The Mating Game: (Potential) Intergenerational Conflicts on Marital Arrangements

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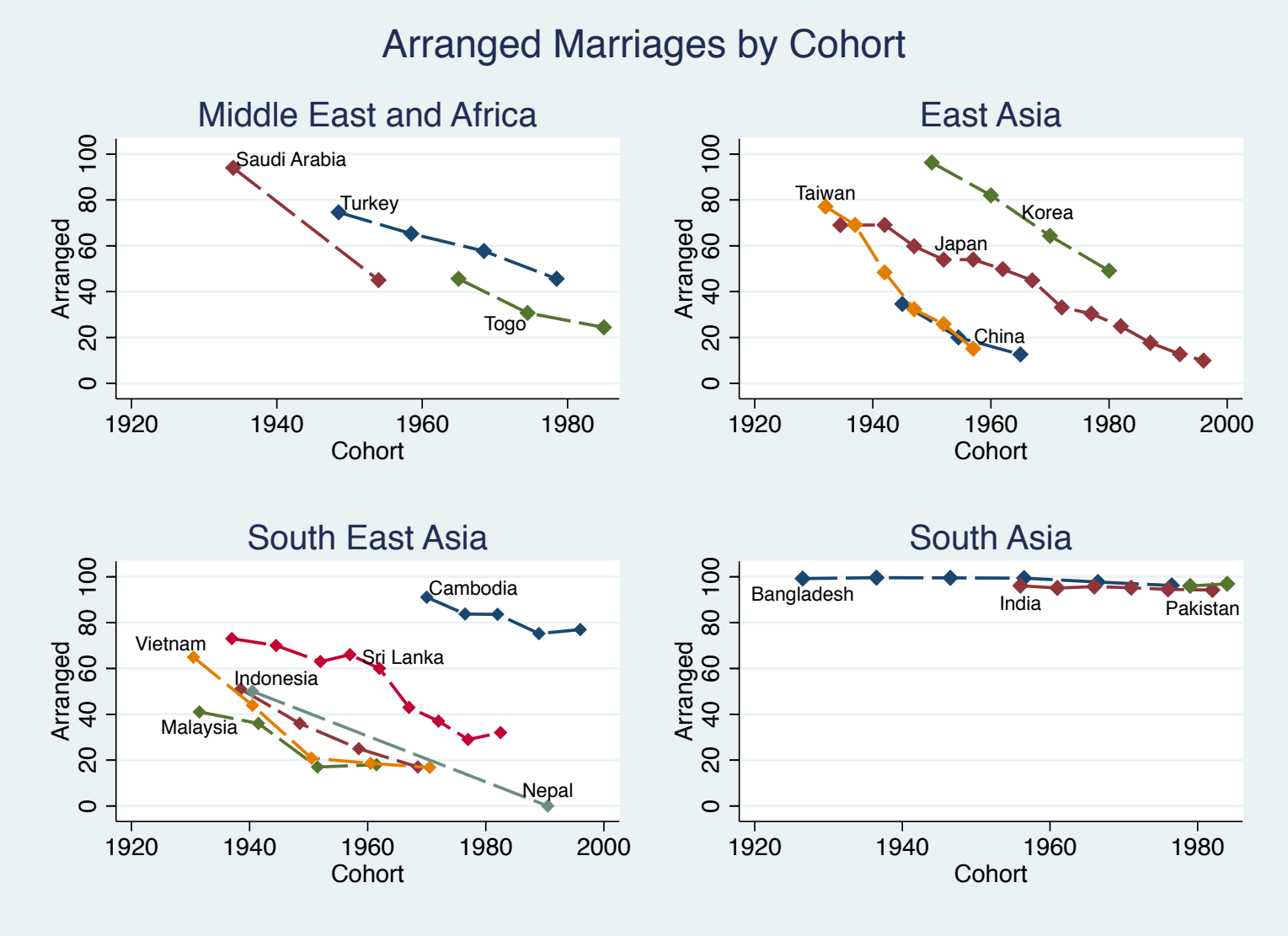
Decline in AM



Introduction

- Historically, Arranged Marriages (AM) have been the most common form of marriage in Asia and Africa.
  - At the beginning of the 20th century, 72.1% of marriages were arranged. They have decreased 40% on average in the Middle East, East and Southeast Asia and Africa.
  - This transition has been associated with industrialization, higher human capital investment, incorporation of younger cohorts into paid jobs, urbanization and the dissolution of extended households - prominent features of the modernization process.

Objectives

- Model one **intrahousehold** mechanism behind the driving forces through which modernization might affect the formation of arranged marriages:
  - Declining economic benefit of the arranged marriage.
  - Increasing opportunity cost of such arrangement.

- Goal: Show that during the transition period there might be inefficient investment in human capital.

- Key features:
  1. AM are used by two families (or groups) to enter into this risk-sharing contract.
     - ⋆ The contract benefits both sets of parents and their children.
  2. There's a wedge between parents and children in the valuation of the marriage.

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Research Questions

1. Benchmark model:
   - Incorporate the trade-off between pecuniary and non-pecuniary benefits and costs of having an arranged marriage.
     - ⋆ Simple model: 2 periods and 2 agents (parents and 1 child).
   - Focus on a stage when intergenerational conflict might arise.
     - ⋆ How parents might endogenously respond to changes in labor markets.
   - Capture static considerations (within the household) that might contribute to the disappearance of AM.
2. Two extensions:
   - Household with two children: (1) partially capture the notion of different sizes of social networks; and (2) analyze the impact of gender composition of children.
   - Possibility of divorce in a third period: Study how exogenous changes in divorce cost might affect the AM decision.

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Motivation

- We are interested in the causes and the consequences of marriage and the institutions that determine it.
  - Becker (1973): *"Marital patterns have major implications for, among other things, the number of births and population growth, labor-force participation of women, inequality in income, ability, and other characteristics among families, genetical natural selection of different characteristics over time, and the allocation of leisure and other household resources."*
- Asia and Africa (except South Asia) are experiencing a "love revolution":
  - Marital institutions serve additional purposes:

    "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).*

  - Once almost all marriages were arranged, now most are not.

Literature Review

- Anthropological and ethnographic studies: Murdock, 1967; Levi-Strauss, 1969; Goode, 1970; Goody, 1983; Fox, 1983;

- Marriage and family: Becker (1973, 1974, 1991); Browning, Chiappori and Weiss (2014).
  - **Marriage markets in developing countries**: Anderson (2007); Fafchamps and Quisumbing (2008); Anukriti and Dasgupta (2017); Rubio (2017a).
    - ⋆ Interaction with missing markets. **Risk-sharing**: Rosenzweig and Stark, 1989; Munshi and Rosenzweig 2016. **Marriage payments:** Corno and Voena (2016); Corno, Hildebrandt and Voena (2017); **Old-age care**: Kochar (1999, 2000), Cox and Fafchamps (2008).
  - Interaction with modernization affecting **welfare**:
    - ⋆ Inefficient responses: **Human capital**: Jensen and Nolan, 2017; Kochar, 2004; Chakrabarti, Lord and Rangazas, 1993. **Age at marriage**: Ambrus and Field, 2008; Vogl, 2013; Bidner and Eswaran, 2015. **Marriage payments and property rights**: Anderson, 2003; Anderson and Bidner, 2015. **Growth**: Edlund and Lagerlof, 2006.
    - ⋆ Benefit certain groups: Mushi and Rosenzweig, 2006; Luke and Munshi, 2011; Ashraf et. al., 2016.

Literature Review

- Interaction with modernization affecting **welfare**:
  - Interaction with **social norms**: Ambrus, A., E. Field, and M. Torero, 2010; Luke and Munshi, 2006.

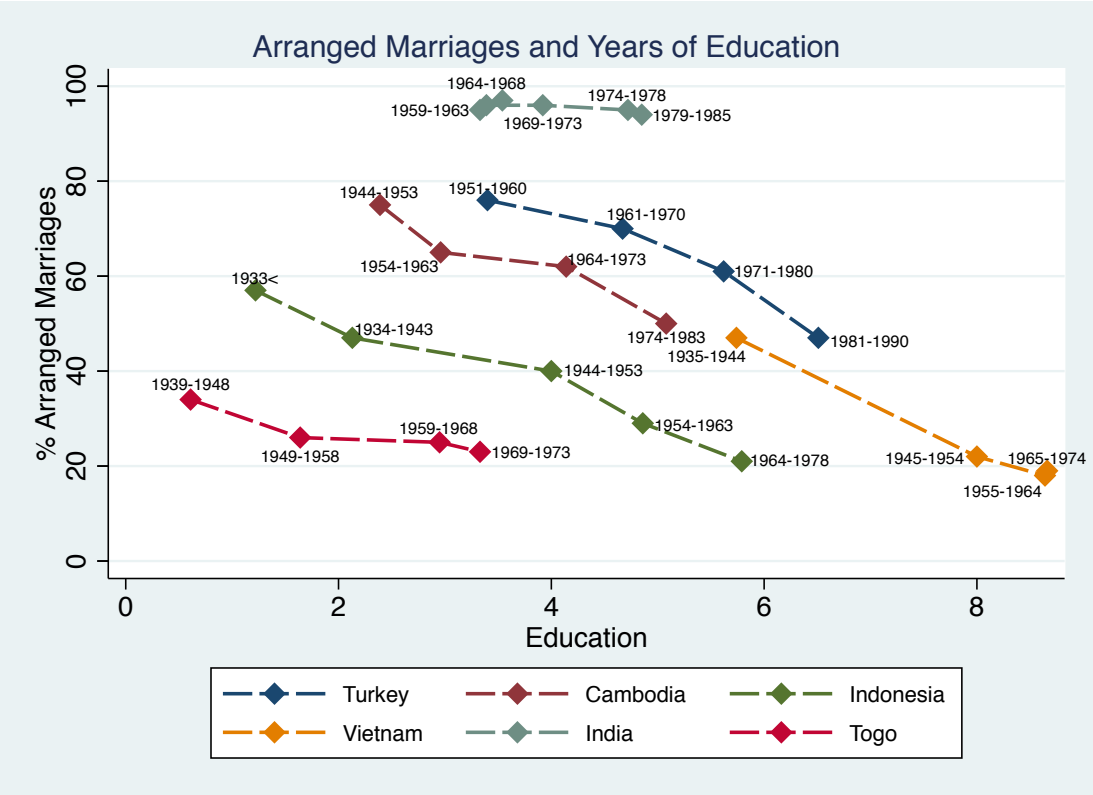
- **Intergenerational decision-making**: Chakrabarti, Lord and Rangazas (1993); Baland and Robinson (2000); Burton et al. (2002); Kochar (2004); Hao et al. (2008); Lundberg et al. (2009); Jensen and Nolan (2017).
  - Intersection on intergenerational decision-making and arranged marriages: Mathur (2007) and Huang, Jin and Xu (2015); Rubio (2017a); Rubio (2017b).

- **Structural transformation literature:**
  - Social Networks: Morten, 2017; Munshi and Rosenzweig, 2009; Munshi and Rosenzweig, 2016.
  - Spacial Misallocation of resources: Bryan and Morten, 2017; Kleemans and Magruder, 2017; Bazzi, Gaduh, Rothenberg, and Wong, 2016; Beegle et al., 2011.

Road Map

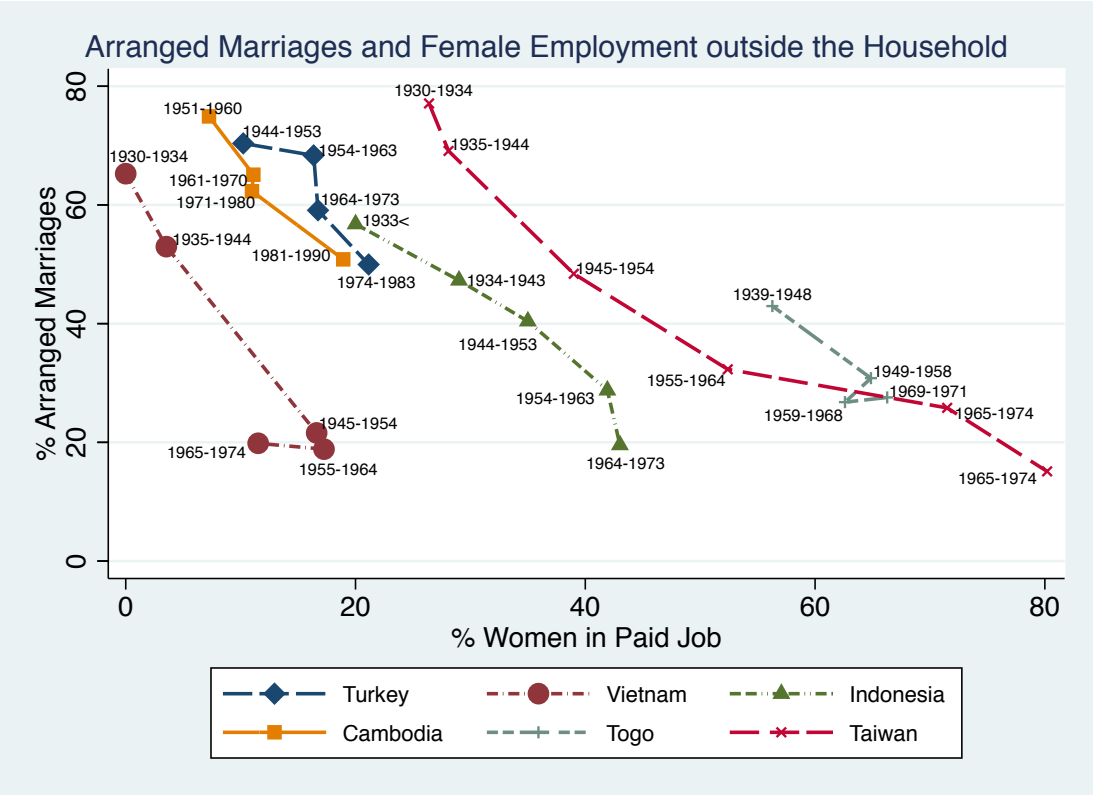
1. Stylized Facts: Education, Employment, Agriculture, Post-marital Living Arrangements.
2. Benchmark model:
   1. Key assumptions.
   2. Main intuition and results.
3. Household with two children.
4. Introducing divorce in a third period.
5. Conclusions.

Stylized Facts: Education



- ↑ Formal Employment $\Longleftrightarrow$ ↑ Education $\Rightarrow$ ↑ Value of outside option (as long as unconstrained returns are higher).
- Changes exposure to and type of risk and changes income covariance across households.

Stylized Facts: Employment



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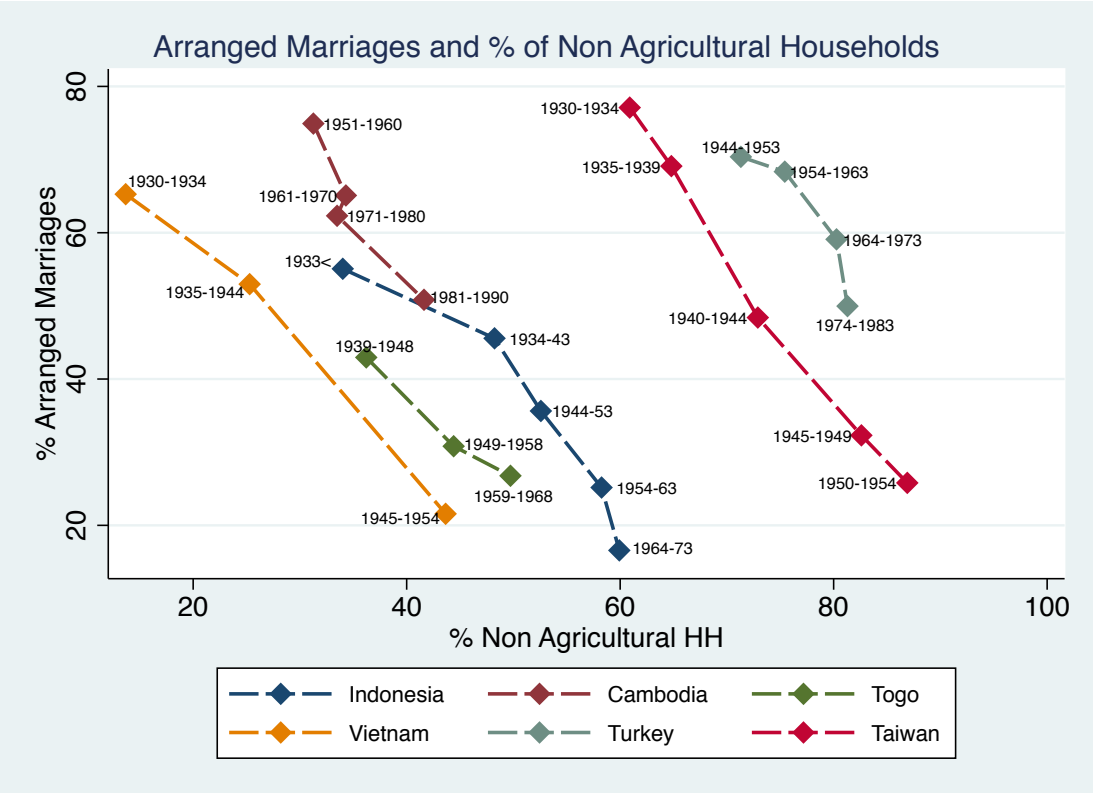
Stylized Facts: Agriculture



- New income sources and increases in mean income.
- Changes exposure to and type of risk and changes income covariance across households.

Stylized Facts: Post-marital Living Arrangements

	Turkey	Cambodia	Vietnam	India
Living with parents or nearby		0.0250*		
		(0.0145)		
Living with parents-in-law or nearby	0.0653***			
	(0.00986)			
Living on their own house			-0.0721***	-0.0897***
			(0.0144)	(0.00647)
Observations	13,524	5,345	3,607	32,018
R-squared	0.011	0.038	0.136	0.034

Data sources and additional controls: For Turkey (Demographic and Health Surveys) are age, urban dummy, education, LFP dummy, employment status (self-employed, paid or employee), region, and year of survey fixed effects; for Cambodia (Demographic and Health Surveys) are age, urban dummy, education, LFP dummy, employment status, occupation, province fixed effects and year of survey fixed effects; for Vietnam (Vietnamese Longitudinal Study) are age, urban dummy, education, LFP dummy, employment status, occupation, and district fixed effects; and for India (India Human Development Survey) are age, urban dummy, education, occupation, employment status, caste and province fixed effects.

- Norms on post-marital living arrangements vary by country: patrilocal, matrilocal, ambilocal, neolocal.

The model: Key assumptions

1. Introducing the risk-sharing through different assumptions on the covariance between the income shocks of the potential spouses.
   - Based on ethnographic evidence (Ter Harr, 1948; Vreede-de Stuers, 1960; Geertz, 1961; Goode, 1970; Chang, 1997; Zaman, 2008; Buunk et al., 2008; Jones, 2010; Apostolou, 2010; among others), previous empirical results from South Asia (Rosenzweig and Stark, 1989; Munshi and Rosenzweig 2016), and additional suggestive results on consumption smoothing.

2. Accepting the AM constrains geographic mobility, marriage market and returns to schooling.
   - AM couples are more likely to follow traditional post-marital living arrangements: live near their parents (or parents-in-law) as a mechanism that allows the enforcement of the informal contract and the management of flows of information across household (mitigating potential moral hazard issues) (Coate and Ravallion, 1993).

3. Alternative insurance mechanisms or increases in permanent income affect the participation in social networks (Morten, 2013; Munshi and Rosenzweig, 2016).

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Key Features and Intuition

Implicitly: AM is equivalent to choosing a mate, geographic location and occupation for the child $\Rightarrow$ allows enforcement, monitoring and better information on insurance partners $\Rightarrow$ **Constrains mobility (and thus returns to education).**

- **Wedge** between parents and child: match quality that parents do not internalize.
- **AM** provide insurance to two extended households. **LM** do not provide insurance but strong post-marital residence patterns are NOT enforced (unconstrained mobility).
- Abstract from: Fertility decision, savings, limited commitment, asymmetric information, matching in the marriage market (general equilibrium), farm production decisions, among others.

Set up of the model

- Following Hess (2004): each agent has a quadratic utility function: $u(c_{i,t}) = c_{i,t} - \frac{d_i}{2} c_{i,t}^2$, $i = f, k$, $t = 1, 2$.
  - $c_{i,t}$ 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.
- Period 1:
  - Parents choose education λ_k for the child and decide whether to exert high effort, $I(e = 1)$, looking for an AM partner for their child.
  - $I(e = 1)$ determines the quality of the mate in terms of risk-sharing gains.
  - The first period budget constraint is therefore: $c_{1,f} = 1 - p\lambda_k - e_{high} I(e = 1)$.

▸ Modeling Choices
▸ Set-up Details

Timing of Decisions, Period 2: The Child

- Child receives returns $x_{k,h}$ for her education $\lambda_{k,h}$, where $h = love(L), arranged(A)$.
  - Returns to schooling differ by type of marriage ($\lambda_{k,h}$ indexed depends on type of marriage)
  - Equivalent to having two sectors:
    - ★ $x_{k,L}\lambda_{k,L} = w(\lambda_{k,L}) \Rightarrow$ reallocate to geographic area where she maximizes her HK returns.
    - ★ $x_{k,A}\lambda_{k,A} = f(\lambda_{k,A}) \Rightarrow$ income received in the rural area if the child accepts the AM.
  - The child faces an additive shock $\delta_k \sim N(0, \sigma_\delta^2)$
  - Gets utility from the match quality term is a random draw from a known cdf: $\alpha_h \sim F_h(\alpha)$, $h = A, L$
  - The child's utility in this period is given by: $u(c_{2,k,h}) + \alpha_{2,h}$, $h{=}L, A$.

▸ Modeling Choices

Timing of Decisions, Period 2: The Child

- Her labor market income is therefore: $x_{k,h}\lambda_{k,h} + \delta_k$, $h = L, A$, where $x_{k,h} > 1$.
- There is assortative matching in the marriage market: $x_k\lambda_k = x_s\lambda_s$
  - Shares equally the household resources with her spouse.: $(\frac{x_{k,h}\lambda_{k,h}+x_{s,h}\lambda_{s,h}}{2} + \frac{\delta_k+\delta_s}{2})$
  - $\lambda_{s,h}$, $x_{s,h}$, and δ_s are the spouses' parameters, where $\delta_s \sim N(0, \sigma_\delta^2)$, and let ρ_{ks} be the correlation between income shocks of the spouses.
- The level of effort exerted will determine the correlation between the child and her spouse if the child accepts the arranged marriage: $\rho_{ks}[(I(e), I(h))]$. 4 cases:
  - $\rho_{ks}[(I(e=1), I(h=A))]$ =-1;
  - $\rho_{ks}[(I(e=0), I(h=A))]$ =0;
  - $\rho_{ks}[(I(e=1), I(h=L)] = \rho_{ks}[(I(e=1), I(h=L)] = 0$

Solution of the Game: Start in Period 2

- Parents and child compute the expected utility given a level of education, a given effort and an expected match quality term.
- the child decides between LM and AM.

$$\underset{h\in\{A,L\}}{Max} \quad E\left[u(c_{2,k,h})+\alpha_{2,h}\right]$$
$$s.t. \quad c_{2,k,h}=1+(1-\varphi)\left(\frac{x_{k,h}\lambda_{k,h}+x_{s,h}\lambda_{s,h}}{2}+\frac{\delta_k+\delta_s}{2}\right)$$

- Anticipating the decision of the child, parents solve in period 1 (Parents receive φ share from the family income of the child income of the child, where $0<\varphi<1$)

$$\underset{\lambda_{k,h},e\in\{0,1\}}{Max} \quad u(c_f)+\beta E[u(c_f)]$$
$$c_{1,f}=1-p\lambda_{k,h}-e_{high}I(e=1)$$
$$c_{2,f,h}=1+\varphi\left(\frac{x_{k,h}\lambda_{k,h}+x_{s,h}\lambda_{s,h}}{2}+\frac{\delta_k+\delta_s}{2}\right)$$

Solution of the Game: Optimal Level of Education and Effort

- The optimal λ is:

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

- Optimal level of effort:

$$\left[1 - p\lambda^*(e=1) - e_{high}\right] - \frac{d}{2}\left[1 - p\lambda^*(e=1) - e_{high}\right]^2 + \beta\left\{\left[1 + \varphi x\lambda^*(e=1)\right] - \frac{d}{2}\left[1 + \varphi x\lambda^*(e=1)\right]^2\right\} \quad >$$
$$\left[1 - p\lambda^*(e=0)\right] - \frac{d}{2}\left[1 - p\lambda^*(e=0)\right]^2 + \beta\left\{\left[1 + \varphi x\lambda^*(e=0)\right] - \frac{d}{2}\left[1 + \varphi x\lambda^*(e=0)\right]^2 - \frac{d}{2}\varphi^2\sigma^2_{i\delta}\right\}$$

▸ Expected Utility Period 2

Solution of the Game: Marriage Decision

$$E[u(c_k)]_L > E[u(c_k)]_A?$$

▸ Equation

Or more generally:

Value AM(insurance)
↓ **as** △ **risk**
↓ *as* ↑ *welfare prog*
↓ *as* ↑ *financ inst.*
↓ *as alt informal arrang.*

− *Cost(search, default, low mob)*
↑ *as* ↑ *mig*
↑ *as* ↑ *urb*

− *Opp Cost(outside option)*
↑ **as** ↑ **opp**
outside network

Solution of the Game: Marriage Decision

$$E[u(c_k)]_L > E[u(c_k)]_A?$$

▸ Equation

Or more generally:

Value AM(*insurance*)	$-$ *Cost*(*search*, *default*, *low mob*)	$-$ *Opp Cost*(*outside option*)
$\downarrow$ **as** $\triangle$ **risk**	$\uparrow$ *as* $\uparrow$ *mig*	$\uparrow$ **as** $\uparrow$ **opp**
$\downarrow$ *as* $\uparrow$ *welfare prog*	$\uparrow$ *as* $\uparrow$ *urb*	**outside network**
$\downarrow$ *as* $\uparrow$ *financ inst*.		
$\downarrow$ *as alt informal arrang*.		

Proposition 1: Ceteris paribus, love marriage is preferred when (among others)

- What drives the solution: LM $>$ AM?
  - *The difference in returns to education (for a fixed level of schooling):* $\uparrow$ $(w'(x_L\lambda_k) = x_L - f'(x_A\lambda_k) = x_A)$
  - σ^2_δ, *the size of the shock decreases.*
  - *the risk-sharing component captured by the correlation between shocks:* $\rho_{ks}(e, I(L=1)) - \rho_{ks}(e, I(L=0)$ *converges to zero.*
  - *Agents are less risk averse:* $d_k > 0$ *or* $d > 0$ *decreases.*
  - $e_{high} > 0$ *increases.*
  - $E(\alpha_L) - E(\alpha_A) > 0$ *when the average in partner "compatibility" is larger in love marriages than in arranged marriages.das*
  - *The transfer* φ *that parents receive in the second period declines (they share the impact of the shock).*
- Note: Eliminating effort from the equation doesn't change the main intuition.

▸ Key Points

▸ Alternative modeling assumptions

Proposition 2: divorce increases as the gains from insurance disappear

- If divorce occur: pay cost ϕ and find a partner in love marriage market in next period. It occurs if:

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

- **Recall that $\alpha_L \sim F_L(\alpha)$ and $\alpha_A \sim F_A(\alpha)$,:**

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

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

▸ Divorce thresholds

Extension to 2 children and Small Social Network

- Two children (N_k=2): Set up
  - Compare families with same number of children, but different gender composition.
    - ★ One boy and one girl: exert high effort for child with lower returns; if $x_b^i/p_b^i > x_g^i/p_g^i \Rightarrow$invest in education of the boy and offer the arranged marriage to the girl. Solution 1
    - ★ If two children of same gender, choose one of them randomly for the arranged marriage. Solution 2
- In general: for N_k Solution

Proposition 3

Limitations

- Rural settings when a country is in the early stages of industrialization, returns to education are still low, and agriculture is main source of income and employment.
- Disregard other pecuniary and non-pecuniary gains from arranged marriages: old age care, investment in productive activities, consolidation of wealth or land, and conservation of social status, among others.
  - The relative importance of these benefits might depend on the social class of the families involved, on the missing markets that each society face, and other idiosyncrasies of the country studied.
- Assumption that children easily find a mate in love marriage markets.

Limitations

- Access to thicker marriage markets might be an additional contributing factor.

- Urban areas are still following traditional marriage practices.
  1. Persistent social norms (i.e. Alesina, Giuliano and Nunn, 2013);
  2. Preferences for mates belonging to the same social or ethnic group (Banerjee et al., 2013);
  3. Other pecuniary and non-pecuniary benefits for parents and children not capture in this model (i.e., Luke and Munshi, 2006); or
  4. Parents strategically limiting the group of peers their children interact with in such a way that marriages are arranged among members of these pre-selected groups (Bisin and Verdier, 2000).

- Assumes commitment between parents and children in the second period, regardless of the marriage (migration) status of the child (Buttler, Rubio and Sheth, 2018).

- Disregard the general equilibrium problem (Rubio and Zhang, 2018).

▸ Current Literature

Conclusion

- There is a growing literature showing that economic changes that are characteristic of the modernization process and that economic policies being implemented in developing countries interact with social norms shaping the responses of individuals to such changes and programs.
- The goal of this paper has been twofold.
  1. Highlight one potential inefficient response in human capital investment
     - ★ During the the early stages of the modernization process in (mostly) agricultural countries that rely on children and social networks to overcome issues related to missing markets.
     - ★ In this framework, love marriages, increases in education and the dissolution of extended households are endogenously determined.
  2. Focus on marriage markets, and in particular on an institution still prevalent in several countries of Asia and Africa, arranged marriages, that has been often associated with welfare decreasing practices
     - ★ The model explicitly incorporating the preferences of parents and one child through a game played in two periods.

THANK YOU!

Set up of the model

- Outcomes of interest:
  - λ_k = education level that the child receives, p = price of education.
  - $I(e=1)$ is an indicator variable that the value of 1 if parents exert a high effort for finding an AM for their child and e_{high} = cost of high effort.
  - Education has lineal returns x_k per unit of education λ_k.
- The Child:
  - All children marry at the beginning of the second period:
    - ★ There's positive assortative matching between spouses in terms of education.
    - ★ Receive an additive utility from a match quality component drawn from a known distribution $\alpha_h \sim F_h(\alpha)$, $h = L, A$.
  - Start working, face an income shock, and pool resources with her spouse:
    - ★ Transfers a share φ of her family income back to her parents (after the realization an income shock).
    - ★ There's a correlation between the child's shock and her spouse's shock, $\rho_{ks}\,[(I(e=1), I(h))]$.

▸ Set-up

Main objective behind modeling choices:

1. Increasing cost of informal insurance (migration and urbanization) is introduced through an effort cost that parents exert for finding a partner for their child.

2. Changes in the risk profile (new technologies are introduced in agriculture, new occupations arise in other areas, welfare programs are implemented, alternative insurance mechanisms arise): mean, variance and covariances are changing.

3. Other changes in the marriage markets: distribution of the match quality component of spouses (by type of marriage) might change.

Back

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▸ Back

Period 2: Expected Utility

- Child

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

- Parents

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

Back

When is love marriage preferred?

When is

$$E[u(c_k)]_L > E[u(c_k)]_A?$$

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

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

Back

Solution of the Game: Marriage Decision, Education and Effort

$$E[u(c_k)]_L > E[u(c_k)]_A?$$

What drives the solution: LM $>$ AM?

- Eliminating effort from the equation doesn't change the main intuition.
- The key drivers are:
  - the difference in returns to education (for a fixed level of schooling): $w'(x_L\lambda_k) = x_L - f'(x_A\lambda_k) = x_A$
  - the risk-sharing component captured by the correlation between shocks and risk-averse agents.
  - the transfer φ that parents receive in the second period (they share the impact of the shock).

▸ Proposition 1

Solution of the Game: Marriage Decision, Education and Effort

$$E[u(c_k)]_L > E[u(c_k)]_A?$$

Which alternative modeling assumptions would deliver a similar intuition?

- Instead of having an income transfer φ, altruistic parents would still potentially underinvest in education as long as they don't value α in the same way as their children ($\pi\beta < 1$):

$$\underset{\lambda_{k,h}, e \in \{0,1\}}{Max} u(c_{1,f}) + \beta E[u(c_{2,f,h})] + \beta\pi E[u(c_{2.k,h}) + \alpha_{k,h}]$$

- Introduce the shock as part the "exogenous" endowment in second period:

$$c_{2,f,h} = 1 + \theta \left[f_h(\lambda_p, \lambda_k, \lambda_s) + \tau_{k,s} \right]$$

$$c_{2,k,h} = 1 + (1-\theta) \left[f_h(\lambda_p, \lambda_k, \lambda_s) + \tau_{k,s} \right]$$

▸ Proposition 1

Set up: Extending to $N_k = 2$ children

Period 1:

- Parents choose education λ_k for each child.
- First period budget constraint is: $c_f = 1 - gp_g \left(\frac{1}{j} \sum_j \lambda_{jg} \right) - bp_b \left(\frac{1}{i} \sum_i \lambda_{ig} \right)$,

  where:
  - $j = 0, 1, 2$ and $i = 0, 1, 2$ are the number of girls and boys.
  - $g = \frac{j}{N_k}$ is the share of girls and $b = \frac{i}{N_k}$ is the share of boys.
- Homogeneous within gender.
- Heterogeneous between gender in price of education ($p_g \neq p_b$) and returns to education ($x_g \neq x_b$).
  - Richer set of strategies for parents: potentially different levels of education for each child.

▸ Back

Solution to the model

Extreme case: $cov(k1, k2) = 1$ (small/constrained network):

Parents might have incentives to exert high effort only for one child: **Which one?**

- $g = 1/2$: If from perspective of parents $x_b^i/p_b^i > x_g^i/p_g^i$, $i = A, L$:
  - $\lambda_b > 0$ and $\lambda_g = 0$
  - Boy's education will endogenously respond to his expected decision in the second period
    - ★ If he chooses LM and $x_{bL} > x_{bA}$, then $\lambda_b(x_{bL}) > \lambda_b(x_{bA})$.

▸ Expected Utility Period 2

▸ Back

Solution to the model

Extreme case: $cov(k1, k2) = 1$ (small/constrained network):

Parents might have incentives to exert high effort only for one child: **Which one?**

- $g = 1$, if girls are identical, parents will toss a coin:
  - Offer $\lambda_{1g}(x_{gA})$ to one of them (if she will accept the AM).
  - Offer $\lambda_{2g}(x_{gh})\, h = L, A$ to the second girl.
  - Education will be endogenously determined by the choice of marriage in period 2:
    - ⋆ If girl 2 is expected to choose LM: $\lambda_{2g}(x_{gL}) > 0, \lambda_{1g}(x_{gA}) = 0$ (if $x_{gL} > x_{gA}$)
    - ⋆ If girl 2 is expected to choose AM: $\lambda_{2g}(x_{gA}) = \lambda_{1g}(x_{gA}) > 0$.

Back

Solving the problem for a given N_k

$$\underset{\lambda_{jg},\lambda_{ib}}{Max}\ u(c_f)+\beta E[u(c_f)]$$

$$s.t. \quad c_f = 1 - gp_g\left(\frac{1}{j}\sum_j \lambda_{jg}\right) - bp_b\left(\frac{1}{i}\sum_i \lambda_{ig}\right)$$

Solution when children are heterogeneous:

- Education of girls:

$$if\ \frac{x_{jg}}{p_g} > \frac{x_{ib}}{p_b} \Rightarrow \lambda^*_{jg} > 0\ \lambda^*_{ib} = 0$$

- Education of boys:

$$if\ \frac{x_{jg}}{p_g} < \frac{x_{ib}}{p_b} \Rightarrow \lambda^*_{ib} > 0\ \lambda^*_{jg} = 0$$

- Although the decision of each child depends on equation $E[u(c_k)]_L - E[u(c_k)]_A \gtrless 0$
  - 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 $x^h_b/p^h_b \gtrless x^h_g/p^h_g$.

▸ Back

Proposition 3: $N_k = 2$ kids and small network

- **Proposition 3.** *If we face the most constrained case, only one potential insurance partner, 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.*

▸ Solution N children

Divorce

- Divorce occurs if:

$$\begin{aligned} &\alpha_h + u(c_k)^{M,h} + \beta\left\{E\left[u(c_k)\right]^{M,h} + \alpha_h\right\} \\ &< u(c_k)^{D} - \phi + \beta\left\{E\left[u(c_k)\right]^{M,L} + E(\alpha_L)\right\},\ h = L, A \end{aligned} \tag{1}$$

- Derive thresholds for divorce for equation 1:

1. If the child chooses a LM period 2:

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

2. If the child chooses AM in period 2:

$$\begin{aligned} \hat{\alpha}_A < (1+\beta)^{-1}\Big[&-\phi - \tfrac{d_k\beta}{2}\tfrac{(1-\varphi)^2}{4}\sigma_\delta^2\left[\rho_{ks}(e, I(L=1)) - \rho_{ks}(e, I(L=0)\right] \\ &+ \tfrac{d_k}{2}(1-\varphi)^2\sigma_\delta^2\left[\tfrac{\rho_{ks}(e, I(L=0))}{2} - \tfrac{1}{2}\right] + \beta E(\alpha_A)\Big] \end{aligned}$$

▸ Divorce

Period 2: Expected Utility with 2 children

Parents:

$$
\begin{aligned}
E[u(c_f)] \quad = \quad & \left\{ \left[1+\varphi\left(gx_g\lambda_g^* + bx_b\lambda_b^*\right)\right] - \tfrac{d}{2}\left[1+\varphi\left(gx_g\lambda_g^* + bx_b\lambda_b^*\right)\right]^2 \right. \\
& -\frac{d}{2}\left\{\varphi^2\left(\frac{\sigma^2_{k1\delta}+\sigma^{k1}_{k1s1\delta}}{2}\right)+\varphi^2\left(\frac{\sigma^2_{k2\delta}+\sigma^{k2}_{k2s2\delta}}{2}\right)\right\} \\
& \left. +\varphi^2 cov(k1,k2)\right\}
\end{aligned}
$$

Each child:

$$
\begin{aligned}
E[u(c_k)] \quad = \quad & \left[1+(1-\varphi)\left(\frac{x_k\lambda_k^* + x_s\lambda_s}{2}\right)\right] - \frac{d_k}{2}\left[1+(1-\varphi)\left(\frac{x_k\lambda_k^* + x_s\lambda_s}{2}\right)\right]^2 \\
& -\frac{d_k}{2}\left\{(1-\varphi)^2\left(\frac{\sigma^2_{k\delta}+2\sigma_{ks\delta}(L)+\sigma^2_{s\delta}}{4}\right)\right\} + E(\alpha)
\end{aligned}
$$

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Two Papers: Jensen and Nolan (2017) and Ashraf et al. (2016)

- Jensen and Nolan (2017)
  - Focus on labor markets, potential migration of sons and assume risk-neutrality of both parents and children.
  - Driving force: inability of parents to appropriate the income of their sons if they migrate.
  - Parents receive a remittance from their son (only part of the son's income)
  - Introduce this component (the share of the son's income that they do not receive) as an additional cost of education.
  - Provide empirical evidence in favor of their model.

Two Papers: Jensen and Nolan (2017) and Ashraf et al. (2016)

- Ashraf et al. (2016)
  - Decline in the cost of schooling in Indonesia and Zambia leads to ethnic groups that traditionally engage in bride-price practice respond by sending their daughters to school and parents obtain a higher bride-price at time of marriage.
  - They develop a theoretical model that allows them to explain these results and derive additional testable implications lending support to their hypothesis and initial results.
  - Their model assumes risk neutral and altruistic parents. Parents invest in education of their daughters in a first period and receive a bride-price compensation in the second period when all the daughters marry.
- This paper: If we introduce a marriage payment as an additional gain, $MP(x_{k,h})$, which is an increasing function of education of the child, the budget constraint of the second period would be:

$$c_{2,f,h} = 1 \quad + \underbrace{\varphi\left(\frac{x_{k,h}\lambda_{k,h} + x_{s,h}\lambda_{s,h}}{2} + \frac{\delta_k + \delta_s}{2}\right)}_{\textit{insurance component}} \quad + \underbrace{MP(x_{k,h})}_{\textit{marriage payment}}$$

- If conflict between parents and their child (parents want the AM, the child wants the LM), the inefficient investment in schooling still holds (although mitigated) as long as:

$$\frac{\partial\left(\varphi\left(\frac{x_{k,h}\lambda_{k,h}+x_{s,h}\lambda_{s,h}}{2} + \frac{\delta_k+\delta_s}{2}\right)\right)}{\partial x_{k,h}} > \frac{\partial MP(x_{k,h})}{\partial x_{k,h}}$$

▸ Limitations