_{r^N} - \rho_{r^M}$.

Proposition 1 implies that for a risk averse agent to migrate it is not sufficient to have positive expected wage gains. Instead, the gains should be greater than the difference in her risk premia incurred between the two locations. The amount of risk premium depends on risk attitudes of agents.[10] For a risk neutral agent, the risk premium is zero and her migration decision is simply determined by expected income gains. Moreover it implies that the decision to migrate is influenced by factors affecting the expectation of urban and/or rural income (θ_M, θ_N). For instance, it may be affected by *information* about migration flows that change the value of expected wage returns, as described by the Harris and Todaro model.

On the other hand, the decision to migrate is also influenced by factors affecting the volatilities of the returns. Imagine that for every realization of rural income, we add noise ε. Under the assumption that the mean value of the noise is zero, this only makes the security N riskier without improving its expectation. In other words, we are spreading the distribution of N without changing the mean. If the agent is risk averse, the expected utility of this security would decrease. For instance, the migration decision may be affected by how yield variations of agricultural products

[10] The higher the curvature of a utility function,, the higher the risk aversion and hence the risk premium. The risk premium can be approximated from utility functions. Appendix 2.1 uses this general property to prove Proposition 1.

have been changed due to changes in the environment. Proposition 2 states the concept formally using the concept of second order stochastic dominance.[11]

Proposition 2. Assume that a risk averse agent is indifferent between M and N. A change in θ_N, *ceteris paribus*, induces the agent to prefer M to N if it results in a mean preserving spread of F_N.

It is worth noting that, in Propositions 1 and 2, objective information and individual perception can be distinguished by θ_N and F_N. Information about one's economic environment is transmitted through (θ_M, θ_N), and her subjective expected income is modified accordingly. While the simple neoclassical model does not differentiate between these two factors, Proposition 1 and 2 allow the possibility that individual perception plays a role in migration decisions and show that it can be incorporated into the neoclassical migration theory as long as the model does not violate the axioms of subjective expected utility.[12]

2.3. Stylized Facts in Rural-Urban Migration

Empirical studies of migration provide a number of stylized facts. In particular, several implications are derived from the human capital model of migration: 1) the higher the distance between two areas, the lower the mobility between them; 2) education tends to increase mobility; and 3) the young adults are more likely to

[11] Second order stochastic dominance measures relative riskiness between two distributions with the same mean. Similar to the first order stochastic dominance, this equality holds as long as the agent is risk averse and her utility is weakly increasing.

[12] See section 2.5.3 for more discussion on this point.

migrate. This chapter focuses on the first two stylized facts and reviews some of their implications.

2.3.1. Distance Effects

Distance effects in migration were first noted and documented in 1885 by Ravenstein. He observed that, from British census data, most migrants move only a short distance and usually to larger cities. Since then his observation of the negative effect of distance on migration propensity has stood the test of time well across countries. Distance effects may be incorporated into the simple human capital model in the form of monetary or nonmonetary costs. Higher moving costs are associated with a longer period of recovery (section 2.2.2.), which in turn leads to a lower propensity to migrate. Transportation costs are considered to be one element of the monetary costs, and according to the neoclassical explanation, the costs increase proportionally as migration distance increases. The effect may be more significant if would-be migrants intend to make frequent return trips to their towns of origin. The explanation, however, may be less convincing for internal migration, especially in small countries, and so may need more empirical investigation.

2.3.1.1. Psychic Costs

Of course, costs do not have to be monetary to be incorporated into the neoclassical migration model. Increased distance may reflect increasing psychic costs. For instance, one's disutility of separation from family and friends may increase as she moves to a destination farther away from home. Costs of maintaining friendships over long distance may be unbearably burdensome for many. However, it is unlikely that psychic costs always increase as distance increases, especially in internal migration. Moreover, Lucas (2001) presents his case for this notion in an elegant manner; "*Establishing a home in a context where a different language is spoken, where peoples of different ethnic groups are in the majority, where the life-style and institutions contrast with those at home, may be seen as a threat by some and as an exciting experience by others.*" The overall psychic effect, however, may depend on the relative size of the two groups and would need to be investigated with data. Schwartz (1973) finds that the effect of psychic costs is relatively weak for internal migration in the US. Since then, few, if any, attempts have been made to test the validity of distance as a proxy for the psychic cost in migration decisions, although this is most likely due to data limitations.

Some may want to use family or friendships variables (e.g., the number of close friends in town) to test if psychic costs indeed increase with distance. In fact, there exist a sizable number of studies that investigate the role of family and social ties in migration decisions (Mincer, 1978; Spilimbergo and Ubeda, 2004; Dawkins, 2006; Zorlu, 2008; Belot and Ermisch, 2009). Yet, the association of family and friendships with psychic costs is not as straightforward as it seems to be, and these studies in general are not aimed to estimate the psychic effects. For instance, Spilimbergo and Ubeda (2004) find that the effects of family ties explain a much lower propensity to migrate of Blacks compared with Whites in the US. In their study, the degree of family attachment is proxied by the ratio of the size spatially close family relative to the size of extended family living elsewhere in the country.

Intuitively, having more relatives elsewhere in the country or oversees could make migration easier while the opposite is likely to result in a lower propensity to migration. Thus, their family variable is not built to identify the psychic effects in migration.

The correlation of family structure with migration is sometimes explained by a theory that is based on strategic consideration with respect to caregiving for parents (Konrad et al, 2002; Reiner and Siedler, 2009). For instance, Konrad et al. (2002) propose a theory that predicts that second-born children should be more ‘tied’ to their parents than first-born children, because of strategic considerations with respect to providing care for their parents in the future. Rainer and Siedler (2005), using German data, find that only-children locate closer to their parents than children with one sibling. Their explanation is mainly based on a sibling power effect, according to which siblings compete in location and employment decisions so as to direct parental care decisions at later stages towards their preferred outcome.

Also, social ties proxied by the number of friendships are unlikely to be good variables for testing psychic effects in migration. The propensity to migrate may be associated with personal attributes such as ‘sociability’ affecting the formation of friendships, while mobile people may invest less in new friendships. So, it is unlikely that the friendship variable is a good indicator of the extent of one’s disutility from migration. Indeed, most studies using social ties focus on the instrumental value of social networks linked through friends, such as the value of friendships in providing access to valuable resources and information. One exception is the study of Belot and

Ermisch (2009), who find that a larger number of close friends living nearby substantially reduces movement of 20 miles or more. While their findings may be seen as evidence for significance of psychic costs, the authors explain that they expect those with a social network that is essentially 'local' to be less likely to hear about other jobs and locations, and therefore less likely to move.

Some may use a residential tenure variable to proxy for one's ties to her location, and hence degrees of attachment. This tie to one's location is sometimes called 'cumulative inertia', which is assumed to be strengthened with the passage of time (Mcginnis, 1968). In contrast, others note changes in individual circumstances that reduce satisfaction with the current residence. As opposed to cumulative inertia, this is called 'cumulative stress' (Gordon and Mohlo, 1995). So depending on dominance of one effect over the other, the residential tenure variable may or may not be linked to propensities to migrate.[13] Again, the residential tenure variable is not likely to be a good proxy for psychic costs.

Overall, considering the reasons discussed so far, it is not surprising that the literature on the roles of family and social ties in migration does not appear to favor the explanation of psychic effects.

2.3.1.2. Information Costs

Increased distance may also lead to increasing information costs. Information on destination regions is a crucial input in migration decisions, and the migration literature has in general stressed the positive role of networks in the process of

[13] In general, empirical investigations fail to find that the duration of residence reduces propensities to migrate (Davies et al., 1982; Pickles et al., 1982; Pickles and Davies, 1985). Gordon and Mohlo (1995) find a nonlinear relationship between the duration and the migration propensity.

gathering information. That is, migration networks are found to be beneficial in the sense that they reduce information and search costs (Borjas, 1999, Chiswick and Miller, 2004, Bauer et al., 2005). On the other hand, some studies have looked at how the lack of information may affect migration decisions (Pessino, 1991; Borjas and Bratsberg, 1996). For instance, Borjas and Bratsberg (1996) find that return migrations take place when would-be migrants base initial migration decisions on erroneous information about opportunities at destination. Yet, there is limited evidence that information costs are positively associated with distance. Some researchers argue that information deteriorates as distance increases, hence incurring search costs (Schwartz, 1973; DaVanzo, 1981, 1983; Farber, 1983).

It is important to realize that migration is more likely to be a response to information about opportunities in general rather than to opportunities per se. That is, migration decisions are more likely to be affected by individuals' perceptions and subjective evaluations of information about labor market conditions rather than by the objective conditions prevailing in current location and in possible destinations. Some scholars have noted that would-be migrants may receive biased or sometime exaggerated information about migration destinations. For instance, migrants may hold unrealistic expectations inflated by television and film images of life abroad (Braga, 2010; Mai, 2004). Or expectations of potential migrants may be affected by returning migrants presenting an overly positive image of migration destinations (Durand and Massey, 2006). Yet, relatively little attention has been paid to the subjective aspects of information costs, such as agents' perception of the quality of information, which may be affected by migration distance. One example is Fuller et al. (1985), who attempted to test the role of information in rural-urban migration. They implemented an experimental information program that introduced *credible* employment information in three experimental villages to see if such a program may be used to divert migrants from large metropolitan centers.[14] Winters et al (2001), in their estimation of network effects, distinguish between the roles of family networks and community networks, which are expected to provide varying degrees of assistance, information, and credibility to potential migrants. Mckenzie et al (2012), on the other hand, obtain moments and quantiles of the subjective distribution of expected earnings using unique survey data on would-be emigrants' probabilistic expectations about employment and incomes in the migration destination. They find that potential male migrants underestimate both the odds of being employed and the incomes that they could earn if employed abroad, whereas potential female migrants have fairly accurate expectations. All these studies indicate that migration decisions are not only affected by sources of information but also individual perceptions about the information. This implies that distance effects may contain more information than the conventional explanation about increasing information costs in the neoclassical migration theory.

2.3.2. Education Effects

Another implication of the human capital model of migration is that education will tend to increase migration. People with more education may also have characteristics

[14] They were not able to demonstrate that the program diverted subsequent migration to Bangkok.

of being more ambitious, more motivated, or less risk averse, which are also likely to be associated with higher propensities to migrate. This is often called positive migration selection and those migrants have also been known to contribute towards a brain drain of many countries.[15] While most people would consider these as nontrivial factors in migration decisions, few studies in neoclassical migration models account for these factors in their analyses, likely due to data limitation. Moreover, there appears to be little room to incorporate these factors into the neoclassical migration models.[16] One possible reason more generally accepted in neoclassical migration models is that agents with more education may be less credit constrained than those with less education. Education may also develop abilities to search and collect information about labor markets in distant urban areas. So, one can expect that more education is associated with a higher propensity to migrate owing to lower searching costs. Another implication can be derived if one assumes that individuals expect diverging returns on their migration investment. For instance, people with higher education may expect greater returns in cities than in rural areas, which gives them another incentive to migrate.[17] Thus, there are several possible explanations that imply positive effects of education on migration propensities within the context of the neoclassical theory of migration.

Irrespective of which of these interpretations is preferred, it is possible that all these explanations are supported by empirical evidence. Yet, there are very few

[15] Many of those who migrated to America early were negatively selected.
[16] The empirical models in this study controls for risk attitudes.
[17] See Appendix 2.3 for a formal derivation of this implication from the conceptual framework of this study.

studies testing these explanations in the literature. One exception is a study of Wozniac (2006), who finds evidence for the explanation of credit constraints using U.S. Census data. She finds that less educated people are capable of making wage arbitraging moves only when their own current wages are not too low and when their average probability of employment is high. She views this as an indication that less educated workers are more credit constrained and hence less responsive to migration opportunities. In her study, college graduates are found to be more responsive to wage arbitraging opportunities in distant labor markets. However, her study has very limited information on individual, household, and regional characteristics. Hence, her study may be missing some important factors that cause the sluggish response of less educated people to distant employment opportunities. Moreover, she does not present direct tests for the other two explanations.

2.3.3. Beyond the Neoclassical Theory of Migration

Migration decisions may not be determined by the outcome of a weighted average of quantitative benefits multiplied by quantitative probabilities. Following the intuitive arguments of Knight (1921) and Ellsberg (1961) and the pioneering formalization by Gilboa and Schmeidler (1989), there has been a growing body of literature that makes the distinction between risk and ambiguity in the field of modern decision theory. In the literature, risk is analogous to an unambiguous belief which may be expressed as an objective probability distribution. An ambiguous belief, in contrast, cannot be expressed using a single objective probability distribution.[18] Also, when subjective aspects play a significant role, the assumption of expected utility maximization is likely to lose its explanatory power. A good example is the equity home bias puzzle, which was first documented by French and Poterba (1991). Their finding is that individuals and institutions in most countries prefer investing close to home although observed returns on national equity portfolios suggest substantial benefits from international diversification. This phenomenon cannot be explained by expected utility theory, and it even casts doubts on the fundamental assumption of the neoclassical economics that human beings are rational.

Likewise, a drastically new approach to rural-urban migration would be required if one can establish that the assumptions of expected utility maximization do not explain well some of the stylized facts in the migration literature. For instance, migration distance may be viewed as a factor increasing the degree of ambiguity (Klibanoff et al, 2005). In Lim (2011), I propose a theoretical model in which the decision to migrate is influenced by factors affecting the volatilities of information on expected returns. According to the model, migration distance may be viewed as a factor that has a negative effect on the credibility of information about the true wage distribution in potential migration destinations.

[18] Knight maintained that there exists "unmeasurable uncertainty", which cannot be represented by numerical probabilities. In modern decision theory, many scholars approach this issue using multiple probability distributions.

2.4. Data and Empirical Estimation of the Propensity to Migration

2.4.1. Survey Data and Characteristics of the Sample Population

Indonesia, the fourth most populous nation in the world, has enjoyed rapid economic growth over the past three decades. Furthermore, since 1980 Indonesia has rapidly urbanized, exceeding many other developing countries in urbanization rates (see **Figure 2.2**)

This paper uses three waves (1993, 2000, and 2007) of panel data from the Indonesian Family Life Survey (IFLS), a high-quality panel survey of individuals, households and communities. The survey contains information from more than 10,000 households representing about 83% of the Indonesian population, those who live in the 13 most populous of the nation’s 26 provinces. The IFLS collected a broad array of demographic, socioeconomic, and health information on individuals, households, and communities while capturing the cultural and socioeconomic diversity of Indonesia.

The survey includes the following modules collected at the individual and household level: multiple indicators of economic well-being (consumption, income, and assets); education, migration, and labor market outcomes; marriage, fertility, and contraceptive use; health status, use of health care, and health insurance; relationships among coresident and non-coresident family members; processes underlying household decision-making; transfers among family members; types of natural disasters and consequences at the household level in the past 5 years; and participation in community activities. Importantly, the IFLS contains detailed migration information. In particular, it contains information on each subsequent location of residence for all moves that crossed a village boundary and lasted for longer than 6 months.

One unique aspect of this data set is that it contains information on time preferences and attitudes towards risk derived from a series of experimental questions asked in the 2007 wave of the IFLS. To measure time preferences respondents were asked to choose between being paid today and being paid one or five years later, where a larger amount of money is paid if they wait longer.[19] Similar to the questions on time preference, respondents were asked to choose between a sure amount of money and lotteries of various types in order to measure attitudes toward risk. Based on their answers to these questions, the respondents can be classified into four groups according to their preferences with respect to risky lotteries. This direct measure of risk attitudes allows one to control for the effects of risk attitudes when analyzing the effects of uncertainty on migration decisions. In addition to the IFLS data, this study utilizes information on travel distance by a car to major cities in Indonesia obtained via Google Maps. The distance information was collected at the kecamatan level, a subdivision of a city. Due to data limitations on less populated islands, regression analyses are conducted only for the sample population who live in Sumatra or Java, which includes approximately 70% of the households in the IFLS. The working sample consists of 6696 individuals in the 18 to 65 age bracket in 2000, for whom

[19] Some respondents may not fully understand the survey questions and so give imprecise answers to these kinds of questions, especially in developing countries. To avoid this, the questionnaire has additional questions to make sure that all respondents answer based on full knowledge and understanding of questions.

complete internal migration and employment histories for the 2000 and 2007 as well as information on other variables of interest were available. Also, this study is limited to migration to major cities in Indonesia, since the neoclassical theory of migration was developed to explain urbanization in developing countries. Migrants are defined to be individuals between the ages of 18 and 65 who crossed a village boundary to move to urban areas for the first time in their lives between the years 2000 and 2007 and who stayed in the destination for longer than 6 months.

2.4.2. Choice of Regressors

The empirical estimation of this study takes into account that individuals are different in terms of personal skills, knowledge, age, sex, and so on. Such differences in socio-economic characteristics and human capital are assumed to lead to differences in the extent to which people expect to gain from migrating, hence affecting their propensity to migrate to urban areas. This paper uses explanatory variables that are commonly included in empirical studies of migration decisions. They can be classified into groups that capture the regional economic environment, social ties, human capital-related attributes, and the wealth position of the (potential) migrant's household. All variables used in the migration models were measured prior to any migration except for the two behavioral variables (time preference and risk attitude), which are available only from the 2007 wave of the IFLS data. Thus the estimates of migration propensities assume that attitudes towards risk and time preferences do not change significantly during the period from 2000 to 2007. Definitions of the explanatory variables used in the migration equations are given in **Table 2.1**. The variable name abbreviations indicated in **Table 2.1** will be used when appropriate, to avoid repetition of the longer names. **Table 2.1** also reports the descriptive statistics for the explanatory variables. The family income variable measures total yearly income of households. For those respondents who were uncertain about the information or unwilling to give an answer, the survey also asked them to choose among multiple ranges of values in rupiah. This variable is intended to proxy for family wealth. Ideally, one can use the value of all household liquid and illiquid assets, but it is problematic to construct the family wealth with the information as the values of assets are often very subjective and imprecise. To control for the effects of illiquid assets, this study also use a dummy for ownership of land. To be consistent with Proposition 2 in section 2.2, the model also controls for income volatility by including variables capturing differences between the standard deviation of income in the closest metro city and that in the individual's home town. The variable is intended to capture relative income variations of urban and rural areas, which would affect individual perception of income volatilities. Intuitively, a greater income variation implies a riskier economic environment, and hence it is likely to be a less attractive property for would-be migrants. In Proposition 2, the individual perception is formed through (θ_M, θ_N). Also included in this study is the network variable, which was constructed by counting the number of previous migrants prior to 2000 from kecamatan of residency to the closest big cities. When there exist positive effects of the migration network, the sign on the coefficient will be positive.

2.4.3. Base Regression Results

Table 2.2 (Model 1) shows the results of a base model probit regression of the propensity to migrate between the 2000 and the 2007 waves of the IFLS data (between 2000 and 2007). The coefficients on variables commonly used in the literature have the expected signs, and the results are consistent with the stylized facts found in other migration studies. In particular, the results indicate that young people are more likely to migrate, education increases the propensity to migrate, and distance has a deterrent effect on migration. Model 2 also shows that the effect of distance is greatest for a distance greater than 300 km. In addition, married people and women have lower propensities to migrate, both of which are consistent with general findings in the literature. The results also show that people who were working regularly in a private sector at the beginning of 2000-2007 period are more likely to migrate than people who were working as unpaid family workers. This suggests that private sector workers have more employment opportunities in urban areas than unpaid family workers who are likely to have less attractive qualifications for urban sector employers. They are also more likely to be tied to their family business. The same reasoning may apply to people working in public sector, but the effect appears to be insignificant. It may be that expected gains from migration are not sufficient enough to trigger migration for public sector workers.

Family income is found to be negatively correlated with the migration propensities, indicating that people in higher-income households are less likely to migrate to urban areas. This is in contrast with the negative sign of the earnings *gap* variable, which implies that people in rural towns with a relatively low mean income are less likely to migrate to big cities than those living in towns with a higher mean income.[20] Although these results may seem inconsistent with the prediction of the neoclassical theory of migration, it may indicate that people living in low income towns have more difficulties obtaining access to credit or to interhousehold assistance that may be needed to facilitate migration.[21] The coefficient on the difference in village income variations shows the expected sign, but it is not statistically significant. Intuitively, the base probit regression also shows that the stock of previous migrants positively affects migration in Indonesia. This is consistent with the findings of other migration studies, which show the benefits of social networks in migration, although most of these studies are based on Mexican migrants to the U.S.

2.5. Empirical Tests of the Neoclassical Explanations of Stylized Facts

2.5.1. The Negative Effect of Distance on the Propensity to Migrate

Although the negative effect of distance is found in nearly all empirical studies on migration, including this study, researchers seem to be less interested in the fact that most migrations are over shorter distances: studies of the distance effects of migration are rare in the migration literature. One exception is the study of Lucas (2001), who

[20] IFLS data show that the mean income level of cities is 63% higher than that of rural areas in Indonesia.

[21] Yang (2008) shows that the impact of an income shock is more likely to deter migration when the shock is aggregate (village-wide) rather than idiosyncratic (household specific). He assumes that the impact of economic shocks on migration will depend on whether such shocks also affect access to financing mechanisms within villages.

documents a number of reasons why migration distance matters in developing countries. Among the arguments, the principle concern is the potential for leaving more remote locations in relative poverty. For instance, remote rural areas may be left with persistent wage gaps by the deterrent effects of distance as labor migration may otherwise contribute to factor price equalization through wage convergence. In fact, there is some considerable cross-sectional evidence of higher incomes and wages within rural areas close to urban areas in developing countries.[22] Partridge and Rickman (2009) also find that poverty rates increase with greater rural distances from successively larger metropolitan areas in the U.S.

Even apart from this kind of policy relevant issue, some aspects of migration distance observed in the data demand a deeper level of explanations than is generally provided in the literature: the *magnitude* of distance effect appears to be much greater than can be explained by the general neoclassical explanations. In Indonesia in the year 2000, the mean income of regions located within 100 kilometers of the nearest urban areas was approximately 30% higher than that of regions 350 km. or farther away from the nearest urban areas (**Figure 2.3**). Of course, comparisons of income in two rural areas may not be so simple. There are many factors to take into consideration - including skill differentials, adjustments for the cost of living, and the property components in the income of the self employed (Squire,1981; Kannappan, 1985). Nonetheless, it may not be as problematic as comparing urban and rural areas, and the income gap seems substantial between those two types of rural areas in

[22] For references, evidence and discussion see Henderson (1991), Tacoli (1998), and Fafchamps and Shilpi (2003).

Indonesia. By Proposition 1 in Section 2, this implies that the residents living 350 km. or farther away from urban areas have an incentive to migrate even if they are rewarded with a risk premium 30% lower than those living in areas 250 km. closer to the cities, assuming the difference in direct costs of migration between two groups of residents is negligible.[23] So it is natural to expect a higher migration rate for those farther away if one assumes that there is no systematic difference in risk attitudes and the riskiness of the rural economic environment between those two groups.[24] However, the rural-urban migration rate of those closer is more than twice that of those farther away according to the IFLS data.[25] Moreover, predicted probabilities of migration based on probit estimations of *average* marginal effects show results opposite of what one would expect (**Table 2.3**).[26] In particular, compared with people living 50 km. away from urban areas, residents living 300 km. farther away are more than 55% less likely to migrate, *ceteris paribus*. Of course, the assumption of the same degree of riskiness in rural economic environment needs more investigation. In fact, Proposition 2 suggests the possibility that two regions may differ in income volatility, which leads to different propensities to migrate. That is, if the implication is true, residents living closer to urban areas must have greater income volatility than the others. Contrary to the speculation, however, the standard deviation

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[23] This assumption will be relaxed in the next section.

[24] The IFLS data show that there is no significant difference in risk preference between these two groups.

[25] The migration rates of the former and the latter are 3.8% and 1.7 %, respectively. These are for first time migrants between 2000 and 2007.

[26] I estimate average marginal effects instead of marginal effects at the means since there are many categorical variables in the model. In this case, a marginal effect is computed for each categorical value, and then all computed marginal effects are averaged.

of the income of the distant rural areas is approximately 35% larger than the comparison group.

Despite the seemingly puzzling aspect of distance effects, the neoclassical theory of migration appears to offer only shallow explanations about this stylized fact. That is, the magnitude of distance effect appears to be much greater than can be explained by an argument of increasing migration costs. The following sections revisit three general explanations of distance effects in the literature, and present more rigorous tests of each possible explanation.

2.5.2. Conventional Explanation of Distance Effects

2.5.2.1. Are transportation costs significant?

In the above exposition, the difference in the direct costs of migration was assumed to be trivial between the two groups of residents. However, the direct costs may not be trivial even for the young, who have a longer life span to recover from the initial costs, and there may be substantial differences in the costs between two regions. One element of direct costs is transportation costs, which may be proxied by travel distance. This is more likely to be true for international migration than for internal migration. An economy class train fare from Jakarta to Purwokerto (395 km. = 245 miles) in Indonesia is less than the total income that can be earned within two days at the minimum wage.[27] Accounting for opportunity costs is not likely to make a big difference as most rural residents can make a trip to nearby big cities within a few

[27] The fare is 40, 000 Rupiah one-way and the lowest minimum wage is 566,485 Rupiah per month in Indonesia in 2007. Source for transportation fare: http://www.kereta-api.co.id/. Source for minimum wage: 2008 country reports on human rights practices, U.S. Department of State. The fare was adjusted using the consumer price index from 2007 to 2011.

days. Moreover, fares are even lower by bus, the most common form of transport in Indonesia. Nevertheless, there may be cases where transport costs are significant even for young migrants with a long lifetime horizon to collect returns to their investment. For instance, frequent return visits may be expected of potential migrants.[28] However, transport costs a few times a year appear to be insignificant in terms of total yearly income in Indonesia. A simple calculation indicates that, for the distance of 395 km., three return visits per year by train cost less than 4% of total yearly income at the minimum wage even after accounting for some opportunity costs.[29] This implies that, from the perspective of the neoclassical theory, migration to cities is rational within a distance of 395 km. if there is at least a 4% gap in income differences between rural and urban areas.

On the other hand, according to the results in **Table 2.3**, even half the distance of 395 km. is associated with a decrease in the marginal propensity to migrate by almost 50%. For instance, residents living 300 km. farther away from cities would have 48% lower propensities to migrate compared with those living in 100 km. away from urban areas. Yet, the above calculation indicates that the difference in transportation costs for a twice longer distance would be only 4% or so higher for the former than for the latter. Moreover, as mentioned above, the expected gain in income of migrants from regions located 350 km. or farther away is approximately 30% higher than that of those moving from regions located within 100 km. from the

[28] It is common that migrants go visit home at least once a year usually during religious holidays like Eid Fitr for Moslems or Christmas for Christians. Even so, some people do not visit home for years.
[29] I assume that migrants visit their home during national holidays, and that opportunity costs occur only once per year.

nearest urban areas in Indonesia. Another simple calculation indicates that transportation costs need to be more than 10 times higher than the actual transportation costs to have a deterrent effect on rural-urban migration. Thus, transport costs alone seem very unlikely to deter migration from distant rural areas.

2.5.2.2. Does distance reflect psychic costs?

On the other hand, costs do not have to be monetary to be incorporated into the neoclassical migration model. Increased distance may reflect increasing psychic costs, although there seems to be no empirical evidence for this conjecture in the literature. This study attempts to control for the effect of psychic costs in two ways. First, ethnicity and language are controlled for in the estimation of migration propensities. This is based on an assumption that substantial part of psychic costs arise from cultural differences, and remote rural residents in Indonesia may be more distinct in such cultural aspects. To this end, ethnic groups were categorized into four groups based on the geographical distribution of ethnic groups. The variable 'ethnic3' indicates the groups that are prevalent in remote rural areas in Indonesia. Language is another control variable included in the model.[30] Second, the elderly may have greater psychic costs; investment in relations with family members and friends is likely to increase with age, and so is the disutility of severing these relations as one gets old. In fact, this is an assumption made by Schwarz (1973) in his study to investigate the significance of psychic costs in migration decisions in the US. Likewise, IFLS data

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[30]Indonesian is the official language and almost all people fluently speak it in Indonesia, but there are many regional languages used at home in rural areas. The variable language3 represents people who speak only Indonesian.

allow one to control for the age-specific psychic costs. Overall this section tests the following hypotheses.

- *People living in distant rural areas are more likely to use languages other than Indonesian and belong to different ethnicities than those who live in or closer to urban areas.*
- *Conditioning on other factors, including distance, people with distinctive languages and ethnicity are less likely to migrate than those who live close to urban areas.*
- *The distance effect diminishes after controlling for ethnicity and languages.*
- *The age effect diminishes after controlling for psychic effects.*

A simple regression result confirms that ethnic groups and language groups are categorized to represent the geographical distribution, which supports the first hypothesis.[31] Nevertheless, regression results show no evidence of significant psychic cost effects on migration. In particular, the distance effects are not weakened by either the inclusion of language variable or its interaction term with distance variable or the ethnic dummies and their interaction terms (Models 1-2 of **Table 2.4**). Similar results are found when including the language variable and its interaction term with distance (Model 3 of **Table 2.4**). Moreover, an inclusion of the interaction term between age and distance does not notably decrease the coefficient of the distance variable (Model 1-3 of **Table 2.4**). The results suggest that distance is likely to be a poor proxy for these kinds of psychic costs, at least for internal migration.

[31] Distance = 3.96 +.07 (language2) – .92 (language3) -.46 (ethnic2) + .37 (ethnic3) - .62 (ethnic4) R^2 = 0.11
t-ratio = (210.35) (1.35) (-16) (-11.76) (7.95) (-11.19) F = 179.45

2.5.2.3. Distance as a proxy for information costs

Increased distance may also reflect increasing information costs. Indeed, the probit regression results (**Table 2.2**) show that the number of prior migrants to urban areas (network) is positively related to the propensity to migrate.[32] Yet, the coefficient on the distance variable is still negative and significant, and its magnitude is unchanged after the migration network effect is controlled for in all models of **Table 2.4**. It is possible that the number of prior migrants does not capture the positive network effect precisely. Also, the migration network variable may be measured with error. Further investigation would be needed to control for some unobserved confounding factors to identify pure network effects. For instance, the effect of the stock of previous migrants may reflect unobserved characteristics of communities or families that are associated with a higher propensity to migrate (Munshi, 2003). Nevertheless, the results suggest that the distance variable may capture some other deterrent effects that outweigh the effect of information benefits from former migrants' networks. For instance, there may be a deterioration of information due to poor telecommunications infrastructure in remote rural areas. This is more likely to be true in less populated islands in Indonesia. **Figure 2.4** shows that nearly all rural areas in Java were covered by a telecom network in 2007 while urban rural disparities in telecom service penetration were more evident in other islands.

2.5.2.4. Empirical Investigation on the Effects of Information Costs

[32] This is consistent with the endogenous moving cost model of migration in the literature (Carrington et al. 1996).

This section tests whether there is any significant difference in the migration propensity between rural areas in Java and other islands using the information on differential telecommunication penetration rates. This test would help determine whether information costs matter in migration decisions. In particular, the following hypothesis is tested using an interaction term between distance and Java and information on a telecommunication law.

- *Migration propensities are higher in remote rural areas of Java than other islands due to better telecommunication infrastructure.*

Table 2.4 shows the first result (Model 5). The coefficient on the interaction term between distance and Java is positive and significant. This implies that residents in distant rural areas in Java are more likely to migrate than residents in other distant rural areas. However, this does not necessarily mean that the telecommunications infrastructure positively affects the migration propensity in Indonesia. Java is one of the most densely populated regions in the world, and information costs there may be less of an issue even without telecommunication networks.

Also, there may be some other unobservable factors that affect both the propensity to migrate and telecommunications penetration rates. For instance, rural areas of Java may have community infrastructure that better facilitates both telecommunications development and the migration process more than other islands of Indonesia. In an attempt to control for such confounding factors, I use the first wave (1993) of the IFLS data to see whether the propensity to migrate is higher from rural areas of Java prior to 2000.[33] This is a reasonable comparison because Indonesia passed a telecommunications law in 1999 that promoted competition and private investment. As a result, the penetration rate of fixed-line and mobile services reached 48% (household) and 55% (population), respectively, as of 2008, which was much higher than the rates in 2000. **Figure 2.5** shows the steep increases in telecommunications penetration rates in Indonesia in recent years.

The regression results show that, contrary to the results for 2000 to 2007 data, there is no evidence that residents in less distant rural areas of Java have greater propensities to migrate to urban areas prior to 2000. Indeed, the interaction term of Java and distance variables has a negative sign, although it is not statistically significant (see Model 2 of **Table 2.5**). The result implies that residents in remote rural areas in Java were not more likely to migrate than residents of other islands prior to 2000. The results, however, should be interpreted with caution since the comparison is not made with a control group. Nonetheless, they support the idea that telecommunication penetration rates positively affect the propensity to migrate, and thus that information costs matter in migration decisions.[34]

2.5.2.5. Is Migration Distance a Good Proxy for Information Costs?

The results, thus far, do not prove that distance is a good proxy for information costs. The distance variable may capture other unobservable factors, and the evidence for positive effects of telecommunication effects does not necessarily mean that distance

[33] **Appendix 2.3** reports the descriptive statistics for the explanatory variables in the 1993-2000 data.
[34] This result is consistent with the recent finding of Muto (2012). He finds that the possession of mobile phone handsets at the household level increases an individual's chance of leaving his or her rural village to find a job.

matters only because of increasing information costs. One way to test this is to use an implication of the information cost approach. That is, higher education weakens the distance effect as educated people are less likely to be restricted by geography in gathering distant labor market information. Empirical evidence for this conjecture can be found in the literature, although it is rare in the context of developing countries (Levy and Wadycki, 1974; Schwartz, 1973).

For instance, Schwartz (1973) acknowledges the role of education in diluting the deterring effect of distance on migration and utilizes it to show that the adverse effect of distance on migration is a diminishing-information phenomenon. To test this implication in the context of Indonesia, one can estimate probit regressions with interaction effects of education dummies with distance. Assuming that education in general increases individuals' capacity to obtain and analyze information using more sophisticated modes of information, one would expect that the slope of the coefficient of interaction terms of higher education to be less steep. Intuitively, the lower the education level, the greater would be the searching cost. Hence, the decrease in migration propensity of the lowest education level should be steeper than others as distance increases. In particular, the following hypothesis can be tested with IFLS data.

- *Higher education weakens the distance effect as educated people are less likely to be restricted by geography in gathering information on distant labor markets.*

Model 5 of **Table 2.4** shows the result to the test. Contrary to expectations, the coefficients on the interaction dummies show the opposite (negative) signs, although they are not statistically significant except that the coefficient on the interaction with the college graduate dummy variable becomes weakly significant (10% significance level) when risk attitude is controlled for (Model 6 of **Table 2.4**). The regression results are similar when migration decisions from the 1993 to 2000 are analyzed (see Model 3 of **Table 2.5**). Both results fail to confirm the conjecture that the deterrent effect of distance on the propensity to migrate is greater for the less educated. It suggests that either distance is not a good proxy for information costs, or that lower search costs due to higher education do not lead to a higher propensity to migrate. For instance, it might be better for the less educated people to do an urban-based job search since vacancies for jobs suited for them are usually filled through employee referrals and gate hiring, whereas people with higher education are less likely to benefit from moving to urban areas to conduct a job search. If this is indeed so, this result may simply be capturing such differential benefits of urban-based job search between these two groups. This argument is not immune to criticism, though. In general, getting a job through a gate hiring process is risky and may not be a desirable option for less educated people, who the data indicate are no more risk loving than more educated people.[35] The true cause of this seemingly counter-intuitive result of education effects is hard to identify using the IFLS data, but the

[35] A simple regression shows that less educated people are more risk averse in Indonesia.

result casts doubt on the belief that distance effects simply reflect the increasing difficulty of gathering information for residents of remote locations.

2.5.3. Alternative Explanations on the Distance Effects

Some may argue that migration may accelerate once it develops momentum, and hence data covering a longer period of time are required to test the validity of the neoclassical model. A good example is the Great Migration of Southern blacks to the North between 1915 and 1960. Migration did not start for many years after the Civil War, despite a considerable income gap between two regions.[36] The results in **Table 2.5** show, however, that distance in Indonesia is significant and negative between 1993 and 2000 as well. Moreover, the smaller magnitudes of the coefficients, compared with the results for later period, do not appear to support the idea that distance effects would become weaker over time.

On the other hand, some may also argue that people make migration decisions based on subjective probability distributions over expected incomes at migration destinations.[37] That is, the perception of potential migrants may be different from the objective information about migration benefits and costs.[38] For instance, Stark (1981) argues that it is not convincing to a rural resident that the objectively higher risk entailed in pursuing migration is rewarded by higher expected income in urban areas;

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[36] Carrington et al. (1996) present a model in which moving costs decrease with stock of previous migrants. It explains well the timing and acceleration of migration. Yet even after controlling for the network effect, distance is still negatively correlated with the migration propensity in Indonesia

[37] Studies based on this assumption are rare. Stark (1981) is the first person to acknowledge the role of the subjective preferences of agents in migration. Mckenzie et al (2012) obtain moments and quantiles of the subjective distribution of expected earnings in the destination country, combining a natural emigration experiment with unique survey data on would-be emigrants' probabilistic expectations about employment and incomes in the migration destination.

[38] In section 2.2.2, these two factors are denoted by θ and F.

it is her subjective risk that counts for her. Stark's insight is compatible with the neoclassical theory of migration to the extent that it does not violate the axioms of the expected utility theory.[39] In fact, his insight is implied by Proposition 1 presented in section 2.2.2. For instance, people living farther away from urban areas might be more pessimistic about their migration benefits, hence demanding greater risk premium to migrate. However, a simple calculation casts doubt on this argument as well. If the estimates of the income gap in section 2.4.2.1 are approximately correct, then the equilibrium condition in the Harris-Todaro model would require that the residents living 250 km farther away expect on average a 23 percentage point higher unemployment rate in urban areas than the residents living within 100 km from urban areas, assuming that the urban wage is exogenously given to both groups. However, an open unemployment rate that is 23 percentage points higher is unreasonably high since Indonesia has never had such an extreme level (see **Figure 2.6**). In reality, of course, would-be migrants may be more interested in current unemployment rates of previous migrants to urban areas, who may have higher unemployment rates. Indeed, IFLS data show that the unemployment rate of those who migrated to urban areas between 2000 and 2007 is 14.2% as of 2007. The rate is approximately 5 percentage points higher than the national unemployment rate in 2007, yet it does not seem to be high enough to deter migration from any region and the gap of 23 percentage point is more than twice greater than its standard deviation. Moreover, a simple regression shows that there is a negative and significant correlation between unemployment rates

[39] There are four axioms of the expected utility theory that define a rational agent. They are completeness, transitivity, independence, and continuity.

of migrants and distance to the nearest cities from their home town. Assuming previous migrants are substantial sources of urban labor market information, the direction of correlation does not appear to support the subjective probability argument. Again, unless some non-linearity is introduced in the perceived expected benefit of migration, the magnitude of the distance effect of migration is not easily explained by the general assumptions of the simple neoclassical theory of migration.

In a sense, this resembles the Ellsberg paradox in that the assumption of subjective expected utility can lead to seemingly irrational human behaviors.[40] To see this, recall the Ellsberg paradox. Suppose there are two urns, each containing 100 balls. Urn I contains 50 red balls and 50 black balls. Urn II contains 100 balls, each of which is known to be either red or black, but there is no information about how many of the balls are red and how many are black. A red bet is a bet that the ball drawn at random is red and a black bet is the bet that it is black. In either case, winning the bet, namely, guessing the color of the ball correctly, yields $100. First, a person is asked, for each of the urns, if he or she prefers a red bet or a black bet. For each urn separately, most people say that they are indifferent between the red and the black bet. Then the person is asked whether he or she prefers a red bet on urn I or a red bet on urn II. Many people say that they would strictly prefer to bet on urn I, the urn with known composition. The same pattern of preferences is exhibited for black bets. That is, people seem to prefer betting on an outcome with a known probability.

[40] The expected utility hypothesis was originally formulated to be used with objective probabilities. Not all uncertainties, however, can be described by objective probability distributions. Some scholars who support the expected utility theory interpret the probability as a numerical expression of beliefs. This view is inconsistent with the Ellsberg paradox.

Likewise, the distance effect in the migration decision may reflect the degree of uncertainty people face in migration decisions. That is, people living in distant rural areas may perceive the urban labor market in a way similar to their view of the urn with unknown composition. People living in areas close to urban areas, to the contrary, are more likely to have a better idea about urban labor markets, hence showing greater propensities to migrate. This may account for the unexplained part of distance effects under the paradigm of the neoclassical migration theory. To see this, consider the way that the pattern of choices described by the Ellsberg paradox diverges from the premise of the expected utility maximization. In particular, the subjective probabilities people may have in mind would have to reflect the belief that it is more likely that a red ball will be drawn from urn I than from urn II, and that it is more likely that a black ball will be drawn from urn I than from urn II. This is impossible for any specification of subjective probabilities because in each urn the probabilities of the two colors have to add up to one. Thus, Ellsberg's findings suggest that many people are not subjective expected utility maximizers.

Likewise, perceived expected benefits of migration seem to diminish with distance more rapidly than can be explained by the simple neoclassical theory of migration. It suggests a possible deviation from the expected utility theory. Following Klibanoff et al (2005), if one hypothesizes that agents are ambiguity averse and perceive more ambiguity with increased distance, then this could explain the negative distance effect from a different angle. Testing this hypothesis could best be done with some experimental survey data on attitudes toward ambiguity (eg. Engle-Warnick et al. 2011) as well as rich household survey data including migration information. Unfortunately, such experimental survey data are not available from the IFLS.

Regardless of the validity of this analogy, the magnitude of distance effects in migration decisions, according to the findings of this study, appear to be inconsistent with the neoclassical theory of migration. Yet, few attempts have been made in the literature to view the determinants beyond the paradigm of the human capital theory of migration.

2.5.4. Education Will Tend to Increase Migration

The positive effect of education shown in **Table 2.2** (Model 1) is another implication of the human capital theory of migration. One may be tempted to draw some policy implications from this stylized fact, if for some reason rural-urban migration needs to be encouraged in certain areas.[41] The positive effect of education, however, does not mean that efforts to promote education will necessarily lead to a higher rate of migration from rural areas.[42] An effective test of education effects on migration propensities would necessarily involve identification of the causal effects of education. Several difficulties in verifying the causal effects of education arise because there may be some unobservable factors that affect both the propensity to migrate and the decision to get higher education (i.e., positive selection). For instance, innate abilities or attitudes toward risk may influence both the propensity to migrate

[41] For instance, agricultural land in the highlands may be severely degraded and cannot support the present size of the rural population. Or public forests in the valleys and lowlands are threatened by the expansion of agriculture (See Anderson, 2002 for more discussion)

[42] Also, higher migration of the educated may not lead to a reduction of regional income disparities and an increase in welfare in distant rural areas. The opposite may be true. See Fan and Stark (2008) for the conceptual model.

and the decision to obtain higher education. If we assume that credit constraints are an important factor in both decisions, we can also expect that family wealth is another confounding factor that needs to be controlled for in migration decision models of empirical studies. The base probit regression in **Table 2.2** (Model 1) controls for the family wealth effect using total family yearly income, but the variable may simply capture the lower propensity to migrate of the land holders.

To further investigate these issues, one can run additional regressions with variables for risk attitudes and land possession. A simple regression reveals that more educated people are more risk loving than the less educated, and the result is statistically significant.[43] Yet the results of regressions with risk attitudes and land possession variables do not show much difference from the base model. Risk attitude dummies do not have any significant effects on the propensity to migrate, and higher education is still significantly correlated with the propensity to migrate (Model 3 of **Table 2.6**). When education years replaced the education dummies, however, a dummy for the most risk-averse attitude becomes weakly significant (Model 5 of **Table 2.6**). Overall, inclusion of the dummy for land possession and the risk attitude variables does not change the effect of education significantly, although the coefficients on education variables become slightly smaller.

2.5.4.1. Conventional Explanation on the Education Effects

Although the results in **Table 2.6** seem consistent with the prediction of the neoclassical model, a question remains as to *why* education is positively correlated

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[43] Risk loving = 2.16 -.209(female) -.004(age) +.002(years of education) $R^2 = 0.01$
t-ratio = (133.2) (-19.1) (-10.5) (9.0) F =199.25

with migration propensities. This section empirically tests the validity of three of the possible neoclassical explanations that were discussed in section 2.3.2. One is that the more educated are less credit constrained and thus less likely to be prevented from investing in migration to change their economic conditions. Second, education may decrease the information cost incurred by geographical deterrence. Finally, the returns to higher education are generally low in the rural areas of most developing countries, so it may be necessary for rural residents to move to a metropolitan area to reap the monetary rewards of higher education. Empirical studies testing these explanations are rare, although identification of true causes has significant importance for policy makers. For instance, information programs could be useful tools for officials who seek to alter the spatial patterns of migration if the second explanation is valid. Alternatively, investing in rural credit markets may be more important when migration tends to be deterred by credit constraints faced by the less educated, assuming policy makers intend to encourage migration.

The first explanation claims that less educated people are financially more constrained and thus less likely to migrate than more educated people. Migrants may need to be supported by their family as they go through a period of recovery defined in section 2.2.[44] This implies that family wealth has positive effects on migration. The explanation, thus, offers two testable hypotheses:

- *People from wealthier families (with more liquid assets) are more likely to migrate.*

[44] The initial costs of migration in this section are different from the transportation costs discussed in section 2.5.2.1. In general, transportation costs are assumed to depend on distance in the literature while other monetary costs are not.

- *The education effect diminishes as family wealth is controlled for.*

As shown in the previous section, regression results indicate that family yearly income is negatively correlated with the propensity to migrate. While family yearly income may not be a good proxy for family wealth, the results are similar even after the variable ‘land holder’ is controlled for (Model 3,4,5 in **Table 2.6**). The results also show that the education effect does not diminish significantly when family income is controlled for (Model 1) in **Table 2.6**. Since there is no evidence that limited financial capacity inhibits rural-urban migration in Indonesia, the first explanation can be excluded from the investigation.

Two testable hypotheses can be derived from the second explanation as follows:

- *Less educated people are more likely to migrate sequentially (due to lack of information).*
- *Higher education weakens the distance effect as educated people are less likely to be restricted by geography in gathering distant labor market information.*

The first hypothesis is tested using probit regressions of sequential migration between 2000 and 2007 **(Table 2.7)**. Sequential migrants in the models are defined to be the ones who migrated multiple times between 2000 and 2007. Model 1 presents regression results for sequential migrations to all destinations while Models 2 and 3 show sequential migrations to big cities and home, respectively. The IFLS data show that, among rural-urban migrants, only 53% remained in the initial migration destinations while 20% moved to other big cities within 3 years between 2000 and 2007. The remaining migrants either moved to other rural areas or returned home. The results of Model 1 appear to support the first hypothesis in that more education is associated with a smaller propensity to migrate sequentially. However, more investigation is needed since the results do not necessarily prove that sequential migrations are mainly caused by insufficient information at initial migration decisions. In fact, Model 2 shows opposite results, indicating that more educated people are more likely to migrate sequentially to other big cities. Model 3 also shows no firm evidence that more education is associated with a lower propensity to return home.

The second hypothesis was tested in section 2.4.1.3, and the results do not support the explanation that education reduces information costs. This implies that there are other significant deterrent effects in migration decisions that outweigh the effects of information and the capacity to collect it. Overall, investigations of the data seem to be unfavorable to the second explanation, at least in Indonesia.

A comparison of both the level and growth rates of the mean incomes of the two groups provides evidence for the third explanation. In particular, between 2000 and 2007, the growth of real income of male college graduates in cities is much higher than that found in rural areas (**Table 2.8**). The mean income growth of the former is approximately 40 percentage points higher than that of the latter for males and 15 percentage points for female workers with college education in urban areas (**Table 2.9**). This seems to be consistent with the third explanation, that college graduates can expect higher rewards for their education in cities than in rural areas of Indonesia.

2.5.4.2. Rationality of Rural-Urban Migration

To investigate further and test the validity of the third explanation, one can compare returns to education between urban and rural areas. Higher returns to education in urban areas would support the third explanation. However, there are two concerns with this test. First, high urban wages found in many countries may induce low-skill workers to migrate to low-productivity city jobs and unemployment, who might otherwise be more productive in rural sectors (Lucas, 1997; McCormick and Wahba, 2005). If this is true, then estimations of returns to education may be misleading when a full urban sample is used. Moreover, returns to education of previous migrants may be more important information in migration decisions. Another concern with this test is that it is based on an assumption that migrants correctly expect their earnings post migration. However, perceived returns and actual returns to education may differ. For instance, Jensen (2010) finds that there is discrepancy between the measured returns to schooling in the Dominican Republic and the returns perceived by students. He shows that students at randomly selected schools given information on the higher measured returns had higher perceived returns when re-interviewed 4 to 6 months later. Furthermore, they completed on average 0.20–0.35 more years of school over the next four years than those who were not. Likewise, returns to education perceived by migrants may be different from measured returns of the full sample.

To circumvent these issues, this section compares the returns to education of migrants and stayers, and tests whether migrants and nonmigrants make rational migration decisions consistent with the prediction of the theory. In particular, using Heckman's (1979) two step procedure, it tests the following hypothesis is tested.

- *Expected returns to higher education are greater for migrants than for stayers.*

Heckman's self selection model recognizes the existence of measured and unmeasured heterogeneous skills among agents. Denoting by y_m^i the log wages of migrants and by y_n^i those of nonmigrants, the two earnings equations can be written as

$$(2.4) \qquad y_m^i = \gamma_m X_m^{i'} + \varepsilon_m^i$$

$$(2.5) \qquad y_n^i = \gamma_n X_n^{i'} + \varepsilon_n^i,$$

where γ_m and γ_n are vectors of exogenous variables.

When standard Heckman (1976, 1979) sample selection bias correction formulae are used, the expected values of the wage data for migrant (i) and nonmigrant (j) are

$$(2.6) \qquad E\left(y_m^i \middle| \mathrm{G_i} > 0\right) = \gamma_m X_m^{i'} + \theta_m \mu_m^i,$$

$$(2.7) \qquad E\left(y_n^j \middle| \mathrm{G_j} \leq 0\right) = \gamma_n X_n^{j'} + \theta_n \mu_n^j,$$

where $\mathrm{G_i}$ is a latent variable that represents gains to migration, and

$$(2.8) \qquad \theta_m = \frac{\sigma_{\eta m}}{\sigma_\eta}, \ \theta_n = \frac{\sigma_{\eta n}}{\sigma_\eta}$$

Unbiased estimates of γ_m and γ_n can be obtained by OLS only when $\theta_m = 0$ and $\theta_n = 0$, respectively. The selectivity control variables μ_m^i and μ_n^j are denoted as follows

(2.9) $\mu_m^i = \frac{f(\gamma' Z_i)}{F(\gamma' Z_i)}, \mu_m^i = \frac{-f(\gamma' Z_i)}{1 - F(\gamma' Z_i)},$

where $F(\gamma' Z_i)$ is the cumulative density function such that $F(\gamma' Z_i) = \Pr(M_i > 0)$ and $f(\gamma' Z_i)$ is the density of the normal distribution.

To predict the wage gains to migration for each education group, however, requires the counterfactual earnings of migrants of each group. For migrant i, the wage gain equals the expected wage in the migration regime less that in the nonmigration regime, conditional on the fact that the agent is a migrant. Following Davanzo and Hosek (1981) and Tunali (2000), I obtain the counterfactual wage by means of the consistent estimates of γ_n, θ_n, and μ_n:

(2.10) $E(y_n^i | G_i > 0) = \gamma_n X_n^{i'} + \theta_n \mu_n^i$

Thus, a migrant's expected wage gain from migration equals

(2.11) $E(y_m^i | G_i > 0) - E(y_n^i | G_i > 0),$

which compares the migrant's predicted wage in the migration regime with her predicted counterfactual wage in the nonmigration regime. A nonmigrant's expected wage gain from staying can also be estimated by

(2.12) $E(y_n^i | G_i \leq 0) - E(y_m^i | G_i \leq 0),$

which compares the nonmigrant's predicted wage in the nonmigration regime with her predicted counterfactual wage in the migration regime. Comparing the expected gain for each educational group, one can test the rationality of migration based on the assumption of the third explanation. **Table 2.10** shows that results of earnings regressions estimated by the Heckman two step procedure. The regression results of the selection equations are presented in the **Appendix 2.4**. As exclusion restrictions, the variable "married" is included for probit regressions for both migrants and stayers. In addition, the variable "land" is included in the selection model of migrants. Intuitively, urban income is less likely to be affected by the possession of land in rural areas while it affects the migration propensities. The regression results are found to be consistent with this conjecture.

The results show that the coefficients on the education dummies have all expected signs and magnitudes, and the results are consistent across all models. Assuming the coefficients on the education dummies properly estimate differential returns to education for each education group in urban and rural areas, the results appear to be consistent with the hypothesis that college graduates have greater incentives to migrate to urban areas in Indonesia between the years 2000 and 2007. In particular, migrants with college education in 2007 have roughly 35% greater returns to education than those in rural areas. The gain in returns is comparatively greater than migrants with high school education, and the opposite is true for migrants with middle school education. The results are consistent when education dummies are replaced with education years (**Appendix 2.5**). Overall, these results appear to support the third explanation that migration of people with higher education is motivated by the rural-urban difference in returns to education.

While the above test results are supportive of the assumption, the test is based on one period of time (2000 -2007) and may not justify the assumption that migrants have correct expectations on their earnings post migration. Ideally, to justify the assumption, one would need data showing historical variations in returns to education as well as changes in migration propensities. This study instead utilizes three waves of survey data and tests the following hypothesis.

- *The increase in migration propensities between 1993-2000 and 2000-2007 is greater for more educated people*
- *The growth in returns to higher education is greater for migrants than stayers.*

Greater growth rates in returns to higher education for migrants would support explanation 3, given that the increase in migration propensities between 1993-2000 and 2000-2007 is greater for more educated people.

In fact, **Table 2.11** shows supportive results. A comparison of migration propensities between two periods (1993-2000 and 2000-2007) indicates that the growth in migration propensities is greater for more educated groups. It shows that one year of education is associated with a *marginal* increase of migration propensities by 0.2% between 2000 and 2007, which is twice the increase in propensities between 1993 and 2000. On the other hand, growth in returns to education appears to decrease between 2000 and 2007, compared with the growth rate between 1993 and 2000. The results are consistent at all education levels, regardless of migrants or stayers. The decrease, however, appears to be much greater for rural stayers than migrants to urban areas. In other words, there is *relatively* a greater incentive to migrate to urban areas for more educated people. Results are consistent whether the estimation models use categorical variables or continuous variables for education levels. Again, the results support the third explanation that there are greater economic gains from migration for more educated people. The results are in contrast with the findings of other studies which fail to find significant economic gains to migrants post migration (Davanzo and Hosek, 1981; Tunali, 2000).

The results of this test also provides evidence for a related yet alternative view that cities are places for accumulating human capital (Glaeser and Mare, 2001; Lucas, 2004). According to this view, benefits of cities accrue over time and the urban wage premium is a wage growth effect rather than a wage level effect. If we adopt this model, then the coefficients of education variables would be returns to investment to human capital for each educational group. For instance, each additional year of education is associated with an accumulation of a 5 times greater earnings premium for migrants, compared with rural stayers, during the period of 2000 and 2007. More intuitively, educated workers may particularly benefit from skill spillovers in urban areas, where human capital accumulation is accelerated by a greater share of educated workers (e.g. Glaeser 1999; Glaeser and Mare 2001).

While this section presents supportive results for one of the neoclassical explanation, there are some caveats to be noted. First, ideally one needs to account for confounding factors such as ambition and motivation as well as risk attitudes.

Assuming these factors count, the returns to education of migrants may have been somewhat overestimated. Also, there still remains, as discussed in section 2.4.1.3, the question of why the more educated people are systematically less likely to migrate than the less educated as distance increases from urban areas (Model 3 of **Table 2.7**).[45] The results are consistent when education years are used instead of education dummy variables (Model 4 of **Table 2.7**). They, again, imply that the reality described by the data is not as straightforward as it is explained by the human capital theory of migration. Among three explanations on education effects, this study finds some evidence for only one of them and opens avenues for future research.

2.6. Conclusion

There is an extensive literature on migration, and many studies are still based on the foundation of the human capital investment theory of migration. This framework has been very useful for both its simplicity and its ability to explain some of the empirical regularities in the migration process. However, the assumptions on which it is based on appear to be strong and unrealistic. This study revisits the implications of the neoclassical migration paradigm and tests the robustness of the foundation. In particular, neoclassical explanations for two stylized facts were scrutinized with rich data from three waves of IFLS. Surprisingly, contrary to conventional assumptions in the literature, the results cast doubt on the validity of many of those explanations. In particular, this study finds no evidence for the validity of the general explanation that

[45] IFLS data show that 2.5% of rural population (between 18 and 65) are college graduates.

migration distance is a proxy for transportation costs, psychic costs, or information costs. Among possible three explanations for positive education effects, this study finds evidence for only one of them and leaves room for future research (See **Table 2.12**). The findings of this study even challenge the general view in the neoclassical theory of migration and stress the need for new migration models. Some of the findings in this study shed light on the role of subjective aspects such as perception, confidence, and pessimism in migration decisions, which have been neglected in the literature.

Figure 2.1: Returns on Securities in a Deterministic and a Stochastic World

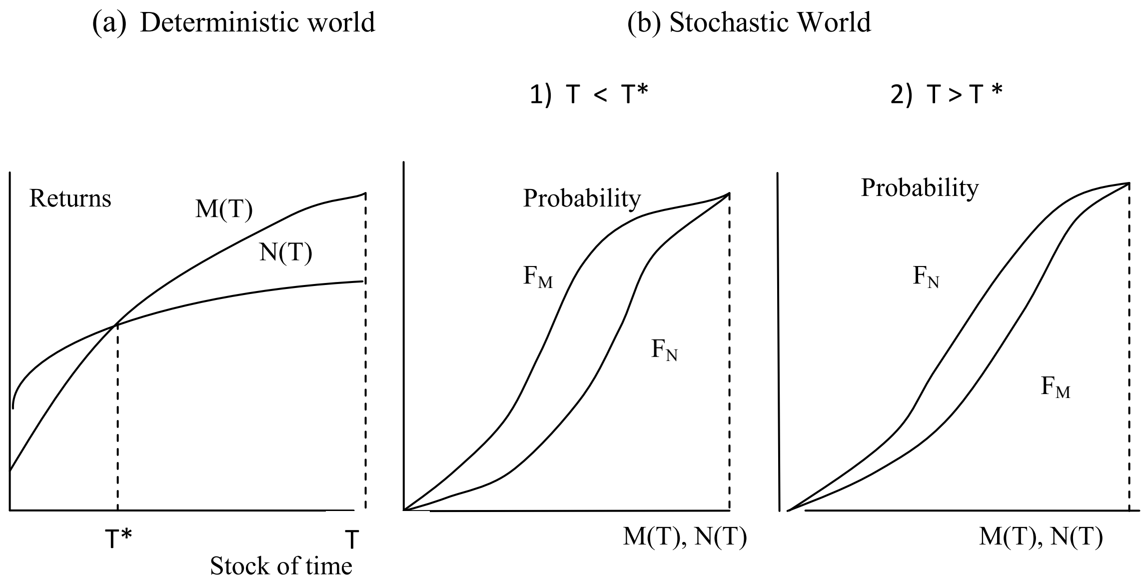
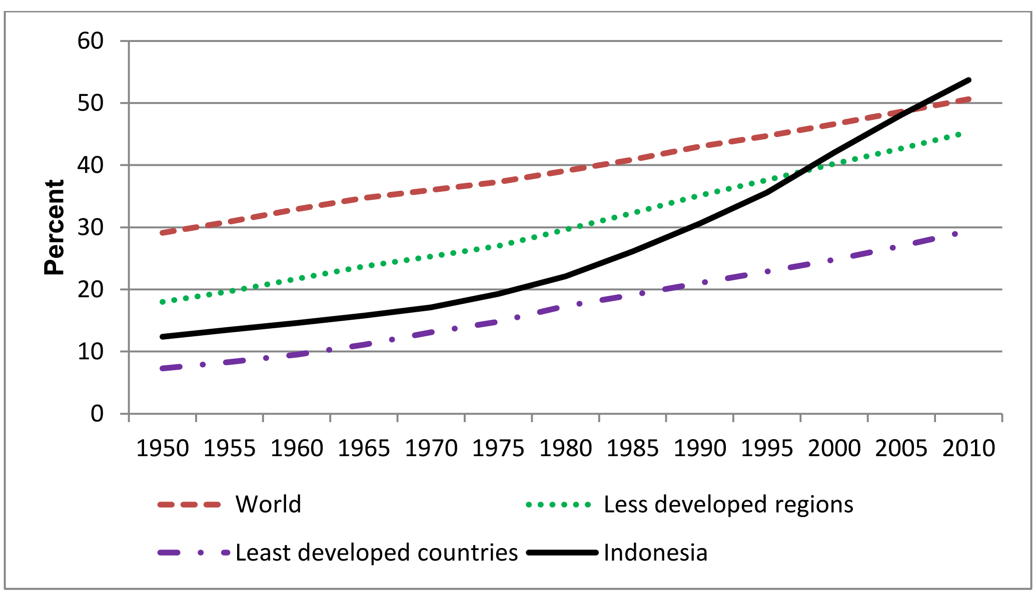
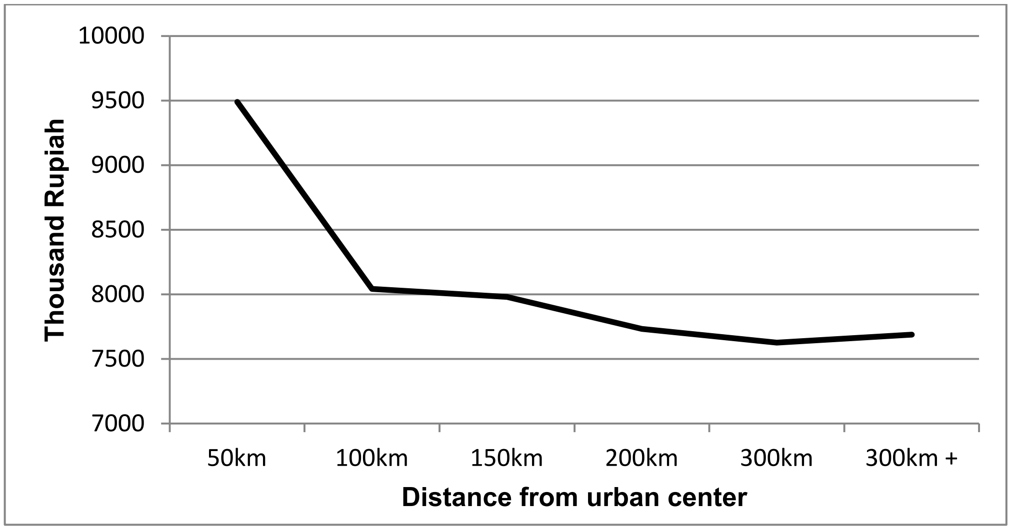


Figure 2.2: Urban Population as a Percentage of the Total Population 1950-2010



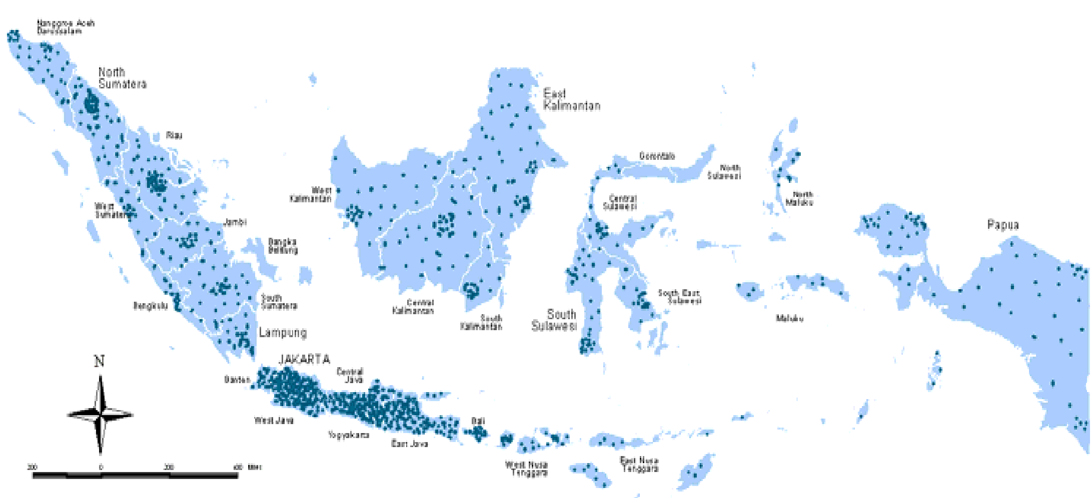
Source: United Nations, World Urbanization Prospects (2007)

Figure 2.3: The Cumulative Distribution of Mean Rural Income by Distance in 2007



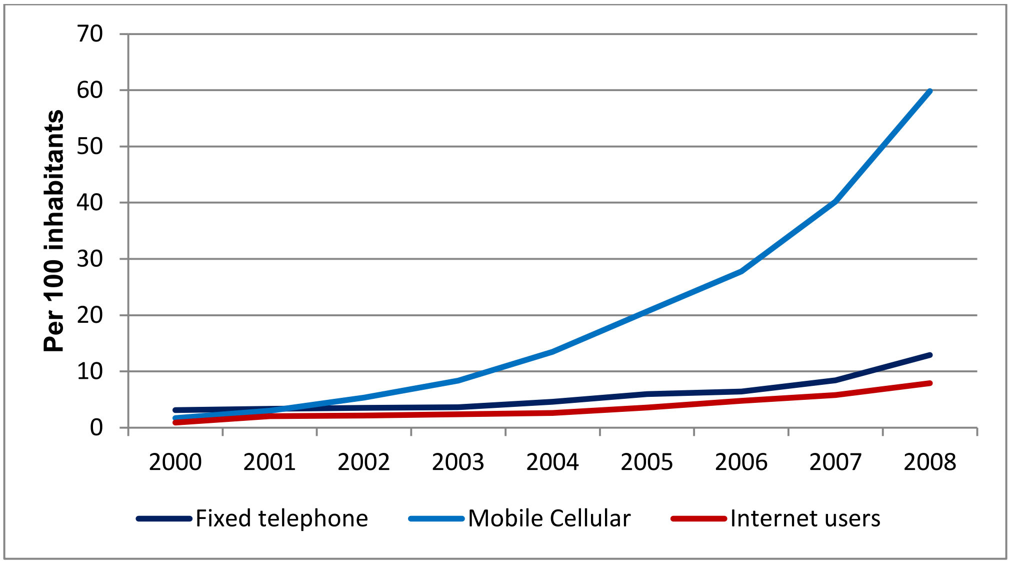
Source: IFLS

Figure 2.4: Telecommunication penetration rates of Indonesia



Source: Sura 2007

Figure 2.5: Telecommunication Penetration Rates in Indonesia.



Source: ITU 2007, Asian ICT indicators database

Figure 2.6: The unemployment rate of Indonesia

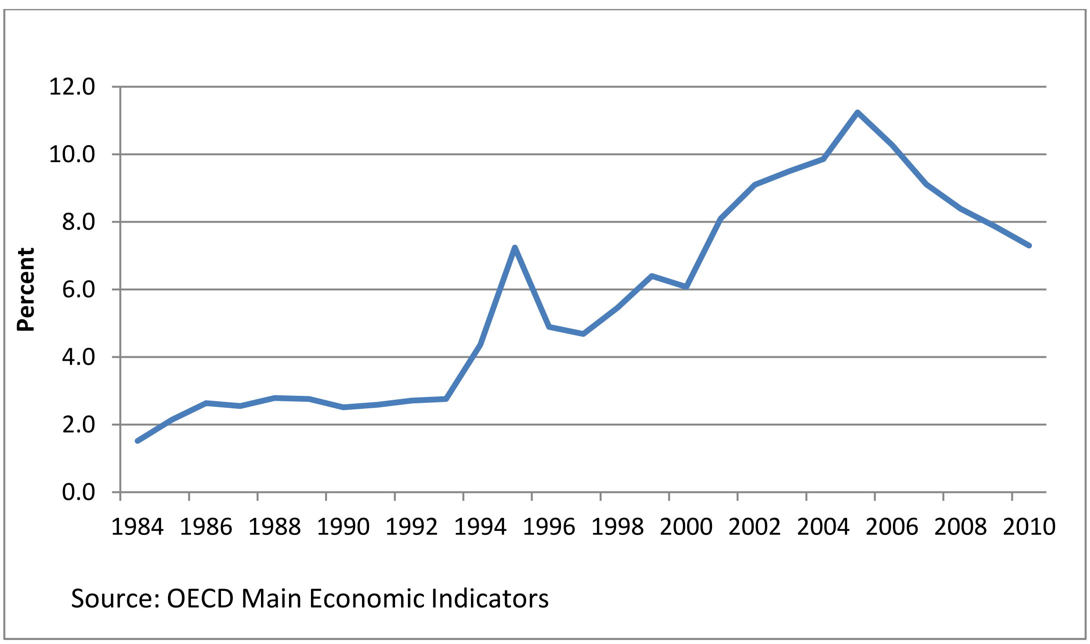


Table 2.1: Definitions of Explanatory Variables and Descriptive Statistics

Abbreviation	Definition		
Dependent Var		Mean	St.Dev
city00-07	Migrated to big cities between 2000 and 2007	0.035	0.184
city93-00	Migrated to big cities between 1993 and 2000	0.027	0.185
Sequential migration	Migrated sequentially to any location between 2000 and 2007	0.471	0.499
Other city	Migrated sequentially to other big cities between 2000 and 2007	0.231	0.382
Return migration	Returned to the place of origin between 2000 and 2007	0.201	0.332
Personal			
Educational			
Elementary	1 if education is higher than elementary school (reference)	0.402	0.490
middle school	1 if education is above elementary school but less than high school	0.199	0.399
high school	1 if education is above middle school but below college	0.275	0.446
University	1 if education is higher than college	0.125	0.330
Demographic			
married	1 if married	0.425	0.494
age	age in years	37.612	11.009
female	1 if female	0.492	0.500
ethnic 1	1 if Javanese (reference)	0.418	0.493
ethnic 2	1 if Sundanese	0.124	0.330
ethnic 3	1 if other ethnic groups prevalent in remote rural areas	0.279	0.448
ethnic 4	1 if other ethnic groups	0.179	0.383
language 1	1 if speak Javanese or Sundanese other than Indonesian (reference)	0.476	0.499
language 2	1 if speak other languages at home	0.407	0.461
language 3	1 if speak only Indonesian	0.117	0.133
Vocational			
self employed	1 if self employed	0.356	0.479
government	1 if government worker	0.068	0.251
private	1 if private worker	0.332	0.471
unpaid	1 if unpaid family worker (reference)	0.125	0.331
casual[1]	1 if casual worker	0.119	0.324
Behavioral			
time preference 1	least patient (reference)	0.661	0.473
time preference 2	Patient	0.279	0.448
time preference 3	most patient	0.060	0.237
risk attitude 1	most risk averse (reference)	0.378	0.485
risk attitude 2	risk averse	0.402	0.490
risk attitude 3	risk loving	0.145	0.352
risk attitude 4	most risk loving	0.074	0.262
Family			
family income (ln)	logarithm of total family yearly income	15.446	1.194
land possession	1 if land holders	0.316	0.328
Village			
earnings gap	mean income of the closest metro city[2] minus that of kecamatan of origin	2.276	4.778
standard deviation gap	Income standard deviation of the closest metro city minus that of kecamatan	0.848	0.695
Network	# of previous migrants prior to 2000 from kecamatan of residency to big cities	7.517	7.740
distance (km)	travel distance by a car to the center of the closest metro city	83.454	82.001
Island			
Java island	1 if Java island	0.725	0.447

Source IFLS.* All variables were measured prior to any migration except risk aversion and time preference variables, which were available only in 2007 IFLS data. 1) Casual workers are defined to be people who supply services on an irregular or flexible basis. 2) Cities with population of one million or larger.

Table 2.2: Base Probit Regression Results of Rural-Urban Migration (2000-2007)

	Model 1	Model 2
Dependent Variable	City00-07	City00-07
Personal		
Educational		
middle school	0.096	0.103
	(1.504)	(1.109)
high school	0.378***	0.380***
	(5.558)	(4.490)
university	0.448***	0.457***
	(4.707)	(4.096)
Demographic		
married	-1.131***	-1.101***
	(-16.074)	(-13.727)
age	-0.014**	-0.013***
	(-2.572)	(-3.581)
female	-0.330***	-0.338***
	(-5.715)	(-4.511)
Vocational		
self employed	0.235	0.292
	(1.380)	(1.504)
government	0.162	0.257
	(0.785)	(1.175)
private	0.525***	0.526***
	(3.065)	(2.766)
casual	0.301	0.326
	(1.540)	(1.585)
Family		
family income	-0.073***	-0.075**
	(-3.396)	(-2.533)
Village		
earnings gap	-0.049***	-0.038***
	(-3.204)	(-2.991)
standard deviation gap	0.01	0.012
	(0.187)	(0.260)
network	0.013***	0.011***
	(3.336)	(2.860)
distance (ln)	-0.143***	
	(-4.643)	
distance < 100 km.		-0.360***
		(-3.942)
distance < 150 km.		-0.405***
		(-4.006)
distance < 300 km.		-0.318***
		(-3.118)
distance > 300 km.		-0.837**
		(-2.005)
Island		
Java island	-0.142*	-0.006
	(1.741)	(-1.408)
constant	0.794	
	(1.405)	
Obs	6696	6696
Pseudo R-2	.24	.24

* p<0.05, ** p<0.01, *** p<0.001, All standard errors were adjusted for within cluster dependence.

Table 2.3: Distance Predicted Probabilities of Migration to the Closest Metro Cities.

Distance to the closest metro city	50km.	100km.	150km.	200km.	300km.
The probability of migration to the closest metro city	4.7%	4.0%	3.7%	3.2%	2.1%
delta method standard error	0.3%	0.2%	0.2%	0.4%	0.7%
The decrease in relative probabilities	-	15.2%	21.1%	31.4%	55.6%

Note: The predicted probabilities and standard errors are based on probit estimations of average marginal effects.

Table 2.4: Probit Regressions for Investigating the Distance Effects (2000-2007)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Dependent Variable	City00-07	City00-07	City00-07	City00-07	City00-07	City00-07
Personal						
Educational						
middle school	0.095	0.095	0.090	0.134	0.382	0.517*
	(1.023)	(1.023)	(0.966)	(1.458)	(1.304)	(1.688)
high school	0.377***	0.377***	0.358***	0.441***	0.745***	0.896***
	(4.623)	(4.623)	(4.375)	(5.417)	(2.876)	(3.275)
university	0.450***	0.450***	0.436***	0.505***	0.962***	1.046***
	(4.015)	(4.015)	(3.832)	(4.490)	(3.069)	(3.217)
distance * middle school					-0.064	-0.089
					(-0.864)	(-1.156)
distance * high school					-0.082	-0.112
					(-1.235)	(-1.609)
distance * university					-0.136	-0.150*
					(-1.561)	(-1.678)
Demographic						
married	-1.095***	-1.093***	-1.098***	-1.134***	-1.134***	-1.144***
	(-15.488)	(-15.467)	(-15.601)	(-15.955)	(-15.850)	(-15.640)
age	-0.013	-0.014	-0.014	-0.011***	-0.011***	-0.009**
	(-1.410)	(-1.442)	(-1.510)	(-2.660)	(-2.662)	(-2.183)
female	-0.340***	-0.337***	-0.342***	-0.331***	-0.331***	-0.320***
	(-5.872)	(-5.811)	(-5.952)	(-5.668)	(-5.652)	(-5.234)
ethnic group 2	0.084	-0.211	0.074			
	(0.889)	(-0.791)	(0.777)			
ethnic group 3	0.148	0.245	-0.046			
	(1.527)	(0.980)	(-0.349)			
ethnic group 4	0.084	0.477	-0.093			
	(0.747)	(1.177)	(-0.618)			
age*distance	0.000	0.000	0.000			
	(-0.017)	(-0.008)	(0.111)			
ethnic group 2 * distance	0.092					
	(1.226)					
ethnic group 3 * distance	-0.027					
	(-0.427)					
ethnic group 4 * distance	-0.136					
	(-1.011)					
language 2			-0.567**			
			(-2.258)			
language 3			-0.108			
			(-0.363)			
language 2 * distance			0.094			
			(1.291)			
language 3 * distance			0.034			
			(0.412)			
Vocational						
self employed	0.307*	0.307*	0.287*	0.235	0.247	0.319*
	(1.764)	(1.767)	(1.647)	(1.363)	(1.437)	(1.732)
government	0.264	0.268	0.262	0.161	0.187	0.256
	(1.265)	(1.288)	(1.243)	(0.779)	(0.899)	(1.167)
private	0.547***	0.546***	0.526***	0.506***	0.515***	0.588***
	(3.104)	(3.105)	(2.968)	(2.923)	(2.982)	(3.177)
casual	0.351*	0.346*	0.32	0.27	0.278	0.370*
	(1.789)	(1.763)	(1.615)	(1.360)	(1.403)	(1.755)
Behavioral						
risk attitude 2						0.034

						(0.425)
risk attitude 3						0.073
						(0.921)
risk attitude 4						0.162
						(0.955)
Family						
family income	-0.075**	-0.076**	-0.081**	-0.114***	-0.114***	-0.119***
	(-2.268)	(-2.293)	(-2.429)	(-3.564)	(-3.549)	(-3.586)
Village						
earnings gap	-0.038***	-0.039***	-0.038**	-0.048***	-0.048***	-0.051***
	(-2.596)	(-2.651)	(-2.560)	(-3.110)	(-3.131)	(-3.079)
standard deviation gap	0.03	0.02	0.016	0.017	0.01	0.005
	(0.565)	(0.360)	(0.302)	(0.313)	(0.190)	(0.098)
network	0.011***	0.011***	0.007	0.011***	0.011***	0.011**
	(2.578)	(2.609)	(1.619)	(2.593)	(2.602)	(2.502)
distance (ln)	-0.144*	-0.147*	-0.228**	-0.221***	-0.160**	-0.171**
	(-1.720)	(-1.667)	(-2.262)	(-3.911)	(-2.454)	(-2.520)
Island						
Java island	-0.075	-0.087	-0.031	-0.584**	-0.598**	-0.747***
	(-0.755)	(-0.867)	(-0.340)	(-2.322)	(-2.375)	(-2.938)
Java * distance				0.118*	0.120*	0.156**
				(1.874)	(1.916)	(2.442)
constant	0.705	0.753	1.325**	1.766***	1.526**	1.453**
	(1.143)	(1.214)	(2.015)	-2.952	-2.475	(2.271)
obs	6696	6696	6696	6696	6696	6696
Pseudo R-2	.25	.25	.25	.25	.25	.25

* p<0.05, ** p<0.01, *** p<0.001, All standard errors were adjusted for within cluster dependence. The omitted ethnic group is Javaneses and the omitted language is Javanese and Sundanese.

Table 2.5: Probit Regression Results of the Propensity to Migrate (1993-2000)

	Model1	Model2	Model3
Dependent variable	City93-00	City93-00	City93-00
Personal			
Educational			
middle school	0.261***	0.257***	0.304
	(2.983)	(2.934)	(1.272)
high school	0.318***	0.312***	0.215
	(3.990)	(3.898)	(1.012)
university	0.346***	0.338***	0.680**
	(3.097)	(3.004)	(2.500)
middle school * distance			-0.013
			(-0.193)
high school * distance			0.031
			-0.548
university * distance			-0.124
			(-1.478)
Demographic			
married	-0.209***	-0.207***	-0.209***
	(-2.804)	(-2.773)	(-2.798)
age	-0.017***	-0.017***	-0.017***
	(-4.437)	(-4.447)	(-4.428)
female	0.011	0.01	0.008
	(0.184)	(0.167)	(0.143)
Vocational			
self employed	-0.228*	-0.230*	-0.231*
	(-1.913)	(-1.931)	(-1.936)
government	-0.267	-0.266	-0.260
	(-1.375)	(-1.370)	(-1.338)
private	-0.119	-0.119	-0.117
	(-1.068)	(-1.068)	(-1.051)
Family			
yearly income	0.005	0.005	0.005
	(1.484)	(1.492)	(1.498)
Village			
distance(ln)	-0.098***	-0.066	-0.094**
	(-3.777)	(-1.287)	(-2.376)
Island			
Java island	-0.047	0.113	-0.043
	(-0.596)	(0.454)	(-0.545)
Java * distance		-0.041	
		(-0.693)	
constant	-1.138***	-1.263***	-1.164***
	(-6.315)	(-4.851)	(-5.588)
Obs	8451	8451	8451
R-2	.11	.11	.11

* p<0.05, ** p<0.01, *** p<0.001, The information on the number of former migrants and casual workers are not available. All standard errors were adjusted for within cluster dependence.

Table 2.6: Probit Regressions for Investigating the Education Effects (2000-2007)

	Model 1	Model 2	Model 3	Model 4	Model 5
Dependent variable	City00-07	City00-07	City00-07	City00-07	City00-07
Personal					
Educational					
middle school	0.088	0.134	0.128	0.546*	
	(0.969)	(1.458)	(1.335)	(1.816)	
high school	0.367***	0.441***	0.432***	0.853***	
	(4.488)	(5.417)	(5.123)	(3.174)	
university	0.435***	0.505***	0.497***	1.045***	
	(4.079)	(4.490)	(4.367)	(3.247)	
education years					0.099***
					(3.408)
Demographic					
married	-1.089***	-1.134***	-1.147***	-1.149***	-1.153***
	(-14.008)	(-15.955)	(-15.513)	(-15.414)	(-13.514)
age	-0.016***	-0.011***	-0.011***	-0.011***	-0.013***
	(-4.242)	(-2.660)	(-2.756)	(-2.767)	(-3.203)
female	-0.355***	-0.331***	-0.369***	-0.368***	-0.402***
	(-4.877)	(-5.668)	(-6.075)	(-6.049)	(-4.969)
middle school * distance				-0.111	
				(-1.421)	
high school * distance				-0.114	
				(-1.636)	
university * distance				-0.160*	
				(-1.755)	
education years * distance					-0.014*
					(-1.705)
Vocational					
self employed	0.518***	0.235	0.358*	0.377**	0.34
	(2.663)	(1.363)	(1.934)	(2.032)	(1.555)
government	0.460**	0.161	0.284	0.317	0.303
	(2.096)	(0.779)	(1.298)	(1.447)	(1.251)
private	0.742***	0.506***	0.538***	0.554***	0.516**
	(3.891)	(2.923)	(2.857)	(2.937)	(2.391)
casual	0.520**	0.27	0.347*	0.358*	0.323
	(2.529)	(1.360)	(1.659)	(1.712)	(1.395)
Behavioral					
risk attitude 2			0.001	0.001	0.043
			(0.016)	(0.010)	(0.517)
risk attitude 3			0.034	0.034	0.07
			(0.425)	(0.428)	(0.860)
risk attitude 4			0.258	0.246	0.274*
			(1.567)	(1.498)	(1.751)
Family					
family income		-0.114***	-0.073***	-0.074***	-0.061**
		(-3.564)	(-2.202)	(-2.243)	(-1.965)
Land possession			-0.389***	-0.391***	-0.374***
			(-3.756)	(-3.769)	(-3.843)
Village					
earnings gap	-0.007	-0.048***	-0.032**	-0.032**	-0.025*
	(-0.785)	(-3.110)	(-2.065)	(-2.065)	(-1.809)
standard deviation gap	0.049	0.017	0.052	0.043	0.035
	(1.032)	(0.313)	(0.934)	(0.770)	(0.697)
network	0.014***	0.011***	0.011***	0.011***	0.012***
	(3.586)	(2.593)	(2.714)	(2.709)	(2.927)
distance (ln)	-0.237***	-0.221***	-0.244***	-0.157**	-0.095

	(-4.976)	(-3.911)	(-4.390)	(-2.325)	(-0.984)
Island					
Java island	-0.661***	-0.584**	-0.739***	-0.752***	-0.690***
	(-3.057)	(-2.322)	(-2.999)	(-3.043)	(-2.969)
Java * distance	0.141**	0.118*	0.157**	0.157**	0.137**
	(2.539)	(1.874)	(2.460)	(2.484)	(2.271)
constant	-0.161	1.766***	1.114*	0.798	0.199
	(-0.529)	-2.952	(1.868)	(1.280)	(0.308)
Obs	6696	6696	6696	6696	6696
Pseudo R-2	.25	.25	.26	.26	.25

* p<0.05, ** p<0.01, *** p<0.001, All standard errors were adjusted for within cluster dependence

Table 2.7: Probit Regressions of Sequential Migration between 2000 and 2007

	Model 1	Model 2	Model 3
Dependent variable	Sequential migration	Other city	Return migration
Personal			
Educational			
middle school	-0.562**	0.432	-0.377
	(-2.178)	(1.118)	(-1.245)
high school	-0.502**	0.591	-0.714***
	(-2.125)	(1.494)	(-2.587)
university	-0.527*	1.029*	-0.408
	(-1.827)	(1.939)	(-1.292)
Demographic			
married	-0.156	0.115	-0.133
	(-0.669)	(0.308)	(-0.506)
age	-0.024**	-0.020	-0.030**
	(-2.344)	(-1.142)	(-2.412)
female	-0.031	0.211	-0.234
	(-0.137)	(0.580)	(-0.908)
Vocational			
self employed	-0.489*	0.581	-0.36
	(-1.655)	(1.131)	(-0.923)
government	0.405	-0.119	0.282
	(1.042)	(-0.207)	(0.579)
private	0.121	0.143	0.543
	(0.439)	(0.319)	(1.610)
Family			
family income	0.104	-0.149	0.083
	(1.388)	(-1.276)	(1.060)
Village			
earnings gap	0.063	-0.008	0.044
	(1.633)	(-0.220)	(1.466)
standard deviation gap	-0.046	-0.262	-0.003
	(-0.396)	(-1.231)	(-0.025)
network	-0.006	0.061***	0.007
	(-0.729)	(3.331)	(0.746)
distance (ln)	0.083	-0.250**	-0.039
	(1.229)	(-2.158)	(-0.553)
Island			
Java island	-0.274	0.182	-0.509**
	(-1.365)	(0.597)	(-2.211)
constant	-0.517	2.225	-0.795
	(-0.423)	(1.051)	(-0.605)
Obs	305	305	305
R-2	.09	.30	.10

* $p<0.05$, ** $p<0.01$, *** $p<0.001$, All standard errors were adjusted for within cluster dependence

Table 2.8: Mean Real Income and Income Growth of Males by Education and Region (2000 and 2007)

		Real Income	% change 2000-2007	Real Income	% change 2000-2007	Real Income	% change 2000-2007
Year	Region	college graduates		high school		less than high school	
2007	Urban	8501	69%	3954	40%	3094	27%
2000		5019		2831		2428	
2007	Rural	5622	30%	3551	47%	2331	51%
2000		4327		2408		1539	

Source: IFLS 3 & 4, Unit: thousand Rupiah

Table 2.9: Mean Real Income and Income Growth of Females by Education and Region (2000 and 2007)

Year	Region	Real Income	% change 2000-2007	Real Income	% change 2000-2007	Real Income	% change 2000-2007
Year	Region	college graduates		high school		less than high school	
2007	Urban	5676	62%	3282	72%	2183	56%
2000		3514		1898		1339	
2007	Rural	4062	46%	3201	162%	1609	120%
2000		2775		1219		729	

Source: IFLS 3 & 4, Unit: thousand Rupiah

Table 2.10: Comparison of Earnings between Migrants and Stayers in 2007

	Model 1	Model 2	Model 3	Model 4	Mode 5	Model 6
Dependent Var	Income 2007 Migrants	Heckman 2007	Heckman 2000	Income 2007 Stayers	Heckman 2007	Heckman 2000
Personal						
Educational						
middle school	0.135	0.168	0.387	0.278***	0.297***	0.321***
	(0.796)	(1.046)	(1.560)	(5.405)	(8.139)	(8.241)
high school	0.709***	0.770***	0.640***	0.662***	0.706***	0.676***
	(4.808)	(5.010)	(2.691)	(11.558)	(20.185)	(17.361)
university	1.372***	1.438***	1.130***	1.098***	1.203***	1.097***
	(8.270)	(8.295)	(4.222)	(13.460)	(25.005)	(19.636)
Demographic						
age	0.042	0.033	0.060	0.072***	0.067***	0.113***
	(1.158)	(0.903)	(1.015)	(6.066)	(7.834)	(11.140)
age squared	0.000	0.000	0.000	-0.001***	-0.001***	-0.001***
	(-0.677)	(-0.538)	(-0.504)	(-6.496)	(-8.314)	(-10.394)
female	-0.297***	-0.293***	0.225	-0.612***	-0.505***	-0.470***
	(-2.670)	(-2.642)	(1.360)	(-15.484)	(-19.682)	(-16.076)
Vocational						
self employed	0.206	0.204	0.092	0.366***	0.356***	0.268***
	(0.988)	(0.997)	(0.350)	(7.005)	(8.750)	(6.831)
government	0.398*	0.404*	0.363	1.154***	0.982***	0.705***
	(1.687)	(1.736)	(1.071)	(14.387)	(17.978)	(11.266)
private	0.189	0.217	0.215	0.543***	0.554***	0.445***
	(1.037)	(1.201)	(0.859)	(9.284)	(13.348)	(10.486)
Behavioral						
risk attitude 2	-0.03	-0.032	-0.219	0.005	0.053*	0.017
	(-0.263)	(-0.285)	(-1.219)	(0.106)	(1.772)	(0.504)
risk attitude 3	0.210*	0.209*	-0.028	0.080*	0.109***	0.075**
	(1.716)	(1.744)	(-0.162)	(1.879)	(3.599)	(2.198)
risk attitude 4	-0.015	0.003	0.036	0.209**	0.325***	0.193**
	(-0.049)	(0.010)	(0.108)	(2.214)	(5.043)	(2.418)
Village						
distance (ln)	-0.119***	-0.131***	-0.187***	-0.106***	-0.152***	-0.112***
	(-3.174)	(-3.238)	(-2.705)	(-5.157)	(-13.435)	(-9.005)
Island						
Java island	0.105	0.099	0.301*	-0.300***	-0.269***	-0.186***
	(0.915)	(0.866)	(1.698)	(-7.261)	(-8.650)	(-5.474)
constant	14.878***	14.725***	11.184***	14.554***	14.871***	12.826***
	(27.734)	(27.769)	(12.776)	(69.407)	(99.590)	(67.531)
R-2	.32			.31		
Inverse mills ratio		.162	1.033***		-.683	-.462
Standard Error		.158	.298		.066	.102

* p<0.05, ** p<0.01, *** p<0.001, All standard errors were adjusted for within cluster dependence.

Table 2.11: Changes in Migration Propensities and Returns to Education

Education level	Trend	Migrants to big cities		Rural stayers	
		1993-2000	2000-2007	1993-2000	2000-2007
education years	Growth in returns to education	0.082	0.050	0.102	0.011
	migration propensities	0.001	0.002		
middle school education vs. elementary education	Growth in returns to education	0.461	-0.219	0.285	-0.024
	migration propensities	0.005	0.007		
high school education vs. elementary education	Growth in returns to education	0.583	0.130	0.613	0.030
	migration propensities	0.011	0.028		
college education vs. elementary education	Growth in returns to education	0.841	0.308	0.994	0.106
	migration propensities	0.012	0.036		

Table 2.12: Summary Test Results of Neoclassical Explanations of Distance and Education Effects.

Stylized Facts	Neoclassical Explanations	Testable Hypotheses	Results
Distance is negatively associated with migration propensities.	Distance is a proxy for transportation costs.	-A decrease in the marginal propensity to migrate is proportional to an increase in transportation costs and a decrease in expected wage gains.	No evidence for significance of transportation costs.
	Distance is a proxy for psychic costs.	-The distance effect diminishes after controlling for ethnicity and languages. - The age effect diminishes after controlling for ethnicity and languages.	No evidence for significance of psychic costs.
	Distance is a proxy for information costs.	-less educated people are more likely to migrate sequentially. -Higher education weakens the distance effect.	No evidence for significance of information costs.
Education is positively associated with migration propensities.	The more educated are less credit constrained.	-People from wealthier families (with more liquid assets) are more likely to migrate. -The education effect diminishes as family wealth is controlled for.	No evidence for significant family income effects.
	Education decreases information costs.	-Less educated people are more likely to migrate sequentially (due to lack of information). -Higher education weakens the distance effect	No evidence for significant education effects.
	Returns to higher education are greater in urban areas.	-Expected returns to higher education are greater for migrants than stayers. -The growth in returns to higher education is greater for migrants than stayers, given that the increase in migration propensities between 1993-2000 and 2000-2007 is greater for more educated people	Results appear to support the explanation.

Appendix 2.1: Proof of Proposition 1

By the standard Arrow-Pratt approximation for certainty equivalent, it must be that

(2) $u\left[E_{F_L}(L(T)|\theta_L) - \rho_{r^L})\right] - u\left[E_{F_H}(H(T)|\theta_H) - \rho_{r^H})\right] = 0,$

where $\rho_{r^L} \approx -\frac{1}{2}\sigma_{ll}\frac{u_{ll}}{u_l}, \rho_{r^H} \approx -\frac{1}{2}\sigma_{hh}\frac{u_{hh}}{u_h},\ \sigma_{kk} = \int (K-\overline{K})^2\, dF(K|\theta_K), \frac{u_{kk}}{u_k}$ is the coefficient of risk aversion estimated at the mean of K, (k=l,h). Suppose otherwise, so that $E_{S_L}(L(T)|\theta_L) - E_{F_H}(H(T)|\theta_H) = \rho_{r^L} - \rho_{r^H} + \delta\ (\delta \neq 0)$. Then by substitution we get $u\left[E_{S_L}(L(T)|\theta_L) - \rho_{r^L} - \delta)\right] = \mathrm{u}\left[E_{S_L}(L(T)|\theta_L) - \rho_{r^L})\right]$, which is a contradiction ■

Appendix 2.2: Proof of Proposition 2

A mean preserving spread of S results in a larger variance of expected return for L. Hence, the risk premium of L will get larger. Then we have $u\left[E_{F_L}(L(T)|\theta_L) -\right.$ *ρrL<uEFHH(T)|θH)−ρrH* ■

Appendix 2.3: Education Effects in Rural-Urban Migration

This can also be expressed more formally. Assume that two education groups differ only in their expected urban income (i.e., ${\theta_M}^h \neq {\theta_M}^l$) and that ${\theta_M}^h$is associated with ${F_M}^h$, which first-order stochastically dominates ${F_M}^l$. Then the following inequality is implied by (2.1): $E\left[M^h(T)\middle|\theta_N, {\theta_M}^h, \rho_{r^N}, \rho_{r^M}, T^*\right] > E\left[M^l(T)\middle|\theta_N, {\theta_M}^l, \rho_{r^N}, \rho_{r^M}, T^*\right]$, where the subscript h and l denote a high and low education, respectively.

Appendix 2.4: Descriptive Statistics – 1993 data-

Variable	Mean	Std. Dev.
Dependent variable		
Rural-urban migration 1993-2000	0.029	0.167
Educational		
Elem (reference)	0.398	0.490
Mid	0.136	0.343
high	0.194	0.395
Univ	0.065	0.247
General		
Marit	0.712	0.453
Age	36.405	13.211
Female	0.527	0.499
Vocational		
Self	0.237	0.425
Gov	0.048	0.215
priv	0.161	0.368
Family worker (reference)	0.128	0.335
Family		
yearly income (ln)	12.503	9.865
Village		
earnings gap b/w city & kecamatan (ln)	4.942	3.974
std gap of earnings b/w city & kecamatan (ln)	-0.874	2.070
distance (km)	80.232	80.021
Island		
Java	0.733	0.443

Appendix 2.5: Heckman Selection Models in Earning Estimations

Dependent Var	Migration=Yes(N=389)
Personal	
Educational	
middle school	0.183*
	(1.785)
high school	0.457***
	(5.094)
university	0.570***
	(4.817)
General	
married	-1.014***
	(-12.274)
age	-0.012***
	(-2.604)
female	-0.493***
	(-6.688)
Vocational	
self	0.912**
	(2.513)
gov	0.849**
	(2.247)
private	1.153***
	(3.179)
casual	0.996***
	(2.688)
Behavioral	
risklv2	0.015

	(0.174)
risklv3	0.018
	(0.213)
risklv4	0.105
	(0.582)
Family	
Yearly income(ln)	-0.160***
	(-3.946)
land	-0.366***
	(-4.289)
Village	
earngap	-0.097***
	(-2.653)
std gap of earnings	0.045
	(0.848)
network	
distance(ln)	-0.135***
	(-4.044)
Island	
Java	-0.134
	(-1.476)
constant	1.311*
	(1.705)

Appendix 2.6: Comparison of Income between Migrants and Stayers in 2007

	Model1	Model2	Model3	Model4	Model5	Model6
Dependent Var	Income 2007	Heckman 2007	Heckman 2000	Income 2007	Heckman 2007	Heckman 2000
Personal		Migrants			Stayers	
Educational						
eduyears	0.154***	0.159***	0.109***	0.104***	0.122***	0.111***
	(9.143)	(8.978)	(3.994)	(13.758)	(26.243)	(20.726)
General						
age	0.071*	0.064	0.066	0.069***	0.067***	0.111***
	(1.721)	(1.536)	(1.112)	(5.767)	(7.740)	(10.826)
age squared	-0.001	-0.001	0.000	-0.001***	-0.001***	-0.001***
	(-1.282)	(-1.184)	(-0.629)	(-6.289)	(-8.372)	(-10.228)
sex	-0.267**	-0.267**	0.22	-0.606***	-0.504***	-0.472***
	(-2.448)	(-2.489)	(1.337)	(-15.484)	(-19.682)	(-15.950)
Vocational						
self	0.176	0.174	0.074	0.375***	0.362***	0.288***
	(0.909)	(0.912)	(0.275)	(7.133)	(8.862)	(7.233)
gov	0.332	0.337	0.348	1.262***	1.044***	0.779***
	(1.480)	(1.520)	(1.005)	(16.115)	(19.439)	(12.490)
private	0.091	0.111	0.154	0.575***	0.569***	0.473***
	(0.528)	(0.646)	(0.603)	(9.785)	(13.691)	(10.981)
Behavioral						
risklv2	0.01	0.009	-0.219	0.026	0.064**	0.017
	(0.083)	(0.079)	(-1.219)	(0.591)	(2.115)	(0.504)
risklv3	0.271**	0.272**	-0.028	0.097**	0.117***	0.075**
	(2.184)	(2.229)	(-0.162)	(2.252)	(3.835)	(2.198)
risklv4	0.19	0.198	0.036	0.257***	0.325***	0.193**
	(0.848)	(0.897)	(0.108)	(2.707)	(5.070)	(2.418)
Village						

distance(ln)	-0.092** (-2.501)	-0.101*** (-2.593)	-0.195*** (-2.741)	-0.101*** (-4.829)	-0.158*** (-13.851)	-0.118*** (-9.335)
Island						
Java	0.171 (1.499)	0.164 (1.450)	0.288 (1.603)	-0.331*** (-7.928)	-0.294*** (-9.299)	-0.211*** (-6.095)
constant	13.318*** (22.355)	13.216*** (21.865)	10.509*** (11.825)	13.918*** (62.588)	14.156*** (91.030)	12.198*** (62.926)
R-2	.32			.31		
Inverse mills ratio		0.109	-0.689		1.307	-0.453
Standard Error		0.160	0.065		0.305	0.102

CHAPTER 3

Essay 2: The Impact of Adult Morbidity on Intrahousehold Labor Substitution and Production

3.1. Introduction

In many developing countries, the burden of morbidity of prime-age adults is greater than in developed countries. Households with ill adults suffer not only from diminished labor supply but also from an inability to borrow against future labor income. Substituting hired labor for family labor is often hindered when markets are incomplete, as is often observed in many developing countries. Few households have the financial capacity to cover the cost of direct and indirect medical costs, and there are only limited formal insurance mechanisms in developing countries (Russell 2004; WHO 2005). The effect of morbidity on households in developing countries has largely been overlooked although, in fact, it may be more difficult for the households to overcome health shocks than crop income shocks (Kochar 1995). With limited access to credit and health insurance systems, households will have serious difficulties in coping with the burden of adult morbidity. Yet, there are relatively few empirical studies that explore the coping strategies adopted by households in response to morbidity shocks in developing countries.

Morbidity is distinct from other types of negative demographic shocks such as a loss of family members or dissolution of the family. It not only tightens the time constraints of healthy family members but also increases the medical expenditure for the sick person over the duration of the illness.[46] Moreover, since the duration of illness and the possibility of recovery are generally difficult to anticipate, households may be more burdened in adjusting to the crisis caused by adult morbidity than they are to other types of demographic shocks or income shocks. Households with health shocks may use various coping strategies according to the nature of the costs imposed by those shocks. For instance, strategies to cope with financial costs are more likely to involve mobilization of financial assets while for time costs rural households are more likely to use external labor or intra-household labor substitution (See Sauerborn et al 1996a; Chambers 1989; Longhurst 1986; Malapit et.al. 2006).

Among possible strategies, intra-household labor substitution in response to morbidity of prime-age adults is of interest in the sense that it may provide insight into the mechanisms by which poor households smooth consumption when they have limited access to other coping strategies. The use of labor as insurance may also have a negative impact on children's educational attainment, which has serious implications for the future welfare of the poor in developing countries (Jacoby and Skoufias 1997).

To address these issues, this chapter investigates the effects of prime age

[46] A number of studies provide empirical evidence. Sauerborn et al (1996a) estimated that the income lost amounted to 70% of the total costs incurred by households with ill family members in Nepal. Pryer (1989) estimated that the poorest income quintile lost 74% of monthly income in afflicted households in Bangladesh. In a study of Ghanian households, Aseno-Okyere (1998) estimated that 79% of the costs were due to time spent seeking care and caring for the sick. Taylor et al (1996) document the extent of time women in Uganda spend caring for the sick, often with insufficient resources at their disposal to do so. This implies that much of the burden of ill health falls particularly on women who are caring for the sick.

morbidity on intra-household labor substitution and household farm production, and the next chapter examines the extent to which households are able to smooth consumption. There are limited numbers of studies investigating the effects of morbidity on intrahousehold resource allocation in developing countries. Using exceptionally detailed information about individual health status provided by the Indonesia Family Life Survey (IFLS, 2007), this study presents a more comprehensive picture of morbidity shock effects and risk coping mechanisms than previous work in the literature.

The plan of this chapter is as follows. Section 3.2 presents a literature review of the fields closely related to this study, which include added worker effects, the impact of HIV/AIDS on farm households, and morbidity effects on labor substitution. Section 3.3 presents the theoretical framework that will be used in this study. The aim of this section is to emphasize the importance of controlling for household specific unobservable factors in empirical estimations of morbidity effects. This study extends the models employed in general studies of intrahousehold time allocation across activities in agricultural households. Section 3.4 describes the IFLS data used in this study, and the methodologies employed are introduced in the next section; in particular, the next section explains the strategies for identifying morbidity effects using difference-in-differences methods. It also argues why these methods are preferable to the village fixed effects method employed by Gertler and Gruber (2002). Section 3.6 describes the characteristics of the sample, and regression results are presented in the following section. That section presents estimation results for three specific phenomena: 1) morbidity effects on own labor supply, 2) morbidity effects on the labor supply of other family members, and 3) morbidity effects on family farm production. This study is distinguished from previous studies in that it controls for the duration and severity of morbidity using exceptionally detailed individual health information from two waves of the Indonesian Family Life Survey (IFLS).

3.2. Literature Review

There is some empirical evidence of time reallocation by household members in response to illness shocks among other household members (Pitt, Rosenzweig, and Hassan 1990; Kochar 1995). Some have analyzed the adjustment to an individual's own time allocation in the face of chronic or acute illness (Pitt and Rosenzweig 1986; Pitt, Rosenzweig, and Hassan 1990). Theoretically, the impact of a negative health shock on the labor supply of the healthy family members is ambiguous. In the context of the life cycle model, the healthy spouse may not be very responsive to the health shock of the ill spouse if such an event is not expected to be permanent. The plausibility of such an expectation may depend on the age of the affected spouse because relatively old individuals would be less likely to recover from illness. Credit constraints can also play a role in the decisions. Households that have better access to credit would be more able to smooth consumption and thus would be less likely to alter their intrahousehold labor allocation, at least in the short run.

3.2.1. Added Worker Effect

As mentioned above, healthy family members may decrease or increase their supply of labor for income generating activities if the health event results in a change in home production opportunities. For instance, this happens if the need for assisting the sick family member becomes more important. On the other hand, the decrease in family income due to a disability of one household member can result in another household member working more, when the negative health shock is not temporary or households are credit constrained. This “added worker effect” (AWE) has long been recognized by researchers (Mincer 1962; Maloney 1987, 1991; Tano 1993; Ashenfelter 1980; Heckman and MaCurdy 1980; Lundberg 1985; Gruber and Cullen 2000).

Traditionally the focus of AWE is mostly on unemployment of the primary earner and its impact on the labor supply response of the secondary earner in a household in developed countries. The literature provides weak or no evidence for the added worker effect. The usual explanation is that the secondary earner is discouraged by the signal of poor job perspectives sent by the primary earner. Other studies argue that actual labor supply may underestimate the actual desire to work by the spouse (Lundberg 1985; Maloney 1987; Tano 1993; Serneels 2002). They argue that the added worker effect may appear to be small while in fact it is large because most studies look at the wife’s actual labor supply, while it would be more accurate to consider her desired labor supply in the estimation of the added worker effects.

Studies on the AWE are rare in the context of developing countries (Bardhan 1984; Serneels 2004). This is thought to be due to the fact that labor markets are far from being complete and competitive in many developing countries. Moreover, the effects may not be well captured because households in developing countries tend to have relatively large family sizes and heavily depend on family labor.

Bardhan (1984), using data from rural West Bengal in India, finds a strong negative effect of the male household unemployment rate on female labor supply. He concludes that the job search discouragement effect outweighs the income effect related to unemployment of men in households. Serneels (2004) provides empirical evidence that women do not want to supply additional labor as a response to male unemployment within the household in urban Ethiopia. He ascribes this to the fact that women get relatively lower income and so their added labor will most likely be supplied in the 'bad' sector when the labor market has two sectors, one with 'good' jobs and one with 'bad' jobs. His study, however, like most other studies on the AWE, does not distinguish between voluntary unemployment and involuntary unemployment, for which the impact on labor supply response of the secondary earner may be different.

3.2.2. The Impact of HIV/AIDS

Although there has been a growing number of studies examining the impact of adult mortality and morbidity caused by HIV/AIDS on farm households in Africa (Barnett and Blaikie 1992; Barnett et al. 1995; Yamano and Jayne 2004), few studies have attempted to analyze the role of intrahousehold labor time reallocation as a coping mechanism for demographic shocks. One exception is Beegle (2005), who uses a panel data set from Tanzania to examine the impact of a prime-age adult death on adjustments in time allocation and household activities. Her results show small and insignificant changes in the labor supply of individuals in households experiencing a prime-age adult death. Coffee farming, generally controlled by men, however, is lowered within 6 months of an adult male death. She also shows significant decreases in wage employment of adult men in response to a future adult death. This suggests that households with an ill adult male may incur additional household responsibilities that require reduction of the time spent on activities that pull individuals out of the household. Her study, however, does not investigate differential effects by household size, seasonal variations,[47] and wealth level, all of which may vary the effects of prime age adult morbidity and mortality.

3.2.3. Morbidity and Labor Substitution

There are a handful of studies that recognize the role of intra-household labor substitution as an important coping strategy in response to general morbidity and mortality of household members (Weisbrod 1973; Nur 1993; Sauerborn et al. 1996a; Goudge and Govender 2000; Ilahi 2001). Sauerborn et al. (1996b) show that intra-household labor substitution is the main strategy to compensate for any labor lost to illness among households in Burkina Faso, although it does not eliminate production losses in the majority of households struck with a severe illness of a productive member. According to their study, working as a wage-laborer is considered a last

[47] For coffee production, for instance, households need much more time, especially of women, in the harvesting season than at other times of the year.

resort for those lacking assets, access to credit and kin/community support. Nur (1993) examines the economic impact of malaria in Sudan. He finds that all the labor hours lost to agriculture through the short-term malaria impact are compensated for through labor from other household members. He also shows that the substitutes are mostly (95%) provided by female adults and children, especially at harvest time. Such results, however, may not necessarily be true for households experiencing chronic illness or mortality, or for small size households that cannot easily substitute for lost labor (Strauss and Thomas 1995).

Intra-household labor substitution may also be affected by household composition. Ilahi (2001), using the Peru LSMS panel data, shows that the presence of prime-age females significantly lowers the work burden of other adults as well as the propensity of men to do housework in the family. The presence of elderly women is also shown to have strong effects on the time use of prime age females, allowing working age women in the household to increase their time in self-employment activities and making it more likely for urban women to participate in the wage labor market. The labor supply response by women, however, needs to be interpreted with caution since the participation in the labor market may be restricted by social norms in some developing countries (Cain et al 1979; Bevan and Pankhurst 1996; Kevane and Wydick 2001). For instance, working for someone else is considered a taboo for women in some villages in Ethiopia (Bevan and Pankhurst, 1996). Cain et al (1979) suggest a theory that powerful local norms of female seclusion due to “patriarchy” extend to the labor market, and this severely restricts women from working outside the family. Kevane and Wydick(2001) also show that, in their study of households in Burkina Faso, social norms significantly explain differences in patterns of time allocation between two ethnic groups.

3.3. Theoretical Framework

Most studies that examine the determinants of intrahousehold time allocation follow the neoclassical model of the household, paying attention to the opportunity cost of time of each household member. To analyze the coping mechanisms of households that experience morbidity of prime age adults, we can extend the agricultural household models employed in the studies of the general intrahousehold time allocation across agricultural and other activities (Evenson et al. 1980; Mueller 1984; Khandker 1988; Skoufias 1993) to situations involving adult morbidity (Pitt and Rosenzweig, 1986; Pitt, Rosenzweig, and Hassan,1990). For simplicity, consider a household that consists of only a husband (h) and a wife (w).[48] The household's utility is assumed to depend on health stocks of the two family members (H_i), their leisure time ($T^L{}_i$), and a vector goods purchased for consumption (C):

(3.1) $$U = U(T^L{}_h, T^L{}_w, C, H_h, H_w\,; Z),\ \frac{\partial U}{\partial T_i^L} > 0, \frac{\partial^2 U}{\partial {T_i^L}^2} < 0, \frac{\partial U}{\partial C} > 0, \frac{\partial^2 U}{\partial C^2} < 0,\ i = h,w$$

where Z denotes a vector of all observable and unobservable characteristics of households influencing the impact of $T^L{}_i$ (i=h,w) and C on utility.

[48] In the empirical model I also include other dependents. While it may present a more realistic conceptual model to include them, adding them does not affect the essence of this conceptual framework.

Family farm goods (Q^F) are assumed to be produced by a combination of market-purchased inputs (X), the time inputs of husband and wife (T_h,T_w), health status of family members, and hired labor (L) as follows:

(3.2) $$Q^F = Q^F(X^F, T^F{}_h, T^F{}_w, L; H_h, H_w, \sigma), \ \frac{\partial Q^F}{\partial X^F} > 0, \frac{\partial^2 Q^F}{\partial X^{F^2}} < 0, \frac{\partial Q^F}{\partial T^F} > 0, \frac{\partial^2 Q^F}{\partial T^{F^2}} < 0, \frac{\partial Q^F}{\partial L} > 0, \frac{\partial^2 Q^F}{\partial L^2} < 0, \frac{\partial Q^F}{\partial H} > 0, \frac{\partial^2 Q^F}{\partial H^2} < 0$$

where σ denotes family farm-specific physical characteristics such as slope and soil quality. When a household member is sick, under the assumption of complete labor markets, his or her work in the production of family farm goods is perfectly substitutable using hired labor at the same wage rate of the sick member.

In this study, health is defined to be a function of consumption (C), home goods (Q^H), and an acute health shock S_i that is beyond the control of the household. Accordingly, morbidity is defined to be a negative change in health stocks caused by an acute health shock.

(3.3) $$H_i = h(C, Q^H, S_i), \qquad \frac{\partial H_i}{\partial C} > 0, \frac{\partial^2 H_i}{\partial C^2} < 0, \frac{\partial H_i}{\partial Q^H} > 0, \frac{\partial^2 H_i}{\partial Q^H} < 0, \frac{\partial H_i}{\partial S_i} < 0$$

where home goods are assumed to be produced by a combination of market purchased inputs (X^H), the time inputs of husband and wife ($T^H{}_h$, $T^H{}_w$), and household-specific unobservable characteristics (ρ).[49]

(3.4) $$Q^H = Q^H(X^H, T^H{}_h, T^H{}_w; \rho)$$

[49] The home good can be considered as health care. More generally, it includes all non-income generating products that affects health of household members, such as cooked meals or activities for sanitation.

Each spouse is endowed with a total stock of time consisting of time for family farm work (T^F), time for market work (T^M), time for home good production (T^H), and time for leisure (T^L), as follows:

(3.5) $\bar{T}_i(H_i) = T_i^H + T_i^F + T_i^M + T_i^L$, i=h,w, $\frac{\partial \bar{T}_i}{\partial H} > 0, \frac{\partial^2 \bar{T}_i}{\partial H^2} < 0$

Overall, health can affect household resource allocations in three ways. First, health has a direct effect on the household utility. Second, it reduces the sick individual's time endowment. Lastly, it may affect production of farm goods. The household also faces a cash income constraint that states that total expenditure cannot exceed the total income earned by both husband and spouse.

(3.6) $P^{XH}X^H + P^{XF}X^F + P^C C + WL \leq P^F Q^F + W_h T_h^M + W_w T_w^M + Y$, i=h,w,

which depends on the prices of inputs for home-produced goods (P^{XH}) and farm produced goods (P^{XF}), the market prices for purchased consumer goods (P^C), the market price for family farm produced goods (P^F), market wage rates (W), and unearned income (Y). The wage rate W_i for an individual i is assumed to depend on human capital E_i and health H_i. such that

(3.7) $W_i = w_i(E_i), \quad \frac{\partial W}{\partial E_i} > 0 \quad and \quad \frac{\partial^2 W_i}{\partial {E_i}^2} > 0$

The household full income constraint can be obtained by combining the cash income constraint (3.6) with the time constraint (3.5) as follows:

(3.8) $\sum_i W_i(T_i^H + T_i^L + T_i^M) + P^{XH}X^H + P^C C \leq \pi + \sum_i W_i \bar{T}_i(H_i) + Y = F(H)$, where F denotes full income and $\pi = P^F Q^F - \sum_i W_i T_i^F - P^{XF} X^F - WL$. For simplicity, assume interior solutions for all choices. Then, using (3.1), (3.2), (3.3), and (3.8), we get the following optimum conditions:

(3.9) $$\frac{\partial U}{\partial C} + \frac{\partial U}{\partial H_i}\frac{\partial H_i}{\partial C} = \lambda(P^{\mathrm{C}} - T_{\mathrm{i}}^{M}\frac{\partial W_i}{\partial H_i}\frac{\partial H_i}{\partial C} - P^F\frac{\partial Q^F}{\partial H_i}\frac{\partial H_i}{\partial C})$$

(3.10) $$\frac{\partial U}{\partial T_i^L} = \lambda \mathrm{W_i}$$

(3.11) $$\lambda\left(P^F\frac{\partial Q^F}{\partial X} - P^{XF}\right) = 0$$

(3.12) $$\lambda(P^F\frac{\partial Q^F}{\partial T_i^F} - W_i) = 0$$

(3.13) $$\lambda(F(H) - \sum_i W_i\,(T_i^H + T_i^F + T_i^L) - P^{XH}X^H - P^C C) = 0$$

Condition (3.9) indicates that changes in consumption augment utility both directly and indirectly through effects on health. In particular, it states that the marginal cost of consumption is lower the greater the extent to which changes in consumption improves the farmer's health and marginal productivity. Condition (3.10) indicates that leisure time is determined at the level where the marginal cost of leisure is equal to the marginal benefit. When there is a health shock, households may have to choose their leisure time at the level different from that indicated by (3.10) as their total time endowment and their full income in (3.13) will decrease. On the other hand, (3.11) and (3.12) are the usual profit maximization conditions of the standard agricultural household model. They indicate that production and consumption allocations are separable, and farm profits are independent of the farmer's health status when market substitutes are easily available for his or her labor input. For instance, in the presence of complete labor markets and under the assumption of perfect substitutability of hired labor, although a sick family member reduces his or her own labor, *total* labor hours for the household's farm production will not be affected (Pitt and Rosenzweig, 1986; Benjamin, 1992).[50] The equation (3.12) will then be changed to $\lambda(P^F \frac{\partial Q^F}{\partial L_T^F} - W) = 0$, where L_T^F indicates total labor hours of the family plus hired labor. In such conditions the decision making process is regarded as separable because time spent on consumption or home good production, and total labor time used by the household including hired labor for farm production become independent; utilization of family labor will be directly linked to the market-determined wage rate, and full income is singled out as the only link between production and consumption. On the other hand, in the absence of complete labor markets, households with sick adults may be more affected by the negative health shocks because *total* labor used on the family farm would be more likely to diminish. In this case the family must decide on the percentage of its total available time to devote to production, and the farm production decision cannot be separated from household consumption and labor supply decisions.

In this study, based on this conceptual framework, two hypotheses are tested. First, this study tests whether households adjust labor hours of healthy members in the face of morbidity shocks. Healthy members may increase their labor hours to

[50] Benjamin (1992) tests his intuitive hypothesis that the number of workers in Baron Rothschild's vineyards should not depend on the number of daughters he has when there exist perfect labor markets. His was not able to reject the null hypothesis. Pitt and Rosenzweig (1986) find that while illness adversely affects own labor supply of farmers, farm profits remain unaffected, supporting the validity of separation hypothesis for Indonesian farm households.

compensate for the lost income of a sick person, or they may work less to care for the sick person. Second, it also tests whether family farm profits are affected by morbidity of prime age adult members. The results of this second test would differ depending on the validity of separability hypothesis. To see this consider the reduced form equations for the time allocated to each activity. In particular, the time demand functions for family farm labor are given as follows.

(3.14) $T^F_i = \varphi^F_i(W_h, W_w, P^{XF}, P^F, H_h, H_w, \sigma)$; $i = h, w$

As explained above, if separability holds then the demand for total farm labor is determined independently of household utility. Furthermore, while the labor hours of family members may be affected by health status, total labor hours for the household farm will not be unaffected by health conditions of household members, as shown in (3.15).

(3.15) $L^F_T = \varphi^K(W_h, W_w, P^{XH}, P^C, \sigma)$

Hence, the issue of separability is important in the estimation of the effect of morbidity on farm profits.

In contrast, the test results of the first hypothesis would not depend on separability of consumption and production decisions. Consider the Hicksian time demand functions for home goods and leisure, which can be obtained from the equations (3.9), (3.10) and (3.13), conditional on (3.11)-(3.12).

(3.16) $T^K_i = \varphi^K_i(\bar{u}, W_h, W_w, P^{XH}, P^C, H_h, H_w, Z, \rho)$, $k = H,L$, $i{:}h,w$

Unlike the farm labor hours, the Hicksian time demand functions for home goods and leisure contain $\bar{u}$, the maximized household utility.[51] The Hicksian time demand for market labor can also be derived residually. Assuming the husband and wife both work for wages in the labor market, the demand function is given as follows:

$$(3.17) \qquad T^M_i = \bar{T} - T_i^H - T_i^F - T_i^L$$

$$= \varphi^M_i(\bar{u}, W_h, W_w, P^C, P^{XF}, P^F, H_h, H_w, Z, \sigma, \rho) \text{ ; } i = h, w$$

As shown in (3.16) and (3.17), time demand functions for other than family farm production are dependent on the maximized household utility, and hence decisions for time allocation of these activities are not separable from household consumption decisions. In the case where separability does not hold, levels of farm production, consumption and family labor use will all be simultaneously determined by the shadow price of labor, as determined by all the variables that influence household decision making.[52] Thus (3.14) and (3.15) will have $\bar{u}$ and ρ in the function. Consequently, the change in the farm profit is ambiguous in the face of morbidity shocks as the household makes a simultaneous decision on time allocation for farm production, home production, and leisure. Farm profits will only be unaffected when separability holds under the condition of perfect labor markets. For a comprehensive investigation of the effects of morbidity on farm profits, we would need detailed knowledge of such unobservable household characteristics.

Regardless of separability, on the other hand, the degree of labor substitution

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[51] $\bar{u}$ will be replaced by full income F in Marshallian demand function.
[52] The reduced form equation of time demand for a person not participating in the labor market includes shadow wages W^*_i instead of the market wage rate W_i.

in response to a morbidity shock is likely to depend on household-specific factors such as household preferences, the household production technology, and the substitution possibilities across different types of family labor. Consider the following household Marshallian demand for home good production time, which is equivalent to (3.15) by the duality theorem.

(3.17) $$T^H_i = \varphi^H(F, W_h, W_w, P^{XH}, P^C, H_h, H_w, Z, \rho)$$

Taking the derivative of both sides with respect to H_{-i}, the health condition of a sick person, we get the following equation.

(3.18) $$\frac{\partial T_i^H}{\partial H_{-i}} = \frac{\partial \varphi_i{}^H}{\partial H_{-i}} + \frac{\partial \varphi_i{}^H}{\partial F}\frac{\partial F}{\partial \bar{T}_{-i}}\frac{\partial \bar{T}_{-i}}{\partial H_{-i}}$$

The first term in the RHS is negative due to an increasing need to assist the sick person. The second term is positive since a health shock reduces full income via decrease in total available hours and wage rates, and by the income effect the demand for home good production changes in the same direction as income changes. Hence, overall the effect of a health shock on home good production is ambiguous. A decrease in household full income due to the loss of labor decreases the time for home good production via an income effect while it increases the time via a substitution effect. So if the income effect dominates the substitution effect, we would observe a decrease in home good production. Similarly, it is ambiguous whether the demand for household labor would increase or decrease for farm production by non-sick household members. While the labor of the sick person may be replaced completely by hired labor, it can also be substituted by labor of other healthy family members. Again, the degree of labor substitution would depend on household specific unobservable characteristics.

On the other hand, there exist reasons for controlling household specific unobservable characteristics in the estimation of morbidity effects on intrahousehold labor substitution and farm profits. For instance, the second term in the RHS of (3.18) indicates that household full income decreases via a decrease in wage and a total stock of time. However, some natural disasters may affect both full income and health status of household members. While such natural disasters are in general village-wide shocks, damages are more likely to differ by each household. Households that grow a variety of crops are less vulnerable to pest shocks than households with a single crop.

Hence, the estimation of morbidity effects would be biased when the household specific unobservable factors are not controlled for. The magnitude of bias would be greater when separability does not hold. For instance, since (3.15) (3.16) and (3.17) will all be determined simultaneously in that case, the effects of morbidity on intrahousehold labor substitution and farm profits would not be independent of confounding factors that affect both health and any of time demand for home goods, farm production, or market labor. The same reasoning applies to households with a more flexibility in labor substitution or a better access to credit markets under the assumption of nonseparability.

Furthermore, the causality of morbidity effects is not as straightforward as shown by the equation (3.18) in the real world. For instance, morbidity of household members may be affected by the degrees of time allocated to the production of public goods such as hygiene or sanitation. The health status of family members may be linked to their time allocation to income-generating activities that would result in higher income and greater consumption of nutrition and health inputs. All these stories occur at the household level, and for these reasons, any empirical estimation unable to control for household specific unobservables would be less credible.

3.4. The Setting and the Data

3.4.1. Characteristics of the Sample

Indonesia, the world's fourth most populous nation, has a population of approximately 200 million, of which 64% live in rural areas. Despite its economic success prior to the onset of Asian crisis in 1997, Indonesia still remains a lower middle income country, with a GDP per capita of around $1500 in 2010.[53] Its recent estimates indicate that 13.3 percent of the population live under the national poverty line (World Bank 2010). Health care expenditures remain relatively low in Indonesia. The total amount of government and private spending on health care is less than 3 percent of GDP, which is less than the average for countries in the East Asia and Pacific region (6.1%) and the lower middle income group of countries (5.9 %) (**Table 3.1**). Indonesia's health infrastructure is also relatively less developed. Many public health facilities suffer from a lack of equipment, and the country as a whole suffers from a lack of doctors and nurses (World Bank 2008). **Table 3.1** shows that Indonesia has much lower numbers of hospital beds, physician density, and nursing density per

[53] Source: IHS Global Insight, Central Bureau of Statistics (2011)

1000 population than other developing countries in Asia.

Furthermore, few households have formal health insurance. In the household survey data used in this study, only 15.9 percent of households have some type of formal health insurance, and only 13 percent have insurance that covers other household members (IFLS 2000). Much of this insurance covers only the minimal user fees at public facilities and excludes the costs of major illness or disability (Dow and Gertler 2001). Indonesian households, thus, are particularly vulnerable to the effects of prime-age adult morbidity.

3.4.2. Survey Data

This paper uses two waves (2000 and 2007) of panel data from the Indonesian Family Life Survey (IFLS). The survey contains information from more than 10,000 households. The sampling scheme is stratified by province in a way that captures the cultural and socioeconomic diversity of Indonesia. The target population consists of the largest 13 of Indonesia's 26 provinces, which together contain 83% of Indonesia's population. The IFLS household questionnaire includes the following modules that collected data at the individual and household levels: multiple indicators of economic well-being (consumption, income, and assets); education, migration, and labor market outcomes; marriage, fertility, and contraceptive use; health status, use of health care, and health insurance; relationships among coresident and non-coresident family members; processes underlying household decision-making; transfers among family members and inter-generational mobility; and participation in community activities.

One useful aspect of this data set is that it contains detailed information about individual work hours for each member, including both the primary job and all additional jobs. It reports the approximate total number of hours worked by each individual during the past week. The data contain information on the value of farm revenue and total expenses for farm production during the past 12 months. For those respondents who were uncertain about the information or unwilling to give an answer, the survey also asked them to choose among multiple ranges of values in rupiah. This study uses the revenue and total expenses information to calculate total farm profits.

Perhaps one of the greatest advantages of using this data set is that it includes extensive measures of health status, including self-reported measures of general health status, morbidity experience, and physical health assessments conducted by health workers with special training in taking such measurements. In the 2007 wave of the IFLS, respondents were asked whether they had been diagnosed with a set of chronic conditions such as hypertension, tuberculosis, cancer, depression, or heart disease.[54] If they had been diagnosed with some chronic illnesses, they were further asked when they were first diagnosed and whether their physical activities were limited by those illnesses. Similar questions were asked about respondents' acute morbidity. Individual health status is recorded both by self-reported measures (i.e., How is your health? How is your health compared with 12 months ago?) and by measures of individuals' physical abilities to perform activities of daily living (ADLs). Responses to ADL questions are coded to three levels: 1) can do it easily, 2) can do it with difficulty, and 3) unable to do it. This allows one to avoid a serious bias

[54] Because in poor countries so many do not see doctors, the survey asked about any modern sector diagnosis, and asked the type of practitioner who gave it.

problem that may arise when using only a single self-reported measure of health status. The errors may be related to seasonality (Sauerborn et al. 1996b), information, and education (Strauss and Thomas 1995).[55] Self reported measures may also be underestimated or exaggerated, and may have different results depending on the peer group of the respondent. For instance, a young male respondent may not view questions on his health status in the same way as a retired respondent. Also, richer and more educated people may be more likely to report that they are ill (Sindelar and Thomas, 1991; Schultz and Tansel, 1997). The actual nature and severity of the illness may have different effects on households and on their coping mechanisms, although self reported measures remain important since ultimately it is this perception that determines the behavior of sick persons (Wilson 2001).

3.5. Methodology

The key to successful identification of morbidity effects is in how to deal with unobservable factors that confound both morbidity and outcomes of intrahousehold resource allocation. To see this, consider the empirical counterparts of the reduced forms in (3.15)-(3.17).

$$T_{it}^{j} = \alpha_0 + \alpha A_k + \delta H_{kt} + \omega W_{it}^{j} + \kappa K_k + \pi P_{vt} + \tau V_v + \eta_t^{j}, \tag{3.19}$$

where i and j are as defined above, t is time, k represents a household, A_k denotes

[55] For instance, Sauerborn et el. (1996b) show that there is seasonal variability in illness perception in Burkina Faso. In particular, according to their study, there were significantly fewer illness episodes perceived in the rainy season, and the proportion of illnesses perceived as severe dropped significantly from 36 % in the dry season and 8 % in the harvest season.

household specific time-invariant *unobservables*, H is the health stock of the household, W is a vector of wage rates, K is a vector of other time-invariant household-specific *observable* characteristics, P is a vector of prices, V is a vector of time-invariant village-specific characteristics, and η_t^j is an error term. The error term is assumed to represent both time-invariant unobserved heterogeneity not captured by A_k (i.e., individual heterogeneity) and time varying random shocks other than health shocks. The coefficient δ is of special interest in this model because it measures the health shock effects. The theoretical framework in this study indicates that the impact of the overall health shock is likely to be affected by household-specific unobservable factors such as the household production technology and the substitution possibilities across different types of family labor. Morbidity of household members may also be affected by the time allocated by household members for the production of public goods (i.e., hygiene or sanitation). Due to data limitations, however, the variable A_k' will be omitted, and so the error term will pick up the influence of this omitted variable. Thus, the error term will be correlated with the regressors, causing OLS estimates to be biased and inconsistent.

One of the methods used in this study to minimize this bias is difference-in-differences (DID) estimation. This is based on the assumption that the most important omitted variables are time invariant, which implies that the effects of omitted variables can be captured by household level fixed effects. A household is assigned to a "treatment group" if an adult in the household has experienced any serious health problem since the initial time period (t=0) (M). In contrast, the comparison group is comprised of households that have not experienced working-age adult morbidity (N). The simplest estimate of the impact of health shocks on time allocations is the difference in the outcomes before (t=0) and after (t=1) the onset of prime age adult morbidity.[56]

(3.20) $$\Delta E(T|i \in M) = [E(T_{M1i}) - E(T_{M0i})]$$

The sample analog of the above population estimates, however, will be biased if the estimator picks up some unrelated time trends or other exogenous shocks unrelated to prime age morbidity. So the difference in outcomes within the control group is subtracted to eliminate such time trends or impacts of unrelated shocks. From (3.19) we get

(3.21) $$\Delta E(T|i \in M) = \omega \Delta W_i^j + \pi \Delta P_v + \delta D_{kt}$$

(3.22) $$\Delta E(T|i \in N) = \omega \Delta W_i^j + \pi \Delta P_v$$

where D_{kt} is a dummy for households that experienced morbidity shocks. As can be seen, the equation (3.20) does not identify the morbidity effect captured by δ as it picks up other effects as well, unless all factors observable and unobservable are controlled for. Thus the following population difference-in-differences is used to calculate the expected change in time spent on activity j by an individual i.

(3.23) $$\Delta E(T) = [E(T_{M1i}) - E(T_{M0i})] - [E(T_{N1i}) - E(T_{N0i})];\ \text{i=m,f}$$

which is equivalent to

[56] This is sometimes called "before and after" estimator

(3.24) $\Delta E(T|i \in M, t) - \Delta E(T|i = N, t) = \delta$

Likewise, the following population difference-in-differences are used for estimations of effects on profits.

(3.25) $\Delta E(\pi) = [E(\pi_{M1i}) - E(\pi_{M0i})] - [E(\pi_{N1i}) - E(\pi_{N0i})]$; i=m,f

Any time-invariant components and 'global' (other than household or area-specific) time trends will be canceled out by differencing the household data in difference-in-differences estimators.

The key identifying assumption here is that trends of outcome variables are the same for both groups in the absence of morbidity shocks. In particular, the following equation is assumed to hold.

(3.26) $\Delta E(T|i \in M) = \Delta E(T|i \in N)$

However, the assumption that the most important omitted variables are time invariant may not be plausible. For instance, although the equation (3.23) controls for unobserved household characteristics, there may be household specific and village specific time-varying effects that might be correlated with both adult morbidity and intra-household time allocation. To see this, assume that the error term can be decomposed into time invariant individual heterogeneity (μ_i) and other random shocks to time allocation (ε_{it}) as follows.

(3.27) $\eta^j_{it} = \mu_i + \varepsilon_{it}$

What is not eliminated from DID is any village-specific or household specific time-varying component (ε_{it}) that is correlated with both prime-age adult morbidity and intra-household time allocation. To control for household specific and area specific time-varying effects, this study uses a regression DID method and includes several *observable* time-varying factors in the model. Among those variables, this study controls for natural disaster shocks, one major confounding factor in estimating morbidity effects on intrahousehold resource allocations. I assume that the influence of other *unobservable* time-varying effects is insignificant or uncorrelated with change in health status, and indeed it may be less of an issue with panel estimations of two periods. The following model offers a convenient way to construct DID estimates with control variables for individual i in household k:

$$(3.28)\quad T^{j}_{ikt}= \alpha_k + \beta_0 d_t + \beta_1 H_{mkt}+ \beta_2 H_{fkt} + \beta_3 W_t + \beta_4 P_t + \beta_5 K_k' + \beta_6 S_k' + \varepsilon_{ik}\ ;\ j = H,F,M,$$

where $\alpha_k (\equiv \alpha_0 + \alpha A_k'$ in (3.19)) controls for household specific unobservables, d_t is a time dummy that switches on for observations obtained in 2007, H_m and H_f are dummies for health status of prime-age male and female adult, respectively. P is a vector of prices, K is a vector of other time-invariant household-specific characteristics, S' is a dummy for natural disaster shocks measured at the household level. As discussed above, it is used to control for one major source of spurious correlation that affects changes in both health and time allocation. Regressions are also run with different health measures for prime age adult morbidity to test whether there are any differential effects of morbidity depending on duration and severity. Since there are only two time periods in this analysis, the above estimator is essentially the same as estimation in deviations from means or differencing. While the unbiased estimation of morbidity effects requires complete data on household specific unobservables in (3.19), the above estimator does not need such data because α_k controls for the effects of the factors.

One distinguishing feature of this study is that it takes into account duration as well as the severity of morbidity rather than simply using an indicator of episodes. This is important because the accuracy of the estimated effects of negative health shocks may depend on the shock magnitudes rather than the existence of a shock (Strauss and Thomas 1995; Larson et al. 2004; Beegle 2005). Brief episodes of illness are likely to have smaller impacts on production decisions and outcomes than longer term illnesses or recurrent shorter episodes of illnesses would have on farm household crop production.[57] Since household income and family size may be endogenous, this study uses variables measured prior to any onset of illness.

To estimate the effects of morbidity on profits, I use the following model specification for each household i:

$$(3.29) \qquad \pi_{kvt} = \alpha_k + \beta_0 d_t + \beta_1 H_{mkt} + \beta_2 H_{fkt} + \beta_3 W_t + \beta_4 P_t + \beta_5 K_k' + \beta_6 S_k' + \varepsilon_{ik}$$

Similar to (3.28), S' is a dummy for natural disaster shocks measured at the household level and it is included to control for the confounding factor that affects both health and family farm profits. Under the assumption of complete labor markets and separability between consumption and production decisions, the coefficients on H_{mk} and H_{fk} are zero, indicating that there is no effect of morbidity on family farm

[57] For instance, Beegle (2005) shows that adult mortality may have differential impacts on adjustments in time allocation and household activities depending on the duration of the shocks.

production. That is, as explained in section 3.3, farm profits will not decrease if separability holds and there is perfect substitutability between hired labor and family labor. On the contrary, if households respond to the health shock through only intrahousehold resource allocation, at least one of the coefficients on H_{mk} and H_{fk} will be nonzero.

An alternative model is possible if one makes a stronger assumption that intrahousehold resource allocation is more likely to be affected by household-specific observables and village-specific unobservables that also affect changes in income and health status. In this case one would need to use a village-specific fixed effect model. In fact, it appears that Gertler and Gruber (2002) make the above assumption in their study to claim that there is very imperfect insurance of consumption over illness episodes in Indonesia.[58] They assume that the model controls for one major source of confounding factors, shocks to the local community economy such as weather, by including a set of community fixed effects. One problem with this approach is that the areas affected by natural shocks may not be the same communities defined by survey designers or econometricians. Even if they coincide, the effects of changes in economic environments are likely to differ for each household as explained above. The 2007 wave of the IFLS data allows one to deal with some of these issues as they contain detailed information on natural disasters over the past five years, such as the timing, severity, and effects on health and income, which were measured at the household level. Also available are changes in the local economy. All this

[58] They use different data, the Indonesian Resource Mobilization Study (IRMS), which was implemented between 1991 and 1993. That survey has a much smaller sample size than the IFLS. They also use two measures of health status, but the duration of morbidity is not controlled for.

information can be used to directly control for some village-specific confounding factors which are time variant while DID model is used to deal with the issue of household-specific time invariant unobservables. Thus, this study favors DID estimation with household fixed effects, but the estimation results of this alternative model are also presented as well, for comparison.

3.6. Description of the Sample and Estimation Results

3.6.1. Descriptive Statistics

Table 3.2 presents descriptive statistics of data used in this study. It shows that 19 percent of husbands and 17 percent of wives reported some health issues that limit to some degree the amount of paid work they can do. Furthermore, one percent of husbands and one percent of wives reported morbidity symptoms that lasted longer than one year. As a way to collect more objective health information, this study also relies on a measure that assesses an individual's physical ability to perform activities of daily living (ADLs). This study uses the following algorithm developed for the RAND Medical Outcome Study (Stewart et al., 1990):

$$Health = \left(\frac{Score - Min\ Score}{Max\ Score - Min\ Score}\right)$$

The Index takes on a value of 1 if the individual is completely healthy (i.e., he or she can perform all ADLs without difficulty). The index value of zero, on the contrary, indicates the opposite extreme case. Following Gruber and Gertler (2002), ADLs are also divided into two categories: Basic and Intermediate ADL. The basic ADL index measures the ability of a respondent to do some basic daily activities such as bathing, feeding, clothing, rising and standing from sitting, and going to the toilet. The intermediate ADL index measures the ability to do work that requires more strength such as sweeping the house yard, drawing a water pail from a well, and carrying a heavy load for 20 meters. It consists of the ability to sweep the floor, walk for 5 kilometers, take water from a well, carry a heavy load for 20 meters, and bend, kneel, or stoop. **Table 3.2** presents the descriptive statistics. Overall, the health status of respondents appears to have deteriorated somewhat. This is shown by all measures used in this study, which is not surprising since respondents are getting older between the surveys. The value of the basic ADL index close to one indicates that people with severe limitations to basic daily activities are rare in Indonesia. Despite the deterioration of overall health between 2000 and 2007, the labor hours of respondents have slightly increased during the period. The increase appears to be greater for spouses and other dependents than household heads.

3.6.2. Regression Results

3.6.2.1. Effects of Chronic Illness and Acute Morbidity on Labor Supply of Heads

Table 3.3 presents regression results of three models that estimate the effects of chronic illness and acute morbidity of husbands and wives on changes in the husbands' labor hours. The first model estimates the effects using ordinary least squares (OLS) regression (the second column). The results show that chronic illness or acute morbidity of husbands that lasts longer than one year is associated with a reduction of weekly labor hours approximately by 18 hours per week. This is roughly about 30% lower than the mean weekly labor hours of husbands. The next column shows regression results using a difference-in differences model, which controls for household fixed effects. The coefficient on the long lasting morbidity symptom of husbands is larger than the result of the OLS estimation. The last column shows results from a village fixed effect model (VFE), which is similar to the model specification of Gruber and Gertler (2002). The results appear to be consistent with the previous results, although the coefficient on the morbidity of husband is closer to the result of the OLS estimation. Gruber and Gertler found no significant effects on own labor hours of household heads for chronic symptoms, which is different from the finding of this study.[59] One major difference other than the result is that they did not control for the duration of chronic illness, whereas this study controls for the effects of chronic symptoms longer than one year. Also this study excludes minor symptoms that are reported to have no effects on physical abilities to work.

On the other hand, there is no evidence that husbands increase or decrease their labor hours even when their spouses have morbidity symptoms that last longer than one year. As explained in section 3.2.1., long lasting chronic symptoms of one household member may increase labor hours of other household members by the added worker effect (AWE). The findings of this section are consistent with general findings of the literature that provides weak or no evidence for AWE. These findings, however, are not comparable with the study of Gruber and Gertler (2002) since they did not include other family members' health status in their model.

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[59] Their study investigates the effects of morbidity on household heads instead of husbands.

Models in this analysis also include other variables to control for effects of some observable factors at the household and the village levels. The indicator variable of natural disasters in the past 5 years has a negative sign and is significant in OLS, but not in the HHFE model. The change in mean village consumption expenditure is used to control for overall changes in the price level at the community level under the assumption that the mean quantity of food consumption remains somewhat constant between the two survey periods.[60] Decreases in food or agricultural product prices may induce farmers to work less, but the opposite may also be true if they try to make up for the decrease in income as sellers of agricultural products. The negative sign in the HHFE model indicates that the latter effect is dominant. The change in mean village income is included to control for the changes in mean productivity of people in village, which is associated with overall changes in wage rates in the village. Labor hours of husbands would increase when the income effect is greater than the substitution effect, which appears to be the case in this analysis.

3.6.2.2. Effects of Chronic Illness and Acute Morbidity on Labor Supply of Other Members

Consistent with the labor hours of husbands, wives also appear to reduce their own labor hours with long lasting symptoms of chronic illnesses, but they are smaller and statistically significant only in the OLS model (**Table 3.4)**. Unlike husbands, in contrast, there is evidence that wives increase their labor hours when household heads

[60] While the level of mean village consumption may change it is assumed that the price elasticity of food consumption is small.

have chronic symptoms for longer than one year. In the HHFE model, wives are shown to increase their labor hours by as many as 15 hours per week when their husbands are sick. The difference in responses between husbands and wives is likely to be due to the fact that morbidity of husbands that lasts longer than one year in general has more detrimental effects on households' financial situations than morbidity of wives. On the other hand, the labor hours of dependents appear to increase when wives have chronic symptoms for longer than one year (**Table 3.5**).[61] The results are consistent across all models. The results of the HHFE model show that approximately 30 hours per week are added by dependents other than wives when wives are sick longer than one year. However, the hours of dependents do not show statistically significant changes in response to sickness of husbands, although they appear to increase. This may be due to substitutability of labor among household members. For instance, the labor of wives may be more substitutable by other household members than that of husbands. There may also be gender roles in substituting for labor of sick members. For instance, female dependents may work more when wives are sick while male members increase their labor hours when household heads are sick. The last two columns of **Table 3.5** show additional regression results with male and female dependents. Unlike the conjecture, they show that male dependents increase their labor hours when wives are sick while female dependents reduce their labor hours when husband or wives have chronic or acute morbidity symptoms. Perhaps the most plausible explanation is that female

[61] Dependents in this analysis are defined to be household members older than 12 years old.

dependents tend to spend more time to take care of sick adults while male dependents increase their hours to earn more income for the households.[62]

Overall, adult morbidity that lasts longer than one year appears to induce some intrahousehold labor substitution in Indonesia. The labor of husbands during their sickness appears to be substituted by their spouse. While wives may not reduce their own labor hours when they are sick, dependents (especially male family members) are shown to increase their labor hours for the sick members. Yet, there is no evidence that labor of spouses is substituted by husbands even when they are sick longer than one year. This may indicate a heavier labor burden for Indonesian women. The findings of this section also contribute to the AWE literature in that they provide evidence for existence of AWE in the context of developing countries. While the AWE literature in general focuses on unemployment of the primary earner and its impact on the labor supply of the secondary earner in households in developed countries, this study also adds a new dimension to the literature by presenting a more comprehensive picture of intrahousehold labor substitution within Indonesian households facing long term morbidity shocks.

3.6.2.3. Effects of Change in ADLs Index Scores on Labor Supply

This study also utilizes health information on each individual's physical ability to perform activities of daily living (ADLs). **Table 3.6** presents the results of the same analyses as the previous section using this alternative health measure. In these analyses, I present only the household fixed effects model as it is believed to be a

[62] Thus, in the equation (3.18) of section 3.3, the substitution effect may be dominant for female dependents while income effect may be dominant for male dependents.

better model in capturing the morbidity effects of adults on intrahousehold labor supply than the OLS and VFE models.[63] For each model specification, two categories of ADLs are used to investigate differential effects of health shocks: basic ADLs and intermediate ADLs. The basic ADLs index measures abilities to perform basic daily activities, and hence intends to capture more drastic changes in health status. Since the morbidity shock is represented by a reduction in the ADL index, a positive coefficient indicates that illness reduces labor supply. The regression results show that, consistent with the previous results, husbands decrease their own labor when their ability to perform basic daily activities deteriorates. The coefficient implies that husbands reduce their labor hours by 50 per week as their health deteriorates from completely healthy (index =1) to completely sick (index = 0). In other words, if the husband moved from able to perform all basic ADLs to unable to perform one of basic ADLs, his labor hours would fall by 18% of baseline hours. As expected, the change in intermediate ADL index scores is associated with a lower magnitude of decrease in own labor hours (28 hours). Unlike the previous results, on the other hand, wives are also shown to decrease their own labor hours and they are statistically significant in all models when their ADL scores are lowered. The magnitude, however, is much less than that of husbands' reduced hours for basic ADLs and intermediate ADLs, respectively. Again, it may indicate relatively heavier labor burdens of women in Indonesia.

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[63] As in the previous analysis, the results of OLS and VF models are similar.

Interestingly, in contrast to the case of chronic symptoms, husbands are found to decrease their labor hours when the ADL index score of their spouses decrease, and the effect is statistically significant for the intermediate ADL. The difference may be because changes in the basic ADL index are likely to include information about more severe and unexpected illnesses or injuries than the measure of chronic illness symptoms. Also, the ADL index is more likely to measure consequences of illness shocks than the indicator of chronic symptoms. For instance, unlike the ADL index, symptoms of acute morbidity of chronic illnesses may not have immediate effects on physical abilities of a person.Thus the difference may indicate that husbands choose to spend more time on production of home goods rather than on income generating activities when their spouses suffer more severe health shocks. On the other hand, labor hours of other family members including spouses are not found to be significantly different when ADL scores of husbands or wives change. In the case of chronic symptoms, spouses were found to increase their labor hours when heads were sick for longer than one year. Also male dependents were found to increase their labor hours while female dependents reduce their hours. The difference may be due to the need for more care time from spouses when husbands experience more severe health changes, captured by ADL index scores.[64] Some of these findings are also consistent with the results of Gertler and Gruber (2002), who find that changes in heads' ADLs have no effect on labor supply of other family members. Their study,

[64] The coefficients indicate that some dependents increase their labor hours, although they are not statistically significant. In this case, substitution effects may be greater than the case of chronic symptoms.

however, focus only on heads' labor hours due to data limitations, and so they have no results for spouses' labor hours.[65]

3.6.2.4. Effects of Adult Morbidity on Family Farm Profits

The previous sections presented some evidence that Indonesian households cope with long lasting chronic illnesses through intrahousehold labor substitution when they appear to be vulnerable to more severe major health shocks. This section investigates whether farm profits are affected by adult morbidity. **Table 3.7** presents the regression results with measures of chronic illness symptoms and changes in ADL index scores. In this analysis, farm profits were rescaled by multiplying 10^{-6}. Due to the existence of some sizable negative values, the log transformation was not viable. The results show that chronic symptoms of husbands and wives are not significantly associated with a decrease in farm profits, although the coefficients on the symptoms of husbands show sizable negative effects. In contrast, the effects of health shocks to heads appear to be negatively significant on farm profits when changes in basic ADLs are used in estimation (Model 2). In particular, according to the results, farm profits decrease by almost 30 % of baseline profits when the health of husbands changes from able to perform all basic ADLs to unable to perform one of basic ADLs. On the other hand, there is no evidence that farm profits are affected by the health status of wives. This may be because family farms in Indonesia are more likely to be managed by husbands. Also, this appears to be consistent with the previous test results that labor hours of spouses do not change when they are sick. Overall, the results in this

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[65] They use imputed earnings as proxy variables for labor hours of other family members due to data limitations. They are used only as the dependent variables in the estimation of morbidity effects of heads.

section appear to be consistent with the previous results: households are able to cope with chronic illnesses of household heads to some degree through intrahousehold labor substitution, but they appear to suffer from more severe health shocks that change the ability to perform basic daily activities.

On the other hand, the findings in this section are different from results of Pitt and Rosenzweig (1986). They find that farm profits are not affected by illnesses of household heads in Indonesia while illness adversely affects own labor supply of farmers. They argue that their results support the validity of the separability hypothesis for Indonesian farm households. Intuitively, farm profits should be independent of the farmer's health status when market substitutes are easily available for his or her labor input, measured by efficiency units or time.[66] The shortcoming of their study, however, is that the data they use have information only on short-term farm profits and illness. Moreover, the health status of family members is indicated only by the occurrence of illness during the previous week and it is based on self-reports of survey respondents. The findings of this section suggest that studies investigating the effects of health shocks should take into account duration as well as severity of morbidity. The theoretical framework in this study also demonstrated the importance of controlling for household fixed effects.

Table 3.8 shows regression results using models similar to Pitts and Rosenzweig (1986). Since they use cross sectional data, they included detailed price information for 13 consumption items in their model in an attempt to control for

[66] This does not mean that potential income or household full income is not affected by morbidity shocks. In their model, household full income is defined to be the sum of the profit maximizing level of profits and labor income when the farmer works full time.

village-specific economic situations. While their estimations may not be directly comparable with the estimates of this study, regression models in **Table 3.8** share the weakness of their model specifications caused by their data limitations: 1) the duration of morbidity is not controlled for, 2) there is no control for household fixed effects, 3) there is no control for other confounding factors such as natural disaster shocks. The results are quite different from the estimates shown in **Table 3.7**. There is no evidence that family farm profits are affected by morbidity shocks. The results are consistent although some of the models control for severity of health shocks (Models 3 and 4).

The results of this study, however, should not be taken as firm evidence against separability in Indonesian agricultural households. For a better estimation of morbidity effects and the test of separability, one would need complete data on the value of family labor, all agricultural secondary inputs, land quality, and steepness. While the profit variable in this study is based on total expenses and total revenue data from IFLS, the value of family farm labor is not likely to be included in the reported total expenses. Also revenue and expenses data are all reported by farmers and prone to measurement errors. The results of this study suggest that model misspecification may be another important source of bias in the investigation of morbidity effects on farm profits and test of separability.

3.7. Conclusion

Despite its significance for development policies, only a few attempts have been made to analyze the coping strategies of households in developing countries in response to prime age adult morbidity. The effects of morbidity are likely to be greater, compared to the effects in developed countries, due to the limited access of those households to health insurance and credit markets. Few households in developing countries have the financial capacity to cope with health shocks. Substituting adult labor for an ill adult may be an important coping strategy, especially for those who have insufficient financial capacity to cover the direct and indirect costs of the illness. The literature on coping mechanisms of households in developing countries has surprisingly little research on the coping strategies of households suffering from prime-age adult morbidity. This study attempts to bridge the gaps in the literature and shed light on the mechanisms households utilize in response to the morbidity shocks under constraints of limited access to other coping strategies. Furthermore, this analysis may also provide useful information to policy makers in the sense that it enables them to identify the individuals within households who are more vulnerable to unexpected health shocks.

The results of this chapter present some evidence that Indonesian households attempt to cope with morbidity shocks through intrahousehold labor substitution. Their coping strategy appears to function much better when husbands suffer from chronic illnesses, compared with the case when they experience more drastic changes in health status as measured by changes in ADL index scores. Moreover, this study finds that households suffering morbidity shocks are unable to keep their family farm profits stable. They appear to be more detrimental effects of morbidity shocks when husbands' health status changes than when their spouses' health status changes. This chapter also shows that Indonesian women may be the ones who suffer more from health shocks due to their heavier labor burdens.

Table 3.1: Health Expenditures and Health Systems of Asian Countries

Indicator	Indonesia	Philippines	Thailand	Malaysia	China	Cambodia	Viet Nam
Total health spending[1] as % of GDP	2.2	3.3	3.5	4.3	4.5	6	6.6
Hospital beds (per 10,000 population)	2.5	13	22	19	22	6	26
Physician density (per 1000 population)	13	58	37	70	106	16	53
Nursing density (per 1000 population)	62	169	28	135	105	61	56

Sources: WHO (2006) and WHOSIS accessed at http://www.who.int/whosis/en/index.html .

1.Total expenditure include both government and private expenditure on health.

Table 3.2: Descriptive Statistics

Variable	Mean	Std. Dev.	Mean	Std. Dev.
	Year 2007		Change 2000 - 2007	
total weekly labor hours: husband	53.49	49.31	0.59	47.98
total weekly labor hours: wife	47.24	35.54	1.11	20.98
total weekly labor hours: dependents	71.27	83.68	4.40	47.24
Profits (ln)	15.25	15.91	1.02	2.63
household consumption (ln)	13.93	0.96	0.10	3.35
morbidity of husband< 1yr (1= yes)	0.18	0.38		
morbidity of husband> 1yr (1= yes)	0.01	0.12		
morbidity of wife < 1yr (1= yes)	0.16	0.37		
morbidity of wife > 1yr (1= yes)	0.01	0.08		
ADL index : husband	0.95	0.11	-0.03	0.12
ADL index : wife	0.94	0.10	-0.02	0.12
Basic ADL index : husband	0.97	0.08	-0.02	0.10
Basic ADL index : wife	0.98	0.07	-0.01	0.09
Intermediate ADL index : husband	0.92	0.16	-0.04	0.16
Intermediate ADL index : wife	0.91	0.15	-0.02	0.17
male head(1=yes)	0.67	0.47		
age of husband	42.86	24.78		
age of wife	38.53	21.52		
family size:	6.37	2.85	2.62	3.87
illness caused by disaster (1=yes)	0.01	0.30		
education level of head (1= < elementary, 4 >= college)	1.86	1.04		
farm size : (ln sq meter)	7.94	1.76	-0.39	1.94
mean village consumption (ln)	14.14	1.04	-0.22	0.05
mean village income (ln)	15.95	0.61	1.06	0.51
disasters last 5 years (1= yes)	0.07	0.33	0.00	1.00
medical costs : (ln)	8.94	6.78	0.95	5.82

Source: IFLS

Table 3.3: Effects of Chronic Illness and Acute Morbidity on Husband's Labor

	OLS	HHFE	VFE
morbidity of husband< 1yr (1= yes)	2.144	0.112	-2.413
	(3.830)	(2.458)	(2.768)
morbidity of husband> 1yr (1= yes)	-18.370**	-25.886***	-19.787**
	(8.159)	(8.921)	(9.977)
morbidity of wife < 1yr (1= yes)	-1.212	0.901	1.065
	(3.696)	(2.364)	(3.071)
morbidity of wife > 1yr (1= yes)	-4.55	-2.317	-2.861
	(5.444)	(10.777)	(8.538)
year (1= 2007)		31.968	
		(32.417)	
illness caused by disaster (1=yes)	3.000***		9.392
	(0.623)		(12.972)
male head(1=yes)	-9.073***		-7.665**
	(2.836)		(3.081)
change in family size	0.016	0.386	-0.243
	(1.260)	(0.425)	(0.452)
education level of head	0.405		0.965
	(0.265)		(1.183)
change in farm size (ln)	-5.788	-0.119	0.174
	(5.077)	(0.240)	(0.225)
change in mean village consumption (ln)	6.924**	-3.974	
	(2.985)	(3.403)	
change in mean village income (ln)	-10.975	5.840***	
	(7.752)	(1.931)	
disasters during last 5 years (1= yes)	54.833	-3.845	-0.754
	(46.771)	(4.267)	(6.132)
constant	54.833	-51.069*	5.303
	(46.771)	(29.498)	(4.172)
household fixed effects	No	Yes	No
village fixed effects	No	No	Yes
Obs	2053	4262	2053

* p<0.05, ** p<0.01, *** p<0.00. Standard errors are in parentheses. All standard errors were adjusted for within cluster dependence.

Table 3.4: Effects of Chronic Illness and Acute Morbidity on Wife's Labor

	OLS	HHFE	VFE
morbidity of husband< 1yr (1= yes)	1.485	0.568	0.991
	(1.488)	(1.721)	(1.690)
morbidity of husband> 1yr (1= yes)	6.733	14.682**	9.995
	(7.126)	(6.245)	(7.500)
morbidity of wife < 1yr (1= yes)	0.277	0.21	-0.222
	(1.515)	(1.655)	(1.683)
morbidity of wife > 1yr (1= yes)	-8.670**	-10.842	-7.384
	(4.057)	(7.544)	(5.725)
year (1= 2007)		16.624	
		(22.693)	
illness caused by disaster (1=yes)	0.102		4.321
	(0.261)		(7.687)
male head (1=yes)	-1.623		-1.277
	(1.398)		(1.820)
change in family size	0.152	0.05	0.16
	(0.254)	(0.298)	(0.294)
education level of head	-0.942		-1.005
	(0.684)		(0.803)
change in farm size (ln)	0.006	-0.017	0.045
	(0.120)	(0.168)	(0.155)
change in mean village consumption (ln)	-0.434	-1.764	
	(2.050)	(2.382)	
change in mean village income (ln)	2.092*	2.189	
	(1.152)	(1.352)	
disasters during last 5 years (1= yes)	-3.182	-1.986	-3.325
	(2.218)	(2.987)	(3.506)
constant	5.702	-20.402	3.944
	(19.247)	(20.649)	(2.499)
household fixed effects	No	Yes	No
village fixed effects	No	No	Yes
Obs	2053	4262	2053

* p<0.05, ** p<0.01, *** p<0.00. Standard errors are in parentheses. All standard errors were adjusted for within cluster dependence.

Table 3.5: Effects of Chronic Illness and Acute Morbidity on Dependents' Labor

	OLS	HHFE	VFE	HHFE	HHFE
Dependent variable	labor of all dependents	labor of all dependents	labor of all dependents	labor of male dependents	labor of female dependents
morbidity of husband< 1yr	-0.514	1.099	0.071	3.747	0.365
(1=yes)	(2.654)	(2.591)	(2.984)	(2.321)	(0.312)
morbidity of husband> 1yr	4.319	-1.011	5.793	-5.514	-0.281**
(1=yes)	(9.146)	(9.403)	(10.339)	(5.402)	(0.118)
morbidity of wife < 1yr	0.666	4.527*	2.545	4.397**	-0.328**
(1=yes)	(3.417)	(2.491)	(2.518)	(1.907)	(0.159)
morbidity of wife > 1yr	19.860***	29.216**	21.064**	15.782**	-0.446***
(1=yes)	(7.323)	(11.359)	(8.429)	(7.722)	(0.168)
year (1= 2007)		14.881		49.465***	-0.402
		(34.167)		(17.577)	(2.251)
illness caused by disaster (1=yes)	0.566		9.108		
	(0.699)		(9.441)		
male head (1=yes)	5.263**		5.447		
	(2.611)		(3.517)		
change in family size	3.802***	3.666***	4.039***	3.797***	0.096**
	(0.512)	(0.448)	(0.581)	(0.478)	(0.044)
education level of head	-3.911***		-2.361*		
	(1.116)		(1.214)		
change in farm size (ln)	0.041	0.093	0.091	0.425***	-0.022
	(0.269)	(0.253)	(0.219)	(0.134)	(0.018)
change in mean village	-7.262	-2.557		-6.082***	0.014
consumption (ln)	(5.338)	(3.586)		(1.904)	(0.242)
change in mean village	2.904	3.104		0.874	0.115
Income (ln)	(3.155)	(2.035)		(1.128)	(0.127)
disasters during last 5 years	-12.07	-8.904**	-9.801*	-2.902	-0.339***
(1=yes)	(8.262)	(4.498)	(5.315)	(2.300)	(0.098)
constant	60.86	-42.664	-9.770**	-3.629	-1.725
	(48.719)	(31.090)	(4.643)	(14.693)	(1.517)
Household fixed effects	No	Yes	No	Yes	Yes
Village fixed effects	No	No	Yes	No	No
Obs	2053	4262	2053	4262	4262

* p<0.05, ** p<0.01, *** p<0.00. Standard errors are in parentheses. All standard errors were adjusted for within cluster dependence.

Table 3.6: Effects of Changes in Basic and Intermediate ADL Indices on Labor Hours of Family Members

Dependent Variable	Husband's labor		Wife's labor		Dependents' labor[1]	
	basic	intermediate	basic	intermediate	male	female
ADL score of husband	50.019***	27.964***	3.642	0.43	-14.065	0.944
	(11.043)	(5.174)	(7.913)	(3.694)	(12.289)	(0.803)
ADL score of wife	12.107	7.872*	20.168***	11.597***	-4.733	-3.974
	(8.760)	(4.390)	(6.209)	(3.139)	(10.578)	(4.078)
year (1=yes)	40.313	39.668	46.383**	44.564**	85.755**	-1.66
	(26.061)	(26.017)	(18.900)	(18.900)	(33.602)	(1.326)
change in family size	-0.251	-0.21	-0.167	-0.164	4.113***	0.082
	(0.284)	(0.283)	(0.202)	(0.202)	(0.432)	(0.071)
change in farm size	-0.09	-0.072	-0.01	-0.009	0.599**	-0.051
	(0.155)	(0.154)	(0.111)	(0.111)	(0.294)	(0.045)
change in mean village	-4.285	-4.18	-4.615**	-4.427**	-9.194**	0.155
consumption	(2.785)	(2.780)	(2.022)	(2.021)	(3.588)	(0.124)
change in mean village	1.537	1.499	1.228	1.258	0.257	-0.081
income	(1.145)	(1.141)	(0.815)	(0.814)	(0.940)	(0.063)
disasters in last 5 yrs	1.572	1.877	3.451	3.684*	-5.646*	-0.063
(1=yes)	(3.075)	(3.068)	(2.215)	(2.214)	(3.253)	(0.055)
constant	-46.568**	-19.453	-20.918	-9.594	28.87	4.017
	(20.907)	(17.042)	(14.781)	(12.022)	(19.928)	(3.994)
Household fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Obs	4262	4262	4262	4262	4262	4262

* p<0.05, ** p<0.01, *** p<0.00. Standard errors are in parentheses. All standard errors were adjusted for within cluster dependence. 1. Basic ADL index only.

Table 3.7: Effects of Adult Health Shocks on Family Farm Profits

	Model 1	Model 2	Model 3
morbidity of husband< 1yr	-0.565		
	(0.413)		
morbidity of husband> 1yr	-1.164		
	(1.509)		
morbidity of wife < 1yr	0.27		
	(0.385)		
morbidity of wife > 1yr	0.032		
	(1.742)		
ADL score of husband: basic		5.805*	
		(3.069)	
ADL score of wife : basic		0.112	
		(2.622)	
ADL score of husband: intermediate			4.047***
			(1.467)
ADL score of wife : intermediate			-0.815
			(1.254)
year	-8.671*	-17.765**	-17.308**
	(5.147)	(6.974)	(6.962)
change in family size	-0.024	0.083	0.087
	(0.060)	(0.081)	(0.081)
change in farm size	0.405***	0.341***	0.342***
	(0.036)	(0.045)	(0.045)
change in mean village consumption	0.938*	1.877**	1.831**
	(0.556)	(0.745)	(0.744)
change in mean village income	2.359***	2.347***	2.357***
	(0.282)	(0.349)	(0.349)
disasters during last 5 years	-0.085	-0.962	-0.952
	(0.659)	(0.833)	(0.832)
constant	-37.476***	-45.654***	-43.009***
	(3.703)	(6.329)	(5.254)
Household fixed effects	Yes	Yes	Yes
Obs	4262	3926	3926

* p<0.05, ** p<0.01, *** p<0.00. Standard errors are in parentheses. All standard errors were adjusted for within cluster dependence.

Table 3.8: Effects of Adult Health Shocks on Family Farm Profits (alternative estimations)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
morbidity of husband< 1yr	-0.172	-0.18				
	(0.184)	(0.198)				
morbidity of wife < 1yr	0.194	0.111				
	(0.175)	(0.187)				
basic ADL score change:			2.056	1.911		
husband			(1.501)	(1.612)		
basic ADL score change:			-1.801	-2.214		
wife			(1.359)	(1.511)		
intermediate ADL score change					0.503	0.198
:husband					(0.706)	(0.801)
intermediate ADL score change					-0.703	-0.918
:wife					(0.558)	(0.623)
male head (1=yes)	0.211	0.171	-0.039	-0.223	-0.123	-0.337
	(0.252)	(0.272)	(0.703)	(0.812)	(0.700)	(0.809)
change in family size	-0.077**	-0.057	0.008	-0.022	0.008	-0.025
	(0.034)	(0.037)	(0.040)	(0.048)	(0.040)	(0.048)
education level of head	-0.017	-0.019	-0.048	-0.024	-0.051	-0.034
	(0.092)	(0.103)	(0.112)	(0.132)	(0.112)	(0.132)
change in farm size	0.038**	0.023	0.037	0.009	0.037	0.01
	(0.019)	(0.021)	(0.024)	(0.028)	(0.024)	(0.028)
change in mean village	0.668**		0.478		0.453	
consumption	(0.271)		(0.336)		(0.335)	
change in mean village	0.397***		0.443**		0.448**	
income	(0.146)		(0.183)		(0.183)	
constant	-5.670**	1.176***	-3.984	1.365	-3.671	1.482*
	(2.568)	(0.352)	(3.267)	(0.888)	(3.260)	(0.884)
Village fixed effects	No	Yes	No	Yes	No	Yes
Household fixed effects	No	No	No	No	No	No
Obs	2053	2053	2053	2053	2053	2053

* p<0.05, ** p<0.01, *** p<0.00. Standard errors are in parentheses. All standard errors were adjusted for within cluster dependence.

CHAPTER 4

Essay 3: Consumption Vulnerability to Prolonged Illness

4.1. Introduction

Households in developing countries face substantial idiosyncratic and covariate risk, resulting in high income variability. Households living in these risky and volatile environments have developed a range of mechanisms to keep their consumption smooth in the face of such fluctuations. A large number of studies have examined the effectiveness of both formal and informal risk-sharing and consumption-smoothing arrangements (e.g. Alderman and Paxson, 1994; Townsend, 1994; Jalan and Ravallion, 1999; Ligon, Thomas and Worall, 2002; Gertler and Gruber,2002; Fafchamps and Lund, 2003; Dercon et al, 2006; Gertler et al. 2009). Most of these studies find evidence consistent with at least partial insurance for food consumption. That is, most households were successful, to a certain degree, in shielding their food and nonfood consumption from the full effects of income shocks.

There are relatively few empirical studies that investigate the extent to which households are able to smooth consumption over a period of prime-age adult morbidity. It is an important issue because morbidity shocks are characterized by unpredictability as well as very high direct and indirect costs. It is much more difficult, compared with other shocks, to cope with morbidity shocks in developing countries, where people typically have limited access to both medical facilities and formal health insurance. Little is known about the impact of illness on variation in households' consumption, or about the capacity of existing risk sharing arrangements to smooth consumption against illness, particularly in developing countries. Moreover, a key limitation of past studies is that they do not control for the duration and severity of morbidity, which are likely to have differential effects on household welfare. This study attempts to bridge these research gaps by investigating the impact of prime-age adult morbidity on the consumption of households, and the extent to which households are able to insure consumption against health shocks. Exceptionally rich health data from the Indonesian Family Life Survey (IFLS) are used to investigate the effects of morbidity on the consumption patterns of Indonesian households.

4.2. Literature Review

There exist a limited number of studies that examine the effect of morbidity on the extent to which households are able to keep their consumption smooth over time in developing countries. The results of those studies show mixed effects on the welfare of households. For example, Townsend (1994) finds that unemployment, illness, or other idiosyncratic shocks have little effect on household consumption in six villages in the semi-arid tropics of southern India (ICRISAT), although he rejects the full insurance hypothesis. In contrast, Gertler and Gruber (2002) find that Indonesian households are able to insure consumption fully against only minor illnesses that do not affect physical functioning, while they are unable to insure against major illnesses. They argue that the ability of households to insure consumption varies with the severity of the illness. Using different Indonesian data (the 1993 and 1997 IFLS data), Gertler et al (2009) find that access to financial institutions helps families to deal with adverse health shocks. One limitation of Gertler and Gruber (2002) and Gertler et al. (2009) studies is that they do not control for the duration of morbidity. Also, as discussed in Chapter 3, they do not control for household specific unobservables, which are likely to be important in intrahousehold resource allocations. Finally, due to some data limitations, their study does not investigate differential effects of morbidity on food and nonfood items.

Dercon and Krishnan (2000), using unpredicted illness as an individual idiosyncratic shock, find that in most Ethiopian households, except poor southern households, full risk-sharing of illness shocks takes place. Using the same data, Asfaw and Braun (2004) examine the impact of illness on different consumption items and find that illness has a statistically significant negative impact on stability of consumption and that the capacity of households or existing intra- and inter-household risk-sharing arrangements in insuring consumption against illness varies across different consumption items. Specifically, they show that the movement of the household head from a healthy to unhealthy status lowers the weekly purchased food consumption of the household by 24 percent and the non-food consumption items by 28 percent.

On the other hand, Wagstaff (2007) employs three measures of health shocks to analyze the effects of morbidity on income and consumption smoothing in Vietnam. The three measures are: i) the death in the previous 2 years of a working-age household member; ii) an inpatient spell of a week or more in the previous 12 months for a working or non-working member of the household (two separate indicators); and iii) a sizeable drop in body mass index (BMI) of the household head over the previous 5 years. He finds that food consumption responds negatively to several of the health shock variables in Vietnam.

One recent paper also presents evidence that supports full insurance of consumption against at least some health shocks. Using panel data on a rural population in Bangladesh, Powell-Jackson and Hoque (2012) find that households are able to fully insure consumption against maternal ill health, although there is a large reduction in household resources driven almost entirely by spending on health care. They ascribe the full consumption insurance of the households to sufficient access to informal credit. Their study, however, as other studies, does not control for the duration of illness and so may not capture the long-term effects of health shocks on consumption.

4.3. Methodology

As in the estimation of morbidity effects on labor allocations and farm profits in Chapter 3, the key to a successful identification strategy involves an effective control of confounding factors that affect both household consumption and morbidity shocks. For instance, consumption may decrease due to some natural disasters that affect both family farm production and the health status of prime age adults. While those shocks may be village-wide, the effects are likely to differ across households due to difference in farm characteristics, the possibility of labor substitution, access to credit, availability of other coping strategies, and so on. In an attempt to control for those household-specific unobservable effects, this chapter uses the same methodologies used in Chapter 3. In particular, assuming that household-specific unobservable time-varying effects are insignificant or uncorrelated with changes in health status, this study employs the difference-in-differences (DID) specification to estimate the effects of morbidity using the following regression equation.

(4.1) $\ln C_{kv} = \alpha_k + \beta_0 d_t + \beta_1 H_{mkt} + \beta_2 H_{fkt} + \beta_3 W_t + \beta_4 P_t + \beta_5 K_k' + \beta_6 S_k' + \varepsilon_{ik}$,

where $\alpha_k (\equiv \alpha_0 + \alpha A_k$ in (3.19)) controls for household specific unobservables, d_t is a time dummy that switches on for observations obtained in 2007, H_m and H_f are dummy variables for prime-age male and prime-age female health status, respectively, between 2000 and 2007. W and P denote village level price and wage information, and these are included to control for some observable time varying village-specific effects. Likewise, K denotes a vector of household observable characteristics and controls for some observable household-specific effects that are time variant. S' is a dummy for natural disaster shocks measured at the household level, which is used to control for one major source of spurious correlation, shocks to local economy that affect both changes in health and household consumption. Multiple regressions are also run with different health measures for prime age adult morbidity to test whether there are any differential effects of morbidity depending on duration and severity. Since there are only two time periods in this analysis, the above estimator is essentially the same as estimation based on deviations from means or differencing.[67]

In addition, the following specification is used to control for village-specific effects and to compare with the estimates of the household fixed effects model.

(4.2) $\Delta \ln(C_{kv}) = \alpha_v + \beta_1 H_{mkt} + \beta_2 H_{fkt} + \beta_3 K_k' + \beta_4 S_k' + \varepsilon_{ik}$,

where the dependent variable denotes the growth in log consumption for household k in village v and the explanatory variables are the same as in equation (4.1). Under the hypothesis of full insurance, β_1 and β_2 will be zero, implying that there is no effect of morbidity shocks on the change in household consumption.

4.4. Data

For the dependent variables in equations (4.1) and (4.2), this chapter uses the the log of total weekly nonmedical expenditures of households. The fourth wave (2007) of the IFLS provides information on expenditures for a variety of food and nonfood goods. More specifically, it includes information on the quantity of foods purchased and the value of foods consumed from self-production or received from another source during the last week. The expenditure categories are identical across the survey waves, so that household expenditures between all waves are comparable. They include spending on some necessities such as electricity, water, and fuel, as well as on non-necessities such as personal toiletries, some household items, domestic services, recreation and entertainment, and transportation. Some data on non-food

[67] While more precise specifications would include some interaction terms between household unobservables and morbidity or other confounding variables in the model, these terms are assumed to be controlled by the household fixed effects model with two periods.

items are annual estimates as they are more likely to fluctuate over seasons or since some spending may occur irregularly. These items include clothing, taxes, and household furniture, and ritual ceremonies, and they are excluded in this study. This study also uses annual medical expenditures of households to investigate the financial burden of households with sick members. The expenditures include hospitalization costs, clinic charges, physician's fee, traditional healer's fee, and spending on medicines. The descriptive statistics of variables are presented in **Table 4.1**.

The explanatory variables included are same as the ones used in the empirical models in chapter 3. They include the change in health status measured by ADL indices and symptoms of chronic illnesses or acute morbidity. Other control variables include changes in family size, farm size, mean village consumption, and mean village income, as well as the head's education and sex. Furthermore, models also control for disasters during last 5 years and health shocks caused by the natural shocks.

4.5. Regression Results

4.5.1. The Effects of Adult Morbidity on Medical Expenditures of Agricultural Households and Benefits of Health Insurance.

In Chapter 3, it was shown that agricultural households in Indonesia are unable to insure their production against severe health shocks to husbands (**Table 3.7**). The results imply that Indonesian agricultural households may not be able to insure their consumption when prime age male adults are sick. In general, household consumption may be affected by health shocks since the full-income constraint of households is most likely to shift inward when some household members are sick for a long period of time. The shift is caused by a decrease in labor hours and productivity of the sick persons and higher expenditures for the medical care. **Table 4.2** shows that indeed chronic illnesses of husbands and wives are positively and significantly associated with medical expenditures (Model 1).[68] For chronic symptoms longer than one year, the coefficient on the wife's chronic illness is much greater than that of the husband's, implying a greater burden of medical costs when women have long lasting symptoms of chronic illnesses or acute morbidity.[69] In the case of a shorter term illness symptoms, the coefficient on the husband's chronic illness is greater than that of the wife.

The change in ADL index is also associated with an increase in medical expenditures (Model 3). As expected, the coefficient on the basic ADL index of husbands is approximately twice the magnitude of that on the intermediate ADL index. A change of health status of husbands from completely healthy (basic ADL index = 1) to completely sick (basic ADL index = 0) is associated with 34 times greater medical expenditures. Or equivalently, moving from being able to perform all basic ADLs to being unable to perform one additional basic ADL is associated with approximately 7 times greater medical expenditures. However, changes in ADL index of wives are associated with smaller changes in medical expenditures compared with

[68] All models in Table 4.2 use the village fixed model specification shown in equation (4.2). This is based on the conjecture that estimates of morbidity effects on medical expenditures are more likely to be confounded by shocks to local economies.
[69] There is no evidence for high correlation between illness variables (see Appendix 4.1).

husbands, and they are not statistically significant. Unlike chronic illnesses, the ADL index includes information on changes in health status caused by injuries or short term health shocks. Also the ADL index is likely to include the results of health shocks, hence capturing more objective health status. Furthermore, this may indicate that Indonesian women in agricultural households tend to delay medical treatments or resort to home remedies, given the fact that Indonesia has the lowest share of physicians and medical facilities in the population among developing countries in Asia (**Table 3.1**). Also, more household resources may be allocated to members engaging in income-generating work. Hence, we may see more medical expenditures for husbands than for wives. Likewise, husbands' chronic symptoms may get more immediate attention and medical treatment while wives wait longer, aggravating the situation. The coefficients on chronic symptoms of husbands and wives seem supportive of this conjecture, although more investigation is needed.

This gender difference may also be because spouses are much less likely to be covered by health insurance in Indonesia. In fact, as of 2007, approximately 41% of husbands in the sample population of IFLS were covered by some type of health insurance while only 27% of wives had health insurance (**Table 4.1**). Among agricultural households, only 21% of wives had some type of health insurance. Most of rural households are insured by social insurance as private health insurance and other schemes cover a very limited portion of households in Indonesia.[70] For instance, the Askeskin health insurance program was introduced in 2005 with the objective to

[70] Rokx et al (2009) report that private health insurance and other schemes covered around 3% of the population and community-based insurance less than 1% .

expand social security to the informal sector, aiming at a target population of 60 million people. The insurance includes only basic outpatient care and third class hospital care in grade A-D hospitals, although it includes special services for remote areas and islands.[71] Bachtiar, Wibisana, and Pujiyanto (2006) claim that indirect costs are not covered and that travel distance still remains a barrier. Beneficiaries of Askeskin are determined by a combination of geographic targeting and selection of individuals within the *kabupaten*, and selected beneficiaries often opt for partial coverage, excluding some household members to avoid some indirect costs they are responsible for (Arifianto, 2005).

There are also issues of inferior quality and discrimination of services for Askeskin recipients (Sparrow et. al, 2010). Furthermore, Indonesia still shows a high variation in medical coverage across the population, with the nonpoor allocating a larger share of their budget on out-of-pocket spending (Van Doorslaer et al., 2007). For these reasons, it may not be so surprising that possession of health insurance does not appear to reduce the burden of medical expenditures of agricultural households in Indonesia. In particular, additional regressions with interaction terms between dummies for health insurance and morbidity variables do not change much the magnitudes of coefficients on the morbidity variables (Model 2, Model 4, and Model 6). While the benefits of health insurance are shown by the opposite signs of the interaction terms to the signs of morbidity variables, there appear to be no sizeable reduction of morbidity effects from possession of health insurance in all models.

[71] Hospitals can submit claims for services delivered to Askeskin beneficiaries based on fee for service, while primary health centers are compensated on a capitation basis.

4.5.2. The Effect of Adult Morbidity on Food Consumption of Agricultural Households

Table 4.3 presents evidence that Indonesian agricultural households are unable to smooth food consumption in the face severe morbidity shocks. The first three columns of regression results show the effects of chronic illness estimated by OLS, the village fixed effects model, and the household fixed effects model, respectively. All three models show that there are sizable effects on food consumption of chronic illnesses or acute morbidity that last longer than one year for both husbands and wives, although the effects are significant only when the household fixed effect model is used for the estimation. The coefficients are two times greater for chronic symptoms of wives, and the magnitudes are similar across models. According to the results from the household fixed effects model, households with wives suffering long lasting chronic illnesses reduced their food consumption by 30% from 2000 to 2007. The results appear to be consistent with the results presented in **Table 4.2** that show greater effects of medical expenditures associated with chronic symptoms of wives, compared with husbands.

The regressions with ADL index scores also show sizable effects of changes in health status on food consumption (HHFE 2 and HHFE 3). In all models, the changes in the basic ADL index of husbands is significantly associated with the reduction of food consumption. The results show that households reduce their food consumption by 60% as the health of husbands deteriorates from completely healthy (index =1) to completely sick (index = 0). The reduction is shown to be smaller (36%)

when the intermediate ADLs are used for regressions. The changes in the basic ADL of wives are also associated with the reduction of consumption in two of the models, but the coefficients are smaller and the effects are not statistically significant, compared with those of husbands. The results appear to be consistent with the lower effects of medical expenditures for wives when health changes are measured by ADLs (Model 3 and 5 of **Table 4.2**).

4.5.3. Effects of Adult Morbidity on Non-Food Consumption of Agricultural Households.

This section investigates the effects of health shocks on household nonfood consumption. In this section, I present only the household fixed effects model, as the theoretical framework in Chapter 3 favors this model relative to the other two models (OLS and VFE) in estimating the morbidity effects on household consumption. The first three columns of **Table 4.4** show the effects of adult morbidity on general nonfood consumption, which include expenditures on necessities as well as non-necessities. In the case of chronic illness of husbands longer than one year, the reduction of nonfood consumption is sizable (50%) and statistically significant. Chronic illness symptoms of wives longer than one year also have a sizable effect (15%) on nonfood consumption, but this is not statistically significant. In contrast, chronic symptoms less than one year for wives are associated with some increase in nonfood consumption, and the effect is statistically significant (but only at the 10% level). While the result seems somewhat counter-intuitive, one possible explanation is that nonfood expenditures include some spending on domestic services which may be substitutes for the labor of wives.[72] Households may also spend more on transportation or other household items to lessen the labor burden of sick women. The changes in ADL index scores of husbands have more sizable and significant effects on nonfood consumption. The changes in the basic ADL index scores of husbands and wives are associated with 60% and 45% less consumption of nonfood items, respectively, although neither effect is statistically significant. When the health status is measured with intermediate ADLs, the morbidity effects of husbands are similar, and the effects for husbands become significant.

The next three columns, on the other hand, show the effects of adult morbidity on non-food consumption excluding some necessities such as electricity, water, fuel, and telephone service.[73] In this case, households with sick members are expected to reduce more of their consumption as they are not essential items. Overall, the coefficients become larger and more significant, consistent with the expectation. For both chronic symptoms and the basic ADLs of husbands, the coefficients are approximately 10% greater in magnitude. The effects on consumption become much greater and more significant in the case of changes in the basic ADL scores of wives as well. Moreover, the effect of morbidity on household consumption appears to be greater for non-necessities than on food items, especially for morbidity of husbands. In particular, the coefficient of non-necessities consumption is approximately four times greater than that of food consumption when the health shock to husbands is

[72] An additional regression (not shown here) shows that households increase expenditures on this item when spouses have symptoms that last less than one year, but the effects are not statistically significant.
[73] While telephone service is in general not necessity, it is included here as the consumption of this service is not likely to vary over time.

measured by chronic illness symptoms. The decreases in the basic and the intermediate ADLs index are associated with 13% and 25% less consumption of non-necessities, compared with food consumption.

4.5.4. The Effect of Adult Morbidity on Nonagricultural Household Consumption.

The previous section shows that the reduction of agricultural household consumption differs by characteristics of consumption items. This implies that the health elasticity of household consumption may also be different for nonagricultural households. In the sample households of this study, compared with the agricultural households, nonagricultural households spend 26% and 107 % more on food and non-necessities consumption, respectively (**Table 4.1**). The regression with nonagricultural households shows similar results to the case of agricultural households except that morbidity of wives longer than one year has somewhat less sizable effects on the food consumption of nonagricultural households (**Table 4.5**). Changes in the basic and the intermediate ADL index are also correlated with the reduction of food consumption, and the coefficients are close to those found in food consumption of agricultural households, especially for husbands.

Perhaps, the most remarkable differences between nonagricultural and agricultural households are found in the coefficients of the basic ADL index of both husbands and wives in the last three regression models of (**Table 4.5)**. Compared with the agricultural households, the basic ADL index of husbands is associated with a 60% greater reduction of non-necessities consumption. The difference is also noticeable with basic ADL index of wives (60%). Regressions with the intermediate ADL index also show greater decreases in consumption than the agricultural households for both husbands and wives, but the gaps are much smaller than the case of the basic ADL index. Overall, the results imply that, compared with the agricultural households, nonagricultural households reduce more of their non-food consumption while they reduce about the same proportion of their food consumption. The results appear to be reasonable as nonagricultural households spend more of their income on consumption of nonfood items.

4.6. Conclusion

Households with sick adults suffer from two types of economic costs: the costs associated with medical expenditures and the loss of income due to the decrease in labor hours and productivity of the sick person. Financial burdens associated with such costs may be greater when the recovery from illness is not expected or household members suffer from chronic illnesses that require long-term medical treatments. Furthermore, the burdens may be even greater for households with limited access to health insurance and medical facilities, as is true in many developing countries including Indonesia.

The results of this chapter support the validity of this conjecture. In particular, there appear to be sizable and significant effects of adult morbidity on medical expenditures of agricultural households in Indonesia. Despite the recent health sector reforms of Indonesia, the health insurance systems do not appear to be effective in shielding Indonesians against some severe and long lasting health shocks. Combined with the negative effects of morbidity on profits shown in the previous chapter, the burdens of medical costs appear to translate into reductions of food and nonfood consumption in Indonesia. The results show greater reductions of non-necessities than food consumption in the face of adult morbidity. They also show that the health elasticity of non-necessities consumption is greater for non-agricultural households than agricultural households. In contrast, agricultural households appear to reduce their food consumption more than do nonagricultural households in Indonesia.

Table 4.1: Descriptive Statistics

Variable	Mean	Std. Dev.	Mean	Std. Dev.
	Year 2007		Change 2000 - 2007	
Agricultural households				
household food consumption (ln)	12.10	0.65	0.30	1.22
household nonfood consumption (ln)	12.19	1.32	1.36	1.30
household nonfood consumption : excluding necessities (ln)	11.54	1.47	1.11	1.52
Nonagricultural households				
household food consumption (ln)	12.33	0.73	0.25	1.20
household nonfood consumption (ln)	13.00	1.34	1.28	1.30
household nonfood consumption : excluding necessities (ln)	12.27	1.54	1.00	1.57
morbidity of husband< 1yr (1= yes)	0.18	0.38		
morbidity of husband> 1yr (1= yes)	0.01	0.12		
morbidity of wife < 1yr (1= yes)	0.16	0.37		
morbidity of wife > 1yr (1= yes)	0.01	0.08		
ADL index : husband	0.95	0.11	-0.03	0.12
ADL index : wife	0.94	0.10	-0.02	0.12
Basic ADL index : husband	0.97	0.08	-0.02	0.10
Basic ADL index : wife	0.98	0.07	-0.01	0.09
Intermediate ADL index : husband	0.92	0.16	-0.04	0.16
Intermediate ADL index : wife	0.91	0.15	-0.02	0.17
health insurance: husband (1= yes)	0.41	0.49		
health insurance: wife (1= yes)	0.27	0.44		
male head (1=yes)	0.67	0.47		
family size:	6.37	2.85	2.62	3.87
illness caused by disaster (1=yes)	0.01	0.30		
education level of husband (1= < elementary, 4 >= college)	1.86	1.04		
farm size : (ln sq meter)	7.94	1.76	-0.39	1.94
mean village food consumption (ln)	14.14	1.04	-0.22	0.05
mean village income (ln)	15.95	0.61	1.06	0.51
number of disasters last 5 years (1= yes)	0.07	0.33	0.00	1.00
medical costs : (ln)	10.16	4.37	0.95	5.82

* p<0.05, ** p<0.01, *** p<0.00.

Table 4.2. Effects of Morbidity on Medical Expenditures

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
morbidity of husband	2.693**	2.656**				
<1yr	(1.158)	(1.35)				
morbidity of husband	3.575	3.556				
>1yr	(4.221)	(4.273)				
morbidity of wife	1.107	0.620				
< 1yr	(1.162)	(1.287)				
morbidity of wife	13.364**	12.758**				
>1yr	(6.116)	(6.192)				
basic ADL change:			-35.754***	-34.721***		
husband			(9.151)	(9.679)		
basic ADL change:			1.075	0.633		
wife			(11.125)	(11.539)		
intermediate ADL					-18.164***	-17.441**
change : husband					(-6.989)	(-7.166)
intermediate ADL:					3.756	3.255
change : wife					(5.511)	(5.729)
morbidity * insurance :		0.128		1.572		1.017
husband		(2.440)		(5.257)		(5.357)
morbidity * insurance:		2.002		2.634		1.253
wife		(2.684)		(4.464)		(4.476)
Insured : husband		0.446		0.247		0.410
		(1.924)		(5.320)		(5.473)
Insured: wife		-1.503		-3.716		-2.027
		(2.212)		(4.786)		(4.813)
male head (1=yes)	-1.297	-1.245	-5.547	-5.283	-4.67	-4.514
	(-1.797)	(-1.812)	(-4.791)	(-4.878)	(-4.824)	(-4.898)
change in family size	0.573**	0.569**	0.702*	0.689*	0.748*	0.735*
	(0.245)	(0.248)	(0.412)	(0.412)	(0.406)	(0.408)
education of husband	-1.618***	-1.576**	(1.266)	(1.285)	(1.204)	(1.257)
	(0.600)	(0.612)	(1.073)	(1.111)	(1.069)	(1.113)
disasters during	0.450	0.546	6.873	7.190	6.575	6.695
last 5 yrs	(3.175)	(3.183)	(5.211)	(5.303)	(5.284)	(5.295)
constant	5.678**	5.767**	8.540	8.156	7.093	6.853
	(2.333)	(2.346)	(5.475)	(5.573)	(5.527)	(5.610)
Village fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Obs	2166	2166	2166	2166	2166	2166

* p<0.05, ** p<0.01, *** p<0.00. Standard errors are in parentheses. Agricultural households only. All standard errors were adjusted for within cluster dependence.

Table 4.3: Effects of Morbidity on Food Consumption - Agricultural Households

	OLS	VFE	HHFE 1	HHFE 2	HHFE 3
morbidity of husband< 1yr	-0.044	-0.034	-0.052*		
	(0.037)	(0.043)	(0.028)		
morbidity of husband> 1yr	-0.061	-0.094	-0.127		
	(0.116)	(0.145)	(0.100)		
morbidity of wife < 1yr	-0.004	0.011	0.01		
	(0.034)	(0.039)	(0.026)		
morbidity of wife > 1yr	-0.223	-0.277	-0.298**		
	(0.176)	(0.193)	(0.126)		
basic ADL score change: husband				0.585***	
				(0.199)	
basic ADL score change: wife				0.233	
				(0.183)	
intermediate ADL score change: husband					0.358***
					(0.101)
intermediate ADL score change: wife					0.001
					(0.087)
illness caused by disaster (1=yes)	0.018***	0.097			
	(0.006)	(0.123)			
year (1= 2007)			-5.681***	-6.205***	-6.192***
			(0.361)	(0.553)	(0.554)
male head (1=yes)	0.102**	0.086			
	(0.047)	(0.054)			
change in family size	0.021***	0.029***	0.043***	0.054***	0.055***
	(0.006)	(0.007)	(0.004)	(0.005)	(0.005)
education level of husband	-0.061***	-0.023			
	(0.016)	(0.019)			
change in farm size	0.003	-0.006	0.031***	0.010***	0.010***
	(0.003)	(0.004)	(0.005)	(0.003)	(0.003)
change in mean village consumption	0.437***		0.625***	0.671***	0.669***
	(0.053)		(0.039)	(0.059)	(0.059)
change in mean village income	0.070**		0.214***	0.261***	0.261***
	(0.030)		(0.019)	(0.022)	(0.022)
disasters during last 5 years	0.031	-0.1	0.015	0.051	0.058
	(0.060)	(0.102)	(0.045)	(0.060)	(0.061)
constant	-3.652***	0.534***	6.413***	4.792***	5.252***
	(0.495)	(0.070)	(0.249)	(0.399)	(0.331)
Household fixed effects	No	No	Yes	Yes	Yes
Village fixed effects	No	Yes	No	No	No
Obs	2166	2166	5052	5052	5052

* p<0.05, ** p<0.01, *** p<0.00. Standard errors are in parentheses. All standard errors were adjusted for within cluster dependence.

Table 4.4: Effects of Morbidity on Nonfood Consumption - Agricultural Households

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	Non-food consumption			Non-necessities consumption		
morbidity of husband	-0.049			-0.089		
<1yr	(0.064)			(0.067)		
morbidity of husband	-0.497***			-0.566***		
> 1yr	(0.179)			(0.213)		
morbidity of wife	0.102*			0.101		
< 1yr	(0.058)			(0.062)		
morbidity of wife	-0.145			-0.142		
> 1yr	(0.166)			(0.249)		
basic ADL score change:		0.600			0.715*	
husband		(0.443)			(0.390)	
basic ADL score change:		0.445			0.679*	
wife		(0.391)			(0.348)	
intermediate ADL change:			0.636***			0.602***
husband			(0.213)			(0.209)
intermediate ADL change:			-0.017			0.163
wife			(0.176)			(0.178)
year (1= 2007)	-6.305***	-7.560***	-7.564***	-7.916***	-9.267***	-9.298***
	(0.779)	(1.146)	(1.144)	(0.788)	(1.117)	(1.118)
change in family size	0.052***	0.068***	0.069***	0.054***	0.074***	0.076***
	(0.009)	(0.011)	(0.011)	(0.010)	(0.012)	(0.012)
change in farm size	0.027**	0.018	0.018	0.038***	0.029**	0.030**
	(0.010)	(0.012)	(0.012)	(0.011)	(0.012)	(0.012)
change in mean village	0.698***	0.813***	0.814***	0.841***	0.963***	0.967***
consumption	(0.084)	(0.122)	(0.122)	(0.084)	(0.119)	(0.119)
change in mean village	0.621***	0.707***	0.707***	0.633***	0.702***	0.703***
income	(0.037)	(0.041)	(0.041)	(0.039)	(0.045)	(0.045)
disasters during	0.047	0.043	0.052	0.086	0.047	0.061
last 5 years	(0.102)	(0.151)	(0.152)	(0.101)	(0.132)	(0.132)
constant	-0.122	-2.679***	-2.259***	-1.136**	-3.823***	-3.215***
	(0.512)	(0.818)	(0.653)	(0.536)	(0.816)	(0.698)
Household fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Village fixed effects	No	No	No	No	No	No
Obs	5052	5052	5052	5052	5052	5052

* p<0.05, ** p<0.01, *** p<0.00. Standard errors are in parentheses. All standard errors were adjusted for within cluster dependence.

Table 4.5: Effects of Morbidity on Consumption – Nonagricultural Households

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	Food consumption			Non-necessities consumption		
morbidity of husband	0.00			-0.004		
<1yr	-0.029			-0.066		
morbidity of husband	0.09			0.086		
> 1yr	-0.111			-0.277		
morbidity of wife	0.051*			0.082		
< 1yr	-0.028			-0.064		
morbidity of wife	-0.176			-0.269		
> 1yr	-0.134			-0.33		
basic ADL score change:		0.550***			1.466***	
husband		-0.149			-0.387	
basic ADL score change:		0.283*			1.150***	
wife		-0.154			-0.322	
intermediate ADL change:			0.376***			0.904***
husband			-0.091			-0.184
intermediate ADL change:			0.03			0.162
wife			-0.072			-0.158
year (1= 2007)	-2.939***	-6.213***	-6.184***	-2.719***	-8.567***	-8.473***
	-0.376	-0.483	-0.485	-0.779	-1.166	-1.16
change in family size	0.021***	0.047***	0.047***	-0.006	0.052***	0.053***
	-0.005	-0.005	-0.005	-0.01	-0.01	-0.01
change in farm size	0.360***	0.669***	0.667***	0.382***	0.905***	0.896***
	-0.039	-0.052	-0.052	-0.081	-0.126	-0.125
change in mean village	-0.001	0.219***	0.219***	0.032	0.542***	0.541***
consumption	-0.019	-0.044	-0.044	-0.055	-0.099	-0.1
change in mean village	0.077*	0.009	0.018	0.159*	0.105	0.13
income	-0.044	-0.049	-0.049	-0.091	-0.106	-0.106
disasters during	10.715***	5.674***	6.125***	9.810***	-2.001	-0.403
last 5 years	-0.301	-0.61	-0.609	-0.851	-1.375	-1.358
Household fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Village fixed effects	No	No	No	No	No	No
Obs	5052	5052	5052	5052	5052	5052

* p<0.05, ** p<0.01, *** p<0.00. Standard errors are in parentheses. All standard errors were adjusted for within cluster dependence.

Appendix 4.1: Correlation Matrix of Health Variables

	morbidity of husband< 1yr	morbidity of husband> 1yr	morbidity of wife < 1yr	morbidity of wife > 1yr
morbidity of husband< 1yr	1.000			
morbidity of husband> 1yr	-0.028	1.000		
morbidity of wife < 1yr	0.094	-0.005	1.000	
morbidity of wife > 1yr	0.023	0.057	-0.025	1.000

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