The Culture of Entrepreneurship*

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Abstract

We study the cultural process through which a society inculcates an entrepreneurial spirit. People work for a guaranteed wage or operate a firm whose risky return depends on business expertise. The latter is culturally acquired, within the family or outside, and people may choose an occupation different from the one they were socialized into. A cultural bias towards safer occupations from colonial and post-colonial policies leads to stagnation where entrepreneurs do not upgrade technology because of their proficiency with existing methods. An aggregate productivity shock can tip this economy towards growth led by established businesses. A human capital shock where existing business expertise is less useful is more disruptive; growth occurs through the emergence of a new class of entrepreneurs. We conclude that culture is not destiny: it adapts even when some cultural traits do not.

KEYWORDS: entrepreneurship, culture, human capital, colonization, growth
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1 Introduction

This paper connects culture to entrepreneurship and economic growth using a model of intergenerational households. Our goal is to identify conditions under which culture matters for development and the same society, freed from its moorings, enjoys rapid growth.

In a model of occupational choice people are either workers or entrepreneurs. The former work for a guaranteed wage, the latter engage in risky business activities. People differ in skills for and subjective biases over the two occupations. These are acquired through upbringing, socialization and occupational experience. Because of bounded rationality, paternalistic parents prefer their offspring to choose occupations they value. For example, a wage-worker parent who perceives entrepreneurship as too risky and values safe employment prefers that his children choose an occupation in a similar risk-class. Similarly, an entrepreneur parent, being adept at running a business, perceives it to be rewarding and tries to pass on his expertise. When within-family cultural indoctrination fails, a child acquires the human capital of a randomly chosen member of the active population. Either way, children's human capital is determined by adulthood at which point they choose occupations.

Entrepreneurs either use the prevailing technology or upgrade to a more productive vintage at the cost of higher risk. A cultural bias towards safe production eventually leads to stagnation where entrepreneurs, because of their considerable proficiency, stay with existing methods of production. This low (zero) growth equilibrium is analogous to colonial and post-colonial regimes where safe employment was highly valued, the pursuit of profits frowned upon and businesses were insular. Escaping stagnation is possible from an exogenous, significant increase to overall productivity or to the human capital specificity of technologies. In the first, growth occurs through innovation by existing entrepreneurial lines that retain their dominant position. In the second, newer entrepreneurial lines emerge that innovate precisely because they lack expertise in prevailing methods. In neither case does culture hold back economic progress.

The notion that culture could matter for economic growth is not new. It goes back at least to Weber's (1930) thesis that cultural change, the Calvinist Reformation in particular, was vital to the development of capitalism and its institutions. While some have extended that view to cultural attributes such as openness to new ideas and a scientific temperament (Landes, 1998), others have seen virtue in the West's individualism (Lal, 1999a, and references therein). Despite this abiding historical interest and an emerging one in empirical development economics (for instance Tabellini, 2010, Gorodnichenko and Roland, 2013), culture has received little formal treatment in modern growth theory. In large measure this reflects the widespread notion that development is limited only by opportunities and technologies: if incentives are strong enough, culture would change to accommodate economic interests.[1] While our work embraces this conclusion – culture

[1] Even as Weber saw virtue in the Protestant ethic, he thought Confucian values would hinder East Asia's prospects

does not limit growth as long as the economy is productive or technological change disruptive enough[2] – we also show that culture matters for the income level.

"Culture" has two related interpretations in this paper, one static, the other dynamic. The static one is an anti-capitalism or anti-innovation bias, a "collective programming of the mind which distinguishes the members of one group (workers) from those of another" (Hofstede, 1991, p. 5). This partly shapes the dynamics of culture, the willingness to intergenerationally transfer "via teaching and imitation, ... knowledge, values, and other factors that influence behavior" (Boyd and Richerson, 1985, p. 2). Differently from Becker (1993), the socialization process is not seamless since purposeful parental involvement can fail, opening the door for social influence. Differently from Bisin and Verdier (2000, 2001) and Hauk and Saez-Marti (2002), human capital, not preference, is transmitted culturally. Our assumption of occupation-specific cultural bias is related to Corneo and Jeanne's (2010) work on the social esteem attached to certain occupations. More generally this paper is related to preference- and evolution-based explanations of long-term change, including Becker and Mulligan (1997), Doepke and Zilibotti (2008), Galor and Moav (2002) and, more recently, Galor and Michalopoulos (2012) and Wu (2014). What distinguishes our paper from the literature are its focus on technology-specific human capital and the overarching theme: "when does culture not matter for growth?" That culture need not be decisive marks a novel contribution and connects the theory to historical and recent episodes where an economy once held back by cultural inertia transitions to modern economic growth.

A benchmark model of occupational choice and cultural transmission is developed in the next section under the assumption that entrepreneurs are locked into a particular technology. Technological upgrading is studied in section 3. We show that the constant-technology model is a special case of this general structure and characterize the dynamic equilibria. Section 4 discusses the implications of productivity shocks. Section 5 concludes.

2 The Baseline Model

Childhood and adulthood are the two stages of life in an overlapping generations economy. In any period $t = 1, 2, \dots, \infty$ a set $\mathscr{H}$ of agents of measure one is economically active in either of two *occupational classes* that differ in their risk. We model these as two specific occupations, wage-

and the caste system India's (Weber, 1951, 1958). This simple and deterministic view of culture is inadequate to the task of explaining the subsequent growth takeoffs in Asia. Also influential has been an earlier debate in the profession between those who proposed culture-based non-rationality as an explanation for agricultural backwardness in traditional societies and those who took the "poor but efficient" view of peasant agriculture, a debate that Schultz' *Transforming Traditional Agriculture* (1963) resolved convincingly in favor of the latter (Ruttan, 1988).

[2]The growth rate does not depend on the share of the population consisting of entrepreneurs. It is this that ensures culture does not affect growth, unlike in Doepke and Zilibotti (2013) and Klasing (2014), as long as the economy enjoys technological progress. It does affect, however, the choice to upgrade technology. On how culture affects innovation and technology adoption and evidence of intergenerational transmission see Spolaore and Wacziarg (2013).

work and entrepreneurship, that are complementary in production. Labor income w_t is riskless while entrepreneurial income π_t is risky.

The tight categorization of the two occupations is for convenience; it is also informed by the protectionist and strongly pro-labor development policies pursued around poorer countries in the last century. The essential assumption is that one of the occupations is riskier. They do not have to produce goods or services that are complementary in production; substitutable goods that enjoy the same rate of productivity growth would deliver qualitatively similar results. Complementarity is assumed to establish a balanced growth path later: when growth occurs because of innovation by entrepreneurs, returns to the two occupations have to grow in tandem for household decisions to be stationary.

Each agent is endowed with a unit time and gives birth to one offspring during this period, dying at the end. An offspring born in t does not become economically active until $t+1$.

2.1 Preferences and Cultural Bias

The expected lifetime utility of an economically active individual at time t depends on his lifetime income, $y_t \in \{w_t, \pi_t\}$, the perceived welfare of his offspring, V_t, and socialization cost $\psi(\tau_t)$

$$U_t = u(y_t) + V_t - \psi(\tau_t).$$

Agents are risk averse over their lifetime income (consumption): $u(y_t) = E_t(\ln y_t)$.

V_t and ψ_t are fully specified later. For now we note that they embody paternalistic behavior and cultural biases. In particular, children are not born with innate skills in the two occupations or a preference about which occupation is "better". The first develops through cultural transmission at home (vertical transmission) or socialization outside (oblique transmission), the latter is the product of work experience and cultural milieu.

Parents are paternalistic in that they believe they know better which occupation would better suit their children (Bisin and Verdier, 2000). In this they are not irrational, only boundedly rational. Specifically V depends on a parent's projection of his child's expected utility based on the parent's own human capital. This projection is endogenous, it depends on intergenerational human capital accumulation and the equilibrium wage rate. Moreover, over their working lives parents acquire a subjective bias towards the occupation they value and have worked in; they dislike the prospect of their children going into an occupation that is in a different risk-class. For example, non-entrepreneurial parents prefer their children to be formally educated/trained for a well-compensated profession such as medicine, engineering, education or public service. Parents of this type dislike having their children abandon these (arguably) low-risk professions in favor of business which the parent, because he has little expertise about, perceives to be too risky.[3]

Not all parent-to-biological-child vertical transmission is successful since children also socialize and absorb ideas outside of home. Higher parental effort $\tau \in (0,1)$ towards cultural education raises the likelihood of the offspring having similar expertise as the parent. But due to socialization outside, such education may fail and the offspring picks up expertise from a randomly matched (cultural) parent who may well be in an occupation different from his biological parent's. We refer to this process of vertical and oblique transmission as *cultural indoctrination*.

2.2 Occupation and Production

Entrepreneurs engage in production through imperfectly understood technologies while workers supply labor on a competitive market.[4] People differ in how they subjectively value the two occupations and in their human capital. We treat this human capital as one dimensional – business expertise – that in the model takes the form of subjective beliefs about the riskiness of production technologies.

At the beginning of each period, an active agent must decide whether to become an entrepreneur or work for entrepreneurs at the market wage. Human capital in entrepreneurship and the broader macroeconomic environment determine this choice.[5] We assume no unemployment or withdrawal from the labor force. Lifetime income y is either profit income π or wage income w. In other words, individuals indivisibly supply their labor to wage-work or in managing their business. Labor income is certain and the wage rate is taken as given by agents: $E_t(\ln w_t) = \ln w_t$. Entrepreneurs, however, face uncertainty and their expected utility from profits depends on their business expertise (see below).

Let $\mathscr{E}_t$ denote the subset of agents who become entrepreneurs at t and $\mathscr{H}\backslash\mathscr{E}_t$ the subset who work for a wage. Product and input markets are perfectly competitive. All workers are hired by entrepreneurs at the market wage rate w_t and all entrepreneurs produce the same homogeneous

[3] In some ways, this interplay of personal experience and transmitted information parallels the intergenerational learning mechanism identified in Piketty (1995). In both cases, learned history influences decisions. The difference is that in our model parents decide how much effort to place on transmitting their information and may saddle their children with poor information sets simply because they lack expertise in alternative occupations.

[4] The alternative occupation can also be low-scale self-employment with lower returns. In other words, here entrepreneurship is not synonymous with self-employment. Rather, an entrepreneur is someone willing to embrace big change and innovate. This distinction is useful to keep in mind as a lot of empirical work proxies entrepreneurship with self-employment which is widespread in developing countries, often exceeding rates in industrialized countries.

[5] Implicitly the labor productivity of all individuals is being normalized to unity. It is easy to introduce heterogenous human capital specific to wage work and allow wage-working parents to transfer their skills to their offspring and build on them. As long as there is no market imperfection preventing the efficient level of such within-family investment and human capital accumulation is subject to diminishing returns, all wage-working families will eventually converge to the same skill level. What matters in that setup, as here, is an individual's comparative advantage in the two occupations; see Chakraborty *et al.* (2015).

good $\{Y_k\}_{k\in\mathscr{E}}$ using a CRS technology.[6] Aggregate output is simply

$$Y_t = \int_{\mathscr{E}_t} Y_t^k dk.$$

The price of each good is normalized to one. Entrepreneur (capitalist) k uses two inputs, labor L_t^k hired in the competitive market and his own input $\tilde{z}_t^k$:

$$Y_t^k = \left(\tilde{z}_t^k\right)^{1-\beta}\left(L_t^k\right)^{\beta},\ \beta \in (0,1). \tag{1}$$

The input, $\tilde{z}^k$, is essentially entrepreneurial human capital that embodies k's expertise on how to run the business. For convenience we will call it business capital, an intangible asset to the firm. This input is *ex ante* uncertain. It depends on the technology, the entrepreneur's skill in using of it and business decision ϕ taken before workers are hired and goods produced. The capital thus produced is an inalienable part of entrepreneur k's business venture, non-transferable to other businesses.[7]

We solve for the decision problem backwards. Given z_t^k, profit maximization leads to the labor demand

$$\beta\left(\frac{z_t^k}{L_t^k}\right)^{1-\beta} = w_t \tag{2}$$

with more productive entrepreneurs – those with higher business capital z – hiring more. Using this in equation (1), the entrepreneur's profit flow (prior to realizing the uncertainty) is the random variable

$$\tilde{\pi}_t^k = (1-\beta)\left(\frac{\beta}{w_t}\right)^{\beta/(1-\beta)} \tilde{z}_t^k \equiv \kappa_t \tilde{z}_t^k \tag{3}$$

which is increasing in business capital chosen prior to going into production.

Denote the technology at the entrepreneur's disposal by some arbitrary index $n \geq 0$. Entrepreneur k takes a decision ϕ_t^k that determines his business capital according to a stochastic production function similar to Jovanovic and Nyarko (1996):

$$\tilde{z}_{nt}^k = a^n e^{-\left(q_{nt}-\phi_{nt}^k\right)^2},\ a > 1 \tag{4}$$

where

$$q_{nt} = \theta_n + \nu_{nt} \tag{5}$$

is a random target that fluctuates around a technology-specific parameter θ_n and ν_{nt} is an *iid* shock drawn from a normal distribution with mean zero and variance σ_ν^2. The same technology is

[6] While k represents a particular entrepreneur, b is used later to tag variables for the entire set $\mathscr{E}_t$.

[7] In section 3 productivity growth will arise from improving quality of business capital. In light of Uzawa (1961), the Cobb-Douglas technology allows us to rewrite it as labor-augmenting growth in steady state.

used by all entrepreneurs and for all $t \geq 1$. Later we allow them to choose between two technologies that differ in risk and return: higher vintages (n) are inherently more productive since $a > 1$ but entrepreneurs may be less informed about them.

The entrepreneur knows a and the distribution of ν_{nt}. What he does not know is the mean target output θ_n, but has some belief (prior) about it. These priors are centered on the true parameter values: Bayesian updating ensures that they remain unbiased as long as initial priors in the population were so. One way to interpret ϕ is as effort devoted towards fine-tuning some machinery that yields a stochastic output, based partly on how effectively it is employed in production. Alternatively and closer to the spirit of the model, think of the entrepreneur as entering a market or innovating a product for which he needs to determine the optimal scale of operation q_{nt} without having full information about market conditions. The quadratic loss function embedded in (4) says that he can lose out from both over- and under-supply of business capital, a reduced-form specification of having to sell below cost in case he overestimates market demand or forgoing profits if he underestimates.

Let $E_t^k(\theta_n)$ be k's conditional expectation and $x_{nt}^k \equiv V_t^k(\theta_n)$ conditional variance of θ_n. The cumulative distribution of x_{nt} in the population is denoted by $G_t(x_{nt})$, with $G_1(x_{n1})$ given in the initial period and G_t for $t > 1$ determined via cultural indoctrination and occupational choice. Priors about θ_n in period 1 are assumed to be, and subsequent priors turn out to be, drawn from a normal distribution.

Proposition 1. *For entrepreneur k with the prior x_{nt}^k*

(i) Expected utility from profit income is maximized at

$$\phi_{nt}^k = E_t^k(\theta_n). \tag{6}$$

(ii) This yields expected business capital of

$$\bar{z}_{nt}^k \equiv E_t\left(\tilde{z}_{nt}^k\right) = \frac{a^n}{\sqrt{1 + 2\left(x_{nt}^k + \sigma_\nu^2\right)}} \tag{7}$$

and

(iii) Maximized expected utility from profit income of

$$E(\ln \tilde{\pi}_t^k | x_{nt}^k) = n \ln a + \ln \kappa_t - x_{nt}^k - \sigma_\nu^2 \tag{8}$$

where $\kappa_t \equiv (1-\beta)\left(\beta / w_t\right)^{\beta/(1-\beta)}$.

Proof. See Appendix A. □

Business capital is higher the closer is the entrepreneur's decision ϕ_{nt}^{k} to the target output level q_{nt}. Equations (7) and (8) show that the entrepreneur's belief – x_{nt}^{k} – is an expertise. Entrepreneurs with more informed beliefs – smaller x_{nt}^{k} – expect to earn a higher return from entrepreneurship. In observing q_{nt} during his lifetime, the agent learns about the technology and updates his belief about θ_n. He then tries to impart this knowledge to his cultural offspring who, in turn, will be able to make a more informed decision $\phi_{n,t+1}^{k}$ should he become an entrepreneur. This means if entrepreneurial human capital is transmitted via cultural transmission, business expertise specific to an entrepreneurial line does not disappear.[8] The learning process is bounded for a given technology (see below): sticking with the same n along an entrepreneurial line allows agents to eventually learn θ_n completely. Consequently, expected business capital converges to $a^n/\sqrt{1+2\sigma_v^2}$ in the limit.[9]

2.3 Socialization and Cultural Transmission

Denote the culturally indoctrinated fraction of wage workers in the population by m and their actual frequency by μ. When an agent endowed with his cultural parent's human capital chooses an occupation different from the parent's, $m \neq \mu$. We introduce two definitions:

Definition 1. *Cultural indoctrination is* ***persistent*** *if a cultural offspring does not choose an occupation different from that in which he has been indoctrinated.*

Definition 2. *Cultural indoctrination is* ***dynamically persistent*** *if it is persistent for all agents and all $t \geq 1$.*

We proceed to study an intertemporal equilibrium path that is dynamically persistent, that is, $m_t = \mu_t$ for all $t \geq 1$. Hence the dynamics of m is identical to that of μ.

A parent educates his naive biological child with the socialization effort τ, for example by selecting childhood activities, screening peer groups and, more generally, shaping the child's views. With probability equal to parental effort, vertical transmission is successful and the child acquires the biological parent's type, here human capital (Hauk and Saez-Marti, 2002). That is, the child of an entrepreneur parent picks up the parent's posterior belief about technologies as his own prior and a child of a wage-worker parent likewise acquires his parent's uninformed belief regarding how to operate businesses. If vertical transmission fails, the child remains naive and gets randomly matched with somebody else whose occupation-specific human capital he acquires. Recall that business capital is stochastic and an inalienable part of an entrepreneur's venture. Though it

[8]There is no mean reversion in intergenerational ability unlike Caselli and Gennaioli's (2013) model of dynastic firms. Of course, neither do we have dynastic firms: what we call an entrepreneurial line is a series of entrepreneurs – some biologically related, some culturally – who are linked through their human capital.

[9]Even an entrepreneur who learns θ_n precisely faces (price, demand) uncertainty via ν_{nt}.

is not possible to acquire business expertise simply by observing a single entrepreneur's success (which could be due to luck), naive children can absorb it from repeatedly observing enough such successes, a proxy for which is the frequency of entrepreneurs in the population $1-\mu$. This makes business expertise partially excludable. Successful intergenerational transmission of human capital is what introduces a *status quo* occupational bias to the model; social influence partly alleviates it.

Let $p_t^{J\ell}$ denote the probability that a child of a type J parent will be of type ℓ where $J,\ell \in \{k,w\}$, k denoting entrepreneurship and w wage-work. For a wage-working parent

$$p_t^{ww} = \tau_t^w + \left(1-\tau_t^w\right)\mu_t \tag{9}$$

$$p_t^{wk} = \left(1-\tau_t^w\right)\left(1-\mu_t\right) \tag{10}$$

and for an entrepreneurial parent

$$p_t^{kk} = \tau_t^k + \left(1-\tau_t^k\right)\left(1-\mu_t\right) \tag{11}$$

$$p_t^{kw} = \left(1-\tau_t^k\right)\mu_t \tag{12}$$

where τ^k is the entrepreneurial parent's effort on social education.

The cost of socialization effort $\psi(\tau)$ satisfies $\psi' \geq 0$, $\psi'' > 0$, $\psi(0) = \psi'(0) = 0$ and $\psi \in [0,1]$. Let $V^{J\ell}$ denote the utility a type J parent derives from his child being type ℓ. Parental altruism is paternalistic in the sense that the parent uses his own payoff matrix to evaluate this utility. Hence given the parent's expected returns y_t, each parent of type $J \in \{w,k\}$ chooses the social education effort τ to maximize

$$p_t^{JJ} V^{JJ}\left(y_t^J\right) + p_t^{J\ell} V^{J\ell}\left(y_t^J\right) - \psi\left(\tau_t\right).$$

Substituting (9)−(12) into the first order condition for an interior optimum

$$\frac{\partial \psi\left(\tau_t\right)}{\partial \tau_t} = \frac{dp_t^{JJ}}{d\tau_t} V^{JJ}\left(y_t^J\right) + \frac{dp_t^{J\ell}}{d\tau_t} V^{J\ell}\left(y_t^J\right)$$

leads to

$$\frac{\partial \psi\left(\tau_t^w\right)}{\partial \tau_t^w} = \left[V^{ww}\left(y_t^w\right) - V^{wk}\left(y_t^w\right)\right]\left(1-\mu_t\right),$$

$$\frac{\partial \psi\left(\tau_t^k\right)}{\partial \tau_t^k} = \left[V^{kk}\left(y_t^k\right) - V^{kw}\left(y_t^k\right)\right]\mu_t.$$

It follows that

$$\tau_t^J = \tau\left[\mu_t, V^{JJ}\left(y_t^J\right) - V_t^{J\ell}\left(y_t^J\right)\right],\ J,\ell \in \{k,w\} \tag{13}$$

with $\partial\tau_t^w/\partial\mu_t < 0$ and $\partial\tau_t^k/\partial\mu_t > 0$: parents have less incentive to educate their children the more frequent their type is in the population. Henceforth we work with the functional form

$$\psi(\tau) = \tau^2/2$$

for which

$$\begin{aligned} \tau_t^w &= (1-\mu_t)\left[V_t^{ww} - V_t^{wk}\right], \\ \tau_t^k &= \mu_t\left[V_t^{kk} - V_t^{kw}\right]. \end{aligned} \tag{14}$$

It remains to specify how parental altruism depends on the offspring's occupation. Lacking the ability to accurately assess the alternative, parents project the utility of their children based on their own experience. An entrepreneurial parent's human capital is his belief x_{nt}^k about the distribution of θ_n. Conversely, a wage-working parent lacks human capital specific to entrepreneurial activities which results in a more dispersed prior of $\overline{x}_n$ (see below). Based on these, we specify parental utilities as

$$\begin{aligned} V_t^{ww} &= \ln w_t, \\ V_t^{wk} &= E_t\left(\ln\pi_t^k(\overline{x}_n)\right) - \ln\delta_w = n\ln a + \ln\kappa_t - \overline{x}_n - \sigma_\nu^2 - \ln\delta_w, \\ V_t^{kk} &= E_t\left(\ln\pi_t^k(x_{nt})\right) = n\ln a + \ln\kappa_t - x_{nt} - \sigma_\nu^2, \\ V_t^{kw} &= \ln w_t - \ln\delta_b. \end{aligned} \tag{15}$$

The parameters δ_b (same for all k) and δ_w denote the subjective dissatisfaction that a type $\jmath$ parent feels when his child ends up in type ℓ occupation. These biases do not affect choice of or utility from own occupation, only socialization effort.

Model predictions are not sensitive to the bias parameters δ_w and δ_b but they serve two roles. They proxy for cultural attributes that are "hardwired", those that do not directly respond to economic incentives. Even so cultural change will be possible when socialization effort changes in response to market forces. In other words, even though δ_w and δ_b are exogenous, their average incidence – frequency of people with these biases – is endogenous.

Second, these biases parsimoniously capture the socio-political milieu in developing countries, particularly those with a colonial past, as they embarked on development policymaking. Barring the Western Offshoots, all former colonies pursued state-led development soon after independence. This was very much a product of their colonial history. Whether through conscious policy choice or exposure to global trade, colonization often decimated local industries, depleted natural resources and confined local entrepreneurs to trade and commerce. The decision to pursue state-led development stemmed from the belief that market-based development would be rapacious, ill suited to tackling chronic poverty (Roy, 2002).

South Asia, particularly India, is a prime example of this thinking. By 1961 India's public sector accounted for close to 58 percent of the total organized sector employment, a number that increased to 68 percent by 1981 before reversing in the 1990s (India Labour Market Report, 2008). Besides offering better-paid and more secure jobs than the private sector, the public sector also benefited from how colonization had shaped India's educational system and middle-class aspirations. The colonial administration promoted certain kinds of education and role models to attract Indians into the administrative service. The by-product was a value system where securing government jobs was perceived as success by the educated elite. Restrictive licensing policies from the mid-1960s added to this: "The contempt in which merchants and markets have traditionally been held in Hindu society was given a new garb by Fabian socialism which appealed to the newly westernized but traditional literary castes of India" (Lal, 1999b, p. 36).

The essential contours of this story – the slant towards public sector jobs and a cultural bias away from risky entrepreneurship – apply also to colonial Africa. The British, and to a lesser extent the French, relied on Africans who were either traditionally-recognized leaders such as chiefs or newly-trained technocrats who would work as middlemen. The system created a set of native administrators, public education systems and easily identifiable characteristics such as western education, Christianity and western attire that set apart the educated African. That educated African was not just aiding the colonial enterprise in his capacity as a government clerk, a teacher or an administrator, he was also projecting a modern image for rest of society to value and emulate (Ekeh, 1975).

A high δ_w, particularly if one were to include the public sector into aggregate production in the model, and low δ_b, are therefore natural descriptions of these two cases. It is useful to think of $(x_n^J, \delta_b, \delta_w)$ as the "cultural endowments", those aspects of preferences and skills that have an impact on the cultural transmission of attitudes (Hayami and Ruttan, 1985). Importantly, cultural endowments have an economic significance here since they shape perceived occupational returns.

2.4 Occupational Income and Choice

Entrepreneurship is preferred as long as it yields a higher expected utility. Entrepreneur k operating technology n in t, starts with a belief about the distribution of θ_n which is, as specified above, normal with variance x_{nt}^k. During the course of his lifetime, the accumulated experience of observing q_{nt} leads him to update this belief to

$$x_{nt+1}^k = \mathscr{F}(x_{nt}^k) = \frac{\sigma_v^2 x_{nt}^k}{\sigma_v^2 + x_{nt}^k}. \tag{16}$$

This posterior belief is then transferred, through imperfect cultural transmission, to the offspring as his prior. Since $\mathscr{F}$ is increasing and concave with $\mathscr{F}(0) = 0 = \mathscr{F}^{'}(0)$, it has a unique fixed point at $x_n^* = 0$. Hence the learning process along an entrepreneurial line – each generation of entrepreneur passing on his accumulated human capital – generates a sequence of variances $\{x_{nt}^k\}_{t=1}^{\infty}$ that converges monotonically to zero. In this sense, the entrepreneurial line eventually achieves full proficiency if it were to stay with technology n forever.

From each entrepreneur's labor demand

$$w_t = \beta \left[\frac{z_{nt}^k}{L_{nt}^k} \right]^{1-\beta},$$

aggregate labor demand is $L_{nt}^D = \int_{\mathscr{E}_t} L_{nt}^k = \beta^{1/(1-\beta)} Z_{nt}/w_t^{1/(1-\beta)}$ where $Z_{nt} \equiv \int_{\mathscr{E}_t} z_{nt}^k$ is aggregate business capital. Since each worker supplies a unit time, aggregate labor supply is $L_t^S = \mu_t$, using which we get the market-clearing wage rate

$$w_t = \beta \left[\frac{Z_{nt}}{\mu_t} \right]^{1-\beta} = \beta \left[\frac{(1-\mu_t)\bar{z}_{nt}}{\mu_t} \right]^{1-\beta}. \tag{17}$$

A higher μ lowers the supply of business capital, raises the supply of labor and lower the wage rate. As a result, expected business profit π_n – see (3) – is increasing in μ. In other words, μ determines the relative attractiveness of the two occupations and, thus, occupational choice. This interdependence reflects the persistence of the culture of *fonctionariat* (civil servants) and underdevelopment in many African countries and in India until recently.

To study occupational allocation and the dynamics of cultural indoctrination we proceed in steps. First we restrict the parameter space, anticipating that the dynamics exhibits convergence, such that indoctrination is dynamically persistent and offspring choose the occupation their cultural parent intended. Section 2.5 then establishes that, under that restriction, the dynamics exhibits convergence to an interior steady state of inefficiently few entrepreneurs.

Assumption 1. *The initial distribution of priors is discrete, taking two values $x_{n1} \in \{\underline{x}_n, \overline{x}_n\}$ with $\overline{x}_n > \underline{x}_n$ and*

$$\Pr\{x_{n1} = \underline{x}_n\} \equiv G_1(\underline{x}_n),\ \Pr\{x_{n1} = \overline{x}_n\} \equiv 1 - G_1(\underline{x}_n) \tag{A1}$$

fractions of the population with these priors respectively.

Assumption 2. G_1 *satisfies*

$$\frac{\beta}{\beta + (1-\beta)\lambda(\underline{x}_n)} < 1 - G_1(\underline{x}_n) < \frac{\beta}{\beta + (1-\beta)\Lambda(\underline{x}_n)} \tag{A2}$$

where

$$\lambda(x) \equiv e^{-(x+\sigma_\nu^2)}\sqrt{1+2(x+\sigma_\nu^2)} > e^{-(\bar{x}_n+\sigma_\nu^2)}\sqrt{1+2(x+\sigma_\nu^2)} \equiv \Lambda(x).$$

Assumption 3.

$$\mu^* \gg \mu^S \equiv \frac{\beta}{\beta + (1-\beta)\lambda(0)}. \tag{A3}$$

Assumption 4.

$$0 < \chi + \sigma_\eta^2 - \ln a < 4. \tag{A4}$$

where $\chi \equiv x_n + \ln\delta_w + \ln\delta_b$.

(A1) and (A2) ensure that initially workers are abundant enough to generate high expected returns from entrepreneurship with prior $\underline{x}_n$, but not too abundant that they perceive a higher return from entrepreneurship at $\overline{x}_n$. By the law of large numbers, (A1) and Proposition 1 imply that $\bar{z}_{nt}^k = \bar{z}_{nt}$ is average business capital per entrepreneur. (A3) is an implicit restriction on the parameter values that determine the steady-state share of wage-workers; μ^* has to be "sufficiently greater than" μ^S in a sense to be clarified later. (A4) is a sufficient condition that ensures stability of steady states; the parameter σ_η^2 becomes relevant later under technology upgrading.

Under these assumptions, agents with the more diffuse prior $\overline{x}_n$ become wage workers, those with the less diffuse prior, some $x_t \leq \underline{x}_n$ become entrepreneurs in any t, and cultural indoctrination is dynamically persistent that is, $m_t = \mu_t = 1 - G_t(x)\ \forall\, t$.

Proposition 2. *Under* (A1)–(A3)*, at any* t*, agents with a prior lower than some* $\hat{x}_{nt} \in (0, \overline{x}_n)$ *become an entrepreneur and choose the socialization effort* τ_t^k *given by* (13) *for* $\jmath = k$*. Conversely, any agent with prior higher than* $\hat{x}_{nt}$ *will choose to become a wage worker and the socialization effort* τ_t^w *given by* (13) *for* $\jmath = w$*.*

Proof. See Appendix B. □

Figure 1 uses (7) and (8) to plot a version of the expected utilities from profit and wage incomes where $\Gamma \equiv n\ln a + \ln(1-\beta) + \beta\ln\beta/(1-\beta)$: entrepreneurial expected utility is monotonically falling in how diffuse the prior x is. Since cultural indoctrination is persistent, workers' prior remains at $\overline{x}_n$ while the entrepreneurial prior converges asymptotically to zero. In other words, the distribution of priors in the population remains discrete at all points in time. As depicted in Fig 1, $\underline{x}_{nt}$ is the prior of all culturally indoctrinated entrepreneurs at t, less than their initial prior $\underline{x}_n$ due to learning-by-doing. For priors lower than $\hat{x}_{nt}$, entrepreneurs have sufficiently high expertise that they can expect a higher income than wage work. If the prior exceeds $\hat{x}_{nt}$, on the other hand, wage work dominates as it does at $\bar{x}_n$.

2.5 Dynamics

Turn next to the dynamics of $\mu_t \equiv 1 - G_t(\underline{x}_n)$. The pool of wage workers in the $t+1$-th generation is comprised of three groups. First are the children of wage working parents from the t-th generation for whom the social education effort was successful,

$$\tau_t^w \Pr\{x_{nt} = \overline{x}_n\} = \tau_t^w \mu_t$$

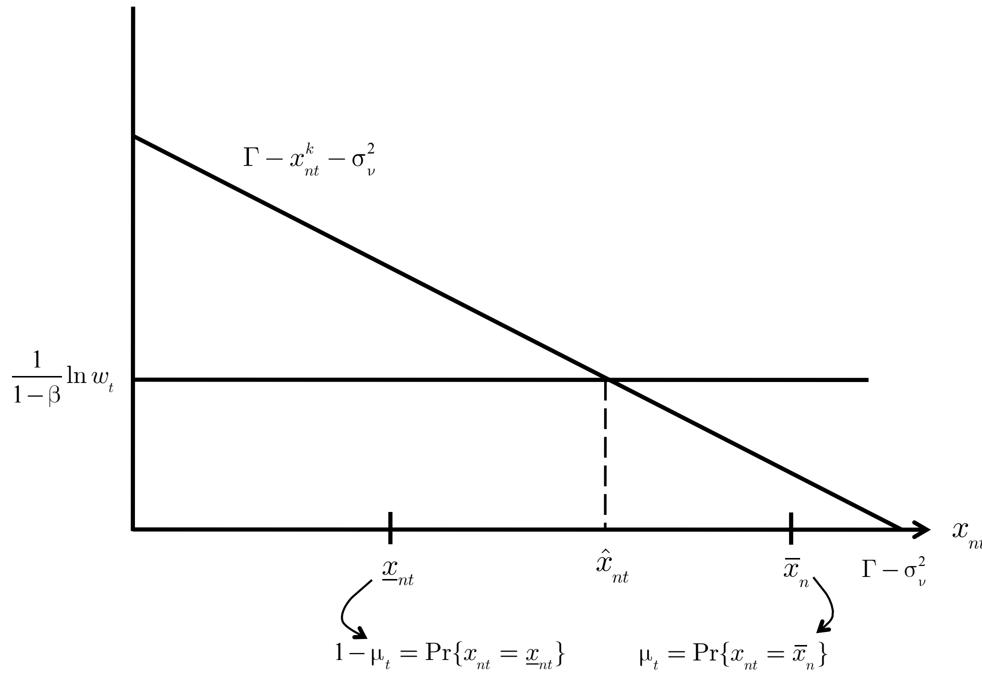


Figure 1: Occupational Allocation at t

The second group consists of those offspring for whom at-home socialization was unsuccessful and who were subsequently matched with a wage working cultural parent. The proportion of these agents is

$$\mu_t(1-\tau_t^w)\Pr\{x_{nt} = \overline{x}_n\} = (1-\tau_t^w)\mu_t^2.$$

Future wage-workers are also drawn from the children of entrepreneurial parents for whom at-home socialization was unsuccessful and who were subsequently matched with a wage working cultural parent:

$$\mu_t(1-\tau_t^b)\Pr\{x_{nt} = \underline{x}_{nt}\} = (1-\tau_t^b)\mu_t(1-\mu_t)$$

where

$$\tau_t^b \equiv \frac{\tau_t^k \Pr\{x_{nt} = \underline{x}_n\}}{1-\mu_t} = \tau_t^k$$

is the average socialization effort among entrepreneurial families, same for all k under discrete priors.

The evolution of μ is then governed by

$$\begin{aligned}\mu_{t+1} &= \tau_t^w \mu_t + (1-\tau_t^w)\mu_t^2 + (1-\tau_t^b)\mu_t(1-\mu_t) \\ &= \mu_t + \left(\tau_t^w(\mu_t) - \tau_t^b(\mu_t)\right)\mu_t\left(1-\mu_t\right) \equiv M(\mu_t) \qquad (18)\end{aligned}$$

where socialization efforts depend on μ_t via equations (14) and (17), given $\mu_1 > 0$.

Proposition 3. *Under* (A1) – (A4)*, the difference equation* (18) *possesses a unique asymptotically sta-*

ble steady state μ^* where $\tau^w(\mu^*) = \tau^k(\mu^*)$ and to which the economy non-monotonically converges from above.

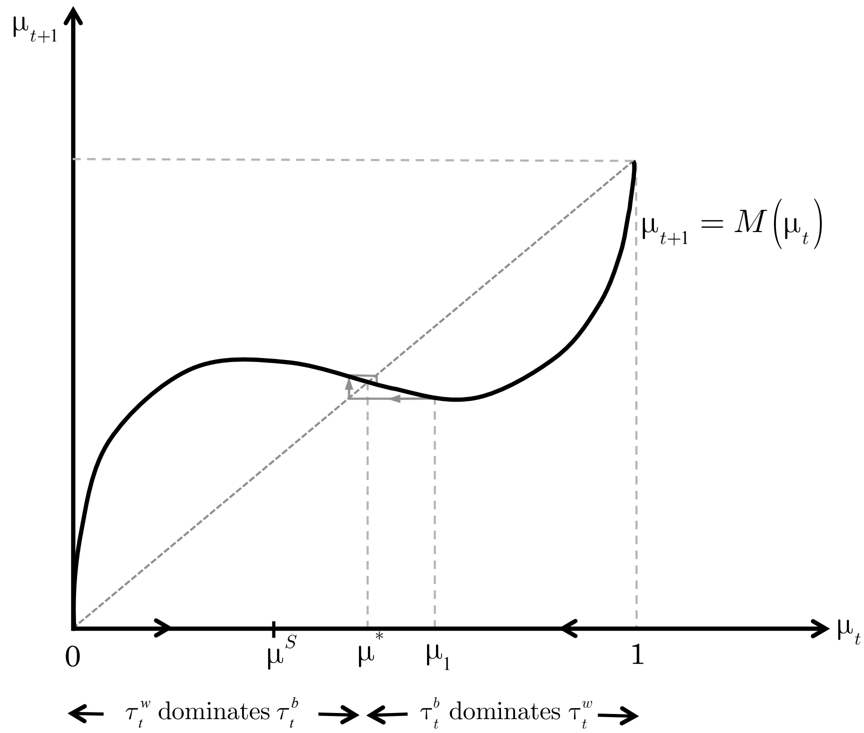


Figure 2: Dynamics of Occupational Type

Proof. See Appendix C. □

As Fig 2 illustrates, the dynamics depends on two forces. A higher μ_t implies a higher gap in the expected utilities of entrepreneurs (at either prior) relative to workers which lowers τ^w, raises τ^b. At the same time, a higher μ_t means stronger chance that the child will be indoctrinated into wage-work through social influence, that is, lower τ^w and higher τ^b. At low values of μ_t, socialization by worker parents dominates, at high values the reverse is true. Persistent indoctrination requires that the trajectory for μ_t remain above μ^S (as drawn), that is, culture be sufficiently distortionary. Non-monotonic convergence likely occurs because parents make naive forecasts of their offspring's future income.

Now consider parametric restrictions that ensure (A2) and inefficiency of μ^*. The socially optimal supply of wage-workers μ^S maximizes steady-state utilitarian social welfare. This occurs when expected utilities from the two occupations are equalized:

$$\ln\left(\frac{1-\mu^S}{\mu^S}\right) = \ln\left(\frac{1-\beta}{\beta}\right) + \ln\lambda(0)$$

that is, $\mu^S = \beta / \left[\beta + (1-\beta)\lambda(0)\right]$. Since $\lambda(0) < 1$,[10] this is higher than the output maximizing supply of wage-workers β: entrepreneurs have to be compensated for the risk they take on by keeping wages relatively low.

Compare this to the decentralized outcome. Using the socialization efforts from above and the equilibrium wage from (17), the steady-state supply of wage-workers μ^* implicitly solves:

$$\ln\left(\frac{1-\mu^*}{\mu^*}\right) = \ln\left(\frac{1-\mu^S}{\mu^S}\right) - (1-\mu^*)\bar{x}_n - \ln\left(\frac{\delta_w^{1-\mu^*}}{\delta_b^{\mu^*}}\right) \tag{19}$$

The second term on the right stems from the inalienability of human capital. The last term captures the relative intensity of within-family cultural bias between the two occupations. Notably, the deviation of μ^* from μ^S does not depend on risk-aversion. The numerical example below illustrates comparative statics properties of μ^*.

Example 1. *Fig 3 shows that μ^* is decreasing in entrepreneurial bias (δ_b), increasing in wage worker bias (δ_w), and increasing in how uninformed wage workers are about business ($\overline{x}_n$). The dotted line shows the efficient outcome μ^S, μ^* always exceeding it under the parameter values chosen.*

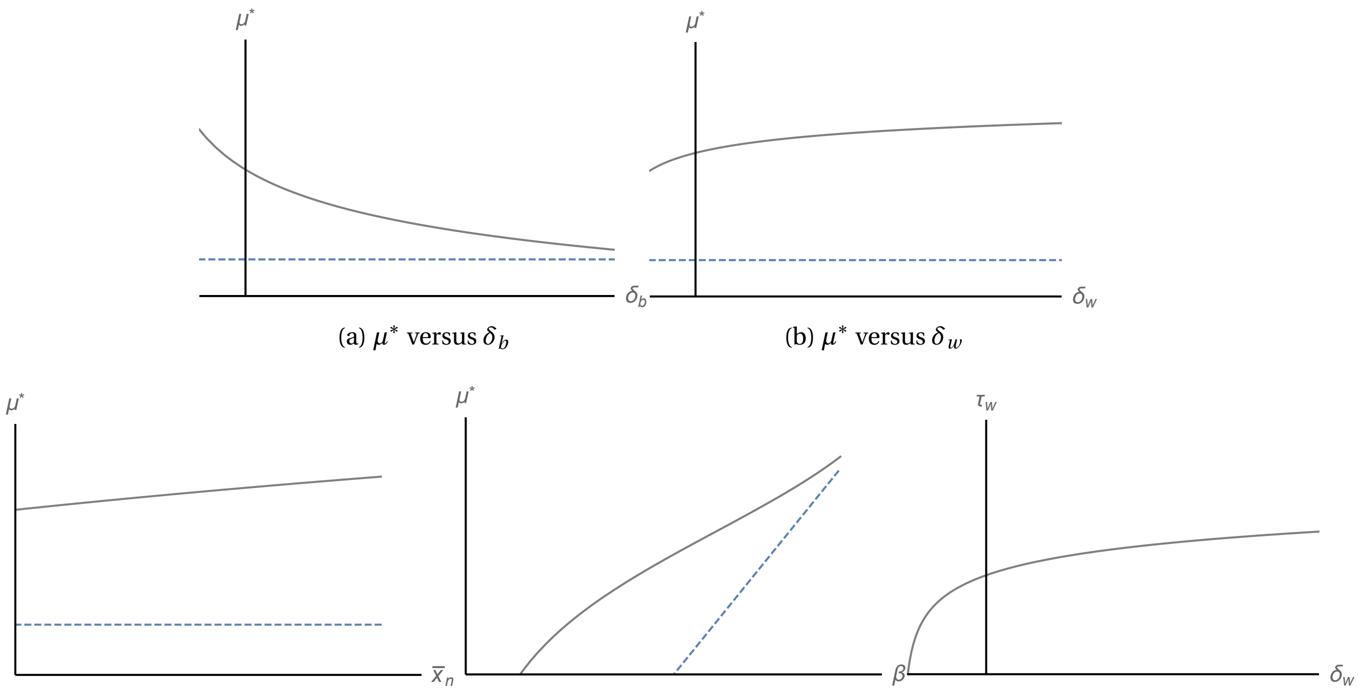
For a given vector $(\delta_b, \delta_w, \beta)$, $\mu^* > \mu^S$ as long as $\overline{x}_n$ is high enough. If occupational biases were absent ($\delta_b = \delta_w = 1$), $\mu^* > \mu^S$ for all $\bar{x}_n > 0$.

*Finally, the last panel of Fig 3 shows τ^w is increasing in occupational bias. This means higher biases increase intergenerational transmission intensity and, thereby **cultural inertia**, as measured by the deviation of μ^* from μ^S.*

The steady state is inefficient, with too few entrepreneurs, as long as $\delta_w \geq \delta_b$. This, however, cannot be the main cultural channel as the allocation is inefficient even with $\delta_w = \delta_b = 1$. Suppose that the frequency of each type in the population depended on Darwinian replicator dynamics: more become entrepreneurial type instead of wage-worker type as long as the expected utility from entrepreneurship is higher. In steady state, with no net inflow into wage-work or entrepreneurship, the expected utility from the two occupations have to equalize and μ^S would obtain. That the decentralized outcome is inefficient is therefore due to purposeful within-family indoctrination – the cultural transmission of human capital – besides the inalienability of business capital. The possibility that within-family transmission can fail tends to attenuate this when $\tau^b > \tau^w$: in fact for a sufficiently high δ_b the supply of entrepreneurs can be inefficiently high. Conversely, $\delta_w > \delta_b$ intensifies the preference towards the safer occupation.

Parental altruism in the model embodies two biases. The occupational bias (δ_w, δ_b) that influences socialization intensity is not essential (Example 2), only a reasonable description of the culture in many developing countries. More fundamental is the paternalism bias that consists of

[10] Follows from noting that for $y > 0$, $1 + y < e^y \approx 1 + y + y^2/2 + y^3/6 + \ldots$



(a) μ^* versus δ_b (b) μ^* versus δ_w

(c) μ^* versus $\overline{x}_n$ (d) μ^* versus μ^S (e) τ_w versus δ_w

Figure 3: Steady-state Entrepreneurship and Socialization
$\beta = 0.6, \delta_w = 6, \delta_b = 1, \sigma_\nu^2 = 0.1, \overline{x}_n = 2$

two assumptions: parents in t use the wage rate w_t they face (instead of forecasting w_{t+1}) and their own business expertise (high or low depending on parent's occupation class) to impute expected payoffs of their children in $t+1$. Most models that rely on Barro-Becker-type pure altruism use a single type of human capital and require the parent to forecast only future factor prices, an already heavy burden on rationality since it involves forecasting over generational, not calendar, time (Michel *et al.*, 2006). In our model pure altruism would require wage-working parents to forecast $\bar{z}_{t+1}$ (see (7) and (8)) since they are uninformed about the business expertise required to be a successful entrepreneur. That we assume bounded rationality is partly for algebraic convenience, partly for plausibility. It is also the case that under pure altruism the dependence of current socialization effort on expectations of the future could open the door for dynamics that is not culturally persistent and/or non-unique under technology upgrading, a topic we reserve for future research.[11]

[11] An alternative formulation is that children automatically inherit their parent's human capital. Then the proportion of wage-workers will always remain at μ_1 and culture would only matter because of the history that created a high μ_1. Boyd and Richerson (1985) caution against such a notion that culture is immutable.

3 Choice of Technologies

The single technology model will be now extended to entertain long-run growth and the possibility of non-persistent indoctrination. Specifically, potential entrepreneurs choose from a menu of technologies (business activities) instead of a fixed and arbitrary n, following Jovanovic and Nyarko (1996). There is no direct cost of switching to a different technology and, as before, no cost to adjusting x. Output from each n has the same functional form so that business capital is defined as in equations (4) and (5). Different technologies are, however, imperfectly related. Specifically the parameters θ_n and θ_{n+1} for any n are linked by

$$\theta_{n+1} = \alpha^{1/2}\theta_n + \eta, \tag{20}$$

where η is drawn *iid* from $N(0, \sigma_\eta^2)$, $\alpha \in (0,1)$ and θ_n and η are independent. Observe that if $\alpha = 1$ and $\sigma_\eta^2 = 0$, then $\theta_{n+1} = \theta_n$ which means any precision about θ_n can be transferred to θ_{n+1}. Hence α is a measure of the specificity of human capital – how well knowledge of one business venture or technology helps in the next. Besides technological factors, it may depend on political capital and entry barriers (e.g. government directed investment, licensing) that create an advantage for incumbent businesses. Similar to Chari and Hopenhayn's (1991) model of vintage-specific skills, the barrier to adopting more productive technologies comes from human capital in current methods.[12] For $\sigma_\eta^2 > 0$ in (20), the entrepreneur faces some uncertainty in transferring his knowledge from θ_n to θ_{n+1} even for $\alpha = 1$. Finally we assume that entrepreneurs cannot skip intermediate technologies when upgrading, that is, upgrading to $n+2$ is possible only via $n+1$ and not directly from n to $n+2$. This means the *possibility* of technological progress is endogenous, its rate is not.

The preference side is similar to the benchmark model. The assumption of discrete initial priors is maintained and the uninformed prior is modified to x' to be consistent with technology upgrading. For cultural indoctrination, the technology grade used to evaluate an offspring's payoff from entrepreneurship needs to be specified. Let the expected return from upgrading technology be Π and from staying with the current technology be π. Parental payoffs from altruism are

$$\begin{aligned}
V_t^{ww} &= \ln w_t \\
V_t^{wk} &= \max\left\{E_t \ln \Pi_t(x'), E_t \ln \pi_t(x')\right\} - \ln \delta_w \\
V_t^{kk} &= \max\{E_t \ln \Pi_t(x_t), E_t \ln \pi_t(x_t)\} \\
V_t^{kw} &= \ln w_t - \ln \delta_b.
\end{aligned}$$

where wage-workers have the prior x', entrepreneurs the prior x_t at t. These and the profit func-

[12] Krusell and Rios-Rull (1996) build on this to explain stagnation versus sustained growth through a political, rather than cultural, mechanism. Specifically, depending on the skill distribution, opposition from determined vested interests may lead to heavy-handed government regulation that prevents technological advancement.

tions are detailed below.

3.1 Updating and Upgrading

We begin by studying what an entrepreneur learns when he upgrades the technology his entrepreneurial parent used. Recall that continuous updating of information without changing the technology will lead to perfect mastery of that technology. In the presence of a menu of technologies distinguished by (20), upgrading to the next one causes posteriors to become more dispersed, that is, business expertise to be diluted, because the prior for vintage $n+1$ is $\alpha x_n + \sigma_\eta^2$.

First consider a hypothetical scenario of constant upgrading-without-updating. If this were to be repeated over time, the diffuse prior – which does not get sharpened through updating – evolves according to

$$x_{n+1,t+1} = \mathscr{J}(x_{nt}) \equiv \alpha x_{nt} + \sigma_\eta^2. \tag{21}$$

$\alpha \in (0,1)$ ensures that the fixed point of this mapping is a well defined $x' \equiv \sigma_\eta^2/(1-\alpha) > 0$, independent of n. The greater the uncertainty surrounding new technologies (higher σ_η^2), the more diffuse is this long-run value. The absence of updating ensures that expertise remains weak. We assign this fixed point as the diffuse prior of wage-workers, analogous to $\overline{x}_n$ before. In other words, we are endowing wage workers with the "best of the worst" possible priors when a menu of technologies is available.[13] We also assume that the economy starts at $t=1$ with technology n in use and a population endowed with the discrete priors x' and $\underline{x}_n < x'$. $G_1(\underline{x}_n)$ fraction of the initial population is indoctrinated as entrepreneurs, $1 - G_1(\underline{x}_n)$ fraction as wage workers.

When an entrepreneurial line is upgrading technologies besides updating priors, the evolution of its human capital is described by

$$x_{n+1,t+1} = \mathscr{F}\left(\mathscr{J}(x_{nt})\right) = \mathscr{F}\left(\alpha x_{nt} + \sigma_\eta^2\right) \tag{22}$$

the fixed point of which, x^{**}, is the positive root of $\alpha x^2 + \left[(1-\alpha)\sigma_\nu^2 + \sigma_\eta^2\right] x - \sigma_\nu^2 \sigma_\eta^2 = 0$. It is easy to show that $x' > x^{**} > 0$: even though a new technology is never fully mastered, updating generates sharper priors than without. Lemma 1 below summarizes these results.

Lemma 1. *The fixed points of the mappings $\mathscr{F}$, $\mathscr{F}(\mathscr{J})$ and $\mathscr{J}$ are 0, x^{**} and x' respectively such that $0 < x^{**} < x'$.*

The model can generate a steady state where advanced businesses do not innovate, resulting in stagnation. The model of section 2 is therefore a special case of this one if we take $\overline{x}_n = x'$.

[13] Assuming that the diffuse prior takes this particular value is not essential. All that is needed is for the prior to be sufficiently diffuse, above x^{**} (Lemma 1) and below $\Gamma + n \ln a - \sigma_\nu^2 - \sigma_\eta^2$, the latter making it possible for indoctrination to be non-persistent.

This equilibrium can be shocked by changes in a, the rate of technological change or (effectively) TFP, and α, the human capital specificity of different technologies. When this happens, existing entrepreneurs may start adopting more productive technologies or a new generation of entrepreneurs may do so and leap-frog over existing ones. Either way the economy moves from stagnation to endogenous growth.

To identify these results we present two parameter-dependent cases in Figure 4. Each expected utility curve in the figure is scaled up by $\beta \ln w_t/(1-\beta)$ to make it stationary; this does not affect technology or occupational choice. For convenience, the decision whether or not to upgrade is shown for the entire range of x. The gray line in each figure corresponds to $\ln w_t/(1-\beta)$ as in Figure 1: as drawn, the equilibrium wage strictly exceeds the payoff from either technology at the diffuse prior x'.

3.2 Long-run Stagnation and Growth

For an individual culturally indoctrinated by the entrepreneurial line k, let $\Pi^k(x)$ be the profit income from switching to $n+1$ based on the expertise x over technology n. Similarly, let $\pi^k(x)$ be the profit from staying with n. Then

$$u\left(\Pi_t^k(x)\right) \equiv E\left(\ln \tilde{\pi}_{nt}^k(x)\right) = \ln \kappa_t + (n+1)\ln a - \sigma_\nu^2 - \alpha x - \sigma_\eta^2, \tag{23}$$

$$u\left(\pi_t^k(x)\right) \equiv E\left(\ln \tilde{\pi}_{t,n+1}^k(x)\right) = \ln \kappa_t + n \ln a - \sigma_\nu^2 - x, \tag{24}$$

where $\kappa_t \equiv (1-\beta)\beta^{\beta/(1-\beta)} w_t^{-\beta/(1-\beta)}$ as before. Because these represent the expected utility from choosing technologies $n+1$ and n respectively, their ranking determines whether k upgrades or not.

In Figure 4(a), $\ln a < \sigma_\eta^2$: the productivity gain from switching (a) is relatively small and/or the optimum scale of a new technology is not easy to learn based on the old one (high σ_η^2). Long-run stagnation can occur. More precisely, an entrepreneur's expertise determines whether or not he is better off upgrading. An entrepreneur with a very low x, that is, a lot of expertise in technology n, will not want to upgrade because his substantial expertise in n does not readily transfer to $n+1$. The threshold $\tilde{x}$ is given by

$$\tilde{x} = \frac{\sigma_\eta^2 - \ln a}{1-\alpha}.$$

Whereas for low values of x, technology n dominates expected earnings, for a high value (still low enough to yield higher expected return over wage work) $n+1$ dominates. This means, if all entrepreneurs start off with minimally dispersed priors (low values of x), it is possible that *all* entrepreneurial lines keep using the vintage n without ever upgrading. Formally this and dynamic persistence require – similar to the equilibrium outlined in section 2– that entrepreneurs start with a prior $\underline{x}_n \leq \tilde{x}$ corresponding to the initial technology n, and that for workers, $\ln w(\mu^*) > \max\{E\ln\pi^k(x', \mu^*), E\ln\Pi^k(x', \mu^*)\}$, that is, a modified version of (A3) allowing for more than one technology holds

Assumption 5.

$$\frac{\beta}{\beta + (1-\beta)\lambda(\underline{x}_n)} < 1 - G_1(\underline{x}_n) < \frac{\beta}{\beta + (1-\beta)a\Lambda(\underline{x}_n)} \tag{A5}$$

λ and Λ were defined under (A2), the latter now redefined using $x' = \sigma_\eta^2/(1-\alpha)$ in place of $\bar{x}_n$; similarly for χ in (A4). Under (A5), all businesses will continuously update and eventually master technology n as in section 2, without ever upgrading.

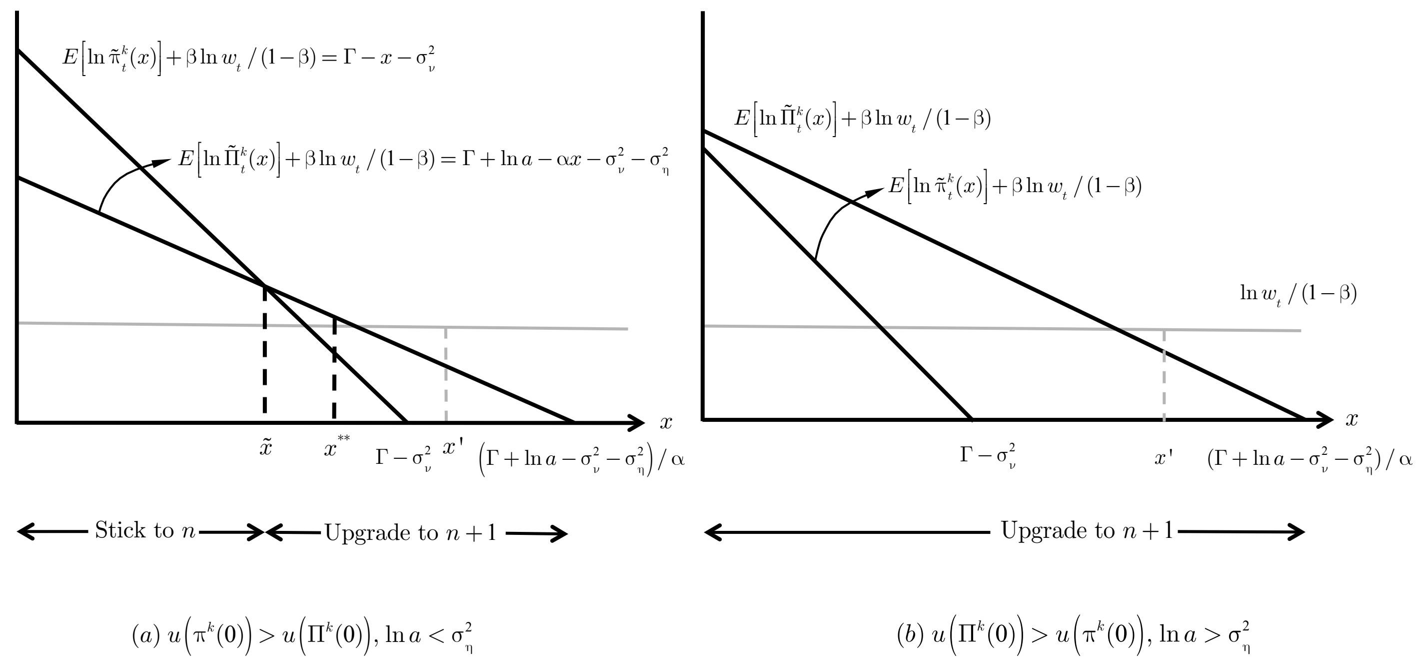


Figure 4: Technology and Occupational Choice

The economy converges to a stationary equilibrium similar to section 2 where aggregate output is constant, indoctrination is dynamically persistent and the supply of entrepreneurs is $1-\tilde{\mu}$ where $\tilde{\mu}$ solves

$$\ln\left(\frac{1-\tilde{\mu}}{\tilde{\mu}}\right) = \ln\left(\frac{1-\tilde{\mu}^S}{\tilde{\mu}^S}\right) - (1-\tilde{\mu})x' + (1-\tilde{\mu})\ln a - \ln\left(\frac{\delta_w^{1-\tilde{\mu}}}{\delta_b^{\tilde{\mu}}}\right)$$

and

$$\tilde{\mu}^S = \frac{\beta}{\beta + (1-\beta)\lambda(0)}$$

is the efficient steady-state supply of workers. Under (A4), $\tilde{\mu}$ is asymptotically stable and, as before, high δ_w, low δ_b, and large gap in entrepreneurial ability ensure that this is inefficient; it is inefficient for sure when $\delta_w = \delta_b = 1$. This steady state is similar to μ^* except that the possibility of becoming entrepreneurs using a more productive technology makes entrepreneurship a little less unattractive to wage-working parents and reduces their socialization effort; hence the steady-state is closer to the efficient one.

Statist development policy emphasizing the public sector, discouraging private enterprise and protecting the economy from foreign competition is one way a society imbibes anti-capitalist bias that thwarts innovation and progress. A different instance is pre-Meiji Japan's cultural insularity, "one of the most conscious attempts in history to freeze society in a rigid hierarchical mold" (Norman, 1940, cited in Lockwood, 1968, p. 5). Landes (1998) notes how in its prohibition of the use of high-quality soil for cash crops and non-agricultural work and proscription against foreign interactions, pre-Meiji Japan was more interested in maintaining the politico-economic *status quo*. The result was an economy – with little growth of income or entrepreneurship – sustained simultaneously by the successful mastery of prevailing methods of production whose growth potential was exhausted and policies that made innovation challenging (high α).

Stagnation, though, is only one possibility. Long-run growth where established business lines constantly upgrade technology is also possible. In Fig 4(b), the payoff from a new technology always exceeds that from the existing one no matter how precise or diffuse the entrepreneur's prior is. In this case, all entrepreneurs always upgrade. This occurs under $\ln a > \sigma_\eta^2$: when the productivity gain from switching is large enough (high a), and/or the optimum scale of the new technology is easy to learn based on the old one (low σ_η). Properties of this equilibrium are developed below. We first summarize the main points.

Proposition 4. *The incentive to upgrade technology depends on productivity a.*

(i) If $\ln a < \sigma_\eta^2$, $u\left(\Pi_t^k(0)\right) < u\left(\pi_t^k(0)\right)$, and for some $\tilde{x} \in (0, (\Gamma + \ln a - \sigma_\eta^2 - \sigma_\nu^2)/\alpha)$, $u\left(\Pi_t^k(\tilde{x})\right) = u\left(\pi_t^k(\tilde{x})\right)$ such that $u\left(\Pi_t^k(x)\right) < u\left(\pi_t^k(x)\right)$ whenever $x < \tilde{x}$ and vice versa.

(ii) If $\ln a > \sigma_\eta^2$, $u\left(\Pi_t^k(0)\right) > u\left(\pi_t^k(0)\right)$ and $u\left(\Pi_t^k(x)\right) > u\left(\pi_t^k(x)\right)$ for all $x \geq 0$.

Proof. Follows from Figure 4. □

4 Culture and Growth

To identify how technological progress may be unleashed in a stagnating economy, we start with the long-run equilibrium predicted by Fig 4(a) and ask whether and what kind of exogenous shocks might spur growth.

4.1 Productivity Shock and Top-Down Development

A natural candidate is improved access to technologies and markets that raises overall productivity a for both existing and new technologies. Starting from the no-growth stationary equilibrium described by Fig 4(a) where all entrepreneurs have fully mastered the status-quo technology, suppose a were to increase sufficiently such that $u\left(\Pi_t^k(0)\right) > u\left(\pi_t^k(0)\right)$, that is, $\ln a > \sigma_\eta^2$. The threshold productivity level $\hat{a} \equiv e^{\sigma_\eta^2}$ is independent of cultural factors, that is, μ^*. If the productivity shock were to be higher than this threshold, the choice of technology would look like Fig 4(b). Entrepreneurial lines would now prefer to upgrade rather than stay with their existing technology. Further, because this increase in a increases the marginal cost of diffuse priors, wage worker cultural lines prefer not to enter the business world. With all old businesses simultaneously switching from n to $n+1$ at the time of the shock, and then upgrading every generation, economic growth takes off without the creation of any new business lines. In this sense, culture ceases to be a constraint on economic growth: a sufficiently large change that improves overall productivity can tip the economy from stasis towards rapid change. The size of the productivity shock needed to tip the economy towards growth is independent of cultural inertia: culture does not affect the propensity to benefit from a productivity shock either.

Let the steady-state share of workers in the growing economy be $\bar{\mu}$. Each generation sees technologies upgraded by one step, so that if technology $r > n$ was being used in t, technology $r+1$ will be used in $t+1$. There is no *net* learning in this steady state, that is, entrepreneurial priors remain at x^{**}, but there is some within-period learning. Business expertise x^{**} received from an entrepreneurial parent is only αx^{**} as valuable in the newer technology. On top, the presence of σ_η^2 means some uncertainty in applying that depreciated business expertise to the newer technology. In steady state, each generation of entrepreneurs learns exactly as much as needed to replenish the depreciated human capital, raising entrepreneurial human capital back to x^{**}. Other properties of the steady state are stated below; stability is established in Proposition 6.

Proposition 5. *Under assumptions* (A1) *and* (A3)–(A5)*, there is a steady state (balanced growth path or BGP) with $\bar{\mu}$ share of workers such that*

(i) Wages, expected entrepreneurial profits and per capita income grow at the (gross) rate $a^{1-\beta}$ per generation,

(ii) The expected utility differential between the two occupations is constant as is the socialization effort of each type of parent.

Proof. See Appendix D. □

Again consider conditions under which $\bar{\mu}$ is inefficient. When entrepreneurs constantly upgrade technologies, using an approach similar to before, the socially optimal steady-state $\bar{\mu}^S$ and decentralized steady-state $\bar{\mu}$ are given by

$$\bar{\mu}^S = \frac{\beta}{\beta + (1-\beta)\lambda\left(x^{**}\right)}$$

and

$$\ln\left(\frac{1-\bar{\mu}}{\bar{\mu}}\right) = \ln\left(\frac{1-\bar{\mu}^S}{\bar{\mu}^S}\right) - (1-\bar{\mu})\left[x' - x^{**}\right] - \ln\left(\frac{\delta_w^{1-\bar{\mu}}}{\delta_b^{\bar{\mu}}}\right)$$

respectively. Compare $\bar{\mu}$ to the steady state with no-upgrading, $\tilde{\mu}$. While within-family cultural transmission of human capital similarly drives a wedge between the decentralized and efficient supplies of entrepreneurship, the growing economy need not have a higher supply of entrepreneurs. On the one hand, in the growing economy, the utility gap between the two occupations is not perceived to be as large since $x^{**} > 0$ and both parental types exert lower socialization effort. This moves the economy closer to efficiency. On the other hand, in the no-growth economy, uninformed wage-workers perceive a higher return from more advanced technologies were they to become entrepreneurs. The weaker transmission of worker human capital moves that economy closer to the efficient outcome. We can unequivocally say, though, that the efficient supply of entrepreneurship is lower under technology upgrading, $\bar{\mu}^S > \tilde{\mu}^S$: risk-averse entrepreneurs have to be compensated more for the higher risk as they never fully master any technology.

In the BGP, culture continues to determine the *level* of output per worker since $\bar{\mu} > \beta$. But the growth factor $a^{1-\beta}$ is independent of cuture; indeed it is the maximal growth rate possible when entrepreneurs can upgrade only one step at a time. Neither does culture determine the size of the shock needed to generate growth as long as $a > \hat{a}$. And growth occurs despite some cultural traits – subjective occupational biases (δ_w, δ_b) – remaining unchanged.

To return to the example of Japan, the Meiji Restoration was essentially a big push to modernize given the perceived military threat of remaining backward (see Smith, 1988, p. 259). That modernization, beginning with agricultural liberalization (exemplified in the Land Tax Reform of 1873) and moving on to industrialization (Macpherson, 1995) was driven primarily by the elites, some scholars going so far as to call in an aristocratic revolution in response to new opportunities (Smith, 1988; Landes, 1998). Within our model this sudden shock to a predicts an increase in growth without any change in social station: it is the existing elite (entrepreneurs) that embraces innovation.

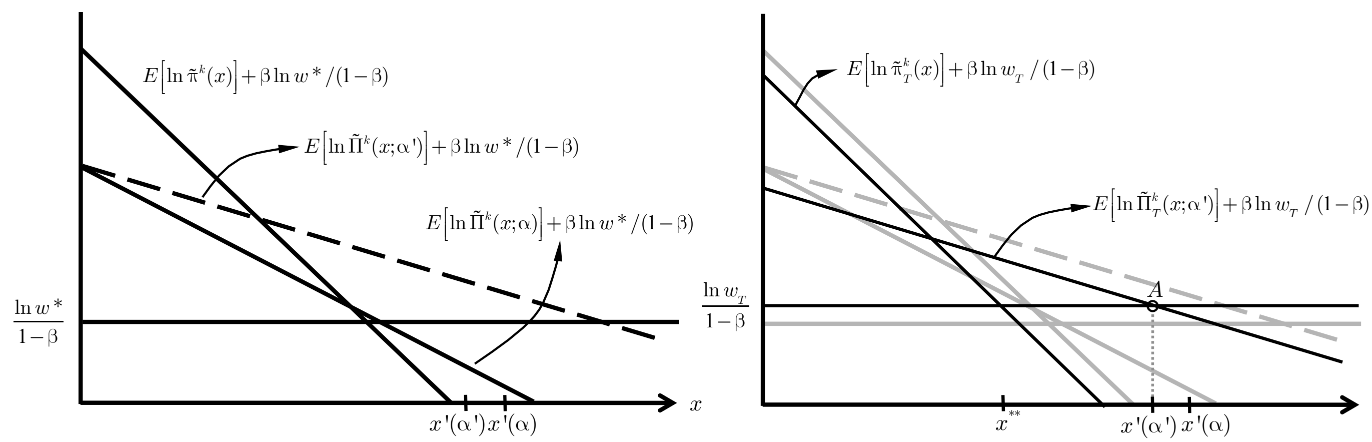
4.2 Human Capital Shock and Overtaking

A growth takeoff with economic mobility and the emergence of a new economic elite is possible too. Starting from the no-growth stationary equilibrium, suppose a human capital shock – a change in technology access or the regulatory environment – lowers α to

$$\alpha' < 1 - \sigma_\eta^2\left[\ln a + \ln\left(\frac{1-\beta}{\beta}\frac{\mu^*}{1-\mu^*}\right) - \sigma_\nu^2 + \frac{1}{2}\ln\left(1+2\sigma_\nu^2\right)\right]^{-1} \equiv \hat{\alpha}(\mu^*), \tag{25}$$

so that $u\left(\Pi^k(x')\right) > \ln w$.[14] The threshold $\hat{\alpha}$ is increasing in cultural biases (that is μ^*): the higher the cultural inertia, the *smaller* the shock needed to overturn cultural indoctrination.

By Lemma 1 and Proposition 4, the ordinal ranking $\tilde{x} < x^{**} < x'$ is maintained at α'. The ranking of $u(\pi_n(0))$ and $u(\Pi_n(0))$ is not affected either. Only those culturally indoctrinated to be wage workers now expect a higher return from entrepreneurship. Suppose that α falls to α' at the beginning of $t = T$ before economically active adults make an occupational choice. The uninformed prior changes from $x'(\alpha)$ to $x'(\alpha') = \sigma_\eta^2/(1-\alpha')$ reflecting the altered environment; qualitative results are unchanged if x' does not change or changes with a one-generation lag. The post-shock economy, before equilibrium is restored, is shown in Fig 5(a). The dashed line represents the new $u\left(\Pi_t^k\right)$ corresponding to α'. At the previous uninformed prior $x'(\alpha)$, expected utility from labor income strictly exceeded utility from both π_t and Π_t so that none of the workers would have preferred entrepreneurship. Now at $x'(\alpha')$, expected utility from upgrading exceeds the wage rate but from the prevailing technology does not. This happens precisely because the shock does not favor current expertise.



(a) Post-indoctrination, Pre-Occupational Choice

(b) Post-Occupational Choice Equilibrium

Figure 5: The period-T problem when α falls to α'

For the first time a separation between an agent's cultural line and occupational choice opens up. As culturally indoctrinated wage workers opt for entrepreneurship, it raises labor demand and lowers labor supply. The wage rate w_T rises and with it falls entrepreneurial return from n and $n+1$ technologies. Fig 5(b) shows – pre-equilibrium relationships are in gray, equilibrium ones in black – that an occupational equilibrium is restored at point A where enough people have opted for entrepreneurship (using $n+1$) such that the remaining workers are indifferent between the two occupations. None of the culturally indoctrinated entrepreneurs switch to wage-work yet.

Denote the first-generation entrepreneurs, the *entrants*, by the set $\mathcal{E}_T^E$. The entrant population

[14] In practice such a policy shock may also raise a. The BGP implications are similar, the difference being both incumbent and entrant lines may start upgrading depending on parameter values.

will grow until the arbitrage condition $\ln w_T = E_T \ln \pi_{n+1,T}\left(x'(\alpha')\right)$ holds. The end result is $\mu_T < m_T$, a decline in business returns for existing entrepreneurial lines and the rise of a new class of entrepreneurs who are, initially, no better off than wage workers. By the end of T, three groups of people have emerged: those indoctrinated as workers and chose to be so, those indoctrinated as workers but chose to venture into entrepreneurship and those indoctrinated as entrepreneurs who chose to be so. We will refer to the last group, with the prior $x_n = 0$, as *incumbents*. Denote by i_t the fraction of the population indoctrinated into this type (that is, acquiring the prior zero) and by ι_t the fraction who choose to be (incumbent) entrepreneurs. Then $i_T = \iota_T$.

We characterize first a particular dynamic path towards the new BGP. For convenience, for all $t > T$, refer to the entrepreneurs with human capital stemming from the period-T first-generation entrepreneurs as entrants. Denote the fraction of the population culturally indoctrinated in entrant entrepreneurship by e_t and the actual fraction who choose to be entrepreneurs by ϵ_t.

Three types of human capital are intergenerationally transmitted. Incumbents culturally pass on the prior $x_n = 0$ ($\tilde{x} > 0$ still holds), entrants pass on $x_{n+t} \in [x^{**}, x'(\alpha')]$, gradually moving from $x'(\alpha')$ to x^{**}, and wage workers pass on their uninformed prior $x'(\alpha')$.

Specify the altruism payoffs as

$$
\begin{aligned}
V_t^{ww} &= \ln w_t \\
V_t^{wk} &= E_t \ln\left(\Pi_{t+1}(x')\right) - \ln \delta_w \\
V_t^{ee} &= E_t \ln\left(\Pi_{t+1}(x_t^e)\right), \\
V_t^{ii} &= E_t \ln\left(\pi_t(0)\right), \\
V_t^{kw} &= \ln w_t - \ln \delta_b,
\end{aligned}
$$

where incumbent and entrant entrepreneurs, $k \in \{i, e\}$, are differentiated by their human capitals. Since a wage-working parent projects his own prior and choice problem onto his offspring, his evaluation of whether the offspring becomes an entrant entrepreneur (acquires x_{t+1}^e) or an incumbent entrepreneur (acquires $x_{t+1}^i = 0$) is the same. For $t \geq T$, within-family socialization efforts of the three types of parents are

$$
\begin{aligned}
\tau_t^w &= (1 - \mu_t)\left(V_t^{ww} - V_t^{wk}\right) \\
\tau_t^e &= \mu_t\left(V_t^{ee} - V_t^{kw}\right) \\
\tau_t^i &= \mu_t\left(V_t^{ii} - V_t^{kw}\right).
\end{aligned}
$$

Proposition 6 specifies an equilibrium path to $\bar{\mu}(\alpha')$ assuming that wage-worker indoctrination is persistent period $T + 1$ onwards.[15] Specifically, it is shown that entrants overtake incumbent

[15] For this to be true, the utility differential between entrepreneurship using the next grade of technology and wage-

entrepreneurs, eventually driving them out of business. Thereafter the economy converges, locally non-monotonically, to $\bar{\mu}(\alpha')$. It is also easy to show that $\bar{\mu}(\alpha')$ is closer to the efficient supply of entrepreneurship.

Proposition 6. *Suppose the economy is in steady state, $\tilde{\mu}$, when α falls to α' at T.*

(i) Cultural indoctrination is not persistent at T. Equilibrium proportion of agents are

$$\begin{aligned} \iota_T &= i_T = 1 - \mu^*, \\ \epsilon_T &= \frac{1}{1+\bar{L}^e_T}\left[\mu^* - (1-\mu^*)\frac{\bar{L}^e_T}{\gamma}\right], \\ \mu_T &= \mu^* - \epsilon_T, \end{aligned} \tag{26}$$

where $\gamma \equiv a\sqrt{(1+2\sigma_v^2)/\{1+2(\alpha' x' + \sigma_v^2 + \sigma_\eta^2)\}}$.

(ii) Suppose that

$$\ln a > \frac{1}{2}\left[(1-\alpha')x' + \frac{\sigma_v^2 \alpha' x'}{\sigma_v^2 + x'}\right]$$

Then $\tau^e_t > \tau^i_t$ for $t > T$, and for a sufficiently large $T' \geq T+1$, $i_t = 0 \; \forall t \geq T'$.

(iii) If $\mu_{T'} > \bar{\mu}(\alpha')$, the economy converges to $\bar{\mu}(\alpha')$ period T' onwards; convergence is oscillatory in the neighborhood of $\bar{\mu}(\alpha')$.

Proof. See Appendix E. □

In this scenario, new technologies are productive enough and learning fast enough that entrant entrepreneurs enjoy higher expected utility from $T+1$ onwards. Hence their socialization effort starts to dominate incumbents', causing them to grow relative to the latter. The effect of constant upgrading and updating also means entrants' labor demand grows, raises the wage rate, and steadily eats into the profits of incumbents. After some $T' \geq T+1$, incumbent entrepreneurs find it no longer worthwhile to continue in their line of work and are absorbed into the workforce.[16]

The BGP characteristics of this economy are similar to that of the previous section: growth is driven by continuous technology upgrading and the fraction of wage workers is equal to $\bar{\mu}(\alpha')$. So long as $\bar{\mu}(\alpha') > \bar{\mu}^S$, the result will be a dynamically persistent movement toward $\bar{\mu}(\alpha')$ after

work has to remain positive during the transition. Since wages grow slower than new entrant incomes as long as incumbents are in business, this is possible if entrants learn at a fast pace.

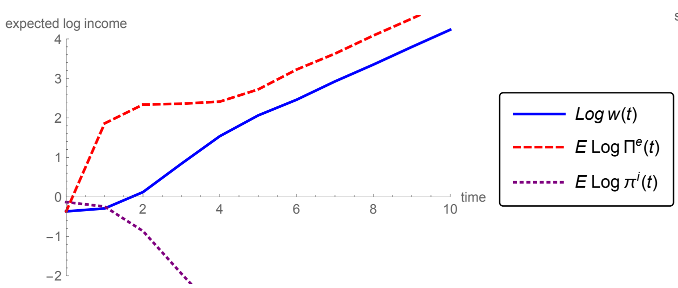
[16]Since the ranking of $\Pi^k(0)$ and $\pi^k(0)$ does not change, neither does it ever become worthwhile for incumbent lines to upgrade to the $n+1$ technology; recall that only one-step ahead upgrading is permissible. It is possible to have $T' > T+1$, that is, several generations during which an arbitrage condition equalizes the expected returns from incumbent entrepreneurship and wage work. With each successive generation after $T+1$, more and more incumbent entrepreneurial offspring choose to become wage workers, until eventually all do.

T', with discrete priors $x_{n+t} = x^{**}$ for entrepreneurs and x' for wage workers. The key difference is that growth here is driven entirely by entrant entrepreneurial lines. The numerical example below shows complete overtaking in two generations after which the economy non-monotonically converges to $\bar{\mu}(\alpha')$.

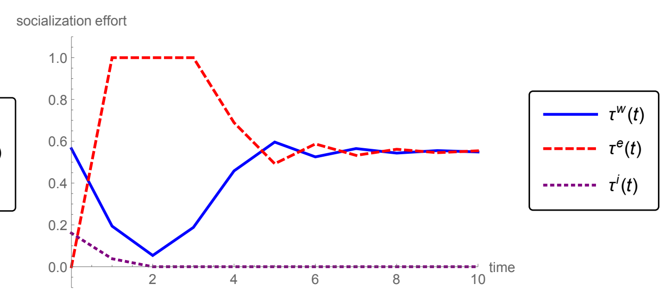
Example 2. *Suppose α and σ_v values are picked to produce a naive prior of $x' = \sigma_v^2/(1-\alpha) = 2$ as before. The shock lowers α to 0.1 in some period, normalized to zero in Figure 6. Steady state is reached when wage-workers' and entrant entrepreneurs' socialization efforts converge and their incomes increase at the same rate. The value of a is chosen to produce an annual growth rate of 1.8% (US long-run average), assuming a generation is 25 years.*

Fig 6(b) illustrates socialization effort by each parent type. In the initial period, socialization by incumbent families dominates that by entrant families. As long as non-upgrading incumbents are present, wages increase at a slower rate than entrant entrepreneurial profits (Fig 6a). Since their earnings rise faster than wages, from period 1 onwards, entrant families invest more intensively in cultural indoctrination (Fig 6b). Hence their frequency rises faster than that of incumbent entrepreneurs (Fig 6c). In the third generation ($t = 2$), all of the incumbent entrepreneurial lines opt for wage work and their human capital dies out.

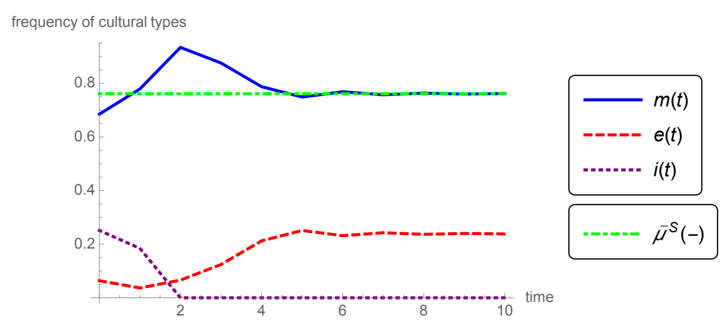
The steady-state proportion of entrepreneurs, consisting entirely of entrants, is 0.24, slightly lower than the 0.26 before, and closer to the (new) efficient level.



(a) Expected incomes, T onwards



(b) Socialization, $T+1$ onwards



(c) Evolution of types, T onwards

Figure 6: Overtaking
$\beta = 0.6, \delta_w = 6, \delta_b = 1, \sigma_v^2 = 0.1, \sigma_\eta^2 = 1.2, a = 3, \alpha = 0.4, \alpha' = 0.1$

An interesting application of this kind of growth is India's recent growth recovery starting with piecemeal reforms initiated during the 1980s and strengthened by the 1991-92 liberalization. Rodrik and Subramanian (2005) argue that while the growth recovery of the 1980s was due to a pro-business "attitudinal shift" that favored the interests of existing businesses, the reforms of the 1990s were pro-market, making possible the emergence of new, dynamic firms. By 1999, 8 of the top 10 Indian billionaires were first generation entrepreneurs, and 6 of the top 10 had made their fortunes in knowledge industries (Das, 2000). Indeed, after liberalization, "middle class" entrepreneurs have often entered sectors and industries that were made possible by liberalization (information, biotechnology) or relatively untouched by established entrepreneurs (travel and hospitality). This may also explain why the liberalization of 1991 has remained robust – making way as it has to shared prosperity by the middle class and the established elite – contrary to an earlier episode in 1966 that was soon reversed (Srinivasan, 2005).[17]

As with a general productivity shock, the overall culture changes here despite unchanging cultural biases (δ_w, δ_b). Additionally, the size of the human capital shock necessary to tip the economy towards growth is *inversely* related to cultural inertia. Family background matters less: in the long run entrepreneurial lines all emerge from a non-entrepreneurial background.[18]

We conclude that culture is not predictive of long-run growth. Economic conditions can provide a sufficiently strong impetus to create a pro-capitalist culture that takes the economy from stagnation to sustained growth; culture adapts to economic incentives.

5 Conclusion

Using a model of intergenerational human capital transmission, this paper has studied the evolution of culture and economic development. The economic effects of a static, "hard", cultural aversion to risk-taking are modulated by a dynamic, imperfect and biased within-family cultural transmission. Culture produces long-run stagnation when productivity is relatively low or past policies were geared towards safer occupations. For sufficiently high productivity improvement or low transferability of human capital across technologies, culture becomes irrelevant for long-run

[17]On the flip side, a general productivity shock may be politically easier to implement as it raises the fortunes of incumbents (elites) without displacing them; arguably both Meiji Japan's and India's productivity shocks were exogenous, necessitated by external events or pressure.

[18]Standard models of human capital transmission within the family do not explain this kind of overtaking as there is no scope for some types of human capital to be better at certain technologies than others. That is not to say ours is the only explanation for overtaking (e.g., see Hassler and Mora, 2000). The Indian case can also be understood as a sector-specific productivity shock where entrepreneurs differ in their sector-specific skills. Where our contribution is novel is to show that the same economy that was once held back by culture – recall from section 3.2 that the economy can stagnate despite access to a menu of technologies if cultural biases are strong (and TFP low) – is capable of dynamism under appropriate conditions.

growth. In this the model's implications are similar to Krugman (1991) where history turns out to be decisive only when the rate of inter-sectoral adjustment and economic growth are low.

The present work may be extended in several directions. While occupational biases are taken to be immutable, they can depend on the economic fortune of different sectors. Allowing parents to indoctrinate their children in an occupation different from their own and to alter their own biases depending on market outcomes would be one way to study how the social esteem with which certain occupations are held changes over time. Secondly, there are likely complementarities between entrepreneurship and the pace of technological progress. An innovation or adoption process that endogenizes the productivity gain from new technologies, for example if technologies can be upgraded by more than one step, could yield different implications for the growth rate which, at present, is independent of culture. Similarly, if the human capital specificity of new technologies is altered by the entry of newer generation of entrepreneurs, more growth may be associated with more intergenerational social mobility. Alternative cultural factors – for example norms of egalitarianism that provide insurance to members of a group but lower the rewards from striking out on one's own – could also limit innovation and growth. Specific political and economic shocks may produce significant deviation from those norms, fostering innovation, cultural change and economic development.

The lesson from our work is not that culture never matters, only that it does not always. Even when culture is not predictive of long-term development – the transition from stagnation to sustained growth – it may matter for differences in the income level across societies. This distinction is useful to keep in mind for culture-based explorations of present-day underdevelopment.

Appendix

A. Proof of Proposition 1

(i) From (3)

$$E_t\left(\ln \tilde{\pi}^k_{nt} | x^k_{nt}\right) = \ln \kappa_t + n \ln a - \left[E_t\theta_n^2 + \sigma_\nu^2 + (\phi^k_{nt})^2 - 2\phi^k_{nt}E_t\theta_n\right], \tag{27}$$

which is maximized at $\phi^k_{nt} = E_t\theta_n$.

(ii) Expected business capital is $E_t\left(\tilde{z}^k_{nt}\right) = a^n E_t\left[e^{-(\theta_n - E_t\theta_n + \nu_{nt})^2}\right]$. The random variable $\zeta_t \equiv (\theta_n - E_t\theta_n + \nu_{nt})$ is the sum of $N(0, x_{nt})$ and $N(0, \sigma_\nu^2)$ variables. Hence $\zeta_t \sim N(0, \sigma^2_{\zeta t})$ where $\sigma^2_{\zeta t} \equiv x_{nt} + \sigma_\nu^2$ and

$$E_t e^{-\zeta_t^2} = \int_{-\infty}^{+\infty} e^{-\zeta_t^2} \frac{e^{-\zeta_t^2/2\sigma^2_{\zeta t}}}{\sigma_{\zeta t}\sqrt{2\pi}} d\zeta.$$

Through the change of variables $\varpi_t{}^2 = \zeta_t{}^2\left(1+1/2\sigma^2_{\zeta t}\right)$ this simplifies to $1/\sqrt{1+2\sigma^2_{\zeta t}}$ and

$$E(\tilde{z}_{nt}) = \frac{a^n}{\sqrt{1+2(x_{nt}+\sigma^2_v)}}.$$

(iii) Follows from substituting $\phi^k_{nt} = E_t\theta_n$ into (27).

B. Proof of Proposition 2

Suppose $G_t(x_t)$ at $t \geq 1$ is discrete with two priors $\bar{x}_n$ and some $x_t \leq \underline{x}_n$. People indoctrinated with the more diffuse prior $\bar{x}_n$ choose to be workers and those with x_t choose to be entrepreneurs, *iff*

$$E\left[\ln\tilde{\pi}_t(\bar{x}_n)\right] < \ln w_t < E\left[\ln\tilde{\pi}_t(x_t)\right]$$

or, using (7), (8) and (17)

$$\frac{\beta}{\beta+(1-\beta)\lambda(x_t)} < \mu_t < \frac{\beta}{\beta+(1-\beta)\Lambda(x_t)}. \tag{28}$$

The initial population is born with the priors $\{\underline{x}_n, \bar{x}_n\}$. Substituting these for $t = 1$ gives (A1).

Now consider dynamic persistence as the economy converges to the steady state $\mu^* < \mu_1$ from above. Along such a path, Bayesian learning causes the prior of successive generations of entrepreneurial families to converge towards zero starting from $\underline{x}_n$. Since $\Lambda(0) < \Lambda(x) < \Lambda(\underline{x}_n)$, the right-hand side inequality of (A1) ensures that the right-hand inequality of (28) is satisfied for all $t > 1$. That is, for $x_t \in [0, \underline{x}_n]$

$$\mu^* \leq \mu_t \leq \mu_1 < \frac{\beta}{\beta+(1-\beta)\Lambda(\underline{x}_n)} \leq \frac{\beta}{\beta+(1-\beta)\Lambda(x_t)} \leq \frac{\beta}{\beta+(1-\beta)\Lambda(0)}$$

since μ_t asymptotically converges to μ^* from above. The left-hand inequality of (28) for all $t > 1$ is ensured by (A2).

Hence (A1) and (A2) imply dynamically persistent cultural indoctrination under which populations acquiring $x_t \leq \underline{x}_n < \bar{x}_n$ and $\bar{x}_n$ choose to be entrepreneurs and workers respectively. The discreteness of the distribution of priors is thus maintained for all $t \geq 1$.

C: Proof of Proposition 3

By inspection equation (18) always contains two steady states, 0 and 1. An interior steady state μ^* where $\tau^w(\mu^*) = \tau^k(\mu^*)$ solves

$$\Omega(\mu^*) \equiv \ln\left(\frac{1-\mu^*}{\mu^*}\right) - \ln\left(\frac{1-\mu^S}{\mu^S}\right) + (1-\mu^*)\bar{x}_n + (1-\mu^*)\ln\delta_w - \mu^*\ln\delta_b = 0.$$

$\Omega(\mu)$ is a continuous, monotonically decreasing function on $(0,1)$. Since $\lim_{\mu\to 0}\Omega(\mu) = +\infty$ and $\lim_{\mu\to 1}\Omega(\mu) = -\infty$, by the intermediate value theorem, there must exist at least one $\mu^* \in (0,1)$ such that $\Omega(\mu^*) = 0$. By monotonicity, μ^* must be unique.

For stability

$$M'(\mu) = 1 + (1-2\mu)(\tau^w - \tau^k) + \mu(1-\mu)(\partial\tau^w/\partial\mu - \partial\tau^k/\partial\mu)$$

is evaluated at the steady states $\{0, \mu^*, 1\}$. Since $\lim_{\mu\to 0} \ln w = \infty$ and $\lim_{\mu\to 1} \ln w = -\infty$, using (15)

$$\lim_{\mu\to 0} M'(\mu) = \lim_{\mu\to 0}\left(V^{ww} - V^{wk}\right) = \infty$$
$$\lim_{\mu\to 1} M'(\mu) = -\lim_{\mu\to 1}\left(V^{ww} - V^{wk}\right) + \chi = \infty$$

where $\chi \equiv \bar{x}_n + \ln\delta_w + \ln\delta_k > 0$. Hence 0 and 1 are asymptotically unstable steady states. On the other hand,

$$M'(\mu^*) = -\mu^*(1-\mu^*)\chi \geq -\chi/4.$$

is negative and less than 1 in absolute value under (A4). Hence μ^* is asymptotically stable with oscillatory convergence.

D. Proof of Proposition 5

The new BGP is reached when cultural indoctrination and learning reach steady states. Assuming the first is true, entrepreneurs' priors to converge to x^{**}. In the BGP, if the productivity of technologies being used in t is $A_t \equiv a^r$, $r \geq n$, then $A_{t+1} = aA_t$ and average business capital

$$\bar{z}_t = \frac{A_t}{\sqrt{1 + 2(x^{**} + \sigma_\nu^2)}} \tag{29}$$

grows at the (gross) rate a. Hence aggregate output (and output per capita)

$$Y_t = \int_{\mathscr{E}_t} Y_t^k = \bar{\mu}^\beta (1-\bar{\mu})^{1-\beta}\left[\frac{A_t}{\sqrt{1+2(x^{**}+\sigma_\nu^2)}}\right]^{1-\beta}$$

grows at the rate $a^{1-\beta}$. By (8), (17) and (29), wages and expected profits grow at $a^{1-\beta}$.

We verify that indoctrination is constant in the BGP. This requires, from section 2, that $V^{JJ} - V^{J\ell}$ for $J, \ell \in \{k, w\}$ be constant. This depends on the expected utility gap between (potential) entrepreneurs and workers

$$\nabla_t \equiv u\left(\pi_t^k(x)\right) - \ln w_t = \ln(1-\beta) + \frac{\beta}{1-\beta}\ln\beta + \ln A_t - \frac{1}{1-\beta}\ln w_t - x - \sigma_\nu^2$$

for $x \in \{x^{**}, x'\}$. Since $d\nabla_t/dt = 0$, socialization efforts are constant.

E. Proof of Proposition 6

We take as given that culture is sufficiently distortionary, that is, $\bar{\mu}(\alpha') \gg \bar{\mu}^S(\alpha')$.

(i) The first part follows from (25) and Fig 5. Next clear the labor market, $\mu_T = (1-\mu^*)\bar{L}_T^i + \epsilon_T \bar{L}_T^e$, and note that entrants and workers come from the same pool, $\mu_T + \epsilon_T = \mu^*$. Average business capital by incumbent entrepreneurs at T is $\bar{z}_T^k = a^n/\sqrt{1+2\sigma_\nu^2}$, $k \in \mathscr{E}_T \backslash \mathscr{E}_T^E$, for entrants is, $\bar{z}_T^k = a^{n+1}/\sqrt{1+2\left(\alpha' x' + \sigma_\nu^2 + \sigma_\eta^2\right)}$, $k \in \mathscr{E}_T^E$. Using (2), $\bar{L}_T^i = \bar{L}_T^e/\gamma$.

(ii) We prove that entrants survive and eventually cause incumbents to exit entrepreneurship.

Let $\tilde{w}$ be the wage rate at which incumbents are indifferent between entrepreneurship and wage-work: $\tilde{w} = \beta^{\beta}(1-\beta)^{1-\beta}(a^n e^{-\sigma_\nu^2})^{1-\beta}$. Suppose the measure of entrants is growing on average which is true if the economy starts sufficiently above the steady-state $\bar{\mu}$ (proved later). At $\tilde{w}$ and for $x_t \in \left(x^{**}, x'(\alpha')\right)$, average labor demand by entrants is

$$\bar{L}_t^e(\tilde{w}) = \frac{\beta^{1/(1-\beta)} a^{n+(T-t)+1}}{\tilde{w}^{1/(1-\beta)}\sqrt{1+2\left(\alpha' x_t + \sigma_\nu^2 + \sigma_\eta^2\right)}}, t \geq T.$$

Since $a > 1$ and x_t is converging to x^{**} from above, $\bar{L}_t^e(\tilde{w})$ increases over time. At some $t = T' \geq T$, we must have $\bar{L}_t^e(\tilde{w}) > 1$. Since the population share of entrants is non-decreasing, total labor demand will for sure exceed supply at $\tilde{w}$ by T' and $w_{T'} > \tilde{w}$. Since $\ln w_{T'} > E_{T'} \ln[\pi_{nT'}]$, it follows that $i_{T'} = 0$. Since there are no incumbents to pass on their business expertise, $i_t = 0 \; \forall \, t > T'$.

We now prove that entrants are growing as long as the economy is sufficiently above steady state during $[T, T']$. We have

$$e_{t+1} = e_t\left[\tau_t^e + (1-\tau_t^e)e_t + (1-\tau_t^i)i_t + (1-\tau_t^m)m_t\right] = e_t\left[1 + (\tau_t^e - \tau_t^m)m_t + (\tau_t^e - \tau_t^i)i_t\right].$$

$e_{t+1} > e_t$ for sure if $\tau_t^e > \tau_t^i$, $\tau_t^e > \tau_t^w$. The assumption in Proposition 6(ii) ensures that entrants earn higher expected utility than incumbents $T+1$ onwards. Hence $\tau_t^e > \tau_t^i \; \forall \, t > T$.

Suppose entrants, with prior $x_t \geq x^{**}$, are the only entrepreneurs. Let $\bar{\mu}(x_t)$ be such that $\tau^w\left(\bar{\mu}(x_t)\right) = \tau^e\left(\bar{\mu}(x_t)\right)$. For any $\mu_t > \bar{\mu}(x_t)$, $\tau_t^e\left(\bar{\mu}(x_t)\right) > \tau^w\left(\bar{\mu}(x_t)\right)$ since $\tau_t^e = m_t(V_t^{ee} - V_t^{ew})$ and $\tau_t^w = (1-m_t)(V_t^{ww} - V_t^{wk})$. Consider any $t > T$. Since $\bar{z}_t^i < \bar{z}_t^e$, $w(i_t = 0, \mu_t) > w(i_t > 0, \mu_t)$. Lower wages in the presence of incumbents mean, at any μ_t, higher τ_t^e and lower τ_t^w than in their absence. So long as $1 - m_t = i_t + e_t < 1 - \bar{\mu}(x_t)$, that is, $m_t = \mu_t > \bar{\mu}(x_t)$,

$$\tau^e(i_t > 0, \mu_t) \geq \tau^e(i_t = 0, \mu_t) > \tau^w(i_t = 0, \mu_t) \geq \tau^w(i_t > 0, \mu_t).$$

Hence wage workers invest less in socialization in the presence of incumbents than without, they invest less than entrants when the latter are the only entrepreneurs as long as $\mu_t > \bar{\mu}(x_t) \geq \bar{\mu}$, and entrants invest more in socialization when there are no incumbents than if there were.

Therefore, given the assumptions laid out above, $\tau_t^e > \tau_t^i$, $\tau_t^e > \tau_t^w$ and e_t is growing over time. This implies that eventually incumbents will exit and the results for $t > T'$ will obtain.

(iii) When only entrants remain, the dynamics of μ_t is as in (18) with socialization efforts given by (14) and

$$\begin{aligned} V_t^{ww} - V_t^{wk} &= \ln w_t - u\left(\Pi_t(x')\right) + \ln \delta_w, \\ V_t^{kk} - V_t^{kw} &= u\left(\Pi_t(x^{**})\right) - \ln w_t + \ln \delta_b. \end{aligned}$$

In particular we know there is a unique interior steady state $\bar{\mu}$ corresponding to α' where

$\tau^w = \tau^b$ and

$$M'(\bar{\mu}) = -\bar{\mu}(1-\bar{\mu})\left[\alpha'(x' - x^{**}) + \ln\delta_w + \ln\delta_b\right] < 0.$$

(A4) is sufficient for $\left|M'(\bar{\mu})\right| < 1$. Hence $\bar{\mu}$ is locally stable with oscillatory convergence.

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