Strategic Fertility, Education Choices, and Conflicts in Deeply Divided Societies

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Abstract

Fertility becomes a strategic choice for minorities when having a larger share of the population helps to increase power. If parents invest resources to educate their children, raising fertility for strategic reasons might be at the cost of future human capital. Census data from several developing countries dispel this view, as small religious groups invest more in both education and fertility compared to larger groups. Solving for the Nash equilibrium of an appropriation game between two groups with education and fertility being prescribed as group-specific behavioral norms, we offer a rationale for the observed patterns provided that human capital is an important input to appropriation.

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1 Introduction

In their analysis of how lowering fertility can help developing countries to grow, economists have mostly considered *individual* incentives to have children: a higher opportunity cost for educated parents (Becker and Lewis 1973 ,de la Croix and Doepke 2003, Becker, Cinnirella, and Woessmann 2010, Vogl 2016), a higher return to education of children (Galor and Weil 2000), higher income and the possibility of inter-generational transfers (Córdoba and Ripoll 2016), a lower cost of contraception (Bhattacharya and Chakraborty 2017), and changing gender-specific opportunities (Voigtländer and Voth 2013). Beyond these mechanisms, a few authors have shown that external social norms affect individual preferences towards having children (Spolaore and Wacziarg 2014, Daudin, Franck, and Rapoport 2019). When social norms matter, the logic of the social group influences the behavior of individuals.

In this paper, we consider that fertility responds to the logic of the social group to which the individual belongs. When the number of groups is small, doing so introduces a game theoretic dimension to fertility behavior, which stems from the strategic power-seeking interactions between groups. This new approach in the literature sheds light on how institutions and demographics interact in societies divided along religious or ethnic dimensions.

Our model is based on the idea of "People as Power" (Yuval-Davis 1996), according to which the population weight of a religious or ethnic group determines its power to appropriate resources when property rights are not perfectly defined. When there are increasing returns to the effect of demographic weight on political power, there is an incentive for each group to increase fertility, so as to benefit from more power in the future (de la Croix and Dottori 2008, Janus 2013). In such a context, the effect of religious and ethnic divisions on a country's economic performance is not limited to the effect of these divisions on the quality of governance and the cost of civil wars (Toft 2005, Alesina and La Ferrara 2005), but may also involve a population race between the groups.

The promotion of fertility may worsen outcomes for its promoters and the country as a whole. One adverse effect in found in education. If people or groups face a Beckerian quality-quantity trade-off (Doepke 2015), higher fertility may come at the expense of the quality of future generations. Intuitively, this adverse effect is mitigated if political power not only depends on the number of people, but is also a function of their human capital.

In a first step, we develop a theoretical framework to model the strategic motives behind fertility and education choices in inter-group competition and determine the conditions under which religious or ethnic division favors fertility at the expense of education. The model captures the following features. Individuals from two distinct groups decide on their fertility and their

children's education. The total output is divided between groups according to their power. Power depends on the relative population size and on human capital. The output increases with labor (population) and human capital.

First, we consider a benchmark case with no cultural norms in which decisions over fertility and education are the prerogative of individuals (i.e., there is no within-group coordination). We show that fertility and education choices are independent of the relative size of the group.

Second, we assume that there exists some cultural norm on education and fertility which coordinates individual behaviors at the group level. Then, each household chooses the level of education and fertility which maximizes the welfare of the group. In that case, both education and fertility vary with the size of the group. When the elasticity of power to human capital is low, at the Nash equilibrium, both fertility and education spending are decreasing functions of the relative size of the group. There is what we label a *reverse quality-quantity trade-off*. Education and fertility are complements. For higher values of the elasticity of power to human capital, the relationship between fertility and education is no longer monotonic with group size: Intermediate size groups have a higher rate of fertility and a lower rate of educational attainment than small groups, which follows a classical quality-quantity trade-off, while large groups have lower rates of fertility and educational attainment than intermediate size groups. Education and fertility are either substitutes or complements.

In our theory, the net impact of a change in group size on the demands for education and fertility is a combination of three distinct effects: a *direct group size effect*, an *indirect strategic effect* and an *indirect substitution effect*. The first effect is negative because the marginal return from appropriation of resources is higher for small groups. The second effect is due to strategic interactions. Because of the conflict technology, the choices of both groups can be either substitutes or complements so that the second effect can be positive or negative. However, the first effect outweighs this second indirect effect so that the combination of both is negative. The third effect is a classical "Beckerian effect" due to the non-separability of child quality and quantity in the cost function. This effect works in the opposite direction by inducing a substitution between quantity and quality.

When the elasticity of power with respect to human capital is low or the group is relatively large, investments in both child quality and quantity are small so that the indirect substitution effect is weak (because the cost of each variable is small). In that case, the negative direct effects prevails: a rise in group size negatively affects both education and fertility. There is a reverse quality-quantity trade-off with respect to group size. However, when the elasticity of power with respect to human capital is high and the group is relatively small, the direct group size effect implies high investments in child quality. The cost of quantity increases substantially,

causing education to be substituted for fertility and therefore fertility decreases. There is a quality-quantity trade-off with respect to group size.

To find out when cultural norms emerge, we extend the previous framework to a broader game in which each group can choose to build a cultural institution that coordinates choices over fertility and education at some fixed cost. In that game, the group acts as a Stackelberg leader by choosing whether to build a cultural institution before the individuals make their choices over fertility and education. An interesting case arises when the fixed cost takes intermediate values. Then, an asymmetric type of equilibrium can emerge in which small groups create a cultural institution while large groups do not. In the absence of clearly defined property rights, and when the power of appropriation is tied to population and human capital, smaller groups have higher incentives to invest in norms of fertility and education, to offset their disadvantage in terms of population size.

In a second step we investigate empirically whether group size affects education as well as fertility. We consider a large fragmented country: Indonesia. Indonesia has hundreds of counties called regencies, for which the Census provides detailed demographic data, including religious affiliation. A majority of regencies are homogenous along the religious dimension, but, in some, various religions coexist. In line with a strategic motive behind fertility behavior, we find that the number of children born per woman is a decreasing function of the share of their religious group in the regency, with the exception of the bottom 5% of the distribution in group size. More surprisingly, we find that the education level of young adults is also decreasing in the share of their religious group. Hence, fertility and education are negatively correlated across groups, which is what the quality-quantity tradeoff model predicts, at the bottom of the distribution of group sizes. They are positively correlated across groups elsewhere. These results can be rationalized by the theory developed in the paper when the elasticity of power to human capital is large enough.

Our results speak to two different literatures. First, they pertain to the field of family macroeconomics and development (Doepke and Tertilt 2016), by introducing multi-dimensional strategies at the heart of fertility and education choices. They also link institutional failure to demographics, as the strategic motives we highlight are made possible by the assumption that property rights are not perfectly defined and enforced. Second, our results speak to the literature on the economics of conflict. A theoretical literature has focused on the trade-off between appropriation (which requires producing "guns") and productive activities, studying implications for economic outcomes (i.e. cost of conflict and distribution of resources); see Garfinkel and Skaperdas (2007a) for a survey. Our work is distinct from this literature because we consider a different conflict technology in which fertility and/or education rather than physical capital are

used as inputs to appropriation. This framework allows us to highlight the role of population size in situations where groups compete for a resource.[1] We are also able to study the impact of conflict on population dynamics and human capital.

In addition, we contribute to the literature on the economics of cultural norms by describing a mechanism of norm formation as the result of strategic interactions. The literature sees norms as the crystalization of a behavior that was optimal in a given historical, geographical and technological context, that is inherited by subsequent generations even after the context that made this behavior optimal disappeared. Alesina, Giuliano and Nunn (2011, 2013) show how norms about unequal gender roles and low fertility were shaped by the suitability of land for the use of the plough. The underlying reasoning is that norms that persisted gave some evolutionary advantage, for instance by solving coordination failures. We extend this view by allowing the possibility that norms give an advantage in inter-group competition.

A part of this literature has more precisely investigated the role of cultural institutions in the emergence of various cultural norms. Berman (2000) proposes a theory where norms over fertility and education reflect a mechanism of group coordination which is due to the existence of religious club goods. This theory provides a rationale for individual choices to follow strict norms.[2] We propose a complementary approach where such norms emerge through group incentives that are generated by inter-group conflicts. Some recent works have considered the role of a centralized mechanism in the formation of cultural norms (Verdier and Zenou 2018, Carvalho and Sacks 2020). For instance, Verdier and Zenou (2018) have examined how cultural leaders or the cultural institutions that they represent (churches, mosques, schools, ethnic associations) impact the integration of immigrants. They consider cultural institutions as coordinating socialization agents and investigate how these institutions affect the dynamics of immigrants' cultural identities. In comparison to this literature, we neglect the dynamic aspects of cultural evolution to focus on the strategic use of education and fertility norms by cultural groups in conflict environments.

Our view on education and human capital as an input in the appropriation technology is new. The literature on conflict generally considers physical capital, not human capital, as an input. We claim that a high-skilled population can more easily use a more advanced war technology. A historical example of the importance of education is the novel tactics implemented by the Prussian army in the nineteenth century, which required a high level of education at all levels, and relied upon independent decision making by the lower ranks. This has led historians to

[1] Mariani, Mercier, and Verdier (2018) also study the impact of population size on inter-group conflict (and conflict resolution). They focus, however, on migration - rather than fertility - as the main driver of demographic change.

[2] The author analyses the case of Ultra-Orthodox Jews.

claim that the outcome of the battle of Sedan in 1870, a victory against the French army, was determined by Prussian elementary school teachers (Nipperdey 1994, p531). This claim received a recent echo in the study proposed by Aghion et al. (2019). They show that public investment in education in Europe over the last 150 years was induced by the military rivalry and the regular occurrence of conflicts with neighboring countries.

In addition to improving military skills, education can also be seen as a way to increase the cohesiveness of a group, through the promotion of a common language and patriotic values.[3] Group cohesiveness may enhance one's ability to prevail in a conflict directly, as well as through the capacity of leaders to implement social norms. For instance, a more educated ethnic group will more easily construct a version of history which heightens the role of that group at the expense of others (Bush and Saltarelli 2000). Additionally, minorities may be excluded from power and influence through lack of access to the language, codes of power, and government (Graham-Brown 1994).

We organise the paper as follows. In Section 2 we elaborate the theory in the absence of norms. In Section 3 we introduce fertility and education norms and derive the main results. We consider in Section 4 the case when the adoption of norms is itself endogenous. In Section 5 we describe the Indonesian context and show how fertility and education are correlated with religious group size. We investigate external validity of our results in Section 6, and conclude in Section 7.

2 The equilibrium without norms

We now define the environment in which two groups which compete to appropriate resources operate. We also analyze in this section how fertility and education are decided in a context where behavioral norms are absent.

2.1 Preferences and technology

Consider a two-period model, $t \in \{1, 2\}$ with three overlapping generations : children, young adults and old adults.

As children, individuals get some education from their parents. The young adults work, support their elderly parents' consumption, choose fertility, and educate their children. Elderly agents consume what is provided by their adult children.

[3]Cinnirella and Schueler (2018) show how public primary education in imperial Germany promoted patriotic values and increased the vote share for pro-nationalist parties.

The population consists of two groups $i \in \{a, b\}$. All individuals belong to either group a or b, and there is no possibility of changing group membership.[4] At date t, group i consists of a continuum of identical adults uniformly distributed over the interval $[0, N_t^i]$. Let $N_t = N_t^a + N_t^b$, be the total number of agents at date t and define the share of group i in the population, $x_t^i \equiv N_t^i / N_t$.

At date $t = 1$, the utility of a young adult $j \in [0, N_1^i]$ of group i is given by

$$U_1^{ij} = c_1^{ij} + \beta d_2^{ij} - \frac{\lambda}{2} \left(n_1^{ij}\right)^2, \tag{1}$$

where c_1^{ij}, resp. d^{ij}, is the consumption of household j in group i at date $t = 1$ (i.e., when she is young), resp. $t = 2$ (i.e., when she is old), and $n_1^{ij} \in [0, \bar{n}]$ is the number of children (the upper bound on the number of children captures physiological constraints). The preference parameters are $\beta > 0$, the discount factor and $\lambda > 0$, the factor affecting the utility cost of child-rearing.

Each adult supports their elderly parents with a fraction τ of their income y_1^{ij}. At date $t = 1$, the young adult's budget constraint is:

$$c_1^{ij} = (1 - \tau) y_1^{ij} - \gamma \, n_1^{ij} e_1^{ij}, \tag{2}$$

where e_1^{ij} denotes the education spending per child, and $\gamma > 0$ is the cost of this spending. At date $t = 2$, the elderly adult's budget constraint is:

$$d_2^{ij} = \tau n_1^{ij} \, y_2^{ij}. \tag{3}$$

It is thus proportional to the number of children they had (at date $t = 1$), and to the income these children will have when adult (at date $t = 2$).

Given the absence of Inada conditions, the following additional constraints must be imposed:

$$c_1^{ij}, \; d_2^{ij} \geq 0. \tag{4}$$

For d_2^{ij}, this is automatically verified by (3). For c_1^{ij}, this condition imposes that the spending on the children does not exceed the date-1 income. The latter is a predetermined variable. We will see later that the choices of n_1^{ij} and e_1^{ij} do not depend on y_1^i. Hence, the condition $c_1^{ij} \geq 0$ amounts to imposing a lower bound on the predetermined y_1^i. Let $\bar{n}$ be the biological maximum

[4] In the context of religious groups, changing religion is usually quite costly, either because it is punished by law, as in the case of apostasy in Islam, or because parents have strong preferences for having children with the same religious faith, as in Bisin, Topa, and Verdier (2004).

number of children. We also assume an upper bound $\bar{e}$ on the possible amounts households can spend on education. We suppose that $(n_1^{ij}, e_1^{ij}) \in \mathcal{X}$ where $\mathcal{X} \equiv [0, \bar{n}] \times [0, \bar{e}]$.

The human capital of a young adult j of group $i \in \{a, b\}$ at date $t = 2$ is positively affected by the spending in education at date $t = 1$, e_1^{ij}:

$$h_2^{ij} = \left(e_1^{ij}\right)^{\rho}, \quad \rho \in [0, 1], \tag{5}$$

The number of young adults in group $i \in \{a, b\}$ at date 2 is given by

$$N_2^i = \int_{j=0}^{N_1^i} n_1^{aj} dj.$$

Total human capital of the young adults at date $t = 2$ is given by

$$H_2 = h_2^a N_2^a + h_2^b N_2^b. \tag{6}$$

To determine future income, the way in which total output is produced and shared between the groups must be defined. The total production at date t is an increasing function of total human capital, given by

$$Y_t = (H_t)^{(1-\alpha)}, \quad \alpha \in [0, 1]. \tag{7}$$

At date t, each worker (young adult) receives the marginal product of her work, $(1-\alpha)H_t^{-\alpha}h_t^i = \omega_t h_t^i$. Property rights are assumed not to be perfectly enforced, so that groups compete for the appropriation of profits. We model the conflict as a contest game where each group might claim the right to a share of the wealth (Garfinkel and Skaperdas 2007b). The claim is settled under the threat of conflict which leads to a division of the contested good equal to the bargaining power of each party.[5] Let us denote by Π_2^i group i's bargaining power at date $t = 2$. The individual income of the young adults j at date $t = 2$ is given by:

$$y_2^{ij} = \omega_2 h_2^{ij} + \Pi_2^i \frac{\alpha Y_2}{N_2^i} \tag{8}$$

Departing from classical models where the conflict technology depends on capital through weapon production, we assume that a group's power increases with both the size of its population of young adults at date t, N_t^i, and the level of human capital in this cohort, h_t^i. More

[5]There is an alternative interpretation where the absence of property rights leads to open conflict rather than negotiations. In this case, conflict is seen as a winner-take-all contest where each contending party has a probability of winning the whole resource. In our framework, this probabilistic interpretation of the model is equivalent to the deterministic view, since agents are assumed to be risk neutral.

precisely, omitting time indexes to alleviate notation, the power of group a, Π^a, is given by:

$$\Pi^a(N^a, N^b, h^a, h^b) = \begin{cases} \dfrac{(h^a)^\mu N^a}{(h^a)^\mu N^a + (h^b)^\mu N^b}, & \text{if } h_t^i \neq 0 \text{ and } N_t^i \neq 0 \quad \forall i \in \{a, b\}, \\ \dfrac{N^a}{N^a + N^b}, & \text{if } h^i = 0 \text{ and } N^i \neq 0 \quad \forall i \in \{a, b\}, \\ \dfrac{(h^a)^\mu}{(h^a)^\mu + (h^b)^\mu}, & \text{if } h^i \neq 0 \text{ and } N^i = 0 \quad \forall i \in \{a, b\}, \\ \frac{1}{2}, & \text{if } h^i = 0 \text{ and } N^i = 0 \quad \forall i \in \{a, b\}, \end{cases} \tag{9}$$

The function Π^a is parametrized by μ. The parameter $\mu > 0$ represents the relative importance of human capital vs group size in a conflict. Π^a satisfies the different axioms stated in Skaperdas (1996).

When $\mu = 0$, we have the classical case of the population race stressed by Bookman (2002): "An inter-ethnic war of numbers is taking place in numerous locations. The goal of this war of numbers is to increase the economic and political power of an ethnic group relative to other groups, and the method by which this is achieved entails the increase in size of one population relative to the others. Most ethnic groups in multinational states across the globe are engaged in this activity in varying degree, ..." When $\mu > 0$, human capital intervenes as an additional argument to determine groups' power.

We have argued that norms on fertility and education are essential to explain the link between group size and investments in both child quantity and child quality. To make the role of these norms clear, we consider a benchmark case where norms are absent, that we will compare to a model where norms affect fertility and education choices.

2.2 The decision problem without fertility-education norms

Without a cultural norm which coordinates individuals' behaviors, fertility and education choices remain the prerogative of individuals. Consider group a. At date $t = 1$, young adult $j \in [0, N_1^a]$ has a payoff function:

$$W(n_1^{aj}, n_1^a, n_1^b, e_1^{aj}, e_1^a, e_1^b, x_1^a) = \beta\tau n_1^{aj} y_2^{aj} - \gamma\, n_1^{aj} e_1^{aj} - \frac{\lambda}{2}\left(n_1^{aj}\right)^2 + (1-\tau) y_1^{aj},$$

where $\forall i \in \{a, b\}$,

$$n_1^i \equiv \frac{1}{N_1^i} \int_{j=0}^{N_1^i} n_1^{ij} dj,$$
$$e_1^i \equiv \frac{1}{N_1^i} \int_{j=0}^{N_1^i} e_1^{ij} dj.$$

Young adult j of group a solves[6]

$$\max_{(n_1^{aj}, e_1^{aj}) \in \mathcal{X}} W(n_1^{aj}, n_1^a, n_1^b, e_1^{aj}, e_1^a, e_1^b, x_1^a).$$

The first-order conditions for an interior maximum writes as

$$\beta\tau y_2^{aj} - \gamma\, e_1^{aj} - \lambda n_1^{aj} = \beta\tau \left(\omega_2 (e_1^{aj})^\rho + \Pi_2^a \frac{\alpha Y_2}{N_2^a} \right) - \gamma\, e_1^a - \lambda n_1^a = 0, \tag{10}$$

$$\beta\tau n_1^{aj} \frac{\partial y_2^{aj}}{\partial e_1^{aj}} - \gamma\, n_1^{aj} = \beta\tau\omega_2\rho(e_1^{aj})^{\rho-1} - \gamma\ = 0. \tag{11}$$

In equation (10), the term $\beta\tau y_2^{aj}$ captures the marginal benefit from fertility. In this benchmark case, child quantity positively affects utility through one channel, i.e., by increasing the number of children who support their retired parents. This quantity increases with the income of children y_2^{aj} (made of labor income and the expected profit per capita).

The marginal benefit from education is given by $\beta\tau n_1^{aj}\omega_2\rho(e_1^{aj})^{\rho-1}$. Investments in child quality increase utility by increasing the human capital and hence the labor income of children. The positive effect of education is stronger when the wage rate of children ω_2 is high.

Equation (11) also shows that no education, i.e. $e_1^{aj} = 0$, cannot be a solution because the marginal productivity of education is infinite when education is nil. As a consequence, having no children is not optimal either, because it would prevent the family from enjoying the benefit of education. In other words, the incentive to invest in education provides the incentive to have a child. Childlessness is thus excluded here by two assumptions: the infinite returns to education at 0 and the non-separability between education and fertility.

To understand how education and fertility are affected by a change in group size, let us first focus on equation (11). Note that the marginal benefit of education depends on the fertility

[6]Note that the term $(1-\tau)y_1^{aj}$ is a constant for the agent. To simplify the reading, we just skip this term in all subsequent expressions of the utility.

of the group and the size of that group through the wage rate only. This variable is the same in group a and b, so that the marginal benefit for education is also the same between groups. Hence, at equilibrium, $e^a = e^b$.

Second, let us examine the first order condition for child quantity, i.e., equation (10). First, the marginal benefit of fertility depends on the wage rate and aggregate investments in conflict. Those quantities are the same in groups a and b. Second, the marginal benefit (and marginal cost) from fertility also depends on group-specific variables through the level of human capital, which can vary between groups. However, as detailed above, education is the same in groups a and b. This implies that the group-specific variables are also the same for both groups. Hence, the marginal benefit from fertility is the same for both groups, which implies $n^a = n^b$.

Finally, note that a change in x affects the marginal benefit from fertility or education through population-level variables, i.e., aggregate investments in conflict or the wage rate. These quantities vary with groups' relative size only if education or fertility differs between groups, which is not the case as detailed before. Hence, a change in x does not impact fertility or education at equilibrium.

We deduce the following Proposition.

Proposition 1 *When norms on fertility and education are absent, at the Nash equilibrium, fertility and education choices are not affected by a change in group size.*

At the Nash equilibrium, fertility and education choices are not affected by a change in group size. This is at odds with our empirical analysis, which will reveal that both fertility behaviors and education choices respond significantly to a change in the size of the group. In the subsequent section, we modify our theoretical framework by assuming that individuals are able to coordinate within a given religious group. We have in mind some cultural institution that sets norms regarding fertility and education. The question of why such an institution exists in the first place is dealt with in a third stage.

3 Strategic decisions on fertility-education norms

We now consider that young adults decide on their consumption path, but they obey the cultural norm as far as fertility and education are concerned. Each group sets the level of the norms by maximizing the utility of its representative household. The payoff of any individual $j \in [0, N_1^a]$, of group a is given by the quantity $V(n_1^a, n_1^b, e_1^a, e_1^b, x_1^a)$ where $V : [0, \bar{n}]^2 \times [0, \bar{e}]^2 \to \mathbb{R}$ is such that

$$V(n_1^a, n_1^b, e_1^a, e_1^b, x_1^a) = W(n_1^{aj}, n_1^a, n_1^b, e_1^{aj}, e_1^a, e_1^b, x_1^a),$$

where

$$n_1^{aj} = n_1^a \quad \forall j \in [0, N_1^a], \quad e_1^{aj} = e_1^a \quad \forall j \in [0, N_1^a].$$

Utility maximization takes place within a two-player game in which each group simultaneously chooses their vector of strategy $(e_1^i, n_1^i) \in \mathcal{X}$ taking the other group's strategy (e_1^{-i}, n_1^{-i}) as given.

We set $x_1^a = x_1$ and we skip the time indexation of x by denoting $x_1 = x$.

Definition 1 (Nash equilibrium) *For all $x \in [0,1]$, a pure-strategy Nash equilibrium is a strategy profile $(n_1^{a\star}, n_1^{b\star}, e_1^{a\star}, e_1^{b\star}) = (n^a(x), n^b(x), e^a(x), e^b(x))$ with $n^i : [0,1] \to [0, \bar{n}]$ and $e^i : [0,1] \to [0, \bar{e}]$ such that for all $i \in \{a, b\}$,*

$$V(n_1^{i\star}, n_1^{-i\star}, e_1^{i\star}, e_1^{-i\star}, x_1^i) \geq V(n_1^i, n_1^{-i\star}, e_1^i, e_1^{-i\star}, x_1^i) \quad \forall (n_1^i, e_1^i) \in \mathcal{X}.$$

In Appendix A.1 we show that a pure-strategy Nash equilibrium exists whenever α is low (i.e., the share of human capital in total production is high) and when μ takes intermediate values (see Lemma 1 and Proposition 1).

The first order conditions of the maximization program of group a are written as

$$\beta\tau y_2^a + \beta\tau n_1^a \frac{\partial y_2^a}{\partial n_1^a} - \gamma\, e_1^a - \lambda n_1^a = 0,$$
$$\beta\tau n_1^a \frac{\partial y_2^a}{\partial e_1^a} - \gamma\, n_1^a = 0.$$

Compared to the benchmark, the marginal benefit from child quantity includes an additional term, $\beta\tau n_1^a \partial y_2^a / \partial n^a{}_1$ (see Equation (10)). Fertility now increases children' s income, by affecting labor income and the appropriated wealth per capita.

The marginal benefit from education also includes additional terms which are embodied in the derivative $\partial y_2^a / \partial e_1^a$. This is because education not only increases labor income but also the appropriated wealth per capita.

We now analyze how strategic fertility and education depend on the demographic weights of the two groups. We consider two cases in succession. First, we solve a model in which human capital and population have the same impact on appropriation (i.e., $\mu = 1$). Second, we consider a case in which the impact of human capital on appropriation is stronger than the impact of population (i.e., $\mu > 1$).

3.1 Human capital and population have the same impact on appropriation

At $\mu = 1$, the first order conditions associated with the maximization program of group a are given by

$$\beta\tau y_2^a - \beta\tau N_1^{-1} n_1^a \alpha Y_2 \frac{(h_1^a)^2\, x}{\left(h_1^a n_1^a x + h_1^b n_1^b (1-x)\right)^2} - \gamma\, e_1^a - \lambda n_1^a = 0, \tag{12}$$

and

$$\beta\tau n_1^a \rho\omega_{t+1}(e_1^a)^{\rho-1} + \beta\tau N_1^{-1} n_1^a \alpha Y_2 \frac{\rho(e_1^a)^{\rho-1} h_1^b n_1^b (1-x)}{\left(h_1^a n_1^a x + h_1^b n_1^b (1-x)\right)^2} - \gamma\, n_1^a = 0. \tag{13}$$

Compared to the benchmark, there is an additional term (i.e., the second term) in each equation. This quantity captures the impact of fertility or education on the appropriated wealth per capita.

Proposition 2 (Reverse quality-quantity trade-off)
For $\mu = 1$, at the Nash equilibrium both the fertility and education of group i are decreasing with the share of group i in the population.

Proof. See Appendix A.2. ■

Through their effect on the appropriated wealth per capita, both fertility and education are affected by a change in the demographic weight. Proposition 2 reveals that there is a reverse quality-quantity trade-off where both education and fertility decrease with group size. This is what we observe in the data (abstracting from the behavior of small groups).

The net impact of a change in group size on the demands for education and fertility is a combination of three distinct effects: the *direct group size effect*, the *indirect strategic effect* and the *indirect substitution effect*.

The direct group size effect is negative. To understand the intuition, consider Equations (12) and (13). The second term in both equations is negatively affected by a rise in x (holding other variables constant). This is because the marginal return from appropriation is higher for small groups. This property follows the logic of the *paradox of power* (Hirshleifer 1991). Initially weaker contenders (here smaller groups) are rationally motivated to fight harder (investing more in child quality and quantity) in power struggles.

The *indirect strategic effect* goes through the reaction of the other group. Because of the conflict

technology, choices of both groups are either strategic substitutes or complements (it depends on the initial power of each group). Therefore, the indirect strategic effect can be either negative or positive. However, overall the direct negative effect outweighs the indirect strategic effect so that the combination of the two first effects is negative.

The *indirect substitution effect*, which is positive, is due to the cost function. If child quality increases (more spending per child), increasing quantity (more children) becomes more expensive and vice versa. This "Beckerian effect" works in the opposite direction. A rise in the size of the group, which tends to reduce education by this group (through the direct effect), also tends to increase the demand for child quantity by decreasing the cost per child. Similarly, a larger group size, which tends to decrease fertility also tends to increase investment in education by reducing the total cost of education.

When the elasticity of power with respect to human capital is low, both fertility and education have a small impact on power so that the marginal benefit from both variables is relatively low. Then, whatever the size of the group, investments in both child quality and quantity remain limited. Therefore, the rise in the cost of each variable is small so that the indirect substitution effect is weak. The negative effect outweighs the indirect (positive) substitution effect. In that case, a rise in group size negatively affects both education and fertility. There is a reverse quality-quantity trade-off with respect to group size.

The left panel of Figure 1 illustrates the point. A numerical example is provided in Appendix C.

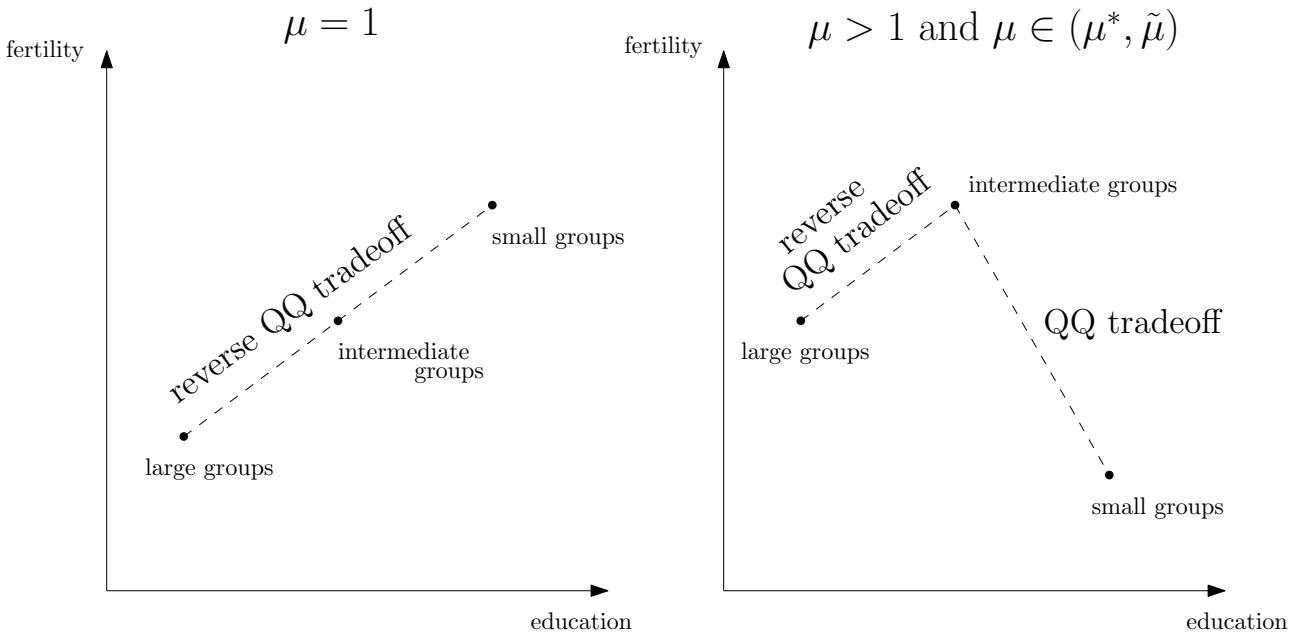


Figure 1: Propositions 2 (left panel) and 3 (right panel)

We conclude that taking into account the effect of population and human capital on the ability

of a given group to appropriate common resources may make rivalry between groups beneficial for long term growth prospects, through enhancing education. This resembles the model of Lagerlöf (2014) where intergroup competition may spur growth through investment in education, although in a different context.

3.2 Human capital has a stronger impact on appropriation

With $\mu > 1$, the model becomes more involved. We can however examine the impact of demography on education and fertility norms by comparing the behaviors of small groups (i.e., $x = 0$), intermediate groups (i.e., $x = 1/2$) and large groups (i.e., $x = 1$).

Let us express the first order conditions in each case.

For $x = 0$, we get

$$\beta\tau y_2^a - \gamma\, e_1^a - \lambda n_1^a = 0,$$
$$\beta\tau n_1^a \rho\omega_2 (e_1^a)^{\rho-1} + \beta\tau n_1^a {N_1}^{-1}\alpha Y_2 \frac{\rho\mu (e_1^a)^{\rho\mu-1}}{\left(h_1^b\right)^{\mu} n_1^b} - \gamma\, n_1^a = 0,$$

For $x = 1$,

$$\beta\tau y_2^a - \beta\tau n^a N^{-1}\alpha Y_2 \frac{1}{(h_1^a)^{\mu}\, n_1^a} - \gamma\, e_1^a - \lambda n_1^a = 0.$$
$$\beta\tau n_1^a N^{-1}\rho\omega_2 (e_1^a)^{\rho-1} - \gamma\, n_1^a = 0.$$

For $x = 1/2$,

$$\beta\tau y_2^a - \beta\tau n_1^a N^{-1}\alpha Y_2 \frac{1}{2\left(n_1^a\right)^2} - \gamma\, e_1^a - \lambda n_1^a = 0.$$
$$\beta\tau n_1^a \rho\omega_2 (e_1^a)^{\rho-1} + \beta\tau n_1^a N^{-1}\alpha Y_2 \frac{\rho\mu (e_1^a)^{\rho\mu-1}\left(h_1^b\right)^{\mu} n_1^b(1/2)}{2\left((h_1^a)^{\mu}\, n_1^a\right)} - \gamma\, n_1^a = 0.$$

Several features are worth noticing. For $x = 0$, the effect of fertility on appropriation disappears so that the marginal benefit from fertility is the same as in the benchmark model. By contrast, in that case, education has a positive impact on appropriation. The intensity of this effect depends on μ. For $x = 1$, the marginal benefit from education is low (i.e., the same as in the benchmark case) since the impact of education on appropriation disappears. We can show the following.

Proposition 3 *There exist $\mu^* > 1$ and $\tilde{\mu} > 1$ such that for any $\mu \in (\mu^*, \tilde{\mu})$, at the Nash*

equilibrium,

$$e^a(0) > e^a(1/2) > e^a(1) \quad \textit{and} \quad n^a(1/2) > n^a(1) > n^a(0).$$

Proof. See Appendix A.3 ■

The right panel of Figure 1 illustrates the result, while a numerical example is provided in Appendix C. Proposition 3 reveals that when μ is higher, the relationship between fertility and education is no longer monotonic with group size. Consider the comparison between groups of intermediate size (i.e., $x = 1/2$) and large groups (i.e., $x = 1$). Both education and fertility decrease with group size (i.e., $e^a(1/2) > e^a(1)$ and $n^a(1/2) > n^a(1)$), that is, there is a reverse quality-quantity trade-off as for the case $\mu = 1$. However, consider now the comparison between small groups (i.e., $x = 0$) and groups of intermediate size (i.e., $x = 1/2$). Proposition 3 reveals that as group size increases, there is a quality-quantity trade-off: education decreases with group size while fertility rises (i.e., $e^a(1/2) < e^a(0)$ and $n^a(1/2) > n^a(0)$).

As detailed in the previous section, the net impact of a change in group size on the demands for education and fertility is a combination of three effects: a negative *direct group size effect*, an ambiguous *indirect strategic effect* and a positive effect: the *indirect substitution effect*. When the elasticity of power with respect to human capital (μ) is high, the third positive effect can be substantial. It crucially depends on group size.

When the group is relatively large, investments in education are limited because of the negative group size effect on power (in particular, the FOC reveal that when $x = 1$, the marginal impact of education on power disappears). In that case, the cost of both child quality and quantity remain sufficiently low that the indirect substitution effect is weak. Because of the direct negative effects of group size, overall a rise in group size negatively affects education and fertility. There is a reverse quality-quantity trade-off with respect to group size.

However, when the group is very small, the group size effect now implies high investments in child quality (see the FOC for the case $x = 0$). But then the cost of quantity increases substantially, causing education to be substituted for fertility and therefore fertility decreases. There is a quality-quantity trade-off with respect to group size for very small group sizes.

4 Strategic decisions on whether to establish norms

Let us now consider an extension in which each group can choose to build a cultural institution which coordinates choices over fertility and education at some fixed cost κ. A schematic representation of the game is provided in Appendix D. In that game, the group (of young adults at date $t = 1$) acts as a Stackelberg leader by choosing whether to build a cultural institution

before the individuals make their choices over fertility and education. In the second stage, individuals choose fertility and education given the optimization constraint (i.e., the cultural norm) imposed by the institution.

In this game, the optimal choices of fertility and education are functions of the choice of the leaders. When the leader of the group chooses to build a cultural institution, each household acts as a representative individual of the group and chooses the level of education and fertility which maximizes the welfare of the group, taking the choices of members of the other group as given. When the leader chooses not to build a cultural institution, each household in the group chooses its level of fertility and education, taking the choices of all other members of the group and the choices of members of the other group as given. A formal definition of the Stackelberg-Nash equilibrium is provided in Appendix B.

We consider a game between a small group ($x \approx 0$) and a large group ($x \approx 1$). We show that the equilibrium is unique and depends on the cost of building a cultural institution (see Proposition 2 in Appendix B.) More precisely, when this cost is high, we are back to the benchmark case where there are no norms on education and fertility. Conversely, when the cost of creating a cultural institution is small, we are back to our main theory where norms on fertility and education are enforced. When the fixed cost is intermediate, an asymmetric type of equilibrium can emerge in which small groups create a cultural institution while large groups do not. This result holds when μ, the impact of human capital on appropriation, is not too low. Rapoport and Weiss (2003) analyze the optimal size of a minority when incentives to cooperate decrease with the relative size of a group. This extension offers a micro-foundation for this negative relationship which is rooted in the technology of appropriation. When norms are endogenous, because the marginal return from appropriation decreases with group size, smaller groups have higher incentives to coordinate on a norm over fertility and education behaviors.

5 Fertility and Education in Indonesia

In this section, we document how fertility and education decision vary with the size of the religious group one belongs to in the context of Indonesia.

5.1 The Indonesian context

Indonesia is a very diverse country with about 700 languages and dialects spoken. Ethnic diversity in particular has been shown to shape socioeconomic outcomes in Indonesia, including the prevalence of community organizations (Okten and Osili 2004), the pattern of public good provision (Bandiera and Levy 2011), and individual social capital (Mavridis 2015). Accounting

for diversity also matters for assessing policy interventions, as in the case of the school building program of the 1970s, for which a positive impact on female education is only observed among girls from ethnic groups that traditionally engage in monetary bride price payments at marriage (Ashraf et al. 2020). Indonesia also experimented with policies targeting ethnic diversity directly: the so-called "transmigration" program reassigned about 2 million volunteers in the 1950s and 1960s from the Inner Islands of Java and Bali to the Outer Islands, in an attempt to promote nation building. Bazzi et al. (2019) find that the program has had positive effects on integration (as measured by national language use at home, intermarriage, and children's name choices), social capital, public goods and ethnic conflicts in fractionalized communities with many small groups. However, the opposite happened in polarized communities with a few large groups.

Beyond ethnicity and language, religious identity is also salient in Indonesia. Gaduh (2012) finds that individuals are more cooperative and trusting of their community members in more religiously homogeneous communities. Chen (2010) shows that Islam played the role of an ex-post insurance mechanism in the aftermath of the Indonesian financial crisis of 1997. Chen (2006) further illustrates how the economic crisis exacerbated violent conflicts along religious lines.[7] Finally, religion also plays an important role when it comes to fertility decisions. Examining six south-Asian countries, including Indonesia, de la Croix and Delavallade (2018) find that while Catholicism is the most pro-child religion (increasing total spending on children), followed by Buddhism, Islam has a strong pro-birth component (redirecting spending from quality to quantity).

We focus on religious affiliation as defining cultural groups.[8] Indeed, religion has an important prescriptive power in Indonesia on issues ranging from clothing and food bans to views about gender roles and political leanings. This power is so strong that it can sometimes strongly curb the effectiveness of public policies. Bazzi, Koehler-Derrick, and Marx (2020) describe how rural elites have used Islamic institutions to circumvent land reforms, highlighting further the role of religion in power struggles in Indonesia. Among other means, one way through which village elders and local religious authorities influence behavior is through the enactment of a *Sasi*, or taboo, which prevents anyone from accessing a common resource: fish and other sea products, fruits from communal orchards, vacant properties etc. But they may influence beliefs and behavior using less drastic tools than a *Sasi*. Relevant to the current issue, Pisani (2014)

[7] See also Schiller and Garang (2002) for a sociological account of the inter-ethnic violence outbreaks of the period.

[8] It may be argued that ethnic divisions are much more salient than religious ones in Indonesia. Unfortunately however we only have information on ethnicity in the 2010 Census, thus drastically limiting statistical power. The results we obtain using ethnic groups are qualitatively similar, though less precise, than using religious groups.

(p62 and p87) reports that some local religious elites promote high fertility, thus undermining the effectiveness of family planning programs, as they judge low fertility and formal education to contravene the transmission of *Adat*, the tradition. We are therefore confident that the religious divide is a relevant dimension to examine.[9]

An important feature of the Indonesian administration[10] for the narrative of this paper is its widespread corruption. Indeed, our story requires property rights to be weakly enforced in order for power struggles and conflict to matter for resource appropriation. Corruption and patronage, nicknamed *KKN* by Indonesians, for *Korupsi, Kolusi, Nepotism*, has been ubiquitous. Political support is traded for kickbacks that range from punctual favors in a local dispute or small credits to finance a local initiative to appointments to civil servant positions or the attribution of public procurements (known as *proyek*). This has become especially true at the regency level since decentralization, as regencies have received generous allowances from their newly gained competencies. The trade of political support for kickbacks is organized at the clan level, or *keluarga besar*. Clans can be tied by blood-lines, and therefore represent extended families, but they can also be metaphorical and bound together by geography, schooling or occupation. Metaphorical clans include local youth or professional organizations. In both cases, clans are usually homogenous in terms of religion as not voting for a coreligionist, especially at the local level, is generally regarded as outlandish.

A final consideration that is essential for our narrative is that education improves a group's technology for appropriating resources. We consider that education in Indonesia entails extra benefits in addition to the usual returns of being eligible for more skilled occupations. In particular, further education is still not widespread and is usually seen as a means to access civil servant positions (Pisani 2014). Indeed, business-related skilled jobs are rather limited, in particular outside of Jakarta, while civil servant positions come with a number of advantages, ranging from the prestige of the uniform, to guaranteed work for life, government-provided retirement benefits, loosely enforced working hours, as well as kickbacks and other bribes for favors or public procurements. In this respect, we consider that investing in education can indeed be seen as a way to improve one group's technology of common resources' appropriation.

The Batak people

The example of the Batak people, who live predominantly in Northern Sumatra, illustrates well the pattern of behavior we are investigating. Indeed, they are presented in Ananta et al. (2015) as having a relatively high fertility rate, 3.18 for the 2000-2005 period, making them the most

[9] In the Indonesian context, ethnic divisions are arguably as, if not more, salient than religious ones. Unfortunately, we do not have information on ethnicity in the Census before the 2010 wave.

[10] A synthetic description of Indonesia's administrative system can be found in Appendix E.

fertile of the five largest ethnic groups (the Javanese, Sundanese, Malay, Batak and Madurese). However, Ananta et al. (2015) go on to indicate that "as the Batak place much importance on education, tertiary education is a goal for many". This is well reflected in the range of occupations usually filled by the modern Batak, professions such as bus and taxi drivers or mechanics, but also attorneys, doctors, engineers, writers and journalists, teachers, economists, scientists, and military officers. Even though the Batak are a minority among the Indonesian population (3.58% according 2010's census), there have been a number of notable Batak who have risen to distinguished positions and careers, especially in the field of law. In terms of religion, the Batak people are divided almost equally between Islam and Protestantism, while a small minority identifies as Catholics. We suggest that the focus the Batak people put on both fertility and education may stem from cultural norms responding to the existence of intergroup conflicts over resource appropriation.

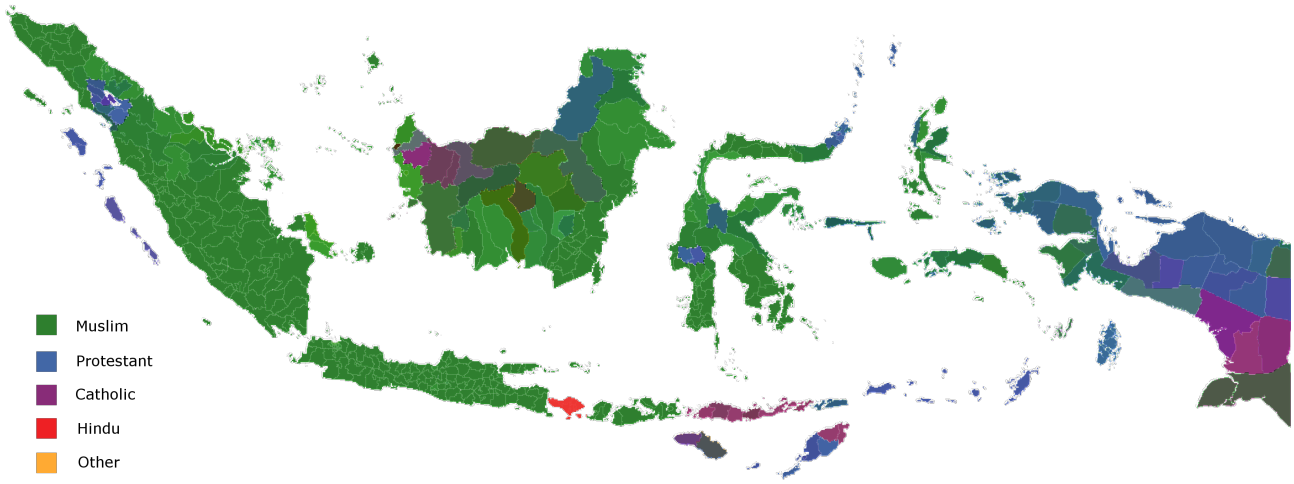
5.2 Description of the data

To document how fertility and education patterns vary with religious group size, we pool extracts of the Indonesian censuses of 1971 (0.5%), 1980 (5%), 1990 (0.5%), 2000, and 2010 (both 10% samples) as made available by IPUMS International.[11] IPUMS provides information on 269 regencies with consistent boundaries across all waves for which we can compute the shares of the various religions. Figure 2, which is drawn using the 2010 census, shows that Indonesia is dominated by Islam, but significant other groups exist and are even the majority on certain islands. At the country level, we have in our sample close to 88% of Muslims, 6% of Protestants, 3% of Catholics, 2% of Hindus, 1% of Buddhists, less that 1% of Confucians and a negligible fraction of people declaring no religion, which we disregard.

In the left panel of Figure 3, we show the distribution of group sizes, by religion, based on the population aged 18-55. The median share of the Muslim population is well over 90%, while the first quartile lies just above 80%, which means that 75% of Muslims live in a regency where Muslims are at least 80% of the population. For all other religions, the third quartile is below 5%, meaning that 75% of the faithful of those minority religions live in a regency where they represent at most 5% of the population. Overall, in most regencies, there is a large majority of Muslims and one or several rather small minorities. However, there are also regencies in which Catholics or Protestants represent a substantial share of the population and even the majority in some cases. Additional descriptive statistics are given in Appendix F.

On the right panel of Figure 3, we represent how we discretize group size in eleven catagories for

[11] Minnesota Population Center. Integrated Public Use Microdata Series, International: Version 7.0 [dataset]. Minneapolis, MN: IPUMS, 2018. https://doi.org/10.18128/D020.V7.0.



Source : *Data Sensus Penduduk 2010 Badan Pusat Statistik*

Figure 2: Religious Affiliations in the Indonesian 2010 Census

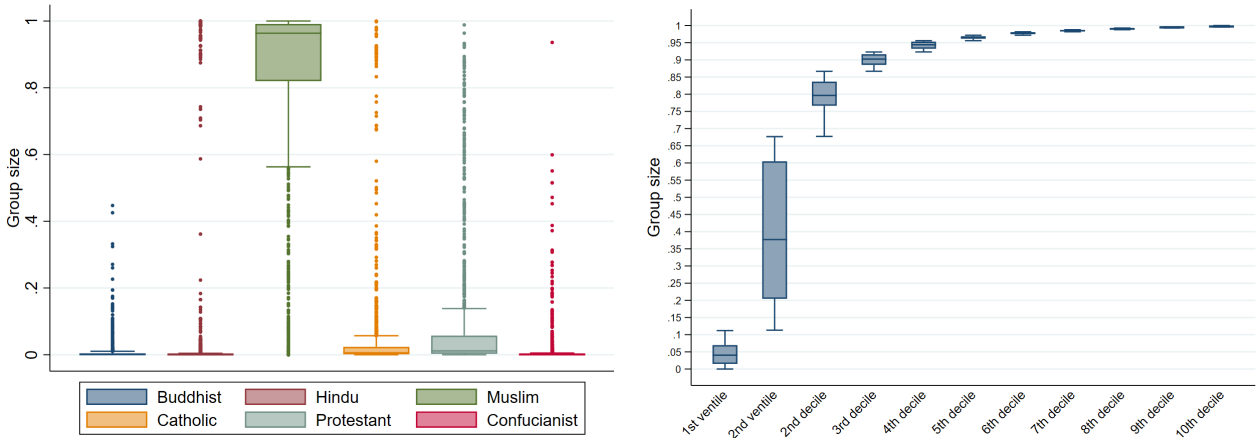


Figure 3: Distribution of size of religious group by religion and deciles

the purpose of our analysis: the 2 lowest ventiles of group size and the 9 subsequent deciles.[12] As becomes apparent from the comparison of the two charts, a large part of non-Muslims are included in the two first ventiles, while all other deciles are mainly made up of Muslims belonging to smaller or larger majority groups.

To analyze fertility, we consider the sample of all women aged 45-59. We obtain a little over 3 million observations, whose characteristics are shown in Table 1. The average woman is aged slightly over 50, has just below five years of education, and gave birth to just below four children, of whom 3.42 were still alive at the time of the survey. Close to 80% of women are

[12]We initially used deciles of group size as our main explanatory variable to allow some flexibility. However, we realized that the confidence intervals around the first decile were much larger than those around all other deciles. We therefore hypothesized that the first decile was much more heterogenous in terms of behavior and decided to split it into two ventiles.

currently married, 42% live in an urban area, and 88% reside in their region of birth.

To analyze education, we consider the sample of all individuals aged 26-32 instead, which amounts to over 6 million individuals. Looking at the educational attainment of individuals 26 and above provides a measure of completed education, which is a better measure of voluntary investment in human capital than educational attainment or school attendance measured at earlier ages. We set an upper bound at 32 years of age in order to capture the completed education of cohorts who are plausibly the children of women we include in the fertility sample. Individuals in this sample are 29 years of age on average, about 8 of which were devoted to schooling. 47% of them live in urban areas and 85% reside in their region of birth. The higher level of educational attainment and urban residence in the education sample reflects rising trends over time in those variables. The slightly larger share of migrants in the older fertility sample instead is probably due to the de facto longer horizon over which migration is measured, which compares current residence to region of birth.

Table 1: Summary statistics at the individual level

Variable	**Mean**	**(Std. Dev.)**
Fertility sample		
Children ever born	3.92	(2.64)
Children surviving	3.42	(2.17)
Currently married (%)	77.57	(41.71)
Age	50.79	(4.22)
Urban status (%)	41.78	(49.32)
Years of schooling	4.77	(4.22)
Average years of schooling in regency	7.41	(2.04)
Child mortality in regency (%)	5.51	(4.48)
Residing in province of birth (%)	88.36	(32.08)
Number of observations	3,187,482	
Education sample		
Years of schooling	8.25	(4.11)
Age	28.96	(1.94)
Urban status (%)	47.12	(49.92)
Average years of schooling in regency	7.5	(2.06)
Residing in province of birth (%)	85.09	(35.62)
Number of observations	6,211,129	

5.3 The variation of fertility and education with group size

We assign to all individuals the size of their group in their regency of residence and regress measures of their fertility and educational attainment on a series of usual explanatory variables, to which we add group size. The rationale for progressively including more determinants of

fertility and education in the regressions is to ensure that the patterns we present do not rely on some obvious omitted factors that would vary with group size. As we do not rely on any sort of exogenous variation in group size, we cannot exclude that our regressions are somewhat contaminated by unobserved factors related to group size. The regression equation takes the following form:

$$E(y_i) = f(\beta_0 + \sum_{k=1}^{11} \beta_{1,k} \mathbb{1}(G_i = k) + \beta_2 X_r + \beta_3 Z_i) \tag{14}$$

where y_i is an individual level outcome: fertility (number of children, ever born and then surviving) and education (number of years of schooling), G_i is a discrete variable indicating which of the 11 categories in group size the individual belongs to, X_r is a set of regency-level controls, and Z_i is a vector of individual level controls. After running the regressions, we compute the predicted outcome for each group size category based on the estimated model to grasp their economic magnitude. Table 2 summarises the different specifications, while Figure 4 illustrates the results.

Table 2: Summary of empirical models

Variable	**(1)**	**(2)**	**(3)**	**(4)**
Fertility equation				
type of model	Poisson			
Outcome	Children every born Surviving children			
Year of birth f.e.	x	x	x	x
Census year * urban status	x	x	x	x
Average years of schooling in regency		x	x	x
Child mortality in regency		x	x	x
Own years of schooling			x	x
Marital status			x	x
Religion			x	x
Sample excluding migrants				x
Education equation				
type of model	OLS			
Outcome	Years of schooling			
Year of birth f.e.	x	x	x	x
Census year * urban status	x	x	x	x
Child mortality in regency		x	x	x
Sex			x	x
Religion			x	x
Sample excluding migrants				x

Since fertility is a count variable, we estimate the fertility equation using a Poisson regression.[13]

[13]Using OLS instead of Poisson does not alter the conclusions.

Model (1) only contains controls for year of birth and a dummy for urban status interacted with survey year. These flexible controls allow us to smooth out systematic differences linked to different age at survey or to general economic conditions common to a whole cohort. They also take away systematic differences linked to urban status, allowing for the fact that urban/rural differences may have changed over time. Model (2) adds plausibly predetermined variables that proxy the general level of development and the stage of a given regency in the demographic transition: the average educational attainment and child mortality in the regency.

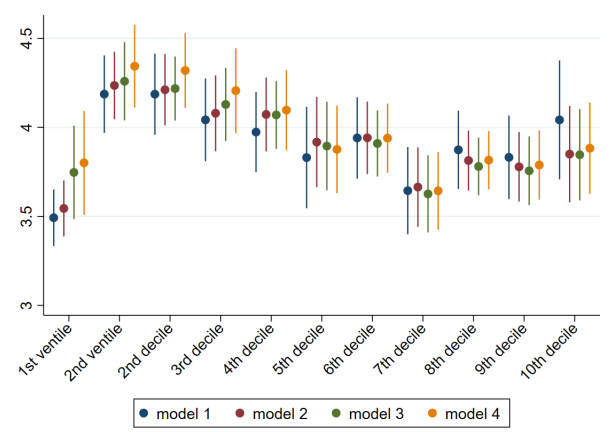
In model (3), we add in educational attainment, marital status and religious affiliation. All of these variables are arguably endogenous to fertility choices, as they are usually co-determined. However they have largely been used in the demographic literature to track "proximate" determinants of fertility. We therefore include them in this specification to make sure that the mechanism we propose does not go through either of these channels exclusively. In particular, mothers' education is our best estimate of their opportunity cost of time, which is documented to be a very strong predictor of fertility. The rationale for including religious affiliation is to avoid relying on cross-religion differences in group size, but rather to focus on the within-religion variation.

Lastly, model (4) repeats the specification in model (3), but excludes migrants (defined as women who do not reside in their region of birth) from the sample, in order to ensure that our results are not driven by selective migration.

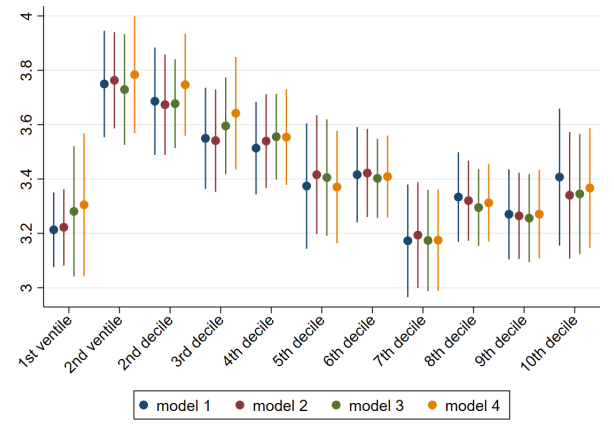
We find that fertility declines with group size for categories going from the 2nd ventiles to the 7th decile, while it remains roughly constant for larger categories. Here, we find the standard result of the minority status hypothesis (Chabé-Ferret and Melindi Ghidi 2013). The difference in fertility across groups is substantial (over half a child per woman) and statistically significant at the 5% level for the 2nd ventile, as well as for the 2nd and 3rd deciles. Notice that the first ventile behaves very differently to other minority groups as it exhibits a much lower fertility, comparable to that in large majority groups. The pattern is qualitatively similar in all specifications and for both children ever born and surviving children.

Figure 4c presents the results of the education regression. As in Figure 4b, model (1) only controls for year of birth and urban status interacted with survey year. Model (2) adds child mortality in the regency, while model (3) additionally includes religious affiliation and sex. Including child mortality allows us to control for the level of development in the regency. We choose not to control for mean educational attainment as it is very closely connected to the outcome we are trying to explain. Finally, model (4) excludes migrants from the sample.

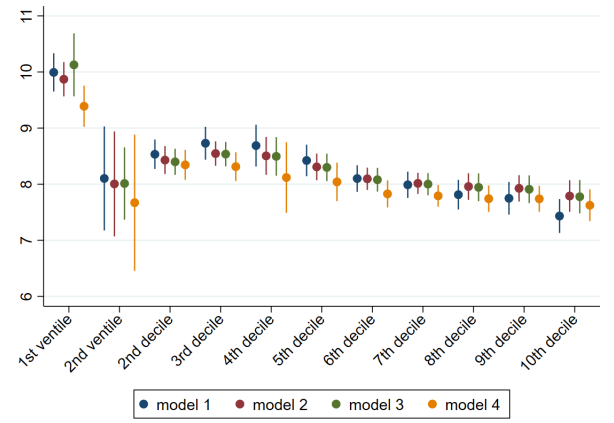
The results in Figure 4c show that, from the 2nd decile onward, there exists a negative relation-



(a) Predicted count of children ever born by group size deciles



(b) Predicted count of surviving children by group size deciles



(c) Predicted years of education by group size deciles

Source: Indonesian Census, waves 1971-2010
Notes: Panels (a) and (b) are based on the fertility equation estimated using Poisson regression. Panel (c) is based on the education equation estimated by OLS. Confidence intervals are all computed based on standard errors clustered at the regency level. Corresponding tables of coefficients are available upon request.

Figure 4: Fertility and Education by Group Size

ship between group size and educational attainment. Indeed, categories going from the 2nd to the 5th decile hover around 8 to 8.5 years of education, while from the 6th onward, educational attainment is about 8 years or less. In contrast, the first decile is split between two ventiles behaving in sharply different ways: the first ventile reaches on average 10 years of education, while the second only reaches 8.

Taken together, the results seem at odds with the predictions of a quality-quantity trade-off. Groups of smaller size do not necessarily substitute quality of children for quantity. Instead, some of these groups tend to invest more heavily in both dimensions. Meanwhile, we also observe a trade-off for very small groups. This corresponds to the predictions of the model developed in the previous sections, when the elasticity of power with respect to human capital is large enough.

We perform four exercises to check the robustness of these results: Appendix G.1 looks at ethnic instead of religious affiliation, on the data for 2010, the only Census wave for which ethnicity is available; Appendix G.2 repeats the analysis excluding the 2000 and 2010 censuses, before the decentralization movement led many regencies to split; Appendix G.3 analyzes separately the behavior of the extensive and intensive margins of fertility; Appendix G.4 explores how the patterns differ according to urban versus rural status. While the patterns appear most clearly in our benchmark exercise, all of these checks suggest that our results from Indonesia are robust to changes in sample selection and heterogeneity analyses.

6 External validity

In this section, we investigate whether our findings for Indonesia replicate in other contexts. We focus on three cases that our model can speak to: Malaysia, Thailand and China. They all feature important specificities, but exhibit a similar level of income per capita and a widespread access to education for a large fraction of the population, which is a key ingredient of our model. Malaysia is possibly the closest case to the Indonesian one, both geographically and because it is also majoritarily Muslim (63.5% of the population) but with substantial religious minorities (mainly Buddhists, Christians and Hinduists). Thailand shares with Indonesia the fact of having a large religious majority: 93% of the population is Buddhist, while there are small Muslim and Christian minorities. China allows us to explore whether our results extend to a context marked by ethnic rather than religious diversity, with 91.5% of the population belonging to the Han majority, while the rest splits among 55 ethnic groups.

We extract data from the Malaysian census waves 1970, 1980, 1991 and 2000, the Thai census waves 1990 and 2000, the Chinese census waves 1982, 1990 and 2000, using IPUMS interna-

tional.[14] We apply the same procedure that we used for Indonesia to construct group shares at the district level and construct a fertility and education sample. To simplify the presentation of the results, we focus on specification (3) presented in Table 2 and plot the fertility and education choices predicted by the model by deciles of group size, to echo the construction of Figure 1.

Figure 5 is a sumary of the findings. Panel A shows the inverted V pattern we uncovered in the Indonesian case, corresponding to Proposition 3, where the elasticity of power with respect to human capital is larger than one. Panels B and C display an overall positive relationship between fertility and education choices, with smaller groups tending to invest the most in both dimensions. This corresponds to the result we obtained in Proposition 2, where human capital and population have the same impact on appropriation ($\mu = 1$). Both the Malaysian and the Chinese example confirm that our main result establishing the existence of a reverse quality-quantity trade-off, according to which smaller groups invest more in both fertility and education than larger ones, replicates beyond the Indonesian context. In particular, the Malaysian example reassures us that our results from Indonesia do not rely uniquely on Muslims being an overwhelming majority. But even more convincing is the case of China, which establishes the reverse quality-quantity trade-off for one of the most populated countries in the world. It also extends our results to the case where ethnic divisions are more salient than religious ones.

China is also a particularly interesting case because of its very stringent fertility policies: the Later, Longer, Fewer campaign in the 1970s, followed by the One Child Policy from 1979 onwards. Both these policies applied to the Han majority, while ethnic minorities were exempt. They can therefore be understood as the Han selecting a low fertility norm for themselves. Rossi and Xiao (2023) study the spillover effects of these policies on ethnic minorities and find that they responded by reducing their fertility as well, although to a lesser extent. They highlight two mechanisms through which these spillovers arise: a cultural mimetism one, whereby minorities culturally close to the Han tended to mimick their behavior, and an economic one, according to which minority groups competing on the labor market with the Hans respond by increasing investment in education at the expense of fertility. This economic channel relies on strategic considerations operating at the group level, which our model captures.

Finally, panel D shows little variation in particular in terms of fertility across group sizes.[15] We believe that this case corresponds to our Proposition 1, when groups cannot coordinate on norms and fertility and education choices do not vary with group size. One reason may be that

[14] Minnesota Population Center. Integrated Public Use Microdata Series, International: Version 7.3 [dataset]. Minneapolis, MN: IPUMS, 2020. https://doi.org/10.18128/D020.V7.3

[15] Note that in this case, we have fewer groups: 8 instead of 11, as the top 4 deciles are all 100% buddhist and are therefore pooled together in the group labeled 7th decile.

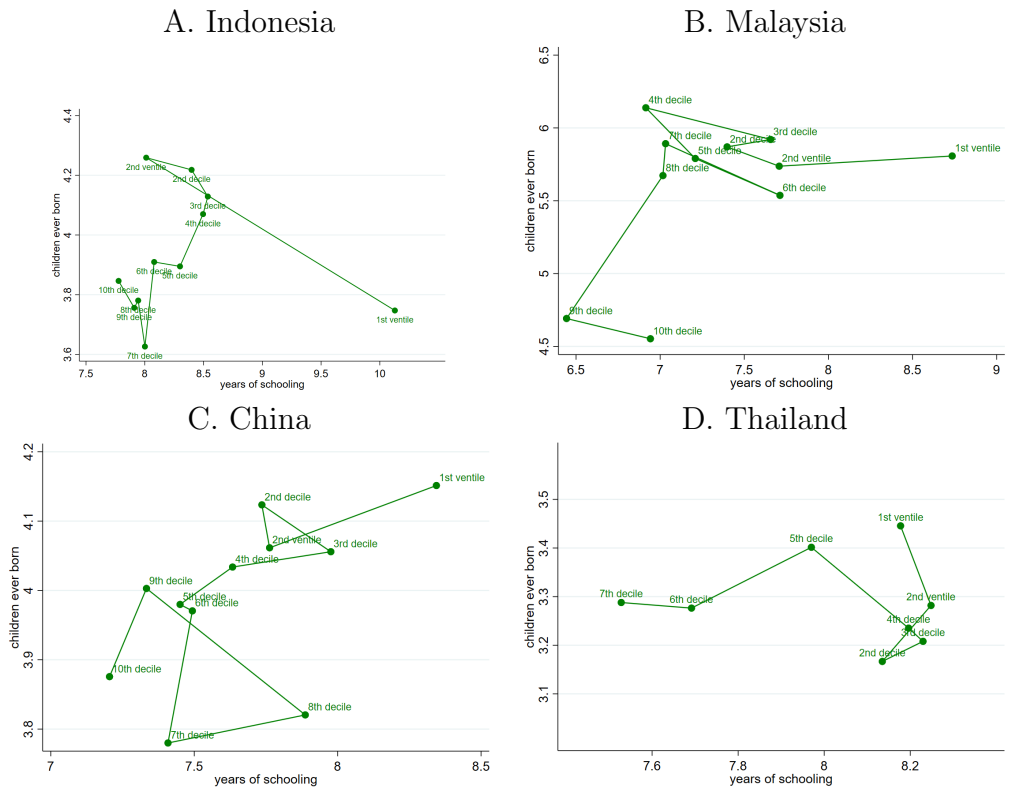


Figure 5: Fertility and education choices by group size

Source: Indonesian Census, waves 1971-2010, Malaysian Census, waves 1970-2000, Chinese Census, waves 1982-2000, Thai Census, waves 1990-2000

Notes: Fertility corresponds to the count of children ever born predicted by the model estimated using Poisson regression. Education is the number of years of schooling predicted by the model estimated using OLS. Corresponding tables of coefficients are available upon request.

the religious divide in Thailand is not salient enough to spur a detectable group reaction. In our model, this could be captured by a high coordination cost κ, which amounts to muting strategic interactions between groups.

For completeness, we also investigated the cases of Ethiopia, Ghana, Mozambique and Senegal, which are the African countries present in IPUMS large enough to exhibit substantial variation in religious or ethnic composition at the district level. The picture is much less in line with the predictions of our model for these countries, as is illustrated by Figure 4 in the appendix. Only Senegal shows a pattern similar to that obtained for China and Malaysia, with a positive relationship between education and fertility with the smallest group investing the most in both dimensions (with the exception of the second decile that stands out). For Ethiopia and Mozambique, we obtain a picture that suggests a more traditional quality-quantity trade-off, with small groups investing less in fertility but more in education. This may be because other factors governing population shares are first order, such as wars and famines, killing and displacing selectively some ethnic groups. Becker et al. (2020) show for instance that forcibly displaced populations after WWII invested more heavily in more easily portable assets

like human capital, which could explain why smaller groups in the face of oppression, respond primarily along the education dimension. Another reason is that all these countries also exhibit a much lower level of income per capita and a drastically limited access to education, which could help explain why it is not an option for large groups to invest in this dimension.

7 Conclusion

When social norms were introduced as determinants of individual fertility, the workhorse model of the economics of fertility gained a new dimension. Still, these norms were considered exogenous in most cases. In this paper, we model the idea that the social norm itself may respond to an economic logic, one of competition between groups. In addition to endogenizing fertility norms, we also take into account the education choice made by parents, and acknowledge that this choice might also be subject to endogenous norms.

We have modelled a deeply divided society in which two groups compete for resources, assuming that property rights are not fully defined and/or enforced. We have analyzed whether a "population race" between the two groups would translate into lower education, as would be predicted by the standard quality-quantity trade-off model. We have shown that when human capital enters the appropriation function as a sufficiently important factor, the smaller group will invest more in both fertility and education than the majority group.

We have also shown that the predictions of the theory on how fertility and education are correlated with group size can be found in Indonesian censuses. We have shown that, at the regency level, smaller religious groups tend to have more children, but also tend to invest more in their education. The correlations between group size and outcomes are not small. Mothers who belong to a median-size group have a predicted net fertility of 3.6 surviving children, while women belonging to the second decile have about 4 children. At the same time, people in the second decile also invest in about an extra half a year of schooling.

While our main focus is Indonesia, we have shown that our main result establishing a reverse quality-quantity trade-off replicates in countries like Malaysia, China and Senegal. The mechanism equally applies to ethnic as well as religious divisions. However we did not find systematic evidence for our mechanism in all deeply divided societies featuring weak institutions. This suggests that other mechanisms superimpose the one we document and calls for further investigation into the determinants of fertility and education norms.

Our results have implications for thinking about how institutions, demographics, and development interact. If institutions were of the highest quality, there would be no need for groups to enhance their investment in children to obtain a larger share of future resources, and the

standard of living of current generations would likely be higher.

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