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Essays on Marriage and Education

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by

Ariana Gabriela Rubio Covarrubias

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ABSTRACT OF DISSERTATION

Essays on Marriage and Education

by

Ariana Gabriela Rubio Covarrubias

Doctor of Philosophy in Economics

University of California, Los Angeles, 2014

Professor Adriana Lleras-Muney, Chair

In this dissertation I present three papers, each as an individual chapter. The first two papers are in the field of development economics, while the third paper is in the field of education economics.

In the first paper, titled "The Love Revolution: Decline in Arranged Marriages in Asia, the Middle East and Sub-Saharan Africa," documents a striking decline in arranged marriages in Asia, the Middle East and Sub-Saharan Africa. Arranged marriages have existed in many societies throughout time, they have acted as a mechanism that allows two families to enter into an informal contract (for example, informal insurance arrangements) that will provide benefits to their members: create political alliances, ensure consumption smoothing, facilitate economic transactions, consolidate power, increase wealth, among others. In Europe, they

disappeared towards the 12th century, remaining popular only among the wealthy class finally disappearing after the Industrial Revolution. In the East (Asia and Africa), they remained to be the most popular marriage institution until the middle of the 20th century. This paper also documents the patterns of the transition, finding that women in arranged marriages tend to live in rural areas, have lower education, belong to agricultural households, and being engaged in non-paid activities.

Using these findings I suggest one main hypothesis regarding the causes behind their disappearance: the decline in the net benefits of arranged marriages relative to an (increasing) outside option. I propose and discuss several of economic changes that could lead to shift in this margin: increase in income covariance, change in type of risk, availability of substitutes, increase in asymmetric information and limited commitment, change in bargaining power of children, and alternative explanations related to changes in marriage markets. Finally, I briefly analyze some potential welfare consequences of the transition by focusing on measures of domestic violence. I find that women having an arranged marriages are more prone to support domestic abuse.

To understand these patterns, in the second chapter, "How Love Conquered Marriage: Theory and Evidence on the Disappearance of Arranged Marriages," I construct and empirically test a model of marital choices that assumes that AM serve as a form of informal insurance for parents and children, whereas other forms of marriage do not. In this model, children accepting the AM will have access to insurance but might give up higher family income by constraining their geographic and social mobility. Children in love marriages (LM) are not geographically/socially constrained, so they can look for the partner with higher labor market returns, and they can have access to better remunerated occupations. The model predicts that arranged marriages disappear when the net benefits of the insurance arrangement decrease relative to the (unconstrained) returns outside of the social network.

Using consumption and income panel data from the Indonesia Family Life Survey (IFLS),

I show that consumption of AM households does not vary with household income (while consumption of LM households does), consistent with the model's assumption that AM provides insurance. I then empirically test the main predictions of the model. I use the introduction of the Green Revolution (GR) in Indonesia as a quasi-experiment. First, I show that the GR increased the returns to schooling and lowered the variance of agricultural income. Then, I use a difference-in-difference identification strategy to show that cohorts exposed to the GR experienced a faster decline in AM as predicted by the theoretical framework. Second, I show the existence of increasing divorce rates among couples with AM as their insurance gains vanish. Finally, using the exogenous variation of the GR, I find that couples having an AM and exposed to the program were more likely to divorce, consistent with the hypothesis of declining relative gains of AM.

The third paper, titled "Peer feedback and teaching performance: A Randomized Controlled Trial," is a first step towards determining whether trained peer feedback has a causal effect on the teaching performance of teaching assistants (TA). The participants of the intervention were the TAs of the Department of Economics of a large public university for one academic quarter. We analyzed the students' evaluations of these TAs, for the quarter in which the intervention took place and the following quarter, as well as the students' raw grades for the intervention quarter. The results show an effect of almost one half of a standard deviation for the students' TA evaluations in the quarter following the intervention. The detailed analysis of the dimension of the evaluations suggests that the intervention had a large effect on the TAs' communication skills, and a more modest effect on the following aspects: concern, organization, concern and interaction. Nonethless, the intervention had no effect in the concurrent quarter, suggesting that it takes time for TAs to adjust their teaching practices.

The dissertation of Ariana Gabriela Rubio Covarrubias is approved.

Leah Michelle Platt Boustan

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Adriana Lleras-Muney, Committee Chair

University of California, Los Angeles,

2014

Dedicated to my parents, with all my love and admiration.

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Acknowledgments

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3. "Peer Feedback and Teaching Performance: A Randomized Controlled Trial," with Carolina Mejia-Mantilla (World Bank).

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Chapter 1

The Love Revolution: Decline in Arranged Marriages in Asia, the Middle East and Sub-Saharan Africa

1.1 Introduction

Until recently, arranged marriages had been the most common marriage institution in Asia, Africa and the Middle East; however, arranged marriages have existed in most societies at some point in time. In Europe and America - or the West -, they disappeared relatively early in time remaining customary only among the wealthy class, finally disappearing towards the beginning of the twentieth century. In the East - Asia and Africa -, they remained deeply rooted until recent decades.

Anthropologists, sociologists, ethnologist, evolutionary psychologists and, more recently, economists have been interested on understanding the role of arranged marriages in these societies. According to these scholars, arranged marriages have served as a way of creating alliances among two families. They are used by two groups - clans, tribes, or families - as a mechanism to enter into an informal contract that allows their members to attain

political objectives, ensure and smooth economic transactions, consolidate power, preserve social status, keep property within the group, among others.

I this paper, I discuss the anthropological and ethnographic evidence on arranged marriages, summarizing the main hypotheses for their existence. I also briefly examine the research within economics on some of the marital institutions identified by anthropologists. I then discuss the patterns of arranged marriages across different areas. For the case of Europe and America, I rely again on the anthropological and historical evidence, which suggests that arranged marriages were common in the Ancient Civilizations but disappear after the Catholic Church gained power. For Asia and Africa (Turkey, Saudi Arabia, Israel, Japan, Korea, China, Taiwan, Indonesia, Malaysia, Cambodia, Vietnam, Sri Lanka, Nepal, Togo, and Ghana), I collect information from several studies and I use micro-data for 10 countries to show that there is an ongoing transition towards the disappearance of arranged marriages. I use the micro-data and the empirical evidence presented in these studies to establish the patterns correlated with the movement away from arranged marriages. I show that arranged marriages have decreased slightly faster in urban areas and that the transition is highly correlated with increasing schooling; and, finally, I also show that arranged marriages are more prevalent among agricultural households and inversely related to employment outside the household or wage jobs.

I use the empirical evidence to propose and discuss several potential explanations for the disappearance of arranged marriages: (i) change in the type and exposure to risk; (ii) availability of substitutes; (iii) increase in asymmetric information across households; (iv) increase in migration which worsens limited commitment problems across and within households; (v) changes in relative bargaining power of children; and (iv) alternative explanations.

And finally, I briefly explore some of the welfare consequences of this transition. I focus on measures mainly related to domestic violence and household decisions. First, I find that women in arranged marriages are more likely to accept domestic abuse and exhibit a stronger preference for sons.[1] Second, I discuss the literature in psychology (and several recent media reports) which has recently documented a high rate of suicide among females in Asia. Most of the case studies analyzed by the mental health literature suggest that domestic violence plays an important role in the decision to commit suicide. Some of these researchers have further concluded that arranged marriages worsen mental distress since they prevent women from leaving abusive relationships.

1.2 Evidence from Anthropology and the Economics of Arranged Marriages

1.2.1 Anthropological and Ethnographic Evidence on Arranged Marriages

The study of marriage institutions has been closely related to the study of kinship, succession and inheritance. Anthropologists, ethnographers and sociologists have traditionally leaded the study of marriage from descriptive and theoretical perspectives trying to understand differences and common features across societies. Within anthropology there has been an ongoing debate regarding the main function of marital institutions throughout history. On the one hand, the British anthropologists, followers of the structural functionalism, with Radcliffle-Brown as their main proponent, study the kinship system as a field of rights and

[1] Chung and Das Gupta (2007) find a similar pattern for Korea.

obligations. In summary, kinship and marriage functioned to produce descent which is closely related to inheritance and succession, and to the supply of non-market goods, for instance, old-age care for parents. This view was challenged by the French anthropologist Lévi-Strauss who defined kinship systems as methods of organizing marriage relations between groups. From his perspective, marriages are a mechanism to create alliances between groups and the difference between kinship systems lays in the different ways of "moving" women around in the system. A more comprehensive view of kinship and marriage has more recently arisen from merging both schools of thoughts, acknowledging the descent function as part of the alliance between groups.

Anthropologists, however, also acknowledge that kinship and marriage are fluid institutions that evolve due to biological, psychological, ecological and social factors.[2] On one hand, "the incest taboo" or the prohibition of mating with nuclear or close family imposed rules of exogamy for finding mates. On the other hand, the need of finding mates outside the local groups led to the appearance of different systems of descent and post-marital living arrangements.[3][4] The exogamy and descent rules combined with geographic restrictions and

[2] For instance, Goody (1983) states that in Europe and the Middle East, rich and powerful landowners were instrumental and thus the settled agriculturalists tended to be more bilateral in inheritance and succession. On the other hand, clan organizations, giving a greater emphasis to branching agnatic kinship, were found in the less accessible regions.

[3] Matrilineal, patrilineal, ambilineal or cognatic, bilateral, or double descent.

[4] The most common post-marital living arrangements are matrilocal (near the parents of the wife), patrilocal (near the parents of the husband), ambilocal (near either set of parents) and neolocal (establishment of a new and independent household).

gender division of labor gave rise in turn to a continuum of kinship and marital organizations, where parents or the kinship group had a larger weight on choosing a partner for their children. These common characteristics across several societies gave rise to the "alliance theory" of marriage, which has ranged from a hostage theory of exogamy (marry the daughters of our enemies to secure survival) to a theory of dynastic marriages (to settle a treaty or an international alliance).

The theory of alliance asserts that marriages arranged by parents or kinship have evolved to serve many purposes. They create linkages across clans to avoid wars, allow them to enter into political and productive alliances, reinforce commitment between groups which facilitate transactions and strengthen social ties, set clear rules on inheritance, succession and post-marital residence, and weaken the marital bond between spouses securing old-age care for parents. Anthropologists further distinguish between two main systems of marriage: elementary systems of exchange and complex systems. The former is characterized by positive marriage rules, whom you should marry, and it is prevalent in Southeast Asia, South and North America. The latter appears mostly as societies grow and become stratified, it primarily imposes negative rules of marriage, whom you should not marry, and it is common in Africa and Indo-European countries. In complex societies, these scholars have tried to uncover systematic patterns, trying to isolate territorial and class mobility that allows them to establish the direction and nature of alliances, for instance, royal marriages in Europe established a negative rule of marriage: "marry outside your own clan and set perpetual relationships."

In this context, this strand of anthropology also explains the appearance of bride-price as an institution that allowed clans to cancel out debts. In principle, a direct exchange of women would allow groups to obtain wives, to create alliances and to prolong descent.

However, as sex-ratio imbalances limited the direct exchange of women, clans provided goods that allowed the members of other clans to obtain wives in a different group. Table 1.1 uses data from Murdock's Ethnographic Atlas to construct some summary statistics for around 860 societies showing the prevalence of some of the marital institutions discussed above.

1.2.2 Economics of Marriage and Kinship in Developing Countries

Economists have joined the study of household formation, recognizing that marriage has benefits and costs and that living arrangements are economic decisions. Within economics, Gary Becker's Treatise on the Family is the first comprehensive study of several marital institutions. His analysis mainly focuses on Western institutions; however, he extended it to study payments at the time of marriage (dowry and bride-price) and polygamous marriages. His research also acknowledges the marriage and kinship arrangements have evolved through time as markets appear and families no longer supply goods and services previously unavailable. Despite his brief analysis on kinship, Becker focuses on the Western experience where the transition away from arranged marriages and towards the self-choice nuclear family happened a long time ago.

More recently the literature in development economics has recognized and studied the economic benefits of kinship and extended family. Postner (1980), Bates (1990), and Fafchamps (1992), among others, discuss the institutional features that allow kinship systems to supply goods and services for which markets are not existent. Repeated interactions minimize coordination problems and groups found ways to minimize moral hazard (ex-ante and ex-post) through the use of signals and monitoring; the creation and maintenance of social networks also allows to reduce transaction costs and achieve efficient outcomes by setting a system of punishments and rewards and to take advantage of altruism across family mem-

bers; even in societies where wealth asymmetries arise, groups might develop institutions that provide benefits to its members, for instance, share-cropping or clientelism. A large literature has emerged investigating the theoretical and empirical benefits of these institutions, relying heavily on the anthropological evidence.[5] Therefore, development economists have recognized the importance of these institutions which influence the growth of developing countries, but also acknowledging that they evolve in rapidly changing societies. One of the main challenges has been to collect data and design of empirical strategies that allows distinguishing causality. Identification issues are a key in the design and implementation of policies in these countries; it will inform organizations and governments about the best design and the potential consequences of welfare programs, industrialization policies, among many other issues.

Despite this large literature within economics, and perhaps surprisingly given the large evidence from anthropology and sociology, there are only a few papers studying arranged marriages, an institution still prevalent in several regions of the world. The economics literature has focused mostly on studying the role and evolution of payments across families: dowry and bride-price. Anderson (2007) discusses and summarizes the prevalence of marriage payments and the main economic explanations in the literature. Although, she acknowledges that these payments are closely related to arranged marriages since it involves a negotiation between groups, there is no further exploration of the role and evolution of arranged marriages. Fafchamps and Quisumbing (2008) review the economic literature on household formation focusing on rural areas of developing countries. They emphasize that insurance, savings, investment and capital accumulation have a bigger role determining the

[5] Cox and Fafchamps (2008) summarize and discuss the current literature on extended family and kinship networks and discuss several open lines of research.

formation of households, and they briefly discuss that parental involvement has a larger weight in marriage decisions.

In the development economics literature, there are a few papers that have studied some of the specific marital institutions described by the anthropological work summarized in this paper. Rosenzweig and Stark (1989) show that arranged marriages are used as a consumption smoothing mechanism in an agrarian society in India. Their analysis shows that families engage in a sophisticated exchange of offspring through marriages in order to mitigate negative economic shocks generated by weather fluctuations. Jacoby and Mansuri (2010) study "exchange marriage" in Pakistan, a marriage practice considered as an "elementary system of exchange" by anthropologists, which usually involves the simultaneous marriage of brother-sister pair from two households. They propose and empirically test a model where parents are altruistic towards children, the emergence of exchange marriage helps to solve commitment problems in a society where husbands usually have coercive power over their wives, through physical and emotional abuse. In this context, the threat of retaliation should deter marital discord. They find support in favor of this model, finding that the likelihood of discord is substantially lower in "exchange marriages" as compared to "conventional" marriages. Do, Iyer and Joshi (2013) study the economics of consanguineous marriages in Bangladesh, another country where arranged marriages still represent more than 95% of total marriages. Their paper proposes a rationale for consanguineous marriages through an agency model where marriage is a joint project where families invest on the marriage of their children through dowries. However, since there is a possibility of dissolution and contracts are incomplete, consanguineous marriages minimize problems of time-inconsistency. They test their model using the 1996 Matlab Health and Socioeconomic Survey, finding that women in consanguineous marriages are between 6% and 7% less likely to bring dowry at marriage,

and 4% more likely to receive any form of inheritance.[6] Jacoby (1995) tests the hypothesis that polygamy is related to female productivity using data from Cote d'Ivore, finding that marked geographic diversity in cropping patterns leads to regional variation in female labor productivity. He also finds that, conditional on wealth, men do have more wives when women are more productive, that is, cheaper. Finally Luke and Munshi (2006) analyze the evolution of marriage institutions in urban Kenya. They argue that the Luo tribe uses exogamous marriages to strength and extend network ties and create new ones. Marriage is traditionally arranged by family, friends or a matchmaker and the ethnographic evidence suggest that it is used to share risk across households. They show evidence supporting the hypothesis that kinship networks have been transplanted to the city, changing the nature of their traditional function. In the city, their primarily function is to provide jobs for their members and other support to new comers.

Overall, the evidence from the economics literature is consistent with the literature from anthropology. Marital institutions have served to mitigate commitment problems across households and they have served to bring closer families and kinships for different purposes.

[6] Their paper does not address, however, the fact that dowry is a recent phenomenon in Bangladesh, where bride-price or mehr has been the common practice for centuries. Ambrus, Field and Torero (2010) propose an explanation for changes in dowry levels. They suggest that dowry ex-ante compensates the groom for the cost of the mehr, which serves as a barrier to leave the marriage.

1.3 The Patterns in Arranged Marriages

1.3.1 Arranged Marriages in Europe and America

According to anthropologist Jack Goody (1983), arranged marriages were common in Ancient Greece, Egypt, Israel, the Roman Empire and among the German and Anglo-Saxon tribes.[7] His research suggests that families tended to marry their children within members of the extended family in order to keep the property intact and preserve social status. The clan or lineage was, therefore, a very important institution. Goody (1983) suggests that the break-down of the Roman Empire and the rise of the Catholic Church marked the transition towards love marriages in Western Europe.

The transition from sect to Church involved the consolidation of doctrines regarding individual and family behavior. Goody draws from different historical documents finding that towards the 4th century, the Church started formalizing its position and doctrines regarding marital choices and family formation. The transition was a slow process, however, around the 12th century the main doctrine had permeated most regions and social classes. The doctrine stressed the individual consent for marriage, forbidden close kin marriages, discourage adoption, polygamy, concubinage, divorce, and remarriage among other practices widely accepted in the past.

Goody hypothesizes that the Church's desire to accumulate wealth in the form of land

[7] Apostolou (2010) collected marriage information for sixteen historical societies: Egyptians, Babylonians, Jews, Greeks, Romans, Byzantines, Medieval German and Arabs, Renaissance Venetians and Florentines, Aztecs, Incas, Mayas, Pre-Victorian English and Edo Japanese. He shows that arranged marriages were the dominant form of marriage for these societies.

shaped its marriage doctrine. The Church, thus, set rules with two underlying objectives. First, to limit the number of legitimate offspring - increasing the Church's likelihood of receiving the inheritances; and, second, to avoid the concentration of land among certain families - by encouraging love marriage, families lost the ability to form alliances and to increase their landholding. Greif (2006) points out that the evolution towards love and monogamous marriages was not monotonic, nor geographically or socially uniform. But by the late medieval period, the nuclear family, monogamy and self-choice marriage were dominant. In contemporary societies, Christianity is significantly correlated with the absence of lineage and clans (Korotayev, 2003) and consanguineous marriages account by less than 1 percent of total marriages in Europe, as opposed to Asia and Africa where they account for 20 to 50 percent of marriages (Bittles, 1994).

Edlund and Lagerlöff (2004) discuss in more detailed the transition from arranged marriages to self-choice marriages during this period and extent the hypothesis posed by Goody (1983). Self-choice marriage was possibly further reinforced by the appearance of the European Marriage Pattern (Hajnal, 1965) in the Anglo-Saxon countries. According to Hajnal and other historians, both adolescent boys and girls were encouraged to work outside the household until they raised enough money to establish an independent home. The adolescents delayed marriage until they were 25 years old or beyond.

In spite of the huge transformation during that period, arranged marriages remained common among the wealthy or landed class. Slater (1976), among other historians (Stone, 1979; MacFarlane, 1986; Perkin, 1989), claims that for the wealthy class arranged marriages offered the beginning of "family life with expanded familial connections; these families served also as credit institutions, levers of power, arbiters of education and professional advancement, an institution for transmission and distribution of property, enhancement of political

and social influence, etc.". Dorothy Marshall (1973) summarizes the view of marriage for this class, "emotions came and went: land remained". Stone (1964, 1979) documents a small change in arranged marriages in the seventeen century. His research shows a modest increase in the "veto" power of children, he concludes that arranged marriages changed to require at least a passive consent of the spouses. He claims that such changes were the result of the widening of the marriage markets which increased the social contacts of children and of legal changes in settlement of families that facilitated the rebellion of the offspring. Despite these changes, it was not until the Industrial Revolution (Goode, 1965) that arranged marriages finally disappeared among the landed class.

Goode (1965) suggests that the industrialization of Europe was the main cause for the disappearance of arranged marriages and the consolidation of the conjugal family. Land ceased to be the main source of income and wealth. Moreover, occupational position was not longer in the hands of the elder. Goode (1965) further claims that since land was no longer the only source of wealth, families lost control over the lives of their children. At the same time, credit and financial markets emerged, and thus, the extended family connection also lost another of its functions. However, it is unclear whether it was an increase in the power of children or a decrease in the incentives of families which cause the change. Interestingly, the change was not limited to Europe, Smith (1973) documents a similar transition in marriage patterns in the United States among wealthy families. His study shows a monotonic decline in parental power in the choice of mates for their children during the eighteenth and nineteenth centuries. Whereas he does not pose a hypothesis to explain such changes, the transition coincides with the industrialization of the country.

1.3.2 Arranged Marriages in Asia and Africa

While arranged marriages disappeared in Europe centuries ago, they remained deeply rooted in most countries of Asia and Africa (Goode, 1965). Despite its prevalence, in the last half century there has been a monotonic decline on arranged marriages and a rise on love marriages in many of these countries. Younger cohorts are having higher decision power in the choice of their mate. The transition is currently ongoing in many of these countries and the trend is strong: the East is experiencing a "love" revolution.

This paper draws from several studies and micro-data that focus primarily on women, their decisions and their welfare; however, similar patterns are found for males when the information is available. The first two tables establish the patterns of change. Table 1.2 shows trends for birth or marriage cohorts for several countries of the Middle East (Turkey, Saudi Arabia, Israel), Asia (Japan, Korea, China, Taiwan, Indonesia, Malaysia, Cambodia, Vietnam, Sri Lanka, Nepal), and Africa (Togo, Ghana). Table 1.3 presents a separate analysis for South Asia (India, Bangladesh and Pakistan).

The transition varies greatly by country and it depends on the sample considered. In some countries such as Japan, Indonesia, Vietnam and urban China, arranged marriages represent 20% or less of all marriages in the youngest cohort. Other countries have achieved a sizable change but they seem to be in earlier stages of the transition, for example, Taiwan and Korea have quickly moved from a position of practically no self-choice marriages to 50% love marriages among the youngest married women. Other countries (Turkey, Cambodia, Sri Lanka and Malaysia) have moved in some medium range, from 20-25% love marriages to 50%-70%. These patterns contrast sharply with the marriage institution in South Asia (India, Pakistan and Bangladesh). In this region, around 95% or more of all marriages are still arranged by the families. The data, however, does shows a small increase in self-choice

marriages in these countries.

The transition also appears to be gradual in the degree of freedom of choice; marriages initially move to a point between self-choice and arranged marriages. For some of the countries studied in this paper there is very detailed information on marriage arrangements where individuals have reported how the selection of spouse took place. Two intermediate cases are often found in these countries, suggesting that the transition has different stages. In the first stage, the family or matchmaker finds a suitable match and, then, they look for the consent of the potential mates. Some examples are India, Malaysia, Turkey, and Vietnam. For these countries there is a category of women who report having an arranged marriage with their previous approval, which suggest that the offspring initially obtains a veto power over the final decision of the spouse and/or the timing of the marriage. The second stage is self-choice marriage with consent of the family. In these cases, potential spouses meet, interact and seek the approval of their parents. And finally, at the other extreme in these continuum of marriage arrangements, we find love marriages where partners report choosing their own mate regardless of the family approval. Usually, men tend to report a higher decision power than women at every stage of the transition period.

1.3.3 Patterns of the transition

This section organizes and analyzes the information contained in the studies described in tables 1.2 and 1.3. In addition, I use micro-data for ten countries (Cambodia, Indonesia, India, Togo, Vietnam, Turkey, Taiwan, Japan, China and Korea) to explore the characteristics of individuals by type of marriage and understand the patterns associated with the movement away from arranged marriages. According to the World Bank development indicators, all the countries included in this study have experienced some degree of urbanization

and industrialization. The movement towards cities and away from agriculture has been accompanied by an increase in education and the incorporation of individuals into occupations outside the household. All these variables are correlated with the transition to self-choice marriages.

Table 1.4 summarizes the samples used by country; it contains the information of the surveys used, the years considered, sample size and summary statistics of some of the main variables of interest. In particular, I focus on education level, age, residence and labor market characteristics (labor force participation, work status, and main occupation).

Tables 1.5 and 1.6 present the regression coefficients for the following equation:

$$\begin{aligned} AM_{i,p,t} &= \beta_o + \beta_1 fem_{i,p,t} + \beta_2 age_{i,p,t} + \beta_3 urban_{i,p,t} + \beta_4 ed_{i,p,t} \\ &\quad + \beta_5 lfp_{i,p,t} + \beta_6 status_{i,p,t} + \beta_7 industry_{i,p,t} + \gamma_p + \delta_t + \varepsilon_{i,p,t} \end{aligned}$$

Where $AM_{i,p,t}$ is a dummy variable that takes the value of 1 if individual i in province p and survey year t has an arranged marriage; $fem_{i,p,t}$ takes the value of 1 if the individual is a female (for the samples with information on both genders); $age_{i,p,t}$ represents the age of the individual; $urban_{i,p,t}$ is a dummy variable taking the value of 1 if the individuals resides in an urban area; $ed_{i,p,t}$ refers to the years of schooling; $lfp_{i,p,t}$ takes the value of 1 if i is in the labor force; $status_{i,p,t}$ is a variable that classifies work status into three categories: employee, self-employed or unpaid family worker (the omitted category is unpaid family worker); finally, $industry_{i,p,t}$ classifies occupations three categories: agriculture, manufacture or services (the omitted category is agriculture). In addition, γ_p is a set of provinces fixed effects and δ_t is a set of survey year fixed effects when more than one cross-section is used. Table 1.5

reports the results for Cambodia, Indonesia, Turkey, Vietnam, Togo and India. For the case of Togo, the Demographic and Health Survey does not report information on work status or occupation, I rely instead on information on whether women worked before being married and whether they could use their wages for personal purposes. Table 1.6 presents separately the results for Taiwan, Japan, China and Korea. It reports the coefficients for cohort of birth instead of age since the East Asian Social Survey reports information on age groups instead of current age.

The results show that for all the countries included in this analysis younger cohorts and males are more likely to choose their spouses. The tables also show that urban residence is negatively correlated with the probability of having an arranged marriage, except for Turkey, Vietnam, Taiwan and Korea. The magnitude indicates that the probability of having an arranged marriage is between 0.38 to 4.6 percentage points lower for individuals residing in urban areas. In the case of Taiwan and Korea, the samples come mostly from urban areas (95% and 99%, respectively), not allowing to compare across residence. For Vietnam and Turkey the effect of urban areas is captured by the province fixed effects; without controlling for province of residence, the coefficients from Vietnam and Turkey would imply a reduction of 8.2 and 1.27 percentage points in the probability of having an arranged marriage.[8] This

[8] Even though urbanization is correlated with self-choice marriage, traditional structures have evolved and coexisted with new industrialized economies in some of these countries have experienced urbanization at an accelerated rate, such as Korea and Japan. After the World War II and the Korean War, South Korea and Japan experienced a rapid transformation of the economy and an accelerated urbanization process. Ethnographic studies from both countries (Vogel, 1961; and Kendall, 1996) suggest that the rapid changes in the economy encouraged the use of matchmakers in urban areas. In the case of Japan, the matchmaker (nakohdo) played an important role until recent years. The nakohdos substituted the families in the process of finding a suitable match. They were in charge not only of finding a potential mate, but also of investigating the background of each family, keeping detailed records to show to the interested parties, participate in the negotiation of the marriage arrangement, and finally, take responsibility for an unsuccessful match. The case

result is consistent with Munshi and Rosenzweig (2009), they find that arranged marriages in rural areas of India have not changed and only around 5-6% of women report being in a love marriage. However, in their sample for Mumbai, love marriages increased from 2% to 12%. Interestingly, and different from the evidence in Munshi and Rosenzweig (2009), I find that for these countries the transition to self-choice marriages is not exclusive of urban areas, adding an interaction between age (or cohort) and urban residence shows that rural areas are following the same pattern of transition (not shown in table).

The effect of education on the probability of having an arranged marriage is also negative for most of the countries of the sample except for Cambodia and Japan. The marginal effect of an addition year of schooling varies between 0.147 and 3.37 percentage points. The largest effects are found in Turkey, Vietnam, Indonesia and Korea. The smallest effects correspond to India, China and Togo. For Cambodia, the effect of schooling is small and not statistically significant. The case of Cambodia requires further analysis since the results might be the consequence of the Khmer Rouge regime between 1975 and 1979, which followed a policy similar to the Cultural Revolution of China, targeting professionals, especially teachers, and anything deemed Western.

The case of labor force participation is ambiguous. Female labor force participation typically has a u-shaped relationship with economic development (Goldin, 1995): women in poorer regions tend to have high economic participation as non-paid family workers or self-

of Korea is similar. Laurel Kendall (1996) describes the arrangement of dates in "modern" Korea, where matchmakers have played an important role. Nonetheless, in both countries, the use of this intermediate figure seems to be decreasing (Applbaum, 1995), possibly both the rise of love marriages and online dating services have contributed to their disappearance.

employed in family business, female labor force participation decreases with industrialization, and then it increases again when white collar occupations become available. In fact, for many of the countries studied, women in arranged marriages have higher (although not always statistically significant) labor force participation but they are concentrated in non-paid jobs.

In addition to labor force participation, I used information on the work status and occupation. In the first case, I classified individuals into self-employed, unpaid family workers and employees (receiving a salary and/or working outside the household). In the second case, I used information on occupation to classify individuals into agriculture, manufacture or services. The omitted categories are unpaid family worker and agricultural activities, respectively. The results suggest that being an employee is negatively correlated with the probability of having an arranged marriage, except for the Chinese sample and one of the samples of Taiwan. Being an employee reduces the probability of having an arranged marriage between 0.6 and 9.6 percentage points. The estimated coefficients for the 2006 sample of Taiwan show a positive but small and not statistically significant effect. A similar conclusion is drawn from the sample of China; the coefficient is slightly larger than the estimated for Taiwan, but it not statistically significant either. The results on self-employed are less conclusive regarding the sign of the correlation; however, it might be due to an ambiguous classification between family workers and self-employment. A better way to assess this relationship would be to refine the definition on work status. Finally, a similar result is found for the controls on type of occupation. With the exception of Japan, having job in manufacture is also negatively correlated with the probability of having an arranged marriage relative to being engaged in agriculture. The coefficients show a 0.17 to 10.5 percentage points reduction in the probability of having an arranged marriage. In the case of services, the results are again ambiguous, possibly the result of larger fractions of population engaged in informal trade.

Finally, table 1.7 briefly studies the correlation between arranged marriages and a few additional variables. The main objective of the table is to support the anthropological evidence discussed in section 1.2 on living arrangements of married couples. Arranged marriages are a bundle of a partner and a geographic location after marriage. Depending on the society, married individuals usually live with or close to their parents or their parents-in-law. Therefore, arranged marriages restrict social and geographic mobility. Table 1.7 indeed shows that couples having an arranged marriage are less likely to move away for Turkey, Cambodia, Vietnam, India and Indonesia, the only countries of my sample that have information on post-marital living arrangements.

1.3.4 Evidence from other studies

Some of the studies summarized in table 1.2 have performed their own analysis regarding the characteristics associated with the movement away from arranged marriages. In this section, I have organized the information to complement the regression analysis of section 1.3.3.

In the case of Thailand, Pakistan and Malaysia the nature of the data available on current residence does not allow me to analyze the dynamics by cohort, but only the aggregate characteristics. Figures 1.1 displays love marriages by urban and rural residence. The conclusion remains unchanged, urban areas have a higher proportion of women in love marriages, although the difference is small for Thailand, where love marriages are high in all the regions, and for Pakistan, where arranged marriages comprise around 96% of all marriages.

Figure 1.2 shows the percentage of women in love marriages by education level for Sri Lanka, Pakistan and a different sample of Turkey.[9] For these countries I am not able to dis-

[9] The other sample for Turkey comes from the study of Fox (1975) who collected his data in 1966.

entangle the cohort effect from the education effect. In the three countries, higher percentage of love marriages are reported among women with higher education, in Turkey only 20% of women with primary or less education are in a love marriage, whereas 51% of women with more than primary education are in a love marriage. In Sri Lanka, the percentage of women in love marriages grows from 40% to 68% when moving from no education to education above 9th grade. And, even in Pakistan, where arranged marriages appear to be resilient to changes, 12.4% of women with completed secondary education report to have "some say" in marriage compared to only 2.3% of women with no education.[10]

Figure 1.3 plots the coefficients and odd ratios estimated and reported by different studies for Taiwan, China, Thailand and Central Java in Indonesia. Table 1.11 reports the same coefficients with standard errors or t-statistics when available, and in addition, it reports the results for Ghana and Nepal which were analyzed including a single dummy for education and a continuous variable for years of education, respectively. Figure 1.3 shows that for Taiwan and China, the trend is monotonic. In the case of Taiwan, I am plotting the unadjusted mean of an ordered variable where zero corresponds to arranged marriages and two to self-choice marriages. For China, the coefficients plotted correspond to the outcome of a linear regression and thus we can interpret them as the marginal effects. For Thailand and Indonesia (secondary axis), I calculated the odd ratios using the coefficients reported in a logit regression, their trend also seems smooth and monotonic with the exception of rural Indonesia for which there is a drastic increase for women in the highest level of education. In table 1.11, the results for Ghana point in the same direction, women with more education

[10] We should note that the sample from Pakistan is less affected by the cohort effect since the survey was conducted only among young women (ages between 15 and 24 years old).

are more likely to select their partners than women with no education. For Nepal, however, education does not impact the selection of partner (after controlling for other variables, see table 1.11), the odd ratio is 0.99 but it is statistically insignificant. However, women enrolled in school at the time of the survey are more likely to report a greater decision power in the selection of their spouses.

The last piece of evidence is organized in table 1.12, which shows the coefficients from regression analysis performed by the studies compiled in this paper for Thailand, Taiwan, China, Nepal, Central Java, Ghana and Togo. In general, the main purpose of those studies has been to understand how arranged marriages respond to economic changes; however, they have also explored how background characteristics affect the effect of such changes.

Thornton, Chang and Sun (1984) do an extensive analysis of the changes in the Taiwanese society for cohorts born between 1930 and 1959. They are interested in understanding how background characteristics deter or boost the transformation. They are particularly concern with the role of father's occupation and father's education. They find that more educated fathers and non-farmers are more likely to have daughters in a self-choice marriage. Cherlin and Chamratrithirong (1988) study Thailand. Similar to Thornton, Chang and Sun (1984), they are interested on how marriage patterns evolve through time and how this evolution is affected by the socioeconomic status of the families. They find an increase in love marriages especially for women with higher education. The transition towards love marriages is, nevertheless, negatively affected by "high" socioeconomic status of parents. The authors classify families into high status if they own land in rural areas or if the household head is engaged in a white collar occupation in urban areas. Their findings are consistent with the evidence discussed above, ownership of land is negatively correlated with arranged marriages for daughters. Malhotra (1991) conducts research in Central Java in the same spirit

as Cherlin and Chamratrithirong (1988) and Thornton, Chang and Sun (1984). The bulk of his results support a similar story to the cases of Taiwan and Thailand. The two exceptions are regarding land ownership and employment in rural areas. For the first variable, they find a slightly negative effect of belonging to a "landless farming" family on love marriages, relative to belonging to a "landed farming" family. Although the coefficient is not statistically significant. In the second case, having a paid farm job also has a small negative effect although not statistically significant either. Ghimire et al. (2006), for Nepal, include information about wage employment of mothers and education of both parents, among other controls. They find that only the coefficient for wage employment of mothers is statistically significant. However, the coefficients on parental education are both positive, the higher the education of the parents, the more likely children will choose their partners. Zhang (2008), in his analysis of the determinants of arranged marriages in urban China, also includes controls for father's education and one dummy variable for father's occupation (state worker). In his study, Zhang (2008) does not find a significant relationship between parental education and arranged marriages.

1.4 The Causes of the Transition

As discussed in section 1.2, anthropologists, sociologists and evolutionary psychologists suggest that arranged marriages originated as a strategy for families to form alliances with other kinship groups, clans or extended families. Their evidence suggests that the alliances may be used to increase or secure political power, keep social status, increase wealth, and/or smooth economic transactions, mainly in the form of informal risk sharing.

The transition to love marriages, therefore, should be the outcome of a change in the

benefits and/or the cost of the economic links across families. The recent economic transformations in these countries have possibly modified the margins that determine the decision to enter into informal economic arrangements across households. The analysis performed in the previous section suggests that there has been a decline in the net benefits of these informal arrangements relative to an outside option, captured by the option to freely move geographically and socially. This relative decline in benefits might lower the incentives of parents to arrange the marriage of their offspring, or the incentives of children to accept the arranged marriage.

In support of this general hypothesis, a recent paper by Munshi and Rosenzweig (2009) show that low mobility in rural India –defined as inter-caste marriages and migration to urban centers- is the consequence of informal insurance arrangements across households. Marriage increase social ties acting as a mechanism to sustain cooperation; while low migration to urban areas is a signal of commitment within the network. As the benefits of the social network decline, the members are more likely to move away and marry outside the caste. They also suggest that urban centers are witnessing a faster change; however, the nature of their data does not allow them to explore it formally.

Based on the evidence presented, I classify the explanations into four main sets of hypotheses: (i) decrease the value of the economic benefits (higher income covariance and availability of substitutes); (ii) increase in the cost of insurance (increase in asymmetric information and limited commitment problem); (iii) increase in bargaining power of children; (iv) alternative explanations (parents acting as matchmakers, children's education as new insurance strategy and changes in marriage laws).

1.4.1 Changes in incentives of Parents

This section considers the economic changes that modify the incentives of parents to arrange marriages for their children and briefly discuss their potential scope explaining the transition to love marriages. These changes might decrease the value of entering into informal insurance arrangements or they might increase the cost of belonging to a network, or both.

1.4.1.1 Decrease in the value of insurance and other economic links

The evidence presented by Rosenzweig and Stark (1989) and Munshi and Rosenzweig (2009) suggests that arranged marriages might be used mainly as a mechanism to smooth consumption across households. Their main assumption is the existence of a social network formed by the clan, kinship, extended family, or caste. Members of the social network interact with each other in times of distress by aiding in consumption smoothing; a key problem in this consumption smoothing mechanism is commitment among members of the social network. Theoretical and empirical research shows that if the outside option -exclusion from the group- is high enough, members of the social network will not reciprocate the help received in past periods and will move out of the network. The limited commitment problem is exacerbated by asymmetric information and moral hazard problems. Therefore, by marring their children with other members of the social network, the families achieve three objectives: (i) they enter into an informal arrangement with the best insurnace parter (lowest risk covariance); (ii) they strengthen social ties (reducing the limited commitment problem), and; (iii) they increase flow of information across the households (mitigating the asymmetric information and the moral hazard problems).

As already discussed, the evidence collected and organized in this paper suggests that arranged marriages are mainly found in agrarian societies, where economic shocks are often

related to weather variability. Informal social networks become vital in these situations since the loss of crops would imply the starvation of families when governments do not intervene. However, as societies develop and industrialization takes place, there is a movement away from agriculture. The economic transformation is usually characterized by an increase in employment in manufacturing and services, migration to urban areas, population growth across all areas, emergence of social security programs, and development of financial institutions.

As families move to industrial activities, i.e. work in factories, *the type and exposure to risk change*. Consumption shocks are no longer related to weather variability; instead, they are related to unemployment and health shocks. The new market activities increase the covariance of risk among members of the network, and arranging marriages no longer might help to mitigate consumption shocks.[11] Parents lose the incentives to marry off their children to members of the social network. The new economic environment does not prevent households from belonging to social networks, but it might change the formation of those networks and the interactions across households.

As countries develop, governments also become more organized and taxation of formal employment increases public income allowing the implementation of *social security programs*. There is a large range of programs implemented that typically target the most vulnerable sectors of the population: pension systems, other old-age support programs, cash transfer programs, temporary employment programs for seasonal workers, unemployment insurance,

[11] Coate and Ravallion (1993) propose a simple model of informal insurance arrangements across households. In their model, the higher the income covariance across households, the lower the value of belonging to the social network. Rosenzweig and Stark (1989) empirically find that the covariance in weather fluctuations is low across members of the social network.

and others. Welfare programs might act as substitutes for the aid of social networks, decreasing the demand for informal insurance across households. Furthermore, if the implementation of these programs are tied to individual negative shocks (unemployment insurance or temporarily relief programs), then families will have less incentives to enter into an insurance agreement with other families since welfare programs do not require reciprocation of help from households. However, the wide range of countries studied in this paper suggests that is unlikely that all of them have established well-functioning social security programs; this concern should specially accurate for developing countries, where welfare programs suffer many problems of implementation in their early stages. Therefore, it seems unlikely that the expansion of welfare programs is the main cause behind the transition, although they could have contributed to mitigate the demand for informal insurance. In addition, at least two conditions might be needed in order to make it the main explanation. First, a large percentage of the relevant population should have information about the availability of the program and should be eligible to participate. Second, individuals should credibly expect to have access to the social security programs. If households are uncertain about the future transfers of the program, they will not modify their behavior until uncertainty is resolved. A more concrete example could be the establishment of an old age programs targeting poorer households. After the establishment of the program, parents will not stop arranging marriages for their children. Once the first cohorts receive the social security benefits, younger generations of parents may start modifying their choices. These two conditions might be met by a handful of these countries, whereas the rest of them are in earlier stages of their design and implementation.

Finally, another characteristic of economic development is the introduction and expansion of *financial and credit institutions*, which reduce the demand for informal loans from family and friends. In these societies, loans can serve two purposes. On one hand, social net-

works might not only offer aid in time of bad shocks, but might also provide loans and other facilities to invest in productive activities, for example, loans before planting. On the other hand, Udry (1990) uses data from Nigeria to show that informal loans can be used as a form of social insurance. He shows that borrowers and lenders dynamically determine the amount and dates of repayment depending on the shocks that each of them faces. The economics literature has further shown (Kaboski and Townsend, 2011) that the introduction of credit institutions helps households to smooth consumption over time. Therefore, the development of credit markets might also contribute to weaken the need for informal networks. However, an argument similar to the case of social welfare programs might be made for credit and financial institutions. Economic development is highly correlated with penetration of financial systems; therefore, the emergence and spread out of these institutions should be lower in countries in earlier stages of development and, even in those countries, it should be higher in urban areas while it might be low or non-existent in rural areas. In addition, we should also expect that the pool of agents qualifying for loan's application is small in developing nations where formal jobs are scarce and income from informal sources is subject to a great deal of volatility. Therefore, the relevant population might not be exposed to them during this period.

1.4.1.2 Increase in the cost of insurance

All the changes discussed so far might have contributed to lower the value of informal social networks by increasing the covariance and variance of income across households or introducing substitutes that mitigate the need of informal networks. However, the cost of belonging to social networks might have also increased in the past decades. This subsection focuses on the effects of migration and urbanization.

In this context, population growth has had two main consequences. First, *urbanization*

has a direct impact in the reputation or information stock of every potential member of the social network. In villages, older generations had accurate information about the assets and other characteristics of the members of their social networks. Finding the right mate for their children was likely the outcome of a search process among these members (Geertz, 1961). Candidate families must met certain requirements; for example, belong to the same social class, being located in distant villages, etc. It is also possible that other characteristics were preferred by households, for instance, a mate belonging to a hard working family would have been preferred to other candidates. In small communities information regarding the type of each family could be easily spread out through repeated interactions and reputation was possibly built through actions and sustained by many generations of the same family. As villages grew, repeated interactions become limited and information regarding the type of each family has been more difficult to obtain. This lack of information might have had a direct impact on the expected cost of informal insurance by increasing the probability of being matched with a low or bad type.

The second direct consequence of population growth has been large scale *migration* from rural areas to urban centers. Migration has a direct impact on the limited commitment problem faced by households that belong to informal social networks. In the simplest economic model, each period households have to decide whether to enter the informal arrangement conditional on expecting other members to participate.[12] The massive migration across areas might lower the incentives of families to enter into an insurance arrangement if they believe that their social network partners will leave the network in the following periods and they will not reciprocate the aid received in the past.

[12] Coate and Ravallion (1993) incorporate this feature through the discount rate (probability of playing the game in the future).

The combination of reduction in the reputation stock and the large scale migration across areas is a feasible explanation to understand the patterns of change. The key is to determine whether the timing of urbanization and migration is plausibly correlated with the transition to love marriages.[13]

1.4.2 Changes in the incentives of Children

The previous section suggested several explanations for changes in parent's incentives. This section looks at transformation that may have shifted the bargaining power from parents to children. The hypothesis discussed in this section assumes some degree of conflict between parents and children in the objective function that they maximize: children have lower valuation for informal insurance arrangements.

Educational attainment has increased in all the regions analyzed in this paper as documented in the results presented in the previous section.[14] Employment outside the agri-

[13] Although there is also another possibility. The change could have started in urban areas and spilled-over to rural areas. Fogli and Veldkamp (2011) propose a model where female labor force participation increases as women "observe" and adjust beliefs about the effect of maternal work on children's outcomes. The change is initially slow since few women participate in the labor force. As more women enter the labor market, information spreads out faster and female labor force participation converges in all regions. The transition to love marriages can be modeled in a similar way. Women start the transition in urban areas, but agents in rural areas slowly learn the effect of love marriages on the relevant outcomes (consumption smoothing, social status, etc.). The change is accelerated in turn by the presence of mass media which disseminates information faster across regions.

[14] This change in educational attainment has been the outcome of both an increase in demand and supply of schooling.

cultural sector (or outside the household) also has grown in these countries and men and women have responded by shifting their labor supply towards new occupations in a more formal employment economy. Younger cohorts are therefore better educated and earn wages outside agriculture, parents are no longer the only potential source of income for the future - by offering inheritance of land or apprenticeship of other skills. The introduction of formal labor markets, therefore, has potentially changed the distribution of power within the household and children have gained bargaining power relative to their parents through their incorporation into the new labor markets.

Most of the societies with arranged marriages share another institutional feature. At the time of the marriage, there is an exchange of gifts between the family of the bride and the family of the groom. These gifts can be either a bride-price (from the family of the groom to the family of the bride) or a dowry (from the family of bride to the family of the groom). Anderson (2007) discusses the changes through time and societies on the prevalence of these payments. However, they seem to be closely related to arranged marriages since they involve negotiation between families. As suggested by Edlund and Lagerloff (2004), the shift of resources from parents to children would free children from the power of parents. As owner of their wages, children would be able to "buy" their own partners. If the institutions of bride-price and dowry are preserved, children will become able to afford their brides or grooms.

1.4.3 Other explanations

The hypotheses discussed above assume that arranged marriages are a response to incomplete markets. Families look for a mechanism to strengthen social ties with their social

networks and smooth economic transactions through time. In this section I discuss three alternative hypotheses.

The evidence presented so far shows a high correlation among agricultural settings, land ownership and arranged marriages. This correlation might have a different interpretation. Rural areas have low population density and both parents and children interact with a small number of agents, marriage markets in rural areas are small or non-existent. If parents are altruistic, they will look for a partner for their children using their social connections. As cities grow, parents are relieved of this function. The cost of search in love marriage markets decreases for younger generations. However, in order to be the main driving force, the search cost should substantially decrease also in rural areas.

An alternative explanation for the observed increase in schooling and employment outside the household is that parents continue to have all the bargaining power and they "own" their children's wages. If this is the case, parents might change their insurance strategy. Instead of selecting a suitable partner for their children, they invest in their children's education, collect their children's wages, postpone marriage decisions until a later age and finally let their children choose their partners. Jensen (2012) conducts a randomized experiment in India aiming to understand if labor market opportunities change marital choices of women. He finds that indeed women marry older when they are presented with formal employment possibilities. Unfortunately, his data does not allow him to study who makes the marriage choice, parents or children. This alternative hypothesis requires that children care about their parents after marriage and enter into an insurance agreement with them through the exchange of goods and loans after they leave home; or that parents have an alternative source of income after children marry.

Lastly, the change in marriage patterns may be the outcome of changes in Marriage and Family Laws. All the countries in this study have enacted family laws with the goal of regulating marriage, inheritance and succession. The validity of this hypothesis depends crucially on the enforceability of the laws and the absence of reverse causality. Table 1.8 summarizes the year of law enactment or law modification for the countries studied and there are two patterns observed. For one group of countries (Turkey in 1926, Taiwan in 1930 and 1937, Korea in 1948, Japan in 1947 and China in 1950) the laws changed in the early 20th century but they were not enforced. Arranged marriages persisted for several decades after the laws were passed and they have just recently began to disappear. Moreover, some of these countries such as Korea, Turkey, Taiwan and China have amended their laws during the last decades to accommodate changes in the marriage markets, but these amendments are more likely the outcome of reverse causality. A second group of countries (Vietnam 1959, Nepal 1963, Indonesia 1974, Malaysia 1976, Thailand 1976, Cambodia 1989) has more recently passed their first Marriage Laws regulating marriage and forbidding arranged marriages. However, the timing of the laws suggests that they are the response to large changes in marital decisions rather than the cause. Moreover, these laws seem to be non-binding for the majority of these countries.

The explanations explored above suggest that technological change and economic development in these countries has caused the decline in arranged marriages through: (1) a decrease in the net benefits of arranged marriages relative to an (increasing) outside option; or (2) a change in the in marriage markets.

1.5 Welfare consequences

Perhaps more important than the causes of the transition are the consequences of this

change. Welfare implications might include changes in the ability to smooth consumption and other behavioral responses. Regarding consumption smoothing, Rubio (2014) finds evidence in Indonesia suggesting that households having an arranged marriage are better able to smooth consumption through time.

For the rest of this section, I will focus on other outcomes. In particular, I am concerned with the welfare of women and children. Are women (and their children) better off when they choose their spouses? Since women in love marriages have different observable characteristics than women in arranged marriages, I expect to observe different characteristics on their partners by type of marriage (unless the objective function, information set and pool of suitable matches of parents and children are exactly identical). Therefore, it is possible that most of the results of this section are driven by the selection of women into love marriages; however, these results might be suggestive of the type of welfare gains or losses we should expect as these regions reach a new marriage market equilibrium.

Moreover, focusing on other outcomes may be as important as studying consumption smoothing changes. Most of the societies considered in this paper are patrilineal, women tend to have a lower position in the social hierarchy and, typically, they also have lower economic value. This social organization has given rise to a strong preference for sons over daughters which is often reflected in differential investment in care, health, education, among others, for boys and girls. Croll (2000) studies China, Korea, Taiwan, Vietnam, India, Bangladesh and Pakistan during the early 90s calculating that there are between 0.5 and 29.1 millions of "missing" girls at birth. Further evidence has been presented showing that indeed there are many millions of "missing" girls and that the main cause is the strong preference for sons. The transition towards love marriages might contribute to mitigate this problem and increase the welfare of girls and women.

In this section I use self-reported measures of domestic violence and other household decisions to study potential changes in these behaviors. Table 1.9 presents suggestive evidence on differences in domestic violence by type of marriage. I use data from Cambodia, Turkey and India, the only countries that report some measures on domestic violence. And table 1.10 analyses household decisions for China, Japan, Korea and Taiwan. For both analyses, I controlled for the same variables used in tables 1.5 and 1.6 (age, residence, education, labor force participation, work status, occupation, and province and survey year fixed effects). Overall the results show a robust and significant correlation between arranged marriages and domestic violence. Women in arranged marriages support being beaten under a several circumstances: if they burn the food or do not cook properly; if they go out without asking permission to their husbands; if they are suspected of neglecting their children; and if they refuse to have sexual intercourse. They also agree with the ideas that men are wiser than women and that most decisions should be taken by the males of the household. These women also exhibit a stronger preference for educating sons relative to daughters. The evidence presented in table 1.9 is also found in other studies, for example Chung and Das Gupta (2007) study the evolution of the preference for sons in South Korea finding that among women with arranged marriages there is a stronger preference for sons over daughters. They conclude that the transition to love marriages has contributed to the decline of son preference, therefore decreasing the strongly skewed sex-ratio. The results on table 1.10 for East Asia are less conclusive. In general, women respond to have lower decision power in the education of children, and perhaps for the decision of purchasing expensive items; however, a multinomial logit analysis show that they report higher marital satisfaction. Finally, the last row of table 1.7 shows that even after controlling for several observable characteristics (age, residence, education, labor force participation, work status, occupation, province and survey year fixed effects), individuals are more likely to marry between 0.2 and 1.3 years younger.

The media has recently documented an increase in gender violence and suicides among women who are forced into marriage (Iran, Morocco, India, etc). The literature of psychology and the World Health Organization (WHO) have been interested in this question for a long time. They have numerous studies analyzing the causes of mental stress that lead to the high rate of female suicide in Asia and the Middle East. Unfortunately, most of them are case studies conducted in small areas due to the low quality of data at the national or regional level; in several of these countries suicide is not reported since it carries a negative stigma for families.[15] The WHO has recognized the deficiencies in the quality of data and has developed a 4-level rating system to assess it when available. Using correction methods, they have calculated national measures by age group and gender, concluding that Asia has one of the highest rates of female suicide (using Europe as a benchmark). The case studies for India, Pakistan, Bangladesh, China and Sri Lanka (Gujarat et al., 2004; Khan et al., 2009; Ahmed et al., 2004; Phillips et al., 2002; Marecek, 2006) provide insights into the determinants of this high suicide rate. Their findings suggest that domestic violence, especially in situations where women cannot leave their partners (for example, in arranged marriages), is one of the main contributing factors to the female suicide in these areas. Nevertheless, the evidence is not conclusive. Some scholars have presented evidence from China suggesting that women in arranged marriages have higher support from families, claiming that women in self-choice marriages have higher risk of mental distress and suicide.

[15] In some Muslim countries it is penalized; for instance, in Pakistan, families have to pay a fine if any of their members commits suicide.

1.6 Conclusions

This paper has extensively documented an ongoing love revolution in Asia, Sub-Saharan Africa and the Middle East (the exception being South Asia). Drawing from numerous studies in many disciplines and constructing my own statistics for a selected number of countries, I have shown that these regions are experiencing a huge transition in marriage arrangements. One of their main institutions, arranged marriages, is vanishing. Understanding the role of arranged marriages in these societies, the causes for their disappearance and the welfare implications are certainly important for the design of welfare programs. As urbanization and industrialization take place, institutions evolve, but so the needs of individuals and the role of the government.

After showing that the decline in arranged marriages is correlated with urbanization, education and work outside agriculture, I proposed and discussed several hypotheses aimed to explain the transition: (i) Changes that decrease the value of insurance (higher income covariance and availability of substitutes); (ii) changes that increase the cost of insurance (increase in asymmetric information and limited commitment); (iii) increase in bargaining power of children; (iv) alternative explanations (parents acting as matchmakers, children's education as new insurance strategy and changes in marriage laws).

Finally, I explored some of potential welfare consequences of this phenomenon, finding that women in arranged marriages are more likely to be in abusive relationships. I also presented suggestive evidence of arranged marriages as a contributing factor to the high suicide rate among women in Asia.

Overall, numerous questions are put forward in this paper and some potential answers are

sketched. More work is needed in order to understand better the patterns documented here. In particular, future work should be focused on providing causal evidence on the transition. An empirical strategy that allows to generate exogenous variation in arranged marriages can be further used to study its effects on consumption smoothing and other welfare measures (domestic violence, health and education of women and children, and others).

1.7 Tables and Figures

Table 1.1: Ethnographic Evidence

Ethnographic Evidence					
Marriage Mode	**Obs.**	**%**	**Family Organization**	**Obs.**	**%**
Bride price	550	63.95	Extended family	428	50.06
No exchange	205	23.84	Independent nuclear family	247	28.89
Dowry	23	2.67	Independent polygamous family	180	21.05
Gift exchange	55	6.4	*Total*	*855*	*100*
Bride-exchange	27	3.14	**Descent**		
Total	*860*	*100*	Patrilineal only	395	45.9
Cousin Marriage			Matrilineal only	120	14
Forbidden/Not encouraged	475	62.34	Bilateral descent	34	4
Favored	287	37.66	None	311	36.2
Total	*762*	*100*	*Total*	*860*	*100*
Exogamy			**Residence**		
None	470	59.27	Matrilocal	149	17.63
Exogamy	254	32.03	Ambilocal, neolocal or none	104	12.31
Endogamy	69	8.7	Patrilocal	592	70.06
Total	*793*	*100*	*Total*	*845*	*100*
			Class categories		
Inheritance			Complex stratification	64	7.81
			Dual (hereditary aristocracy and lower class)	182	22.22
By children of either sex or both	51	8.25			
Both, daughters receive less	29	4.69	Elite stratification	18	2.2
Matrilineal by sister's sons	16	2.59	None	391	47.74
Matrilineal heirs precedence over sister's sons	35	5.66	Wealth distictions	164	20.02
			Total	*819*	*100*
None	177	28.64	**Caste Categories**		
Patrilineal by sons	56	9.06	Complex stratification	20	2.45
Patrilineal heirs precedence over sons	254	41.1	One or more out-castes	74	9.06
			Ethnic Stratification	17	2.08
Total	*618*	*100*	None	706	86.41
			Total	*817*	*100*

The ethnographic evidence was collected and clssified by Murdock (1967). The table is constructed using 862 societies from Sub-Saharan Africa, Circum-Mediterranean, East Easia, Insular Pacific, North America and South and Central America. The atlas focuses mostly on Africa and North America, it does not cover Europe and it only surveys a few societies in Asia.

Table 1.2: Arranged Marriages by Country and Cohort

Country	Author	Project/Year	Sample Size	Birth Cohort	Arranged	Love
Turkey	Fox (1975)	Ankara city, 1966	754 married couples	<1921	80.7	19.3
				1936-1922	71.9	28.1
				>1937	71.2	28.3
Turkey	Calculated by the author	Turkey Demographic and Health Survey: 1993, 1998, 2003	1993: 5,820 women	1944-1953	74.6	19.4
			1998: 5,581 women	1954-1963	65.3	30.3
			2003: 7,479 women	1964-1973	57.7	38.3
				1974-1983	45.6	49.3
Israel	Al-Haj (1988)	Shefar 'Am Arab community, 1988	2586 married couples	All Cohorts	15	85
Saudi Arabia	Alsuwaigh (1989)	City of Damman, Eastern province of Saudi Arabia, 1989	62 women	<1934	94	6
				>1954	45	55
Taiwan	Thornton, Chang and Sun (1984)	Taiwan Provincial Institute of Family Planning Surveys: 1973, 1980	4313 married women	1930-1934	77.1	22.9
				1935-1939	69.1	30.8
				1940-1944	48.4	51
				1945-1949	32.3	67.3
				1950-1954	25.8	73.6
				1955-1959	15.1	84.7
Taiwan	Calculated by the author	East Asian Social Surveys: Families in East Asia 2006	2040 individuals	1927-1936	36.3	63.7
				1937-1946	22.3	77.7
				1947-1956	15.5	84.5
				1957-1966	7.5	92.5
				1967-1976	7.9	92.1
				1977-1986	0.6	99.4
China [1]	Whyte (1995)	Chengtu City, Szechwan: Urban Area, 1987	586 ever married women	1933-1948	68	32
				1949-1957	27	73
				1958-1965	0	100
				1966-1976	1	99
				1977-1987	2	98
China	Zhang (2008)	Urumchi, the capital city of the Xinjiang Uyghur Region, 2005	1583 married women	<1950	34.6	65.4
				1950-59	20	80
				>1959	12.6	87.4

[1] Marriage Cohort

Country	Author	Project/Year	Sample Size	Birth Cohort	Arranged	Love
China	Calculated by the author	East Asian Social Surveys: Families in East Asia 2006	3110 individuals	1937-1946	17.3	82.7
				1947-1956	10.0	90.0
				1957-1966	8.3	91.7
				1967-1976	5.7	94.3
				1977-1986	3.6	96.4
Japan [1]	Takahashi et al. (2003)	Nationally Representative: Japanese National Fertility Survey 1977, 1982, 1987, 1992, 1997	1997: 7,069 ever-married women 1992: 8,627 ever-married women 1987: 8,348 ever-married women 1982: 7,803 ever-married women 1977: 8,314 ever-married women	1930-39	69	31.1
				1940-44	69.1	31
				1945-49	59.8	40.3
				1950-54	53.9	46.1
				1955-59	54	46
				1960-64	49.8	50.2
				1965-69	44.9	55.1
				1970-74	33.1	66.9
				1975-79	30.4	69.6
				1980-84	24.9	75.1
				1985-89	17.7	82.3
				1990-94	12.7	87.3
Japan	Calculated by the author	East Asian Social Surveys: Families in East Asia 2006	1555 individuals	1917-1926	30.3	69.7
				1927-1936	14.4	85.6
				1937-1946	14.4	85.6
				1947-1956	7.3	92.7
				1957-1966	4.3	95.7
				1967-1976	2.7	97.3
Korea [1]	Kong et al.(1990)	National Fertility Survey 1990	---	1950s	96.3	3.7
				1960s	82	18
				1970s	64.3	35.7
				1980s	49.1	50.9
Korea	Calculated by the author	East Asian Social Surveys: Families in East Asia 2006	1555 individuals	1917-1926	68.2	31.8
				1927-1936	60.2	39.8
				1937-1946	46.9	53.1
				1947-1956	20.0	80.0
				1957-1966	16.9	83.1
				1967-1976	8.5	91.5
				1977-1986	4.6	95.4
Sri Lanka [1]	Caldwell et al. (1989) Caldwell (1996)	Coastal Sri Lanaka, district of Colombo 1985, 1987	1,817 with completed marriage history	1940-1949	70	30
				1950-1954	63	37
				1955-1959	66	34
				1960-1964	60	40
				1965-1969	43	57
				1970-1974	37	63
				1975-1979	29	71
				1980-1985	32	68

[1] Marriage Cohort

Country	Author	Project/Place	Sample Size	Birth Cohort	Arranged	Love
Nepal [1]	Ghimire et al. (2006)	Chitwan Valley, Nepal: 1996	2788 ever-married women	1936-1945	100	0
				1986-1995	50	50
Cambodia	Calculated by the author	Cambodian Demographic and Health Survey 2000, 2005	2000: 1,954 women 2005: 3,568 women	1951-1960	74.9	25.1
				1961-1970	65.1	34.9
				1971-1980	62.3	37.7
				1981-1990	50.8	49.2
Vietnam	Calculated by the author	Vietnam Longitudinal Survey, 1995	1,938 ever-married females	1930-1934	65.3	34.7
				1935-1944	53.0	47.0
				1945-1954	21.6	78.4
				1955-1964	18.8	81.2
				1965-1974	19.8	80.2
Malaysia	Chang and Jones (1990)	Kelantan, Pahang, Penang, Negeri Sembilan, Melaka, Selangor, and Kuala Lumpu: 1981	2310 currently married women	<1936	41	58
				1937-46	36	64
				1947-56	17	83
				1957-66	18	82
Indonesia	Calculated by the author	Indonesia Family Life Survey, 1993	6620 ever-married women	1933<	56.8	43.2
				1934-1943	47.3	52.7
				1944-1953	40.4	59.6
				1954-1963	28.8	71.2
				1964-1978	19.6	80.4
Ghana	Takyi et al. (2003)	Southern Ghana 1992-1993	909 women	All cohorts	6.49	93.51
Togo [1]	Meekers (1995)	Togolese Demographic and Health Survey, 1988	1968 ever-married women with one marital union	<1970	45.6	54.3
				1970-1979	30.7	69.3
				1980+	24.4	75.6

[1]Marriage Cohort

Table 1.3: Arranged Marriages by Country and Cohort: South Asia

Country	Author	Year of Survey	Project/Place of Survey	Birth Cohort	Arranged	Love
India	Calculated by the author	2004	India Human Development Survey	1954-1958	96.1	3.9
				1959-1963	95.1	4.9
				1964-1968	95.7	4.3
				1969-1973	95.2	4.8
				1974-1978	94.5	5.5
				1979-1985	94.2	5.8
Bangladesh	Calculated by the author	1996	Matlab Health and Socioeconomic Survey	<1931	99.2	0.8
				1932-1941	99.6	0.4
				1942-1951	99.5	0.5
				1952-1961	99.4	0.6
				1962-1971	97.7	2.3
				1972-1981	96.2	3.8
Pakistan	UNICEF, Pakistan	2001-2002	Adolescents and Youth Survey	1977-1981	96	4
				1982-1986	96.9	3.1

Table 1.4: Samples used for each country

Country	Dataset	Years	Observations	AM	Age	Urban	Ed.	Fem.
Cambodia	Demographic and Health Survey	2000 and 2005	5474 women	0.65 (0.48)	33.85 (8.63)	0.19 (0.40)	3.01 (2.94)	
Indonesia	Indonesia Family Life Survey	1993	11579 men and women	0.28 (0.45)	42.06 (13.53)	0.46 (0.50)	5.06 (4.26)	0.56 (0.50)
Turkey	Demographic and Health Survey	1998	5832 women	0.63 (0.48)	32.87 (8.49)	0.68 (0.47)	4.91 (3.83)	
Vietnam	Vietnam Longitudinal	1995	3607 men and women	0.25 (0.43)	39.47 (11.22)	0.19 (0.39)	7.85 (2.92)	0.54 (0.50)
Togo	Demographic and Health Survey	1988	2609 women	0.87 (0.34)	30.75 (8.56)	0.30 (0.46)	1.74 (2.96)	
India	India Human Development	2005	32018 women	0.96 (0.20)	33.00 (8.00)	0.36 (0.48)	4.57 (4.80)	
Taiwan	East Asian Social Survey*	2006	1929 men and women	0.13 (0.33)	3.22 (1.63)	0.95 (0.22)	10.65 (4.69)	0.50 (0.50)
Korea	East Asian Social Survey*	2006	1406 men and women	0.21 (0.41)	3.14 (1.46)	0.99 (0.08)	11.95 (4.47)	0.57 (0.49)
China	East Asian Social Survey*	2006	3056 men and women	0.08 (0.28)	2.88 (1.28)	0.68 (0.47)	8.34 (4.24)	0.55 (0.50)
Japan	East Asian Social Survey*	2006	2088 men and women	0.09 (0.28)	3.86 (1.66)	0.88 (0.32)	12.28 (2.56)	0.55 (0.50)
Taiwan	Province-Wide Fertility Survey**	1973 and 1986	9850 women	0.42 (0.49)	43.36 (6.79)		2.26 (1.07)	

* The East Asian Social Survey reports age group instead of current age. The groups are: 1 = 20-29 years old; 2 = 30-39; 3 = 40-49; 4 = 50-59; 5 = 60-69; 6 = 70-79; 7 = 80-89.

** The Knowledge, Attitudes, and Practice of Contraception in Taiwan: Province-Wide Fertility Survey reports education in groups: 1 = none; 2 = some primary; 3 = some junior high; 4 = some senior high; 5 = some college; 6 = some university.

Table 1.5: Country regressions: Cambodia, Indonesia, Turkey, Vietnam, Togo and India

	Cambodia	**Indonesia**	**Turkey**	**Vietnam**	**Togo**	**India**
Female		0.111***		0.00245		
		(0.00951)		(0.0136)		
Age	0.00241**	0.00666***	0.00533***	0.00875***	0.00115	0.000672***
	(0.00109)	(0.000301)	(0.000823)	(0.000681)	(0.000766)	(0.000150)
Urban	-0.0187	-0.0316***	0.00472	0.0633*	-0.0144	-0.00382
	(0.0207)	(0.00917)	(0.0157)	(0.0327)	(0.0197)	(0.00340)
Education	0.00159	-0.0123***	-0.0337***	-0.0227***	-0.00394	-0.00147***
	(0.00272)	(0.00105)	(0.00208)	(0.00285)	(0.00284)	(0.000312)
LFP	0.0463**	0.000411	-0.239**	0.142***	0.0257	
	(0.0226)	(0.0102)	(0.101)	(0.0415)	(0.0162)	
Employee	-0.0544*	-0.0269***	-0.0233	-0.0880**		-0.0206***
	(0.0303)	(0.00998)	(0.0336)	(0.0406)		(0.00302)
Self-employed	0.00535	0.0355***	0.0308	-0.166***		
	(0.0187)	(0.0125)	(0.0379)	(0.0367)		
Manufacture	-0.105***	-0.0161	-0.0915**	-0.0931***		-0.00169
	(0.0360)	(0.0122)	(0.0390)	(0.0199)		(0.00337)
Services	-0.00812	7.04e-05	-0.144***	0.0557		-0.00156
	(0.0210)	(0.0116)	(0.0395)	(0.0481)		(0.00360)
Keep wages					-0.0338**	
					(0.0168)	
Parter Agric					0.0268	
					(0.0179)	
Constant	0.736***	-0.0705***	0.820***	0.0962*	0.833***	0.950***
	(0.0508)	(0.0255)	(0.108)	(0.0527)	(0.0319)	(0.0144)
Obs	5,474	11,579	5,832	3,607	2,609	32,018
R-squared	0.166	0.222	0.146	0.213	0.038	0.027

Table 1.6: Country regressions: Taiwan, Korea, China and Japan

	Taiwan	**Korea**	**China**	**Japan**		**Taiwan**
Female	0.0758***	0.0526**	0.0239**	0.0542***	Female	
	(0.0159)	(0.0234)	(0.0104)	(0.0146)		
Cohort 2	0.0560**	0.0254	0.00587	0.0270	Age	0.0131***
	(0.0237)	(0.0358)	(0.0157)	(0.0248)		(0.000756)
Cohort 3	0.0530**	0.105***	0.0351**	0.0392	Education 1	-0.157***
	(0.0234)	(0.0356)	(0.0160)	(0.0249)		(0.0122)
Cohort 4	0.113***	0.113***	0.0450***	0.0715***	Education 2	-0.296***
	(0.0261)	(0.0416)	(0.0171)	(0.0240)		(0.0178)
Cohort 5	0.153***	0.353***	0.117***	0.141***	Education 3	-0.390***
	(0.0336)	(0.0494)	(0.0196)	(0.0257)		(0.0190)
Cohort 6	0.288***	0.487***		0.148***	Education 4	-0.447***
	(0.0386)	(0.0586)		(0.0296)		(0.0350)
Cohort 7	0.292***	0.492***		0.313***	Education 5	-0.470***
	(0.0517)	(0.0961)		(0.0397)		(0.0401)
Urban	0.0838	0.0128	-0.0459***	-0.0298		
	(0.140)	(0.144)	(0.0175)	(0.0190)		
Education	-0.00566**	-0.0108***	-0.00281*	0.00534*		
	(0.00222)	(0.00313)	(0.00159)	(0.00286)		
LFP	0.0491	0.0164	-0.00195	0.0327	LFP	-0.165
	(0.0378)	(0.0523)	(0.0559)	(0.0509)		(0.226)
Employee	0.0159	-0.0134	0.00409	-0.0958***	Employee	-0.00602
	(0.0289)	(0.0594)	(0.0391)	(0.0365)		(0.0213)
Self-employed	0.00734	-0.0151	0.0101	-0.116***	Self-employed	-0.0634***
	(0.0352)	(0.0620)	(0.0407)	(0.0408)		(0.0199)
Manufacture	-0.0941*	-0.0409	-0.0244	0.0220	Manufacture	-0.0516*
	(0.0500)	(0.0563)	(0.0209)	(0.0407)		(0.0293)
Services	-0.0724	0.0182	-0.00866	-0.00214	Services	-0.0794***
	(0.0497)	(0.0557)	(0.0199)	(0.0402)		(0.0297)
Constant	-0.123	0.113	0.0873	-0.0148	Constant	0.279
	(0.158)	(0.183)	(0.0768)	(0.0846)		(0.231)
Obs	1,929	1,406	3,056	2,088	Obs	9,850
R-squared	0.158	0.226	0.074	0.083	R-squared	0.163

Table 1.7: Other measures

	Turkey	Cambodia	Vietnam	India	Indonesia
Living with parents or close to them	-0.000771	0.0250*			0.116***
	(0.00317)	(0.0145)			(0.0214)
Living with parents-in-law	0.0653***	0.00309			
	(0.00986)	(0.0106)			
Living on their own house			-0.0721***	-0.0897***	
			(0.0144)	(0.00647)	
Spouse is blood relative	0.0516***			-0.0242***	
	(0.00860)			(0.00817)	
Age at first marriage	-0.638***	-0.199	-1.278***	-0.343***	-1.050***
	(0.0763)	(0.125)	(0.151)	(0.0856)	(0.119)

Table 1.8: Marriage and Family Laws

Country	Year	Law	Addition to the Law
Turkey	1926	*Abolishion of Shariah Law*	Forbade polygamy, instituted civil marriage, allowed the initiation of divorce proceedings by either partner, and guaranteed equality of women before the law. Age at marriage changed from 9 to 15 for girls, from 11 to 17 for boys.
	2001	*New Civil Code*	Among others: minimum age at marriage was raised to 18 for both genders; and minor and adult women pressured to marry are allowed file for an annulment.
Taiwan	1930	*Taiwanese Civil Code*	Adopted male-female equality from German law.
	1937, 1947	*Reform Taiwanese Civil Code and Constitution of the Nationalist government*	Women obtained the right to vote, run for public office, inherit property, obtain education, and to enter into contracts. Both partners in a marriage have equal voice and women can initiate a divorce.
	1996, 1998	*Reform to Family Law*	Father/husband and mother/wife are equal with regard to parental rights, child custody and domicile.
Japan	1947	*Japanese Constitution*	Established minimum age at marriage to 18 for males and 16 for females, and requiered mutual consent of partners.
Korea	1948	*Korean Constitution*	Guaranteed the equality of all citizens and prohibited political, economic, and social discriminationo n accounto f sex, religion, and social status.
	1960	*Korean Civil Code*	The law contained many male-dominant provisions in marriage, divorce, and inheritance.
	1977	*Revision of Korean Civil Code*	The family law maintained the patrilineal family system designating the eldest male as the head of the family. Also limited the wife's role in adoption proceedings, parental authority, division of property, and divorce.
	1991	*Revision of Korean Civil Code*	It greatly limited the family head's power and changed the inheritance of the family headship to a succession system.

Country	Year	Law	Addition to the Law
India	1955	*Hindu Marriage Act*	Established age at marriage to 15 for females and 18 for males.
	1978	*Child Marriage Restraint Act*	Increased minimum age at marriages to 18 for females and 21 for males.
Vietnam	1959	*Family Law*	Ended arranged marriages and polygamy. Brought equality between men and women and protected the basic rights of women and children.
	1986	*Reform of Family Law*	Strenghten and clarified the previous provisions.
	1994	*Reform of Family Law*	
Nepal	1963	*Civil Code*	Child marriage is prohibited under the Nepali law. Minimum age at marriage set at 20 years old. However, it perpetuated the gender segregation.
Indonesia	1974	*Indonesia Family Law*	Set minimum age to 19 for men and 16 for women. Required consent of spouses.
Malaysia	1976	*Malaysia Family Law*	Abolishes polygamy and and sets minimum age at marriages to 18 for males and 16 for females.
Thailand	1976	*Thailand Family Law*	Arranged marriages are forbidden and bans engagements before the age of 17 for both genders.
Cambodia	1989	*Cambodian Family Law*	Minimum age of 20 for males and 18 for females, and required consent of spouses.

Table 1.9: Domestic Violence

	Turkey	**Cambodia**	**India**
Decisions should be made by men	0.0672***	0.0344*	
	(0.00955)	(0.0182)	
Married women should not work		0.0572***	
		(0.0170)	
Wife has the right to express her opinion		-0.0255**	
		(0.0116)	
Better to educate sons	0.0446***	0.0394**	
	(0.00832)	(0.0179)	
It is ok the beat wife if:			
Food is late or burn	0.00932*	0.0173	0.0276**
	(0.00482)	(0.0116)	(0.0116)
Goes out without permission		0.0583***	-0.00227
		(0.0164)	(0.0122)
Neglects children/house	0.0503***	0.0498***	0.0349***
	(0.00876)	(0.0170)	(0.0120)
Argues	0.0571***	0.0299*	
	(0.00942)	(0.0155)	
Refuses to have sexual intercourse	0.0455***	0.0212*	
	(0.00758)	(0.0128)	
Suspects cheating			0.0236***
			(0.00868)

Table 1.10: Household Decisions

	China	Japan	Korea	Taiwan
Children's education				
AM	0.0321	0.0637	0.0859*	-0.00196
	(0.0433)	(0.0584)	(0.0497)	(0.0545)
Female	0.0631***	0.374***	0.328***	0.167***
	(0.0167)	(0.0258)	(0.0345)	(0.0288)
AM*Female	-0.0656	-0.121*	-0.170***	-0.0739
	(0.0542)	(0.0707)	(0.0626)	(0.0677)
Support to parents				
AM	0.0718	0.0823	-0.0332	0.0748
	(0.0525)	(0.114)	(0.0653)	(0.0746)
Female	0.000487	0.192***	0.166***	-0.0810***
	(0.0200)	(0.0341)	(0.0361)	(0.0312)
AM*Female	-0.0240	-0.120	0.00230	-0.0821
	(0.0673)	(0.128)	(0.0791)	(0.0899)
Expensive purchases				
AM	-0.0728	0.0124	0.0961**	-0.0188
	(0.0472)	(0.0647)	(0.0469)	(0.0582)
Female	-0.0601***	-0.0677**	0.152***	-0.0913***
	(0.0181)	(0.0275)	(0.0322)	(0.0305)
AM*Female	0.0450	-0.0329	-0.129**	-0.100
	(0.0593)	(0.0776)	(0.0590)	(0.0724)
Allocation of living expenses				
AM	-0.0275	0.0165		0.0648
	(0.0452)	(0.0635)		(0.0604)
Female	0.0650***	0.548***		0.170***
	(0.0175)	(0.0276)		(0.0316)
AM*Female	0.0385	-0.0670		-0.129*
	(0.0569)	(0.0767)		(0.0751)
Marital Satisfaction	-0.261*	-0.0910	-0.442***	0.190
(1 = highest, 3 = lowest)	(0.150)	(0.172)	(0.158)	(0.165)

Figure 1.1: Percentage of Love Marriages by Urban and Rural Areas for all cohorts: China, Thailand, Malaysia and Pakistan

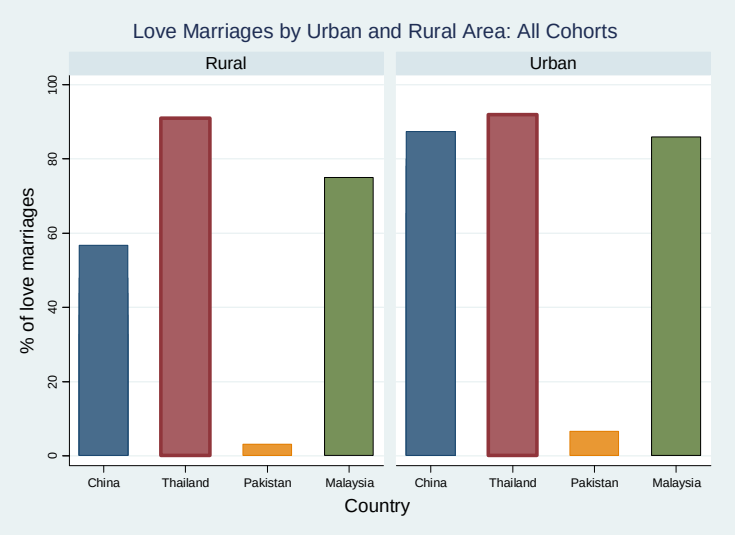

Figure 1.2: Percentage of Love Marriages by Schooling Level: Pakistan, Sri Lanka and Turkey

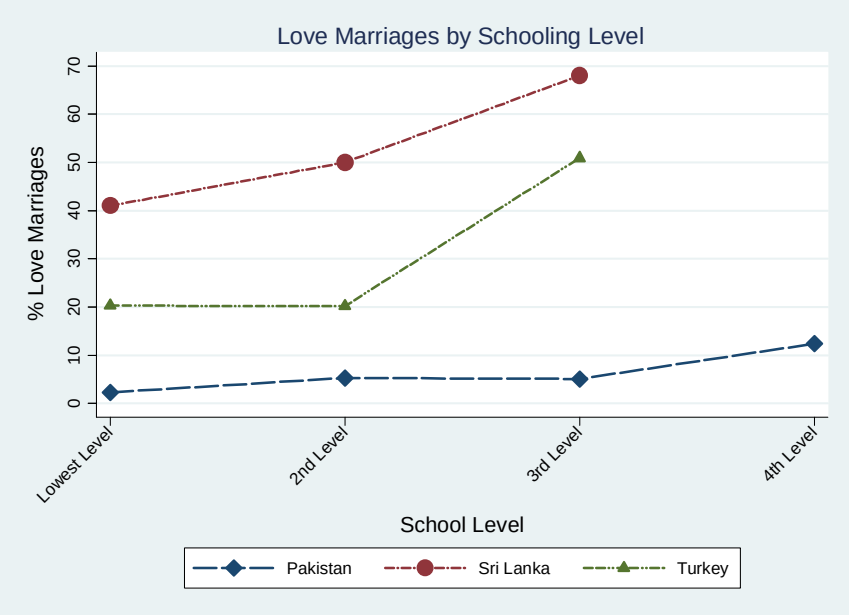

Figure 1.3: Odd Ratios and Regression Coefficients for Taiwan, Thailand, China and Indonesia

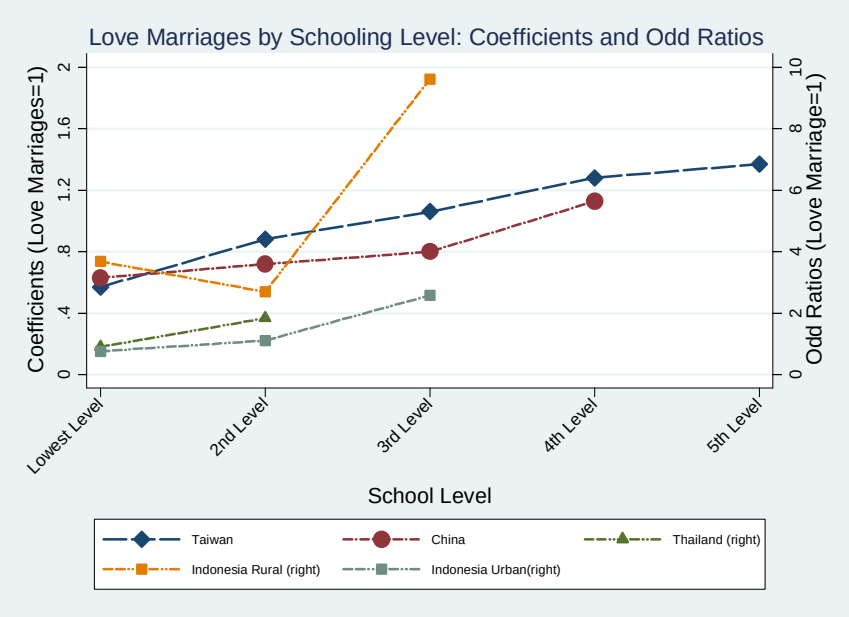

Table 1.11: Coefficient and sign on education variables

Country	Year of Survey	Type of Analysis	Dependent Variable	Education Variable	Coefficient	Odd Ratio	t-stat/ std error
Thailand	1978-1979	Logistic Regression	Arranged Marriage	**Years of ed.**			
				4	0.105	1.111	(0.53)
				5	-0.61*	0.543	(2.40)
Taiwan	1973, 1980	Mean Value of	**Ordered Var.**	None	0.57		
		Dependent Variable	0 = Arranged	Primary	0.88		
			1 = Intermediate	Junior high	1.06		
			2 = Love	Senior high	1.28		
				College/university	1.37		
China	2005	Linear Regression	Arranged Marriage	Primary school	-0.630**		(0.214)
				Junior high school	-0.719**		(0.224)
				Senior high school	-0.800**		(0.247)
				University	-1.128**		(0.289)
Ghana	1992-1993	Logistic Regression	Love Marriage	Educated (=1)	0.51**	1.67	
Nepal	1996	Ordered Logit	Degree of participation in selection of first spouse	Enrolled in School	1.06	1.06	(0.38)
				Years of schooling	0.99	0.99	(0.85)
Indonesia	1979-1980	Multinomial Logit	Love Marriage	**Rural Sample**			
				<Primary	1.304	3.68	
				Primary	0.989*	2.69	
				Secondary	2.263***	9.61	
				Urban Sample			
				<Primary	-0.274	0.76	
				Primary	0.105	1.11	
				Secondary	0.946*	2.58	

Thailand: 0-3 years of schooling is the omitted category; t-statistics reported. Taiwan: values closer to 2 imply love marriage. China: "Less than primary" is the omitted category; standard errors reported. Ghana and Indonesia: no education is the omitted category; no standard errors or t-statistics were reported. Nepal: "arranged marriage" is the reference category for the dependent variable; t-statistics reported.

Table 1.12: Other Background Characteristics

Country	Year of Survey	Type of Analysis	Dependent Variable	Variable	Coefficient	Odd Ratios	t-stat/ std error
Thailand	1978-1979	Logistic Regression	Arranged Marriage	**Father's occupation**			
				Landed farmer	0.199	1.22	1.08
				Landless farmer	*-0.614***	0.54	*2.11*
				Laborer	0.037	1.04	0.12
Taiwan	1973, 1980	Mean Value of Dependent Variable	**Ordered Variable**	**Father's Occupation**			
			0 = Arranged	Farmer	0.83		
			1 = Intermediate	*Non-farmer*	*1.07*		
			2 = Love				
				Father's Education			
				None --illitterate	0.76		
				None -- can read	0.96		
				Japanese --NA	1.01		
				Primary	1.02		
				Junior High	1.19		
China	2005	Linear Regression	Arranged Marriage	**Father education**			
				Primary school	-0.148		(0.172)
				Junior high school	-0.199		(0.303)
				Senior high school	0.225		(0.282)
				Father state worker	-0.712		(0.199)
Nepal	1996	Ordered Logit	Degree of participation in selection of first spouse	**Family background**			
				Mother's no. of children	0.98		(1.29)
				Mother's work for pay	1.21**		(1.72)
				Mother's education	1.22		(0.70)
				Father's education	1.11		(0.88)
				Residential moves	1.05		(1.12)

Country	Year of Survey	Type of Analysis	Dependent Variable	Variable	Coefficient	Odd Ratios	t-stat/ std error
Indonesia	1979-1980	Multinomial Logit	Love Marriage	**Family Background: Rural**			
				Landed farm	---		
				Professional/business	0.049	1.05	
				Laboring	0.804**	2.23	
				Landless farm	-.252	0.78	
				Family Background: Urban			
				Landed farm	---		
				Professional/business	2.349***	10.48	
				Laboring	1.659**	5.25	
				Landless farm	1.540*	4.66	
				Premarital Work: Rural			
				None	---		
				Farm family	0.592	1.81	
				Other family	-1.722*	0.18	
				Farm paid	-0.163	0.85	
				Blue-collar	0.307	1.36	
				Premarital Work: Urban			
				None	---		
				Farm family	-0.690	0.50	
				Blue-collar	0.546	1.73	
Ghana	1992-1993	Logistic Regression	Love Marriage	Working	0.26	1.3	
				Earned Income	-0.61	0.55**	
Togo	1988	Logistic Regression	Love Marriage	**Premarital Wage**			
				For Family	-.3537	0.7	
				For Respondent	0.4278*	1.5	

Thailand: "white collar" is the omitted category; t-statistics reported. Taiwan: values closer to 2 imply love marriage. China: "Less than primary" is the omitted category; standard errors reported. Indonesia:"landed farm" is the omitted category for the family background dummy variables and "no work" is the omitted category for the premarital work dummy variables; no standard errors or t-statistics were reported. Nepal: "arranged marriage" is the reference category for the dependent variable; t-statistics reported. Ghana and Togo: no standard errors or t-statistics were reported.

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Chapter 2

How Love Conquered Marriage: Theory and Evidence on the Disappearance of Arranged Marriages

2.1 Introduction

At the beginning of the 20th century, 72% (or more) of all marriages in Asia and Africa were arranged by the families of the couple. Throughout the last century, these marriages have decreased by approximately 40%. This paper uses a variety of sources to document this continuous and large decline in arranged marriages in several countries of Asia and Africa (Turkey, Saudi Arabia, Israel, Japan, Korea, China, Taiwan, Indonesia, Malaysia, Cambodia, Vietnam, Sri Lanka, Nepal, Togo and Ghana). Although a few countries (India, Pakistan and Bangladesh) do not follow the same patterns (arranged marriages still represent at least 95% of all marriages), young cohorts living in these countries' urban areas have also started to move away from arranged marriages. The goal of this paper is to understand the main driver(s) of the transition by proposing and testing empirically a model of marital choices. I first show that this transition away from arranged marriages in favor of self-choice or "love" marriages is correlated with increases in education, formal employment, urbanization, and declines in agriculture. These trends are common in all the countries where micro-data is available, suggesting that despite having different institutions at work, there is a fundamental

economic explanation behind these changes in marriage institutions.

Based on these patterns, I build a simple model of marriage choice. I assume that arranged marriages serve as a form of informal insurance (as suggested in the literature of sociology, anthropology and economics, e.g. Rosenzweig and Stark (1989)) whereas other marriages (outside one's networks) do not. In the first period, parents spend resources on educating their offspring and looking for a spouse for an arranged marriage. Both investments have pay-offs in the second period when the child earns an education dependent wage subject to a shock, transfers a share back to her parents and decides to marry the parental arranged spouse or choose her own spouse. Arranged marriages provide insurance (to both parents and children) because parents (but not the children) can observe who within their network faces income shocks that are negatively correlated with their child's shocks (by observing the entire shock histories of other households and by having repeated interaction with them). However, arranged marriages come with a cost: they constrain the choice set and the mobility of the child, thereby reducing her potential income, compared to the case in which she has the option to move geographically, find a more lucrative occupation or a spouse with higher earnings. Thus, there is a trade-off between marrying within the network and marrying outside the network: individuals might be willing to give up potentially higher income in exchange for a risk-sharing agreement. The model predicts that arranged marriages disappear when the net benefits of the insurance arrangement decrease relative to the (unconstrained) returns outside of the social network. When this is the case, parents invest in more education for the child, effectively increasing her outside option and, thus, the probability that she will reject the arranged marriage.

In this framework, the decline in arranged marriages and the increase in years of schooling are endogenously determined; more specifically, the theoretical framework predicts that when

the returns to schooling increase or the variance of income declines, the demand for insurance decreases — households pay a greater cost or "premium" for the insurance. I extend the base model in two directions that provide additional testable implications. First, motivated by the fact that divorce has a low cost in some of the countries studied (e.g. Indonesia), I introduce the possibility of divorce in a third period. Holding the cost of divorce constant, the model implies that couples in arranged marriages will have higher rates of divorce as their insurance gains vanish. Second, I assume two children within the household and theoretically explore how parents decide which child to offer an arranged marriage. I show that when social networks are small (equivalent to have insurance partners with positively correlated shocks), parents have incentives to arrange the marriage of only one child and they choose to marry only the child with the lowest expected return in the labor market.

The second part of the paper uses micro data to test the model. First, I test the main assumption of the model that arranged marriages provide insurance to the couple.[1] I implement a standard test of full insurance using the first three waves (1993, 1997 and 2000) of the Indonesia Family Life Survey (IFLS). This is the only data set containing both marriage type, and monthly consumption and income data of couples. For this test, I assume that the relevant unit for risk sharing is the village or town. If there is full insurance, the consumption of each individual household should not depend on its income but should have a one-to-one relationship with the average consumption of the insurance group. Although the test is formally rejected for both types of marriages, the results show that the consumption of arranged marriage couples does not depend on their income.[2] In contrast, the consumption

[1] I only have information on the marital arrangement, and income and consumption of children. In principle, their parents should also have access to insurance but I cannot test it with the current data.

[2] The results on aggregate consumption drive the rejection of the test for both samples.

of couples in love marriages varies significantly with their income, suggesting that individuals in arranged marriages are better insured. These results are consistent with Rosenzweig and Stark (1989), who show that households in India use the marriage of their children as insurance to mitigate the effect of profits shocks on consumption.

I then test the two main predictions of the model, namely that factors that lower the demand for informal insurance (increasing returns to schooling and decreasing income variance) accelerated the transition to love marriages and increased the investment in education. To test these predictions, I use the gradual introduction of the Green Revolution in Indonesia as a quasi-experiment. The Green Revolution refers to a series of technological innovations associated with the diffusion of higher yield variety seeds in developing countries in the late 1960s, which increased the returns to schooling and agricultural income (Foster and Rosenzweig, 1996).[3] I collected data from the 1963 and 1983 Indonesian agricultural census (and other printed sources) on the intensity of the Green Revolution by district (% of inputs use, % of land covered, rice yields, among others). I combine this information with the 1976 and 1995 census, the early 1980s socioeconomic surveys and the 1993 wave of IFLS to study the effect on labor market outcomes.

The results show that the Green Revolution increased returns to schooling by an additional 2.1% to 4.7% per additional year of schooling, it increased mean income of agricultural households, and importantly, it decreased their income variance by 8.1% and 8.3%, respectively. To identify how these changes affected the outcomes of interest (arranged marriages

[3] The Green Revolution in Indonesia was introduced from the mid-1960s to the mid-1980s and consisted of the expansion of higher yield rice seeds across regions in addition to availability of fertilizer and pesticides, access to credit, and rehabilitation of irrigation systems.

and education), I compare cohorts before and after the introduction of the program, in areas with high and low program intensity. As predicted, the Green Revolution resulted in a decline of 9 to 20 percentage points in the probability of having an arranged marriages for the cohort exposed to the Green Revolution, and in an increase in education of 0.3 to 0.5 years of schooling for the same cohort. The results are robust to adding controls for other programs implemented during the same period (school construction program, and expansion of water and sanitation supply), to adding controls at district level from the 1971 census, and to instrumenting the intensity of the Green Revolution with agricultural characteristics of 1963 (in order to mitigate concerns of potential endogeneity). In addition, they are also robust to using splines defined as the 4 quartiles of the treatment intensity distribution, to allowing for concave or convex effects by adding a quadratic term of the treatment variable, and to using an alternative definition of the treatment variable. Moreover, I use the cohorts not exposed to the Green Revolution to conduct a placebo test and I show that the probability of having an arranged marriage did not change for them, providing additional support to my identification strategy.

I then use the Green Revolution to test the prediction that divorce among arranged marriage couples should increase as their insurance advantage decrease. First, I show that Indonesia and Turkey have had an increasing divorce rate among couples in arranged marriages, whereas the divorce rate among couples in love marriages has declined. Then, I study divorce in arranged marriages in the three first cohorts of my Indonesian sample. These individuals should have married for insurance but the Green Revolution lowered the insurance value of the arrangement. Indeed, I show that the Green Revolution changed the likelihood of divorcing. The cohort born before 1933 and exposed to the Green Revolution had a 18% lower probability of divorcing; however, this probability increased to 25% for the cohort born between 1933 and 1942, and to 29% for the cohort born between 1943 and 1952. The Green

Revolution did not change significantly the probability of divorce for any cohort of the love marriage sample.

Overall, the empirical evidence is consistent with the hypothesis that arranged marriages disappear as the demand for informal insurance declines, specifically when countries experience economic transformations that raise the returns to education and lower the variance of income. The theoretical framework, however, delivers a richer set of predictions discussed in sections 2.4.1 to 2.4.4 (that are not alternative explanations to the evidence presented in this paper). On the one hand, the value of the informal insurance provided by the arranged marriages might have fallen as formal and informal arrangements appeared as substitutes (for instance, welfare programs or temporary migration) or as the type (and exposure to) of risks shifted as countries moved away from agriculture (parents no longer have an advantage in choosing the best insurance partner since they no longer observe the history of shocks).[4] On the other hand, the cost of belonging to this insurance arrangement might have increased as migration and urbanization have reduced the pool of potential insurance partners, increased the barriers to information flows and limited the enforceability of the contracts. However there are two alternative (and potentially complementary) explanations. One alternative is that in the past parents had full control over children (through controlling all the resources of the economy), but they have lost it as new (possibly more profitable) occupations become available. A second possibility, suggested by research within sociology and anthropology, is that love marriages result from the process of westernization and expansion of mass media that often accompanies economic development. I cannot entirely rule out these alternatives, but I discussed them in section 2.6.

[4] As economies move away from agriculture, income risk is no longer only associated with weather, and parents lose their information advantage.

Finally, this paper opens a new interesting and extensive research agenda. First, the case of South Asia presents a puzzle. The countries of this region (India, Pakistan and Bangladesh) are experiencing a similar transition away from agriculture, and they have adopted some of the new technology available in other countries; for instance, the higher yield seeds in the agricultural sector exploited in this paper. However, 95% of all marriages are still arranged. I discuss possible explanations for this puzzle in the paper. Second, modeling general equilibrium effects on the marriage markets might yield additional insights; for instance, dowry and bride-price payments might be needed to clear the markets. Lastly, the results on consumption smoothing and divorce indicate that the transition toward love marriages might have important welfare consequences for parents and children, and more generally, for economic growth as geographic and social mobility constrains are relaxed.

The rest of the paper is organized as follows. Section 2.2 briefly discusses the related literature. Section 2.3 shows the trends and patterns of marriage transition. Section 2.4.1 presents a simple model of marriage choice as a game between parents and one child. Section 2.4.2 presents the extension of the model that allows for divorce. Section 2.4.3 presents the second extension, where households have two children and different gender composition. Section 2.5 presents the empirical results. Finally, section 2.6 discusses alternative explanations, and briefly examines the case of South Asia and other future work.

2.2 Literature Review

Since Becker (1973, 1974), there has been an increasing interest in studying marital decisions and, more specifically, in studying the economics of the family. Despite the large

literature developed since the 1970s, and perhaps surprisingly, there are only a few papers within economics that have studied the role of arranged marriages, which is a widespread practice in several regions of the world. Rosenzweig and Stark (1989) focus on India and analyze the strategies that rural households use to smooth consumption. They find that migration and marriage arrangements (mostly arranged by parents) contribute to mitigate variation in consumption expenditure. They show that parents choose partners living in distant villages for their daughters and use a spatial diversification strategy by marrying them into different areas with low weather covariance across them. They hypothesize that these marriage arrangements allow households to enter into an informal insurance contract and show that the variance in consumption expenditure decreases with the number of married daughters and the distance to the households where they are married. Munshi and Rosenzweig (2009) further show that low spatial and marital mobility in rural India are likely due to the existence of informal risk-sharing networks. Households marry within the subcaste and remain living in rural areas as a way to show commitment with their network and strengthen their ties. Positive economic shocks that increase permanent income and that increase inequality within the insurance group, raise the likelihood that individuals leave the insurance networks, migrate to urban centers and marry outside the insurance network. The effect they find, however, is relatively small, leading them to conclude that these insurance networks generate large benefits relative to the outside option. To my knowledge, relative to this literature, this paper is the first to show the transition away from arranged marriages outside South Asia, to propose an explanation for it and to provide empirical evidence consistent with a decline in the insurance motive.

Beyond the literature in economics, there is a large research in sociology and anthropology that asserts that families use the marriage of their children as a way to create alliances with other groups and to strengthen their social ties within their communities. Some examples

from the literature on anthropology that has focused on Indonesia (where the main analysis of this paper is carried out) are the following:

> "Marriage, in adat law, is in varying degrees a matter of kinship group, community and personal concern. It is also a matter of social status. Marriage is the means by which the organized relationship groups which form autonomous communities maintain their existence. Social classes maintain themselves through well-regulated marriages, and hence the tie-up between marriage and social status.[...] Fellow members aid each other reciprocally. And groups, particularly kin groups, and exogamous sub-clans, are in a regular exchange of goods, which is linked to the exchange of women." (Ter Harr, 1948).[5]
>
> "Parental marriage arrangement in Java must be seen not in terms of kinship organization as such, but as an aspect of the economic and prestige systems of the larger society, and as a function of the internal authority structure of the elementary family. For the choice of spouse, serves the interests of the parents primarily, by expanding the range of their social ties, or consolidating those already existing, and by validating their social rank in their community." (Geertz, 1961).
>
> "Adat never protects individual interests but guarantees in first place interests appertaining to the group. The settlement of a marriage should be regarded as an agreement between two families. Marriage and issue do not exist to further the happiness of the individual; they have a very different meaning: they are institutions which help to maintain the existence of the clan." (Vreede-de Stuers,

[5] Adat law is the term used to refer to customary law.

1960).

Similar research can be found for other countries, for instance:

> "Leaving aside divorce-dissolved families, couples who marry after free courtship are less likely permanently to be obliged to provide material and emotional care for their relatives and in-laws, in particular the husband's parents." (Korea: Chang, 1997).
>
> "At the micro level, especially in developing countries like Pakistan, the family remains centrally responsible for providing food and sustenance, offering also protection and safety to individuals, particularly in childhood and old age. The family as a supreme institution, however, then also dominates individual agency and asserts its will over choices in marital selection, thus potentially undermining individual emotions and causing hardship. Families promote such marriages where they perceive the possibility of gaining certain types of benefits or various forms of security." (Pakistan: Zaman, 2008).
>
> "The fact that lineages and clans are widespread does not differentiate Africa, except in degree, from many other culture areas. They are common, however, and thus the choice of spouse, gift exchanges at marriage, and the subsequent attention paid to marital behavior by the clan has a corporate character." (Sub-Saharan Africa: Goode, 1970).
>
> "The maintenance of the caste system [...] depended completely upon the arranged marriage. Maintenance of the caste was too important a matter to be left to the young. [...] in India it developed not only among the wealthy, who could afford early marriages and whose union might mark an alliance between

two families, but also among the poor, who had nothing to share but their debts." (India: Goode, 1970).

In contrast with the little attention paid to arranged marriages, there is an important and large strand of the literature of development economics that has focused on understanding the (ex-ante and ex-post) mechanisms used to cope with risk, especially in rural areas. This literature has found overwhelming evidence of large needs of insurance, which often lead to inefficient choices in other spheres, creating poverty-traps and exacerbating inequalities (Banerjee and Duflo, 2007; Morduch, 1994, 1995). Among the ex-ante strategies we can find shared tenancy or share-cropping, which has been shown to create inefficient investments but might allow risk-sharing between a landlord and a tenant (Stiglitz, 1974; Ackerberg and Botticini, 2002); asset and occupational diversification, and investment in less risky (less profitable) assets (Rosenzweig and Binswanger, 1993); savings (Paxson, 1992; Calomaris and Rajaraman, 1998; Klonner, 2003); formal insurance, e.g. weather based insurance, although there is large evidence of low take-up rates when available (Hazell et al., 2010; Cole et al., 2013; Giné, Townsend and Vickery, 2008); and location diversification through temporary or permanent migration (Lucas and Stark, 1985; Rosenzweig and Stark, 1989; de la Briere et al., 2002; Morten, 2013). Once shocks are realized, individuals also engage in activities to mitigate their effects on consumption. Ex-post mechanisms include borrowing (Udry, 1994), selling assets or dis-saving (Rosenzweig and Wolpin, 1993; Fafchamps, Udry and Czukas, 1998), transfers (Townsend, 1994; Ravallion and Chaudhuri, 1997) and other labor supply adjustments (Jayachandran, 2006). Despite the efforts to mitigate risk, there is substantial evidence that these mechanisms are not sufficient.[6] Relative to this large literature, this

[6] Rose (1999) finds that drought increases mortality among Indian girls; Jacoby and Skoufias (1997) find that child labor, and thereby school attendance, play a significant role in the self-insurance strategy of rural household in India; Gertler and Gruber (2002) find that while families are able to full insure minor illness,

paper provides some evidence on one risk sharing mechanism, arranged marriages, and how it has evolved and disappeared as economic growth takes place. However, I leave open the question of the long-run consequences for consumption smoothing of parents and children.

This literature has also tried to quantify the extend of the insurance in both developed and developing countries (how effective are the ex-post informal insurance mechanisms (transfers) at insuring consumption). Mace (1991) and Cochrane (1991) test the hypothesis of full insurance using data from the USA. Both papers reject the hypothesis of efficient risk sharing under homogeneous preferences. Townsend (1994) and Ravallion and Chaudhuri (1997) perform a similar test in rural India using data from ICRISAT and assuming that the village is the relevant unit for risk sharing. Although both papers find co-movement between individual consumption and aggregate consumption, they reject the full insurance hypothesis since they find that income does matter for consumption decisions. Mazzocco and Saini (2012) relax the assumption of homogenous risk preferences allowing for heterogeneity in the taste for risk and perform a test of full insurance at the sub-caste level. They are unable to reject efficient risk sharing at the sub-caste level under heterogeneous preferences. Borrowing from this literature, I implement the standard test of full insurance to show that the consumption of arranged marriage does not vary with their income, whereas the consumption of love marriages does. However, my results also suggest that the village or town might not be the appropriate insurance unit.

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they are not able to insure illnesses that limit their ability to physically perform activities of daily living; Maccini and Yang (2009) show that women who experienced drought as young children are shorter, poorer, and obtain less education. These are only a few examples of the short-run and long-run consequences of imperfect insurance markets and imperfect risk coping mechanisms.

This study also contributes directly to the larger literature initiated by Gary Becker (1973, 1974, 1991) that studies the determinants of marriage. As summarized by Browning, Chiappori and Weiss (2014), marriage exists due to potential gains shared by the couple: sharing of a public good, division of labor to exploit comparative advantage, extension of credit and coordination of investment activities, and risk pooling, among others. Within this large literature, this paper is close to Hess (2004), who studies the decision to marry and divorce in the presence of incomplete markets. He constructs and tests a model of individual marriage decision where men and women insure each other, and he shows that joint economic characteristics from the beginning of the marriage have a sizable impact on marital duration. Shore (2010) presents evidence supporting the risk-sharing component of marriage. He shows that while individuals face more idiosyncratic risk in bad times, households do not. In contrast to their work, this paper focuses on the insurance gains of both spouses *and* their families (parents and parents-in-law) and studies the transition from marriage as a decision of the family to marriage as a decision of the couple. Within the literature of development economics there is has been an effort to understand the determinants of marriage in developing countries, particularly in rural areas (Fafchamps and Quisumbing, 2008). Among the main factors behind the formation of households, they emphasize the role of insurance, savings and capital accumulation, and parental involvement. Relative to this literature, this paper presents supportive evidence on the insurance gains from arranged marriages and further shows that economic growth has eroded the value for these informal insurance arrangements.

Finally, although I leave for future work the question of long run consequences of the transition to love marriages, Edlund and Lagerlof (2006) propose a model where love marriages might cause economic growth.

2.3 Stylized Facts

The literature on sociology, anthropology and psychology (Goode, 1970; Buunk et al., 2008; Jones, 2010; among others) suggests that arranged marriages originated as a strategy of families to form alliances with other families, groups or clans.[7] Arranged marriages have existed in most societies throughout history. In Europe, arranged marriages disappeared as the Catholic Church consolidated its place as the main religion. Anthropologist Jack Goody (1983) documents that arranged marriages were common among the ancient Greeks, Romans and Anglosaxon tribes until the rise of the Catholic Church, which favored self-choice marriage and monogamy. The goal of these rules was to limit the ability of families to form alliances (and, thus, to limit their ability to increase wealth) and to limit the number of legitimate heirs in order to divert inheritance toward the Church. This evolution was not monotonic nor uniform; however, by the late medieval period, the nuclear monogamous and self-chosen marriage was dominant in Europe (Greif 2006), except among the wealthiest class, which continued to arrange marriages for their children until the dawn of the Industrial Revolution (Goode, 1970).

In Asia and Africa, arranged marriages continued to be the dominant marriage institution until recent decades. In a companion paper (Rubio, 2013), I provide extensive and detailed analysis of the transition for eighteen countries: Turkey, Saudi Arabia, Israel, Japan, Korea, China, Taiwan, Indonesia, Malaysia, Cambodia, Vietnam, Sri Lanka, Nepal, Togo, Ghana,

[7] Another example found in the evolutionary psychology literature also supports the hypothesis posed by sociologists and anthropologists: "Parents may have a relatively stronger preference for children's mates with characteristics suggesting high parental investment and cooperation with the in-group, whereas children may have a relatively stronger preference for mates with characteristics signaling heritable fitness." (Buunk et al., 2008)

India, Pakistan and Bangladesh. Figure 2.1 shows these trends by region (Middle East and Africa, East Asia, South East Asia and South Asia). For the first three regions, we observe a clear trend toward the disappearance of arranged marriages, although at different rates. The exception is South Asia (India, Bangladesh and Pakistan), where arranged marriages are still the most common form of marriage. However, a closer examination of India suggests that urban areas have started the transition to love marriages, increasing from 5% to 10%.

The next four figures show some of the main correlates of the decline of arranged marriages. Figure 2.2 shows that the decline in the share of arranged marriages across cohorts is correlated with the increase in educational attainment. Furthermore, education and arranged marriages are negatively correlated even within cohorts and countries, ruling out the possibility that the time series correlation is exclusively driven by a common unobserved time trend (Figure 2.3). Figure 2.4 shows that the decline in arranged marriages is correlated with the increase in the percentage of women working in the formal labor market, and figures 2.5 and 2.6 indicate that the decline in agriculture and the increase in urbanization are also associated with lower shares of arranged marriages. Although not shown here, most of these results also hold when using a regression analysis that includes all the variables.[8] Overall, the correlations suggest that economic growth has been associated with a dramatic change in the formation of households.

2.4 The Model

The fundamental assumption of the model is that arranged marriages are used as an insurance mechanism. The model emphasizes a potential trade-off between insurance gains from arranged marriages and returns outside the social network (the outside option).[9] The

[8]Results available upon request.

[9] The recent literature in development economics has modeled this problem in the context of a limited

outside option is represented by unconstrained returns to education; if individuals give up the arranged marriage, they have the possibility of moving geographically (and thus accessing a broader set of occupations) and/or finding a partner with higher education/income.[10] I start by analyzing a two-period model for a household with only one child which captures this trade-off.[11] I then extend the the model to allow for the possibility of divorce. Finally, I modify model to analyze how the number of children and their gender composition might affect parental choices.

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commitment model (Coate and Ravallion, 1993; Lingon, Thomas and Worral, 2002), where households participate in the agreement as long as they receive at least a reservation value (equivalent to the outside option being lower than the net gain from the risk-sharing agreement). The model proposed in this section omits the potential limited commitment problem; however, a similar intuition should follow if we relax this assumption.

[10] To solve the model, I assume assortative matching in terms of education level which might be interpreted as children finding a partner with higher education/income.

[11] The model also captures other economic changes experienced throughout this period and the numerical simulations try to show their relative importance: (i) Changes in the risk profile (as countries move from agriculture to manufacture and services, and as welfare programs are introduced by governments) can be studied by changing the variance and covariance (across agents) of the shock to returns to schooling; (ii) The increasing cost of informal insurance (as migration and urbanization reduce the pool of potential insurance partners, increase the barriers to information flows and limit the enforcement of the agreements) is introduced through an effort cost that parents exert for finding a partner for their child; (iii) The outside option is captured by assuming potential higher returns to education in love marriages (relative to arranged marriages); and (iv) other changes in the marriage markets are introduced through a match or love term drawn from a distribution that differs by type of marriage.

2.4.1 One-child Model: Setup

There are two periods and each household has two agents: parents (who act as one agent) and one child, denoted by the subscript f and k, respectively. Each agent maximizes a quadratic utility function, $u(c_{t,i}) = c_{t,i} - \frac{d_i}{2}c_{t,i}^2$, $i = f,\ k,\ t = 1, 2$, where $c_{i,t}$ is consumption of agent i at time t, d_i is the parameter that captures her degree of risk aversion and it is bounded such that $u(c_{i,t}) > 0$, $u'(c_{i,t}) > 0$ and $u''(c_{i,t}) < 0$ in the relevant region in which $c_{i,t}$ takes values. Parents and child have an income endowment normalized to 1 in each period.

In period 1, parents choose investment in education λ_k for the child and the level of effort, $e \in \{0, 1\}$, they exert to find her a partner. The first period budget constraint for parents is given by $c_f = 1 - p\lambda_k - e_{high}I(e = 1)$, where p is the price of education, $I(e = 1)$ is an indicator variable taking the value of one if parents choose high effort and e_{high} is its cost. In this period, the child consumes what she produces. In period 2, the child receives $x_k\lambda_k + \delta_k$, where x_k are the known returns to her education λ_k and faces a shock $\delta_k \sim N(0, \sigma_\delta^2)$. Formally, in this model the average returns to schooling are different by type of marriage, $x_{k,h}$, $h = L, A$. The shock, however, is the same regardless of the level of education or type of marriage. Parents receive a share $0 < \varphi < 1$ from the returns to schooling of the child (this assumes commitment between parents and children under both type of marriages; the data supports this assumption, table 2.1 at the bottom shows evidence on transfers from and to parents and parents-in-law for both types of marriages).

All children marry at the beginning of the second period, and within marriage the child shares resources with her spouse equally. Under these assumptions, the consumption in the second period for each agent is given by:

$$c_{k,h} = 1 + (1-\varphi)(\frac{x_{k,h}\lambda_{k,h} + x_{s,h}\lambda_{s,h}}{2} + \frac{\delta_k + \delta_s}{2}) \tag{2.1}$$

$$c_{f,h} = 1 + \varphi(\frac{x_{k,h}\lambda_{k,h} + x_{s,h}\lambda_{s,h}}{2} + \frac{\delta_k + \delta_s}{2}) \tag{2.2}$$

where $x_{s,h}\lambda_{s,h}+\delta_s$ is the income of the child's spouse and assortative matching is assumed between spouses in terms of education.[12] The child receives additional utility from a love term, $u(c_{k,h})+\alpha_h$, $h = A, L$, which comes from a known distribution: the cdf in the arranged marriage market is denoted by $\alpha_A \sim F_A(\alpha)$, and the cdf in the love marriage market is represented by $\alpha_L \sim F_L(\alpha)$.

The effort of parents in the first period determines the insurance quality of the partner in the second period. I define insurance quality as the correlation between the child's shock and her spouse's shock, $\varrho_{ks}\left(I(e=1),\, I(L=1)\right)$, where $I(L=1)$ is an indicator variable taking the value of one if the child chose the love marriage: (i) If parents exert high effort, $e = 1$, and the child accepts the arranged marriage, $L = 0$, she and her spouse have a perfectly negatively correlated income; (ii) If parents exert low effort, $e = 0$, and the child accepts the arranged marriage, $L = 0$, the negative correlation between spouses' shocks is less than perfect — for simplicity I assume that it is $\varrho_{ks}\left(I(e=0),\, I(L=0)\right) = 0$; (iii) If the child decides to find her own mate in the love marriage market, $L = 1$, the correlation with her spouse's income might be positive, negative or zero, regardless of the effort of the parents — for solving of the model I set it equal to zero.

[12] This assumption allows me to find the optimal education level for the child in terms of the parameters of the model; otherwise, the optimal education for the child will depend on the expected education (and return) of her spouse. This assumption might be relaxed to analyze other cases.

2.4.2 Analysis and Discussion

The model is solved backwards. Starting in period 2, parents and children calculate their expected utility for a given level of education, a given effort and an expected love term. Anticipating the decision of the child in period 2, parents choose effort and education in period 1 by solving the following maximization problem:

$$\begin{aligned} &\underset{\lambda_{k,h}, e\in\{0,1\}}{Max}\ u(c_f) + \beta E[u(c_f)] \\ s.t.\quad &c_f = 1 - p\lambda_{k,h} - e_{high} I(e=1) \end{aligned} \tag{2.3}$$

where:

$$\begin{aligned} E[u(c_{f,h})] \;=\; &\left[1+\varphi\left(\frac{x_{k,h}\lambda^*_{k,h} + x_{s,h}\lambda_{s,h}}{2}\right)\right] - \frac{d}{2}\left[1+\varphi\left(\frac{x_{k,h}\lambda^*_{k,h} + x_{s,h}\lambda_{s,h}}{2}\right)\right]^2 \\ &-\frac{d}{2}\varphi^2\sigma^2_\delta\left(\frac{1+\varrho_{ks}\left(I(e=1),\, I(L=1)\right)}{2}\right) \end{aligned} \tag{2.4}$$

The first order condition delivers:[13]

$$\lambda(e)^*_{k,h} = \frac{(\beta\varphi x_{k,h} - 2p)(1-d) - 2pde_{high}I(e=1)}{d(2p^2 + \beta\varphi^2 x^2_{k,h})} \tag{2.5}$$

Parents invest in the child's education if the discounted share of returns they receive ($\beta\varphi x_{k,h}$) is higher than the foregone consumption in the first period ($2p$).[14] Parents also face

[13] In equilibrium $x_{k,h} = x_{s,h}$, by the assumption of assortative matching. Therefore the FOC can be simplified and expressed only in terms of $x_{k,h}$.

[14] The optimal education level is increasing in the returns to education and on the share that parents

a trade-off ($2pde_{high}I(e=1)$) between investing in education and looking for a high quality insurance partner for their child.[15]

The optimal effort is chosen based on the comparison of the expected utility under each scenario; high effort, $e=1$, is optimal if its present discounted value of consumption is higher than choosing the alternative (suppressing the subscripts k and h):

$$\begin{aligned} &[1-p\lambda^*(e=1)-e_{high}]-\frac{d}{2}[1-p\lambda^*(e=1)-e_{high}]^2 \\ +\beta\left\{[1+\varphi x\lambda^*(e=1)]-\frac{d}{2}[1+\varphi x\lambda^*(e=1)]^2\right\} &> [1-p\lambda^*(e=0)]-\frac{d}{2}[1-p\lambda^*(e=0)]^2 \\ &+\beta\left\{[1+\varphi x\lambda^*(e=0)]-\frac{d}{2}[1+\varphi x\lambda^*(e=0)]^2-\frac{d}{2}\varphi^2\sigma_{i\delta}^2\right\} \end{aligned} \tag{2.6}$$

High effort decreases consumption in the first period and decreases education ($\frac{\partial\lambda}{\partial e_{high}}\mid_{I(e=1)} < 0$) (and therefore consumption in the second period), but it is optimal as long as the child accepts the arranged marriage and the gains in utility from offsetting the income shock ($\frac{d}{2}\varphi^2\sigma_\delta^2$) are large enough to compensate for the loss in consumption in both periods.

In this model all children marry; they decide at the beginning of period 2 either to accept the arranged marriage or not based on the comparison of the expected utility under each marriage (suppressing the subscript k):

receive as long as $\frac{2p}{\beta}\frac{[1+d(e_{high}-1)]}{(1-d)} < \varphi x_{k,h} < \frac{4p}{\beta}\frac{[1+d(e_{high}-1)]}{(1-d)}$. For the rest of the analysis, I assume that the returns to education fall within this range in order to derive comparative statics.

[15] The introduction of the effort cost mechanically introduces a trade-off between investing in education and finding an insurance partner for the child. This trade-off might be assumed away by setting $e_{high}=0$, the main results still follow.

$$E[u(c_{k,L}) + \alpha_L] - E[u(c_{k,A}) + \alpha_A] = (1-\varphi)\left(x_L\lambda_L^* - x_A\lambda_A^*\right)\Bigg[(1-d_k) - \frac{d_k}{2}(1-\varphi) \quad (2.7)$$

$$(x_L\lambda_L^* + x_A\lambda_A^*)] - d_k\frac{(1-\varphi)^2}{4}\sigma_\delta^2\left[\varrho_{ks}\left(e,\, I(L=1)\right) - \varrho_{ks}\left(e,\, I(L=0)\right] + E\left(\alpha_L\right) - E\left(\alpha_A\right) > 0$$

Using these results and the assumptions outlined, we can summarize the main implications of the model in the following proposition.

Proposition 1. *Parents and children receive benefits from insurance (and thus from arranged marriages) and from the returns to education. The child, however, receives additional utility from the love term; she might be willing to give up insurance in order to find a love mate. In contrast, parents do not receive utility from this love term, generating a wedge between the child and the parents. Ceteris paribus, love marriage is preferred when (among others):*

(i) $(x_L - x_A) > 0$*, the returns to education are higher or increasing in love marriages. For a given level of education, higher* ***unconstrained*** *returns increase the probability that the child chooses the love marriage. In turn, parents internalize it, decrease effort, which produces two additional effects. It further increases education, which increases the value of the outside option. It also decreases the insurance quality of the arranged marriage mate, decreasing the insurance benefits of the arrangements.*

(ii) *And,* σ_δ^2*, the size of the shock decreases. For a given level of education, a decrease in the size of the shock decreases the probability that the parents will exert high effort; in turn, this lowers the insurance quality of the arranged marriage partner. It also increases the investment in education,* λ_k*, effectively increasing the outside*

option of the child. For the child, the insurance advantage of the arranged marriage also disappears.

Proof. *Section 2.7 shows the analytical proofs for changes in* $(x_L - x_A)$ *and* σ_δ^2*. In addition it shows analytical results for changes in* $\varrho_{ks}(e,\, I(L=1)) - \varrho_{ks}(e,\, I(L=0),\, d_k,\, d,\, e_{high}$*, and* $E(\alpha_L) - E(\alpha_A)$*.*

2.4.3 Extending the Model to Include Divorce

The goal of this section is to understand how divorce behavior differs by type of marriage as the insurance advantage of arranged marriages vanishes. This extension is motivated by large divorce rate in some Southeast Asian countries. In order to derive the intuition, I allow for a third period when the divorce decision takes place.

The sequence of decisions remains unchanged for the first two periods. At the beginning of period 3, the child observes the realization of the love term, α, and decides whether to remain married or not. If she divorces, she will face the realization of her shock and pay a utility cost $\phi > 0$ in period 3; and in the next period, she will find a new partner in the love market regardless of the previous type of marriage. Therefore, the child will divorce if:

$$\alpha_h + u(c_k)^{M,h} + \beta\left\{E\left[u(c_k)\right]^{M,h} + \alpha_h\right\} < u(c_k)^{D} - \phi + \beta\left\{E\left[u(c_k)\right]^{M,L} + E(\alpha_L)\right\},\ h = L, A \quad (2.8)$$

M represents the utility of married individuals, D represents the utility of divorced individuals, h refers to the type of marriage, L refers to love marriage and A to arranged marriage; α_h is the realized love term for the married individual in type of marriage $h = L$, A, and α_L

is the love term drawn from $F_L(\alpha)$. This expression is simplified in section 2.7 and used to derive the thresholds for divorce by type of marriage.

Since the distribution of α_h differs by marriage, the probability of divorce depends directly on the distribution of the love term in each marriage market. Let us define the expressions (see 2.7 for details on these thresholds):

(i) $$\hat{\alpha}_L = (1+\beta)^{-1}\left[-\phi + \tfrac{d_k}{2}(1-\varphi)^2\sigma_\delta^2\left[\tfrac{\varrho_{ks}(e,\,I(L=1))}{2} - \tfrac{1}{2}\right] + \beta E(\alpha_L)\right]$$

(ii) $$\hat{\alpha}_A = (1+\beta)^{-1}\quad \left[-\phi - \tfrac{d_k\beta}{2}\tfrac{(1-\varphi)^2}{4}\sigma_\delta^2\left[\varrho_{ks}(e,\,I(L=1)) - \varrho_{ks}(e,\,I(L=0)\right] + \tfrac{d_k}{2}(1-\varphi)^2\sigma_\delta^2\left[\tfrac{\varrho_{ks}(e,\,I(L=0))}{2} - \tfrac{1}{2}\right] + \beta E(\alpha_A)\right]$$

Recall that $\alpha_L \sim F_L(\alpha)$ and $\alpha_A \sim F_A(\alpha)$, delivering the following probabilities of divorce (divorce occurs for any draw, α_h, that falls below the thresholds defined above):

$$P^{D,L} = \int_{-\infty}^{\hat{\alpha}_L} dF_L(\alpha)d\alpha \;\; and \;\; P^{D,A} = \int_{-\infty}^{\hat{\alpha}_A} dF_A(\alpha)d\alpha \tag{2.9}$$

The solution to the model is found in a similar way as before. Once the probabilities of divorce are calculated for each type of marriage, the child uses them to calculate the expected utility for each type of marriage in period 2, and the parents incorporate them into the optimal choices (education and effort) of period 1. Section 2.7 shows the expressions determining these choices.

Proposition 2. *For arranged marriages, ceteris paribus, divorce increases as the gains from insurance disappear:* $\downarrow [\varrho_{ks}(e,\,I(L=1)) - \varrho_{ks}(e,\,I(L=0)]$.

Proof. *The threshold,* $\hat{\alpha}_A$*, increases as* $\downarrow [\varrho_{ks}(e,\,I(L=1)) - \varrho_{ks}(e,\,I(L=0)]$. *This leads to an increase in* $P^{D,A}$ *from equation 2.9.*

If arranged marriages provide more insurance, $\varrho_{ks}\left(e,\, I(L=1)\right) > \varrho_{ks}\left(e,\, I(L=0)\right.$, their divorce threshold will be smaller $\hat{\alpha}_A < \hat{\alpha}_L$. In countries where the cost of divorce (ϕ) is the same by type of marriage, we should expect $P^{D,A} > P^{D,L}$ only if $F_L(\alpha)$ first order stochastically dominates (FSD) $F_A(\alpha)$ and the difference between thresholds, $\hat{\alpha}_A - \hat{\alpha}_L$, is small. If the threshold difference is large, or if $F_A(\alpha)$ FSD $F_L(\alpha)$, then we should expect the opposite result. Notice, however, that the risk aversion of the child, d_k, will determine how important the variances and covariance of the shock are. Less risk-averse children will place a higher weight on the love term. β plays a similar role; impatient children will put a higher weight on the dis-utility generated by being single during period 3. While these features are interesting, section 5 will only test the prediction of proposition 2.

2.4.4 Extending the Model to Two Children

I extend the model to consider the case in which parents have two children. This extension enables me to examine two important dimensions that are assumed away in the base model: the role of the size of the network and the effect of the gender composition of the children (within the household, abstracting from general equilibrium effects on the marriage markets). As the number of children increases, the size and quality of the social network play a crucial role; parents must take into account that the households where their children may be married might have correlated shocks. If the social network is small (in this context, equivalent to having insurance partners with positively correlated shocks), parents have incentives to arrange marriages for only some children.

For the rest of the section I assume that all households have two children, differing only in the gender composition: (i) 2 boys; (ii) 1 girl and 1 boy; (iii) or 2 girls. In period 1, parents

invest in the education of both children and decide the amount of effort exerted looking for a partner for each. The first period budget constraint is now given by:

$$\begin{aligned} c_f &= 1 - gp_g\left(\frac{1}{j}\sum_j \lambda_{g,j}\right) - bp_b\left(\frac{1}{n}\sum_n \lambda_{b,n}\right) \\ &\quad -g(\frac{1}{j}\sum_j e_j^g I(e_{j,g}=1)) - b(\frac{1}{n}\sum_n e_n^b I(e_{n,b}=1)) \end{aligned} \tag{2.10}$$

where $j = 0,\ 1,\ 2$ and $n = 0,\ 1,\ 2$ are the number of girls and boys, respectively; $N_k = j+n$ is the total number of children; $g = \frac{j}{N_k}$ is the share of girls and $b = \frac{n}{N_k}$ is the share of boys; $e_{g,,j} \in \{0,1\}$ is the effort for girl j with cost e_j^g and $e_{b,n} \in \{0,1\}$ is the effort for boy n with cost e_n^b; $I(e_{j,g}=1)$ is an indicator variable that takes the value of 1 if parents choose to exert high effort for girl j; and $I(e_{n,b}=1)$ has a similar interpretation for boy n. Children are homogeneous within gender but heterogeneous between gender in the price of education ($p_g \neq p_b$) and the returns to schooling ($x_g \neq x_b$).[16] Again, the returns to schooling differ by type of marriage, $h = A, L$; for notational simplicity, I am omitting the subscript h.

[16] We might interpret the differences in prices as boys and girls having different opportunity cost of studying; for example, girls might have a lower opportunity cost of being taking away from home or from agricultural production (in the societies where female labor is less used for agricultural production). The differences in returns to schooling might be considered in a similar way; in agricultural societies, boys might have an advantage due to larger returns to physical strength, so as countries move away from agriculture the differences in returns to education might be reduced. The main goal of this section is to explore gender differences that in the absence of differences in cost and/or returns are not present, leading to a less interesting case for analysis. In the absence of gender differences, the analysis from the previous section can be directly applied provided that the budget constraint is properly adjusted to account for more costly children (as there are more children within a household).

Under these assumptions, the choice of education for the children depends on the gender composition of the family. I focus here on the case of one boy and one girl; the other two cases can be analyzed in a similar manner. The problem faced by the parents in the first period can be re-written as:

$$\underset{\lambda_{g,j},\lambda_{b,n},e_j\in\{0,1\},e_n\in\{0,1\}}{Max} u(c_f) + \beta E[u(c_f)] \tag{2.11}$$
$$s.t. \quad c_f = 1 - \tfrac{1}{2}p_g\lambda_{g,1} - \tfrac{1}{2}p_b\lambda_{b,1} - \tfrac{1}{2}e_1^g I(e_{g,1}=1) - \tfrac{1}{2}e_1^b I(e_{b,1}=1)$$

For given effort levels $e_{g,1}$ and $e_{b,1}$, the first order conditions for $\lambda_{g,1}$ and $\lambda_{b,1}$ determine the parents' optimal investment in education for boys and girls:

$$if\ \frac{x_g}{p_g} > \frac{x_b}{p_b} \Rightarrow \lambda_{g,1}^* = \frac{(1-d)\left(\beta\varphi x_g - 2p_g\right) - 2dp_g e}{dg\left(2p_g^2 + \beta\varphi^2 x_g^2\right)},\ \lambda_{b,1}^* = 0 \tag{2.12}$$

$$if\ \frac{x_g}{p_g} < \frac{x_b}{p_b} \Rightarrow \lambda_{b,1}^* = \frac{(1-d)\left(\beta\varphi x_b - 2p_b\right) - 2dp_b e}{db\left(2p_b^2 + \beta\varphi^2 x_b^2\right)},\ \lambda_{g,1}^* = 0 \tag{2.13}$$

where $e = \frac{1}{2}e_1^g I(e_{g,1}=1) + \frac{1}{2}e_1^b I(e_{b,1}=1)$.

In the case of households with two boys or two girls, we might expect a priori that parents provide the same level of education to both children (they are homogeneous within gender); however, the final choice of education might be asymmetric and it will depend on the marriage choice of each child (see discussion in section 2.7).

The model is solved backwards starting in the second period. Parents and children

calculate their expected utility for a given level of education and effort. The expected utility of parents is given by (let $e_{g,1}$ and $e_{b,1}$ denote the chosen effort):

$$\begin{aligned} E[u(c_f)] \;=\; & \left\{ \left[1+\varphi\left(gx_g\lambda_g^*+bx_b\lambda_b^*\right)\right] - \tfrac{d}{2}\left[1+\varphi\left(gx_g\lambda_g^*+bx_b\lambda_b^*\right)\right]^2 \right. \\ & -\frac{d}{2}\sigma_\delta^2\left\{\varphi^2\left(\frac{1+\varrho_{g_1 s}\left(I(e_{g,1}=1),\, I(L=1)\right)}{2}\right)\right. \\ & \left.\left.+\varphi^2\left(\frac{1+\varrho_{b_1 s}\left(I(e_{b,1}=1),\, I(L=1)\right)}{2}\right)+\varphi^2\varrho_{g_1,b_1}(e_{g,j},e_{b,i})\right\}\right. \end{aligned} \tag{2.14}$$

where $\varrho_{g_1,b_1}(e_{g,j},e_{b,i}) = \varrho_{g_1 b_1}+\varrho_{g_1 s_2}+\varrho_{b_1 s_1}+\varrho_{s_1 s_2}$.[17] This term captures the correlation between the households where the children are married, and it depends on: (i) the effort level exerted for each child (recall that effort determines the insurance quality of the partner proposed by the parents); and (ii) the type of marriage chosen by each child. In contrast to parents, each child still decides based on 2.7, which does not depend on $\varrho_{g_1,b_1}(e_{g,j},e_{b,i})$.

In the extreme case in which the parents belong to a very small network, i.e., they have access to only one potential insurance partner (only one available household), arranging the marriage of both children into this household will increase the dis-utility term (the last term of 2.14, $\varrho_{g_1,b_1}(e_{g,j},e_{b,i})$) instead of providing more insurance;[18] furthermore, as the number of children increases, the concern of a small social network increases as well (see section 2.7

[17] $\varrho_{g_1 b_1}$ is the income correlation between the two children; $\varrho_{g_1 s_2}$ is the income correlation between the first child and the spouse of the second child; $\varrho_{b_1 s_1}$ is the income correlation between the second child and the spouse of the first child; and $\varrho_{s_1 s_2}$ is the income correlation between the spouses of the two children.

[18] The goal of considering the extreme case of a unique insurance partner is to provide a clear intuition on how parents decide how to allocate education and effort. Studying other cases of small networks should deliver a similar intuition, but a more complex analysis might be required.

for proof).

Proposition 3. *If* $\varrho_{g_j,b_n}(e_{g,j}=1,e_{b,n}=1) \Rightarrow \varrho_{k,s}=1\ k=g_j,b_n,\ s=s_j,s_n$ *(the most constrained case, only one potential insurance partner, each component of* $\varrho_{g_1,b_1}(e_{g,j},e_{b,i})$ *has a positive correlation equal to 1) and* $\varrho_{g_j,b_i}(e_{g,j}=0,e_{b,i}=1)=\varrho_{g_j,b_i}(e_{g,j}=0,e_{b,i}=0)=0$*, then, ceteris paribus, parents exert high effort for (offer the arranged marriage) and give no education to the child with the lowest net return in the labor market. Parents invest in positive education for the child with the highest net return in the labor market and exert low effort for her (section 2.7 shows a more detailed analysis for different gender composition).*

Proof. *Section 2.7.*

In summary, the results suggest that parents use education investment and effort to induce children to accept the arranged marriage. By reducing education (for the child with the lowest net returns), parents are effectively reducing her outside option. When the child with a low outside option is offered the possibility of entering into the insurance arrangement by marrying a high insurance quality partner (through parents exerting high effort for finding her a partner), she will likely accept it. These results depend crucially on the assumption of limited or small social network, which imply that the households where the children would be married (under arranged marriages) have high income correlation.

Corollary 3.1. *As* $\varrho_{g_j,b_i}(e_{g,j}=1,e_{b,i}=1)$ *increases, the probability of both children having an arranged marriage decreases.*

Proof. *This statement follows directly from 2.14. When* $\varrho_{g_j,b_i}(e_{g,j}=1,e_{b,i}=1)<0$*, parents gain from arranging the marriage of both children, as long as the outside option is sufficiently low. As* $\varrho_{g_j,b_i}(e_{g,j}=1,e_{b,i}=1)$ *increases and becomes positive, the dis-utility*

term of equation 2.14 dominates and parents prefer to arrange the marriage for only one of their children.

Current data does not allow me to test this prediction, I lack of data on the type of marriage for each sibling/child. However, preliminary empirical results suggest that within household there might an endogenous relationship between the gender composition and the probability of having an arranged marriage. In order to explore this prediction for the whole population, it is necessary to incorporate a general equilibrium framework.[19]

2.5 Empirical Results

2.5.1 Test of Full Insurance

The model is based on the assumption that arranged marriage couples are able to smooth consumption over time better than love marriage couples, since on average love marriages should provide less insurance.[20] I use a test of full insurance to examine this assumption. The test is derived by solving the social planner's problem, under the assumption the social

[19] These results are available upon request.

[20] Rosenzweig and Stark (1989) study how the variance in consumption is related to marital arrangements. They show that rural households in Southern India use a strategy to diversify risk by marrying their daughters into distant villages and rarely two into the same one, finding that arranged marriages contribute to mitigating the volatility of consumption. India, however, is among the countries where arranged marriages are resilient. Love marriages have recently started to increase in urban areas, growing from 5% to 10%. This feature of the Indian context makes it unsuitable for testing formally whether arranged marriages are indeed used as a commitment device and provide access to insurance for the agents.

planner maximizes a weighted sum of individual household utilities subject to the aggregate income constraint, as follows:

$$Max \sum_{i=1}^{N} \lambda_i \sum_{t} \beta^t \sum_{s} \pi_s u_i(c_{ist}) \tag{2.15}$$
$$s.t. \sum_{i=1}^{N} c_{ist} \leq \sum_{i=1}^{N} y_{ist}$$

The first order conditions of the problem link the marginal utility between two households. Equation 2.16 shows that the relative consumption of each pair of households will depend on their relative Pareto weights, which are assumed to be time invariant:

$$\frac{\lambda_i}{\lambda_j} = \frac{u_j'(c_{jst})}{u_i'(c_{ist})} \tag{2.16}$$

The reduced form test depends on the utility function assumed. The typical functional forms used in the literature are constant absolute risk aversion and constant relative risk aversion utility functions. Both utility functions enable us to express the consumption of each individual household only as a function of the aggregate consumption, the Pareto weights and other non-separable variables considered to be relevant (leisure, taste shifters, among others). If a CRRA utility function is assumed, the first order condition can be rewritten as $ln\, c_{jst} = \frac{1}{N}\sum_i ln\, c_{ist} + \frac{1}{\sigma - 1}\left[\frac{1}{N}\sum_i ln\, \lambda_i - ln\, \lambda_j\right]$. This equation links the logarithmic consumption of household j to the aggregate consumption of the economy. It also suggests that consumption of household j will depend on its Pareto weight relative to the average Pareto weight of the economy. In order to eliminate the time invariant Pareto weight component, we might use a fixed effects model or a first differences model:

$$
\begin{aligned}
First\,Differences:\ & \triangle ln\, c_{ist} = \beta_1 \triangle ln\, \bar{c}_{st} + \beta_2 \triangle ln\, y_{ist} + v_{jst} \\
Fixed\,Effects:\ & ln\, c_{ist} = \alpha_i + \beta_1 ln\, \bar{c}_{st} + \beta_2 ln\, y_{ist} + u_{ist}
\end{aligned}
\tag{2.17}
$$

Full insurance is not rejected if $\beta_1 = 1$ and $\beta_2 = 0$. In other words, the growth rate of individual consumption moves perfectly with the growth of aggregate consumption, and it does not depend on any other variable, particularly on individual income. The implementation of the test requires panel data on individual or household income and consumption.

2.5.1.1 Data

I use the Indonesia Family Life Survey to estimate equations 2.17. The IFLS started in 1993, surveying 7224 households in 13 provinces of Indonesia. It followed these households, in 1997, 2000 and 2007, with a low rate of attrition. The IFLS is the ideal data set to implement this test by type of marriage. It collected detailed information on consumption expenditure (durables and non-durables) and on income (wages, profits from farm and non-farm business, rents from assets, and other non-labor income, among others). The IFLS also collected detailed marital history, in particular, it has information on the type of marriage arrangement for the first marriage of each ever-married individual. Specifically, the IFLS asks respondents to report whether they or their parents chose their spouse.[21]

[21] The other data-sets with information on type of marriage (Turkish, Cambodian and Togolese Demographic and Health Surveys, and Vietnam Longitudinal Study), used to derive the stylized facts, do not have information on consumption and/or income. Other data sets with available information on consumption and income do not have information on type of marriage, with the exception of data from India and Bangladesh; however, in both countries most marriages are still arranged, making them unsuitable for the analysis.

The sample is restricted to couples where both husband and wife are still in their first marriage in 1993 and remained married through the next two waves (1997 and 2000). I define a household as an arranged marriage household if both spouses self-report having an arranged marriage, and as a love marriage household if both spouses report having chosen their spouses. Finally, I restrict the test to villages and small towns (less than 2500 families) and to those households that did not move outside the village/town between surveys.[22] I assume that the village is the relevant insurance group.

The implementation of the test of full insurance requires information on non-durable consumption expenditure and on non-insured income (Mace, 1991). The consumption component is constructed using monthly information on expenditure on food, utilities, personal toiletries, small household items, recreation and entertainment, transportation, clothing, taxes and rent. Income is calculated using information on labor income, which includes wages, profits from farm and non-farm businesses, and non-labor income (pensions, rents from assets and other bonuses from work). All monetary values are converted to dollars using the 1993 PPP exchange rate.

Table 2.1 presents the summary statistics for the sample. The final sample contains 1438 households having a love marriage and 410 households having an arranged marriage. There are 313 households reporting a "mixed marriage," where one spouse reports having an arranged marriage and the other reports having a love marriage (in 75% of these marriages the wife reports the arranged marriage). I have excluded these couples since it is unclear who provides insurance in these arrangements. Focusing on 1993, the households having an

[22] Households moving might have lower insurance gains. However, they might also migrate to diversify risk geographically. This is testable in the data.

arranged marriage are almost 8 years older, are slightly larger, and are primarily engaged in agriculture; they are also poorer, their income and expenditure are lower than that of households in love marriages. But in both types of households, expenditure on food represents between 70% and 80% of total non-durable consumption, and the majority of their income comes from labor. Consistent with the theory, households in arranged marriages are more likely to farm and have lower levels of schooling. Interestingly, the "mixed marriages" have an intermediate level of education (both spouses have more schooling than spouses in an arranged marriage, but less than spouses in a love marriage). The last two panels provide suggestive evidence on the extent of informal and formal insurance available for each type of marriage. Transfers to and from other families members are observed for both, though they constitute a larger share of total per capita income for arranged marriages in 1997 and 2000.[23] The levels of formal insurance are very low for both groups, but couples in a love marriage have better access to this type of insurance, and in addition, a larger percentage of them also report having savings (and report a higher amount of savings, measured as a percentage of total monthly income) as well as a higher debt/income ratio, suggesting that they have access to other sources of credit.

2.5.1.2 Results

Table 2.2 reports the results for the first differences and fixed effects models, where the aggregate consumption is calculated at the village/town level.[24] The results are very

[23] Although not in 1993, but this year arranged marriage couples reported a higher amount of other non-labor income that includes gifts and arisan winnings, among others.

[24] Some households report losses in profits or zero income in some components. I use two alternative transformations, widely used in the literature, instead of using directly a logarithmic transformation: (i) Inverse sine transformation $asinh(y) = log[y_i + (y_i^2 + 1)^{1/2}]$; and (ii) the neglog transformation $neglog(y) =$

similar across all the specifications used. For love marriages, the coefficient on aggregate consumption ranges between 0.342 and 0.474 and it is always statistically significant at a 1% level. The coefficient on individual income is smaller, ranging between 0.00852 and 0.0977, and statistically significant at a 5% level in all cases. These results lead to a rejection of the full insurance hypothesis for couples in love marriages: the joint test of significance presented at the bottom of each panel strongly rejects that the coefficient on aggregate consumption is equal to one and the coefficient on individual income is equal to zero. In contrast, the results for arranged marriages show that income is not statistically significant in the determination of consumption. Furthermore, the coefficient is smaller in magnitude, ranging from -0.00303 to 0.00151. Although, the estimated coefficient on aggregate income is statistically smaller than 1, also leading to the rejection of the full insurance hypothesis, the coefficient on income is always not significant, suggesting that they have access to insurance.

The main concerns in this estimation are measurement error, particularly in income, and omitted variable biases (other variables determine the allocation of consumption, for example, leisure). Tables 2.9 and 2.10 perform a series of robustness exercises using a first differences model. The results are robust to dropping the top and bottom 1% of the income distribution and to implementing a robust regression that gives lower weight to observations that might be outliers. They are also robust to using only labor income, adding education and medical expenditure in the non-durable consumption, to using each period separately (1993-1997 and 1997-2000) and to instrumenting for income changes using lags. Overall, all the specifications support the assumption that arranged marriages allow families to share risk —since income does not predict consumption for arranged marriages they appear to be

$\begin{cases} log(y+1) & if\ y \geq 0 \\ -log(1-y) & if\ y < 0 \end{cases}$. The results found under either transformation are very similar.

better insured than love marriages; however, the results also suggest that neither love nor arranged marriages have access to full insurance (or that there is a model mis-specification).[25] This is a strong test of insurance — arranged marriage households might not be perfectly insured— rather they might have access to differentially greater levels of insurance. Overall, the results suggest that arranged marriages provide more insurance than love marriages. Next I test the predictions of the model.

2.5.2 The Indonesian Green Revolution

2.5.2.1 The Bimas/Inmas Program

The main implication of the model is that the demand for informal insurance determines the level of arranged marriages. I use the introduction of the Green Revolution (GR) in Indonesia to test this prediction. The GR refers to the combined introduction of higher yield rice seeds and improved agricultural techniques that occurred in several developing countries in the second half of the 20th century. Foster and Rosenzweig (1996) show that the GR substantially increased the returns to (primary) schooling in India, possibly because the adoption and implementation of these innovations required learning. The GR also intended to reduce the variance of agricultural output, and thus most likely also reduced the variance of farming households' incomes. The model predicts that both of these changes (lower variance and increased education returns) will result in fewer arranged marriages and higher investment in education. First, I use the timing of the GR in conjunction with variation in the intensity of the program's implementation across regions of Indonesia to identify the effect of

[25] If individuals within groups do not have homogenous preferences, —for instance if they differ in their risk aversion, then the coefficients in this specification are biased (Mazzocco and Saini, 2012). Alternatively, the insurance group may not be correctly defined, also causing bias in the coefficient of aggregate consumption.

the program on the returns to schooling and on the variance of income. In addition, I show that the introduction of this program also increased the income of agricultural households, possibly allowing them to self-insure — a margin not explored in the model but potentially an important mechanism for coping with risk. Then, I use the same variation to identify the effect on marriage arrangements and years of schooling. I discuss the relative effects of the program below.

At the beginning of the 1960s, the Indonesian government started an increasing effort to raise rice production. In 1964/65, they launched in West Java a pilot project known as Demostrasi Massal (Demas) — Mass Demonstration Program— with the goal of testing the suitability of higher yield variety seeds (HYVs) in Indonesian soil. In 1965, the Mass Guidance Program (Bimas) was born. The disappointing results of the first few years led to several changes, and in 1967, the program was divided into Bimas and a new Mass Intensification Program (Inmas). The more intense diffusion of both programs started in Java toward the end of the 1960s and slowly expanded into the other islands; by the mid-1980s around 75% of rice areas were covered under some sort of intensification (Hill, 2000). The program suffered several modifications and additions throughout the years; however, the main components of the program remained unchanged and were composed of: (i) expansion of HYVs; (ii) increased availability of fertilizer and pesticides; (iii) access to credit; and (iv) rehabilitation of irrigation systems (Palmer, 1976). The Bimas/Inmas program successfully increased yields by approximately 65% between 1960/61 (1.4 tons/ha) and 1980/81 (2.3 tons/ha) (Manning, 1995) and eliminated the import of rice, which had reached a maximum during the 1970s.[26]

[26] By 1979 Indonesia was still the largest rice importing country in the world, with annual imports of 2.9 million metric tons. By 1983, Indonesia became a rice self-sufficient country for the first time in its history (Resosudarmo and Yamazaki, 2011)

I collected information for approximately 200 districts on the implementation and outcomes of the Bimas/Inmas program from the 1963 and 1983 agricultural census and other documents on land utilization and agricultural production (table 2.11). Using the information from the beginning of the 1980s, I first confirm (table 2.12) that rice areas under Bimas/Inmas used agricultural inputs more intensely: they had a higher percentage of irrigated land; a larger percentage of households used fertilizer and used it more intensely per hectare; and they were more likely to use HYVs. These districts had an average increase of 1.35 tons/ha in rice production, and this increase is explained by a more intense use of agricultural inputs (table 2.13). The 1963 agricultural census reports information on total sawah land (land available for the production of wet paddy or rice), total dry land, total land harvested (wet and dry rice), number of farms, average farm size and number of livestock for each agricultural district. Using this information, I show that areas with a higher percentage of sawah land and more farms per hectare (farms/ha) benefited more from the expansion of the Bimas/Inmas program. In other words, both variables and its interaction are good predictors of the implementation of the Bimas/Inmas program (tables 2.14 and 2.15). The reduced form analysis, using the percentage of sawah land and farms/ha instead of the intensity of the program, indicates that these areas had an average increase of 1.28 tons/ha in rice yield.[27]

2.5.2.2 The Effects of the Green Revolution on Labor Market Outcomes

To document the effects of the GR, I use data from the 1976 and 1995 Population Census,

[27] Tables 2.14 and 2.15. The reduced form refers to the following equation: $yield\,rice_{d,1980} = \beta_o + \beta_1 \%\, sawah\, land_{d,1963} + \beta_2 \left(farms/ha\right)_{d,1963} + \beta_3 \%\, sawah\, land_{d,1963} * \left(farms/ha\right)_{d,1963} + \varepsilon_{d,1980}$

and the 1980, 1981, 1982, 1984 and 1987 socioeconomic surveys (SUSENAS).[28] I also confirm these results with the IFLS 1993 sample.[29] Specifically I estimate the following Mincerian wage equation:

$$ln\, wage_{i,p,t} = \beta_o + \pi_t + \delta_d + \beta_1 s_{i,d,t} + \beta_2 (s_{i,d,t} * bimas_{d,1982}) + X_{i,d,t} + \varepsilon_{i,d,t} \qquad (2.18)$$

where the log wages of individual i in district d at time t are a function of (survey) year fixed effects (π_t), district-of-residence fixed effects (δ_d), the years of education ($s_{i,d,t}$) and other individual variables, $X_{i,c,t}$ (gender, age, age squared and a dummy for rural residence). The variable $bimas_{d,1982}$ measures the intensity of the program as the percentage of total agricultural wet paddy (rice) land under any type of Bimas/Inmas intensification in 1982/83. The coefficient of interest is β_2, and it tests whether the returns to school are larger in areas where the GR had a larger impact.

The identification relies on variation in the intensity of the treatment across districts and cohorts, and assumes that there are no unobserved determinants of wages (in particular

[28] The 1976 Census is the first survey containing information on any type of income, collecting for the first time information on wages (only for employees). The 1980, 1981 and 1982 SUSENAS and the 1995 Census collected information on wages and educational attainment. The 1981, 1982, 1984 and 1987 SUSENAS surveys collected detailed information on income at the household level from all sources (including profits from agricultural and non-agricultural business).

[29] Section 2.7 and tables 2.16 and 2.17 present a more detailed description of the data construction and report the summary statistics for the estimation samples.

of the returns to school) that are correlated with the timing and intensity of the program. Outcomes before the mid-1960s/early-1970s should not have been affected by the program; in addition, the intensity of the treatment must have varied across younger generations, i.e., some individuals were exposed to the program for a longer period of time (parents and children reaped the benefits earlier relative to other areas receiving the program at a later period). The main threats to identification are differential trends across areas and adoption of other programs at the district/cohort level. In order to mitigate these potential concerns of endogeneity (less conservative areas, with higher wages, adopting the HYVs earlier and having a faster transition towards love marriages), I additionally instrument $bimas_{d,1982}$, the intensity of the GR, with the percentage of sawah land in 1963, the number of farms per hectare in the same year and their interaction (taken from the 1963 agricultural census).

Another important issue to consider is that the GR coincided with the introduction of other programs. Indonesia experienced an intense school construction program between 1973 and 1978, exploited by Duflo (2001), who shows that it successfully increased the education of children across districts and cohorts. During the same period, the government also expanded sanitation and water supply across areas. Figure 2.11 plots the intensity of the Bimas/Inmas program (% of sawah land under intensification) against the intensity of the school construction program (# schools for 1000 children), and against the allocation of water and sanitation programs (per capita) by district. In both cases, there seems to be a slightly negative correlation between each pair of variables, mostly driven by one district, suggesting the omitted variables bias (OVB) is potentially unimportant—I add these controls as a check.

Panel A of table 2.3 reports the results for the pooled sample of SUSENAS and Census. The coefficients show that each additional year of schooling increases the returns to schooling

between 5.4% and 5.9%, while individuals residing in areas exposed to the average intensity of the Bimas/Inmas program have a statistically additional return of 2.1% to 2.6% for each extra year of schooling. The table also shows the reduced form effect of the 1963 agricultural characteristics on log wages and the IV results of instrumenting $bimas_{d,1982}$ with them. In both cases, the effect of the GR is larger, raging between 3.3% to 4.7%. Panel B presents the results for the 1993 cross-section of IFLS. The results are slightly larger for this sample; each year of education increases wages by 7.4% to 8%, and an additional 3.6% to 3.9% for individuals living in districts with average exposure to the Bimas/Inmas program. Table 2.18 adds controls for the school construction program and the water and sanitation projects; the results of the direct effect of Bimas/Inmas are slightly smaller but still significant at a 1% level (columns 1 and 2) suggesting that the effect of the Bimas/Inmas program is not capturing an additional effect of these programs. Reassuringly, the IV results do not change.

Table 2.4 presents the results of the joint estimation of the effect of the program on the mean and variance of income using the following specification:

$$\begin{aligned} ln\, income_{i,d,t} &= \beta_o + \pi_t + \eta_p + \beta_1 bimas_{d,1982} + \beta_2 rural_{i,d,t} \\ &\quad + \sum_{2}^{4} (\pi_t * bimas_{d,1982})\beta_{3,t} + \varepsilon_{i,d,t} \end{aligned} \tag{2.19}$$

where $ln\, income_{i,d,t}$ is the logarithm of the per capita income of household i, residing in district d at survey time t, π_t and $bimas_{d,1982}$ are defined as in equation 2.18, η_p are a set of province fixed effects, $rural_{i,d,t}$ is dummy variable for rural residence, and $(\pi_t * bimas_{d,1982})$ captures differences of the Bimas/Inmas program for each survey year. The specification jointly estimates the effect on the mean and variance of (log per capita) income using a

maximum likelihood model that assumes normally distributed errors.

Panel A contains the results for the SUSENAS sample using only agricultural households. The first two columns present the results for specification 2.19. In columns 3 and 4, I add a dummy variable for two islands (Sulawesi and Kalimantan) interacted with $bimas_{d,1982}$, π_t and $\sum_{2}^{4}(\pi_t * bimas_{d,1982})$ because these islands received the intensification program late (towards the end of the 1970s and beginning of the 1980s); the districts on these islands had less time to show a perceivable change in production.[30] The coefficients in columns 1 and 3 show an average income increase between 6.7% and 8.2%.[31] The results in column 2 would suggest an average increase in the income variance of 2.9%; however, this coefficient masks the fact that some districts (the outer islands) received the program much later and had not reaped the benefits by the time of the surveys (as also suggested by the slightly lower coefficient in column 1). Once I account for this fact in column 4, the estimated coefficient shows a decrease in variance of 8.2%.

The reduced form effect of the 1963 agricultural characteristics in columns 7 and 8 (once I control for the two islands) indicate a smaller gain in income and much larger decrease in variance, 0.5% and 46% respectively. Panel B repeats the same analysis for the sample of agricultural households of the 1993 IFLS cross-section; the results are much larger in

[30] The specification used is: $ln\,income_{i,d,t} = \beta_o + \pi_t + \eta_p + \beta_1 bimas_{d,1982} + \beta_2 rural_{i,d,t} + \sum_{2}^{4}(\pi_t * bimas_{d,1982})\beta_{3,t} + \beta_4(bimas_{d,1982} * islands_{i,d,t}) + \sum_{2}^{4}(\pi_t * islands_{i,d,t})\beta_{5,t} + \sum_{2}^{4}(\pi_t * islands_{i,d,t} * (bimas_{d,1982})\beta_{6,t} + \varepsilon_{i,c,t}$

[31] The coefficients of the interaction terms, $\beta_{3,t}$, are not shown in the tables but they do indicate that the program had a different impact by year, increasing income further in 1982 and 1987, and slightly less in 1984, although always having a positive effect relative to areas with lower treatment intensity.

magnitude, but the signs and conclusions remain unchanged (both for the OLS and the reduced form analysis). Table 2.19 adds controls for the other programs implemented during the same period (school construction, water and sanitation supply). The coefficients do not change significantly and the signs are the same as before.

2.5.2.3 Effect on Arranged Marriages and Education

The results from returns to education indicate that the program caused an increase in the outside option and, at the same time, decreased the size of the expected shock for agricultural households.[32] The model predicts that these changes should increase the incentives to invest in education (increasing years of schooling) and speed up the transition toward love marriages (decreasing the probability of having an arranged marriage). I use the following specification in order to test the effect on arranged marriages:

$$\begin{aligned} AM_{i,d,c} &= \beta_o + \gamma_c + \delta_d + \sum_c (\gamma_c * bimas_{d,1982})\beta_{1,c} + \sum_c (\gamma_c * P_{d,61})\beta_{2,c} \\ &\quad + \beta_3 female_{i,d,c} + \sum_c (\gamma_c * X_d)\beta_{4,c} + \varepsilon_{i,d,c} \end{aligned} \tag{2.20}$$

where $bimas_{d,1982}$ is defined as before, δ_d are district-of-birth fixed effects, γ_c are cohort-of-birth fixed effects, $P_{d,61}$ is total population residing in district d in 1961, $female_{i,c,d}$ is a

[32] Additionally, the increase in income might allow households to self-insure, which it is not captured by my model but might be another potential channel. Also, it should be noted that I cannot separate the effects of increasing returns to education, increasing income and decreasing income variance; however, all these changes should lead to the reduction of arranged marriages according to the theoretical framework.

dummy that takes the value of one if individual i, in cohort c and in district d is a woman; and X_d includes a set of district level controls from the 1971 census, the intensity of the school construction program from the mid-1970s and controls for the expansion of water and sanitation supply programs during the same period. The coefficients of interest are $\beta_{1,c}$, which represent the effect of the Bimas/Inmas program on the probability that individual i, born in district d and in ten-year birth cohort c (year of birth: 1932<, 1933-42, 1943-52, 1953-62 and 1963>) has in an arranged marriage. If the program was exogenous and unanticipated, we should not observe any effect for individuals married before 1970 (before the GR took place). The average age at marriage is approximately 18; thus, we should expect an effect for individuals born after 1953. The specific timing should depend on how long it took for the program to be implemented and to deliver successful outcomes that are perceived as permanent by households.

The identification strategy is ilustrated in figures 2.7 and 2.8, and in table 2.21. The first figure plots the density of the residuals of the treatment variable after controlling for the total population by district in 1961 and province fixed effects. It then adds controls for district characteristics of 1971. And finally, it controls for the intensity of the school construction, and the water and sanitation supply program. The density does not change as I add information at the district level suggesting that the intensity of the treatment in the early 1980s is not correlted with district characteristics in 1970s. The results are also shown in table 2.20 where I show that I cannot reject that the 1971 district characteristics and the intensity of other programs are jointly not statistically significant determining the intensity of the treatment in 1982. In figure 2.8 I divided the treatment variable into the four quartiles of the distribution of sawah land covered by any intensitifcation program. The figure plots the mean AM by cohort of birth and treatment intensity, where treatment one corresponds to the lowest treatment (the districts with the lowest percentage of sawah land

covered by the GR). The figure shows that cohorts 1933-42, 1943-52 and 1953-62 follow the same trends in the four treatment intensity areas. It also shows the that identification is obtained from the last cohort by comparing areas more intensily treated against areas with low treatment intensity (after differencing out the common pre-trends). The figure also suggests that the oldest cohort (born before 1933) might not be the proper comparison group. I show results using all cohorts and using only the 4 youngest cohorts. Finally table 2.21 shows the difference-in-difference raw results in a table with the four treatments. Panel A show the results of the **placebo tests** using the first three cohorts (not exposed to the green revolution), the difference-in-difference specification shows no effect for them. Panel B presents the experiment of interest, showing a large effect for this cohort and slighly increasing with the intensity of the treatment. These results are formally explored using equation 2.20.

Panel A of table 2.5 presents the summary statistics for the final sample used. I matched 9,068 individuals to their district of birth using retrospective information on migration. Each cohort has between 1000 and 2500 observations. As already summarized in section 3, arranged marriages have decreased in each generation and education has increased. Interestingly, the percentage of the population currently residing in a rural area has remained relatively stable at approximately 60%. Panel B shows the results of the reduced form effect of the Bimas/Inmas program on arranged marriages using 4 cohorts (columns 1 to 4) and 5 cohorts (columns 5 to 8) estimating specification 2.20. Column 1 (5) shows the base results, column 2 (6) adds controls at the district level interacted with cohort fixed effects, column 3 (7) adds controls for the school construction program as used by Duflo (2001), finally column 4 (8) adds controls for the expansion of water and sanitation supply. The results support the predictions of the model. The only statistically significant coefficient is for the youngest cohort (born after 1963). Adding controls at the district level does not change the size of the

effect, while adding controls for the school construction and the water and sanitation supply programs reduces the magnitude of the coefficient, but still shows a large decline in arranged marriages for the cohorts exposed to the GR (although imprecisely estimated). The results imply that the areas and cohorts exposed to the mean treatment intensity had a 9 to 20 percentage points reduction in the probability of having an arranged marriage, a decline on the order of 30 to 66 percent relative to the sample mean.

Accoding to the theoretical framework, increases in returns to education and the reduction in the net benefits of the insurance of arranged marriages should lead to an increase in years of schooling for the youngest cohort exposed to the program (assuming that the opportunity cost of child labor remains smaller relative to the increase in returns). To test this prediction, I estimate the following equation:

$$\begin{aligned} Yrs\,sch_{i,d,c} &= \beta_o + \gamma_c + \delta_d + \sum_c (\gamma_c * bimas_{d,1982})\beta_{1,c} + \sum_c (\gamma_c * P_{d,61})\beta_{2,c} \\ &\quad + \beta_3 female_{i,d,c} + \sum_c (\gamma_c * X_d)\beta_{4,c} + \varepsilon_{i,d,c} \end{aligned} \tag{2.21}$$

where all the variables have the same definition as in specification 2.20 and $Yrs\,sch_{i,d,c}$ represents the years of schooling of individual i, born in district d and beloging to cohort c. The coefficients of interest are $\beta_{1,c}$, which represent the effect of the Bimas/Inmas program on schooling. The Bimas/Inmas program should have affected the education of children of school age by the time that it delivered benefits. Since the program started in the mid-1960s and slowly expanded, average education should start increasing for children born after 1963 (of school age by early 1970).

The results are reported in table 2.6. The first column presents the results for equation 2.21. Column 2 (4) adds controls at the district level interacted with cohort fixed effects, and column 3 (6) adds controls for the school construction program and for the expansion of water and sanitation supply. The coefficients in column 1 suggest that all cohorts living in areas with higher intensity of the program have more education; however, the results show a 0.3-0.5 years increase for the youngest cohort relative to the two previous generations. Controlling for the school construction program reduces the magnitude of the coefficients for all cohorts but the relative increase remains the same. The school construction program targeted areas with low enrollment in elementary school. The reduction in the coefficients suggests that the previous results may be explained by differences in supply of schooling across districts.

The results on the probability of having an arranged marriage and years of schooling support the main predictions of the model. As the net insurance benefits of arranged marriages decline relative to the outside option, parents invest in more education for their children, and children switch faster to love marriages. I next present several robustness exercises and then the test of the divorce extension of the base model.

2.5.2.4 Robustness Checks

I perform several robustness exercises that deliver similar results to those of the previous section. In the case of arranged marriages, I first instrument $bimas_{d,1982}$ with agricultural characteristics of 1963: the percentage of sawah land, the number of farms per hectare and their interaction (taken from the 1963 agricultural census). I then use splines defined as the four quartiles of the treatment intensity.[33] I also allow for other non-linear effects by introducing a quadratic term of the treatment variable. Finally, I use an alternative defition

[33] Treatment intensity refers to the percentage of sawah land cover by any intensification program

of treatment. I redefine treatment as the percentage of total agricultural land covered by any intesification program.

The results of the first exercise are presented in table 2.22. I present the results using 4 and 5 cohorts, adding sequentially controls for the introduction of other program.[34] The base results are larger in magnitude than the OLS results presented in the previous section and they imply a decline of 25 to 42 percetange points. The magnitude of the decline decreases as I add controls for the other programs implemented during the 1970s. However, the results still support the hypothesis of my model.

Table 2.23 shows the results using splines for the Bimas/Inmas intensity program (columns 1 to 4) and for the alternative definition of treatment (columns 5 to 6), estimating the following equation:

$$\begin{aligned} AM_{i,d,c} &= \beta_o + \gamma_c + \delta_d + \sum_{c=2}\sum_{j=2}(\gamma_c * T_j)\beta_{1,c,j} + \sum_{c}(\gamma_c * P_{d,61})\beta_{2,c} \\ &\quad + \beta_3 female_{i,d,c} + \sum_{c}(\gamma_c * X_d)\beta_{4,c} + \varepsilon_{i,d,c} \end{aligned} \tag{2.22}$$

where T_j is a dummy variable for each quartile of the treatment distribution, the omitted category corresponds to the first quartile. The rest of the variables are defined as in equation 2.20. I present the baseline results where I only control population in 1961 and the results

[34] I do not include controls at the district level in 1971. Since my instrumental variables are taken from the 1963 agricultural census, they might have likely influenced the district characteristics in 1971.

with the full set of controls (district level characteristics in 1971, the intensity of the school construction program and the expansion of water and sanitation supply program).[35] The results of all the specifications still show that cohorts affected by a higher intensity of the GR transitioned faster to love marriages. The point estimates of my preferred specification using Bimas/Inmas (colums 2 and 4 which have the full set of controls) imply a reduction of 7.4 to 10.6 percetange points for the case where the base is the cohort born in 1933-43; and a reduction of 17.9 to 19.7 percentage points for the 5 cohorts case. Columns 6 and 8 use the alternative definition of treatment. In the case of the 4 cohorts specification, the reduction implied by the results is between 10.1 and 16.3 percentage points; while for the 5 cohorts case, the decline is between 15.5 and 20.4 percentage points. All these results are within the same range found in the previous section.

Table 2.24 allows for concavity or convexity in the effect of the treatment by including a quadratic term:

$$\begin{aligned} AM_{i,d,c} &= \beta_o + \gamma_c + \delta_d + \sum_c (\gamma_c * Treatment_{d,82})\beta_{1,c} + \sum_c (\gamma_c * \\ &\quad Treatment^2_{d,82})\beta_{2,c} + \beta_3 female_{i,d,c} + \sum_c (\gamma_c * X_d)\beta_{4,c} + \varepsilon_{i,c,d} \end{aligned} \tag{2.23}$$

Similar to table 2.23, I present the baseline results where I only control for the district population in 1961 and the results with the full set of controls for the both treatment variables. At the bottom of the table, I present the total effect and its standard errores calculated

[35] The other results are available upon request.

at the mean of the treatment intensity.[36] The results are again within the range found in the previous exercises, the marginal effect evaluated at the mean of the treatment intensity implies a decline in arranged marriages between 8 to 30 percentage points.

Finally, I use the the 1995 inter-census survey to study the effect on investment in education as a robustness exercise. I estimate equation 2.21 using larger samples, 327,404 individuals when I use only 4 cohorts, and 360,383 when I use the 5 cohorts. The results are shown in table 2.25, where I also present the results of instrumenting my treatment intensity with the 1963 agricultural characteristics. The point estimates are slightly different from the results using IFLS (the mean education in the the inter-census survey is higher than the mean education in IFLS). However, the implied increased caused by the GR for the cohorts exposed is similar to the previous results. The estimates imply an increase between 0.22 to 0.41 years of schooling relative to the two previous cohorts (using either 4 or 5 cohorts and evaluated at the mean treatment intensity). The IV results are larger in magnitude, suggesting an increase of an additional 0.6 to 0.9 years of schooling for the youngest generation relative to the previous two cohorts. Although not shown in tables, similar results are found using splines, adding a quadratic term for the treatment variable and using the alternative definition of treatment intensity.[37]

2.5.2.5 Additional Prediction: Divorce

Indonesia and other countries from Southeast Asia have traditionally had a low cost

[36] $Total\,effect{=}\beta_{1,c} + \beta_{2,c} * 2 * (Treatmet)$

[37] Results available upon request

of divorce.[38] Prior to its independence and until 1974, Indonesia had a plural marriage law system. The population was divided into five groups (Muslims, Christians, Chinese, Europeans and natives) and each of them had its own law.[39] However, the large majority of the population was subject to the unwritten customary (adat) law in combination with the Muslim Family Law. In 1974, the government approved the Family Law Bill, which provided a unified framework (keeping a separation between Muslims and other religions). The law effectively increased the cost of divorce for all individuals through enforcing the registration of the marriage and requiring court approval before any divorce was effective. This increase in the cost of divorce occurred during the same period when the demand for informal insurance fell. Younger cohorts faced an increasing drop in the net insurance benefits as risk profiles shifted, the cost of informal insurance increased, and the outside option raised. Holding constant the cost of divorce, the model predicts that we should observe an increasing divorce rate among arranged marriage couples; however, since at the same time the cost of divorced went up, the effect might be smaller. To test this prediction, I use the following specification:

$$\begin{aligned} D_{ipc} &= \beta_0 + \gamma_c + \eta_p + \beta_1 AM_{ipc} + \sum_c (\gamma_c * AM_{ipc})\beta_{2,c} \\ &\quad + \sum_p (\eta_p * AM_{ipc})\beta_{3,p} + \beta_4 female_{ipc} + \beta_5 duration_{ipc} + \varepsilon_{ipc} \end{aligned} \tag{2.24}$$

[38] Jones (1981, 1997) presents and discusses evidence on the trends of divorce in Indonesia, Malaysia and Singapore since 1950.

[39] For Muslims, Islamic Law applied; for indigenous Indonesians and some "Foreign Orientals," their customary law applied; for Indonesian Christians the marriage ordinance applied; and for Chinese and European the Civil Code applied.

where D_{ipc} takes the value of one if individual i in province p and cohort c divorced her first spouse, γ_c are cohort fixed effects, η_p are province fixed effects, AM_{ipc} is a dummy variable taking the value of one if individual i in province p and cohort c had an arranged marriage, $female_{ipc}$ takes the value of one for females, and $duration_{ipc}$ controls for the number of years that the first marriage lasted. The coefficients of interest are $\beta_{2,c}$ and the coefficients on γ_c . The former captures the probability of divorce among couples in arranged marriages for each cohort (the omitted category is the oldest cohort, born before 1933), while γ_c capture the divorce probability among couples in love marriages. Figure 2.9 plots the coefficients of a linear probability model. The results support the prediction of increasing divorce rates among arranged marriage couples for younger cohorts, despite the increased legal cost of divorce. Interestingly, they also show a decreasing divorce rate for individuals in a self-choice marriage even prior to the 1974 family law change. These results might be the outcome of better matching in the love marriage markets and possibly other changes that lowered their threshold for divorce. For example, individuals might have improved their search process in love marriage markets finding mates that provide them insurance,$\varrho_{ks}\left(e,\, I(L=1)\right)$, for new types of risk, σ^2_δ.

I additionally use the exogenous variation generated by the Green Revolution to provide more convincing evidence on the declining insurance benefits of arranged marriages. I estimate the following equation by type of marriage using the first three cohorts of my sample (couples mostly married before mid-1960s):[40]

[40] I am concerned that the introduction of the GR changed selection into marriage for both arranged and love marriages. Thus, I focus on couples married before it initiated.

$$D_{idc} = \beta_0 + \gamma_c + \delta_d + \sum_{2}^{3}(\gamma_c * bimas_{d,1982})\beta_{1,c} + \sum_{2}^{3}(\gamma_c * ymb65_{idc})\beta_{2,c} + \sum_{2}^{3}(\gamma_c * ymb65_{idc} * bimas_{d,1982})\beta_{3,c} + \beta_4 female_{idc} + \beta_5 duration_{idc} + \varepsilon_{idc} \quad (2.25)$$

where γ_c, $female_{idc}$ and $duration_{idc}$ are defined as in equations 2.24; δ_d are district-of-birth fixed effects and $bimas_{d,1982}$ measures the intensity of the program as the percentage of total agricultural wet paddy (rice) land under any type of Bimas/Inmas intensification in 1982/83.[41] Finally, $ymb65_{idc}$ is dummy variable that takes the value of one if the individual was married before 1965. The coefficients of interest are $\beta_{3,c}$, that capture the effect of the GR on individuals married before the Bimas/Inmas was implemented and allowing the effect to vary by cohort.[42] The results in table 2.7 show that individuals having an arranged marriage and exposed to the GR indeed have an increasing probability of divorce. The results from column 1 suggest that the cohort born before 1933 and exposed to the Bimas/Inmas program has a 18% lower probability of divorcing; however, this probability increases to 25% for the cohort born between 1933 and 1942, and to 29% for the cohort born between 1943 and 1952. The results from column 2, which uses data from individuals having a love marriage as a placebo test, suggest that the GR did not change significantly the probability of divorce for

[41] I am using district of birth to assign the intensity of the Green Revolution. It might not be the proper measure if individuals in arranged marriages and love marriages have different migration patterns.

[42] Cohorts married before 1965 experienced different historical and economic changes, which might affect differentially the selection into marriage. For instance, couples married before 1950 (year of birth before 1933) were formed during the war period.

this group.

2.5.3 Other countries: Divorce in Turkey

Finally, I study divorce trends in Turkey using the 2003 and 2008 cross sections of the Turkish Demographic and Health Survey (TDHS). The TDHS collects information on ever-married women whose ages are between 15 and 49; I focus on women born before 1983, leaving a total of 7321 from the 2003 cross-section and 5884 from the 2008 TDHS. In contrast with Indonesia, Turkey has had a low rate of divorce during the last century (around 2% of ever-married women have had a divorce) and women have been granted equal rights to men almost since its foundation (after the foundation of the Turkish Republic in 1923, the family law banned polygamy, and divorce and inheritance rights were made equal for men and women; and in the 1930s women acquired full political rights, including the right to elect and be elected locally and nationwide). Figure 2.10 plots the (raw) percentage of women in an arranged marriage by year of marriage. It shows decades of accelerated decline (1960 to 1970 and mid-1990s to late-1990s) and other phases with a slower and smoother transition (1970s, 1980s and 2000s).

I use the following specification to explore changes in divorce rates by cohort and type of marriage:

$$\begin{aligned} D_{idct} &= \beta_0 + \gamma_c + \delta_d + \beta_1 AM_{idct} + \sum_c (\gamma_c * AM_{idct})\beta_{2,c} \\ &\quad + \beta_3 duration_{idct} + \pi_t + \varepsilon_{idct} \end{aligned} \tag{2.26}$$

where where D_{idct} takes the value of one if woman i in district d, cohort c and survey year t divorced her first spouse, γ_c are cohort fixed effects, δ_d are district-of-residence fixed effects, AM_{idct} is a dummy variable taking the value of one if the woman had an arranged marriage, $duration_{ipc}$ controls for the number of years that the first marriage lasted and π_t is a survey-year fixed effect. The coefficients of interest are β_1, $\beta_{2,c}$ and the coefficients on γ_c. Panel A of table 2.8 presents summary statistics for the sample used; women in love marriages are slightly younger, have approximately 3 years more of education and are more likely to live in urban areas. Panel B shows the results of equation 2.26, showing that women having an arranged marriage are 1% more likely to have had a divorce (columns 1 and 2) than women having a love marriage. This effect is statistically significant at a 1% level. The next two columns (3 and 4) suggest that this result is mostly driven by women born between 1964-1973 and 1974-1983, who are 0.9% and 0.62% more likely to have divorced, respectively. These results are especially interesting when analyzed jointly with the patterns of figure 2.10. Women born between 1964 and 1973 married approximately in 1983-1992 (average age at marriage is 19 years old), a period where the decline in arranged marriage was slow; but they divorced during the mid-1990s (average duration of marriage is 7.5 years), a period of rapid decline in arranged marriages. The theoretical framework would suggest that this period experienced a rapid decline on the insurance benefits of arranged marriages, thus leading to a larger rate of divorce as found in the empirical analysis. In contrast, women born between 1974 and 1983, married between 1992-2003. This period (1992-2003) witnessed another accelerated rate of decline in arranged marriages (possibly also changing selection into marriage). This last cohort divorced during the 2000s, again a period of slower decline in arranged marriages, which possibly resulted in the slightly lower probability of divorce for this cohort.

2.6 Discussion

This paper documents a transition in marital arrangements in several regions of Asia and Africa: arranged marriages are disappearing. To understand and explain the causes behind this change, I document the factors associated with this transition. Overall, arranged marriages have declined as the returns to school have increased and countries have moved away from agriculture, becoming more urban. Based on these observations and on previous literature, I propose a simple model of marital formation to understand how these economic changes have affected the incentives of households for entering into an arranged marriage.

The main assumption of the model is that arranged marriages provide a form of informal insurance that other marriages do not. In the model, parents invest in the education of their child and exert an effort to find her an insurance partner (the arranged marriage). The child receives the returns to education, transfers a share back to her parents and decides to accept the arranged marriage or not. The main implication of the model is that a net reduction of the insurance benefits relative to the outside option leads to the disappearance of arranged marriages (both children and parents face an increasingly costly trade-off). I extend the model to allow for the possibility of divorce. I show that there will be a higher divorce rate among arranged marriage couples as their insurance benefits disappear.

I provide empirical evidence in support of the theoretical framework. Households in arranged marriages are better insured than those in love marriages: changes in income do not predict changes in consumption among arranged marriage couples, but they do for love marriage couples. Then, I use the introduction of the Indonesian Green Revolution as an exogenous technological shock to the distribution of earnings that increased the returns to schooling, lowered the variance of income, and increased the level of income of agricultural

households that traditionally married by parental arrangement. As predicted by the model, the intensity of the GR accelerated the transition toward love marriages and increased the investment in education for the cohorts (and areas) more exposed to the technological innovation. Finally, using data from Indonesia and Turkey, I also show that arranged marriage couples have had an increasing divorce rate consistent with the declining insurance benefit that these marriages provide.

Overall, the results presented in this paper are consistent with a relative decrease in the insurance value of arranged marriages. The net benefits of this type of informal insurance arrangement have decreased relative to the (unconstrained) returns outside of the social network. The transition, however, might also be consistent with two alternative (or complementary) explanations. First, in an alternative model, children might have experienced an increase in their bargaining power as older generations lose control over the resources of the economy. Being excluded from land inheritance or denied access to traditional occupations might no longer be a sufficiently severe punishment to influence the children's decisions. Second, there has been an increasing media penetration highly correlated with economic growth that might lead to cultural changes or westernization of these regions. Both of these alternatives are also compatible with the decrease in the insurance motive I propose (potentially increasing the speed of the marital transition). Moreover, these explanations cannot fully account for all the patterns, in particular, for early changes in some countries (especially for more rural regions where media might have arrived only in recent decades).[43] However, I

[43] The first alternative explanation might be incorporated in a framework where parents use their children to increase their ties to the community (create alliances or conserve social status) in order to have access to other benefits (which might be considered as a broader insurance motive). As children increase their relative bargaining power, their tastes have a bigger role in the determination of the final choices. The movement away from arranged marriages would suggest that children obtain lower utility from this particular type of insurance; however, it does not imply that they will not have access to other forms of social risk-sharing

cannot disentangle them with the current data.

This paper leaves open several questions for future research. First, there is the puzzle of South Asia. This region, and India in particular, has experienced high economic growth and several economic changes in the last decades. Foster and Rosenzweig (1996) and Munshi and Rosenzweig (2009) show that the Green Revolution increased the returns to schooling and the income of agricultural households. Despite these changes, arranged marriages remain resilient. The low mobility in marital arrangements is consistent with the fact that marriage takes place within the sub-caste or jati, constraining geographic and social mobility (documented by Munshi and Rosenzweig (2009) among others). The jati acts as an insurance network, allowing households to spread across regions and reduce the impact of negative shocks. Mobarak and Rosenzweig (2012) and Munshi and Rosenzweig (2006), among others, show that the jati plays an important role in business investments, in employment (in rural and urban areas), and in risk sharing. Their networks span large regions and maintain rules of strict marital endogamy. In this context, the second extension of the model may help explain why South Asia is resilient to the economic changes. As households have more children, they benefit from insurance only if they are able to diversify their marriages across different areas. Access to large and efficient social networks guarantees that parents are able to find good insurance partners for all or most of their children. Moreover, if the networks span large geographic areas, they also might reduce the value of the outside option. Then constrained returns to schooling are closer to unconstrained returns under these conditions.

arrangements. The second alternative explanation might also be considered as complementary if media penetration sped up the transition across areas within a country (experiencing high economic growth) by disseminating information on new employment opportunities (at the same time that tastes of parents and children shifted).

Larger net benefits and a smaller outside option lower the impact of the economic changes, consistent with the evidence presented in this paper. The marital transition, however, has started in urban areas (love marriages have increased from 5% to 10%) where the outside option is rapidly increasing. Munshi and Rosenzweig (2009) also document a similar pattern in Mumbai, where marriage outside the jati has grown from 2% to 12%. More research is needed to show that economic agents indeed have larger insurance gains and a lower outside option in South Asia.

Another open question is the determination of demand and supply in the marriage markets as countries move from arranged to love marriages. The second theoretical extension of the model, where I study the case of households with two children and varying gender composition, shows that if children are heterogeneous (in price and returns to schooling) and parents belong to a small social network, they have incentives to arrange the marriage only of the child with the lowest expected return in the labor market (and satisfy their insurance needs). If women are considered to have lower returns than men (Strauss and Thomas, 1996; Behrman, 1997), then parents will prefer to arranged the marriage of their daughters. Preliminary results using data from Indonesia, Turkey and Vietnam, show that gender sibling composition is indeed associated with the probability of having an arranged marriage (even after instrumenting this measure).[44] However, in equilibrium, households should supply the same number of boys. It is not clear then how the marriage markets would reach the equilibrium. More research in needed in this direction.

Finally, recent literature in development economics has shown important welfare losses for some individuals living in arranged marriage societies (South Asia). Field and Ambrus

[44] Available upon request.

(2008) show that women in Bangladesh attain less schooling as a result of social and financial pressure to marry young. Vogl (2013) shows that arranged marriage cultivates rivalry among sisters in South Asia. During spousal search, parents with multiple daughters reduce the reservation quality for an older daughter's groom, rushing her marriage to allow sufficient time to marry off her younger sisters. Younger sisters cause earlier exit from school, lower literacy, a match to a husband with less education, and lower adult economic status. This paper further shows that arranged marriages are unstable in some of these regions (have a high divorce rate), leaving open the question of the welfare cost for their offspring. Moreover, the theoretical paper by Edlund and Lagerlof (2006) also suggests that love marriages might reinforce the process of economic growth. Thus, the transition to self-choice marriages might have important effects on the distribution of welfare. Answering the question of what drives the transition is the first step toward exploring who gains and who loses in this "love" revolution.

2.7 Proofs and Other Extensions

2.7.1 Proposition 1

Proposition 1 establishes two testable results regarding the choice between love and arranged marriages. Children calculate their expected utility and compare it for each type of marriage.

$$\begin{aligned} E[u(c_k)] &= \left[1+(1-\varphi)\left(\frac{x_{k,h}\lambda^*_{k,h}+x_{s,h}\lambda_{s,h}}{2}\right)\right] \\ &\quad -\frac{d_k}{2}\left[1+(1-\varphi)\left(\frac{x_{k,h}\lambda^*_{k,h}+x_{s,h}\lambda_{s,h}}{2}\right)\right]^2 \\ &\quad -\frac{d_k}{2}\left\{(1-\varphi)^2\sigma^2_\delta\left(\frac{1+\varrho_{ks}\left(I(e=1),\,I(L=1)\right)}{2}\right)\right\}+E(\alpha) \end{aligned} \tag{2.27}$$

(i) The assumption on assortative mating allows me to simplify equation 2.7, in equilibrium $x_{k,h} = x_{s,h}$, which implies that $\lambda_{k,h} = \lambda_{s,h}$. The first term of this equation is positive as long as $x_L - x_A > 0$ and $\frac{2p}{\beta}\frac{\left[1+d(e_{high}-1)\right]}{(1-d)} < \varphi x_{k,h} < \frac{4p}{\beta}\frac{\left[1+d(e_{high}-1)\right]}{(1-d)}$, $h = A, L$:

$$(1-\varphi)\left(x_L\lambda_L^* - x_A\lambda_A^*\right)\left[(1-d_k) - \frac{d_k}{2}(1-\varphi)\left(x_L\lambda_L^* + x_A\lambda_A^*\right)\right] > 0 \tag{2.28}$$

This follows from $\frac{\partial\lambda}{\partial x} = \frac{\beta\varphi(1-d)\left[2dp^2+d\beta\varphi^2x^2\right]-[(1-d)(\beta\varphi x-2p)-2pde]\left[2d\beta\varphi^2x\right]}{d^2(2p^2+\beta\varphi^2x^2)^2} > 0$ and $\lambda > 0$ as long as the returns to school belong to the range defined above. For simplicity, I am assuming that $e = 0$ and $d = d_k$. Therefore, $(x_L\lambda_L^* - x_A\lambda_A^*) > 0$ since $x_L > x_A \rightarrow \lambda_L^* > \lambda_A^*$.

As long as the returns to schooling are larger than the lower bound, the increase on $x_L - x_A$ leads to an increase in the probability of love marriage. The remaining question is whether equation 2.28 holds when x_L reaches the upper limit. Notice that as x_L or x_A increase, the negative term of equation 2.28 increase as well, $-\frac{d_k}{2}(1-\varphi)\left(x_L\lambda_L^* + x_A\lambda_A^*\right)$. We should consider the possibility that this term becomes larger than $(1-d_k)$, leading children to prefer arranged marriages. I will consider the upper bound of the term $(x_L\lambda_L^* + x_A\lambda_A^*)$, which will be reached when $x_L = x_A = \frac{4p}{\varphi\beta}$.

If both $x_L = x_A = \frac{4p}{\varphi\beta}$, the first part $(x_L\lambda_L^* - x_A\lambda_A^*)$ becomes zero. I am disregarding this effect since I am interested in showing only that:

$$|\, -\frac{d_k}{2}(1-\varphi)\left(x_L\lambda_L^* + x_A\lambda_A^*\right) \,| \leq |\,(1-d_k)\,| \tag{2.29}$$

when the term on the left hand side reaches the maximum. Therefore, by assuming $x_L = x_A = \frac{4p}{\varphi\beta}$, I can show that 2.29 holds as long as $1 > \frac{(1-\varphi)}{\varphi}\left[\frac{4}{\beta+16}\right]$. Then as long as parents receive a sufficiently large share φ that satisfies this condition, even when the returns to education are close to their upper boundary, the second term will remain be positive. Then, for a given x_A, as $\uparrow x_L$, the gain represented by the term 2.28 will increase relative to the dis-utility generated by the loss of insurance (arranged marriage).

(ii) Follows from equations 2.6 and 2.7. As the potential shock is reduced ($\downarrow \sigma^2_{i\delta}$), the insurance benefits decrease and the utility loss from incurring the effort cost increases, leading parents to switch to low effort (increasing education for the child and, therefore, increasing her outside option). Holding constant education, it also increases $E[u(c_{k,L})+\alpha_L]-E[u(c_{k,A})+\alpha_A]$.

The other parameters of the model also matter for the final decision since they will determine the value of insurance, the investment in education and the decision on effort:

(iii) $As\varrho_{ks}\left(e,\, I(L=1)\right) - \varrho_{ks}\left(e,\, I(L=0)\right.$ *converges to zero. Arranged marriage partners lose their insurance advantage relative to love marriage partners when there is no difference in the dispersion of income between both types of marriages.*

(iv) $d_k > 0$ *or* $d > 0$ *decreases. More risk-averse agents will prefer arranged marriages over love marriages.*

(v) $e_{high} > 0$ *increases. Parents face a trade-off between exerting high effort and investing in education/consuming; the rising cost of effort will increase the foregone consumption in both periods.*

(vi) $E\left(\alpha_L\right) - E\left(\alpha_A\right) > 0$ *when the average in partner "compatibility" is larger in love*

marriages than in arranged marriages.

These additional results follow from:

(iii) Follows directly from equation 2.7, as $\varrho_{ks}\left(e,\, I(L=1)\right) - \varrho_{ks}\left(e,\, I(L=0) \rightarrow 0\right.$, then $E[u(c_{k,L}) + \alpha_L] - E[u(c_{k,A}) + \alpha_A]$ increases.

(iv) More risk-averse children will give higher weight to the insurance gain:

$$\begin{aligned}\frac{\partial(E[u(c_k)]_L - E[u(c_k)]_A)}{\partial d_k} &= -\frac{1}{2}\left[1 + (1-\varphi)\, x_L \lambda_L^*\right] + \frac{1}{2}\left[1 + (1-\varphi)\, x_A \lambda_A^*\right] \\ &\quad -\frac{(1-\varphi)^2}{4}\left[\varrho_{ks}\left(e,\, I(L=1)\right) - \varrho_{ks}\left(e,\, I(L=0)\right]\right.\end{aligned}$$

where $x_L > x_A \rightarrow \lambda_L^* > \lambda_A^* \rightarrow -\frac{1}{2}\left[1 + (1-\varphi)\, x_L \lambda_L^*\right] + \frac{1}{2}\left[1 + (1-\varphi)\, x_A \lambda_A^*\right] < 0$, and $\varrho_{ks}\left(e,\, I(L=0) < 0\right.$ by assumption, therefore $-\frac{(1-\varphi)^2}{4}\left[\varrho_{ks}\left(e,\, I(L=1)\right) - \varrho_{ks}\left(e,\, I(L=0)\right]\right. < 0$, leading to $\frac{\partial(E[u(c_k)]_L - E[u(c_k)]_A)}{\partial d_k} < 0$. More risk-averse children prefer the insurance provided by the arranged marriage.

In the case of parents, a similar result follows:

$$\begin{aligned}\frac{\partial(E[u(c_k)]_L - E[u(c_k)]_A)}{\partial d} &= \left[(1-\varphi)\, x_L\,(1+\lambda_L) - d_k\right]\frac{\partial \lambda_L}{\partial d} \\ &\quad -\left[(1-\varphi)\, x_A\,(1+\lambda_A) - d_k\right]\frac{\partial \lambda_A}{\partial d}\end{aligned}$$

where $\frac{\partial \lambda_i}{\partial d} = -\frac{(\beta\varphi x - 2p)}{d^2[2p^2+\beta\varphi^2 x^2]^2} - \frac{2pe}{d^2[2p^2+\beta\varphi^2 x^2]^2} - \frac{[(\beta\varphi x - 2p)(1-d) - 2pde]\left[2p^2+\beta\varphi^2 x^2\right]}{d^2[2p^2+\beta\varphi^2 x^2]^2} < 0$, in addition

$x_L > x_A \rightarrow \lambda_L^* > \lambda_A^* \rightarrow [(1-\varphi)\, x_L\, (1+\lambda_L) - d_k] > [(1-\varphi)\, x_A\, (1+\lambda_A) - d_k]$ and $\frac{\partial^2 \lambda}{\partial d \partial x} = \frac{-\beta\varphi\left(2p^2 - \beta\varphi^2 x^2 + 4\varphi x p\right)}{d^2(2p^2+\beta\varphi^2)} < 0$, therefore $\frac{\partial(E[u(c_k)]_L - E[u(c_k)]_A)}{\partial d} < 0$. More risk-averse parents also prefer insurance. They invest in lower education for their child, reducing her outside option and effectively increasing the probability that the child will accept the arranged marriage.

(v) The derivative of equation 2.6 with respect to e_H:

$$\left[p\frac{\partial \lambda}{\partial e_H} + 1\right][d\,(1 - p\lambda^* - e_H) - 1] + \beta\varphi x \frac{\partial \lambda}{\partial e_H}\,[1 - d\,(1 + \varphi x \lambda^*)] < 0$$

where $\left[p\frac{\partial \lambda}{\partial e_H} + 1\right] = 1 - \frac{2p^2}{2p^2+\beta\varphi^2 x^2} > 0$; $[d\,(1 - p\lambda^* - e_H) - 1] < 0$ since $(1 - p\lambda^* - e_H) \leq 1$; $\frac{\partial \lambda}{\partial e_H} < 0$ and $[1 - d\,(1 + \varphi x \lambda^*)] = (2p^2 + 2p\varphi x)\,(1-d) + 2pde\varphi x > 0$. The utility from choosing high effort decreases as the cost of effort increases to the point where parents will switch to low effort, increasing the education of children and their outside option.

Therefore, as e_{high} increases, education decreases $\frac{\partial \lambda(e_{high})}{\partial e_{high}} < 0$ and $\frac{\partial E[u(c_p)]}{\partial e_{high}} < 0$ leading parents to switch to low effort instead.

(vi) Also follows from equation 2.7; a sufficient condition for *(iv)* is that $F_L(\alpha)$ first order stochastically dominates $F_A(\alpha)$ (by definition of FSD).

2.7.2 Extending the Model to Include Divorce

Expression 2.8 might be reduced to[45]:

[45] I am assuming that individuals in arranged marriages will find a partner with returns $x_A$in the love marriage market. If this assumption is relaxed, the threshold for divorce for individuals in arranged marriages

$$\begin{aligned}\alpha_h - \beta\left[E\left(\alpha_L\right) - \alpha_h\right] \quad &< \quad -\phi - \frac{d_k\beta}{2}\frac{\left(1-\varphi\right)^2}{4}\sigma_\delta^2\left[\varrho_{ks}\left(e,\, L=1\right) - \varrho_{ks}\left(e,\, h\right)\right] \\ &+\frac{d_k}{2}\left(1-\varphi\right)^2\sigma_\delta^2\left[\frac{\varrho_{ks}\left(e,\, h\right)}{2} - \frac{1}{2}\right]\end{aligned} \tag{2.30}$$

where $\varrho_{ks}\left(e, h\right)$ is the correlation between the child and her spouse and depends on the type of marriage and the effort of parents in the first period; $\varrho_{ks}\left(e,\, L=1\right)$ is the correlation between spouses' income in a love marriage (independent of effort) and σ_δ^2 is the variance of the shock.

The final expression of 2.30 depends on the type of marriage chosen in period 2 and determines the thresholds for divorce:

(i) If the child chooses love marriage in period 2, then $\varrho_{ks}\left(e,\, L=1\right) = \varrho_{ks}\left(e, h\right)$ and the divorce threshold is given by:

$$\alpha_L < \left(1+\beta\right)^{-1}\left[-\phi + \frac{d_k}{2}\left(1-\varphi\right)^2\sigma_\delta^2\left[\frac{\varrho_{ks}\left(e,\, I(L=1)\right)}{2} - \frac{1}{2}\right] + \beta E\left(\alpha_L\right)\right] \tag{2.31}$$

---

will depend directly on the difference of returns $x_L - x_A$and on the education level λ:

$$\begin{aligned}\alpha_A \quad &< \quad \left(1+\beta\right)^{-1}\left\{-\phi - \frac{d_k\beta}{2}\frac{\left(1-\varphi\right)^2}{4}\sigma_\delta^2\left[\varrho_{ks}\left(e,\, L=1\right) - \varrho_{ks}\left(e,\, L{=}0\right)\right] + \beta(1-\varphi)\lambda\left(x_L - x_A\right)\right. \\ &\left.\left[1 - d_k - \frac{d_k}{2}(1-\varphi)\left(x_L + x_A\right)\lambda\right] + \frac{d_k}{2}\left(1-\varphi\right)^2\sigma_\delta^2\left[\frac{\varrho_{ks}\left(e,\, L{=}0\right)}{2} - \frac{1}{2}\right] + \beta E\left(\alpha_L\right)\right\}\end{aligned}$$

If this is the case, the optimal solution for λ^*in period 1 depends on the partial derivative of the probability of divorce with respect to λ ($\frac{\partial P^d}{\partial \lambda}$) delivering a cubic term on λ. There is no closed form solution for this case and we need to rely on numerical solutions. For simplicity, I am assuming that this is not the case. However, if the assumption is relaxed, it will deliver a higher divorce rate for arranged marriages as $x_L$increases relative to x_A. This in turn is internalized by parents in period 1 when choosing education and effort.

(ii) If the child chooses arranged marriage in period 2, then $\varrho_{ks}(e,\, L=1) > \varrho_{ks}(e,h)$ and the threshold is given by:

$$\begin{aligned}\alpha_A \;<\; & (1+\beta)^{-1}\left[-\phi - \frac{d_k\beta}{2}\frac{(1-\varphi)^2}{4}\sigma_\delta^2\left[\varrho_{ks}(e,\, I(L=1)) - \varrho_{ks}(e,\, I(L=0)\right]\right. \\ & \left. + \frac{d_k}{2}(1-\varphi)^2\sigma_\delta^2\left[\frac{\varrho_{ks}(e,\, I(L=0))}{2} - \frac{1}{2}\right] + \beta E(\alpha_A)\right]\end{aligned} \tag{2.32}$$

These thresholds are used to derive the divorce probabilities in 2.9. The solution of the model, therefore, is found by calculating the expected utility from period 2, taking into account these (endogenous) probabilities of divorce for period 3. For a given level of education λ_k, the child will prefer love marriage if:

$$\begin{aligned}& E\left[u(c_k)\right]^{M,L} + \beta(1-P^{D,L})E\left[u(c_k)\right]^{M,L} + \beta P^{D,L}E\left[u(c_k)\right]^{D,L} \\ & > E\left[u(c_k)\right]^{M,A} + \beta(1-P^{D,A})E\left[u(c_k)\right]^{M,A} + \beta P^{D,A}E\left[u(c_k)\right]^{D,A}\end{aligned} \tag{2.33}$$

In period 1, parents will choose the education and effort levels also taking into account the probability of divorce:

$$\lambda(e) = \frac{(1-d)\left\{(1-\varphi)\left[\left(\beta+\beta^2\left(1-P^D\right)\right)(1+\beta) + 2\beta^2P^D\right]x + (1-\varphi)\beta^3P^Dx - 2p\right\} - 2dep}{d\left\{2p^2 + (1-\varphi)^2\left[\left(\beta+\beta^2(1-P^D)\right)(1+\beta) + 2\beta^2P^D\right]x + (1-\varphi)^2\beta^3P^Dx\right\}} \tag{2.34}$$

These results show that individuals will divorce depending on the realization of the love term relative to the economic characteristics of the spouse (her insurance quality)

Proposition 4. *For both type of marriages, the probability of divorce will:*

(i) *Increase if the discounted expected match quality from a new draw from the love distribution is larger than that of the current partner:* $\uparrow \left[\beta E\left(\alpha_L\right)\left(1+\beta\right)^{-1}-\alpha_h,\right] h = L, A.$

(ii) *Increase if the income covariance between spouses increases for a given size (variance,* σ_δ^2*) of the shock.*

(iii) *Decrease if the size of the shock (*σ_δ^2*) increases for a given income covariance between spouses.*

(iv) *Decrease as the cost of divorce increases,* $\uparrow \phi$.

Proof of proposition 4. They follow directly from expressions 2.31 and 2.32 combined with equation 2.9.

2.7.3 Proposition 3

Proposition 3. *If* $\varrho_{g_j,b_n}(e_{g,j}=1, e_{b,n}=1) \Rightarrow \varrho_{k,s}=1\ k=g_j,b_n,\ s=s_j,s_n$ *(the most constrained case, only one potential insurance partner, each component of* $\varrho_{g_1,b_1}(e_{g,j},e_{b,i})$ *has a positive correlation equal to 1) and* $\varrho_{g_j,b_i}(e_{g,j}=0,e_{b,i}=1)=\varrho_{g_j,b_i}(e_{g,j}=0,e_{b,i}=0)=0$*, then ceteris paribus:*

a) If $g = 1/2$, families are composed of one boy and one girl, and if $x_b^h/p_b^h > x_g^h/p_g^h$, $h = A, L$ (Strauss and Thomas, 1996; Behrman, 1997), the optimal education level is: (i) $\lambda_b > 0$ for the boy; and (ii) $\lambda_g = 0$ for the girl. Given the choice of education, parents endogenously decide to exert high effort for the girl $e_{g,1} = 1$ and low effort for the boy $e_{b,1} = 0$ (given a low enough love term for the girl, such that she does not reject the arranged marriage). The education of the boy endogenously responds to his marriage decision in the second period: (i) $\lambda_b(x_L)$ if he chooses love marriage with returns x_L; or (ii) $\lambda_b(x_A)$ if he chooses the proposed arranged marriage (corresponding to the low insurance quality mate) with returns x_A. And if $x_L > x_A$, then $\lambda_b(x_L) > \lambda_b(x_A)$.

b) If $g = 1$ or $g = 0$, families are composed of two girls or two boys, and if they are identical in $p_g(p_b)$ and $x_g(x_b)$, then parents toss a coin and offer with 50% probability the high insurance quality mate to girl (boy) 1 ($e_{g,1} = 1$) and the low insurance quality mate to girl (boy) 2 ($e_{g,2} = 0$), conditional on the high insurance quality arranged marriage being accepted. The education level of both girls (boys) responds endogenously to the marriage decision of the second girl (boy). If she (he) decides to reject the low quality partner and $x_L > x_A$, then $\lambda_{2g}(x_{gL}) > 0$, $\lambda_{1g}(x_{gA}) = 0$. If the girl (boy) decides to accept the low quality arranged marriage, then $\lambda_{2g}(x_{gA}) = \lambda_{1g}(x_{gA}) > 0$.

It is important to emphasize that although the decision of each child depends on equation 2.7, the second period utility for each of them depends on the set of strategies of the three agents (parents, son and daughter). The agents affect each other through the budget constraint (education and effort are costly) and through $x_b^h/p_b^h \gtrless x_g^h/p_g^h$.

In the game with two girls, since by construction parents have incentives to marry only one of them ($\varrho_{g_j,b_n}(e_{g,j} = 1, e_{b,n} = 1) \Rightarrow \varrho_{k,s} = 1\, k = g_j, b_n,\ s = s_j, s_n$ and $\varrho_{g_1,g_2}(e_{g_1} = 0, e_{g_2} = 1) = 0$), their probabilities (of having an arranged marriage) are inversely correlated. As

$(x_{gL} - x_{gA}) \uparrow$, since both girls are identical, both of them face the same trade-off between insurance and returns outside the network, leading to a decreasing probability of arranged marriage for each of them. Note also that when both girls choose the same type of marriage, the model delivers identical education for them.

Proof

Proposition 3 compares two-children households with different gender composition under the assumption that boys and girls might have different prices/returns to education:

a) The proof of the education levels follows directly from the results of equation 2.13. Since the returns (per dollar spent) for the boy are larger than the returns (per dollar spent) for the girl, parents choose to educate only the boy. Parents still have incentives to acquire insurance since

$$\begin{aligned} E\left[u(c_f\left(\lambda_{b,1}>0,\lambda_{g,1}=0,e_{g,1}=1,e_{b,1}=0\right)\right] &= \\ \left[1+\varphi\left(\frac{1}{2}x_b\lambda_b^*\right)\right]-\frac{d}{2}\left[1+\varphi\left(\frac{1}{2}x_b\lambda_b^*\right)\right]^2-\frac{d}{4}\sigma_\delta^2\varphi^2 &> \\ E\left[u(c_f\left(\lambda_{b,1}>0,\lambda_{g,1}=0,e_{g,1}=0,e_{b,1}=0\right)\right] &= \\ \left[1+\varphi\left(\frac{1}{2}x_b\lambda_b^*\right)\right]-\frac{d}{2}\left[1+\varphi\left(\frac{1}{2}x_b\lambda_b^*\right)\right]^2-\frac{d}{2}\sigma_\delta^2\varphi^2 & \end{aligned}$$

Therefore parents will prefer to offer the arranged marriage to the girl since her outside option is low enough ($\lambda_g = 0$) such that she will accept the arranged marriage as long as $E(\alpha_L) - E(\alpha_A)$ is sufficiently small (recall that each child still decides the type of marriage based on equation 2.7).

(b) If the two children are identical, parents are indifferent choosing between them for the arranged marriage. Parents will calculate the expected utility under each scenario and

choose education and effort that gives them the highest expected utility (payoff):

$$\begin{aligned} E[u(c_f(\lambda_{g1}(e_{g1}),\lambda_{g2}(e_{g2}),e_{g1}=1,e_{g2}=0)] &= \\ E[u(c_f(\lambda_{g1}(e_{g1}),\lambda_{g2}(e_{g2}),e_{g1}=0,e_{g2}=1)] &= \\ \left[1+\frac{\varphi}{2}\left(x_{g1}\lambda_{g1}(e_{g1})+x_{g2}\lambda_{g2}(e_{g2})\right)\right] &- \frac{d}{2}\left[1+\frac{\varphi}{2}\left(x_{g1}\lambda_{g1}(e_{g1})+x_{g2}\lambda_{g2}(e_{g2})\right)\right]^2 \\ & -\frac{d}{4}\sigma_\delta^2\varphi^2 \end{aligned} \quad (2.35)$$

$$\begin{aligned} E[u(c_f(\lambda_{g1}(e_{g1}),\lambda_{g2}(e_{g2}),e_{g1}=0,e_{g2}=0)] &= \\ \left[1+\frac{\varphi}{2}\left(x_{g1}\lambda_{g1}(e_{g1})+x_{g2}\lambda_{g2}(e_{g2})\right)\right] &- \frac{d}{2}\left[1+\frac{\varphi}{2}\left(x_{g1}\lambda_{g1}(e_{g1})+x_{g2}\lambda_{g2}(e_{g2})\right)\right]^2 \\ & -\frac{d}{2}\sigma_\delta^2\varphi^2 \end{aligned} \quad (2.36)$$

Then equation 2.35 is larger than equation 2.36 for sufficiently low (unconstrained) returns (since both children are identical, and the unconstrained returns are high enough, they will prefer to educate both children and give up the insurance). Parents will choose to offer the arranged marriage to girl 1 (girl 2) if $E(\alpha_{g1,L}) - E(\alpha_{g1,A})$ is sufficiently small (equivalent to girl 1 (girl 2), accepting the arranged marriage with the high insurance quality groom).

The education levels depend on the choices of the girl offered the low insurance quality arranged marriage ($e_{g,j}=0$). From the maximization problem 2.11, if she accepts the low quality arranged marriage, then $x_{g1,A}=x_{g2,A}$, and since both girls face p_g cost of education, then $\lambda_{2g}(x_{gA})=\lambda_{1g}(x_{gA})>0$. If she rejects the low insurance quality arranged marriage, and if $x_{g,L}>x_{g,A}$, then from equations 2.12 and 2.13 we have a corner solution where the girl with the higher returns receives all the education, $\lambda_{g,2}(x_{g,L})>0$, $\lambda_{g,1}(x_{g,A})=0$.

2.7.4 Size of the network and the number of children

This section shows how the number of children affects the role of the size and insurance quality of the network. For the rest of this section, I assume that insurance quality of the network refers to income covariance across the households where the children are married (conditional on having an arranged marriage). For simplicity, I abstract from the children's decision. I only consider the side of the parents who face a shock; they have incentives to smooth it out by marrying off their N_k children with their insurance partners. If we consider the children as decision makers, the analysis becomes increasingly complicated as the number of players in the game increases to $N_k + 1$.

Let ε be the shock faced by parents in period 2 with mean 0 and variance σ_ε^2. If the parents marry off all their children, they pool their resources with the N_k households and consume the average. Their consumption in the second period is given by:

$$c_f = 1 + \frac{\varepsilon + \sum_i^{N_k} \varepsilon_i}{N_k + 1}$$

The size of the network (including the household) is $N_k + 1$, corresponding to the total number of children plus the parents. The parents calculate their expected utility in period 2:

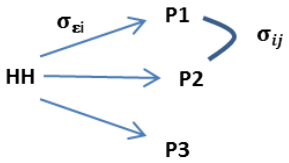
$$E[u(c_f)]_A = E\left\{\left(1 + \frac{\varepsilon + \sum_i^{N_k} \varepsilon_i}{N_k + 1}\right) - \frac{d}{2}\left(1 + \frac{\varepsilon + \sum_i^{N_k} \varepsilon_i}{N_k + 1}\right)^2\right\}$$

$$E[u(c_f)]_A = 1 - \frac{d}{2}\left\{1 + \frac{\sigma_\varepsilon^2}{(N_k+1)^2} + \frac{1}{(N_k+1)^2}\left[\sum^{N_k}\sigma_i^2 + \sum^{m}\sigma_{ij} + \sum^{N_k}\sigma_{\varepsilon i}\right]\right\} \quad (2.37)$$

$$m = \begin{pmatrix} N_k \\ 2 \end{pmatrix} = \frac{N_k!}{2!(N_k-2)!}$$

where σ_ε^2 is the variance of the shock of the parents' household, σ_i^2 is the variance of the N_k households where children are married, σ_{ij} is the covariance across the households where children are married, and $\sigma_{\varepsilon i}$ is the covariance between the parents' household and the other households.

From expression 2.37, the need of a large and high quality insurance network becomes evident. As the number of children increases, so does the number of income covariances between them:



The total number of covariances that parents should be consider is: $m = \begin{pmatrix} N_k \\ 2 \end{pmatrix} = \frac{N_k!}{2!(N_k-2)!}$. Households belonging to a small social network face a potentially large dis-utility if they arranged the marriage of all their children.

2.7.5 Data Section

This paper uses data from several sources in order to show changes in insurance motive. The challenge is to show that wages, income, income variance and education varied in response to the program at the time (or before) individuals made their marital choices. In order to show it, I have used data from the Population Census and the Socioeconomic Surveys (SUSENAS) which were conducted approximately at the same time that the Bimas/Inmas program was delivering successful outcomes. The inter-census from 1976 is the first survey that contains any information on income.

The data used to construct the intensity of the Green Revolution and measure its impact was collected from several printed sources. The main variables used for the analysis come from the 1963 and 1983 agricultural census. The data on production and land utilization come from Kompilasi data reports (reports on production by district in 1980, 1981 and 1982) and from Luas tanah menurut penggunaannya Jawa-Madura & di luar Jawa (land utilization reports from Java and Outer Java).

The analysis in table 2.3 was done using information on wages from the 1976 and 1995 inter-census surveys, and the 1980, 1981, and 1982 SUSENAS. I restricted the sample to individuals aged 17 to 65 in each survey year, with non-missing information on education, wages, district of residence and the other relevant demographic characteristics. Panels A and B of table 2.16 present the average characteristics and standard deviation for each of the relevant variables used in the analysis, as well as the total number of observations and source of the data. Panel C reports the same information for the 1993 IFLS sample of wage earners matched with districts with information on the intensity of the Bimas/Inmas program in 1982/83 and for the sample matched with the information on agricultural characteristics from the 1963 census (Note that some districts in 1983 did not appear in the 1963 agricultural

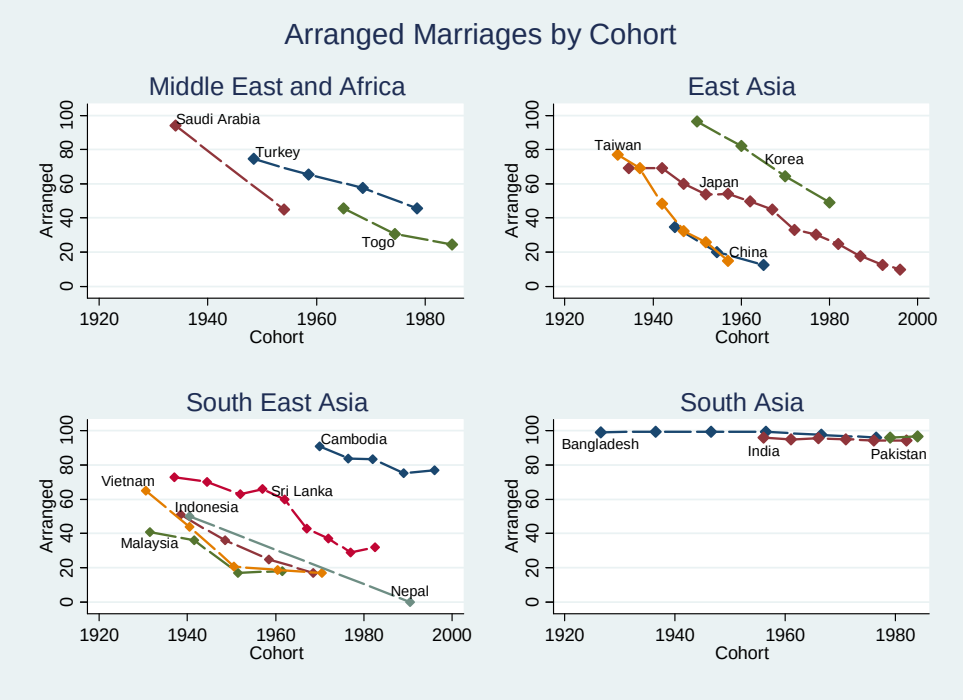
census, and that accounts for the difference in observations reported in table 2.16; the results, however, do not change substantially).

The information used for panel A of table 2.4 comes from the 1981, 1982, 1984 and 1987 SUSENAS surveys. I used information on labor income from all sources at the household level: wages and profits (agricultural and non-agricultural). The measure I used refers to the total household income in real terms divided by the total number of household members, and I focused on households that report agriculture as the main source of income. Table 2.17 summarizes the per capita figures by year in dollars using the 1993 PPP exchange rate. It also show the total number of observations by year and reports the information for agricultural and non-agricultural households. Panel B of table 2.17 summarizes the information of the 1993 IFLS sample used for the analysis of panel B in table 2.4. As with the analysis in panel A, I use only information on labor income (from all sources). I present the summary statistics for the districts matched with the 1983 Bimas/Inmas intensity, and separately for the districts matched with the 1963 agricultural characteristics.

Finally, the analysis in table 2.6 used data from the 1995 inter-census survey focusing on individuals born before 1978 and matched to their district of birth. The final sample used was determined based on having information on the Bimas/Inmas program, the 1963 agricultural characteristics and the data provided by Duflo (2001) on the intensity of the school construction program (1973-1978).

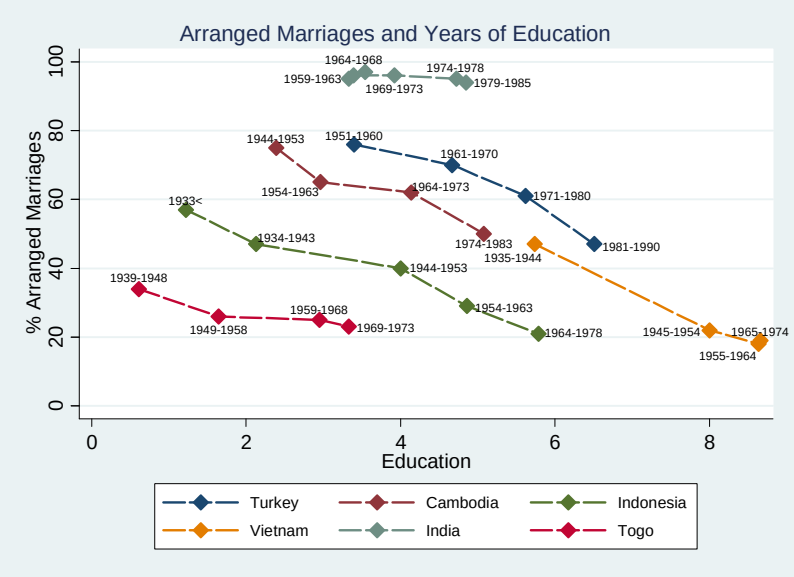
2.8 Tables and Figures

Figure 2.1: Arranged Marriages by Cohort and Region



The data sources used to generate figures 2.1 to 2.6 are described in detail in Rubio (2013). For the following countries, I have used aggregate information collected from survey reports and other research papers: Japanese National Fertility Survey (Japan), Korean National Fertility Survey (Korea), Chitwan Valley Family Study (Nepal), Chengtu City and Urumchi city Surveys (China), Shefar 'Am Arab community (Israel), Coastal Sri Lanka Survey (Sri Lanka), Southern Ghana Survey (Ghana), Asian Marriage Survey (Thailand), City of Damman Survey (Saudi Arabia), Taiwan Provincial Institute of Family Planning (Taiwan), Malaysian Marriage Survey (Malaysia). For the rest of the countries I have used micro-data from: Cambodian (2000 and 2005), Togolese (1988) and Turkish (1998, 2003 and 2008) Demographic and Health Survey, Vietnam Longitudinal Survey (1995-1998), Indonesia Family Life Survey (1993, 1997, 2000, 2007), India Human Development Survey (2005), and Matlab (Bangladesh) Health and Socio-Economic Survey (1996).

Figure 2.2: Arranged Marriages and Education by Cohort



Each line of the graph refers to a different country and each point represents a different cohort for women. It correlates the average years of schooling of the cohort with the average percentage of women who ever had an arranged marriage within the same cohort.

Figure 2.3: Arranged Marriages and Years of Schooling within Cohort: Geographic Variation within Country

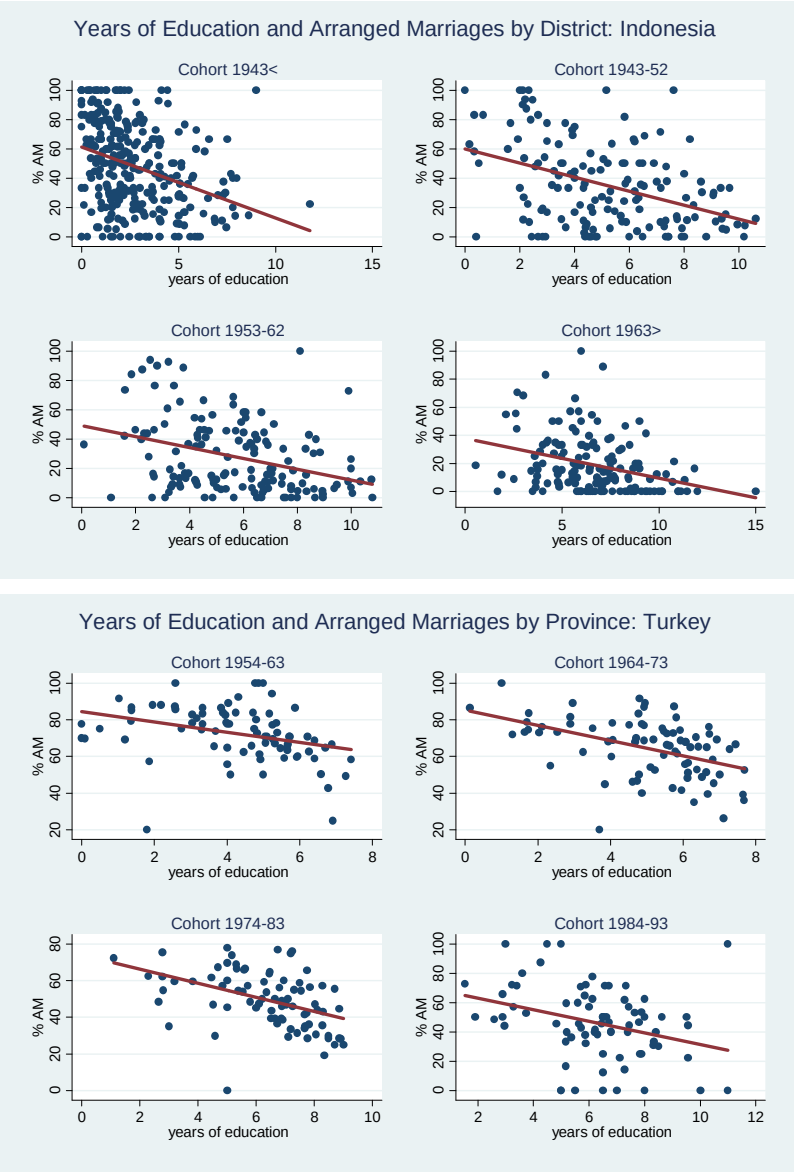


Figure 2.3: Arranged Marriages and Years of Schooling within Cohort: Geographic Variation within Country

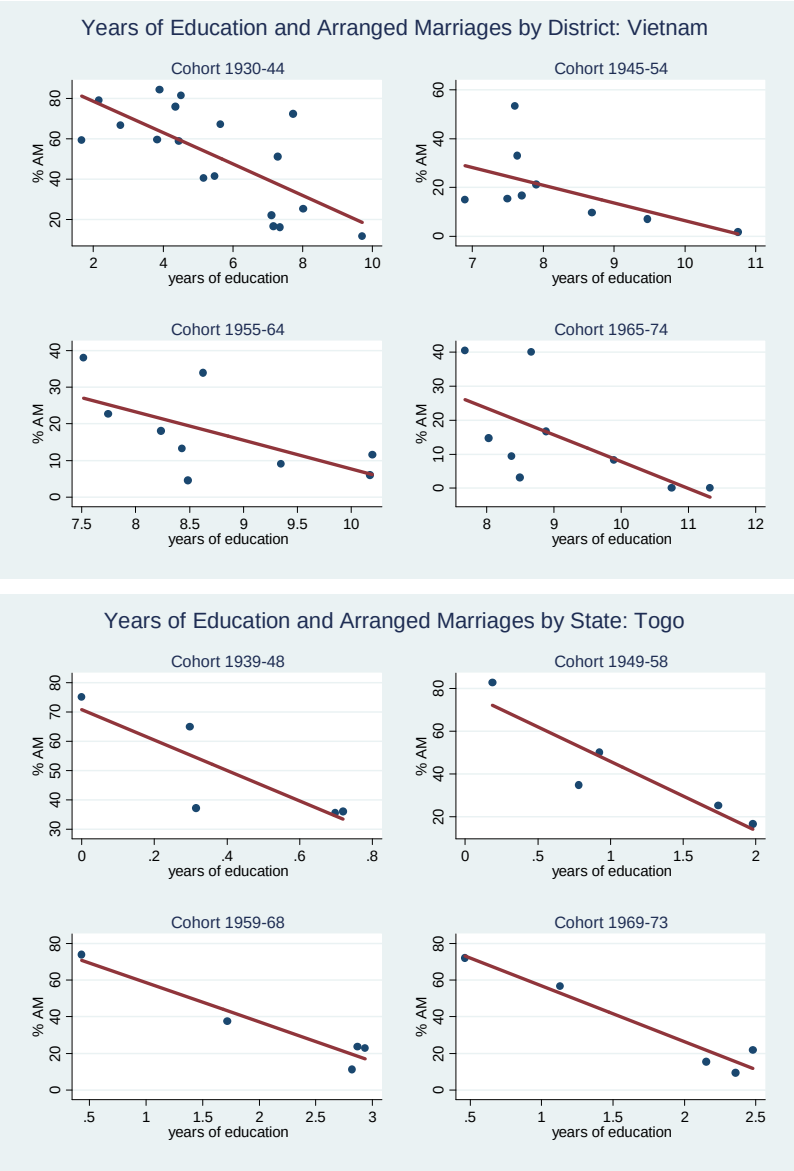
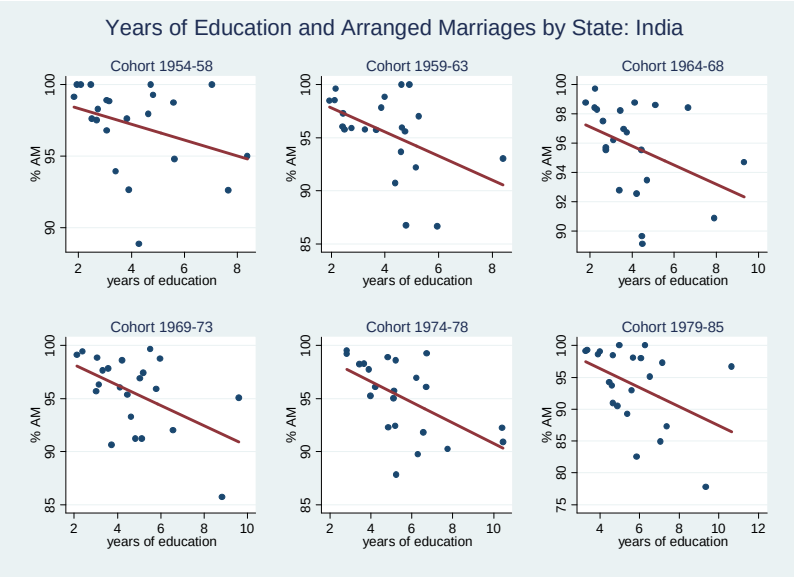
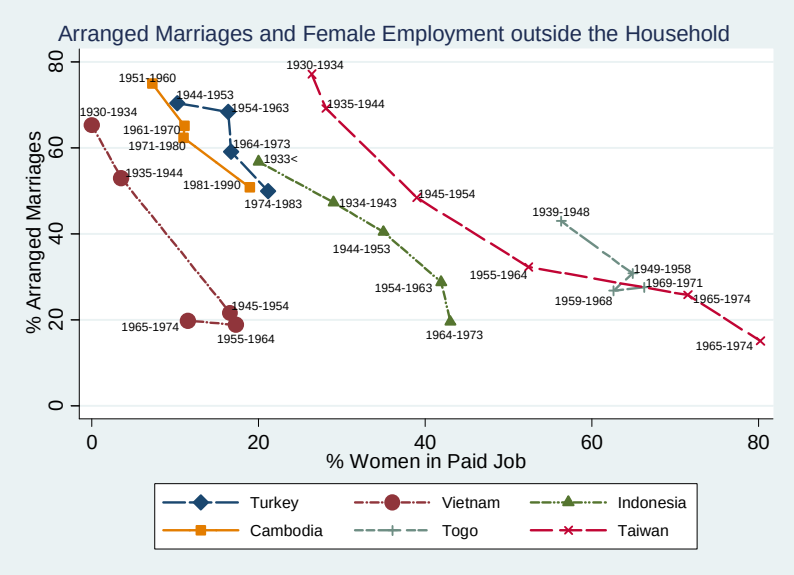


Figure 2.3: Arranged Marriages and Years of Schooling within Cohort: Geographic Variation within Country



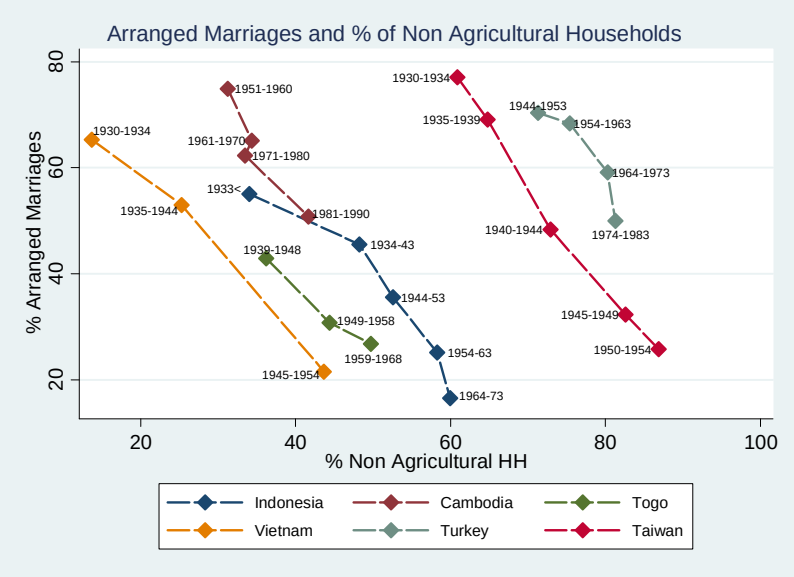
The graph for Indonesia uses data from 148 districts belonging to the provinces of Sumatera Utara, Sumatera Barat, Suamtera Selatan, Lampung, Dki Jakarta, Jawa Barat, Jawa Tengah, Di Yogyakarta, Jawa Timur, Bali, Nusa Tenggara Barat, Kalimantan Selatan and Sulawesi Selatan. For Turkey, the geographic variation comes from the provinces Adana, Adiyaman, Afyon, Agri, Amasya, Anakara, Antalya, Artvin, Aydin, Balikesir, Bilecik, Bingöl, Bitlis, Bolu, Burdur, Bursa, Çanakkale, Çankiri, Çorum, Denizli, Diyarbakir, Edirne, Elazig, Erzingan, Erzurum, Eskisekir, Gaziantep, Giresun, Gümüshane, Hakkari, Hatay, Isparta, Içel, Istanbul, Izmir, Kars, Kastamonu, Kayseri, Kirklareli, Kirsehir, Kocaeli, Konya, Kütahya, Malatya, Manisa. K. Maras, Mardin, Mugla, Mus, Nevsehir, Nigde, Ordu, Rize, Sakarya, Samsun, Siirt, Sinop, Sivas, Tekirdag, Tokat, Trabzon, Tunceli, Sanliurfa, Usak, Van, Yozgat, Zonguldak, Aksaray, Bayburt, Karaman, Kirikkale, Sirnak, Bartin, Ardahan, Igdir, Yalova, Karabük, Kilis, Osmaniye, and Düzce. For Vietnam, the variation used is across districts: Binh Luc, Hai Hau, Nam Dinh, Nam Ninh, Ninh Binh, Phu Ly, Thanh Liem, Xuan Thuy, and Yen Khang. For Togo, I used the following regions: Maritime, Des Plateaux, Centrale, De la Kara, and Des Savanes. And finally for India, I focused on differences across states: Jammu & Kashmir, Himachal Pradesh, Punjab, Uttaranchal, Haryana, Delhi, Rajasthan, Uttar Pradesh, Bihar, Assam, West Bengal, Jharkhand, Orissa, Chhatishgarh, Madhya Pradesh, Gujarat, Maharashtra, Andhra Pradesh, Karnataka, Goa, Kerala, and Tamil Nadu.

Figure 2.4: Arranged Marriages and Female Employment



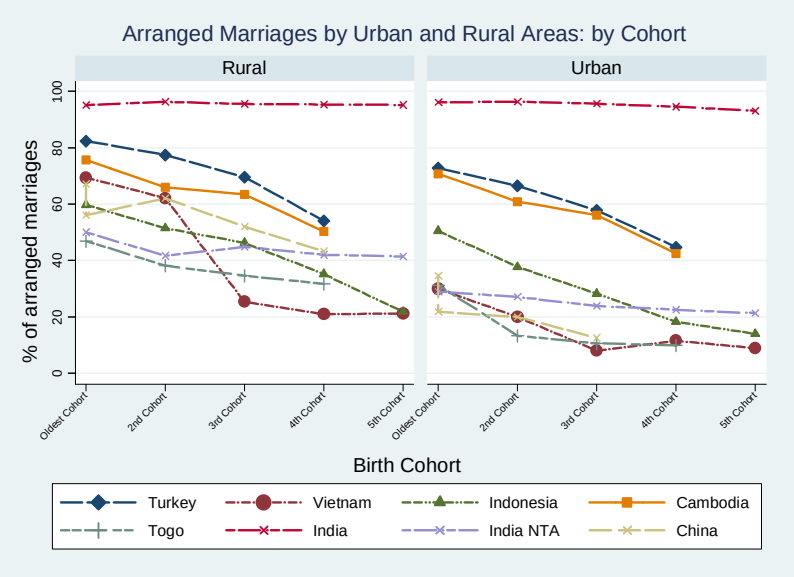
The definition of employment outside the household varies for each country depending on the information available. For Cambodia, Indonesia, and Turkey, women report three types of work status: employee, self-employed and family worker. This figure plots the percentage of employees by cohort. For Togo, there is no information on the work status of women; the variable used instead is the percentage of women "owning" their wages conditional on being in the labor force (women who can freely spend their wages). For Vietnam, the variable used corresponds to women working outside the household for non-relatives conditional on being in the labor force. For Taiwan, I use aggregate information on work status reported by cohort.

Figure 2.5: Arranged Marriages and Percentage of Non-Agricultural Households



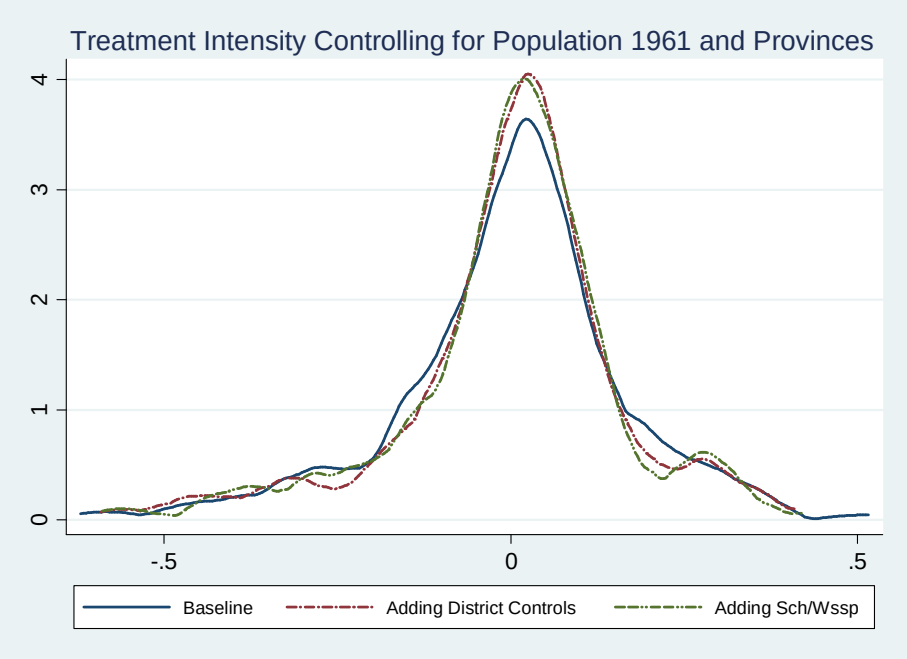
Non-agricultural refers to households whose main income source is not agriculture.

Figure 2.6: Arranged Marriages by Cohort and Residence



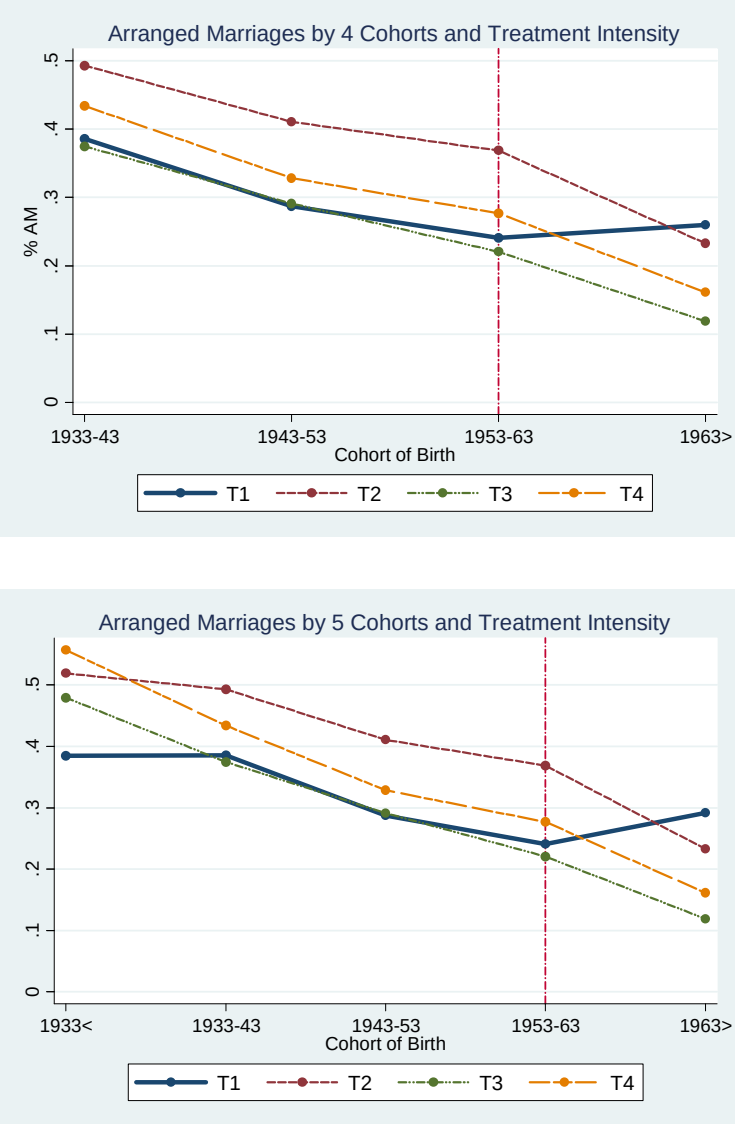
For Turkey, the cohorts are 1944-53, 1954-63, 1964-73, and 1974-83; for Vietnam, 1930-34, 1935-44, 1945-54, 1955-64 and 1965-74; for Indonesia,1933<, 1934-43, 1944-53, 1954-63 and 1964-78; for Cambodia, 1951-60, 1961-70, 1971-80 and 1981-90; for Togo, 1939-48, 1949-58, 1959-68 and 1969-73; for India, 1959-63, 1964-68, 1969-73, 1974-78 and 1979-85.

Figure 2.7: Plotting Residuals of Treatment Intensity



The baseline figure plots the density of the residuals of the treatment variable after controlling for the total population by district in 1961 and province fixed effects. It then adds controls for district characteristics of 1971. And finally, it controls for the intensity of the school construction, and the water and sanitation supply program. The density does not change as I add information at the district level suggesting that the intensity of the treatment in the early 1980s is not correlated with district characteristics in 1970s. The results are also shown in table 2.20.

Figure 2.8: Arranged Marriages by Cohort of Birth and Treatment Intensity



I divided the treatment variable into the four quartiles of the distribution of sawah land covered by any intensitifcation program. The figure plots the mean AM by cohort of birth and treatment intensity, where treatment one corresponds to the lowest treatment (the districts with the lowest percentage of sawah land covered by the GR). The figure shows that cohorts 1933-42, 1943-52 and 1953-62 follow the same trends in the four treatment intensity areas. It also shows the that identication is obtained from the last cohort by comparing areas more intensily treated against areas with low treatment intensity (after differencing out the common pre-trends).

Table 2.1: Demographics, Mean and Median Per Capita Expenditure and Income

Demographics by type of marriage						
1993	Type of Marriage		Love	Arranged	Mixed=1 Love, 1 Arranged	
	Observations		1438	410	313	
	Yrs School Husband		6.30	4.14	5.01	
	Yrs School Wife		5.12	3.48	4.16	
	1993		1997		2000	
	Love	Arranged	Love	Arranged	Love	Arranged
Age	39.60	47.00	43.43	51.27	46.40	54.04
AE size	3.94	4.22	4.02	4.23	4.02	4.24
Urban	37.9%	27.5%	38.6%	27.5%	37.9%	29.0%
Farmer	46.9%	63.3%	42.6%	55.2%	52.7%	65.5%
Business	35.0%	36.3%	37.5%	34.3%	49.3%	44.3%
Mean Monthly per capita Expenditure by type of marriage						
	1993		1997		2000	
	Love	Arranged	Love	Arranged	Love	Arranged
Food	31.3	24.5	38.9	32.1	41.0	33.0
Exp1	7.5	4.5	10.5	6.2	9.7	6.1
Exp2	4.0	2.5	4.1	3.1	4.4	4.8
Total	43.8	31.7	52.5	40.4	53.4	41.3
Median Monthly per capita Expenditure by type of marriage						
	1993		1997		2000	
	Love	Arranged	Love	Arranged	Love	Arranged
Food	23.8	18.4	30.1	23.6	31.7	27.2
Exp1	3.7	2.3	4.3	3.2	4.7	3.4
Exp2	1.9	1.3	2.4	1.7	2.3	1.7
Total	32.6	24.2	38.9	29.0	41.0	33.5
Mean Monthly per capita Income by type of marriage						
	1993		1997		2000	
	Love	Arranged	Love	Arranged	Love	Arranged
Wages + Profits	89.8	118.2	89.2	43.9	80.1	59.3
All income	170.0	186.9	109.4	49.8	85.4	64.7
Median Monthly per capita Income by type of marriage						
	1993		1997		2000	
	Love	Arranged	Love	Arranged	Love	Arranged
Wages + Profits	31.7	20.1	40.2	25.7	45.8	37.4
All income	32.9	21.1	42.0	29.2	48.6	40.3

Mean Monthly Transfers by type of marriage						
Transfers out HH	53.0	26.8	18.0	11.9	34.7	70.9
Transfers in HH	24.4	12.2	11.2	11.9	12.3	12.6
% Transfers out HH*	86%	76%	84%	76%	90%	89%
% Transfers in HH*	67%	62%	70%	75%	82%	86%
As % of Total Income Per Capita						
Transfers out HH	31.2%	14.3%	16.5%	23.9%	40.6%	109.6%
Transfers in HH	14.3%	6.5%	10.2%	23.8%	14.4%	19.5%
(Means of) Formal Insurance and Other NLI						
	1993		1997		2000	
	Love	Arranged	Love	Arranged	Love	Arranged
% Insurance**	21%	10%	18%	6%	18%	7%
% Savings ***	34%	25%	31%	22%	43%	33%
Savings Amount	1362.0	176.7	373.2	256.8	574.5	622.5
Debt	372.7	202.4	445.7	171.7	254.8	127.8
Pensions	296.0	307.4	60.8	23.6	19.7	18.3
Other NLI	180.3	173.7	34.3	27.3	18.5	15.2
As % of Household Monthly Total Income						
Savings Amount	3.97	1.93	0.68	0.41	1.26	1.28
Debt	2.75	1.68	1.48	1.10	0.64	0.51
Pensions	0.04	0.03	0.05	0.06	0.04	0.04
Other NLI	0.41	1.10	0.12	0.13	0.05	0.06
Transfers to and from parents and parents-in-law as % of Household Monthly Total Income						
To Parents	13.3%	2.0%	3.2%	2.9%	17.5%	20.7%
From Parents	4.6%	3.8%	1.5%	1.2%	0.9%	0.5%

Exp 1= utilities +personal toiletries +small household items.

Exp 2 = recreation and entertaiment +transportation +clothing +taxes.

*% of Households where the head or his wife report receiving/giving a transfer; **% of Households where at least one member reports having any type of formal insurance; ***% of Households reporting having savings.

I use the total amount of wages reported within a household (from all household members); and the total profit for agricultural and non-agricultural business reported in the household roster and in the individual questionnaire. Non-labor income includes pensions, rents from assets and other bonuses. Expenditure on non-durables includes food expenses, utilities, personal toiletries, small non-durable household items, recreation, entertainment, transportation, clothing, taxes and rent. Transfers out (in) refers to the monthly amount of transfers given (received) to (from) parents and siblings by the household head or his wife. Savings amount refers to the total self-reported amount of savings, certificate of deposit, stocks and receivables. Debt is the total outstanding debt value at the household level. Other non-labor income (not included as part of all income) includes scholarships, insurance claims, arisan, and gifts reported in the household roster and in the individual questionnaire. % Insurance refers to the percentage of households where at least one member reports having formal insurance (provided by employer or other). % Savings is the percentage of households that report having savings.

Table 2.2: Full Insurance Tests by Type of Marriage: First Differences and Fixed Effects

	Inverse hyperbolic sine transformation				**Neglog transformation**			
	First Differences		Fixed Effects		First Differences		Fixed Effects	
	Arranged	Love	Arranged	Love	Arranged	Love	Arranged	Love
Log Agg Cons	0.469***	0.342***	0.484***	0.461***	0.483***	0.357***	0.497***	0.474***
	(0.0856)	(0.0512)	(0.0731)	(0.0437)	(0.0865)	(0.0516)	(0.0739)	(0.0439)
Log Income	**-0.00298**	**0.00913****	**0.00120**	**0.00852****	**-0.00303**	**0.00977****	**0.00151**	**0.00911****
	(0.00550)	(0.00392)	(0.00547)	(0.00341)	(0.00584)	(0.00412)	(0.00581)	(0.00358)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	820	2,876	1,230	4,314	820	2,876	1,230	4,314
R-squared	0.051	0.087	0.154	0.171	0.052	0.088	0.155	0.172
Number of hhid			410	1,438			410	1,438
Joint Test (Log Agg Cons = 1) (Log Income = 0)								
F-statistic	19.49	85.04	24.93	79.48	18.08	80.02	23.26	75.12
P-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Some households report losses in profits or zero income in some components. I use two alternative transformations used in the literature instead of directly using a logarithmic transformation: (i) Inverse sine transformation $asinh(y) = log[y_i + (y_i^2 + 1)^{1/2}]$; and (ii) the neglog transformation $neglog(y) = \begin{cases} log(y+1) & if\ y \geq 0 \\ -log(1-y) & if\ y < 0 \end{cases}$. The results found under either transformation are very similar.

Additional controls are age of the household head, number of adult equivalent members, a dummy variable for residence and a dummy variable for agricultural activities. Standard errors clustered at the household level.

Table 2.3: Effect of the Green Revolution on Returns to Education

Panel A. Effect on Wages using SUSENAS and Census

	Dep. Var: ln wage					
	BIMAS/INMAS		Reduced Form		IV	IV
	(1)	(2)	(3)	(4)	(5)	(6)
Years of schooling *BIMAS/INMAS	**0.0369*** **	**0.0306*** **			**0.0671*** **	**0.0551*** **
	(0.00545)	(0.00539)			(0.0124)	(0.0132)
Years of schooling*Sawah Area			**0.0605*** **	**0.0495***		
			(0.0231)	(0.0257)		
Years of schooling*Farms per Ha			**0.0409*** **	**0.0349*** **		
			(0.00789)	(0.00838)		
Years of schooling*% Sawah Area* Farms/Ha			**-0.0572*** **	**-0.0512*** **		
			(0.0202)	(0.0227)		
Years of schooling	0.0544***	0.0596***	0.0407***	0.0497***	0.0289***	0.0379***
	(0.00418)	(0.00413)	(0.00763)	(0.00784)	(0.0104)	(0.0114)
Constant	7.918***	8.111***	8.265***	8.153***	7.954***	6.023***
	(0.0551)	(0.155)	(0.0659)	(0.275)	(0.0666)	(0.418)
District FE	yes	yes	yes	yes	yes	yes
Interaction with Islands Dummy	no	yes	no	yes	no	yes
Observations	131,793	131,793	131,793	131,793	131,793	131,793
R-squared	0.724	0.726	0.725	0.726	0.724	0.726
F-statistic of excluded instruments					25.43	16.13

Standard errors clustered at the district level

Panel A. Years of education were imputed for 1980, 1981 and 1982 using self-reported information on highest level of education completed. 1976 and 1995 report the number of years of education.

Table 2.3: Effect of the Green Revolution on Returns to Education

Panel B. Effect on Wages using IFLS

	BIMAS/INMAS		Reduced Form		IV	IV
	(1)	(2)	(3)	(4)	(5)	(6)
Years of schooling	**0.0557***	**0.0527****			**0.211****	**0.200****
***BIMAS/INMAS**	(0.0260)	(0.0238)			(0.105)	(0.101)
Years of schooling*Sawah Area			**0.0127**	**0.0570**		
			(0.0701)	(0.0639)		
Years of schooling*Farms per Ha			**0.0145**	**0.0368**		
			(0.0320)	(0.0320)		
Years of schooling*% Sawah			**-0.0110**	**-0.0437**		
Area* Farms/Ha			(0.0621)	(0.0615)		
Years of schooling	0.0806**	0.0744***	0.109***	0.0656**	-0.0575	-0.0576
	(0.0266)	(0.0205)	(0.0348)	(0.0325)	(0.0943)	(0.0917)
Constant	2.743***	3.063***	2.542***	3.622***	2.709***	1.170***
	(0.228)	(0.266)	(0.361)	(0.379)	(0.950)	(0.259)
Province FE	yes	no	yes	no	yes	no
District FE	no	yes	no	yes	no	yes
Observations	2,394	2,394	2,730	2,730	2,298	2,298
R-squared	0.371	0.428	0.414	0.476	0.352	0.415
F-statistic of excluded instruments					3.54	3.74

Standard errors clustered at the district level

Panel B. The variable on years of education was constructed using information on highest level of education and grade completed (see data section for other details on the samples). Bimas/Inmas = % of total agricultural wet paddy (rice) land under any type of Bimas/Inmas intensification in 1982/83; Sawah Area = % of agricultural land available for production of wet paddy (rice) in 1963; Farms/Ha = Total number of farms in 1963/ Total Agricultural Land (Ha) in 1963.

Table 2.4: Effect of the Green Revolution on Mean and Variance of Income

Panel A. Effect on per capita Income using SUSENAS and Census

MLE effect on log pc income mean and variance: Agricultural Households								
	Effect of BIMAS/INMAS				Reduced Form of Sawah Land and Farms/ha			
	Income	Variance	Income	Variance	Income	Variance	Income	Variance
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
% Area BIMAS/INMAS	**0.0960**	**0.0420**	**0.117**	**-0.118**				
	(0.0826)	(0.0880)	(0.106)	(0.189)				
% Sawah Area					**-0.0717**	**-0.481**	**0.301**	**-0.985**
					(0.241)	(0.451)	(0.323)	(0.646)
Number farms per Ha					**-0.328*** **	**-0.249**	**-0.224**	**-0.402**
					(0.105)	(0.177)	(0.137)	(0.253)
% Sawah Area* Farms/Ha					**0.557*** **	**0.406**	**0.313**	**0.736**
					(0.204)	(0.351)	(0.270)	(0.486)
Rural	-0.200***	-0.0137	-0.200***	-0.0147	-0.196***	-0.0133	-0.200***	-0.0138
	(0.0218)	(0.0185)	(0.0219)	(0.0198)	(0.0214)	(0.0188)	(0.0212)	(0.0196)
Constant	10.28***	0.783***	10.26***	0.918***	10.44***	1.062***	10.30***	1.286***
	(0.0631)	(0.0831)	(0.0829)	(0.181)	(0.122)	(0.233)	(0.149)	(0.348)
Province FE	yes	yes	yes	yes	yes	yes	yes	yes
Interaction with Islands Dummy	no	no	yes	yes	no	no	yes	yes
Observations	48,079	48,079	48,079	48,079	48,079	48,079	48,079	48,079

Standard errors clustered at district level

See data section for details on the samples. Bimas/Inmas = % of total agricultural wet paddy (rice) land under any type of Bimas/Inmas intensification in 1982/83; Sawah Area = % of agricultural land available for production of wet paddy (rice) in 1963; Farms/Ha = Total number of farms in 1963/ Total Agricultural Land (Ha) in 1963.

Table 2.4: Effect of the Green Revolution on Mean and Variance of Income

Panel B. Effect on per capita Income using IFLS

	Income	**Variance**	**Income**	**Variance**	**Income**	**Variance**	**Income**	**Variance**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
% Area	**1.245****	**-1.390**	**1.423*****	**-0.545**				
BIMAS/INMAS	(0.525)	(1.161)	(0.513)	(0.680)				
Age of household	-0.0128***	-0.00574	-0.0132***	-0.00438	-0.0116***	-0.000290	-0.0110***	0.00333
head	(0.00316)	(0.00850)	(0.00303)	(0.00831)	(0.00282)	(0.00893)	(0.00259)	(0.00696)
Number of household	-0.0488	0.0536	-0.0334	0.0327	-0.0468	0.0278	-0.0456	-0.0218
members	(0.0420)	(0.0596)	(0.0413)	(0.0634)	(0.0421)	(0.0763)	(0.0334)	(0.0493)
% Sawah Area					**2.534**	**-1.971**	**3.561****	**-5.862***
					(1.834)	(4.862)	(1.434)	(3.321)
Number farms per Ha					**0.573**	**-0.660**	**0.695**	**-0.927**
					(0.640)	(0.995)	(0.703)	(1.719)
% Sawah Area*					**-0.676**	**1.367**	**-1.179**	**3.318**
Farms/Ha					(1.320)	(3.045)	(1.240)	(3.341)
Constant	10.06***	3.087***	9.876***	2.345***	10.16***	2.317**	9.956***	2.961*
	(0.602)	(1.128)	(0.537)	(0.759)	(0.775)	(0.942)	(0.792)	(1.608)
Province FE	yes	yes	yes	yes	yes	yes	yes	yes
Interaction with	no	no	yes	yes	no	no	yes	yes
Islands Dummy								
Observations	2,505	2,505	2,505	2,505	2,611	2,611	2,611	2,611
Wald chi2	111.81		126.34		215.12		210.29	

Standard errors clustered at district level

See data section for details on the samples. Bimas/Inmas = % of total agricultural wet paddy (rice) land under any type of Bimas/Inmas intensification in 1982/83; Sawah Area = % of agricultural land available for production of wet paddy (rice) in 1963; Farms/Ha = Total number of farms in 1963/ Total Agricultural Land (Ha) in 1963.

Table 2.5: Effect of the Green Revolution on Arranged Marriages

Sample and Results using the introduction of BIMAS/INMAS program					
Panel A. Mean Characteristics of Sample merged with BIMAS/INMAS program					
Cohort	Obs	Arranged	Female	Education	Rural
1933<	1,185	51.5%	47.5%	2.10	64.8%
1933-1942	1,679	41.9%	54.1%	3.14	65.5%
1943-1952	1,803	32.5%	51.0%	4.85	60.9%
1953-1962	2,488	26.8%	53.3%	5.23	59.8%
1963>	1,913	16.6%	67.7%	5.97	64.1%
Total	9,068	31.8%	55.3%	4.52	62.6%

For columns 1 to 4, the omitted cohort is the cohort born 1933-43. For columns 5 to 8, the omitted cohort is the cohort born before 1933. Bimas/Inmas = % of total agricultural wet paddy (rice) land under any type of Bimas/Inmas intensification in 1982/83.

Table 2.5: Effect of the Green Revolution on Arranged Marriages

Panel B. OLS estimates

	Dep. Var: Arranged Marriage							
	OLS (1)	**OLS** (2)	**OLS** (3)	**OLS** (4)	**OLS** (5)	**OLS** (6)	**OLS** (7)	**OLS** (8)
cohort 33-42					-0.0526	-0.358***	-0.421***	-0.304***
					(0.0792)	(0.109)	(0.117)	(0.101)
cohort 43-52	-0.0414	-0.0720	-0.104	-0.0847	-0.102	-0.416***	-0.513***	-0.380***
	(0.0565)	(0.113)	(0.116)	(0.111)	(0.0637)	(0.148)	(0.160)	(0.127)
cohort 53-62	-0.189***	-0.296*	-0.343**	-0.291**	-0.242***	-0.646***	-0.753***	-0.591***
	(0.0710)	(0.150)	(0.151)	(0.146)	(0.0869)	(0.184)	(0.198)	(0.169)
cohort 63>	-0.0996	-0.178	-0.301	-0.264	-0.156	-0.532***	-0.713***	-0.570***
	(0.0844)	(0.183)	(0.183)	(0.181)	(0.102)	(0.202)	(0.219)	(0.201)
cohort 33-42*Area BIMAS/INMAS					-0.104	-0.148*	-0.113	-0.0756
					(0.0815)	(0.0861)	(0.0889)	(0.0836)
cohort 43-52*Area BIMAS/INMAS	-0.0308	-0.0246	-0.00152	0.00872	-0.121	-0.159*	-0.101	-0.0556
	(0.0679)	(0.0721)	(0.0698)	(0.0694)	(0.0810)	(0.0873)	(0.0837)	(0.0776)
cohort 53-62*Area BIMAS/INMAS	**0.0434**	**0.00189**	**0.0342**	**0.0630**	**-0.0544**	**-0.141**	**-0.0774**	**-0.0129**
	(0.0922)	(0.106)	(0.106)	(0.103)	(0.109)	(0.131)	(0.130)	(0.119)
cohort 63>* Area BIMAS/INMAS	**-0.206****	**-0.222***	**-0.152**	**-0.134**	**-0.295****	**-0.359****	**-0.259***	**-0.208**
	(0.103)	(0.130)	(0.125)	(0.122)	(0.127)	(0.152)	(0.146)	(0.137)
Female	0.148***	0.148***	0.149***	0.148***	0.151***	0.152***	0.152***	0.152***
	(0.0125)	(0.0126)	(0.0126)	(0.0126)	(0.0125)	(0.0125)	(0.0125)	(0.0125)
Constant	-0.0459	-0.304**	-0.538**	-0.0395	0.00790	-0.361**	-0.422	-0.0486
	(0.0839)	(0.127)	(0.220)	(0.163)	(0.104)	(0.155)	(0.275)	(0.190)
District FE	yes	yes	yes	yes	yes	yes	yes	yes
District Controls	no	yes	yes	yes	no	yes	yes	yes
School Const. Program	no	no	yes	yes	no	no	yes	yes
School Const. Program	no	no	no	yes	no	no	yes	yes
Observations	7,883	7,883	7,883	7,883	9,068	9,068	9,068	9,068
R-squared	0.264	0.266	0.267	0.268	0.278	0.282	0.283	0.284

Standard errors clustered at the district level

For columns 1 to 4, the omitted cohort is the cohort born 1933-43. For columns 5 to 8, the omitted cohort is the cohort born before 1933. Bimas/Inmas = % of total agricultural wet paddy (rice) land under any type of Bimas/Inmas intensification in 1982/83.

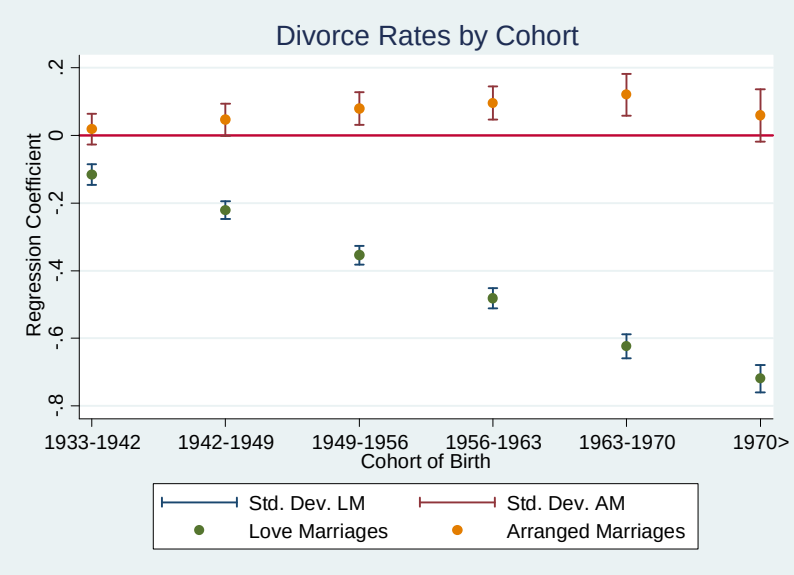
Table 2.6: Effect of the Green Revolution on Years of Education

Dep. Var: Education						
	IFLS	**IFLS**	**IFLS**	**IFLS**	**IFLS**	**IFLS**
	(1)	(2)	(3)	(4)	(5)	(6)
cohort 33-42				1.383	3.726***	1.016
				(0.880)	(1.295)	(1.047)
cohort 43-52	1.082*	1.217	0.564	2.472***	5.010***	1.566
	(0.591)	(0.910)	(0.821)	(0.905)	(1.584)	(1.102)
cohort 53-62	1.617**	3.721***	2.099***	3.005***	7.412***	3.119**
	(0.664)	(1.166)	(0.762)	(1.064)	(2.073)	(1.228)
cohort 63>	2.233***	3.493***	2.650***	3.585***	7.033***	3.602**
	(0.796)	(1.307)	(0.905)	(1.269)	(2.056)	(1.460)
cohort 33-42*Area BIMAS/INMAS				0.00956	0.169	0.143
				(0.941)	(0.734)	(0.974)
cohort 43-52*Area BIMAS/INMAS	0.940	1.490*	0.680	0.943	1.671*	0.847
	(0.749)	(0.760)	(0.700)	(1.080)	(0.895)	(1.077)
cohort 53-62*Area BIMAS/INMAS	0.691	1.271*	0.162	0.687	1.410*	0.328
	(0.731)	(0.689)	(0.757)	(1.181)	(0.849)	(1.206)
cohort 63>*Area BIMAS/INMAS	**1.465***	**1.782****	**0.937**	**1.485**	**1.916***	**1.149**
	(0.810)	(0.795)	(0.789)	(1.339)	(1.005)	(1.364)
Female	-1.749***	-1.744***	-1.747***	-1.729***	-1.731***	-1.729***
	(0.0875)	(0.0881)	(0.0871)	(0.0789)	(0.0800)	(0.0789)
Constant	8.660***	9.057***	6.815***	7.158***	8.255***	5.718***
	(0.793)	(1.017)	(1.040)	(1.273)	(1.238)	(1.588)
District of birth FE	yes	yes	yes	yes	yes	yes
District Controls	no	yes	yes	no	yes	yes
Int. w/other Programs	no	no	yes	no	no	yes
Observations	7,883	7,883	7,883	9,068	9,068	9,068
R-squared	0.255	0.257	0.257	0.287	0.291	0.289

Standard errors clustered at the district level

For columns 1 to 4, the omitted cohort is the cohort born 1933-43. For columns 5 to 8, the omitted cohort is the cohort born before 1933. Bimas/Inmas = % of total agricultural wet paddy (rice) land under any type of Bimas/Inmas intensification in 1982/83.

Figure 2.9: Divorce Trends Indonesia



The coefficients plotted come from the following regression:

$$\begin{aligned} D_{ipc} \quad &= \beta_0 + \gamma_c + \eta_p + \beta_1 AM_{ipc} + \sum_c (\gamma_c * AM_{ipc})\beta_{2,c} \\ &+ \sum_p (\eta_p * AM_{ipc})\beta_{3,p} + \beta_4 female_{ipc} + \beta_5 duration_{ipc} + \varepsilon_{ipc} \end{aligned}$$

The first graph shows $\beta_{2,c}$, the second graph plots $\beta_{3,p}$. The coefficients are reported in table 2.26.

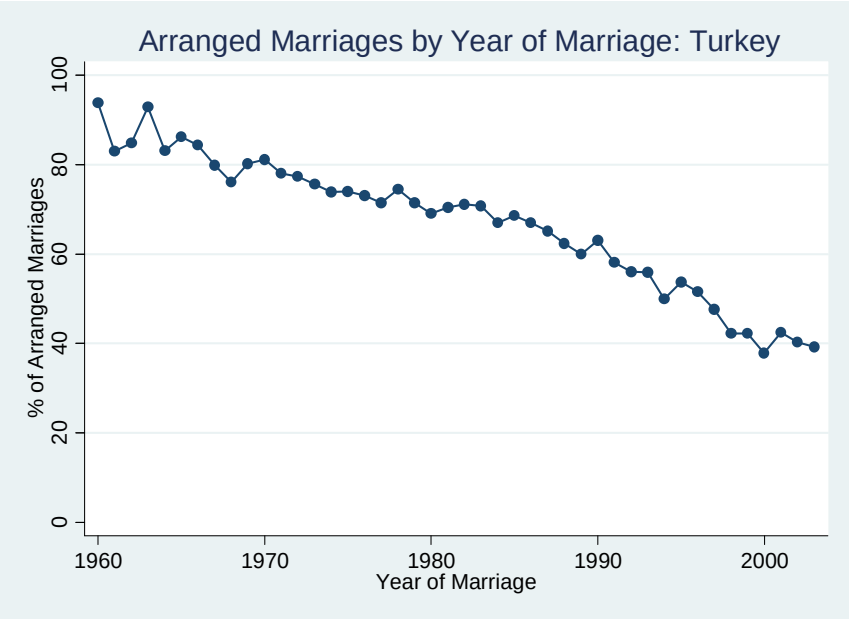
Table 2.7: Effect of the Green Revolution on the Probability of Divorce for cohorts born before 1952

Dep. Var: Divorce		
	AM	**LM**
	(1)	(2)
Cohort 33-42	0.204***	0.136
	(0.0616)	(0.220)
Cohort 43-52	0.280**	-0.0213
	(0.110)	(0.137)
Area BIMAS/INMAS*Married before 1965	**-0.250****	**0.00893**
	(0.108)	(0.233)
Cohort 33-42*Area BIMAS/INMAS*Mbf1965	**0.360*****	**0.123**
	(0.125)	(0.280)
Cohort 43-52*Area BIMAS/INMAS*Mbf1965	**0.421*****	**-0.0635**
	(0.151)	(0.224)
Married before 1965	0.513***	0.300*
	(0.0658)	(0.167)
Cohort 33-42*Married before 1965	-0.339***	-0.207
	(0.0867)	(0.226)
Cohort 43-52*Married before 1965	-0.463***	-0.0279
	(0.110)	(0.162)
Area BIMAS/INMAS	0.681***	0.251
	(0.0957)	(0.206)
Cohort 33-42*Area BIMAS/INMAS	-0.342***	-0.166
	(0.107)	(0.272)
Cohort 43-52*Area BIMAS/INMAS	-0.350**	-0.0309
	(0.149)	(0.209)
Female	0.0130	0.00252
	(0.0140)	(0.0137)
Duration	-0.0181***	-0.0206***
	(0.000630)	(0.000744)
Constant	0.195***	0.296**
	(0.0406)	(0.136)
District FE	yes	yes
Observations	1,800	2,686
R-squared	0.580	0.564

Standard errors clustered at the district level

The omitted cohort is individuals born before 1933. Bimas/Inmas = % of total agricultural wet paddy (rice) land under any type of Bimas/Inmas intensification in 1982/83. Mbf1965 and Married before 1965 refer to a dummy variable that takes the value of one if the individual was married before 1965.

Figure 2.10: Percentage of Woman having an Arranged Marriage by Year of Marriage in Turkey



Turkey is another country that has experienced a transition toward love marriages. This graphs plots the (raw) percentage of woman that have an arranged marriage by year of marriage. It shows some differences in the speed of the transition across the years. The decade of the 1960s witnessed a rapid decline (around 15-20%), which slowed down during 1970s and 1980s. The mid-1990s to the late-1990s experienced another phase of accelerated decline which seemed to have also slowed down in the 2000s.

Table 2.8: Arranged Marriages and Divorce in Turkey

Panel A. Summary Statistics				
	AM		LM	
	Mean	Std Dev	Mean	Std Dev
Age	35.92	7.82	33.31	7.70
Education	4.31	3.20	7.34	4.49
Urban	0.71	0.46	0.80	0.40
Obs	7835		5361	
	Divorce			
Cohort	Mean	Std Dev		
1954-1963	0.018	0.132		
1964-1973	0.024	0.152		
1974-1983	0.023	0.151		

Panel B. Determinants of Divorce				
	Dep. Var: Divorce			
	OLS	**OLS**	**OLS**	**OLS**
	(1)	(2)	(3)	(4)
Age	0.0106***	0.0107***		
	(0.000785)	(0.000813)		
Arranged	**0.0180*** **	**0.0179*** **	**0.00504**	**0.00531**
	(0.00308)	(0.00313)	(0.00486)	(0.00505)
Duration	-0.0107***	-0.0108***	-0.00759***	-0.00760***
	(0.000761)	(0.000785)	(0.000564)	(0.000579)
Cohort 64-73			-0.0814***	-0.0804***
			(0.00833)	(0.00863)
Cohort 74-83			-0.147***	-0.146***
			(0.0130)	(0.0135)
Cohort 64-73*Arranged			**0.0151** **	**0.0150** **
			(0.00633)	(0.00665)
Cohort 74-83*Arranged			**0.0104**	**0.0106**
			(0.00715)	(0.00739)
Constant	-0.218***	-0.228***	0.181***	0.173***
	(0.0194)	(0.0189)	(0.0145)	(0.0138)
District FE	No	Yes	No	Yes
Province FE	Yes	No	Yes	No
Observations	13,196	13,196	13,196	13,196
R-squared	0.133	0.164	0.104	0.136

Standard errors clustered at the district level

The omitted cohort is women born between 1954 and 1963. The average age at marriage in around 19 years old, thus women born in the 1964-1973 cohort married around 1983-1992 and women born in the 1974-1983 married approximately during 1993-2002.

Table 2.9: Test of Full Insurance: Robustness Checks

	First Differences					
	Alternative Expenditure		Robust Regression		Dropping 1% top/botom	
	Arranged	Love	Arranged	Love	Arranged	Love
Log Agg Cons	0.498***	0.314***	0.471***	0.347***	0.482***	0.334***
	(0.0870)	(0.0525)	(0.0753)	(0.0382)	(0.0909)	(0.0529)
Log Income	**-0.000995**	**0.00690***	**-0.00172**	**0.00918*****	**-0.00135**	**0.0259*****
	(0.00572)	(0.00403)	(0.00499)	(0.00256)	(0.00945)	(0.00605)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	820	2,876	820	2,876	790	2,776
R-squared	0.054	0.074	0.085	0.093	0.050	0.091
Joint Test (Log Agg Cons = 1) (Log Income = 0)						
F-statistic	16.67	86.57	24.95	154.30	16.28	87.71
P-value	0.00	0.00	0.00	0.00	0.00	0.00

	First Differences					
	Wages+Profits		1993-1997		1997-2000	
	Arranged	Love	Arranged	Love	Arranged	Love
Log Agg Cons	0.470***	0.341***	0.403***	0.261***	0.472***	0.367***
	(0.0855)	(0.0512)	(0.0986)	(0.0607)	(0.129)	(0.0671)
Log Income	**-0.00419**	**0.00846****	**-0.00126**	**0.0107****	**-0.00717**	**0.00754***
	(0.00484)	(0.00367)	(0.00479)	(0.00517)	(0.00950)	(0.00438)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	820	2,876	410	1,438	410	1,438
R-squared	0.051	0.087	0.070	0.085	0.036	0.090
Joint Test (Log Agg Cons = 1) (Log Income = 0)						
F-statistic	19.67	85.14	18.32	76.10	8.89	47.01
P-value	0.00	0.00	0.00	0.00	0.00	0.00

All results are for a first differences model. Column 1 adds education and medical expenditure to the consumption expenditure; column 2 uses a robust regression which gives lower weight to observations that are potential outliers; column 3 drops the bottom and top 1% of the income distribution in levels by year; column 4 uses only wages and profits as income; column 5 uses period 1993 and 1997; and finally column 6 uses period 1997 and 2000. Standard errors clustered at the household level.

Table 2.10: Test of Full Insurance: IV using lagged changes in log aggregate consumption and lagged changes in log income

First Differences: IV using lagged consumption and lagged income				
	Arranged		Love	
	OLS	IV	OLS	IV
Log Agg Cons	0.472***	0.505**	0.367***	-0.107
	(0.129)	(0.212)	(0.0671)	(0.122)
Log Income	**-0.00717**	**-0.00635**	**0.00754***	**0.00821**
	(0.00950)	(0.0172)	(0.00438)	(0.0122)
Controls	Yes	Yes	Yes	Yes
F-statistic		104.23		117.35
		9.88		16.2
Observations	410	410	1,438	1,438
R-squared	0.036	0.036	0.090	0.050

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The change in log aggregate consumption between 1997 and 2000 is instrumented using the change in log aggregate consumption between 1993 and 1997. Similarly, the change in log household income between 1997 and 2000 is instrumented using the change in log household income between 1993 and 1997. Standard errors clustered at the household level.

Table 2.10: Test of Full Insurance: IV using lagged changes in log aggregate consumption and lagged changes in log income

	First Stage: IV using lagged consumption and lagged income			
	Arranged		Love	
	Log Agg Cons 2000-1997	Log Inc 2000-1997	Log Agg Cons 2000-1997	Log Inc 2000-1997
Log Agg Cons 1997-1993	-0.458***	-0.716	-0.479***	0.495
	(0.0325)	(0.585)	(0.0314)	(0.364)
Log Income 1997-1993	-0.00276	-0.479***	0.00136	-0.429***
	(0.00209)	(0.116)	(0.00139)	(0.0765)
Controls	Yes	Yes	Yes	Yes
Observations	410	410	1,438	1,438
R-squared	0.354	0.276	0.277	0.152

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The change in log aggregate consumption between 1997 and 2000 is instrumented using the change in log aggregate consumption between 1993 and 1997. Similarly, the change in log household income between 1997 and 2000 is instrumented using the change in log household income between 1993 and 1997. Standard errors clustered at the household level.

Table 2.11: 1963 Agricultural Characteristics and 1982/83 Bimas/Inmas Program Characteristics

1963 Agricultural Characteristics by District				
Agricultural Charact.	Mean	Std. Dev.	Min	Max
% Sawah Land	36%	21%	0%	92%
# Farms	62,396	53,720	2,737	513,274
Total Agric Land (Ha)	66,259	62,278	1,858	499,280
Farms/Ha	1.09	0.53	0.13	2.85

BIMAS Program in 1982/1983 by District					
Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
% Area Bimas/Inmas	204	70%	32%	0%	100%
% Total Irrigated Land	205	24%	20%	0%	85%
% with Irrigation System	205	16%	17%	0%	83%
% Rainfed and other irrigation	205	8%	8%	0%	51%
% HH using Fert 1982/1983	204	77%	29%	1%	100%
Avg use of urea (kg)	198	134.4	93.8	0.0	333.4
Avg use of tsp (kg)	198	52.1	39.9	0.0	157.5
Avg use of kcl (kg)	198	5.0	5.7	0.0	31.9
% Land with VUTW I Seeds	204	12%	12%	0%	100%
% Land with VUTW II Seeds	204	53%	30%	0%	95%
% Land with VUB Seeds	204	9%	10%	0%	72%
% Land with VUN Seeds	204	1%	2%	0%	20%
% Land with Local Seeds	204	26%	31%	0%	100%

Table 2.12: Correlation of Intensity of Bimas/Inmas Program and Agricultural Inputs in 1982/83

Area Bimas/Inmas and Agricultural Inputs in 1982/1983				
	% Land with Irrigation System	Avg use of urea (kg)	% HH using Fertilizer 1982/1983	% Land with VUTW II Seeds
	(1)	(2)	(3)	(4)
% Area Bimas/Inmas	0.334***	257.2***	0.885***	0.718***
	(0.0289)	(10.23)	(0.0163)	(0.0429)
Constant	-0.0721***	-47.80***	0.152***	0.0195
	(0.0223)	(7.983)	(0.0126)	(0.0331)
Observations	203	196	203	203
R-squared	0.400	0.765	0.936	0.582

Standard errors in parentheses

Table 2.13: Effect of Agricultural Inputs on Wet Paddy Yields

Dep. Var.: Yield of Sawah Paddy					
	(1)	(2)	(3)	(4)	(5)
% Area Bimas/Inmas	1.924***	1.333***	-0.0490	-0.117	
	(0.119)	(0.139)	(0.192)	(0.226)	
% Land with Irrigation System		1.766***	0.656**	0.653**	0.656**
		(0.263)	(0.255)	(0.259)	(0.258)
Avg use of urea (kg)			0.00679***	0.00679***	0.00652***
			(0.000747)	(0.000786)	(0.000592)
% Land with VUTW II Seeds				0.00278	0.00947
				(0.213)	(0.213)
% Land with Local Seeds				-0.0882	-0.0430
				(0.198)	(0.178)
Constant	1.990***	2.117***	2.371***	2.442***	2.379***
	(0.0918)	(0.0853)	(0.0788)	(0.186)	(0.141)
Observations	202	202	195	195	195
R-squared	0.567	0.647	0.751	0.751	0.751

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 2.14: Reduced Form effect of 1963 Agricultural Characteristics on Inputs

Agricultural Inputs in 1980s					
	% Land with Irrigation System	Avg use of urea (kg)	% HH using Fertilizer 1982/1983	% Land with VUTW II Seeds	% Land with Local Seeds
	(1)	(2)	(3)	(4)	(5)
% Sawah Land	-0.00726	101.5	0.666***	0.885***	-0.842***
	(0.116)	(68.90)	(0.216)	(0.241)	(0.261)
Farms/Ha	-0.0377	84.72***	0.407***	0.303***	-0.379***
	(0.0410)	(24.43)	(0.0766)	(0.0852)	(0.0922)
% Sawah	0.378***	11.52	-0.370*	-0.457**	0.604***
Land*Farms/Ha	(0.102)	(60.61)	(0.191)	(0.213)	(0.230)
Constant	0.0348	-1.000	0.256***	0.0965	0.690***
	(0.0378)	(22.93)	(0.0706)	(0.0785)	(0.0850)
Observations	183	177	183	183	183
R-squared	0.486	0.425	0.405	0.257	0.189

Standard errors in parentheses

Table 2.15: Reduced Form effect of 1963 Agricultural Characteristics on Intensity of Bimas/Inmas and Output

Intensity of Bimas/Inmas and Output 1980s		
	% Area Bimas/Inmas	Yield of Sawah Paddy
	(1)	(2)
% Sawah Land	0.696***	1.355**
	(0.237)	(0.588)
Farms/Ha	0.423***	0.972***
	(0.0839)	(0.208)
% Sawah Land*Farms/Ha	-0.347*	-0.415
	(0.209)	(0.520)
Constant	0.145*	1.967***
	(0.0773)	(0.192)
Observations	183	183
R-squared	0.409	0.451

Standard errors in parentheses

Table 2.16: Sample Statistics of Wages

Wages Statistics and Demographic Characteristics by Sample

Panel A. Wages in PPP Dollars by Year

Year	Median	Mean	Std. Dev.	Max	Min	Obs	Source
1976	50.09	84.22	143.04	7,141	7.16	12,824	Census
1980	62.56	302.40	2178.10	42,618	0.22	25,089	Susenas
1981	76.08	124.53	168.26	13,368	0.95	19,805	Susenas
1982	87.60	120.58	122.81	4,043	3.37	30,571	Susenas
1995	83.06	104.63	107.77	6,592	6.59	43,504	Census
Total	77.5	147.0	960.5	42,618	0.2	131,793	

Panel B. Mean Characteristics of the Sample by Year

Year	Age	Female	Urban	Education
1976	34.41	30.8%	27.2%	2.86
1980	34.93	29.1%	27.6%	2.70
1981	34.65	28.8%	28.0%	3.01
1982	35.75	34.4%	29.6%	2.82
1995	34.60	28.5%	28.6%	4.04
Total	34.92	30.2%	28.4%	3.23

Panel C. Wages in PPP Dollars and Mean Characteristics of the Sample 1993 IFLS

	Median	Mean	Std. Dev.	Max	Min	Obs
BIMAS/INMAS	67.0	262.7	2769.4	79317.8	0.4	2,730
Area Sawah	58.2	228.5	2589.8	79317.8	0.4	2,394
			Mean			
	Age	**Female**	**Urban**	**Education**		
BIMAS/INMAS	39.5	32.1%	37.7%	5.70		
Area Sawah	39.3	31.0%	44.2%	6.04		

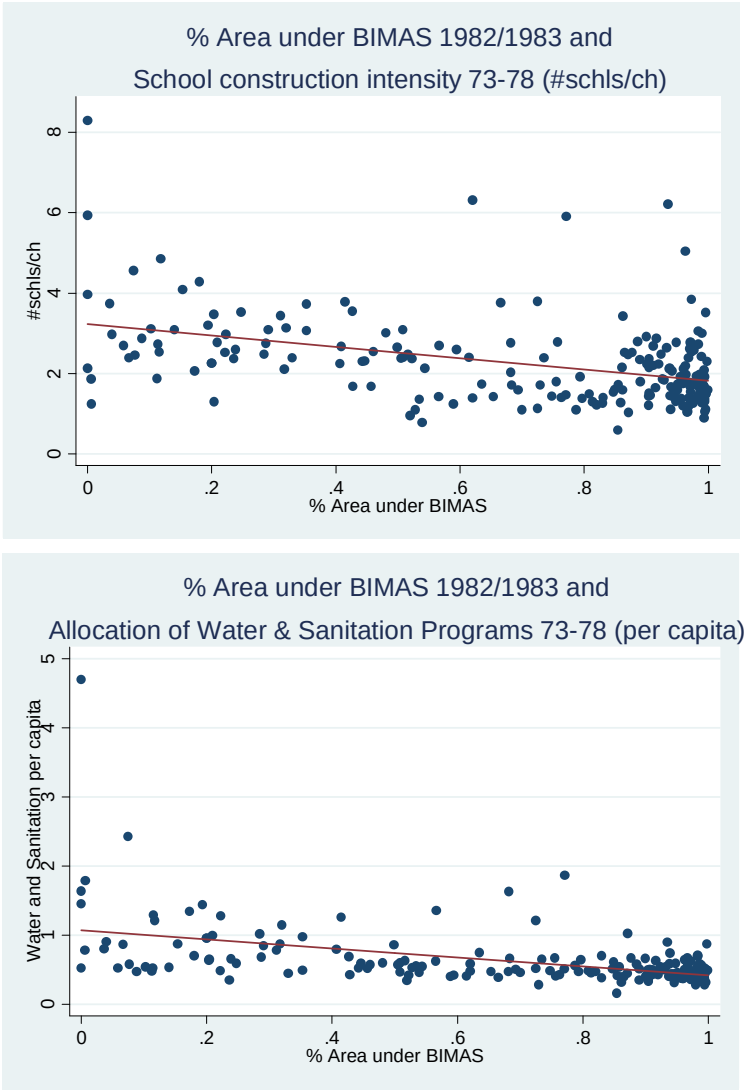
BIMAS/INMAS refers to the sample of IFLS merged with the districts with information on intensity of Bimas/Inmas in 1982/83. Area Sawah refers to the sample of IFLS merged with the districts with information on 1963 agricultural characteristics.

Table 2.17: Sample Statistics of per capita Income

Per Capita Income Statistics by Sample in PPP Dollars					
Panel A. Per Capita Income in PPP Dollars by Year (SUSENAS)					
Year	**Median**	**Mean**	**Std. Dev.**	**Obs**	**% Agric HH**
1981	18.64	12.66	85.69	15,112	67.7%
1982	14.36	9.99	57.62	10,399	64.5%
1984	15.52	11.47	23.70	32,778	59.9%
1987	17.01	12.32	31.75	19,049	60.5%
Total	16.34	11.74	48.68	77,338	62.2%
Agricultural Households					
Year	**Median**	**Mean**	**Std. Dev.**	**Obs**	
1981	16.13	11.57	30.43	10,227	
1982	11.04	7.93	24.47	6,704	
1984	12.33	9.97	14.28	19,619	
1987	12.70	10.49	10.91	11,529	
Total	13.05	10.19	19.88	48,079	
Non-agricultural households					
Year	**Median**	**Mean**	**Std. Dev.**	**Obs**	
1981	23.88	15.31	144.01	4,885	
1982	20.40	14.62	90.57	3,695	
1984	20.27	14.43	32.52	13,159	
1987	23.63	16.76	47.95	7,520	
Total	21.75	15.22	74.61	29,259	
Panel B. Per Capita Income in PPP Dollars 1993 (IFLS)					
	Median	**Mean**	**Std. Dev.**	**Obs**	
BIMAS/INMAS	30.61	41.73	51.82	4,817	
Area Sawah	32.31	46.70	57.57	5,371	

BIMAS/INMAS refers to the sample of IFLS merged with the districts with information on intensity of Bimas/Inmas in 1982/83. Area Sawah refers to the sample of IFLS merged with the districts with information on 1963 agricultural characteristics.

Figure 2.11: Intensity of Bimas/Inmas Program and School Construction Program and Allocation of Water and Sanitation



% Area under Bimas/Inmas refers to percentage of agricultural wet paddy (rice) land under any type of intensification in 1982/83. School construction intensity 73-78 and allocation of water & sanitation programs 73-78 were collected and used by Duflo (2001). The former refers to the total number of INPRES schools planned to be constructed between 1973 and 1978 for 1000 children.

Table 2.18: Effect of the Green Revolution on Returns to Education (controlling for other programs)

Panel A. Effect on Wages using SUSENAS and Census

	Dep. Var: ln wage					
	BIMAS/INMAS		**Reduced Form**		**IV**	**IV**
	(1)	(2)	(3)	(4)	(5)	(6)
Years of schooling*BIMAS/INMAS	**0.0293*** **	**0.0228*** **			**0.0664*** **	**0.0484*** **
	(0.00698)	(0.00695)			(0.0157)	(0.0150)
Years of schooling*Sawah Area			**0.0614** **	**0.0487***		
			(0.0240)	(0.0266)		
Years of schooling*Farms per Ha			**0.0376*** **	**0.0316*** **		
			(0.00791)	(0.00831)		
Years of schooling*% Sawah			**-0.0588*** **	**-0.0519** **		
Area* Farms/Ha			(0.0205)	(0.0230)		
Years of schooling	0.0671***	0.0723***	0.0487***	0.0588***	0.0309**	0.0454***
	(0.00734)	(0.00737)	(0.00942)	(0.00914)	(0.0140)	(0.0136)
Female	-0.575***	0.0228***				-0.00240
	(0.0131)	(0.00695)				(0.00234)
District FE	yes	yes	yes	yes	yes	yes
Interaction with Islands Dummy	no	yes	no	yes	no	yes
Observations	131,793	131,793	131,793	131,793	131,793	131,793
R-squared	0.725	0.726	0.725	0.726	0.724	0.726
F-statistic of excluded instruments					16.23	11.42

Standard errors clustered at the district level

Panel A. Years of education were imputed for 1980, 1981 and 1982 using self-reported information on highest level of education completed. 1976 and 1995 report the number of years of education.

Table 2.18: Effect of the Green Revolution on Returns to Education (controlling for other programs)

Panel B. Effect on Wages using IFLS

	BIMAS/INMAS		**Reduced Form**		**IV**	**IV**
	(1)	(2)	(3)	(4)	(5)	(6)
Years of schooling*BIMAS/INMAS	**0.0631****	**0.0576****			0.183	0.167
	(0.0282)	(0.0286)			(0.159)	(0.147)
Years of schooling*Sawah Area			**0.0582**	**0.0855**		
			(0.0787)	(0.0728)		
Years of schooling*Farms per Ha			**0.0340**	**0.0716****		
			(0.0332)	(0.0300)		
Years of schooling*% Sawah Area* Farms/Ha			**-0.0543**	**-0.0881**		
			(0.0620)	(0.0585)		
Years of schooling	0.0945***	0.0739*	0.105**	0.0208	-0.0160	-0.0389
	(0.0351)	(0.0379)	(0.0512)	(0.0428)	(0.147)	(0.144)
Province FE	yes	no	yes	no	yes	no
District FE	no	yes	no	yes	no	yes
Observations	2,394	2,394	2,442	2,442	2,298	2,298
R-squared	0.376	0.430	0.370	0.439	0.360	0.420
F-statistic of excluded instruments					2.34	2.31

Standard errors clustered at the district level

Panel B. The variable on years of education were constructed using information on highest level of education and grade completed (see data section for other details in the samples).

Table 2.19: Effect of the Green Revolution on Mean and Variance of Income (controlling for other programs)

Panel A. Effect on per capita Income using SUSENAS and Census

MLE effect on log pc income mean and variance: Agricultural Households								
	Effect of BIMAS/INMAS				Reduced Form of Sawah Land and Farms/ha			
	Income	Variance	Income	Variance	Income	Variance	Income	Variance
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
% Area BIMAS/INMAS	**0.0934**	**0.0466**	**0.107**	**-0.105**				
	(0.0851)	(0.0857)	(0.103)	(0.180)				
% Sawah Area					**-0.0670**	**-0.493**	**0.308**	**-0.988**
					(0.242)	(0.446)	(0.325)	(0.644)
Number farms per Ha					**-0.324*** **	**-0.252**	**-0.217**	**-0.403**
					(0.104)	(0.174)	(0.137)	(0.252)
% Sawah Area*					**0.547*** **	**0.413**	**0.300**	**0.737**
Farms/Ha					(0.201)	(0.345)	(0.268)	(0.483)
Rural	-0.202***	-0.0188	-0.202***	-0.0188	-0.197***	-0.0160	-0.201***	-0.0140
	(0.0225)	(0.0192)	(0.0226)	(0.0203)	(0.0219)	(0.0196)	(0.0218)	(0.0203)
Constant	10.27***	0.765***	10.25***	0.891***	10.44***	1.045***	10.30***	1.262***
	(0.0821)	(0.0863)	(0.0884)	(0.175)	(0.130)	(0.230)	(0.158)	(0.346)
Province FE	yes	yes	yes	yes	yes	yes	yes	yes
Interaction with Islands D	no	no	yes	yes	no	no	yes	yes
Observations	48,079	48,079	48,079	48,079	48,079	48,079	48,079	48,079

Standard errors clustered at district level

See data section for details on the samples. Bimas/Inmas = % of total agricultural wet paddy (rice) land under any type of Bimas/Inmas intensification in 1982/83; Sawah Area = % of agricultural land available for production of wet paddy (rice) in 1963; Farms/Ha = Total number of farms in 1963/ Total Agricultural Land (Ha) in 1963.

Table 2.19: Effect of the Green Revolution on Mean and Variance of Income (controlling for other programs)

Panel B. Effect on per capita Income using IFLS

	Income (1)	**Variance** (2)	**Income** (3)	**Variance** (4)	**Income** (5)	**Variance** (6)	**Income** (7)	**Variance** (8)
% Area BIMAS/INMAS	**0.988****	**-1.380**	**1.330****	**-0.777**				
	(0.487)	(1.825)	(0.573)	(1.357)				
Age of household head	-0.0134***	0.00850	-0.0132***	0.00772	-0.0129***	0.0108*	-0.0106***	0.00543
	(0.00301)	(0.00775)	(0.00290)	(0.00712)	(0.00273)	(0.00643)	(0.00278)	(0.00794)
Number of household members	-0.0542	-0.0674	-0.0505	-0.0726	-0.0485	-0.0855*	-0.0446	-0.0637
	(0.0396)	(0.0506)	(0.0382)	(0.0481)	(0.0320)	(0.0498)	(0.0329)	(0.0639)
% Sawah Area					**1.123**	**0.381**	**3.270****	**-4.717**
					(1.171)	(2.166)	(1.663)	(3.512)
Number farms per Ha					**-0.132**	**0.456**	**0.430**	**0.0108**
					(0.497)	(0.675)	(0.813)	(1.815)
% Sawah Area* Farms/Ha					**0.646**	**-0.778**	**-0.713**	**1.874**
					(0.840)	(1.488)	(1.483)	(3.585)
Constant	10.63***	0.476	10.46***	0.0563	10.89***	-1.726	9.871***	2.014
	(0.724)	(2.482)	(0.774)	(1.674)	(0.645)	(1.502)	(0.828)	(1.744)
Province FE	yes	yes	yes	yes	yes	yes	yes	yes
Interaction with Islands D	no	no	yes	yes	no	no	yes	yes
Observations	2,505	2,505	2,505	2,505	2,598	2,598	2,598	2,598
Wald chi2	163.33		167.38		430.7		251.95	

Standard errors clustered at district level

See data section for details on the samples. Bimas/Inmas = % of total agricultural wet paddy (rice) land under any type of Bimas/Inmas intensification in 1982/83; Sawah Area = % of agricultural land available for production of wet paddy (rice) in 1963; Farms/Ha = Total number of farms in 1963/ Total Agricultural Land (Ha) in 1963.

Table 2.20: Correlation between District Characteristics in 1971 and Treatment Intensity in 1982

District Characteristics from 1971 and Treatment Intensity

	Area Bimas/Inmas			**Alternative Treatment Variable**		
	(1)	(2)	(3)	(4)	(5)	(6)
Total Population 1961	1.76e-07**	1.73e-07**	1.18e-07	1.17e-07	9.54e-08	4.32e-08
	(7.30e-08)	(7.52e-08)	(7.70e-08)	(7.22e-08)	(7.36e-08)	(7.56e-08)
% Male Population in Labor		0.139	0.208		-0.0801	-0.0125
Force		(0.159)	(0.159)		(0.155)	(0.156)
% Female Population in		-0.0244	-0.0142		0.00720	0.0187
Labor Force		(0.0985)	(0.0970)		(0.0964)	(0.0952)
% Male Population in Salary		-0.0311	-0.0631		0.154	0.127
Employment		(0.141)	(0.139)		(0.138)	(0.136)
% Female Population in		0.0258	0.0521		0.0703	0.0977
Salary Employment		(0.125)	(0.123)		(0.122)	(0.121)
% Population born in		0.492	0.464		-0.290	-0.327
different Province		(0.376)	(0.370)		(0.368)	(0.363)
% Population living in		-0.240	-0.204		0.122	0.168
Urban Area		(0.243)	(0.241)		(0.238)	(0.236)
School Construction			-0.0196			-0.00813
Program Intensity			(0.0201)			(0.0197)
W&S Supply Intensity			-0.159*			-0.178*
			(0.0930)			(0.0913)
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Test of Joint Significance		**0.79**	**1.35**		**1.27**	**1.66**
P-value		**0.5816**	**0.2252**		**0.275**	**0.1126**
Observations	170	170	170	170	170	170
Adjusted R-squared	**0.651**	**0.645**	**0.657**	**0.449**	**0.453**	**0.468**

Standard errors clustered at the district level

Bimas/Inmas refers to the % of total agricultural wet paddy (rice) land under any type of Bimas/Inmas intensification in 1982/83. Alternative Treatment Variable refers to the % of total agricultural land under any type of Bimas/Inmas intensification in 1982/83. The district level characteristics come from the 1971 census.

Table 2.21: Means by Cohort and Treatment Intensity (4 quartiles of treatment distribution): Placebo Tests and Experiment of Interest

PANEL A. Placebo Tests					
			Differences		
Treatment	*Cohort 33-42*	*Cohort 43-52*	T2 - T1	T3 - T1	T4 - T1
1	0.39	0.29	-0.099	-0.099	-0.099
2	0.49	0.41	-0.082		
3	0.37	0.29		-0.083	
4	0.43	0.33			-0.106
Difference-in-Difference			***0.016***	***0.015***	***-0.007***
Treatment	*Cohort 33-42*	*Cohort 53-62*	T2 - T1	T3 - T1	T4 - T1
1	0.39	0.24	-0.145	-0.145	-0.145
2	0.49	0.37	-0.124		
3	0.37	0.22		-0.154	
4	0.43	0.28			-0.157
Difference-in-Difference			***0.020***	***-0.009***	***-0.012***
PANEL B. Experiment of Interest			**Differences**		
Treatment	*Cohort 33-42*	*Cohort 1963>*	T2 - T1	T3 - T1	T4 - T1
1	0.39	0.29	-0.094	-0.094	-0.094
2	0.49	0.23	-0.260		
3	0.37	0.12		-0.256	
4	0.43	0.16			-0.273
Difference-in-Difference			***-0.166***	***-0.162***	***-0.178***

Table 2.22: Effect of the Green Revolution on AM instrumenting with Agricultural Characteristics of 1963

Dep. Var: Arranged Marriage						
	IV	**IV**	**IV**	**IV**	**IV**	**IV**
	(1)	(2)	(3)	(4)	(5)	(6)
cohort 33-42				0.0618	-0.0156	0.0511
				(0.126)	(0.155)	(0.155)
cohort 43-52	-0.0840	-0.209	-0.223	-0.0270	-0.214	-0.152
	(0.127)	(0.169)	(0.171)	(0.132)	(0.147)	(0.128)
cohort 53-62	-0.0930	-0.270	-0.281	-0.0223	-0.289	-0.234
	(0.179)	(0.230)	(0.229)	(0.190)	(0.216)	(0.181)
cohort 63>	0.0228	-0.392	-0.402	0.102	-0.383*	-0.320
	(0.190)	(0.247)	(0.249)	(0.194)	(0.225)	(0.203)
cohort 33-42*Area BIMAS/INMAS				-0.246*	-0.200	-0.174
				(0.137)	(0.148)	(0.159)
cohort 43-52*Area BIMAS/INMAS	0.0253	0.121	0.184	-0.213	-0.0886	-0.0138
	(0.163)	(0.181)	(0.196)	(0.166)	(0.152)	(0.146)
cohort 53-62*Area BIMAS/INMAS	**-0.0750**	**0.0594**	**0.158**	**-0.325**	**-0.139**	**-0.0143**
	(0.223)	(0.246)	(0.270)	(0.240)	(0.231)	(0.226)
cohort 63>*Area BIMAS/INMAS	**-0.358**	**-0.0523**	**0.0246**	**-0.614****	**-0.275**	**-0.186**
	(0.240)	(0.271)	(0.289)	(0.246)	(0.247)	(0.248)
Female	0.148***	0.148***	0.148***	0.151***	0.152***	0.152***
	(0.0123)	(0.0123)	(0.0123)	(0.0124)	(0.0124)	(0.0124)
Constant	-0.274	-34.09***	0.417	-0.332**	-48.71***	0.0256
	(0.175)	(5.719)	(0.271)	(0.159)	(10.97)	(0.172)
District FE	Yes	Yes	Yes	Yes	Yes	Yes
Int. w/nin	No	Yes	Yes	No	Yes	Yes
Int. w/wssp	No	No	Yes	No	No	Yes
Observations	7883	7883	7883	9068	9068	9068
R-squared	0.263	0.265	0.266	0.278	0.280	0.281
F-statistics of excluded instruments						
cohort 33-42*Area BIMAS/INMAS				215.22	165.82	153.01
cohort 43-52*Area BIMAS/INMAS	282.99	231.65	215.2	251.78	207.14	193.04
cohort 53-62*Area BIMAS/INMAS	290.62	249.39	230.5	251.68	216.39	199.87
cohort 63>*Area BIMAS/INMAS	270.57	227.02	211.76	233.85	195.54	182.29

Standard errors clustered at the district level

For columns 1 to 4, the omitted cohort is the cohort born 1933-43. For columns 5 to 8, the omitted cohort is the cohort born before 1933. Bimas/Inmas = % of total agricultural wet paddy (rice) land under any type of Bimas/Inmas intensification in 1982/83. Excluded instruments used in columns 3 and 4: Sawah Area = % of agricultural land available for production of wet paddy (rice) in 1963; Farms/Ha = Total number of farms in 1963/ Total Agricultural Land (Ha) in 1963.

Table 2.23: Effect of the Green Revolution on AM using splines

Dep. Var: Arranged Marriage				
	Treatment = Area Bimas/Inmas			
	(1)	(2)	(3)	(4)
cohort 33-42			-0.0594	-0.293***
			(0.0573)	(0.110)
cohort 43-52	-0.0704	-0.0758	-0.132***	-0.358***
	(0.0505)	(0.115)	(0.0403)	(0.125)
cohort 53-62	-0.223**	-0.309*	-0.278***	-0.599***
	(0.0869)	(0.173)	(0.0679)	(0.180)
cohort 63>	-0.155*	-0.252	-0.207**	-0.541***
	(0.0817)	(0.189)	(0.0919)	(0.189)
cohort 33-42*Treatment 2			-0.0366	-0.0632
			(0.0788)	(0.0693)
cohort 33-42*Treatment 3			-0.0906	-0.0973
			(0.0623)	(0.0680)
cohort 33-42*Treatment 4			-0.105*	-0.0983
			(0.0601)	(0.0605)
cohort 43-52*Treatment 2	-0.00422	0.0157	-0.0377	-0.0467
	(0.0581)	(0.0700)	(0.0580)	(0.0645)
cohort 43-52*Treatment 3	0.0189	0.0533	-0.0675	-0.0396
	(0.0541)	(0.0708)	(0.0492)	(0.0647)
cohort 43-52*Treatment 4	-0.0118	0.0193	-0.108*	-0.0729
	(0.0557)	(0.0646)	(0.0559)	(0.0600)
cohort 53-62*Treatment 2	0.0722	0.0709	0.0358	0.00685
	(0.0859)	(0.103)	(0.0835)	(0.100)
cohort 53-62*Treatment 3	0.0836	0.0792	-0.00641	-0.0202
	(0.0903)	(0.109)	(0.0755)	(0.0961)
cohort 53-62*Treatment 4	0.0658	0.0748	-0.0371	-0.0250
	(0.0932)	(0.110)	(0.0819)	(0.101)
cohort 63>*Treatment 2	**-0.115**	**-0.106**	**-0.156**	**-0.179***
	(0.0843)	(0.0999)	(0.0988)	(0.104)
cohort 63>*Treatment 3	**-0.106**	**-0.0740**	**-0.196***	**-0.178**
	(0.0837)	(0.106)	(0.0996)	(0.110)
cohort 63>*Treatment 4	**-0.146**	**-0.0952**	**-0.245****	**-0.197***
	(0.0899)	(0.108)	(0.105)	(0.113)
District FE	yes	yes	yes	yes
District Controls	no	yes	no	yes
School Const. Program	no	yes	no	yes
Water & Sanitation Supply	no	yes	no	yes
Observations	7,883	7,883	9,068	9,068
R-squared	0.264	0.268	0.278	0.285

Standard errors clustered at the district level

For columns 1 to 4, the omitted cohort is the cohort born 1933-43. Bimas/Inmas = % of total agricultural wet paddy (rice) land under any type of Bimas/Inmas intensification in 1982/83.

Table 2.23: Effect of the Green Revolution on AM using splines

Dep. Var: Arranged Marriage				
	Treatment = Alternative Measure			
	(5)	(6)	(7)	(8)
cohort 33-42			-0.0671	-0.283**
			(0.0711)	(0.134)
cohort 43-52	-0.0289	-0.0450	-0.0988	-0.315**
	(0.0436)	(0.119)	(0.0645)	(0.157)
cohort 53-62	-0.153***	-0.261*	-0.214***	-0.535***
	(0.0581)	(0.156)	(0.0795)	(0.188)
cohort 63>	-0.130**	-0.209	-0.191*	-0.489**
	(0.0591)	(0.203)	(0.0983)	(0.235)
cohort 33-42*Treatment 2			-0.0681	-0.0365
			(0.0795)	(0.0794)
cohort 33-42*Treatment 3			-0.0823	-0.0545
			(0.0698)	(0.0733)
cohort 33-42*Treatment 4			-0.0779	-0.0500
			(0.0759)	(0.0758)
cohort 43-52*Treatment 2	-0.0802	-0.0793	-0.142*	-0.114
	(0.0513)	(0.0553)	(0.0740)	(0.0715)
cohort 43-52*Treatment 3	-0.0107	-0.000131	-0.0862	-0.0510
	(0.0466)	(0.0555)	(0.0658)	(0.0753)
cohort 43-52*Treatment 4	-0.0157	-0.00164	-0.0850	-0.0462
	(0.0534)	(0.0576)	(0.0790)	(0.0818)
cohort 53-62*Treatment 2	-0.0254	-0.0250	-0.0947	-0.0672
	(0.0687)	(0.0815)	(0.0931)	(0.0904)
cohort 53-62*Treatment 3	0.0197	0.0228	-0.0641	-0.0363
	(0.0600)	(0.0833)	(0.0811)	(0.0893)
cohort 53-62*Treatment 4	0.0131	0.0178	-0.0654	-0.0359
	(0.0699)	(0.0863)	(0.0987)	(0.0984)
cohort 63>*Treatment 2	**-0.158****	**-0.163****	**-0.222****	**-0.204***
	(0.0703)	(0.0817)	(0.104)	(0.106)
cohort 63>*Treatment 3	**-0.152****	**-0.114**	**-0.234****	**-0.175**
	(0.0622)	(0.0847)	(0.102)	(0.114)
cohort 63>*Treatment 4	**-0.145****	**-0.101**	**-0.218***	**-0.155**
	(0.0722)	(0.0868)	(0.115)	(0.120)
District FE	yes	yes	yes	yes
District Controls	no	yes	no	yes
School Const. Program	no	yes	no	yes
Water & Sanitation Supply	no	yes	no	yes
Observations	7,883	7,883	9,068	9,068
R-squared	0.264	0.268	0.278	0.285

Standard errors clustered at the district level

For columns 5 to 8, the omitted cohort is the cohort born before 1933. Alternative treatment measure refers to the % of total agricultural land covered by any type of intensification.

Table 2.24: Effect of the Green Revolution on AM allowing for non-linear (quadratic) effects

Dep. Var: Arranged Marriage				
	Treatment = Area Bimas/Inmas			
	(1)	(2)	(3)	(4)
cohort 33-42*Treatment			0.0125	-0.161
			(0.442)	(0.388)
cohort 43-52*Treatment	0.214	0.241	0.213	0.0693
	(0.353)	(0.388)	(0.384)	(0.376)
cohort 53-62*Treatment	**0.682***	**0.634**	**0.672**	**0.460**
	(0.388)	(0.444)	(0.502)	(0.486)
cohort 63>*Treatment	**-0.0848**	**-0.243**	**-0.150**	**-0.473**
	(0.470)	(0.520)	(0.552)	(0.526)
cohort 33-42*Treatment^2			-0.0947	0.0665
			(0.377)	(0.333)
cohort 43-52*Treatment^2	-0.191	-0.182	-0.267	-0.0991
	(0.291)	(0.308)	(0.338)	(0.302)
cohort 53-62*Treatment^2	**-0.510***	**-0.451**	**-0.583**	**-0.375**
	(0.308)	(0.329)	(0.429)	(0.388)
cohort 63>*Treatment^2	**-0.0850**	**0.0982**	**-0.108**	**0.220**
	(0.391)	(0.405)	(0.459)	(0.405)
District FE	yes	yes	yes	yes
District Controls	no	yes	no	yes
School Const. Program	no	yes	no	yes
Water & Sanitation Supply	no	yes	no	yes
Observations	7,883	7,883	9,068	9,068
R-squared	0.265	0.268	0.279	0.285
Total Effect 33-42			-0.121	-0.0673
			(0.121)	(0.112)
Total Effect 43-52	-0.0549	-0.0461	-0.163	-0.0703
	(0.0887)	(0.0913)	(0.122)	(0.0968)
Total Effect 53-62	-0.0363	-0.0608	-0.150	-0.0691
	(0.108)	(0.113)	(0.158)	(0.144)
Total Effect 63>	**-0.205**	**-0.188**	**-0.302***	**-0.163**
	(0.135)	(0.145)	(0.166)	(0.146)

Standard errors clustered at the district level

For columns 1 to 4, the omitted cohort is the cohort born 1933-43. For columns 5 to 8, the omitted cohort is the cohort born before 1933. Bimas/Inmas = % of total agricultural wet paddy (rice) land under any type of Bimas/Inmas intensification in 1982/83. The alternative treatment measure refers to the % of total agricultural land covered by any type of intensification. The total effect is calculated at the mean of the treatment variable.

Table 2.24: Effect of the Green Revolution on AM allowing for non-linear (quadratic) effects

Dep. Var: Arranged Marriage				
	Treatment = Alternative Measure			
	(5)	(6)	(7)	(8)
cohort 33-42*Treatment			-0.00541	0.0336
			(0.290)	(0.292)
cohort 43-52*Treatment	-0.0375	0.0350	-0.0289	0.0809
	(0.235)	(0.233)	(0.318)	(0.254)
cohort 53-62*Treatment	**-0.0301**	**-0.0323**	**-0.0304**	**0.00707**
	(0.367)	(0.349)	(0.461)	(0.392)
cohort 63>*Treatment	**-0.771****	**-0.587**	**-0.771**	**-0.548**
	(0.376)	(0.364)	(0.504)	(0.446)
cohort 33-42*Treatment^2			-0.0936	-0.133
			(0.377)	(0.341)
cohort 43-52*Treatment^2	0.215	0.140	0.115	0.00277
	(0.270)	(0.278)	(0.381)	(0.297)
cohort 53-62*Treatment^2	**0.195**	**0.179**	**0.0890**	**0.0371**
	(0.375)	(0.378)	(0.495)	(0.412)
cohort 63>*Treatment^2	**0.985****	**0.827****	**0.883**	**0.684**
	(0.402)	(0.394)	(0.574)	(0.485)
District FE	yes	yes	yes	yes
District Controls	no	yes	no	yes
School Const. Program	no	yes	no	yes
Water & Sanitation Supply	no	yes	no	yes
Observations	7,883	7,883	9,068	9,068
R-squared	0.265	0.268	0.278	0.285
Total Effect 33-42			-0.0625	-0.0475
			(0.105)	(0.121)
Total Effect 43-52	0.0939	0.121	0.0413	0.0826
	(0.0943)	(0.0936)	(0.129)	(0.115)
Total Effect 53-62	0.0886	0.0769	0.0239	0.0297
	(0.153)	(0.139)	(0.193)	(0.168)
Total Effect 63>	**-0.171**	**-0.0827**	**-0.233**	**-0.131**
	(0.156)	(0.150)	(0.199)	(0.183)

Standard errors clustered at the district level

For columns 1 to 4, the omitted cohort is the cohort born 1933-43. For columns 5 to 8, the omitted cohort is the cohort born before 1933. Bimas/Inmas = % of total agricultural wet paddy (rice) land under any type of Bimas/Inmas intensification in 1982/83. The alternative treatment measure refers to the % of total agricultural land covered by any type of intensification. The total effect is calculated at the mean of the treatment variable.

Table 2.25: Effect of the Green Revolution on Education using Census 1995

Dep. Var: Education				
	OLS	**OLS**	**IV**	**IV**
	(1)	(2)	(3)	(4)
cohort 43-52	1.220***	1.734***	1.165***	1.663***
	(0.141)	(0.167)	(0.248)	(0.315)
cohort 53-62	2.346***	2.593***	2.168***	2.292***
	(0.161)	(0.229)	(0.314)	(0.448)
cohort 63>	3.746***	3.593***	3.166***	2.663***
	(0.210)	(0.258)	(0.445)	(0.665)
cohort 43-52*Area BIMAS/INMA	0.540***	0.350**	0.609*	0.422
	(0.158)	(0.155)	(0.349)	(0.358)
cohort 53-62*Area BIMAS/INMA	0.431**	0.331*	0.671	0.668
	(0.195)	(0.200)	(0.461)	(0.502)
cohort 63>*Area BIMAS/INMAS	**0.877*** **	**0.921*** **	**1.743*** **	**2.028*** **
	(0.260)	(0.261)	(0.657)	(0.743)
Female	-1.374***	-1.375***	-1.374***	-1.374***
	(0.0335)	(0.0335)	(0.0334)	(0.0335)
Constant	4.787***	5.144***	21.02***	12.28***
	(0.160)	(0.196)	(1.617)	(0.534)
District of birth FE	yes	yes	yes	yes
Int. w/other programs	no	yes	no	yes
Observations	327,404	327,404	327,404	327,404
R-squared	0.218	0.219	0.218	0.218
F-statistics of excluded instrument				
cohort 43-52*Area BIMAS/INMA			9606.39	8389.43
cohort 53-62*Area BIMAS/INMA			10037.12	8697.52
cohort 63>*Area BIMAS/INMAS			9987.86	8527.24

Standard errors clustered at the district level

For columns 1 to 4, the omitted cohort is the cohort born 1933-43. Bimas/Inmas = % of total agricultural wet paddy (rice) land under any type of Bimas/Inmas intensification in 1982/83. Excluded instruments used in columns 3, 4, 8 and 9: Sawah Area = % of agricultural land available for production of wet paddy (rice) in 1963; Farms/Ha = Total number of farms in 1963/ Total Agricultural Land (Ha) in 1963.

Table 2.25: Effect of the Green Revolution on Education using Census 1995

Dep. Var: Education				
	OLS	**OLS**	**IV**	**IV**
	(6)	(7)	(8)	(9)
cohort 33-42	1.255***	1.759***	1.353***	1.799***
	(0.152)	(0.224)	(0.315)	(0.438)
cohort 43-52	2.478***	3.552***	2.524***	3.508***
	(0.187)	(0.308)	(0.397)	(0.558)
cohort 53-62	3.605***	4.477***	3.546***	4.334***
	(0.189)	(0.307)	(0.419)	(0.636)
cohort 63>	5.010***	5.428***	4.753***	4.788***
	(0.217)	(0.314)	(0.468)	(0.726)
cohort 33-42*Area BIMAS/INMA	0.350*	0.0914	0.327	0.0323
	(0.178)	(0.193)	(0.483)	(0.508)
cohort 43-52*Area BIMAS/INMA	0.884***	0.407	0.982	0.448
	(0.235)	(0.256)	(0.654)	(0.673)
cohort 53-62*Area BIMAS/INMA	0.768***	0.374	1.005	0.541
	(0.248)	(0.262)	(0.705)	(0.758)
cohort 63>*Area BIMAS/INMAS	**1.209*** **	**0.963*** **	**1.874** **	**1.823** **
	(0.283)	(0.290)	(0.788)	(0.872)
Female	-1.419***	-1.419***	-1.419***	-1.419***
	(0.0316)	(0.0317)	(0.0317)	(0.0318)
Constant	3.351***	3.877***	3.788***	3.711***
	(0.140)	(0.266)	(0.355)	(0.360)
District of birth FE	yes	yes	yes	yes
Int. w/other programs	no	yes	no	yes
Observations	360,683	360,683	360,683	360,683
R-squared	0.284	0.284	0.284	0.284
F-statistics of excluded instrument				
cohort 33-42*Area BIMAS/INMA			7423.58	6576.85
cohort 43-52*Area BIMAS/INMA			7919.82	6925.27
cohort 53-62*Area BIMAS/INMA			8265.09	7171.96
cohort 63>*Area BIMAS/INMAS			8165.28	6961.17

Standard errors clustered at the district level

For columns 5 to 8, the omitted cohort is the cohort born before 1933. Bimas/Inmas = % of total agricultural wet paddy (rice) land under any type of Bimas/Inmas intensification in 1982/83. Excluded instruments used in columns 3, 4, 8 and 9: Sawah Area = % of agricultural land available for production of wet paddy (rice) in 1963; Farms/Ha = Total number of farms in 1963/ Total Agricultural Land (Ha) in 1963.

Table 2.26: Divorce Rates by Cohort Indonesia

Dep. Var: Divorce			
	OLS	**OLS**	**OLS**
	(1)	(2)	(3)
Female	0.0643***	0.0649***	0.0658***
	(0.00536)	(0.00534)	(0.00533)
Duration	-0.0191***	-0.0192***	-0.0191***
	(0.000503)	(0.000505)	(0.000503)
Cohort 33-42	-0.116***	-0.116***	-0.119***
	(0.0157)	(0.0157)	(0.0159)
Cohort 42-48	-0.221***	-0.221***	-0.223***
	(0.0134)	(0.0134)	(0.0134)
Cohort 49-55	-0.354***	-0.355***	-0.351***
	(0.0142)	(0.0141)	(0.0139)
Cohort 56-62	-0.482***	-0.483***	-0.478***
	(0.0153)	(0.0153)	(0.0153)
Cohort 63-69	-0.624***	-0.625***	-0.626***
	(0.0178)	(0.0177)	(0.0181)
Cohort 70>	-0.719***	-0.722***	-0.734***
	(0.0204)	(0.0206)	(0.0212)
Arranged	-0.0371	0.0425**	0.0458**
	(0.0300)	(0.0177)	(0.0179)
Cohort 33-42*Arranged	0.0179	0.0141	0.0112
	(0.0231)	(0.0231)	(0.0233)
Cohort 42-48*Arranged	0.0463*	0.0419*	0.0378
	(0.0242)	(0.0245)	(0.0242)
Cohort 49-55*Arranged	0.0797***	0.0732***	0.0711***
	(0.0243)	(0.0240)	(0.0244)
Cohort 56-62*Arranged	0.0956***	0.0864***	0.0856***
	(0.0245)	(0.0247)	(0.0247)
Cohort 63-69*Arranged	0.120***	0.116***	0.107***
	(0.0312)	(0.0334)	(0.0327)
Cohort 70>*Arranged	0.0589	0.0529	0.0508
	(0.0390)	(0.0393)	(0.0400)
Constant	0.735***	0.725***	0.706***
	(0.0203)	(0.0219)	(0.0186)
District FE	No	No	Yes
Province FE	Yes	Yes	No
Interaction Prov FE*Arr	Yes	No	No
Observations	12,206	12,206	12,206
R-squared	0.395	0.391	0.413

Standard errors clustered at the district level

The first column presents the results of $D_{ipc} = = \beta_0 + \gamma_c + \eta_p + \beta_1 AM_{ipc} + \sum_c (\gamma_c * AM_{ipc})\beta_{2,c} + \sum_p (\eta_p * AM_{ipc})\beta_{3,p} + \beta_4 female_{ipc} + \beta_5 duration_{ipc} + \varepsilon_{ipc}$. The second column does not interact the province fixed effects with the dummy variable for arranged marriages. And the third column uses district fixed effects instead of province fixed effects.

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Chapter 3

Peer Feedback and Teaching Performance: A Randomized Controlled Trial

3.1 Introduction

Recently, there has been a significant effort within the academic literature to understand what types of interventions improve teaching practices, yet very little is known in the context of higher education, and even less with respect to teaching assistants, who play an increasingly important role in instruction in large American universities.[1] In part, this is explained by the fact that most of the quantitative studies on the subject have focused on performance-based incentives at the elementary and secondary school levels, in which teachers are rewarded according to their students' results in terms of standardized tests or grade improvement (Umansky, 2005). The studies that have explored interventions to improve teaching practices at the higher education level, primarily from the education literature, have done so from a qualitative perspective. These are, of course, informative but can not establish causality

[1] Although there has been limited attention given to teaching assistants in the literature, they do appear to have an effect on students' performance (Hanushek and 2007, Koedel and Betts 2007, Borjas 2000, Watts and Lynch, 1989).

between a given program or intervention and teaching outcomes, and can not be used to rank different alternatives in terms of their effectiveness (or cost-effectiveness). As Caroll (1980) points out, interventions such as training sessions, the assessment of teacher performance by an education expert or a school administrator, peer observation by colleagues, and to a much lesser extent, self-reviews from the individuals themselves, have been analyzed within this strand of the academic literature.

One particularly attractive alternative that has not been fully explored quantitatively is *peer observation*, defined by Bell and Mladenovic (2008) as a "collaborative and developmental activity in which professionals offer mutual support by observing each other teach; explaining and discussing what was observed; sharing ideas about teaching...". Peer observation provides competent asessment from colleagues who perform the same activity (and thus possess comparable academic qualifications), and who are familiar with the context in which the teaching is taking place. Peer observation ideally builds a sense of collegiality between peers, and can improve teaching abilities not only through feedback but through reciprocal observation and learning. On the downside, peer observation may be percieved as intrusive or unconfortable by participants, and could be influenced by the subjective opinion of the observer. This intervention is more likely to be a positive and useful experience when the feeback is non-judgemental and constructive.

Previous qualitative studies have investigated the effect of peer observation on the behavior and performance of university's teaching assistants (TA), and suggest that it is both useful and valuable (Sparks, 1986 and Bell and Mladenovic 2008). Nonetheless, to the best of our knowledge, no quantitative studies have attempted to understand the effect of peer feedback in the performance of teaching assistants. This study represents a first step to overcome this shortcoming of the existing literature. Using a randomized controlled trial

(RCT), it aims to establish a causal relationship between trained peer feedback and teaching performance of TAs, and between trained peer feedback and student performance or grade (deviation from course mean). We randomly assigned all the TAs in the Department of Economics of a large public university to either a control group, which was left untouched for the quarter, or a treatment group, which participated in trained peer feedback and receieved a cash reward as compensation. We refer to our intervention as trained peer feedback, because at the beginning of the intervention, the TAs in the treatment group participated in an interactive workshop in which they learned how to impart feedback in a constructive and positive manner.

The intervention targeted 55 available TAs in the Economics Department of a large public university during the Fall Quarter of 2012 (ten weeks long). Of these TAs, 32 were assigned into the treatment group and 23 into the control group. Only 25 of those assigned to the treatment group agreed to participate in the intervention, which translates into a take up rate of 78%.[2] The treatment consisted of two elements: first, at the beginning of the intervention, the TAs participated in a two hour workshop that covered the most important teaching skills and gave guidance on how to provide constructive criticism to others. Second, all the TAs in the treatment group were observed while teaching and received detailed written feedback from other TAs in the treatment group; over the course of the quarter, all TAs belonging to the treatment group were evaluated on two occasions by two fellow TAs, and, in turn, twice provided feedback to two fellow TAs. Both the observation and the feedback activities were performed using predetermined formats provided by the research group in order to standardize the type of feedback given and to guide the dimensions over which the TAs were

[2] For this reason we estimate both intent to treatment effects (ITT) and effects of treatment on the treated (ToT).

evaluated. To promote participation and justify the hours of extra work, the TAs in the treatment group were compensated with a cash reward of a $100.

The analysis of the effect of the RCT on the TAs' teaching skills was performed using data from the students' evaluation for the Fall 2012 and Winter 2013 quarters. The results for the Fall Quarter suggest that the intervention had a positive but non-significant effect on the student evaluations for that quarter. Since the TAs had little time to incorporate the peer feedback into their teaching before the student evaluations took place, this result was not unexpected. We find no evidence of an effect on the students' performance during that same quarter, proxied by deviation of the section mean grade from that of the course mean (most courses, particularly the introductory and lower level courses, have multiple sections and multiple TAs). As mentioned before, it might be possible that the TAs did not fully adjust their teaching during that same quarter, and thus those students did not receive the full benefit from the intervention. An alternative explanation is a relatively low weight of TA in the students' performance production function.[3]

Nonethless, the intervention had a significant effect of substantial magnitude on the students' teaching evaluations of the Winter Quarter. We find an increase of at least one half of a standard deviation in the TAs' performance both for the intent to treat (ITT) and treatment groups (ToT). Interestingly, the intervention had a positive effect over many dimensions of what is considered good teaching: concern about the students' learning, organization of the class, interaction with students (making them feel welcome), and communication skills.

[3] As future research, we propose to analyze if there was any effect of the intervention on the students' grades of the Winter Quarter, to better understand the role of TAs in students' performance; the data has not been released to us at the time of writing.

Regarding the design of the intervention: the post-intervention qualitative survey suggests that while the TAs were aware that they were being observed, and generally felt the program was valuable. They mentioned that the contents of the feedback itself were more a reinforcement of the positive aspects of their teaching and a reminder of problems they already knew they had to work on, instead of specific actions they could take to improve their teaching. The qualitative input also suggests that TAs learned not only through feedback they received, but also by observing their peers teach. In future studies, we should be more emphatic of the importance of having specific suggestions as part of the feeback given to TAs and we should try to distinguish between the effect of feedback and that of learning through observation, in order to understand better the mechanisms through which the intervention is operating.

The rest of the paper is organized as follows. Section 3.2 provides a brief literature review regarding the importance of teaching quality in higher education, and interventions aimed at enhancing teaching quality, with a focus on papers that have addressed the topic of peer observation. The details of the sample and the experimental design are presented in Section 3.3, while the descriptive statistics and the results of the effects of the intervention on teaching skills and students' performance are included in Section 3.4. Section 3.5 contains some complementary analyses on the qualitative survey that the treated TAs answered after the the intervention. Section 3.6 concludes.

3.2 Literature Review

The literature on the economics of education has based its analysis on a simple production model in which different inputs interact –school resources, teacher quality, family attributes,

among others– to determine student achievement (Hanushek, 2007). Extensive research has been conducted on the effect of each input on student outcomes – e.g. grades, labor market wages, choice of major – with special interest on those inputs that can be affected by public policies, such as institutional aspects of the school system, differing school resource funding models and the teachers' payscale (Hanushek, 2003).

Most of the research on the effect of teacher quality on students' performance has focused on primary and secondary education. However, recent studies have started investigating the effect of professors' quality on students' achievements at the college level (Ehrenberg and Ziang, 2005; Bettinger and Long, 2011; Hoffman and Oreopolus, 2006; Carrell and West, 2008), finding sizable effects on different outputs such as likelihood of dropping a class, number of same-subject courses taken in second and third year, and overall GPA.

While the impact of professors' quality has become a subject of great interest, researchers have paid little attention to the impact of graduate Teaching Assistants (TAs) despite their widespread use in the American higher education system (Park, 2004). Tuckman (1975) is one of the first studies to explore the impact of TAs on students' outcomes. He is concerned, however, with a different question. The main aim of his study is to compare the performance of TAs as instructors to the performance of more experienced faculty, finding that TAs are as effective as experienced faculty. Watts and Lynch (1989) consider several factors affecting students' achievement; among those factors, they stress the effect of non-native English speaker TAs. Their findings suggest a negative impact on the output of students.

However, their results contrast with Norris (1991) who finds that non-native English-speaker TAs outperformed natives after controlling for "teaching experience". Finally, Borjas (2000) conducts a similar study in which he analyzes the impact of non-native English-speaker

TAs on students' grades. He finds that lack of English-language proficiency among foreign-born TAs adversely affects students' understanding of the material, resulting in a lower grade for the course. Nonetheless, he also finds that the results go away for better prepared foreign-born TAs. The results of these papers suggest two key things. First, TAs' "quality" seems to matter for students' performance in a given course. Second, increased effort, better preparation, or increased teaching skills seem to be as important as other characteristics of the TAs; better teaching skills or higher effort compensate for a lower proficiency in English.

Once the importance of teaching quality was established, the literature on the economics of education became greatly interested in understanding how teaching and/or teachers' quality can be improved. There are a wide range of studies that try to understand the effects of monetary and non-monetary incentives. The studies on monetary incentives have found that the effects are concentrated in those areas at which the incentives were targeted, but these effects appear to be short-termed, and non-existent in related but untargeted areas of knowledge (Umansky, 2005, Glewwe et al. 2010). Similarly, this type of incentive can lead teachers either to "teach to the test" or, even more disturbing, to cheat (Levitt and Jacob, 2003).

As mentioned above, the education literature has explored, primarly from a qualitative perspective, the effectiveness of alternative types of incentives and interventions to improve teaching practices, such as training sessions, the assessment of teacher performance by an education expert or a school administrator, peer observation by colleagues in the same discipline, and to a much lesser extent, self-reviews from the individuals themselves (Carroll, 1980). Peer observation seems to be an appealing alternative, as pointed out by Bell and Mladenovic (2008), given that the feedback provided by peers is competent and relevant, and because the assesment is coming from someone who is familiar not only with the context of

the teaching (in terms of the institution, and the expectation of the students) but also with the content of the material.

Supporters of this option emphasize the fact that it is based on constructive feedback and monitoring among colleagues that results in improvements in teaching practices and the enhancement of teaching confidence (Bell, 2005), development of collegiality and an increased respect for colleagues (Quinlan and Akerlind, 2000), and integration of tutors into the department (Allen, 2002). The common methodology of these studies is to engage small/medium (30 people) groups of instructors or lecturers in peer review exercises (of short duration, one or two observations) and assess the success of the intervention based on qualitative surveys (or interviews) of the participants. These surveys usually inquire about how satisfied are they with the peer feedback exercise and how helpful they think it was.

Despite the overall positive appraisal of peer feedback, some studies have found negative aspects to it. It may be considered intrusive and uncomfortable by the teachers who are being observed and it has a subjective component that is sometimes difficult to assess (David and Macayan, 2010). Similarly, as pointed out by Bell (2005), it maybe challenging to engage in critical reflection and providing and accepting feedback. Finally, the participants sometimes believe that the peer evaluation may not reflect their true ability, particularly when it is used as an input for institutional decisions, such as promotions (Allen 2002).

In this context, this study contributes to the existing literature in several ways. This paper provides new insight into the effect of peer observation interventions by conducting (to the best of our knowledge) the first quantitative assement that can establish a causal link between intervention and outcome. Secondly, this paper contributes to the understanding of the impact and importance of teaching assistants by reporting (to the best of our knowledge) on

the first randomized control trial that focuses on teaching assistant instructional performance.

3.3 Experimental Design

The intervention took place during the Fall Quarter of 2012 in the Economics Department of a large public university. The class enrollment requirements allowed for a total of 55 TAs to be eligible for the intervention.[4] Every graduate student with a Teaching Assistant Fellowship is responsible for teaching two discussion sessions of a given course per week throughout the academic quarter (the only exception being the three TAs of the core graduate courses, all of which were included in the control group since the beginning, they only teach one section per quarter). The eligible TAs were randomly selected into one of two groups: the control or the treatment group, and those in the treatment group could decline to participate in the intervention. This section provides specific details of the experimental design and the recruitment process of the intervention.

3.3.1 Experimental Design

Most peer review programs are designed in such a way that within a school or department, teachers and/or professors evaluate each other. Along those lines, the TAs assigned to the treatment group acted both as observers and observed subjects. Within the treatment group, each TA was observed and evaluated by two other TAs of the same group while teaching discussion section, twice during the quarter. The evaluation took place around week four and

[4] It must be noted that there were a total of 57 TAs in the Department, but for two of them, the format of the discussion section was significantly different than the rest, so they were discarded from the beginning.

week six of the ten week quarter, but this varied according to the dates in which midterms took place (most discussion sections immediately following the midterm are cancelled or simply review the exam answers) and to individual TA availability. The observation date was only announced to the observer but not to the observed TA, in an attempt to prevent any special preparation; however, TAs could have more or less inferred the timing based on their own observation dates.

All observations/assessments followed a detailed format (shown in Figure 3.1) that emphasizes the factors related to teaching effectiveness that are under the TAs control. Observers were instructed not to interfere with the discussion session in any way and to submit written feedback to the project managers within the next couple of days. The feedback format was similar to the observation format but it included suggestions of specific actions in each of the fields related to teaching efficiency that the TA could adopt to improve their discussion sections (see Figure 3.2). This way, the feedback provided to the TA was meant to have a constructive and useful tone, instead of being mere criticisms. Note that because all the observers belong to the treatment group, the intervention also involved attending the TA sections of two different TAs. In that sense, they could have learned or noticed a teaching practice that could have been useful to them in their own teaching. This to underline that feedback was not the only component of the treatment - members of the treatment group were also exposed to teaching practices of their peers, an experience which may also have had an impact on their teaching.

One of our initial concerns was that most graduate students have no training or previous knowledge in assessing teaching performance, which might reduce the efficacy of the feedback. In order to mitigate this problem, we approached the Office of Instructional Development, who provided assistance to design and implement a training workshop before the

observations took place. The workshop took place at the beginning of the intervention and was conducted by an education professional who is an expert in evaluating teaching skills. It is important to note that both the contents of the training and of the observation and feedback formats were closely related to the basic components of good teaching skills according to the framework developed by Marsh (1983) and traditionally cited in the education literature. According to this framework, there are some factors commonly related to teacher effectiveness: i) organization/clarity, ii) group interaction, iii) instructor enthusiasm, iv) learning/value, v) breadth of coverage, vi) examinations/grading, vii) assignments/readings, and viii) workload/difficulty. In the context of this study, only those factors i) through v) are relevant, since the rest are not under the TA's influence.

After each observation round, the project manager emailed the two anonymous feedback formats to each TA, who had to acknowledge their receipt. Even thought there is no way to ensure that all TAs read the feedback formats, the qualitative surveys suggests that they indeed read it shortly after the observation took place. Another intital concern was the cash compensation may not be enough incentive to provide thoughtful and careful feedback. Therefore, to promote better quality and more useful feedback each treated TA was assigned two different observers who would observe simultaneously and provide feedback on the same sessions - this increases the likelihood that a TA would receive useful feedback from at least one person, as well as providing some peer pressure for the observing TAs to attend and take the process seriosuly. This is an essential component of the experimental design to mitigate low-quality feedback as a major issue for the intervention. As stated before, the TAs in the treatment group received a cash reward of $100 as compensation for approximately 5 hours of work throughout the quarter (an effective rate slightly lower than the $25 hourly rate TAs generally receive for teaching).

3.3.2 Recruitment Process

With the help of the Department's Graduate Advisor, we contacted all the TAs that were assigned to the treatment group via email and let them know they had been selected to participate in a "teaching training program", for which they would be compensated if they agreed to participate. Of the initial 32 TAs assigned to the treatment group, only 25 agreed to participate in the program, which translates into a take up rate of 78%. The TAs who agreed to participate attended a two hour workshop in which we explained the activities expected from them and the compensation scheme: they would receive a $100 cash compensation at the end of the quarter if they agreed to: i) observe and provide feedback to two fellow TAs twice during the quarter, using the formats previously described, and, ii) be observed and receive feedback from two fellow TAs twice throughout the quarter. We emphasized that even though this project was supported by the Department, there was no penalty for not participating and no additional reward for doing so. After the explanation, an experienced professional on teaching evaluation gave a participative workshop on the key elements of good teaching and on how to provide constructive criticism to peers.

The last section of the workshop emphasized how to provide constructive feedback: both negative and positive aspects should be brought up and any criticism should be accompanied with a suggestion on how to improve. After the workshop, all the attendees signed a consent form in which they agreed to be a part of the program and in which it was clear that failing any of requirements of the program would result in receiving no compensation at all.

3.4 Descriptive Statistics and Results

This section provides some descriptive statistics of the sample of TAs that were eligible for the intervention, as well as the results of the intervention on the main outcomes of interest: the students' evaluation of the TA, for both the Fall (when the intervention took place) and Winter (one quarter later) quarters, which includes an overall assessment of the TA as well as of some particular aspects of his teaching; and the impact on students' course performance (measured as the deviation of the TAs section grade average from the course average) for the Fall Quarter. Note that for the last outcome of interest, the students' grades, the effect can only be identified in courses with many sections, mainly the introductory and lower division courses (see Table 3.2).

As discussed above, the observations were planned to take place on weeks four and six of the ten week quarter, but the dates were adjusted according to the midterm calendar of each particular course (to avoid the abstenteeism observed in discussion sections right after the midterm) and the observer's individual availability. For the most part, all first round observation took place in weeks four or five (98%), but only 86% second round observations took place in weeks six or seven, the reminder of which took place in week eight. Usually, the TA evaluations are distributed by TAs in week nine or week ten (last week) of the quarter, so it may be the case that for those TAs who were observed later in the quarter there was not enough time to incorporate the second round of feedback before the evaluations of that same quarter took place.

We present the effects of the intervention on both the Intent to Treat group (ITT), all the TAs that were assigned to treatment and were offered the chance to participate in the program, and on the Treatment group (ToT), those TAs who agreed to participate in the

program and actually received treatment. The ITT group is selected at random, and is not subject to the concern that those choosing to participate in treatment might be those who believe they will get a particularly strong benefit from the treatment and might therefore differ in unobserved ways from the (small number of) TAs who chose not to participate. An additional rationale for examing the ITT effects is that all TAs who were offered the chance to participate in the program recieved a signal that the Department was interested in improving the teaching skills of the TAs, because it was explicitly acknowledged that the Department was strongly supporting the intervention; this signal was not given to the control group. Even though we explained that the intervention was not mandatory and that there was no punishment for not participating, the signal may have reminded them of how important teaching is to the Department, incentivizing them to exert more effort when teaching.

3.4.1 Descriptive Statistics and Comparison of Means

As in many graduate economics programs, TAs came from different countries and backgrounds. Figures 3.3 and 3.4 show the country and undergraduate major of the TAs in the sample. As illustrated in Figure 3.3, a large portion of the TAs, roughly 80%, come from outside the US, mainly from China, Korea and Latin America. Not surprisingly, most of them (55%) majored in Economics for their undergraduate degrees, or Economics and Math (15%).[5] Figure 3.5 shows that among this group of PhDs, the most popular field is Macroeconomics (40%), followed by Theory (24%), Labor (14%), Econometrics (11%) and Industrial Organization (11%). Finally, as can be seen in Table 3.1, the average age of the

[5] TAs are PhD students that are in their second year or above that are making satisfactory progress in the program and are not hired as research assistants or obtain funding from other fellowhships.

TAs is 27, approximately three fourths are male and, consistent with the information of country of origin, only 22% are native English speakers. In terms of teaching experience, they have taught an average of six quarters in the university, and roughly half of them had taught that same course in the past.

The assignment to the treatment and control groups was done randomly (except for the three TAs of graduate courses), but stratified by course, as shown in Table 3.2. The table shows the distribution both for the ITT group (where TAs were assigned to treatment but did not necessarily agree to participate) and the treatment group across the courses offered. The purpose was to minimize the effect of course specific traits, such as difficulty, teaching skills of the main lecturer, individual student interest on the subject, etc, on the TA evaluations. After randomization, we verifed that the randomization created balance among treatment groups in terms of the observable characteristics of the participants. Table 3.3 shows that this was the case both across the control and ITT groups, and across control and treatment groups. In both cases, the difference in means between groups is not significantly different from zero (Table 3.3) for any of the eight variables. This is a key aspect of the experimental design, given that characteristics such as age and previous teaching experience may affect the teaching skills of the TAs.

Even though covariates are balanced between the treatment and the control groups, we should analyze whether there was selection into treatment. That is, whether the complier TAs (the ones assigned to the treatment group who agreed to participate in the intervention) are inherently different from the non-complier TAs (those who were assigned to the treatment group but chose not to participate). Table 3.4 illustrates that there was no observed selection into treatment in terms of the covariates, except perhaps for the PhD year. TAs who are more advanced in the program were less willing to participate in the intervention, likely due

in part to the time constraints and stress created by the job market process as students near the end of their program. However, it does not appear that selection into treatment is a big issue in this study.[6]

As mentioned above, the main outcomes of interest for the intervention are: (i) the student evaluations of the TA performance that students fill at the end of the quarter (both for the Fall 2012 and Winter 2013 quarters); and (ii) the students' grades, more specifically, the deviation of the TA's section grade average from the average for the whole course (which in most cases comprises many TA sections) for the Fall Quarter. The purpose of taking deviations from the course mean was to reduce the noise caused by differences between courses and focus on differences betweentreated and non-treated TAs. Regarding the student evaluations, we were particularly interested in two questions: i). What is your overall rating of the teaching assistant? (TA evaluation) and ii). The overall value of the sections justified your time and effort (section evaluation). Both questions were answered on a scale from 1 (Very Low) to 9 (Very High). It must be noted that for the empirical analysis we used only the evaluations of sections with more than 10 responses to the evaluations, in order to obtain a valid measure of the TA's performance and teaching skills.

For the Fall Quarter, the average overall TA evaluation by section is 7.8, while average section evaluation is slightly lower, 7.6 (in a 1 to 9 scale). Tables 3.5 and 3.6 show the section average and median for these two questions, as well as the deviation of the TA section average of students' grades from the course average of students' grades, for the control, intent to treat

[6] The comparison of the outcome variables (both the average overall TA evaluation, the average section evaluation and the raw grade for students) between compliers and non-compliers also show that there is no statistical difference between the groups.

and treatment groups.[7] As suggested in Table 3.5, peer feedback seems to have a positive ITT effect on the average evaluation of TAs of around 0.14, which is almost 1/5 of the standard deviation; nonetheless, it is not statistically significant from zero. There does not seem to be any ITT effect on the evaluation of the section or on grades.

The results for Treatment on Treated (ToT) are quite similar, the effect over the average TA evaluation is around 0.13 but still not statistically significant, and no effect on the section evaluation or final grades. These results (Fall 2012 Quarter) are not surprising since the peer review program took place between weeks four and nine, leaving only a few sections for the TAs to internalize the feedback and adjust their teaching practices.

In order to fully estimate the impact of the program, we conducted a follow up of the Teaching Assistants during the Winter Quarter of 2013. The allocation of TAships is made on a quarterly basis depending on the needs of the deparment and the availability of the graduate students. For the Winter Quarter, only four of the graduate students involved in the intervention were not followed. Three of them belonged to the original control group; the fourth was a non-complier from the original treatment group. Tables 3.7 and 3.8 show the descriptive statistics and how covariates are balanced for the subsample of TAs who taught during the Winter Quarter of 2013. The samples are very similar between the Fall and Winter quarters, except that in the Winter a greater number of TAs (25%) reported having been asked to meet with the TA coordinator at some point in their career - a corrective step taken following poor student evaluations. Nonetheless, the covariantes remain balanced for both the IIT and the ToT groups, which reduces any potential concerns regarding sample

[7] Note that the treatment is at the TA level and each TA has two sections. This will be relevant for the clustering of errors at the TA level.

bias for the Winter results.

For the Winter Quarter, the average overall TA evaluation by section is also 7.8, when compared to the Fall Quarter, while the average section evaluation is 8.0, an increase from the previous quarter. Table 3.9 shows the differences in means of these main outcomes between the ITT and the control groups. The results are larger in magnitude than those for the Fall Quarter. They show an effect of 0.37 points, which represent almost one half of a standard deviation from the mean. Table 3.10 shows comparable results for the ToT group. The magnitude is slightly higher, 0.39, which is also close to one half of a standard deviation. Importantly, in both cases the effect is statistically significant, suggesting that the intervention was succesful. Once the TAs had enough time to incorporate the suggestions made by their peers and to adopt the lessons from their own observations, they improved their performance considerably. It would be interesting to evaluate if the results are long lasting, but at least they suggest that a peer review program might help to boost the performance of TAs.

3.4.2 Regression Analysis

The effects of the peer review intervention can be assessed by comparing outcomes across groups in a simple Ordinary Least Squares regression model. For each TA-section outcome we estimate the following specification:

$$y_{i,a} = \alpha + \theta Treat_a + \beta X_a + \delta_i + \varepsilon_{i,a} \tag{3.1}$$

where, $y_{i,a}$ is the outcome of interest for section i of TA a, $Treat$ is the intent to treat (ITT) or the treatment (ToT) indicator at the TA level, X_a are a set of controls at the TA level[8], and δ_i are course-specific fixed effects used in some specifications, and $\varepsilon_{i,a}$ are robust errors, clustered at the TA level. The coefficient of interest is θ, which should be an unbiased indicator of the causal effect of the intervention, because the unobservable characteristics of the TAs should be distributed randomly across the groups due to the experimental design.

Table 3.11 shows the effects of the ITT on the average TA evaluation, while Table 3.12 shows the effect of ToT both for the Fall Quarter. The estimated effect is positive but statistically insignificant. As discussed before, these results (Fall 2012 Quarter) are not surprising since the peer feedback program took place between weeks four and nine, leaving only a few sections for the TAs to internalize the feedback and adjust their teaching practices.

Tables 3.13 and 3.14 repeat this exercise for the students' grades for the Fall Quarter, more specifically the deviation of the TA average grade from the course average grade. The empirical analysis suggests that there was no effect of peer feedback on the students' performance; both ITT and ToT coefficients are very close to zero, and again not statistically significant. It must be noted that the effect of any treatment at the TA level will depend not only on how early they were able to adjust their teaching behavior in response to feedback, but also on how important the TA is for the students' performance (what is the weight of this in the production function), relative to other factors such as the students' effort or ability at the section level.[9]

[8] The covariates include: age, male, English native speaker, PhD year, Master degree, number of quarters that they have taught, whether they have taught the course before and whether they have met with the TA coordinator.

[9] Similarly, the teaching skills of the TA are only relevant for those students who attend to TA section,

Another difficulty in the interpretation of these results is that students may switch TA sessions within a same course, depending on the time of the discussion section or if they don't feel the TA met their expectations. There is no way to account for this problem in the sense that the evaluations are anonymous and there's no way to track the switching. This issue could be an alternative explanation of why we do not observe any statistical effect of the treatment on the students' performance.

These results for the Fall Quarter suggest that the peer feedback did not produce large effects within the quarter, but (as described above) it is possible that the timing of the intervention did not allow the TAs to fully incorporate feedback early enough to observe an impact in TA evaluations or student grades in the same quarter. If the intervention did in fact provide TAs with valuable and actionable feedback, we would expect to see a larger impact on outcomes in the following quarter, when the treated TAs could incorporate the Fall Quarter feedback to inform their teaching throughout the whole Winter Quarter.

Table 3.15 contains the regression analysis of the ITT effect using the Winter TA evaluations. Column 1 presents the mean difference between samples clustering errors at the TA level (most TAs taught two sections): the effect size is 0.366, equivalent to one half of a standard deviation, and significant at a 10% level. Column 2 shows that the size of the ITT effect does not change after introducing the first set of covariates, as expected if the covariates are balanced (as shown before). The next column adds the lagged TA evaluation

which is known to be way below the number of students enrolled (all of which are used in the calculation of the average grade by section).

reducing slightly the size of the coefficient to 0.337, but it remains significant[10]. The results in column 3 also show that there is consistency in the TA evaluations, those who obtained higher grades in the Fall Quarter also obtained higher grades in the Winter Quarter.

Column 4 controls for the fields of the TAs, the coeffient is significant at a 11% level, and the magnitude does not change significantly showing robustness to the inclusion of additional controls. Column 5 includes course dummies in the specification, which restricts the identification of the effect to those course with various sections. According to this result, the effect of peer feedback was almost one standard deviation and statistically significant at the 1% level. The increase in the effect of the intervention may be explained by the fact that most of the courses that have many sections are introductory courses, for which good communication skills are particularly relevant, an aspect of teaching which was largely affected by the intervenion, as will be discussed in detail in the next section.

The last column adds dummies for nationality, with the coefficient on the ITT increasing to 0.46. While we would not normally expect the results of an RCT to change with the addition of covariates, some nationalities are represented in only one of the groups. The slight increase in the coefficient could indicate that the intervention is particularly effective for one or more of the larger nationality groups, e.g. China (35%) or the US (20%), who make up a larger proportion of the effective sample in this specification.

[10] Note that this specification may control away some of the treatment effect - if the insignificant positive effect seen in the Fall represents some small improvement thanks to the intervention, by controlling for the Fall evaluation scores we restrict ourselves to examining the incremental improvement in outcomes between the Fall and Winter quarters, rather than the full impact of the intervention.

Table 3.16 shows the results for the ToT. The coefficients of the six columns mimic the results of the previous table. The effect under the first three specifications remains unchanged around 0.36-0.39 and is statistically different from zero. Overall, the results from both tables suggests that the peer feedback was sucessful in terms of improving the TAs teaching skills and the randomization was successfull. In addition, they show that even after controlling for those variables for which it was not possible to randomize, the results are large and, in most cases, statistically significant. Finally, it shows that it was correct to expect an effect on the ITT group, given that those TAs who did not accepted treatment still perceived the signal that the Department was highly interested in the teaching skills of the graduate students.

Tables 3.17 and 3.18 show the results for the log of the TA evaluations. The results can be directly interpreted as percentage changes when the covariates are dummies. Both the ITT and the ToT would suggest an increase of between 4.69% and 5.36% in the evaluations caused by the peer review program (columns 1 to 4 in both tables). If we control for the course differences by adding course fixed effects, the change would increase to almost 10%. While if we control by the differences in nationality (which may mask differences in teaching styles), the change would be around 6%.

3.4.3 Decomposition of TA evaluations

The previous section discussed the results on the overall TA's evaluations and students' grades. However, the evaluation formats have six areas that are assessed by the students and that refer to more concrete skills: (i) The first category refers to the knowledge of the TA in the course taught; (ii) The second one evaluates the concern of the TA regarding the students understanding of the material; (iv) The third category focuses on the preparation and organization of the course; (iv) The fourth refers to the scope of the TA session relative

to the course, more specifically whether the TA helped the students to improve their understanding on the material and expand on the topics covered in class; (v) The fifth area looks at the interaction between the TAs and the students outside the classroom; (vi) Finally, the sixth component evaluates the communication skills of the TA referring to the ability to transmit ideas. As before, all questions are framed in a scale from 1 (Very Low) to 9 (Very High).

Given that the overall TA evaluation is an assessment of all these categories, we believed that the intervention should have different impact across categories. In particular, we expected improvement in pedagogical areas which correspond to categories two, three, five and six, related to concern, organization, interaction and communication of the TA. It is unlikely that the intervention can modify the knowledge of the TA (although it could be correlated with organization and preparation of the course) or the scope of the sessions (because most TAs follow instructions from professors about what topics to cover).

We analyze if there was improvement in the areas in which we originally expected using the Winter 2013 TA evaluations, because it was for this quarter that students perceived a change for the better in the TAs.[11] Table 3.19 shows the summary statistics for each of the six categories (knowledge, concern, organization, scope, interaction and communication). Overall, students seem to consider that the TAs of the Economics department are knowledgable of the topics teaching (8.05 average grade) and concerned about the students' learning (7.84 average grade). However, the TAs seem to lag behind precisely in the areas at which the intervention is aiming at -organization, interaction and communication-, ranging

[11] We also analyzed the individual components of the TA evaluations for the Fall Quarter, but as with the overall TA evaluations, we found no significant effect of the intervention in any individual category.

from 7.37 to 7.75 average grades.

Tables 3.20 and 3.21 explore the differences in means between groups for the ITT and the ToT, respectively, relative to the control group. The results on both tables are almost identical in magnitude and statistical significance. As expected, knowledge does not respond to the intervention, which is a skill that would require a different type of intervention to affect. It might seem surprising that there is an effect on scope of around 3/7 of a standard deviation if the professors dictate the pace of activities. However, the TAs might have learnt from their peers how to approach the content indicated by the professors in a better way.

Concern, organization, and interaction increase by 0.3 points each which represent also a 3/7 of a standard deviation of each component. The largest effect is seen on communication, which increased by 0.68, which is slightly more than 2/3 of a standard deviation of the mean. This result suggests that after the intervention TAs were more concerned with how they expressed themselves and how to convey the material clearly.

Tables 3.22 and 3.22 show the results of the regression analysis for each sub-score, following the exact same specification as before, for the ITT and ToT groups respectively. For the former, 3.22 shows that with the exception of knowledge and organization, the magnitude of the coefficients barely change once the controls are added. More encouragingly, we find that for concern, scope, interaction and communication, the results are robust to the inclusion of covariates. The effect of the treatment is signifcant at the 11% level for the concern and interaction sub-score regressions, significant at the 10% level for the scope sub-score, and at the 5% level for communication. As can be seen in Table 3.22, the results for the ToT group are very similar except for the fact that the effects on concern, organization and interaction are significant at 11%.

Among the covariates, the dummy for native english speakers is not surprisingly positive and highly significant for communication skills. Also for that category, having met with the TA coordinatot has a negative and important effect on the average grade. Overall, the intervention seems to have an important effect on the communication skills of the TAs, a smaller effect on organization, scope, concern and interaction, and no effect on knowledge.

3.5 Complementary Analyses

This section presents two complementary analyses relevant for scaling up the intervention. The first part presents the main findings of the qualitative surveys that the treated TAs completed shortly after the intervention. The responses provide valuable information on which aspects of the intervention worked reasonably well and which aspects could be improved in the future. The second part discusses alternative experimental designs that could be implemented in order to distinguish the mechanisms at work (incorporation of feedback, incidental learning from observation of others, mitigation of potential moral hazard from TAs, among others) or to perform comparisons across different types of interventions.

3.5.1 Qualitative Survey

We conducted a qualitative survey at the end of the peer feedback project in order to assess some of the key aspects of the intervention. In particular, we had two sets of questions: (i) The first set tried to elicit information regarding the experience of the TAs while they were being observed; (ii) The second set of questions tried to gather information on the TAs as observers and evaluators.

For the first part, our objective was to qualitatively assess whether the TAs were aware (self-conscious) of the presence of observers and whether they modified their behavior while teaching or preparing for class, and finally, whether they found the feedback received useful. Overall, the project ran smoothly, all TAs claim to have received their feedback shortly after being observed and all TAs claim to have read it carefully. Most of the TAs agreed that the feedback was useful; however, they believe that it mostly contained positive reinforcement or that it pointed out problems of which the TAs were already aware, instead of pointing specific actions they could take in order to improve their teaching. Regarding the observation, the responses are mixed, some TAs did not notice the observers, while others felt somewhat uncomfortable while they were being observed.

Despite self-awareness, there are mixed responses regarding their attitude towards the preparation of the class: not all TAs modified their behavior knowing that a fellow TA could be present. Finally, we also included a question regarding what type of observer would the TAs rather have (peers or experts) - our concern was that since all observers were other graduate students of the same department, the TAs would feel more nervous or uncomfortable compared to having a stranger observe them. Even though the responses to this question are also mixed, most of them still prefer having somebody within the department evaluating their classes.

The objective of the second part of the survey was to evaluate the perception of the TAs regarding their qualifications as evaluators. The first question, which referred to the initial training workshop, showed that most of the TAs do no believe it helped them to improve their abilities as evaluators. This is an important point to consider for future interventions: the training workshop should be carefuly tailored to the needs of each department and the

contents should be revised. The next question tried to assess whether they felt capable of performing the task. Most of them agreed that they could evaluate the teaching skills of their colleagues and that the feedback formats helped them to transmit their thoughts and comments. Regarding the perceived change in teaching "skills" between the two observations, most TAs did not feel that there was any improvement, which is consistent with the results for the Fall Quarter (and unsurprising given that the two observatinos were only 2-3 weeks apart). We also wanted to know if they would feel more comfortable evaluating a stranger from a different department, but most of the answers expressed a preference for observing TAs in the same Department, possibly because they know the content of the courses better.

The last question elicited their perception of the project overall. In particular, we were interested in knowing whether they believed that it was useful and had potential for a large scale implementation. 80% of them answered that they liked the project and that they believed that it had potential. It seems that the TAs took their role seriously during this experiment, that they considered themselves fit to observe and assess the teaching skills of their peers, and that they preferred both to observe and to be observed by peers of the same department.

3.5.2 Discussion of Potential Future Interventions

Considering the non-trivial effect of the peer feedback intervention, it is interesting to ponder slightly different experimental designs that can both disentangle the mechanisms of this past intervention and compare this to other options to improve teaching skills. In terms of distentangling the different mechanims of the peer feedback observation, it is worth distinguishing the effects of feedback (and learning by observation) from a mere Hawthorne effect in which TAs modify their behavior because there is someone different from their regular students ob-

serving him teach the class. This is plausible, particularly because in the qualitative survey the TAs mentioned that they did not purposively modify the way they were preparing to teach their sections.

Similarly, at various points through out this intervention, we thought about the option of an alternative intervention: having a professional in teaching to observe the TAs and provide them feedback. This option solves some of the concerns of having peers observing each other, mainly the quality of the feedback and the possibility of having subjective opinions interfering with the provision or reception of the feedback. Nonetheless, when compared to the peer feedback intervention, it would mean giving up the opportunity of TAs learning teaching practices by observing their peers, it could make observers more uncomfortable since the observer would be an outsider and, lastly, the observer is likely to be less familiar with the contents of the courses being taught.

Along these lines and as part of future research, it would be interesting to design a larger intervention with three different treatments, each of them involving a number of TAs similar to the the number of treated TAs in this study. The first treatment would involve pure observation (no feedback at all), in order to capture any possible Hawthorne effects for the observed TAs, and any learning though observation effects for the observer TAs. The second treatment would replicate the peer feedback intervention of this study, TAs would observe each other and provide feedback based on some guidelines. The third treatment would consist of having an external expert to observe the TAs and provide them with some feedback. The purpose of the latter would be to compare which alternative works better, peer review or an external observer. The main idea would be to carry out a cost-effectiveness comparison of treatments two and three.

3.6 Conclusions

Peer feedback is an attractive alternative to improve teaching practices, but even though some qualitative studies of the educational literature have assessed its effectiveness, to the best of our knowledge, there is no study with a solid quantitative approach on the subject. Our study is a first step to fill this gap in the literature by using a randomized intervention in the Department of Economics of a large public university to establish a causal relationship between peer feedback and teaching skills of TAs.

The results from the study suggest that peer feedback at the TA level has a positive but not significant effect on the overall TA student evaluations during the quarter that the experiment took place. The RCT, however, had a non-trivial and significant effect in the following quarter (Winter 2013): it increased the TAs evaluations by one half of a standard deviation. The results are robust to the addition of covariates, showing that the randomization was sucessful in terms of balancing the observable characteristics between the control and both the ITT and the ToT groups. In terms of the specific areas of improvement, the results show that the intervention had an important effect on the communication skills, and a smaller, less significant effect on organization, scope, concern and interaction with the students. As expected, the intervention had no effect on how knowledgeable about the material covered in the section was the TA.

The analysis of the students' performance indicates that the intervention had no effect on the students' grade in the quarter of the intervention. This could be partially explained by the fact that during that quarter, the TAs did not have enough time to implement the suggestions made by their observers, and thus students could not benefit from the intervention. Also, it is a common practice among students to switch TA sections throughout the quarter and there

is no way to track whether students changed sections, which introduces some measurement error.

The qualitative survey provided valuable information on the components of the intervention that worked well and those which must be improved for future interventions. Regarding the first aspect, it seems that having TAs from the same department to observe each other was an effective choice, not only because they are familiar with the content of the classes, but also because the TAs expressed a preference for both observing and being observed by a peer from their Department. Also, it appears that the observation and feedback formats were useful tools to guide observers, and that the TAs took the exercise seriously and found it valuable. Nonetheless, there are aspects of the program that require some adjusment. In particular, TAs pointed out that the training workshop was not very helpful for their tasks later on in the intervention. Similarly, they mentioned that a drawback from the feedback they received was that it did not contain enough specific actions that they could take to improve their teaching. As emphasized before, in order for peer feedback to be a positive activity, constructive criticism is crucial. One potential solution to this issue is to include in the feedback format a brief reminder of how important constructive cricitism and a list of examples of proactive actions to help improve the different aspects of teaching.

3.7 Tables and Figures

Figure 3.1: Observation Format

TA being observed: _____

Time and place:_____

Observer:_____

OBSERVATION FORMAT

INSTRUCTIONS:
Read the format before attending the session, so that you know what to look for. Make sure to know what topics and concepts are going to be covered during the session beforehand.

		Not aplicable	Strongly disagree		Disagree		Neither agree nor disagree		Agree		Strongly agree
	Organization/Clarity										
1	The aims, objectives and structure of the session were clear.	N/A	1	2	3	4	5	6	7	8	9
2	The topic and concepts covered were prepared beforehand.	N/A	1	2	3	4	5	6	7	8	9
3	The TAs speech was easy to understand.	N/A	1	2	3	4	5	6	7	8	9
4	The board or other teaching aids were used appropriately.	N/A	1	2	3	4	5	6	7	8	9
5	The TA managed properly the time of the session	N/A	1	2	3	4	5	6	7	8	9
	Specific comments on this factor:										
	Group Interaction										
6	The TA effectively managed the group interaction.	N/A	1	2	3	4	5	6	7	8	9
7	The TA encouraged students to actively participate in the session.	N/A	1	2	3	4	5	6	7	8	9
8	Students were engaged in the explanation and discussion of the section.	N/A	1	2	3	4	5	6	7	8	9
	Specific comments on this factor:										
	Instructor Enthusiasm										
9	The TA was enthusiastic about and interested in the topic.	N/A	1	2	3	4	5	6	7	8	9
10	The TA developed good rapport with the students and responded to their needs.	N/A	1	2	3	4	5	6	7	8	9
	Specific comments on this factor:										

	Learning/Value										
11	The TA explained things well and the examples used helped the students to understand the topic.	N/A	1	2	3	4	5	6	7	8	9
12	Ideas were transmitted clearly and in a way students would understand them.	N/A	1	2	3	4	5	6	7	8	9
13	The TA's feedback/answers to questions helped students to learn.	N/A	1	2	3	4	5	6	7	8	9
	Specific comments on this factor:										
	Breadth of Coverage										
14	The session was well integrated with the rest of the course (following the syllabus).	N/A	1	2	3	4	5	6	7	8	9
15	The concepts discussed were framed into the broad scope of the course.	N/A	1	2	3	4	5	6	7	8	9
16	The TA linked the topics in a coherent manner.	N/A	1	2	3	4	5	6	7	8	9
	Specific comments on this factor:										
	Comments										
17	Please list the three best things about the TA.										
18	Please list three suggestions for improving the session.										
19	Comments on the lesson plan e.g. activities, structure and timing.										

Based on the Danielson framework (Danielson, 2011) of assessing teaching skills and also, based on the students' evaluations used in the large public university. It is also consistent with the framework developed by Marsh (1983) on what set of factors are important for good teaching.

Figure 3.2: Feedback Format

TA being observed: _____

Time and place:_____

Observer:_____

FEEDBACK FORMAT

INSTRUCTIONS:

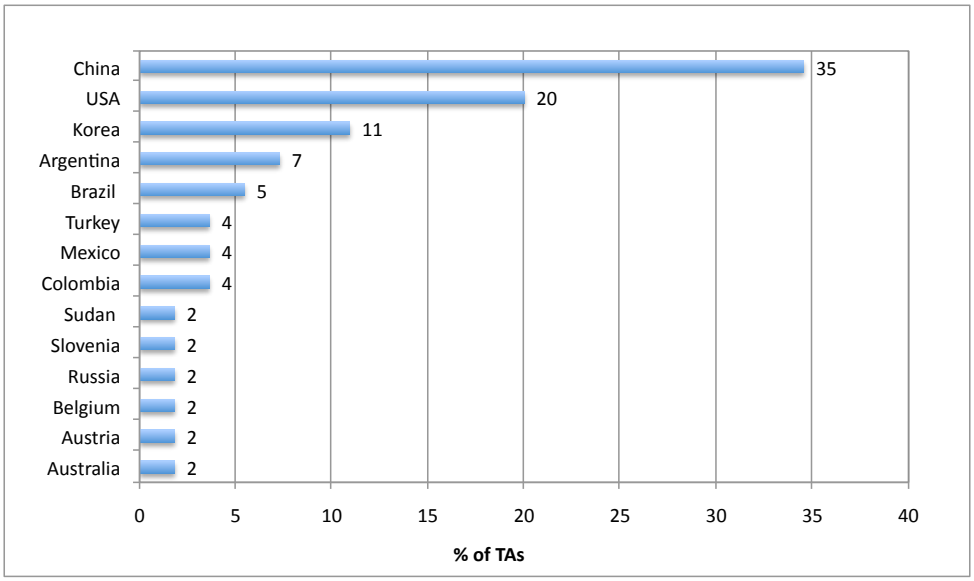
Please record the main comments and feedback points you would like to provide to your peer TA. Please be very specific about the actions she can take in each field to improve her performance.

1	*Organization/Clarity*
	Specific comments on this factor:
	Specific actions towards improvement:
2	*Group Interaction*
	Specific comments on this factor:
	Specific actions towards improvement:
3	*Instructor Enthusiasm*
	Specific comments on this factor:
	Specific actions towards improvement:
4	*Learning/Value*
	Specific comments on this factor:
	Specific actions towards improvement:

5	*Breadth of Coverage*
	Specific comments on this factor:
	Specific actions towards improvement:
6	Comments
	Other comments

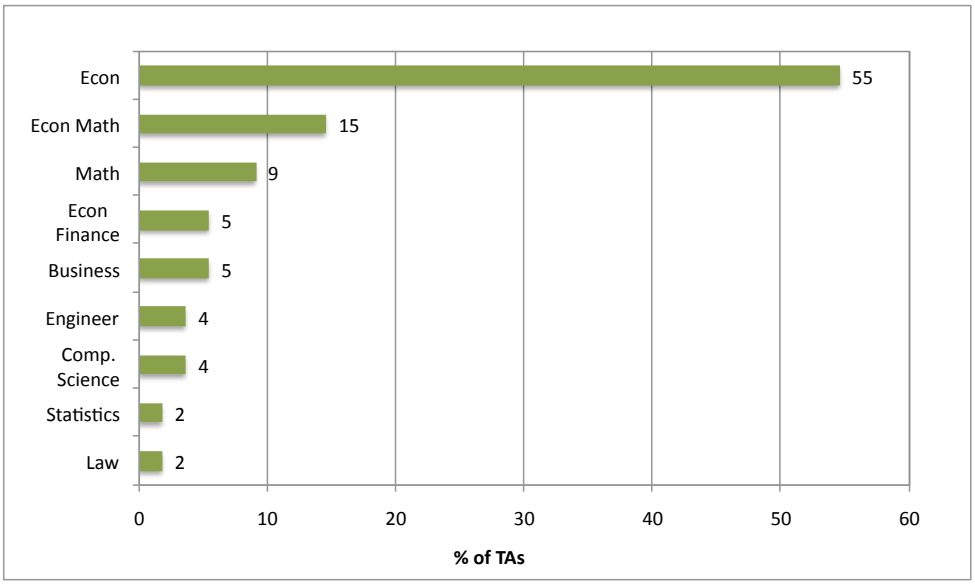
Based on the Danielson framework (Danielson, 2011) of assessing teaching skills and also, based on the students' evaluations used in the large public university. It is also consistent with the framework developed by Marsh (1983) on what set of factors are important for good teaching.

Figure 3.3: TAs Nationality



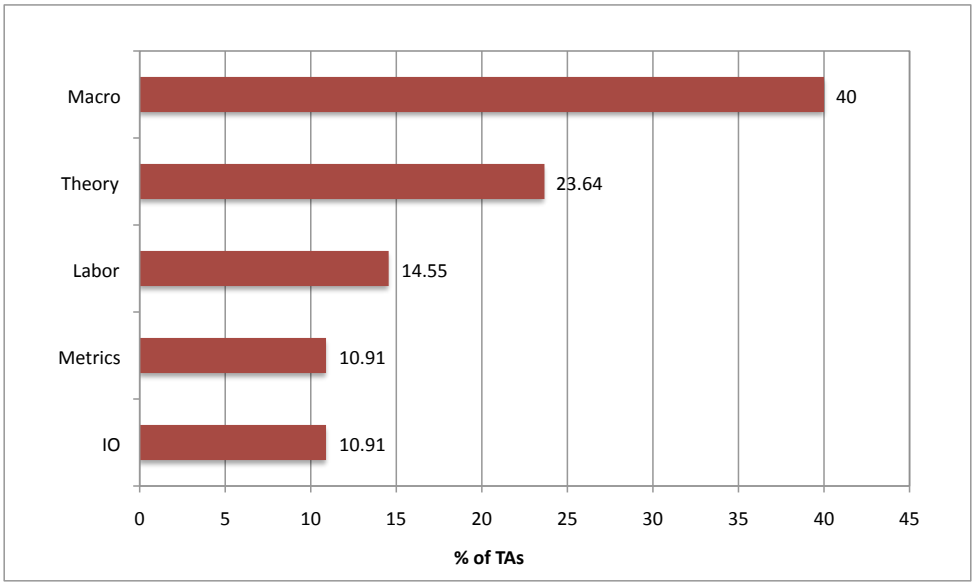
This figure shows the country of origin of all TAs, as reported by them in the post-intervention survey.

Figure 3.4: TAs Undergraduate Major



This figure shows the TAs undergraduate major, as reported by them in the post-intervention survey.

Figure 3.5: TAs PhD Main Field



This figure shows the TAs main Field of specilization in the PhD, as reported by them in the post-intervention survey.

Table 3.1: Descriptive Statistics: Covariates

Variable	Mean	Median	St. Dev.	Min	Max
Age	27.02	27.00	2.32	23	32
I(male)	0.75	1.00	0.44	0	1
I(English native)	0.22	0.00	0.42	0	1
PhD year	3.15	3.00	0.89	2	5
I(MA)	0.40	0.00	0.49	0	1
Quarters taught	6.40	6.00	4.65	0	18
I(taught this course before)	0.45	0.00	0.50	0	1
I(coordinator)	0.16	0.00	0.37	0	1

This table presents the descriptive statistics of the obsevable characteristics of the TAs, as reported by them in the post-intervention survey.

Table 3.2: Randomiztion by Course (Number of TAs)

	Course	Control	ITT	Treatment
Principles of Economics	Econ 1	2	3	2
Principles of Economics	Econ 2	3	3	2
Microeconomic Theory	Econ 11	5	7	5
Statistics for Economists	Econ 41	2	5	5
Microeconomic Theory	Econ 101	2	3	3
Macroeconomic Theory	Econ 102	2	2	2
Introduction to Econometrics	Econ 103L	2	3	3
Economics of Technology and E-commerce	Econ 106TL	1	2	0
Investments	Econ 106VL	1	2	1
Public Economics	Econ 130L	0	1	1
Economic Growth	Econ 164L	0	1	1
Microeconomic Theory (Grad)	Econ 201A	1	0	0
Macroeconomic Theory (Grad)	Econ 202A	1	0	0
Econometrics (Graduate)	Econ203A	1	0	0
	Total	23	32	25

The table displays the courses offered by the Economics Department that has one or more TAs. As noted in the text, most of the introductory courses offered have various TAs, and we were able to stratify the randomization accordingly. Nonethless, this was not the case for the most advanced courses.

Table 3.3: Balancing of Covariates

Variable	Control	ITT	p-value (equal means)	Control	Treatment	p-value (equal means)
Age	27.04	27.00	0.946	27.04	26.84	0.764
I(male)	0.70	0.78	0.481	0.70	0.76	0.625
I(english native)	0.13	0.28	0.188	0.13	0.28	0.211
PhD year	3.13	3.16	0.917	3.13	3.04	0.716
I(MA)	0.52	0.31	0.123	0.52	0.32	0.163
Quarters taught	6.39	6.41	0.991	6.39	6.04	0.784
I(taught this course before)	0.43	0.47	0.807	0.43	0.48	0.760
I(coordinator)	0.17	0.16	0.865	0.17	0.16	0.900
N	23	32		23	25	

This tables depicts the summary statistics of the observable characteristics of the TA participating in the intervention, which include age, indicator variable for male, indicator variable for being an English Native, the PhD year the TA is currently attending to, an indicator variable for obtaining a Masters Degreeb before entering the PhD, number of quarters as a TA in the current university, an indicator variable of whether the TA has taught the course before, and finally and indicator variable of whether the TA has been called by the TA coordinator of the Department due to obtaining very low scores in previous students' evaluations.

Table 3.4: Selection into Treatment: Takers vs. Non-takers

Variable	Takers	Non-takers	p-value (equal means)
Age	26.84	27.6	0.461
I(male)	0.76	0.86	0.597
I(english native)	0.28	0.29	0.977
PhD year	3.04	3.57	0.106
I(MA)	0.32	0.29	0.868
Quarters taught	6.04	7.71	0.344
I(taught this course before)	0.48	0.43	0.817
I(coordinator)	0.16	0.14	0.916
N	25	7	

This table shows the difference of the means of the observable characteristics described above between taker (TAs that decided to participate in the intervention) and non-takers (TAs that refused to participated but were offered to participate in a program intended to improve teaching abilities of the teaching assistants of the Economics Department). The third column shows the p-value of the test of equality of mean between two groups.

Table 3.5: Difference of Means: ITT

Variable	Control	ITT	Difference	p-value (equal means)
Average evaluation of TA	7.76	7.90	0.14	0.338
Median evaluation of TA	8.15	8.21	0.06	0.689
Average evaluation of discussion section	7.63	7.63	0.00	0.994
Median evaluation of discussion section	8.15	8.04	-0.10	0.578
Grade (dev. from course mean)	0.004	0.003	-0.002	0.769
N	41	58		

This table shows the difference of the averages of the main outcome variables of interest between the control group and the ITT group (TAs who were offered to participate in the program). The outcomes of interest are mainly the TAs overall evaluation, the section overall evaluation (value of the section to the students), and the deviation of the section average grade from the course average (reacll that most of the courses had many sections). The last column shows the p-value of the test of equality of mean between two groups.

Table 3.6: Difference of Means: ToT

Variable	Control	Treatment	Difference	p-value (equal means)
Average evaluation of TA	7.76	7.89	0.13	0.422
Median evaluation of TA	8.15	8.18	0.04	0.828
Average evaluation of discussion section	7.63	7.68	0.05	0.786
Median evaluation of discussion section	8.15	8.03	-0.11	0.575
Grade (dev. from course mean)	0.004	0.001	-0.004	0.565
N	41	44		

This table shows the difference of the averages of the main outcome variables of interest between the control group and the treatment group (TAs who actually participated in the program). The outcomes of interest are mainly the TAs overall evaluation, the section overall evaluation (value of the section to the students), and the deviation of the section average grade from the course average (reacll that most of the courses had many sections). The last column shows the p-value of the test of equality of mean between two groups.

Table 3.7: Descriptive Statistics Winter 2013: Covariates

Variable	Mean	Median	St. Dev.	Min	Max
Age	27.00	27.00	2.31	23	32
I(male)	0.76	1.00	0.43	0	1
I(English native)	0.22	0.00	0.42	0	1
PhD year	3.06	3.00	0.83	2	5
I(MA)	0.41	0.00	0.50	0	1
Quarters taught	6.12	6.00	4.34	0	17
I(taught this course before)	0.55	1.00	0.50	0	1
I(coordinator)	0.25	0.00	0.52	0	2

This table presents the descriptive statistics of the obsevable characteristics of the TAs, as reported by them in the post-intervention survey.

Table 3.8: Balancing Covariates Winter 2013

Variable	Control	ITT	p-value (equal means)	Control	Treatment	p-value (equal means)
Age	27	27	1.000	27	26.84	0.817
I(male)	0.75	0.77	0.846	0.75	0.76	0.940
I(english native)	0.15	0.26	0.369	0.15	0.28	0.308
PhD year	2.95	3.13	0.460	2.95	3.04	0.701
I(MA)	0.55	0.32	0.111	0.55	0.32	0.126
Quarters taught	5.40	6.58	0.348	5.4	6.04	0.594
I(taught this course before)	0.45	0.61	0.263	0.45	0.56	0.475
I(coordinator)	0.25	0.26	0.958	0.25	0.28	0.855
N	20	31		20	25	

This tables depicts the summary statistics of the observable characteristics of the TAs participating in the intervention, which include age, indicator variable for male, indicator variable for being an English Native, the PhD year the TA is currently attending to, an indicator variable for obtaining a Masters Degree before entering the PhD, number of quarters as a TA in the current university, an indicator variable of whether the TA has taught the course before, and finally and indicator variable of whether the TA has been called by the TA coordinator of the Department due to obtaining very low scores in previous students' evaluations.

Table 3.9: Difference of Means Winter 2013: ITT

Variable	Control	ITT	Difference	p-value (equal means)
Average evaluation of TA	7.58	7.95	0.37	0.029**
Median evaluation of TA	7.84	8.24	0.39	0.0510*
Average evaluation of discussion section	7.35	7.82	0.47	0.011**
Median evaluation of discussion section	7.61	8.15	0.54	0.014**
N	35	59		

This table shows the difference of the averages of the main outcome variables of interest between the control group and the ITT group (TAs who were offered to participate in the program). The outcomes of interest are mainly the TAs overall evaluation, the section overall evaluation (value of the section to the students), and the deviation of the section average grade from the course average (recall that most of the courses had many sections). The last column shows the p-value of the test of equality of mean between two groups.

Table 3.10: Difference of Means Winter 2013: ToT

Variable	Control	Treatment	Difference	p-value (equal means)
Average evaluation of TA	7.58	7.94	0.36	0.042*
Median evaluation of TA	7.84	8.21	0.37	0.096*
Average evaluation of discussion section	7.35	7.83	0.47	0.017**
Median evaluation of discussion section	7.61	8.10	0.49	0.040*
N	35	48		

This table shows the difference of the averages of the main outcome variables of interest between the control group and the treatment group (TAs who actually participated in the program). The outcomes of interest are mainly the TAs overall evaluation, the section overall evaluation (value of the section to the students), and the deviation of the section average grade from the course average (recall that most of the courses had many sections). The last column shows the p-value of the test of equality of mean between two groups.

Table 3.11: Regression Analysis ITT: TA Evaluation

	Dependent Variable: Average Evaluation of TA				
	(1)	(2)	(3)	(4)	(5)
Intent to Treat	0.1441	0.0458	0.1232	-0.0679	-0.1769
	(0.182)	(0.182)	(0.169)	(0.172)	(0.221)
Age		0.0849*	0.1210**	0.0805	0.1164*
		(0.045)	(0.046)	(0.051)	(0.067)
I(male)		0.1350	0.5783**	0.0616	0.0937
		(0.192)	(0.240)	(0.187)	(0.195)
I(English native)		0.1685	0.0186	0.3338	0.0028
		(0.196)	(0.185)	(0.247)	(0.372)
PhD year		-0.3096	-0.4212**	-0.4776*	-0.4520*
		(0.205)	(0.205)	(0.268)	(0.228)
I(MA)		-0.2858	-0.3233	-0.3396	-0.5779**
		(0.228)	(0.203)	(0.255)	(0.280)
Quarters taught		0.0630	0.0601	0.0935*	0.0523
		(0.045)	(0.047)	(0.047)	(0.053)
I(taught this course before)		0.2064	0.1842	-0.0362	0.3087
		(0.242)	(0.224)	(0.240)	(0.263)
I(coordinator)		-0.2486	-0.1947	-0.2727	-0.0873
		(0.236)	(0.223)	(0.291)	(0.253)
Labor			0.4655*		
			(0.256)		
Macro			-0.5697*		
			(0.322)		
Metrics			-0.2583		
			(0.370)		
Theory			-0.1616		
			(0.300)		
Constant	7.759***	5.999***	5.303***	6.315***	5.485***
	(0.138)	(1.088)	(1.116)	(1.177)	(1.847)
Course dummies	No	No	No	Yes	No
Nationality dummies	No	No	No	No	Yes
Observations	99	99	99	99	99
R-squared	0.009	0.136	0.236	0.324	0.309

Robust standard errors in brackets and clustered by TA.

Results from OLS regressions in which the dependent variable is the TA's average student overall evaluation by section (in general, TAs are responsible for teaching two sections) and the variable of interest is ITT, an indicator variable of the intent to treat. The controls include age, male, English native speaker, masters degree before the PhD, number of quarters taught, a variable indicating if the TA has taught the same course before, an indicator variable for having met the TA coordinator and field of specilization (Industrial Organization is the excluded category). Robust errors cluster by TA.

Table 3.12: Regression Analysis ToT: TA Evaluation

Dependent Variable: Average Evaluation of TA					
	(1)	(2)	(3)	(4)	(5)
Treatment	0.1303	-0.0129	-0.0126	-0.2364	-0.2151
	(0.196)	(0.205)	(0.203)	(0.186)	(0.226)
Age		0.0838*	0.1116**	0.0524	0.1278*
		(0.047)	(0.050)	(0.042)	(0.069)
I(male)		0.0693	0.2912	-0.0016	0.0207
		(0.210)	(0.296)	(0.169)	(0.227)
I(English native)		0.2193	0.0728	0.7958***	0.5604
		(0.206)	(0.211)	(0.253)	(0.407)
PhD year		-0.5285	-0.6278	-1.0586***	-0.6547*
		(0.351)	(0.425)	(0.307)	(0.380)
I(MA)		-0.3958	-0.4557*	-0.3673	-0.6909**
		(0.251)	(0.232)	(0.247)	(0.337)
Quarters taught		0.0938	0.0845	0.2231***	0.0952
		(0.069)	(0.081)	(0.061)	(0.077)
I(taught this course before)		0.2234	0.1588	-0.1386	0.2712
		(0.254)	(0.233)	(0.207)	(0.271)
I(coordinator)		-0.2740	-0.2539	-0.3729	-0.0948
		(0.243)	(0.227)	(0.278)	(0.255)
Labor			0.4806		
			(0.345)		
Macro			-0.3174		
			(0.428)		
Metrics			-0.5252		
			(0.480)		
Theory			-0.0371		
			(0.410)		
Constant	7.75***	6.60***	6.24***	7.57***	5.69***
	(0.138)	(1.202)	(1.345)	(1.006)	(1.931)
Course dummies	No	No	No	Yes	No
Nationality dummies	No	No	No	No	Yes
Observations	85	85	85	85	85
R-squared	0.008	0.146	0.235	0.449	0.306

Robust standard errors in brackets and clustered by TA.

Results from OLS regressions in which the dependent variable is the TA's average student overall evaluation by section (in general, TAs are responsible for teaching two sections) and the independent variable of interest is Treatment, an indicator variable of receiving treatment. The controls include age, male, English native speaker, masters degree before the PhD, number of quarters taught, a variable indicating if the TA has taught the same course before, an indicator variable for having met the TA coordinator and field of specilization (Industrial Organization is the excluded category). Robust errors cluster by TA.

Table 3.13: Regression Analysis ITT: Grades (Dev. from Course Mean)

	Dependent Variable: Grade (dev. from course mean)				
	(1)	(2)	(3)	(4)	(5)
Intent to Treat	-0.0018	-0.0064	-0.0045	-0.0054	-0.0072
	(0.005)	(0.005)	(0.005)	(0.005)	(0.006)
Age		0.0033***	0.0028**	0.0025	0.0030*
		(0.001)	(0.001)	(0.002)	(0.002)
I(male)		0.0021	0.0077	0.0021	0.0014
		(0.005)	(0.006)	(0.005)	(0.005)
I(English native)		-0.0058	-0.0045	-0.0061	0.0114
		(0.005)	(0.005)	(0.006)	(0.015)
PhD year		-0.0006	0.0011	0.0002	-0.0038
		(0.005)	(0.005)	(0.007)	(0.006)
I(MA)		-0.0200***	-0.0165**	-0.0193***	-0.0209***
		(0.007)	(0.007)	(0.007)	(0.007)
Quarters taught		-0.0006	-0.0006	-0.0004	-0.0010
		(0.001)	(0.001)	(0.001)	(0.001)
I(taught this course before)		-0.0035	-0.0006	-0.0054	-0.0013
		(0.006)	(0.007)	(0.007)	(0.006)
I(coordinator)		0.0116	0.0114	0.0171**	0.0162*
		(0.007)	(0.008)	(0.008)	(0.009)
Labor			-0.0054		
			(0.008)		
Macro			-0.0065		
			(0.008)		
Metrics			0.0177**		
			(0.008)		
Theory			-0.0060		
			(0.008)		
Constant	0.0044	-0.0676**	-0.0645**	-0.0502	-0.0591
	(0.004)	(0.027)	(0.031)	(0.035)	(0.044)
Course dummies	No	No	No	Yes	No
Nationality dummies	No	No	No	No	Yes
Observations	92	92	92	92	92
R-squared	0.001	0.088	0.127	0.128	0.197

Robust standard errors in brackets and clustered by TA.

Results from OLS regressions in which the dependent variable is the deviation of the students' grade by TA section from the overall course average, and the independent variable of interest is ITT, an indicator variable of intent to treat. The controls include age, male, English native speaker, masters degree before the PhD, number of quarters taught, a variable indicating if the TA has taught the same course before, an indicator variable for having met the TA coordinator and field of specilization (Industrial Organization is the excluded category). Robust errors cluster by TA.

Table 3.14: Regression Analysis ToT: Grades (Dev. from Course Mean)

	Dependent Variable: Grade (dev. from course mean)				
	(1)	(2)	(3)	(4)	(5)
Treatment	-0.0037	-0.0077	-0.0068	-0.0077	-0.0392
	(0.006)	(0.005)	(0.006)	(0.007)	(0.024)
Age		0.0030**	0.0027*	0.0020	-0.0066
		(0.001)	(0.001)	(0.002)	(0.005)
I(male)		0.0019	0.0050	0.0028	-0.0165
		(0.005)	(0.008)	(0.005)	(0.027)
I(English native)		-0.0039	-0.0005	0.0030	0.0807***
		(0.006)	(0.007)	(0.007)	(0.028)
PhD year		0.0035	0.0085	-0.0011	-0.0218
		(0.008)	(0.009)	(0.011)	(0.048)
I(MA)		-0.0186**	-0.0163*	-0.0177**	0.0053
		(0.008)	(0.009)	(0.008)	(0.029)
Quarters taught		-0.0015	-0.0018	0.0003	-0.0022
		(0.001)	(0.002)	(0.002)	(0.009)
I(taught this course before)		-0.0034	-0.0023	-0.0065	0.0656**
		(0.007)	(0.008)	(0.007)	(0.029)
I(coordinator)		0.0135*	0.0138	0.0193**	0.0082
		(0.008)	(0.009)	(0.009)	(0.026)
Labor			0.0013		
			(0.010)		
Macro			0.0062		
			(0.012)		
Metrics			0.0234**		
			(0.011)		
Theory			0.0053		
			(0.011)		
Constant	0.004	-0.069**	-0.083**	-0.047	0.957***
	(0.004)	(0.031)	(0.035)	(0.039)	(0.124)
Course dummies	No	No	No	Yes	No
Nationality dummies	No	No	No	No	Yes
Observations	78	78	78	78	83
R-squared	0.004	0.100	0.121	0.171	0.432

Robust standard errors in brackets and clustered by TA.

Results from OLS regressions in which the dependent variable is the deviation of the students' grade by TA section from the overall course average, and the independent variable of interest is Treatment, an indicator variable of receiving treatment. The controls include age, male, English native speaker, masters degree before the PhD, number of quarters taught, a variable indicating if the TA has taught the same course before, an indicator variable for having met the TA coordinator and field of specilization (Industrial Organization is the excluded category). Robust errors cluster by TA.

Table 3.15: Regression Analysis ITT Winter 2013: TA Evaluation

	Dependent Variable: Average Evaluation of TA (one quarter later)					
	(1)	(2)	(3)	(4)	(5)	(6)
Intent to Treat	0.3661*	0.3653*	0.3372*	0.3444	0.7209***	0.4632*
	(0.193)	(0.210)	(0.199)	(0.210)	(0.214)	(0.256)
Age		-0.0060	-0.0368	0.0175	-0.0391	0.1043
		(0.062)	(0.063)	(0.068)	(0.042)	(0.101)
I(male)		0.0331	-0.0268	0.1852	0.1978	0.2315
		(0.186)	(0.190)	(0.269)	(0.171)	(0.209)
I(English native)		0.2588	0.1654	0.1776	0.4229**	-0.0388
		(0.243)	(0.224)	(0.252)	(0.174)	(0.382)
PhD year		-0.0810	0.1082	-0.1026	-0.0777	-0.1373
		(0.221)	(0.225)	(0.256)	(0.203)	(0.275)
I(MA)		0.2311	0.2865	0.1870	0.4408**	-0.0566
		(0.272)	(0.265)	(0.276)	(0.212)	(0.322)
Quarters taught		0.0367	-0.0048	0.0236	0.0605	0.0524
		(0.043)	(0.044)	(0.052)	(0.043)	(0.052)
I(taught this course before)		0.0690	0.0796	0.1384	-0.1634	0.3549
		(0.285)	(0.273)	(0.298)	(0.275)	(0.319)
I(coordinator)		-0.2097	-0.0896	-0.1599	-0.0074	-0.3444**
		(0.145)	(0.140)	(0.155)	(0.135)	(0.161)
Lagged TA eval			0.3238*			
			(0.178)			
Labor				0.3641		
				(0.327)		
Macro				-0.1760		
				(0.425)		
Metrics				-0.2024		
				(0.507)		
Theory				0.1275		
				(0.314)		
Constant	7.5809***	7.5691***	5.6157***	7.0116***	8.2518***	4.1761
	(0.142)	(1.507)	(1.816)	(1.710)	(1.069)	(2.896)
Course dummies	No	No	No	No	Yes	No
Nationality dummies	No	No	No	No	No	Yes
Observations	94	94	94	94	94	94
R-squared	0.051	0.114	0.166	0.151	0.467	0.239

Robust standard errors in brackets and clustered by TA.

Results from OLS regressions in which the dependent variable is the TA's average student overall evaluation by section (in general, TAs are responsible for teaching two sections) and the variable of interest is ITT, an indicator variable of the intent to treat. The controls include age, male, English native speaker, masters degree before the PhD, number of quarters taught, a variable indicating if the TA has taught the same course before, an indicator variable for having met the TA coordinator and field of specilization (Industrial Organization is the excluded category). Robust errors cluster by TA.

Table 3.16: Regression Analysis ToT Winter 2013: TA Evaluation

Dependent Variable: Average Evaluation of TA (one quarter later)						
	(1)	(2)	(3)	(4)	(5)	(6)
Treatment	0.3631*	0.3937*	0.3681*	0.3322	0.6935***	0.4252
	(0.207)	(0.217)	(0.209)	(0.226)	(0.220)	(0.262)
Age		-0.0279	-0.0534	-0.0107	-0.0341	0.1249
		(0.065)	(0.066)	(0.072)	(0.051)	(0.095)
I(male)		0.0623	0.0166	0.1020	0.1681	0.2821
		(0.208)	(0.212)	(0.276)	(0.169)	(0.242)
I(English native)		0.2347	0.1405	0.1432	0.5079**	0.5733
		(0.276)	(0.259)	(0.348)	(0.196)	(0.450)
PhD year		-0.0327	0.1429	-0.0030	-0.0023	-0.0857
		(0.248)	(0.265)	(0.316)	(0.203)	(0.285)
I(MA)		0.2959	0.3707	0.2447	0.4744**	-0.0875
		(0.289)	(0.288)	(0.293)	(0.222)	(0.341)
Quarters taught		0.0428	0.0037	0.0146	0.0613	0.0633
		(0.046)	(0.050)	(0.058)	(0.044)	(0.056)
I(taught this course before)		-0.0570	-0.0176	0.0385	-0.1881	0.2474
		(0.290)	(0.281)	(0.314)	(0.274)	(0.321)
I(coordinator)		-0.2027	-0.0901	-0.1666	-0.0051	-0.3949**
		(0.161)	(0.150)	(0.174)	(0.149)	(0.159)
Lagged TA eval			0.2815			
			(0.180)			
Labor				0.3534		
				(0.492)		
Macro				-0.0532		
				(0.658)		
Metrics				-0.3736		
				(0.639)		
Theory				0.1530		
				(0.479)		
Constant	7.5809***	7.9806***	6.1997***	7.5931***	7.8272***	3.4248
	(0.143)	(1.620)	(1.917)	(1.849)	(1.353)	(2.787)
Course dummies	No	No	No	No	Yes	No
Nationality dummies	No	No	No	No	No	Yes
Observations	83	83	83	83	83	83
R-squared	0.050	0.119	0.156	0.163	0.477	0.299

Robust standard errors in brackets and clustered by TA.

Results from OLS regressions in which the dependent variable is the TA's average student overall evaluation by section (in general, TAs are responsible for teaching two sections) and the independent variable of interest is Treatment, an indicator variable of receiving treatment. The controls include age, male, English native speaker, masters degree before the PhD, number of quarters taught, a variable indicating if the TA has taught the same course before, an indicator variable for having met the TA coordinator and field of specilization (Industrial Organization is the excluded category). Robust errors cluster by TA.

Table 3.17: Regression Analysis ITT Winter 2013: Log TA Evaluation

Dependent Variable: Log Average Eval. of TA (one quarter later)						
	(1)	(2)	(3)	(4)	(5)	(6)
Intent to Treat	0.0490*	0.0501*	0.0469*	0.0478	0.0971***	0.0635*
	(0.027)	(0.029)	(0.028)	(0.029)	(0.030)	(0.035)
Age		-0.0018	-0.0058	0.0014	-0.0063	0.0131
		(0.009)	(0.009)	(0.009)	(0.006)	(0.014)
I(male)		0.0038	-0.0041	0.0251	0.0259	0.0300
		(0.025)	(0.026)	(0.037)	(0.024)	(0.029)
I(English native)		0.0349	0.0226	0.0232	0.0571**	-0.0066
		(0.033)	(0.030)	(0.034)	(0.023)	(0.052)
PhD year		-0.0092	0.0149	-0.0136	-0.0085	-0.0169
		(0.030)	(0.031)	(0.035)	(0.028)	(0.037)
I(MA)		0.0383	0.0458	0.0326	0.0674**	-0.0023
		(0.039)	(0.038)	(0.039)	(0.031)	(0.044)
Quarters taught		0.0048	-0.0004	0.0032	0.0079	0.0070
		(0.006)	(0.006)	(0.007)	(0.006)	(0.007)
I(taught this course before)		0.0111	0.0117	0.0204	-0.0186	0.0488
		(0.039)	(0.038)	(0.040)	(0.038)	(0.043)
I(coordinator)		-0.0251	-0.0097	-0.0180	0.0009	-0.0438**
		(0.020)	(0.019)	(0.021)	(0.019)	(0.021)
Lagged TA eval			0.3061*			
			(0.180)			
Labor				0.0441		
				(0.044)		
Macro				-0.0288		
				(0.057)		
Metrics				-0.0313		
				(0.069)		
Theory				0.0131		
				(0.042)		
Constant	2.0192***	2.0347***	1.4812***	1.9659***	2.1260***	1.5833***
	(0.020)	(0.208)	(0.381)	(0.235)	(0.153)	(0.390)
Course dummies	No	No	No	No	Yes	No
Nationality dummies	No	No	No	No	No	Yes
Observations	94	94	94	94	94	94
R-squared	0.048	0.111	0.154	0.147	0.446	0.234

Robust standard errors in brackets and clustered by TA.

Results from OLS regressions in which the dependent variable is a logistic transformation of the TA's average student overall evaluation by section (in general, TAs are responsible for teaching two sections) and the variable of interest is ITT, an indicator variable of the intent to treat. The controls include age, male, English native speaker, masters degree before the PhD, number of quarters taught, a variable indicating if the TA has taught the same course before, an indicator variable for having met the TA coordinator and field of specilization (Industrial Organization is the excluded category). Robust errors cluster by TA.

Table 3.18: Regression Analysis ToT Winter 2013: Log TA Evaluation

	Dependent Variable: Log Average Eval. of TA (one quarter later)					
	(1)	(2)	(3)	(4)	(5)	(6)
Treatment	0.0482*	0.0536*	0.0507*	0.0463	0.0932***	0.0579
	(0.028)	(0.030)	(0.029)	(0.031)	(0.031)	(0.035)
Age		-0.0048	-0.0081	-0.0023	-0.0057	0.0161
		(0.009)	(0.009)	(0.010)	(0.007)	(0.013)
I(male)		0.0083	0.0019	0.0155	0.0226	0.0368
		(0.028)	(0.029)	(0.038)	(0.023)	(0.033)
I(English native)		0.0317	0.0193	0.0177	0.0690**	0.0720
		(0.037)	(0.035)	(0.047)	(0.027)	(0.061)
PhD year		-0.0024	0.0202	-0.0007	0.0019	-0.0096
		(0.034)	(0.036)	(0.043)	(0.027)	(0.038)
I(MA)		0.0477	0.0576	0.0410	0.0730**	-0.0067
		(0.041)	(0.041)	(0.042)	(0.032)	(0.046)
Quarters taught		0.0054	0.0005	0.0020	0.0079	0.0084
		(0.006)	(0.007)	(0.008)	(0.006)	(0.007)
I(taught this course before)		-0.0052	-0.0010	0.0075	-0.0216	0.0345
		(0.040)	(0.039)	(0.042)	(0.038)	(0.044)
I(coordinator)		-0.0239	-0.0092	-0.0184	0.0016	-0.0503**
		(0.022)	(0.020)	(0.023)	(0.020)	(0.021)
Lagged TA eval			0.2682			
			(0.182)			
Labor				0.0426		
				(0.067)		
Macro				-0.0150		
				(0.089)		
Metrics				-0.0544		
				(0.087)		
Theory				0.0154		
				(0.065)		
Constant	2.0192***	2.0897***	1.5940***	2.0434***	2.0700***	1.4763***
	(0.020)	(0.224)	(0.393)	(0.254)	(0.192)	(0.375)
Course dummies	No	No	No	No	Yes	No
Nationality dummies	No	No	No	No	No	Yes
Observations	83	83	83	83	83	83
R-squared	0.046	0.115	0.146	0.157	0.453	0.293

Robust standard errors in brackets and clustered by TA.

Results from OLS regressions in which the dependent variable is a logarithmic transformation of the TA's average student overall evaluation by section (in general, TAs are responsible for teaching two sections) and the independent variable of interest is Treatment, an indicator variable of receiving treatment. The controls include age, male, English native speaker, masters degree before the PhD, number of quarters taught, a variable indicating if the TA has taught the same course before, an indicator variable for having met the TA coordinator and field of specilization (Industrial Organization is the excluded category). Robust errors cluster by TA.

Table 3.19: Summary Statistics Winter 2013: Other outcomes

Average evaluation of TA's:	Mean	Median	St. Dev.	Min	Max
Knowledge	8.05	8.22	0.62	5.83	8.95
Concern	7.84	7.91	0.74	5.50	9.00
Organization	7.75	7.90	0.78	4.80	8.90
Scope	7.65	7.77	0.76	5.20	8.88
Interaction	7.76	7.84	0.76	5.67	8.95
Communication	7.37	7.50	1.04	4.00	8.89

The table presents the summary statistics of the more specific questions of the students' evaluation of the TA regarding how knowlegdable the TA is, how concern is the TA about the student learning, the organization and preparation of the section, the scope of the section, how welcome students felt (interaction), and the TAs communication skills.

Table 3.20: Difference of Means (Other Outcomes) Winter 2013: ITT

Average evaluation of TA's:	Control	ITT	Difference	p-value (equal means)
Knowledge	8.00	8.08	0.07	0.58
Concern	7.66	7.95	0.29	0.06*
Organization	7.56	7.87	0.31	0.05*
Scope	7.44	7.77	0.33	0.04**
Interaction	7.57	7.88	0.31	0.050*
Communication	6.95	7.62	0.68	0.002***
N	35	59		

The table presents the difference in means of the more specific questions of the students' evaluation of the TA, specified above, between the control and the ITT groups. The fourth column presents the p-value of the equality test of means between the two groups. Also, *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 3.21: Difference of Means (Other Outcomes) Winter 2013: ToT

Average evaluation of TA's:	**Control**	**Treatment**	**Difference**	**p-value (equal means)**
Knowledge	8.00	8.06	0.06	0.67
Concern	7.66	7.94	0.28	0.17
Organization	7.56	7.90	0.34	0.05*
Scope	7.44	7.76	0.32	0.06*
Interaction	7.57	7.88	0.31	0.07*
Communication	6.95	7.59	0.64	0.006***
N	35	48		

The table presents the difference in means of the more specific questions of the students' evaluation of the TA, specified above, between the control and the ToT groups. The fourth column presents the p-value of the equality test of means between the two groups. Also, *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 3.22: Regression Analysis ITT Winter 2013: Other outcomes

	Dependent Variable: Average Evaluation of TA (one quarter later)					
	Knowledge		Concern		Organization	
	(1)	(2)	(3)	(4)	(5)	(6)
Intent to Treat	0.0739	0.0344	0.2898*	0.2889	0.3131*	0.2467
	(0.140)	(0.144)	(0.165)	(0.174)	(0.187)	(0.201)
Age		0.0074		0.0468		0.0346
		(0.050)		(0.050)		(0.055)
I(male)		0.0271		-0.0006		-0.1195
		(0.140)		(0.173)		(0.170)
I(English native)		0.0906		-0.0536		0.1673
		(0.193)		(0.242)		(0.263)
PhD year		-0.1384		-0.1701		-0.4470
		(0.177)		(0.172)		(0.278)
I(MA)		0.0114		0.0121		-0.0061
		(0.184)		(0.203)		(0.216)
Quarters taught		0.0331		0.0221		0.0900
		(0.033)		(0.033)		(0.057)
I(taught this course before)		0.1433		0.1231		0.1460
		(0.222)		(0.269)		(0.278)
I(coordinator)		-0.2274**		-0.1571		-0.0445
		(0.111)		(0.104)		(0.129)
Constant	8.0046***	7.9496***	7.6629***	6.7417***	7.5574***	7.3776***
	(0.076)	(1.207)	(0.110)	(1.265)	(0.130)	(1.393)
Observations	94	94	94	94	94	94
R-squared	0.003	0.070	0.037	0.077	0.038	0.107

Results from OLS regressions in which the dependent variables are the average scores by TA of the specific questions of the students' evaluation and the independent variable of interest is ITT, an indicator variable of intent to treat. The controls include age, male, English native speaker, masters degree before the PhD, number of quarters taught, a variable indicating if the TA has taught the same course before, an indicator variable for having met the TA coordinator and field of specilization (Industrial Organization is the excluded category). Robust errors cluster by TA.

Table 3.22: Regression Analysis ITT Winter 2013: Other outcomes

	Scope		Interaction		Communication	
	(7)	(8)	(9)	(10)	(11)	(12)
Intent to Treat	0.3268*	0.3348*	0.3128*	0.3076	0.6760**	0.6757**
	(0.171)	(0.167)	(0.179)	(0.187)	(0.280)	(0.281)
Age		0.0100		0.0094		-0.0289
		(0.054)		(0.052)		(0.080)
I(male)		0.1006		-0.0033		0.1557
		(0.148)		(0.169)		(0.224)
I(english native)		0.1963		0.1551		0.7114**
		(0.234)		(0.241)		(0.271)
PhD year		-0.1665		-0.1241		-0.0012
		(0.180)		(0.193)		(0.311)
I(MA)		0.1613		0.1665		0.5380
		(0.193)		(0.230)		(0.386)
I(taugh before)		0.0253		0.0120		0.0287
		(0.034)		(0.037)		(0.063)
I(taugh this before)		0.1161		0.2480		0.2218
		(0.261)		(0.272)		(0.353)
I(coordinator)		-0.1840		-0.1122		-0.2976*
		(0.126)		(0.142)		(0.171)
Constant	7.4440***	7.2946***	7.5674***	7.4001***	6.9474***	6.9807***
	(0.119)	(1.358)	(0.129)	(1.300)	(0.234)	(1.822)
Observations	94	94	94	94	94	94
R-squared	0.043	0.085	0.040	0.076	0.100	0.248

Robust standard errors in brackets and clustered by TA

Results from OLS regressions in which the dependent variables are the average scores by TA of the specific questions of the students' evaluation and the independent variable of interest is ITT, an indicator variable of intent to treat. The controls include age, male, English native speaker, masters degree before the PhD, number of quarters taught, a variable indicating if the TA has taught the same course before, an indicator variable for having met the TA coordinator and field of specilization (Industrial Organization is the excluded category). Robust errors cluster by TA.

Table 3.23: Regression Analysis ToT Winter 2013: Other outcomes

Dependent Variable: Average Evaluation of TA (one quarter later)						
	Knowledge		Concern		Organization	
	(1)	(2)	(3)	(4)	(5)	(6)
Treatment	0.0596	0.0354	0.2758	0.2876	0.3444	0.2978
	(0.157)	(0.157)	(0.180)	(0.185)	(0.205)	(0.214)
Age		-0.0032		0.0389		0.0253
		(0.054)		(0.054)		(0.061)
I(male)		-0.0217		-0.0012		-0.1080
		(0.148)		(0.194)		(0.190)
I(English native)		0.0696		-0.0214		0.1359
		(0.214)		(0.266)		(0.292)
PhD year		-0.1516		-0.1592		-0.4457
		(0.201)		(0.187)		(0.297)
I(MA)		-0.0250		0.0004		-0.0026
		(0.201)		(0.220)		(0.238)
Quarters taught		0.0442		0.0290		0.0986
		(0.035)		(0.035)		(0.061)
I(taught this course before)		0.0372		0.0247		0.0856
		(0.235)		(0.285)		(0.304)
I(coordinator)		-0.2394**		-0.1615		-0.0651
		(0.119)		(0.116)		(0.138)
Constant	8.0046***	8.3157***	7.6629***	6.9261***	7.5574***	7.5992***
	(0.077)	(1.351)	(0.110)	(1.409)	(0.130)	(1.548)
Observations	83	83	83	83	83	83
R-squared	0.002	0.070	0.033	0.064	0.044	0.107

Results from OLS regressions in which the dependent variables are the average scores by TA of the specific questions of the students' evaluation and the independent variable of interest is Treatment, an indicator variable of receiving treatment. The controls include age, male, English native speaker, masters degree before the PhD, number of quarters taught, a variable indicating if the TA has taught the same course before, an indicator variable for having met the TA coordinator and field of specilization (Industrial Organization is the excluded category). Robust errors cluster by TA.

Table 3.23: Regression Analysis ToT Winter 2013: Other outcomes

	Scope		Interaction		Communication	
	(7)	(8)	(9)	(10)	(11)	(12)
Treatment	0.3168*	0.3474*	0.3127	0.3173	0.6403**	0.6627**
	(0.185)	(0.177)	(0.193)	(0.200)	(0.296)	(0.293)
Age		-0.0081		0.0004		-0.0447
		(0.057)		(0.057)		(0.086)
I(male)		0.0797		-0.0155		0.1871
		(0.168)		(0.189)		(0.248)
I(english native)		0.1504		0.1650		0.7473**
		(0.262)		(0.269)		(0.309)
PhD year		-0.1432		-0.1062		0.0633
		(0.206)		(0.214)		(0.331)
I(MA)		0.1908		0.1676		0.6056
		(0.205)		(0.250)		(0.415)
I(taugh before)		0.0337		0.0231		0.0328
		(0.037)		(0.040)		(0.067)
I(taugh this before)		0.0025		0.1375		0.0937
		(0.274)		(0.284)		(0.364)
I(coordinator)		-0.1800		-0.1226		-0.2841
		(0.134)		(0.156)		(0.194)
Constant	7.4440***	7.7179***	7.5674***	7.5792***	6.9474***	7.1779***
	(0.119)	(1.515)	(0.129)	(1.440)	(0.234)	(2.002)
Observations	83	83	83	83	83	83
R-squared	0.040	0.077	0.039	0.068	0.088	0.243

Robust standard errors in brackets and clustered by TA

Results from OLS regressions in which the dependent variables are the average scores by TA of the specific questions of the students' evaluation and the independent variable of interest is Treatment, an indicator variable of receiving treatment. The controls include age, male, English native speaker, masters degree before the PhD, number of quarters taught, a variable indicating if the TA has taught the same course before, an indicator variable for having met the TA coordinator and field of specilization (Industrial Organization is the excluded category). Robust errors cluster by TA.

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