On Governance and the Demographic Transition

Flaubert Mbiekop *

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Abstract

It is now common knowledge that part of an explanation for high fertility rates in developing countries hinges on their institutional features. This note develops a game theoretical framework with a simple overlapping generations model to shed light on the comparative advantage of a child-bearing strategy over conventional savings when facing weak institutions. While disguised unemployment might prevent adult children from providing the expected old-age financial support, the typical household designs a child quality-quantity strategy to avoid such outcome. In the meantime, poor governance might cause individuals to lose their savings if relying on conventional outlets, hence the arbitrage of risks underlying parental decisions in this environment. Mild conditions are sufficient to show that sound institutions induce less fertility while fostering private savings and raising old-age consumption. Yet, a simple voting experiment unveils a complex socio-economic dynamics whereby wealthier households may have vested interest in opposing institutional improvements, hence limiting intergenerational social mobility.

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*Corresponding author: Flaubert Mbiekop, Department of Economics and Business, Drew University, 301 Lewis House, Madison, New Jersey, 07940, U.S.A. Phone: +1-973-408-3764. Email: flaubert.mbiekop@gmail.com. This note has benefited from comments by Kaushik Basu, Peter McClelland, Cristina Echevarria, participants at the 2007 annual meeting of the Canadian Economic Association at Dalhousie University, and at the 2008 annual conference of the Global Development Network in Brisbane. The usual disclaimer applies.

1 Introduction

This note emphasizes weak institutions and competition over modern sector employment to explain the recent experience of many of today's developing countries for which the demographic transition is still awaited. Sub-Sahara African and Middle-Eastern countries are good examples of places where fertility rates are still surprisingly high. Recent estimates suggest that among all regions worldwide, by 2050 Africa will experience the largest percentage increase (184 percent). Its estimated population of 2.1 billion is also expected to be almost three times as large as the 1998 figure and ten times that of 1950 - see Todaro and Smith (2006), p. 267.

When applying the conventional theory of consumer behavior to fertility analysis, children are considered a special kind of good and childbearing a rational economic response to the family's demand for children relative to other goods (*e.g.* Schultz, 1974; Becker and Lewis, 1973; Becker and Nigel, 1976; De Tray, 1973; Gronau, 1973; Willis, 1973).

As far as developing countries are concerned, children are generally viewed, at least partly, as economic investment goods in that childbearing involves an expected return in the form of both child labor and old-age financial assistance (*e.g.* Schultz, 1997; Dasgupta, 1995). With alternative forms of asset accumulation foreclosed because of primitive financial institutions, missing social security plans and old-age pensions, individuals are assumed to rely on their children for old-age security, although children themselves are a risky investment due to early death probabilities. In fact, Lilard and Willis (1997) document significant child-to-parent old-age transfers in Malaysia. Yet, these authors also insist on the difficulty of applying the traditional old-age security model to such a country, since there is no evidence that Malaysia has inadequate outlets for saving.

Over the recent years the international community has been raising serious concerns about persistently high fertility rates in some developing countries. As improvements in health care systems allow for drastic reductions in early death risks, current fertility trends are viewed as a threat to developing countries' ability to provide for the basic needs of fast growing populations. Therefore, gaining more insights into the fundamentals of fertility choices in the developing world is of prime importance if one is to induce the endogenous and necessary behavioral adjustments. James Grant recently emphasized that "the central issue of our time may well turn out to be how the world addresses the problem of ever-expanding human numbers."[1] Of course, it is now common knowledge that the aforementioned trends have to do with missing or weak institutions. However, very few attempts have been made so far to formalize the mechanisms through which missing or weak institutions play out. This note shows how and why governance may be shaping household fertility throughout the developing world. While it is usually argued that high fertility arises because of missing institutions or limited female wage employment opportunities, I show that, even if women had more employment opportunities and the relevant institutions were in place and yet lack credibility and viability, current fertility attitudes may persist as individuals refrain from relying on conventional outlets for saving.[2]

As motivated above this note departs from the recent literature on household fertility in developing countries. In Dessy (2000) individuals have to make a fertility decision in an environment where child labor may be illegal and formal education mandatory for all children. The author uses that framework to show that when schooling isn't mandatory for children, there exists a threshold level of parental labor income below which the household completed fertility and income are positively correlated. This is because the typical parent takes advantage of child labor income in such circumstances to raise the household income, hence the incentive for increased fertility. As this characterization illustrates, the intertemporal trade-off between current child labor income and old-age financial assistance is not investigated. This might implicitly be assuming that current contribution from child labor to the household's income can safely be converted into old-age consumption, so that parents can disregard the implication that their children will not provide old-age financial support,

[1]James Grant is UNICEF's Former Director General quoted in Todaro and Smith (2006), p.262.

[2]For instance, insecure property rights may prevent people from investing in land or livestock acquisition. Similarly, in a context of daily cases of misappropriation and public funds mismanagement, weak judiciary systems may dampen incentives for conventional savings and limit the extent to which individuals take advantage of financial systems.

for child labor would have prevented them from upgrading on parental (low) labor income status. Reintroducing the issue of converting current earnings into old age consumption it is not clear that parents would still opt for child labor, hence the unpredictability of the household behavior with regard to fertility, especially in an environment like the one considered here and where schooling is costly.

On a different ground, Portner (2001) rationalizes the risk-insuring motive of fertility choices in less developed countries. He develops a model in which children serve as an incomplete insurance good allowing parents to shift resources from a period with certain income to periods in the future where income is highly uncertain. Yet, while disguised unemployment rates are well beyond estimates of early death probabilities in most developing countries, Portner's framework emphasizes the latter source of uncertainty and overlooks the fact that low income may still prevent surviving children from providing the expected insurance to their elderly parents. Thus, the model does not investigate conditions under which surviving children can fulfill their old-age security mission.

Furthermore, like most analyses of children as security assets (see, *e.g.* Eswaran, 1996; Appelbaum and Katz, 1991), Portner's framework misses the strategic motives of fertility choices common to many communities throughout the developing world. Strategic behaviors stem from social and cultural values that still underlie fertility attitudes. For instance, it is not rare in rural communities that childless couples are considered a shame to the family at large while prolific couples are praised for their extended progeny. In the latter case, admiration is rooted in the perception that the parents are "wealthy", not because of extensive asset holdings, but in that children will by large provide for their old-age needs.

Dessy and Pallage (2002) first brought strategic considerations into the analysis of household fertility. They developed a model with strategic decisions between households and firms, and used that framework to rationalize the coexistence of high fertility rates and outdated technologies in Africa. In an environment where both human and physical capital investments are risky, a coordination failure can lead to an underdevelopment trap with no investment and high fertility. These authors showed that if parents, who have not seen much modern technology in the past, do not believe strongly enough that entrepreneurs are investing in such skilled biased technologies, then choosing high fertility and child labor is always a winning strategy. However, the authors overlooked the strategic interplays between households and which pertain to competition over scarce, modern sector employment opportunities.

This note develops a model with formal and informal sector employment, the latter paying lower wages relative to the former. The typical household designs a child quality-quantity strategy to maximize the probability of modern sector employment for its offspring. At stake is the prospect of larger old-age financial assistance. A game theoretical approach is then used to capture the strategic interplays underlying fertility and human capital investment choices in an environment that shares some features with Dessy and Pallage (2002). This approach is appealing in that it offers a nice way to account for such important factors like social norms. In fact, Munshi and Myaux (2006) use the same feature to explain why fertility choices have been slow to adjust to external interventions in rural Malaysia. They find that an individual's use of contraceptive methods strongly reacts to the changes in contraceptive prevalence in her own religious group within the village, whereas cross-religions effects are nil. In clearly, they rationalize that the changes in reproductive behaviors that emerge from their data arise from religion-specific interactions at the village level. These authors go on explaining that while religious resistance may be persistent, it has been weakening as more people in the group have gradually been deviating from the traditional social rules. Those deviations in turn have introduced a strategic aspect to the contraception decision in that information about neighbors' decision became important.

The current analysis also departs from the implementation literature (see, *e.g.* Kocherlakota, 1996; Mace, 1991) in a significant way. In this framework, parental choices alter a child's future employment status through the probability for modern sector employment, and hence impact the amount of transfer to be received from adult children.[3]

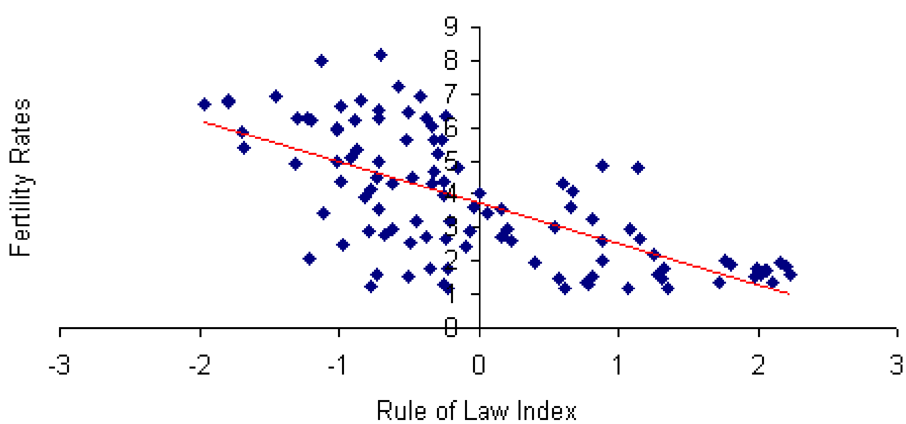
The premise in this note is that when facing weak institutions, household fertility may

[3]Side payment is not an issue since it is assumed that adult children always assist their elderly parents whenever they can afford to do so.

not fall even with significantly high incomes. As an implication, the traditional mechanism operating through mothers' opportunity cost of time may fail to be triggered. This is because current earnings cannot safely be converted into old-age consumption. In such situations, old-age financial assistance remains crucial to elderly parents. Understanding this, the typical parent seeks to increase the probability for her offspring securing well-paid positions. The note emphasizes a child quality and quantity strategy in that respect. One of the trade-offs facing each household is illustrated by the model's feature that both the number and the quality of same-household children are important determinants of the probability to secure well-paid jobs, yet these two ingredients underlie competing claims on household resources.

The notion that governance impacts household fertility decisions is inspired by Chart 1 below. The Chart is based on a sample of 108 countries documents a strong negative correlation (to the order of -0.67) between fertility rates and rule of law indexes worldwide.[4]

Chart 1: Rule of Law Indexes and World-wide Fertility Figures



[4]Data source: United Nations Population Division http://www.esa.un.org/unppg/ and World Bank Institute, Governance and Anti-Corruption Resource Center.

The Rule of Law indicator is a measure of the extent to which agents have confidence in, and abide by the rules of society. The index, which originally ranges between -2.25 and +2.25, incorporates perceptions of the incidence of crime, judicial quality and honesty, and the enforceability of contracts, all of which are considered indicators of governance. Kaufmann, Kraay and Mastruzzi (2003) offer an in-depth discussion of the methodology underlying its calculation.

That child-bearing can serve as an investment/insurance device is all but trivial. If unemployed or if struggling in the informal sector, even well-educated children can fail to provide the expected financial support to their elderly parents. Yet, this not shows that weak institutions make child-bearing more appealing an option when weighing the risks pertaining to conventional outlets for saving against the risk of informal sector employment facing one's progeny.

From a child-survival perspective as common to most models of children as security assets, the note emphasizes labor market uncertainty using five features: (1) A typical household allocates resources to current consumption, saving for old-age consumption, and child rearing. However, depending on their institutional environment, investors may lose their savings and hence, have to rely only on their progeny for financial assistance. I use an index ranging from 0 and 1 to measure the quality of governance, and hence the riskiness of formal outlets for savings. Better and more trustworthy institutions map into a higher probability that investors can recover their savings. This arises as the rule of law induces more rigorous management, and brings about contracts enforcement and property rights protection.

The simple overlapping generations model in this note also accounts for competition over well-paid positions and postulates an endogenous probability to secure such position. Clearly, the probability of modern sector employment depends on (2) the number, *i.e.* quantity of children, and (3) the average human capital levels, *i.e.* quality of children in household j relative to the economy's aggregate, as well as (4) the extent of job rationing in the modern sector as captured by another index ranging from 0 and 1. In addition, following Hazan and Zoabi (2006), it is assumed that, (5) child-rearing expenditures break down into pure rearing costs, including sheltering, clothing and food on the one hand, and formal education expenditures on the other hand. The model assumes parental altruism away, and each generation plays a "game" whereby each household picks a number of children and invests in their human capital. Reporting these two entries to the economy's aggregate then gives the household's probability to secure modern sector jobs through its progeny. Assuming that elderly parents receive an exogenously-fixed fraction of their offspring's income, and letting wages be constant, a higher probability of modern sector employment translates into larger transfers, hence parental stake in their offspring economic status.

To summarize the findings, under mild conditions, better institutions:

(1) induce less fertility at the household level;[5]

(2) foster private savings;

(3) and raise old-age consumption.

(4) Yet, a simple voting experiment unveils that wealthier households have vested interests to oppose institutional improvements.

The remainder of this note is structured as follows. Section 2 presents the model, the results are discussed in Section 3, and Section 4 contains concluding remarks.

2 The model

Consider an overlapping-generations, two-sector model in which economic activities extend over an infinite number of periods and let τ denote the generation of individuals born at time $t = \tau$. At the beginning of every period, a new generation of three period-lived, ex-ante homogenous agents is born. This new generation coexists with two other generations, one (which I refer to as the active generation) with two periods left to live, and the other (elders) with only one period left.

Initially, the economy is inhabited by $M_0 > 0$ (active) households, each of which bears a number of $n_{j,\tau+1} \in [0, n^{\max}]$ children at the beginning of the first period, where $n^{\max}$ is the biological maximum and $j \in \Delta_0 \equiv [1, M_0]$. Unlike active households, elderly individuals play no active role apart from enjoying old-age consumption. Likewise, children make no decision and enjoy parental supervision. A typical household consists of active parents with their children (if any) and lives apart from retired individuals.

[5] Recent experiences, including those of China (1998 rule of law index of -.22), Indonesia (-.97), and Russia (-.78), suggest that modernization does not necessarily imply the rule of law. Therefore, it is unlikely that the latter might just be acting as a proxy for conventional modernization variables affecting fertility (e.g. female education).

A typical individual receives education in the first period of his live (childhood, τ), supplies labor in the labor market in the second period (adulthood, $\tau+1$), and then retires (old-age, $\tau+2$). In the third and last period of their live, individuals consume all out of their savings. Let $A_{j,\tau+1}$ denote an active agent income net of financial assistance to elderly parents. It is assumed that financial assistance to elderly parents claims an exogenously-fixed fraction, $\alpha \in (0,1)$, out of an individual's labor income, regardless of his sector of employment.

Adults supply labor either in the modern or in the traditional sector, and there is no child labor in this economy. Each active household plays a pool strategy with respect to job openings in the modern sector. In clear, such households compete with each other on the basis of their offspring's average human capital (quality), and number (quantity). This specially the case as modern sector employment is uncertain, even for well-educated individuals. A job rationing index, $\delta \in [0,1]$, summarizes labor market conditions, and assumes higher value to signal fewer job openings in the modern sector. All else equal, as the index increases, the probability, $\rho_j\left(.\right)$, that the labor market contest can be successful to household $j's$ offspring decreases. Clearly, the following endogenous probability of success is attached to household $j's$ offspring:

$$\rho_{j,\tau+1}\left(\delta, n_{j,\tau+1}, \bar{h}_{j,\tau+1}\right) = \left(\frac{n_{j,\tau+1}\bar{h}_{j,\tau+1}}{\int_{\Delta_\tau} n_{l,\tau+1}\bar{h}_{l,\tau+1}dl}\right)^{\delta}, \tag{1}$$

where $\bar{h}_{j,\tau+1}$ is the average human capital in household j as chosen for children (new generation) by parents (previous generation), $n_{j,\tau+1}$ is the number of children in household j, and $\int_{\Delta_\tau} n_{l,\tau+1}\bar{h}_{l,\tau+1}dl$ is the economy's aggregate number of children adjusted for their human capital.

In addition to labor market conditions, δ, the above formulation shows that the probability for modern sector employment depends on each household's number and average quality of children relative to the economy's same generation aggregate. It also aligns with Becker and Lewis' (1973) assumption of equal quality for household $j's$ offspring. Since by construction $\rho_j \in (0,1)$, it follows that a child's economic status, $\lambda_{j,\tau+1}$, as captured by labor income status in adulthood, is uncertain.

Old-age financial assistance motivates parental investment into the human capital formation of the new generation, hence the stake on one's offspring's economic status. Clearly, in addition to making fertility decisions, $n_{j,\tau+1}$, a typical parent from generation τ chooses how much to consume, $c_{j,\tau+1}$, to save, $s_{j,\tau+1}$, and through formal education expenses, offspring's average human capital, $\bar{h}_{j,\tau+1}$.

An essential feature of this environment is that while saving individuals have access to a storage technology whereby current resources can be converted into old-age consumption at no cost. However, depending on institutional features as summarized by ζ, there is a non-trivial probability, $1 - \pi(\zeta) > 0$, of losing one's savings. This is because weak institutions pave the way for misappropriation, spoliation, mismanagement, etc., hence the risk facing investors. Better institutions map into a higher index $\zeta \in (0, 1)$, which in turn raises the probability, $\pi(\zeta)$, that investors might recover their savings. For simplicity, I shall assume that this probability is a linear function of the quality of governance, i.e. $\pi(\zeta) = \zeta$. A typical household thus faces the following gamble over old-age consumption:

$$\varsigma_{j,\tau+2} \equiv \left\{ \left(\pi^1 \circ a^1_{j,\tau+2}, \pi^2 \circ a^2_{j,\tau+2} \right) \ / \ \pi^i \geq 0, \ \sum\nolimits_{i=1}^{2} \pi^i = 1 \right\}, \tag{2}$$

where the set of outcomes is given by $\breve{A}_j = \left\{ a^1_{j,\tau+2}, a^2_{j,\tau+2} \right\}$ and the associated probabilities by $\pi^1 = \zeta$, and $\pi^2 = 1 - \zeta$, with

$$a^1_{j,\tau+2} = s_{j,\tau+1} + \alpha\lambda_{j,\tau+1}, \text{ and } a^2_{j,\tau+2} = \alpha\lambda_{j,\tau+1}, \tag{3}$$

where $\lambda_{j,\tau+1}$ is offspring's income/employment status.

The above formulation calls for two important remarks. First, although saving is an option, there is no loss of generality in assuming that capital market imperfections prevent people from borrowing. Second, it is assumed that real return on saving is negligible, *i.e.* $r \approx 0$. It then follows that $\beta = 1/(1+r)$ as in Baland and Robinson (2000), and Rosenzweig and Schultz (1982).

2.1 Labor market competition and production

The numeraire and unique good of this economy can either be produced in the traditional/informal or in the modern sector. Workers inelastically supply labor to firms in any of both sectors. Because of widespread disguised unemployment common to many developing countries it is assumed that labor demand is perfectly elastic in the traditional sector. For simplicity, I consider the following linear technology for the informal sector:[6]

$$F(L) = L. \tag{4}$$

As for the modern sector, not only does it generally involves more productive technologies but it is well-known for labor market regulations and unionization, all features that introduce a wage differential relative to the traditional sector. With only one good in this model economy, letting ω denote the modern sector's real wage rate, perfect competition in the traditional sector implies that in natural log terms, ω can also be interpreted as the wage premium to modern sector workers, hence the stake of the job contest.

2.2 The problem of a typical household

A typical household in this economy faces the following lifetime utility function:

$$U\left(c_{j,\tau+1}, c^i_{j,\tau+2}\right) = u\left(c_{j,\tau+1}\right) + \sum_i^2 \pi^i v\left(c^i_{j,\tau+2}\right) \tag{5}$$

where the functions u and v are assumed to be strictly increasing, strictly concave and to satisfy Inada conditions. A typical household seeks to

$$\max_{\{c_{j,\tau+1}, s_{j,\tau+1}, n_{j,\tau+1}, \bar{h}_{j,\tau+1}\}} U\left(c_{j,\tau+1}, c^i_{j,\tau+2}\right),$$

subject to the sequence of its periodic budget constraints given below:

[6] Modern-sector's wage rate may clearly vary from one generation to the other. However, this dynamics is irrelevant in the current framework as wages are exogenously determined.

$$c_{j,\tau+1} + s_{j,\tau+1} + \kappa n_{j,\tau+1} + \bar{h}_{j,\tau+1} \leq A_{j,\tau+1}, \tag{6}$$

$$c^i_{j,\tau+2} \leq a^i_{j,\tau+2}, \tag{7}$$

where $\kappa > 1$ is a scale parameter and $A_{j,\tau+1}$ is household $j's$ income net of transfers to their elderly parents.

Parental maximization program as written above calls for some important remarks. First, individuals are Von Newman-Morgenstern utility maximizers. Second, there is no parental altruism. Third, the current analysis emphasizes a *hoarding* approach to fertility, since children have to be "stockpiled" in advance, *i.e.* before the job contest starts. Fourth, following Hazan and Zoabi (2006), it is assumed that child-rearing expenses break down into pure rearing costs, $\kappa n_{j,\tau+1}$, including sheltering, clothing and food on the one hand, and formal education expenses, $\bar{h}_{j,\tau+1}$.[7] Therefore, in terms of equation (1), household $j's$ children have no chance of securing modern sector jobs unless a positive amount of resources is devoted to their formal education. The above formulation clearly accounts for the quality-quantity trade-off of fertility choices. This is because given $A_{j,\tau+1}$, $c_{j,\tau+1}$, and $s_{j,\tau+1}$, increasing the number of children comes at the expense of their human capital ($\kappa n_{j,\tau+1}$ versus $\bar{h}_{j,\tau+1}$ in the budget constraint).

Combining (1), (3), (6), (7) and substituting the result back into the objective function for an interior solution yields the following maximization program facing household j:

$$\max_{\{s_{j,\tau+1}, n_{j,\tau+1}, \bar{h}_{j,\tau+1}\}} V\left(s_{j,\tau+1}, n_{j,\tau+1}, \bar{h}_{j,\tau+1}, \rho_{j,\tau+1}\right), \tag{8}$$

with

$$\begin{aligned} V\left(s_{j,\tau+1}, n_{j,\tau+1}, \bar{h}_{j,\tau+1}, \rho_{j,\tau+1}\right) \equiv\ & u\left(A_{j,\tau+1} - s_{j,\tau+1} - \kappa n_{j,\tau+1} - \bar{h}_{j,\tau+1}\right) \\ & + \zeta v\left(s_{j,\tau+1} + \alpha\omega\rho_{j,\tau+1}\right) + (1-\zeta)\, v\left(\alpha\omega\rho_{j,\tau+1}\right). \end{aligned}$$

The next section solves the model for parental optimal choices.

[7] Clearly, it is assumed that there exists a one-to-one relationship between overall formal education expenses in household j and the average human capital of its offspring.

3 Solving the model

This section first characterizes fertility choices and human capital investments as a double-Nash equilibrium outcome of a non-cooperative game involving the aggregate all families facing exogenously given institutions. Next, it considers a simple voting experiment over the quality of institutions to govern economic activities.

3.1 Fertility, saving and old-age consumption

Let household j stand as player j, $j \in [0, M_\tau]$, and let $N_{j,\tau+1} \equiv [0, n^{\max}] \subset \mathbb{N}$ denote the strategy set of player j with respect to fertility, with generic element $n_{j,\tau+1}$. Let also $\Omega \equiv N_1 \times N_2 \times ..... \times N_{M_\tau}$ denote the space of all feasible strategy profiles, with generic element $n_{\tau+1}$. Since competition over modern sector employment involves both the number and the quality of household $j's$ offspring, the latter feature clearly underlies a second strategic variable in this environment. Hence, let $H_{j,\tau+1}$ denote the strategy set of player j with respect to human capital investments, with generic element $\bar{h}_{j,\tau+1}$, and $\Phi \equiv \bar{h}_1 \times \bar{h}_2 \times ..... \times \bar{h}_{M_\tau}$ the space of all feasible strategy profiles, with generic element $\bar{h}_{\tau+1}$. Next, let $V^{j\tau} : N_{j,\tau+1} \times H_{j,\tau+1} \rightarrow \Re$ define a real-valued function such that $\theta_{j,\tau+1} = V^{j\tau}\left(n_{j,\tau+1}, \bar{h}_{j,\tau+1}, s_{j,\tau+1}; n_{-j,\tau+1}, \bar{h}_{-j,\tau+1}, \zeta\right)$, where $\theta_{j,\tau+1}$ denotes the payoff to player j when the strategy profile $n_{\tau+1} \times \bar{h}_{\tau+1} = \left(n_{j,\tau+1}, n_{-j,\tau+1}; \bar{h}_{j,\tau+1}, \bar{h}_{-j,\tau+1}\right)$ is played, $n_{-j,\tau+1}$ and $\bar{h}_{-j,\tau+1}$ denoting the strategy profiles chosen by the aggregate same-generation players other than player j.

To keep the model tractable, from now on I shall consider the following functional forms:

Assumption A1: Let $u(.) = \ln(.)$ and $v(.) = \ln(.)$. Let also strong competition prevails in the modern sector, *i.e.* $\delta = 1$. The latter clearly entails no loss of generality as the focus in this note is not on labor market imperfections.

From equation (8), using assumption A1 and rearranging terms yield the following payoff function for player j:

$$\theta_{j,\tau+1} = \ln\left(A_{j,\tau+1} - s_{j,\tau+1} - \kappa n_{j,\tau+1} - \bar{h}_{j,\tau+1}\right) \\ +\zeta \ln\left(s_{j,\tau+1} + \alpha\omega\rho_{j,\tau+1}\right) + (1-\zeta)\ln\left(\alpha\omega\rho_{j,\tau+1}\right), \tag{9}$$

where $\rho_{j,\tau+1}$ is as defined in (1). Next, I show in the appendix section that given n_{-j}, and $\bar{h}_{-j,\tau+1}$, the first order conditions of player $j's$ maximization problem can be rewritten as follows:

$$\frac{1}{c_{j,\tau+1}} = \frac{\zeta}{s_{j,\tau+1} + \alpha\omega\rho_{j,\tau+1}}, \tag{10}$$

$$\frac{\kappa n_{j,\tau+1}}{A_{j,\tau+1} - s_{j,\tau+1} - \kappa n_{j,\tau+1} - \bar{h}_{j,\tau+1}} = \frac{\alpha\zeta\omega\rho_{j,\tau+1}}{s_{j,\tau+1} + \alpha\omega\rho_{j,\tau+1}}, \tag{11}$$

and

$$\frac{\bar{h}_{j,\tau+1}}{A_{j,\tau+1} - s_{j,\tau+1} - \kappa n_{j,\tau+1} - \bar{h}_{j,\tau+1}} = \frac{\alpha\zeta\omega\rho_{j,\tau+1}}{s_{j,\tau+1} + \alpha\omega\rho_{j,\tau+1}}. \tag{12}$$

Equation (10) is for the optimal level of savings, equation (11) for the optimal level of fertility, and equation (12) for the optimal level of human capital investment.

The left-hand-side (LHS) in equation (10) gives the marginal opportunity cost of conventional saving (less consumption), whereas the right-hand-side (RHS) gives the associated marginal benefit in the subsequent period (self-financed old-age consumption). Equation (10) lends support to the argument that institutions matter for investors and drive their arbitrage between current and next period consumption. Likewise, the RHS in (11) gives the marginal benefit of childbearing, whereas in (12) it gives the benefit that derives from an extra unit of human capital investment. The LHSs in each of these two last equations give the associated costs in terms of less consumption in the current period.

Using (10), (11), and (12) the Value function reduces to:[8]

$$\bar{V}\left(n_{j,\tau+1};\zeta, A_{j,\tau+1}\right) = (1+\zeta)\ln\left(A_{j,\tau+1} - \kappa n_{j,\tau+1}\right) - \ln(1+\zeta) + \zeta \ln\frac{\zeta}{(1+\zeta)} + (1-\zeta)\ln\left(\kappa n_{j,\tau+1}\right). \tag{13}$$

[8]The appendix section shows the details for deriving the Value function.

Definition 1 (Double-Nash Equilibrium) *A double-Nash equilibrium for the M_τ-player game* $G = \left\{ \left(N_{1,\tau+1} \times H_{1,\tau+1}\right), \left(N_{2,\tau+1} \times H_{2,\tau+1}\right) ..., \left(N_{M_\tau,\tau+1} \times H_{M_\tau,\tau+1}\right); \bar{V}_{1,\tau+1}, \bar{V}_{2,\tau+1}, ..., \bar{V}_{M_\tau,\tau+1} \right\}$ *is a collection of pairs of fertility and human capital levels* $\left(n^*_{j,\tau+1}, \bar{h}^*_{j,\tau+1}\right)$, *and a collection of saving levels* $s^*_{j,\tau+1}$, $j \in \Delta_\tau \equiv [1, M_\tau]$, *such that for each player* j *from generation* τ *and given* $n^*_{-j,\tau+1}$, *and* $\bar{h}^*_{-j,\tau+1}$, $n^*_{j,\tau+1}$, $\bar{h}^*_{j,\tau+1}$ *and* $s^*_{j,\tau+1}$ *solve (10) - (12),* $j \in \Delta_\tau \equiv [1, M_\tau]$.

This definition underlies the only theorem in this note:

Theorem. *There exists a unique double-Nash equilibrium for the* M_τ *model economy.*

Proof. While proving proposition 1 below, I show that there is a unique $n_{j,\tau+1}$ such that $d\bar{V}\left(n_{j,\tau+1}; \zeta, A_{j,\tau+1}\right)/dn_{j,\tau+1} = 0$, with

$$\frac{d\bar{V}\left(n_{j,\tau+1}; \zeta, A_{j,\tau+1}\right)}{dn_{j,\tau+1}} = \frac{\left(1-\zeta\right) A_{j,\tau+1} - 2\kappa n_{j,\tau+1}}{\left(A_{j,\tau+1} - n_{j,\tau+1}\right) n_{j,\tau+1}}. \tag{14}$$

On the other hand,

$$\left.\frac{d^2\bar{V}\left(.\right)}{dn^2_{j,\tau+1}}\right|_{n^*_{j,\tau+1}} = \frac{-2\kappa - \left(A_{j,\tau+1} - 2n_{j,\tau+1}\right)\left[\left(1-\zeta\right) A_{j,\tau+1} - 2\kappa n_{j,\tau+1}\right]}{\left[\left(A_{j,\tau+1} - n_{j,\tau+1}\right) n_{j,\tau+1}\right]^2} < 0.$$

Clearly, $n^*_{j,\tau+1}$ is a dominant strategy since $n^*_{j,\tau+1} = \arg\max \bar{V}_{j,\tau+1}$. Likewise, proposition 1 below unveils a one-to-one relation between $n^*_{j,\tau+1}$ and $\bar{h}^*_{j,\tau+1}$, thus the uniqueness property.

This ends the proof. ■

The next result highlights the properties of a double-Nash equilibrium in this economy:

Proposition 1 *The Nash equilibrium profiles for the* M_τ*-player game satisfy* $n^*_{j,\tau+1} \equiv \eta\left(\zeta, A_j\right)$, $\bar{h}^*_{j,\tau+1} = \kappa n^*_{j,\tau+1}$ *and (i)* $\eta_\zeta < 0$, *(ii)* $\eta_{A_j} > 0$.

Proof. Solving $d\bar{V}\left(n_{j,\tau+1}; \zeta, A_{j,\tau+1}\right)/dn_{j,\tau+1} = 0$ yields $n^*_{j,\tau+1}\left(\zeta, A_{j,\tau+1}\right) = \left(1-\zeta\right) A_{j,\tau+1}/2\kappa$. Next, in the appendix section I show that, $\bar{h}^*_{j,\tau+1} = \kappa n^*_{j,\tau+1}$.

This ends the proof. ■

Part one replicates the well-known income effect of the standard micro-economic theory of household fertility. Part two formally rationalizes the connection between institutional features and fertility decisions. It shows that weak institutions bring about higher fertility rates. This is because poor institutions discourage conventional savings and child-to-parent transfers need to take over parental savings in financing old-age consumption. However, since there are only limited job opportunities in the modern sector, old-age consumption might still be negligible, thus parental strategy to widen the base for financial assistance.

Furthermore, Part two lends support to the intuition that weak institutions may prevent the high opportunity costs for mothers' time mechanism from operating. This is because current earnings cannot safely be converted into old-age consumption, thus causing parents to rely on their children for old-age security. Therefore, in addition to increased non-agricultural employment opportunities for women as often emphasized in the literature, sound institutions may be necessary to induce changes in fertility behaviors in developing countries.

Admittedly, that better institutions deter human capital investments may seem counter-intuitive at first glance. Yet, to the extent that sound institutions make it more likely to recover one's savings, there might be less of a need for old-age assistance. Thus, in the absence of any parental altruism, individuals have less stake in their offspring's employment status as institutions improve. This in turn reduces human capital investments, including direct child-rearing resources, $\kappa\eta(\zeta, A_j)$, and formal education expenditures, $k_{j,\tau+1}$. As a result substitution of child quality for child quantity fails to take place.[9]

This note clearly adds valuable insights into fertility decisions in developing countries by formally showing the influence of the institutional environment. Institutional enhancements are specially desirable as the next proposition shows that such improvements may have a positive impact on private saving and old-age consumption.

Proposition 2 *Let $\zeta > \underline{\zeta}$, with $\underline{\zeta} = 1/2$, then better institutions spur private savings and raise old-age consumption.*

Proof. Provided in the appendix section. ■

[9] As the evidence is for less fertility and higher human capital investments in wealthier households, this suggests some parental altruism in the real world - although this remains an unsettled issue for most economists.

Proposition 2 carries important implications for both living standards and economic growth in developing countries. Yet, with lifetime utility-maximizing agents, one might dread some dynamic inefficiency as better institutions foster private savings (*i.e.* less consumption in the current period). Thus, characterizing the institutional environment that would lead to an optimal trade-off between current and old-age consumption is of interest.

3.2 A simple voting experiment

In this experiment the typical household has the opportunity to vote on the quality of institutions to govern economic activities.

Substituting the (Nash equilibrium) solution for fertility, human capital and savings back into equation (9) yields the following welfare function for household j:

$$\begin{aligned} W\left(\zeta;\eta\left(\zeta,A_j\right),A_{j,\tau+1}\right) \;=\;& \ln\left(A_{j,\tau+1}-s^*_{j,\tau+1}-\kappa n^*_{j,\tau+1}-\bar{h}^*_{j,\tau+1}\right) \\ &+\zeta\ln\left(s^*_{j,\tau+1}+\alpha\omega\rho^*_{j,\tau+1}\right)+(1-\zeta)\ln\left(\alpha\omega\rho^*_{j,\tau+1}\right) \end{aligned} \tag{15}$$

Each household now must make a proposal on the value that ζ should take in the society. The next Proposition summarizes the finding:

Proposition 3 *Under the maintained assumption that $\zeta > \underline{\zeta}$, with $\underline{\zeta} = 1/2$, wealthier households typically support weaker institutions.*

Proof. The proof calls upon the Envelop theorem. Clearly,

$$\frac{dW}{d\zeta} = \left.\frac{d\theta_{j,\tau+1}}{d\zeta}\right|_{\eta(\zeta,A_j)},$$

and it is easy to derive that $\zeta^*_{j,\tau+1} = 2/\left(2 + A_{j,\tau+1}\right)$.

This ends the proof. ■

Proposition 3 suggests that it might be all but trivial to address the population problem facing most developing countries, at least to the extent that institutional features shape fertility choices. It points to the fact that wealthier, and often most influential households may have vested interests to oppose institutional improvements. This follows from the standard income effect underlying the current analysis and which implies that in the absence of any parental altruism, fertility rates and human capital investments should be higher for richer households, especially when facing weak institutions. In terms of the competition for modern sector employment, more and better educated children raise the probability to secure well-paid positions. Hence, the results ultimately suggest an intricate socio-economic dynamics whereby wealthier households may attempt to limit upward intergenerational social mobility by opposing institutional improvements. This is because maintaining the *status quo,* as far as institutions are concerned, raises the probability of an intergenerational, economic *status quo.*

4 Concluding remarks

This note formally rationalizes the connection between developing countries' institutional features and their recent fertility experiences. A simple overlapping generations model involving competition over modern sector employment is developed and solved analytically. Under mild conditions, the results show a substitution away from childbearing and towards conventional savings as institutions improve, while old-age consumption also rises. Yet, the results show that wealthier households may have vested interests to oppose institutional improvements and hence prevent intergenerational social mobility arising through the labor market. The real world counterpart of this finding is the well-known reluctance of most developing countries' ruling class to open up the political game by allowing any significant democratic break-trough. In fact, the results suggest that in the context of developing countries where the vast majority is still fighting a fierce battle for even a minute improvement in their daily life, democratic voting would generate a plebiscite in favor of sound governance. This is because sound governance would relieve more individuals from the need to rely on child-bearing for savings in an attempt to preserve old-age consumption (proposition 2). The two-dimensional advantage in terms of quantity and quality of children in favor of wealthier households would then be reduced to a one-dimensional one, hence tightening competition for well-paid jobs among same-generation children. Therefore, the intricate socio-economic dynamics highlighted in this note provides a potential explanation for weak institutions co-existing side by side with high fertility rates and low old-age consumption levels in many developing countries.

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Appendix: Proof of Lemmas and Propositions.

Proof of Claim 1: $\rho_{j,\tau+1}$ *is a decreasing function of* δ.

Since by definition $a^x = \exp(x \ln a)$, the probability to secure modern sector employment can be re-written as follows:

$$\begin{aligned}\rho_{j,\tau+1}(.) &= \left(\frac{n_{j,\tau+1}\bar{h}_{j,\tau+1}}{\int_{\Delta_\tau} n_{l,\tau+1}\bar{h}_{l,\tau+1}dl}\right)^{\delta} \\ &= \exp\left[\delta \ln\left(\frac{n_{j,\tau+1}\bar{h}_{j,\tau+1}}{\int_{\Delta_\tau} n_{l,\tau+1}\bar{h}_{l,\tau+1}dl}\right)\right].\end{aligned}$$

Next, differentiating the above with respect to δ yields:

$$\frac{\partial\rho_{j,\tau+1}(.)}{\partial\delta} = \left[\ln\left(\frac{n_{j,\tau+1}\bar{h}_{j,\tau+1}}{\int_{\Delta_\tau} n_{l,\tau+1}\bar{h}_{l,\tau+1}dl}\right)\right]\exp\left[\delta \ln\left(\frac{n_{j,\tau+1}\bar{h}_{j,\tau+1}}{\int_{\Delta_\tau} n_{l,\tau+1}\bar{h}_{l,\tau+1}dl}\right)\right].$$

The result then follows from $\left(n_{j,\tau+1}\bar{h}_{j,\tau+1}/\int_{\Delta_\tau} n_{l,\tau+1}\bar{h}_{l,\tau+1}dl\right) < 1$ by definition.

Proof : Transforming the first order conditions

Given n_{-j}, and $\bar{h}_{-j,\tau+1}$, player $j's$ best response satisfies the following first order conditions for the optimal levels of saving, fertility and child quality respectively:

$$\frac{1}{c_{j,\tau+1}} = \frac{\zeta}{s_{j,\tau+1} + \alpha\omega\rho_{j,\tau+1}},$$

$$\frac{\kappa n_{j,\tau+1}}{c_{j,\tau+1}} = \frac{(1-\rho_{j,\tau+1})\,\alpha\zeta\omega\rho_{j,\tau+1}}{s_{j,\tau+1} + \alpha\omega\rho_{j,\tau+1}} + \alpha(1-\zeta)(1-\rho_{j,\tau+1}), \tag{16}$$

and

$$\frac{\bar{h}_{j,\tau+1}}{c_{j,\tau+1}} = \frac{(1-\rho_{j,\tau+1})\,\alpha\zeta\omega\rho_{j,\tau+1}}{s_{j,\tau+1} + \alpha\omega\rho_{j,\tau+1}} + \alpha(1-\zeta)(1-\rho_{j,\tau+1}), \tag{17}$$

with

$$c_{j,\tau+1} = A_{j,\tau+1} - s_{j,\tau+1} - \kappa n_{j,\tau+1} - \bar{h}_{j,\tau+1}.$$

Since $\zeta \in (0,1)$, $\rho_{j,\tau+1} \in (0,1)$ and $\alpha \in (0.01, 0.1)$ - Lilard and Willis (1997), there is no significant loss of information in assuming that $\alpha\zeta\rho^2_{j,\tau+1} \longrightarrow 0$, and $\alpha(1-\zeta)(1-\rho_{j,\tau+1}) \longrightarrow 0$, all j and τ. Equations (16) and (17) thus respectively reduce to (11) and (12).

Proof : Deriving the Value function

First combine (11) and (12) to get that

$$\kappa n_{j,\tau+1} = \bar{h}_{j,\tau+1}. \tag{18}$$

Likewise, combining (10) and (11) using (18) yields

$$\int_{\Delta_\tau} n_{l,\tau+1}^2 dl = \alpha\omega n_{j,\tau+1}, \tag{19}$$

Observe that using (19), (1) reduces to

$$\rho_{j,\tau+1} = \frac{\kappa n_{j,\tau+1}}{\alpha\omega}. \tag{20}$$

Next (18) and (19) can be substituted back into (12). Arranging terms then yields

$$s_{j,\tau+1} = \frac{\zeta}{(1+\zeta)} A_{j,\tau+1} - \frac{(1+2\zeta)}{(1+\zeta)} \kappa n_{j,\tau+1}. \tag{21}$$

Substituting (18), (19) and (21) into (9) and arranging terms gives the Value function:

$$\begin{aligned} \bar{V}\left(n_{j,\tau+1};\zeta, A_{j,\tau+1}\right) &= (1+\zeta)\ln\left(A_{j,\tau+1} - \kappa n_{j,\tau+1}\right) - \ln\left(1+\zeta\right) \\ &\quad + \zeta \ln \frac{\zeta}{(1+\zeta)} + (1-\zeta)\ln\left(\kappa n_{j,\tau+1}\right). \end{aligned} \tag{22}$$

Proof of Proposition 1:

To prove the result, first equate (14) to 0 to get that

$$n_{j,\tau+1}^{*}\left(\zeta, A_{j,\tau+1}\right) = (1-\zeta)\frac{A_{j,\tau+1}}{2\kappa}. \tag{23}$$

Substituting (23) back into (18) then yields

$$\bar{h}_{j,\tau+1}\left(\zeta, A_{j,\tau+1}\right) = (1-\zeta)\frac{A_{j,\tau+1}}{2}$$

This ends the proof.

Proof of Proposition 2:

Claim 1: *Better institutions foster private savings.*

To prove the result, we first substitute the Nash solution level of fertility back into (21) and then take a first order Taylor series expansion about $\zeta = 1$ of the resulting equation. This yields

$$s^*_{j,\tau+1}(\zeta, A_j) = \begin{cases} (\zeta - 1/2) A_{j,\tau+1} & \text{if } \zeta > \underline{\zeta}, \\ 0 & \textit{otherwise}. \end{cases} \tag{24}$$

with $\underline{\zeta} = 1/2$.

Claim 2: *Better institutions foster old-age consumption.*

To prove the result, first combine (7) and (3) using (20), (24) and (23) to get expected old-age consumption at time $\tau + 1$:

$$\begin{aligned} E_{\tau+1}(c_{j,\tau+2}) &= \zeta (s_{j,\tau+1} + \alpha\lambda_{j,\tau+1}) + (1-\zeta)\alpha\lambda_{j,\tau+1} \\ &= \zeta s_{j,\tau+1} + \alpha\omega\rho_{j,\tau+1} \\ &= \zeta(\zeta - 1/2) A_{j,\tau+1} + \kappa n^*_{j,\tau+1}(\zeta, A_{j,\tau+1}) \\ &= [1 + 2\zeta(\zeta - 1)] A_{j,\tau+1}/2. \end{aligned}$$

Differentiating the above with respect to ζ then shows that $[dE_{\tau+1}(c_{j,\tau+2})/d\zeta] > 0$, all $\zeta > \underline{\zeta}$.

This ends the proof.