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CULTURE AND DEVELOPMENT: AN ANALYTICAL FRAMEWORK

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Discussion paper

Culture and Development: An Analytical Framework[*]

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Abstract

This paper develops a framework which analyzes how a population's culture affects the decisions of rational profit maximizing firms, while simultaneously exploring how the actions of these firms in turn affect the population's culture. By endogenizing culture as well as the more usual economic variables, it shows how an economically valuable behavioural trait can be sustained as part of a competitive equilibrium. It is shown that, for given primitives, an economy can be in either a "good" steady state, in which the valuable cultural trait is present, or a welfare dominated "bad" one in which the valuable cultural trait disappears. Starting from the "good" steady state and implementing productivity improvements raises welfare, but if changes are too rapid this steady state will not be reached from the old one. Instead, the unique trajectory is to the bad steady state where welfare is reduced.

Keywords: Culture, Evolution, Inequality, Technological Change

JEL: O1, O3, O4, Z1

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1 Introduction

Does culture play a central role in economic development? Many have asserted that it does. Amongst the most prominent was Max Weber (1905) who argued a critical role was played by a population's "work ethic". He linked it with Calvinist Protestantism, and argued it was a crucial ingredient in the advent of modern capitalism in Northern Europe. A large body of work in sociology followed, pursuing cultural explanations for economic and developmental differences across countries.[1] An empirical field, psychometrics, based on individual surveys, aimed to document in a systematic way the cross-country variations in "cultures"; for a review see Furnham (1990).

Economists, on the other hand, typically proceed by assuming cultural differences away, and build models to explain development (or underdevelopment) that start from different building blocks.[2] This has not been to deny the potential importance of culture, but rather has reflected economists' difficulty in coming to terms with culture using the standard tools of theory. Culturalist type explanations have been met with some sympathy by development economists: For example, Ostrom (1990) emphasizes such considerations in explaining why societies can sometimes solve free-rider problems arising from unlimited access to natural resources. The term "social capital", used by Putnam (1993) to describe regional differences in Italian civic attitudes, has found wider use as a term to capture intangible factors such as cooperation, trust and civic mindedness, that seem helpful to the emergence of modern capitalist production.[3]

However, what has stopped culture from gaining wider currency amongst the economic profession has been the lack of models allowing cultural type considerations to be analyzed alongside more traditional economic concerns. Without such models, culture is inevitably treated as exogenous, and "explanations" thereby arising are not convincing. Merely attributing underdevelop-

[1] This work has often attempted to explain phenomena which are clearly economic. For example, in the field of development studies, writers have long evoked Weberian work ethics, in a Confucian guise, as an explanatory variable in successful South East Asian development (see Kunio 1994).

[2] Institutions, technology, resource endowments, incentives, etc.

[3] Landes (1998) argues culture to be a critical factor in explaining cross-country experiences. A broad overview of related work in this area, which is mainly non-economic, can be found in Harrison and Huntington (2000). The theme of this work, which is largely by sociologists and cultural anthropologists, is that cultures have critical determining effects on societies' economic and institutional development. This literature is rich with examples of both cultural impediments and aids to development across countries, regions and groups, but is not generally concerned with the reasons for cultural difference, nor with the direction of causation running from the economic to the cultural. The present work complements that literature by attempting to understand a mechanism whereby an economically useful cultural trait can be rewarded and thus reinforced.

ment to cultural factors, which are treated as exogenous endowments, is more a re-labelling than an explanation and provides little insight. What seems to be needed is a framework where the influence of culture on more traditional economic factors such as work, production and business formation is allowed, but also in which the influence of these economic factors on the population's culture can be examined. That is, we need a framework which allows culture to play a role but which also makes it endogenous. This is what we do here: we allow for a production process that admits a valuable role for culture, however, our framework also attempts to explain where the population's culture comes from.

Specifically we assume production is "complex" by which we mean subject to moral hazard that cannot be contracted away. Thus firms seek workers who are less likely to exploit opportunities to shirk. This is where culture comes in. We allow for individuals to differ in their propensity to shirk, a characteristic we term "cooperativeness". This characteristic is meant to roughly capture many features sociologists have argued to be important - cooperation, work ethics, or trust. In our framework, simply, "cooperators" receive relatively little intrinsic benefit to shirking in comparison with "non-cooperators". This is consistent with them having a high work ethic and thus not minding work. Alternatively, it is also consistent with cooperators valuing keeping their promises to work, or simply enjoying cooperating. The precise underpinning is immaterial, and may vary, all that matters is the net dampening effect this has on their propensity to shirk.

We then use a somewhat standard evolutionary dynamic to explain where this culture comes from. This means that the prevalence of cooperators in a population changes, albeit slowly, in response to economic rewards. The better cooperators fare, over their life-times, in comparison to non-cooperators the more prevalent they will eventually be, and vice versa.[4]

Importantly, the individuals in our framework are not automata; they make rational choices based on economic returns and their own inherent tendencies. These inherent tendencies reflect the population's culture, but cooperators may still shirk if economic rewards to cooperating are too low, and so too non-cooperators may work if the returns are high enough, it is simply that the margins for these individuals differ.

This slowly evolving culture and the actions of profit maximizing firms are highly interrelated processes. Firms have access to the complex technology and, with the right effort from workers,

[4] For recent examples of evolutionary approaches to characteristics and preferences see Nyberg (1997), Lindbeck, Nyberg and Weibull (1998) and Fershtman and Weiss (1998).

will be more productive than alternative producers who do not require worker cooperation. For expositional purposes, we interpret this alternative technology as traditional or household level individual production. The problem for these firms, however, is that the complexity of these tasks makes monitoring workers difficult and not solvable by contract, so that workers who shirk impose costs on the firms. Moreover, a worker's cooperativeness (and thus propensity to shirk) is not directly observable. Firms thus choose whether to enter production with the complex technology knowing that if they hire a non-cooperator they may suffer losses. The prevalence of cooperators in a population will thus affect firms' entry decisions. But firms' entry decisions will also affect the prevalence of cooperators (i.e. the population's culture). Cooperators are relatively good workers in complex production but not any better in traditional production, which is individualistic. If firms do not enter, and thus complex production does not occur, cooperators cannot reap rewards to their character. If, on the other hand, enough firms enter, cooperators have a chance of reaping extra economic rewards. When these rewards are high enough evolutionary forces favour the emergence of cooperation.

It is this interaction between firms who are rationally deciding, based on profit maximization, whether to enter production, and workers whose characteristics are affected by these firms' choices through evolutionary forces, that yields the model's interesting results. There are two sets of results. Firstly relating to existence, this symbiosis between firms and culture can lead to two distinct types of steady state. In the first one, there is only traditional production, firms do not enter and the population has a low level of cooperativeness. In the second, many individuals are cooperators. This induces firms to engage in complex production and evolutionary incentives support the continued existence of cooperativeness in the population. These steady states can be welfare ranked with the latter one better than the first.

The second set of results show that such a "good" steady state can be sensitive to changes in the external environment. In particular, evolutionary incentives for the maintenance of cooperativeness depend critically on the relationship between the productivity of the technology available to firms and the pervasiveness of cooperativeness. This leads to the paper's most important result: improvements in the productivity of firms' complex technology that are too rapid (this will be made formal) can make a society unambiguously worse off. In short, if the productivity of technology rises too quickly and outstrips changes in the population's culture, not only will the technology fail in production, but it can set in motion evolutionary forces that will eventually destroy the population's existing levels of cooperativeness. Changes that are too rapid will result in monotonic and unique convergence to the Pareto inferior steady state. However, if technological improvements are introduced slowly enough so that they allow time for the population's culture to keep pace, productivity improvements will always lead to Pareto improvement.

This points to a possible reason for why development was successful in the West but may not be readily emulated in follower countries. Slow change was a condition imposed on the West by the fact that new technologies and institutions had to be "home-grown". This contrasts with the potential for rapid change which has accompanied the implementation of such "off-the-shelf" Western technologies and institutions in LDCs over the second half of this century.

The paper proceeds as follows: Section 2 sets up the model, Section 3 analyses the model, determining steady states, dynamics and welfare, and Section 4 derives the main results. We withhold discussion of related literature to Section 5, and there also provide a brief conclusion.

2 The Model

The economy comprises measure 2 of individuals at all times. Measure 1 of individuals is born in every period and each individual lives for two periods (young and old). There is free entry of firms. Each firm can employ one unskilled worker (a laborer) and one manager. Firms live for one period only.[5] Firms can be ordered according to their entry costs which are denoted E_i for firm i; and are drawn from a distribution with density function $e(\cdot)$; which is continuous on support $[\underline{E}; \infty)$; with $\underline{E} \geq 0$: Firms incur this cost when entering. The number of firms with entry cost $\hat{E}$ or lower is given by $m \int_{\underline{E}}^{\hat{E}} e(x)dx$; where $m > 1$; which means that the total number of potential firms is greater than the number of workers. The number of firms that enter is endogenously determined and will be denoted as γ: Both firms and individuals are risk neutral and there is no discounting. If not working, individuals receive utility normalized to zero each period of their lives, which is also the opportunity cost of entry to a firm.

All values in the model are expressed in the utility metric.

A worker's cooperativeness is determined before knowing their ability by nature (a process described below), and ability is revealed to a worker before period 1 of life. In period 1, young workers are unskilled and they either work at a firm or are unemployed. The output of unskilled

[5] The model's steady states are qualitatively unchanged if firms are allowed to live for an arbitrary number of periods; this would only require that the cost E is reinterpreted as a periodical fixed cost of operating. They could even be infinitely lived, as long as discounting is introduced.

work in period 1 is observed by all firms, together with the abilities of all workers.[6] In period 2, old individuals are either employed as managers or unemployed, after which they retire. The sequence of events in each individual's life is summarized as follows:

Birth		Young		Old
Nature chooses Cooperativeness	ability revealed to worker	unskilled work or unemployed	output and ability observed	manager or unemployed

2.1 Cooperativeness

Individuals are either cooperators, type c, or not, type n. Noncooperators are simply the standard homo-economicus. For them the cost of effort contributed in any job is δ. Cooperators, on the other hand, actually enjoy being involved in production and performing their tasks properly. Thus, we model them as having a lower cost of effort provision, which we normalize to 0. Thus, in summary:

$$\text{effort cost} = \begin{cases} 0 \text{ for } c \text{ types} \\ \delta > 0 \text{ for } n \text{ types.} \end{cases}$$

Cooperativeness is inculcated at an early age (most realistically by parents, but we remain agnostic about the source) and also imposes a lifetime utility cost, F, on individuals.[7]

An individual's own cooperativeness is private information.

2.2 Ability

Ability is entirely exogenous and is revealed to individuals after nature has determined their cooperativeness, and to all firms only after the first period of an individual's employment. The distribution of ability types in the population is binary:

$$\text{proportion } \mu \text{ are low ability}$$

$$\text{proportion } 1 - \mu \text{ are high ability.}$$

[6] Identical results obtain if ability is non-observable as will become clear.

[7] This cost can be thought of as the cost of being taught to consider others at an early age (again this is probably a cost also borne by parents but we will render this internal to the individual). It could also arise if being a cooperator were costly in other ways, for instance, if other individuals took advantage of cooperators. Our approach here is to short cut much of the complexity of a realistic account of social evolution by internalizing all of the costs and benefits of a "type" to the individual. In reality, parents bear large costs too. However, the pattern of evolution will be qualitatively identical provided they make decisions based on some combination of their children's and their own welfare. See Bowles (1998) for further discussion and a survey of work on endogenous preferences.

Ability influences the level of skills a worker accumulates when young. The skill level will, in turn, determine the worker's productivity in some tasks when old. The details are spelled out in section 2.4 below.

2.3 Output of a laborer

As discussed in the introduction, there are benefits to shirking which can not be ameliorated either by contract or by direct supervision. We assume that employers can condition payment on output, but there is limited liability so that in the event of insufficient output, the maximal penalty is zero payment.

The worker employed as a laborer chooses to either work (contribute effort) or shirk (no effort). If working, output of value Y is produced. If shirking, output $= 0$ and the firm loses z which the shirking worker obtains herself. If w_1 denotes wages paid to laborers, these possibilities are summarized as follows:

	firm receives	worker receives	effort cost
worker works	$Y - w_1$	w_1	0 for c type; δ for n type
worker shirks	$-z$	z	0 for both types

Shirking is thus an activity like slacking on the job, or using the company's resources for one's own benefit.[8] Even though for c workers effort costs nothing, shirking may still be attractive since it allows the possibility of obtaining z.[9]

2.4 Output of a manager

Each firm needs one worker in a managerial position. The productivity of the manager is independent of the firm's laborer. Management requires effort and again allows a potential gain to shirking. Effort cost in a managerial position is identical to that incurred in a laborer position, i.e., 0 for c, and δ for n types. If effort is provided, output depends on the manager's skills developed during the previous period. Since the young workers have not had the chance to develop skills during the previous period, their output if employed as managers is zero, which means they would never be hired for this position. The skills of an old worker depend on the individual's

[8] The critical feature of this environment is that shirking provides some benefit to the employee and that it imposes some costs on the firm, which is ensured by the limited liability assumption. That the workers' benefits and firms' costs of shirking are equivalent, as in the current formulation, is not necessary for the results to follow, though it does serve to make the model simpler.

[9] To make the model more general, one could also assume that a cooperator benefits from shirking less than a non-cooperator. A simple way to model this would be to assume that the benefit from shirking to a cooperator is αz, where $\alpha \in (0, 1)$. This would not change any of our results qualitatively.

ability. A high ability type produces output valued at $H(\gamma)$ as a manager (recall that γ denotes the total number of firms in the economy). The low ability type produces a lower value of output denoted L, where $L \leq H(\gamma)$.

If shirking, either type receives a personal gain of $\varepsilon > 0$; where $\varepsilon < L$; while the cost imposed on the firm is an amount k. We assume management is more vital to the firms than unskilled labour; formally, we will let $k \to \infty$; to rule out the possibility of firms with shirking managers ever being productive. Contracting possibilities are the same as for the young, i.e., output conditioned wages can be paid but there is limited liability, so that wages are non-negative. This implies that firms will avoid hiring a shirking manager at all costs.[10] If the manager's wage is denoted $w_2(j)$; where $j = H; L$; or 0 denotes the three possible outputs, the possibilities can again be summarized in a table:

	firm receives	worker receives	effort cost
high ability manager works	$H - w_2(H)$	$w_2(H)$	0 for c type; δ for n type
low ability manager works	$L - w_2(L)$	$w_2(L)$	0 for c type, δ for n type
manager shirks	$-k$	ε	0 for both types

Productivity of an old individual who was unemployed in the first period is zero in any managerial position. Individuals who do not work as managers when old will be unemployed.

We would like to note here that the model described above is fairly general. For example, with a little effort, it could be reinterpreted to capture the following setting (used, for example, in Aghion and Tirole (1997) and Burkart, Gromb, and Panunzi (1997)): The employee (the manager and/or the laborer) has to exert effort to learn about the payoffs of an array of available projects. Based on his private information, the employee then chooses a project which the firm will undertake. However, the project that maximizes the firm's profit may be different from the one that yields the greatest private benefit to the employee. Thus, as in our model, the employee can harm the firm, this time by not choosing the optimal, profit maximizing, project rather than by shirking.

[10] If we let k be finite, the only change would be a decrease in the equilibrium number of workers who become cooperators. The source of k is not explicitly modelled but it is meant to correspond to situations where employers cannot safeguard against the actions of bad managers and will therefore only produce when they can "trust" them. We have in mind, in particular, situations where managers have important responsibilities whose timely execution is vital to the firm. Some examples are where a manager is responsible for decision making related to production and input choices, or where there is sensitive equipment that must be maintained and properly used. Once again, the delays in inferring irresponsible behaviour, and the limited liability when that occurs, make firms wary of hiring the wrong types.

2.5 Dynamics

Firms adjust instantaneously according to expected profit from entering, but culture does so slowly. The critical state variables are the proportion (or measure) of individuals that are cooperative, β; and the measure of firms that enter, which we denote γ.

Assume population types adjust gradually according to a replicator dynamic. The exact form of the replicator is immaterial for our results – all that matters is that the number of cooperators increases if cooperativeness is rewarded and that the adjustment is not immediate. Specifically, we assume that the proportion of cooperators, β; adjusts according to:

$$\frac{\Delta\beta}{\Delta t} = (1 - \beta)\beta\Phi(E[u^c] - E[u^n]); \tag{1}$$

where the function Φ is increasing and $E[u^s]$ denotes the expected lifetime utility of a cooperator ($s = c$) or non-cooperator ($s = n$).[11] There are numerous stories which could be evoked to justify the adjustment of a population's cooperativeness via a replicator dynamic. One story would be that parents choose the type of values to inculcate into their children based on the expected returns of those values. Thus, at a cost, F, parents can make their children "enjoy" cooperation; when they grow up they will like cooperating, and hence working, more. According to the dynamic above, parents will be more likely to choose this when it yields benefits, since the extra future returns to being a cooperator must justify the costs incurred. Importantly also, the replicator implies that when returns change, not all individuals immediately switch. There are, once again, a number of reasons that could be used to support this assumption: diffusion effects, underlying time-varying heterogeneity in adjustment costs or age differences and inertia. We do not explicitly tie the model to any of these because, as mentioned earlier, the precise form is of no consequence.[12]

[11] Thus, we chose a simple form of replicator, without drift. For a general discussion of equilibrium selection and analysis with stochastic components see Samuelson (1997).

[12] One can also interpret such an evolutionary dynamic in a more strictly biological sense, as arising when those with higher economic rewards are "fitter", more able to attract mates, and thus more able to leave behind surviving progeny. We do not favour that interpretation but it is not inconsistent with our model. For more on the underpinnings evoked to explain a replicator dynamic see Ben Ner and Putterman (1998, Ch. 1). Some readers will be bothered by the coexistence of fully rational firms and a replicator dynamic which drives the types of individuals. We think this modelling is sensible if one believes the choice of attitudes to cooperation is qualitatively different to the choice of mode of production to employ in a firm. We believe the former is much more likely to be subject to inertia, e.g. from one's background and the practices of one's parents, than is the latter, where best practices should be implemented much more rapidly. The replicator is a reduced form way of modelling this. Other models that have used both rational decision makers and others driven by evolution are Hoffler (1999) and von Thadden (1992).

The adjustment of firms, in contrast, is immediate; that is, γ is a jump variable. Letting $\pi(t)$ denote the expected profit (gross of entry costs) of a firm from hiring a young worker in period t[13], the behaviour of $\gamma(t)$ is as follows:

$$\text{if } \pi(t) < \underline{E} \text{ then } \gamma(t) = 0 \tag{2}$$

$$\text{if } \pi(t) > \underline{E} \text{ then } \gamma(t) = m \int_{\underline{E}}^{\hat{E}} e(x)\,dx \text{ and } \pi(t) = \hat{E}. \tag{3}$$

The conditions above are simply the implications of assuming free and immediate entry on the part of firms. Condition (2) says that the measure of firms entering equals zero when operating profits are insufficient to cover the fixed costs of even the least costly firm. Condition (3) says that if operating profits are high enough to cover fixed costs for some firms, the number of firms entering in period t, $\gamma(t)$, will be such that expected operating profits just cover fixed costs of entry for the marginal firm.

2.6 Parameter restrictions

We restrict parameters in order to focus on situations where interior equilibria (both c and n types) have a possibility of existing. These restrictions are considerably more complicated than the usual Inada conditions, so that we explain each in turn.

Assumption 1: Full employment is feasible in a cooperative population

For $E^{*} : m \int_{\underline{E}}^{E^{*}} e(x)\,dx = 1; \quad E^{*} < Y + L - z$

This says that if all individuals are cooperators, then full employment is feasible even given the contracting limitations. The value of output produced when young, Y, plus the increased productivity a low type obtains due to training, L, net of the benefit they could obtain due to shirking, z, exceed the fixed costs of entry even if enough firms enter to guarantee full employment.

Assumption 2: Diminishing returns to ability

$H(\cdot)$ is concave and decreasing in γ, with $H(1) = L$.

[13] It will be seen that hiring old workers as laborers never generates positive profit in equilibrium, so we ignore it without loss of generality here.

The assumption that $H(\cdot)$ is a decreasing function is meant to capture the fact that the higher is the number of firms the more intense is the competition among them.[14] The assumption that $H(1) = L$ ensures that if there is full employment competition is so intense, that any extra returns due to higher ability managers are completely dissipated.

Assumption 3: Shirking is attractive for some individuals

(i) $z > H(0)$.

(ii) $\delta > \max\{H(0) - \varepsilon, Y + \varepsilon - z\}$.

If the benefits of shirking, z, were so low that an individual's deferred benefit to being revealed as a cooperator always exceeded the benefit of shirking, then shirking would never be a problem. Part (i) in Assumption 3 guarantees that shirking is attractive enough to make it a problem to firms. It also ensures that optimal wages are positive. Part (ii) limits the number of cases that need to be investigated. It assumes that it is not efficient to elicit effort from non-cooperators either as workers or as managers. By assuming the cost of effort, δ, is high for these types, we ensure that separation can occur between the c and n types. This is analogous to a single crossing assumption for this binary production function.

3 Analysis

3.1 Job assignment and wages of old workers

The restrictions placed on the relative costs and benefits of effort in each mode of organization, and the potential for high losses to firms, ensure firms will be wary of obtaining the wrong sorts of agents as managers. That is:

Lemma 1

(i) Workers believed to be cooperators will be assigned to management when old and, in any competitive equilibrium, will receive wages equal to L or H, depending on their ability.

[14] Alternatively, we could have assumed that H is decreasing because the higher is the number of firms, the less efficient is the training process of young workers. For example, the training process may require some scarce resource common to all firms using the same technology. Then a high number of firms using the technology means that the price of this resource is high, which makes the training process costly and therefore less training is provided by each firm. Assumption 2 is stricter than necessary. It is not necessary that $H(\cdot)$ is monotonic, but we will assume it is in order to simplify the analysis.

(ii) All the other workers who are not believed with certainty to be cooperators will be unemployed when old.

Proofs of this and all other results are in the appendix.

Workers who are not believed with certainty to be cooperators will never be placed in management. The reason is that, due to limited liability and large attraction to shirking, it is not profitable to elicit effort from these workers. If placed in management they would therefore shirk and impose large costs on the firm, k. Firms thus never employ old non-cooperators: The large cost k also implies they will not risk placing a worker about whose cooperativeness they are unsure in a management position. Old workers will also never be placed in unskilled jobs because, since they are in their last period of life, they have no deferred benefits to being revealed as cooperators and, as will become clear subsequently, are thus more costly to motivate than the young.

The wages of managers will be L or H; depending on their ability. The reason is that the number of these managers is limited and firms therefore compete for them. Note also that this would be equivalently the case if ability were not observed, since contracts would simply condition pay on output produced, subject to the limited liability constraint. Finally, due to competition between the firms, whether a firm employs a high or low ability manager, its profit from this manager is always zero.

3.2 Revelation of cooperativeness

When young, both abilities and types are private information, but a firm's output and the identity of its employee are common knowledge. In some situations, this knowledge may indirectly reveal information about an employee's cooperativeness.

Lemma 2 (i) If a young worker produces output of value Y, then it becomes common knowledge that this worker is a cooperator.

(ii) If a young worker produces output of value 0, then with positive probability this worker is a non-cooperator.

Positive output perfectly reveals a cooperator because at any feasible wages, i.e., $w_1 \cdot Y$; non-cooperators would always prefer to shirk, even if, by not shirking, they can obtain management work for certain: According to Lemma 1, then, non-shirking workers will be assigned to management: In contrast, output of 0 suggests some uncertainty as to the worker's cooperativeness.

3.3 Wages of young workers

Firstly note that if $\gamma < 1$, a firm could always set its wage at an arbitrarily low level and still induce participation. This would, however, not be profit maximizing as there would be insufficient incentive for a worker accepting such a wage to provide effort. To calculate the profit maximizing wage it is necessary to compute a firm's expected operating profit from hiring a young worker conditional on the wage. This will depend on the distribution of cooperators. Let p denote the probability that the worker hired by a firm will not shirk. Then the firm's expected profit (again, gross of E) is

$$\pi = p(Y - w_1) - (1 - p)z, \tag{4}$$

recalling that w_1 is the wage paid by the firm to young non-shirkers under the contract. It will be seen below that p is affected by w_1.

To be viable, a firm must offer a wage attracting at least some cooperators, and inducing them to work. However, any feasible (i.e., non-negative) wage will always attract non-cooperators too since these individuals can benefit by shirking. The profit maximizing wage for firms depends critically on the underlying ability distribution in the population, and returns to ability when working as a manager, as follows:

Lemma 3

The profit maximizing wage for firms to pay young workers is

$$w_1 = \begin{cases} z - L & \text{when } H(\gamma) \le \hat{H} \\ z - H(\gamma) & \text{when } H(\gamma) > \hat{H} \end{cases}, \tag{5}$$

where $\hat{H} \equiv \frac{\theta Y + L}{1 - \theta}$.

Note that the wage setting decision of a firm is independent of its cost of entry, E_i, since these costs are sunk. Wages for the young cannot fall to clear the market in this framework, because they must also induce effort. A firm offering a positive wage will thus always face an excess supply of workers if $\gamma < 1$. However, there does not exist a wage that can induce effort from the non-cooperators. This is because such workers would always shirk when put in a management position and receive ε. From Assumption 3 part (ii) this means these individuals are better off shirking even if the firm were to promise them all of the output they produce when young. Since cooperativeness is not observable, firms thus accept that they will, with some probability, hire a young shirker. They thus design wages to induce no shirking in the event that they happen to hire a worker who is a cooperator. In doing this they face a trade-off: if they offer the lower wage, $z - H(\gamma)$, only cooperators with high ability will exert the appropriate effort, low ability cooperators will take the job and shirk. By paying a higher wage, $z - L$, both high and low ability cooperators will work (note that part (i) of Assumption 3 immediately implies that all these wages are positive). Equation (5) describes the determinants of that decision: when returns to the high ability are relatively large, firms can induce effort from these individuals much more cheaply than they can from the low, thus making the low wage strategy more attractive.

3.4 Interior equilibria

We first establish the existence of interior equilibria – those in which both c and n types exist and there is entry of firms. Since cooperativeness is evolutionarily costly ($F > 0$), an interior equilibrium requires the existence of some economic rewards to it. In turn, for this to happen, some firms must make a non-negative profit net of their entry costs. We first discuss necessary conditions for both of these occurrences before formally describing interior equilibria.

The existence of economic rewards to cooperativeness turns on the wages paid to young workers. Suppose that the firms paid the low wage in equation (5), $w_1 = z - H(\gamma)$. Then even high ability individuals would receive no return to being a cooperator, and cooperativeness could never be part of the population's culture. To see this, suppose that a high ability individual does not shirk and is indirectly revealed as a cooperator. This person then receives a payment of $H(\gamma)$ as a manager when old; however, this only yields for them a combined two period utility of z, at the wage $w_1 = z - H(\gamma)$, which is what they could have had as a non-cooperator by simply shirking when young. A cooperator with low ability would be even worse off. Consequently, evolutionary incentives for cooperation can only exist if firms pay young workers the high wage, that is, if $w_1 = z - L$.[15] From Lemma 3.3, a necessary and sufficient condition for this to be the optimal wage is

$$H(\gamma) \leq \hat{H}. \tag{6}$$

[15] The general point here is that the high ability receive a rent when firms wish to induce effort from the low types too. If firms care only about inducing the high type, they can adjust wages so that the high type receive none of the rent. This feature corresponds to the ability/informational rents which occur in standard principal agent models with adverse selection, and is well known to be robust to extension; see Salanie (1997) for a treatment of this.

Another necessary feature of an interior equilibrium is that the firms who allow cooperators to be indirectly revealed must obtain non-negative profits. At $w_1 = z - L$, it can be seen from (4) that this implies $\beta(Y - z + L) - (1 - \beta)z \geq \underline{E}$, since $p = \beta$ as this wage attracts all workers. Rearranging yields:

$$\beta \geq \beta_1 \equiv \frac{\underline{E} + z}{Y + L}. \tag{7}$$

If this condition is violated, then even the lowest cost firms earn negative expected profit and choose not to operate. Note, however, that values of β satisfying the above condition always exist (i.e., $\beta_1 < 1$) by Assumption 1.

We are now ready to establish necessary and sufficient conditions for the existence of a unique, stable, interior steady state.

Proposition 1 *(i) If an interior equilibrium $(\beta^*, \gamma^*) \in (0, 1)$ exists, it corresponds to a solution to the following conditions:*

$$\hat{E} = \beta^*(Y + L) - z \tag{8}$$

$$F = \gamma^*(1 - \mu)[H(\gamma^*) - L] \tag{9}$$

$$\gamma = m \int_{\underline{E}}^{\hat{E}} e(x)\,dx. \tag{10}$$

(ii) Holding all other parameters fixed, there exist $F^* > 0$ and $Y^*(F) \geq 0$ such that:

(a) If $F > F^*$ no interior equilibrium exists.

(b) If $F = F^*$ and $Y \geq Y^*(F)$ then there exists a unique interior equilibrium (β^*, γ^*) with $0 < \beta^* < 1$, $0 < \gamma^* < 1$. This equilibrium is unstable.

(c) If $F < F^*$ and $Y \geq Y^*(F)$ then there exist exactly two interior equilibria, (β^*_A, γ^*_A) and (β^*_B, γ^*_B), with $0 < \beta^*_i < 1$, $0 < \gamma^*_i < 1$, $i = A, B$. If $\beta^*_i > \beta^*_j$, $i, j \in \{A, B\}$, $i \neq j$, then equilibrium i is stable while equilibrium j is unstable.

The necessity part of the proposition needs little explanation: To observe positive entry of firms and both types existing in a steady state requires that (i) marginal firms are indifferent to entering, and (ii) being a cooperator is equivalent, in expected utility terms to not being one. Also, condition (6) must hold, and this is reflected, through the firm's wage setting, in equation (8). Sufficiency is less immediate. The first condition, that F cannot be too high, is relatively straightforward, since for too high values of F, economic rewards can never justify nature's choice of cooperativeness. The existence of two interior steady states for lower values of F, A and B in Figure 1, follows from counteracting effects of γ on expected returns to cooperativeness. For increasing γ, the probability of being revealed as a cooperator rises, but the relative return to this happening falls due to $H'(.) \leq 0$. The second effect eventually dominates so that the higher γ steady state, B in Figure 1, is the stable one. Finally, Y must be sufficiently high in order for firms to be willing to pay the higher wage, $w_1 = z - L$, that induces both the low and the high ability cooperators to provide effort. The proof of the proposition, in the appendix, demonstrates that the sufficiency conditions ensure (7) and (6) hold, so that these do not also need to be assumed.

The stable steady state B, described in the proposition and depicted in Figure 1, has the following characteristics: firms earn positive expected operating profits from hiring unskilled young workers, some workers are unemployed when young and these ones remain so when old. All cooperators that obtain employment are employed in the second period of life as managers, others are unemployed. The movement of individuals is sketched in Table 1:

Table 1: Steady State B

Birth	ability realized	probability	Young	output revealed	Old
Cooperator with prob.	$\rightarrow$	γ^*_B	work	$\rightarrow$	manager
β^*_B	$\rightarrow$	$1-\gamma^*_B$	unemployed	$\rightarrow$	unemployed
Non-coop. with prob.	$\rightarrow$	γ^*_B	shirk	$\rightarrow$	unemployed
$(1-\beta^*_B)$	$\rightarrow$	$1-\gamma^*_B$	unemployed	$\rightarrow$	unemployed

3.5 Corner Equilibria

A corner equilibrium is also possible:

Proposition 2 *There exists a stable steady state in which $\beta = 0$, $\gamma = 0$.*

At a corner equilibrium described by Proposition 2, the non-entry of firms, $\gamma = 0$, implies that cooperators can never be revealed. Consequently evolutionary forces continue to favour non-cooperators, $\beta = 0$, so that then it is not viable for firms to exist. Note that this is a stable steady state: the introduction of a small number of cooperators will not induce firms to enter because, since these cooperators cannot credibly communicate their type, any firms entering would be inundated with applications from all workers, most of whom are going to shirk.

A steady state at the other corner, $\beta = 1$, is not possible. If all workers are employed, then $H(\gamma) \to L$ by Assumption 2, part (i). Thus being a cooperator yields no net benefit since the amount of rent is $H(\gamma) - L$. In that case, individuals who are non-cooperators and hence do not incur the evolutionary cost, F, will have higher lifetime utility; β will fall.[16]

We now compare society's welfare in the interior steady state with the no cooperator steady state.

Proposition 3 *Social welfare in the interior steady state described in Proposition 1 is strictly higher than social welfare in the steady state described in Proposition 2.*

For existence of the interior steady state, investment in cooperativeness must be socially efficient, that is, F must be relatively low. The considerable efficiency gain to having cooperators thus ensures that even though there is shirking by some of the young in the interior steady state, infra-marginal firms make positive expected profits. There is never shirking in management because firms are careful only to hire cooperators there. Moreover, individuals are also better off, in expectation, since those with high ability have a possibility of receiving an ability rent in the interior steady state.

3.6 Dynamics

Consider the dynamics of this system in (β, γ) space in Figure 2 below. Note that the phase space for the analysis undergoes a fundamental change at the point where conditions (7) and (6) bind. The line $H = \hat{H}$, given by condition (6), is horizontal since it is unaffected by β, and, conversely, condition (7) is independent of γ. The curve $\frac{\Delta \gamma}{\Delta t} = 0$ comprises three parts: for values of γ above the line $H = \hat{H}$, firms pay the high wage, $w_1 = z - L$, so that the curve in this region is simply given directly from (8). For values of γ below the line $H = \hat{H}$, firms pay the low wage,

[16] Note that our parameter restriction requiring $H(1) = L$ was much stricter than necessary. All our qualitative results obtain even if $H(1)$ is greater than L, as long as it is not "too large", i.e., as long as $H(1) - L < F$. As $H(1) - L$ increases and approaches F, the stable interior equilibrium of Proposition 4 converges to the corner equilibrium with $\beta = 1$. We concentrate here on parameters allowing for an interior equilibrium because we consider this equilibrium to be more interesting and realistic, as it implies the simultaneous occurrence of both cooperators and non-cooperators.

$w_1 = z - H(\gamma)$; so that the entry condition for firms is given by

$$\hat{E}(\gamma) = \beta(1-\theta)[Y - z + H(\gamma)] - [1 - \beta(1-\theta)z]; \qquad (11)$$

which is flatter than the part of the curve given by (8), since lowering γ also lowers the wage that needs to be paid through $H(\gamma)$; in addition to lowering entry costs through $\hat{E}$: The third part of the curve is flat and this starts where condition (7) holds at point β_1: for values of $\beta < \beta_1$ net profits in all entering firms are negative, so none enter.

When both conditions (6) and (7) are satisfied, the analysis in Proposition 1 applies and we have the two curves for (9) and one for (8) depicted, which represent $\frac{\Delta\beta}{\Delta t} = 0$ and $\frac{\Delta\gamma}{\Delta t} = 0$ respectively. (Figure 2 depicts only the stable curve for (9)): The steady state B is locally stable. Furthermore, given that firms adjust instantaneously, while culture adjusts according to the replicator dynamic, movement to the steady state from any point in the region involves a vertical jump to the line $\frac{\Delta\gamma}{\Delta t} = 0$ and then gradual convergence along the arm under the dynamic in (1), as indicated by the heavy arrows.

At points where either one of conditions (6) or (7) does not hold, non-cooperators always do better: When (7) fails, there is no firm entry and thus no possibility of being revealed as a cooperator, or, if firms enter, when (6) fails, the reward to being revealed as a cooperator is too small. In either of these cases (i.e., in the shaded region in Figure 2) $\frac{\Delta\beta}{\Delta t} < 0$ and continues so until $\beta = 0$; that is, final convergence on the steady state described in Proposition 2, represented by point C in Figure 2.

4 Productivity improvements

Consider the effect of improvements in either institutions or technology that increase productivity but that tend to be ability intensive. The simplest way of modelling this is as a change which increases the average productivity of those who are skilled, while leaving unaffected the productivity of the unskilled. Amongst the skilled, consider an improvement that increases returns to the H types more than those of the L types. A number of changes seem to correspond with this: implementation of new technologies or work practices, changes in institutions (for example privatization, or allowing more competition in the labour market), or perhaps opening up to trade.[17]

[17] The exact reason is immaterial to the analysis, and all qualitative results are unchanged provided, for any changes, returns to the high types increase relatively more than returns to the low. We discuss the implications of our model for non-ability intensive development subsequently.

Since the crucial assumption here is the ability intensity of this productivity improvement, we model these changes by assuming that returns to the H types rise while returns to the L types are fixed. Since $H(\cdot)$ is a function we do this by defining a new function corresponding to an upward shift in the previous one. Formally, we now define H to be also a function of a parameter q, $H(q,\gamma)$, with $H_q(q,\gamma) > 0$ for all $\gamma < 1$ and $H_q(q,1) = 0$ (the latter constraint serves to preserve Assumption 2).[18] Thus, an increase in productivity is denoted by an increase in parameter q.

4.1 Effects of a productivity increase on welfare

Consider now two different productivity parameters q_l and q_h, and let $q_h > q_l$ so that the economy with q_h has more productive managers. Figure 3 sketches the change arising from a higher q and corresponding increase in H. First consider equation (9). The left hand side is unaffected by the change but the right hand side increases in value, so that the stable steady state γ_B is higher. Thus the curve γ_B^*, defined by (9), shifts up. In the figure, all curves drawn with solid lines correspond to values under q_l, whereas dashed lines are those under q_h. (Note that there is a simultaneous decrease in γ_A, but this is immaterial to the analysis and is not depicted.) The curve $H(q_h,\gamma) = \bar{H}$ also rises above $H(q_l,\gamma) = \bar{H}$. This upward shift arises because $\bar{H}$ is independent of q. Hence, an increase in $H(q,\gamma)$ due to a higher q must be counter-balanced by a higher γ, since $\frac{dH}{d\gamma} < 0$. A final shift is in a segment of $\frac{\Delta\gamma}{\Delta t} = 0$, defined by (8). Note firstly that this curve does not change for values of γ above those at which $H(q_h,\gamma) = \bar{H}$. This is because, at these values, firms choose the high wage strategy, $w_1 = z - L$, so that the change in H does not affect them. However, at lower values of γ, firms optimally choose the low wage strategy, $w_1 = z - H$, which has become more profitable with an increase in H. Therefore, in order to preserve the zero expected profit condition at the entry margin, γ must increase, as depicted by the arced arrow, denoting an upward movement in the part of the curve below $H(q_h,\gamma) = \bar{H}$.

By inspection of Figure 3, it can be seen that, in the new steady state (γ_D^*, β_D^*), both γ and β are higher. Intuitively, this is because higher expected productivity implies higher rewards for those revealed to be cooperators. Consequently, evolutionary forces drive more individuals towards cooperation, and β rises. Moreover, since the population has a better culture of cooperation, more firms are willing to enter. This new steady state, denoted by D in Figure 3, is also locally stable. Finally, it is also the case that β_1 falls, but since this plays no role in the analysis,

[18] $H_q(\cdot,\cdot)$ denotes the derivative of $H(\cdot,\cdot)$ with respect to q.

we consider it no further.

The following proposition characterizes the effect of this productivity increase on social welfare.

Proposition 4 *Let $q_h > q_l$. If q increases from q_l to q_h and the economy moves from the stable steady state corresponding to q_l to the stable steady state corresponding to q_h, social welfare in the economy increases.*

Such a productivity improvement thus seems unambiguously good. By raising returns to ability, it raises the expected value of cooperativeness. In turn, with more cooperators in the population, firms respond by entering, which reinforces the population's improved cooperativeness, β rises. Firms' profits rise because, on average, fewer workers shirk. Workers are better off because more can reap the benefits of cooperativeness.

However, the issue of transition from the low productivity interior steady state to the higher one, i.e., moving from B to D in Figure 3, has not yet been addressed.

4.2 Productivity improvements may fail

Economies do not instantaneously jump between steady states. Firms are relatively fluid and can enter quickly to reflect the new opportunities. However, the culture adjusts more slowly, a feature we have captured by using a replicator dynamic. In terms of the model's dynamics, this means that the model always converges along (8) as discussed in the previous section. This sluggishness in culture's adjustment renders the final outcome far from clear. In fact, as the following proposition shows, even though productivity improvements make a better steady state possible, such a steady state will not always be attainable.

Proposition 5 *Suppose that the economy starts in a stable interior equilibrium (β_B^*, γ_B^*) corresponding to q_l. Consider an increase in the productivity parameter to $q_h > q_l$, while all other parameters remain fixed. There exists a $\Delta > 0$ such that if $H(q_h;\gamma_B^*) - H(q_l;\gamma_B^*) > \Delta$, the economy converges monotonically to a steady state in which: (1) all cooperativeness is destroyed, i.e. $\beta = 0$; (2) all firms shut down, and (3) no workers are employed.*

The proposition says that if the effects of attempted productivity improvement, represented by Δ, are too large, it may not be possible to achieve the more efficient interior steady state, D

in Figure 3; instead, the economy converges to an inferior corner equilibrium in which initially existing cooperativeness is destroyed, as depicted by point C in Figure 3.

Figure 4 represents the dynamics of this situation graphically (the dashed horizontal lines correspond to q_h, and solid lines to q_l). As depicted, the rise in productivity has moved the line $H(q,\gamma) = \hat{H}$ above the original equilibrium value of γ, denoted γ^*_B. This is the condition for the transition to fail. With β starting at point β^*_B, the marginal firms at the old level of γ strictly prefer to enter, reflecting the higher productivity of H, and they do so up until the point denoted γ_1 in the figure. This is the upward arrow from point B in Figure 4. But as the point (γ_1, β^*_B) is below $H(q_h, \gamma) = \hat{H}$, all firms now strictly prefer the low wage strategy.

Intuitively, since the productivity enhancement improves productivity and rewards the high ability relatively more this increases the rent of high ability individuals, ceteris paribus. It now becomes optimal for firms to target these individuals when setting wages. An implication of this is that not even high ability workers can receive ability rents and evolutionary incentives force a decline in cooperativeness. In the next period then, the economy has even fewer cooperators (β falls), which leads to a decrease in γ, so that the economy traverses along the arm of $\frac{\Delta\gamma}{\Delta t}(q_h) = 0$ in the South-West direction in Figure 4. This arm then monotonically converges to the non-cooperative steady state, point C. Note that this would not have happened if β could somehow increase directly to its new interior steady state level, β^*_D, depicted at point D. This is because, at point D, β is high enough for the relative difference between the low and high ability's returns to be small, so that firms choose to continue with the high wage strategy.

On the other hand, productivity improvements which are not ability intensive will surely succeed. If L were to increase by more than H, firms would have even stronger incentives to pay the high wage, and evolutionary incentives would persist in transition to the better steady state.[19]

In summary, although the productivity improvements create the possibility of a better equilibrium, it may be that this better equilibrium cannot be reached starting from the economy's old equilibrium. Moreover, not only can the new one not be reached, but the favourable characteristics of the old equilibrium: some firms entering, some cooperators existing, and some managers being trained, may also be lost. In such a case, the economy converges uniquely to the bad corner

[19] In terms of figure 3, the dashed curve $H = \hat{H}$, shifts downward instead of up, so that transition to the new interior steady state is ensured.

equilibrium C.

4.3 Gradual development

Suppose now the productivity changes occur gradually. This more closely corresponds to the emergence of technologies and institutions in the West.[20] Here we model this as corresponding to a number of convex combinations of the dramatic increase in the productivity parameter q considered previously. Gradual development is a sequence of K technology or organizational changes, $K > 1$, such that in change k, $k = 1, 2, ..., K$, the productivity parameter q increases from q_{k-1} to q_k, where $q_0 = q_l$ and $q_K = q_h$. Suppose also that after each of these steps is implemented the economy is given enough time to converge to the new steady state before the next step is undertaken. This will be referred to as a *gradualization* K of development. The next proposition shows that properly sequenced changes allow the undesirable outcome of Proposition 5 to be avoided:

Proposition 6 *Suppose that the economy starts in a stable interior equilibrium* (β_B^*, γ_B^*) *corresponding to* q_l. *Consider an efficiency enhancing change that increases the productivity parameter to* $q_h > q_l$. *There exists a gradualization* K *of this change that ensures a unique path of development that converges on the superior interior equilibrium.*

Intuitively, implementing a series of small changes allows the population's culture to keep pace with the development process. Evolutionary incentives to maintain cooperativeness depend on wages paid by firms that encourage cooperators, which in turn depend on the magnitude of rents enjoyed by high ability cooperators. Gradualization of development ensures these rents do not become so high as to tempt firms to lower their wages, which would destroy any evolutionary incentives to become a cooperator.

Gradualization of development is not the only way to ensure convergence to the development steady state. In general, dramatic changes can still be implemented provided the dispersion in returns to the H and L types is limited. If earned income is observable and taxable, increased dispersion can be offset by increasing progressivity in the tax and transfer system: Firms will

[20] Dramatic change did occur there too, but even large technological innovations are not likely to have presented as profound a change as the introduction of centuries of accumulated know-how in the largely agrarian economies of contemporary LDCs.

persist with the high wage strategy, which preserves evolutionary incentives for cooperativeness, causing development to succeed.

While we concede that our model is too stylized to generate unconditional policy recommendations, it is noteworthy that the prominent development success stories of the Asia Pacific all started with tightly compressed earnings distributions, comparable to OECD and high income countries, that remained stable over the periods of high per capita income growth (in the range of 5% for the region as a whole) from the early 60s to the 90s. Comparison with the world's low growth regions over the same period, Latin America (approximately 1.5% per capita income growth), and Sub-Saharan Africa, (less than 1% per capita income growth) are consistent with the model.[21] Both of these regions had significantly more dispersed income distributions than the Asia Pacific (Gini coefficients in the 50's and 40's respectively, compared with the mid 30's for the Asia Pacific; see Deininger and Squire (1998)), and grew much more slowly. This negative impact of inequality on growth is already well known and has spawned a considerable literature to explain it. Our model provides another reason to expect such a link and further relates it to the population's culture.

On the cultural perspective, the extent of the locus of "trust" and how far this extends beyond the family is an old topic in the development studies literature. This is linked to attitudes about cooperation and compromise and argued to be a successful ingredient of enterprises' effective organization. Foster (1967) summarizes outcomes of these early surveys that attempt to elicit measures of trust.[22] The basic finding is that in most poor countries the radius of identification and trust is confined to the family, outside the family is an object of indifference and even hostility. Anthropologists have noted the similarity of such value attitudes in peasant societies around the world which have been described as a zero sum world view - one individual's gain comes only at the expense of another. A widely cited early case study is by Banfield (1958) of an Italian peasant village, which has been repeated in numerous countries.[23] This body of work has an obvious parallel with the present paper. Trust will tend to be high when a large proportion of the population are cooperators, as we have defined them. The point of our model, however, is to argue that this should not be treated as an exogenous feature of the society's environment but

[21] The precise figures vary depending on precise start and end dates and the countries defined in a region, but are always close to these approximations.

[22] Jones (1997) provides a more recent survey of this psychometric literature.

[23] Many of these studies are discussed in Potter, Diaz and Foster (1967).

that it too depends on that environment.

5 Discussion and conclusions

In this section we discuss some of our crucial modeling assumptions and the robustness of our results to relaxing these assumptions. We also relate our model to existing literature. Finally, we offer some concluding remarks.

5.1 Robustness

We believe that much of the model's structure could be generalized while preserving the main results. We have not attempted this since our aim has not been to provide the most general treatment, nor the most realistic model of LDC labour markets, but rather to construct as simple a framework as possible to examine the critical forces at play in our argument. Here we discuss these.

The inability of firms to fully control all elements of the production relationship, either by a complete contract or supervision, ensured cooperativeness could have a socially beneficial role in our model. The precise way we modelled this was by assuming that contracts were limited to specifying non-negative payments for workers, i.e. limited worker liability. This ensured that shirking was costly to the firm, since it was not able to recoup all losses via a penalty payment from workers. Under the accompanying assumption that such shirking was beneficial to workers (the term z) this meant firms were concerned about the possibility of shirking, and cooperativeness could play a role. Thus, workers' shirking being costly to firms is clearly a crucial ingredient of our model. However, that this arises through limited worker liability is not.

Another crucial ingredient was the existence of differing ability types in the population. This ensured that when firms found it optimal to provide performance incentives for those with low ability, the high type received an informational rent that was critical in maintaining evolutionary incentives for development of cooperativeness. This basic effect would persist in a model with more than two types, and where firms were not able to extract all of the rents of unskilled workers. In such a world, the rents enjoyed by high ability types would fall as some of the lower ability types were ignored by firms, but perhaps not disappear altogether. As long as they fell, the same dilution of evolutionary incentives for cooperativeness as considered in the paper would occur, but would simply be less stark.

We couched our analysis of cooperativeness in an explicitly evolutionary environment because we believe that framework provides a realistic framework for thinking about cultural variables. However, evolutionary environments are often criticized for their lack of individual rationality, a feature which is also evident here when the economy is transitioning to a steady state. It should be noted, however, that the evolutionary framework is not strictly necessary for our main results. The critical factor is that, at the aggregate level, changes in cooperativeness should occur slowly (relative to firms' entry decisions and technology choices). This is, of course, a feature of replicator based evolutionary models, but not exclusively so. A non-evolutionary based reason for such slow changes in aggregate could be, for example, randomly realized heterogeneous costs of individual adjustment, or variations due to differences in age. Provided this feature of differences in speed of adjustment is preserved, the main concerns raised in this paper will still arise, since, once again, economies will not be able to instantly jump to the better steady state.

5.2 Related literature

Fershtman and Weiss (1998) are also concerned with the evolution of a potentially valuable cultural trait. However, in their framework, the trait is observable. Thus there is no possibility for considering the feature we analyze which is the role played by firms in facilitating this trait. Thus the two way interaction between cultural factors and economic which is the aim of our paper is something that cannot be studied in their framework.

A related paper on "managerial ethics" was due to Noe and Rebello (1994). There, ethical managers could be trusted to apply appropriate effort even when financial incentives were not sufficiently strong to mitigate agency problems. They also similarly considered how production choices varied with aggregate ethic levels, and, in turn, how ethic levels affected returns to previous levels of ethics. They modelled choices of managerial ethics in a richer way than we have here by explicitly considering the effects of parental socialization; considerations that we have buried in our replicator dynamic. A principal difference in their framework is that, like Fershtman and Weiss, there are no firms (or any other such similar mechanism) which allow ethics to be revealed. Thus, in their model, ethical agents can never obtain an economic reward to this characteristic and are, at best, just as well off as the non-ethical. The reason ethical types can still stabilize at non-zero levels in their model is that both ethical and unethical parents have positive chances of producing ethical offspring, even though these suffer lifetime losses. Different parameterizations of transition functions thus lead to either stable managerial ethical levels or cyclical ones, which they used to explain their main focus, i.e., the dependence of economic activity on ethics levels. Our focus is instead on the dynamics of adjustment to positive shocks, where this type of positive shock is an increase in productivity that is ability intensive.

Though structurally much more different, the model bears a closer conceptual resemblance to Cozzi (1998). He similarly deals with the inappropriability of returns to a characteristic that is productivity enhancing, which he also called "culture". In his model, culture is a costly to acquire trait that is useful in production and is transmitted from the old to the young by explicit learning. This broad definition of the word culture can be interpreted as being consistent with our definition of culture here. He showed that, even without a direct reward to culture in production, it could persist in steady state if people will pay to acquire it in anticipation of payment for training the next generation when they themselves become old. Culture can thus persist as an asset whose value is positive as part of a rational bubble. Here, in contrast, with enough firms entering, cooperative individuals can benefit directly from their cultural trait. Unlike Cozzi we do not allow for individuals to benefit by selling this skill to future generations so that the returns to cooperativeness depend exclusively on the possibility of an informational rent to the high ability that is obtained when firms want to induce effort from the low ability too. This is what causes the potentially negative impact of productivity enhancing changes, since these can lead firms to give up on inducing effort from the low ability altogether.

A final relationship is to the large literature on culture, or norms, as a description of the equilibrium behaviour of agents that maintain reciprocity by within group sanctioning and punishment. This work focuses on community based cooperation, as in Ostrom (1990), that arises due to repeated interaction and reputations. A formal analysis in a repeated prisoner's dilemma context is undertaken by Greif (1994). He shows that when group sanctioning is strong enough cooperation can be sustained even if all agents are of the same type. Thus, there is no need to posit a cultural tendency to cooperativeness, as we have done here, since with good enough communal enforcement even homo-economicus will not shirk. This suggests that where culture might be of more importance is precisely in those situations where there is no longer the possibility of traditional group enforcement. That is, where economies are attempting a transition to more large scale and hence anonymous and complex forms of production. We believe this to be a closer parallel to the process of development or modernization today than a framework where enforcement is sustained by group punishment.

One interpretation of the paper's main result is as providing a reason for why the plight of currently developing countries may be different from that of Western countries at their own early stages of development. In the West, continued productivity growth, occurring gradually over a number of centuries, encouraged development of the right cultural characteristics. However, follower countries that are attempting to develop by the implementation of efficiency enhancing Western type technologies or institutions, are attempting a much more dramatic change which, as the model shows, may not succeed even where gradual ones would. However, even dramatic changes may succeed if they do not lead to too large an increase in relative returns of those who are already relatively highly rewarded. Thus, a development process in which relative returns of the high ability do not dramatically outstrip the low is more likely to be a success.

6 Appendix

Proof of Lemma 1: (ii) Suppose a firm decides to assign to management a worker whom it believes is a cooperator with probability less than 1. The firm would never do this unless it provides this manager with incentives not to shirk. That is, it must offer a wage $w_2(H)$ for high output such that $w_2(H) \geq \varepsilon + \delta$ (otherwise the worker will shirk if he is a non-cooperator). But, Assumption 3, part (ii), implies that $\varepsilon + \delta > H(\gamma)$ for any γ. Hence, in this case $w_2(H) > H(\gamma)$, which means that the firm earns negative expected profit. It will therefore never assign to management a worker about whom it is unsure.

(i) Now suppose a worker is believed with probability one to be a cooperator. Then she will provide effort when assigned to management as long as $w_2(H) \geq \varepsilon$. Since $\varepsilon < L$, this can be easily satisfied. In a steady state, the number of firms at time t, γ_t, is greater than the number of managers (who only come from workers who are cooperators), $\gamma_{t-1}\beta_{t-1}$, because $\gamma_{t-1} = \gamma_t$ and β_{t-1} is less than one, as will be shown in the proof of Proposition 4. Competition for these workers will then lead the firms to bid their wages up to L and H, depending on the ability. ■

Proof of Lemma 2: (i) Consider a non-cooperator employed in a firm. Suppose the wage this firm pays is w_1'. Then if this individual provides effort, her lifetime utility is $w_1' - \delta + \varepsilon$, because when old she will be assigned to management and then shirk (this follows from the argument in the proof of part (ii) in Lemma 1 above). If she shirks, in contrast, her payoff is z. Thus, the worker will provide effort only if $w_1' \geq \delta + z - \varepsilon$, which from part (ii) in Assumption 3 implies $w_1' > Y$. The firm will therefore never offer this wage, which means that a non-cooperative worker will always shirk when employed.

Part (ii) is immediate. ■

Proof of Lemma 3: According to the proof of Lemma 2, a firm will never want to elicit effort from a young non-cooperator. The wage w_1 is therefore determined so as to provide incentives to cooperators. The lifetime utility of a high ability cooperator who does not shirk is $w_1 + H(\gamma)$, since the worker receives payments w_1 and then $H(\gamma)$ as a manager (Lemma 2). If this worker shirks, he receives z only, so that a wage of $w_1 = z - H(\gamma)$ just induces an H cooperator not to shirk. Correspondingly a higher wage of $w_1 = z - L$ induces both the high and the low ability cooperator not to shirk. The non-cooperators, who are proportion $(1 - \beta)$ of the labor force, will always take a job and shirk. Thus the expected profit from the high wage strategy exceeds that from the low if and only if:

$$\beta(Y - z + L) - (1 - \beta)z \geq \beta(1 - \theta)(Y - z + H(\gamma)) - (1 - \beta(1 - \theta))z.$$

This rearranges to the condition in the lemma. ■

Proof of Proposition 1: (i) We first show that if an interior equilibrium exists, it solves conditions (8) to (10). In an interior equilibrium, the expected utility of both cooperators and non-cooperators must be equal, and firms hiring the young must make non-negative profit at the equilibrium values of β and γ. If not, then either β or γ (or both) will change from their conjectured equilibrium values.

Both cooperators and non-cooperators strictly prefer to obtain work when young. The non-cooperators because they can cheat and obtain the positive amount z without effort, and the cooperators because by working at one of these firms and not shirking they obtain w_1, are revealed to be a cooperator, and receive payment $w_2 \in \{L, H\}$ as a manager which is commensurate with their abilities. If an equilibrium has γ firms hiring, the probability of an individual receiving one of these jobs when young is $\gamma < 1$, because these jobs are assumed to be rationed randomly. Reciprocally, measure $1 - \gamma$ of the young who do not obtain work are unemployed.

The dynamic governing an individual's cooperativeness conditions on expected ability, the θ distribution. In an interior equilibrium, condition (6) must hold (otherwise the wage would equal $z - H(\gamma)$ and any cooperator would do strictly worse than a non-cooperator, so that β would converge to zero). Thus, a cooperator has expected utility $-F + \gamma[(1 - \theta)(H(\gamma) - L) + z] + (1 - \gamma)(0)$. For a non-cooperator expected utility is $(1 - \gamma)(0) + \gamma z$, since this individual will shirk. Combining these yields a condition that is necessary for a positive proportion of each type in steady state:

$$\gamma z = -F + \gamma[(1 - \theta)(H(\gamma) - L) + z]. \tag{12}$$

Rearranging, we obtain condition (9) in the proposition.

Next consider the profit of a firm j. Given a measure of cooperators, β, the expected profit of this firm is $\pi_j = \beta(Y - w_1) - (1 - \beta)z$, which from Lemma 3.3 implies that $\pi_j = \beta(Y + L) - z$ if condition (6) holds. This firm thus enters as long as

$$E_j \leq \hat{\varepsilon} \equiv \beta(Y + L) - z, \tag{13}$$

which yields condition (8) from the proposition. For (12) and (13) to be consistent it is necessary that

$$° = m \int_{\underline{E}}^{\hat{E}} e(x)\,dx;$$

which is condition (10) in the proposition. For simplicity we can denote the function $\hat{E}(°)$ as the value of $\hat{E}$ corresponding to a particular value of ° in the distribution. Clearly, this function is increasing.

(ii) Figure 1 plots equations (8) and (9) in $(¯; °)$ space. Consider equation (9) first.

Step 1. Existence of a solution to equation (9):

Both the right hand side (RHS) and the left hand side (LHS) of this equation are plotted in Figure 1. It is easy to check that Assumption 2 implies that RHS is concave in °. At the same time, when $° = 0$ RHS is equal to zero and increasing in °; where the latter follows from $H(0) > 1$. Finally, when $° = 1$ then RHS < 0; which follows from $H(1) = L$ (Assumption 2). Thus, there exists a $\hat{} \; 2 \; (0;1)$ such that RHS increases in ° if $° < \hat{}$, decreases if $° > \hat{}$ and reaches a maximum when $° = \hat{}$; while RHS$(\hat{}) > 0$:

Therefore, if $F > F^{¤} \; ´ \; RHS(\hat{})$ then (9) has no solution and claim (a) follows. If $F = F^{¤}$ then (9) has exactly one solution, $° = \hat{} \; 2 \; (0;1)$: If $F < F^{¤}$ then (9) has exactly two solutions, $°_A$ and $°_B$; both from $(0;1)$; this case is depicted in Figure 1. Note that (9), and therefore also $\hat{}$; $°_A$ and $°_B$; are independent of ¯; so that $°_A$ and $°_B$ are represented as horizontal lines in Figure 1.

Step 2. Existence of an interior solution to the system of equations (9) and (8). Suppose $F < F^{¤}$ (when $F = F^{¤}$ the proof is similar). From Step 1 above we know that (8) has exactly two solutions $°_A$ and $°_B$ that are between 0 and 1: Now look at equation (8): Solving for ¯ we obtain $¯(°) = \frac{\hat{E}(°)+z}{Y+L}$, so that differentiating with respect to ° yields

$$\frac{d¯(°)}{d°} = \frac{\hat{E}'(°)}{Y + L} > 0;$$

where the inequality follows since $\hat{E}(:)$ is an increasing function. Thus the function $¯(°)$ is upward sloping, as depicted in Figure 1: Because $¯(°)$ is always between 0 and 1 (from Assumption 1, parts (ii) and (iii)), there exist $¯_A$ and $¯_B$ from $(0;1)$ such that $¯_A = ¯(°_A)$ and $¯_B = ¯(°_B)$: By monotonicity, $¯_A$ and $¯_B$ are unique and (8) and (9) have exactly two interior solutions.

Step 3. $¯_A$ and $¯_B$ obtained in the previous step satisfy conditions (6) and (7): Condition (6) holds for any $\hat{}$ that satisfies (9) if $Y^{¤}(F)$ is chosen so that $H(\hat{}) \cdot \frac{µY^{¤}(F)+L}{1 ¡ µ}$: $Y^{¤}(:)$ is a function of F because $\hat{\gamma}$ is a function of F. Then (9) holds for any $Y \geq Y^*(F)$. To see that (7) holds note that $\beta_i = \frac{E(\gamma_i)+z}{Y+L} \geq \frac{\underline{E}+z}{Y+L} = \beta_1$, for $i = A$ or B.

Step 4. Stability. Suppose first that $F < F^*$ and let $\beta_A^* < \beta_B^*$ (this can be assumed without loss of generality). By comparing expected utilities of cooperators and non-cooperators we find that the expected utility of a cooperator is higher if and only if

$$F < \gamma(1-\theta)[H(\gamma) - L]. \tag{14}$$

Because of the concavity of the RHS (14), this holds if and only if $\gamma \in (\gamma_A^*, \gamma_B^*)$. Thus, if $\gamma \in (\gamma_A^*, \gamma_B^*)$ the number of cooperators, β, tends to increase, otherwise it tends to decrease.

Similarly, the number of firms entering, γ, rises iff the expected profit of the (initially) marginal firm is larger than the entry cost:

$$\hat{E}(\gamma) < \beta(Y+L) - z. \tag{15}$$

This is true iff $\beta > \beta(\gamma)$.

Consider equilibrium A and suppose that γ increases slightly above γ_A^*. Then (14) holds, which implies that β increases, which in turn implies the inequality in condition (15) holds, so that γ rises further, and so on. Equilibrium A is therefore unstable.

Now consider equilibrium B. Suppose γ increases slightly above γ_B^*. Then the opposite of (14) holds and β tends to decrease below β_B^*. But this means that the opposite of (15) holds so that γ decreases back to γ_B^*. The opposite happens when we consider a slight decrease of γ below γ_B^*. Similarly, if β deviates below β_B^*, the opposite of (15) holds so that γ starts decreasing below γ_B^*, which in turn implies that (14) holds and β rises back towards β_B^*. The opposite happens when β deviates slightly above β_B^*.

The instability of the unique equilibrium of part (b) follows immediately from the fact that the reverse of (14) holds for all $\gamma \neq \gamma^* = \hat{\gamma}$, so that β has a tendency to decrease whenever $\beta \neq \beta^*$. ■

Proof of Proposition 2: Suppose no individuals are cooperators, $\beta = 0$. Then the profits from entry are strictly negative for all firms, from (4). Thus, from (2) $\gamma = 0$. Furthermore, since there are no firms, no young workers are revealed as cooperators and consequently net returns to cooperativeness are strictly negative, so that evolutionary forces drive β to 0. ■

Proof of Proposition 3: Compare firms' expected profits in each steady state. In the corner steady state, firms do not exist. In the interior steady state, infra-marginal firms earn positive expected profits. Now consider individuals. In the corner steady state, all individuals have expected utility equal to zero. In the interior steady state cooperators have equal expected utility to non-cooperators, that is: $E[u^c] = E[u^n]$. Thus, consider the expected utility of non-cooperators. Since, such individuals have a positive probability of obtaining work, where they will shirk and obtain z, their expected utility is $\gamma z > 0$. Thus these individuals are strictly better off in the interior steady state, as are, in expectation, cooperators. Thus economy wide welfare is higher in the interior steady state. $\blacksquare$

Proof of Proposition 4: Look at the expected utility of workers in steady state, $W(q)$, in the economy for a given q:

$$W(q) = \beta\gamma[w_1 + \theta L + (1 - \theta)H(q;\gamma) - F] + (1 - \beta)[\gamma z].$$

The first term reflects the fact that only cooperators work when young and employed. These individuals are then revealed as cooperators and are assigned to management where their output depends on their ability. The last term captures the fact that non-cooperators take a job and shirk. Now consider two values for q, $q_l < q_h$, and their corresponding steady states, denoted with l and h subscripts respectively. In these it is the case that $\beta_h > \beta_l$ and $\gamma_h > \gamma_l$. In any steady state, by evolutionary pressures it must be the case that the two terms in square brackets in $W(q_h)$ are equalized. But since $\gamma_h > \gamma_l$ then $W(q_h) > W(q_l)$. So workers have higher expected utility in steady state with higher q. Firms have higher expected profits as a whole since $\gamma_h > \gamma_l$ implies that there are more infra-marginal firms earning positive profit. Moreover, each firm with $E_j < \hat{E}(\gamma_B)$ earns higher profit in the steady state corresponding to q_h because $\pi_j = \beta(Y + L) - z$ and $\beta_h > \beta_l$. $\blacksquare$

Proof of Proposition 5: Consider an initial interior steady state (β^*_B, γ^*_B) corresponding to the productivity parameter q_l. At this steady state, condition (6) must hold, i.e. $H(q_l;\gamma^*_B) \leq \hat{H}$. Let $\Delta = \hat{H} - H(q_l;\gamma^*_B)$ and consider a market reform that shifts the productivity from $H(q_l;\gamma^*_B)$ to $H(q_h;\gamma^*_B) > H(q_l;\gamma^*_B) + \Delta$. Since condition (8), determining equilibrium levels of γ, is independent of H provided (6) continues to hold, the number of firms, γ, does not react to this productivity increase immediately; rather, it adjusts slowly with β, which follows a gradual replicator dynamic.

Therefore, the economy moves away from the initial equilibrium B slowly and continuously. Meanwhile, a sudden increase in H by $H(q_h, \gamma^*) - H(q_l, \gamma^*) > \Delta$ causes a discrete jump in $H(., \gamma^*_B)$, to $H(q_h, \gamma^*_B)$, so that

$$\hat{H} - H(q_h, \gamma^*_B) < \hat{H} - H(q_l, \gamma^*_B) - \Delta = 0,$$

where the inequality follows from $H(q_h, \gamma^*_B) > H(q_l, \gamma^*_B) + \Delta$. This obviously violates condition (6). The number of cooperators therefore gradually starts to decrease and the economy monotonically converges to the $\beta = 0$ steady state as described in the dynamics section above. ∎

Proof of Proposition 6: Let $\left(\beta^*_{k-1}, \gamma^*_{k-1}\right)$ be the stable interior equilibrium corresponding to t_{k-1}, $k = 1, 2, ..., K$. Define $\Delta(q_{k-1})$ as $\Delta(q_{k-1}) \equiv \hat{H} - H(q_{k-1}, \gamma^*_{k-1})$ and choose the gradualization $1, 2, ..., K$ so that $H(q_k, \gamma^*_{k-1}) < H(q_{k-1}, \gamma^*_{k-1}) + \Delta(q_{k-1})$. By continuity of $H(., .)$, it is always possible to find a finite K such that this holds for all $k \leq K$. In each of these K the increase in q causes first a discrete jump in $H(., .)$ from $H(q_{k-1}, \gamma^*_{k-1})$ to $H(q_k, \gamma^*_{k-1})$ and then a gradual decrease from $H(q_k, \gamma^*_{k-1})$ to $H(q_k, \gamma^*_k)$ as γ slowly increases with β. Moreover, $H(q_k, \gamma^*_k) < H(q_{k-1}, \gamma^*_{k-1})$, which follows from condition (9) and from $\gamma^*_k > \gamma^*_{k-1}$. Thus, a transition from an interior stable steady state $\left(\beta^*_{k-1}, \gamma^*_{k-1}\right)$ to an interior stable steady state (β^*_k, γ^*_k) can occur only if condition (6) holds for $\beta_1(q_k, \gamma^*_{k-1})$ and β^*_{k-1}, because β^* adjusts slowly. But it holds because

$$\hat{H} - H(q_k, \gamma^*_k) > \hat{H} - H(q_k, \gamma^*_{k-1}) > \hat{H} - H(q_{k-1}, \gamma^*_{k-1}) - \Delta(q_{k-1}) = 0,$$

where the first inequality follows from $\gamma^*_k > \gamma^*_{k-1}$ and the second inequality follows from $H(q_k, \gamma^*_{k-1}) < H(q_{k-1}, \gamma^*_{k-1}) + \Delta(q_{k-1})$.

Thus, if enough time is allowed for β to adjust in every step, condition (6) can remain satisfied, and the economy can gradually move from the interior stable steady state corresponding to q_l to the interior stable steady state corresponding to q_h. ∎

References

[1] Aghion, P. and Tirole J. (1997) Real and formal authority in organizations, *Journal of Political Economy*, CV, 1-29.

[2] Ben-Ner, A. and Putterman, L. eds. (1998) *Economics, values, and organization*, Cambridge: Cambridge University Press.

[3] Bowles, S. (1998) Endogenous preferences: the cultural consequences of markets and other economic institutions, *Journal of Economic Literature*, XXXVI, 75-111.

[4] Burkart, M., Gromb, D., and Panunzi F. (1997) Large shareholders, monitoring, and the value of the firm, *Quarterly Journal of Economics*, CXII, 693-728.

[5] Cozzi, G. (1998) Culture as a bubble, *Journal of Political Economy*, April, 106(2), 376-94.

[6] Doi, T. (1971) *The anatomy of dependence*, Tokyo Kodansha International

[7] Deininger, K. and L. Squire (1998) New ways of looking at old issues: inequality and growth, *Journal of Development Economics*, 57(2), 259-287.

[8] Fershtman, C. and Y. Weiss (1998) Social rewards, externalities and stable preferences, *Journal of Public Economics*, 70, 53-73.

[9] Foster, George M. (1967) in Peasant Society: A reader, ed J.M. Potter, M. N. Diaz and G.M. Foster, Boston, Little Brown

[10] Furnham, A. (1990) *The protestant work ethic: the psychology of work-related beliefs and behaviours*, London and New York: Routledge.

[11] Greif, A. (1994) Cultural Beliefs and the Organization of Society: A Historical and Theoretical Reflection on Collectivist and Individualist Societies, *Journal of Political Economy*, 102(5), 912-950.

[12] Harrison, L.E. and S.P. Huntington (eds.) (2000) Culture Matters: How Values Shape Human Progress,

[13] Hoffler, F. (1999) Some Play Fair, Some Don't: Reciprocal Fairness in a Stylized Principal-Agent Problem, *Journal of Economic Behavior and Organization*; 38(1), 113-31.

[14] Inglehart, R. (1990) Culture shift in advanced industrial society, Princeton, Princeton University Press.

[15] Jones, H.B. jr. (1997) The protestant ethic: Weber's model and the empirical literature, Human Relations, 50(7), 757-778.

[16] Kunio, Y. (1994) Japanese economic development, 3rd edition, Oxford: Oxford University Press.

[17] Landes, D.S. (1998) Culture counts, Challenge, July-August, 41(4) 14.

[18] Lindbeck, A., Nyberg, S., Weibull,J.W. (1999) Social Norms and Economic Incentives in the Welfare State, Quarterly Journal of Economics,114, (1) p.1.

[19] Niles, F.S. (1999) Toward a cross-cultural understanding of work-related beliefs, Human Relations 52(7), 855-867.

[20] Noe, T. H., and M. J. Rebello (1994) The dynamics of business ethics and economic activity, American Economic Review, 84(3) June, 531-47.

[21] Nyberg, S. (1997) The honest society: stability and policy considerations, Journal of Public Economics, 64, 83-99.

[22] Ostrom, E. (1990) Governing the commons: the evolution of institutions for collective action, Cambridge: Cambridge University Press.

[23] Pejovich, S. (1997) Law, tradition and the transition in Eastern Europe, Independent Review, Fall, 2(2), 243-55.

[24] J.M. Potter, M. N. Diaz and G.M. Foster (1967) (editors) Peasant Society: A reader, Boston, Little Brown.

[25] Putnam R. D. (1993) Making Democracy Work: Civic Traditions in Modern Italy, Princeton University Press, Princeton, New Jersey.

[26] Saeed, S. M. (1986) Managerial challenges in the third world, New York: Praeger.

[27] Salanie, B. (1997) The economics of contracts, Cambridge, MIT Press.

[28] Samuelson, L. (1997) *Evolutionary games and equilibrium selection*, Cambridge: MIT Press.

[29] Sen, A. (1996) A matter of choice: is culture merely an adjunct to development? *Unesco Courier*, September, 10-14.

[30] von Thadden E.-L. (1992) Optimal pricing against a simple learning rule, *Games and Economic Behavior*, 4, 627-649.

[31] Weber, M. (1905) [1970] *The protestant work ethic and the spirit of capitalism*, London: George Allen and Unwin.

[32] Weibull, J. (1995) *Evolutionary game theory*, Cambridge: MIT Press.

FIGURE 1

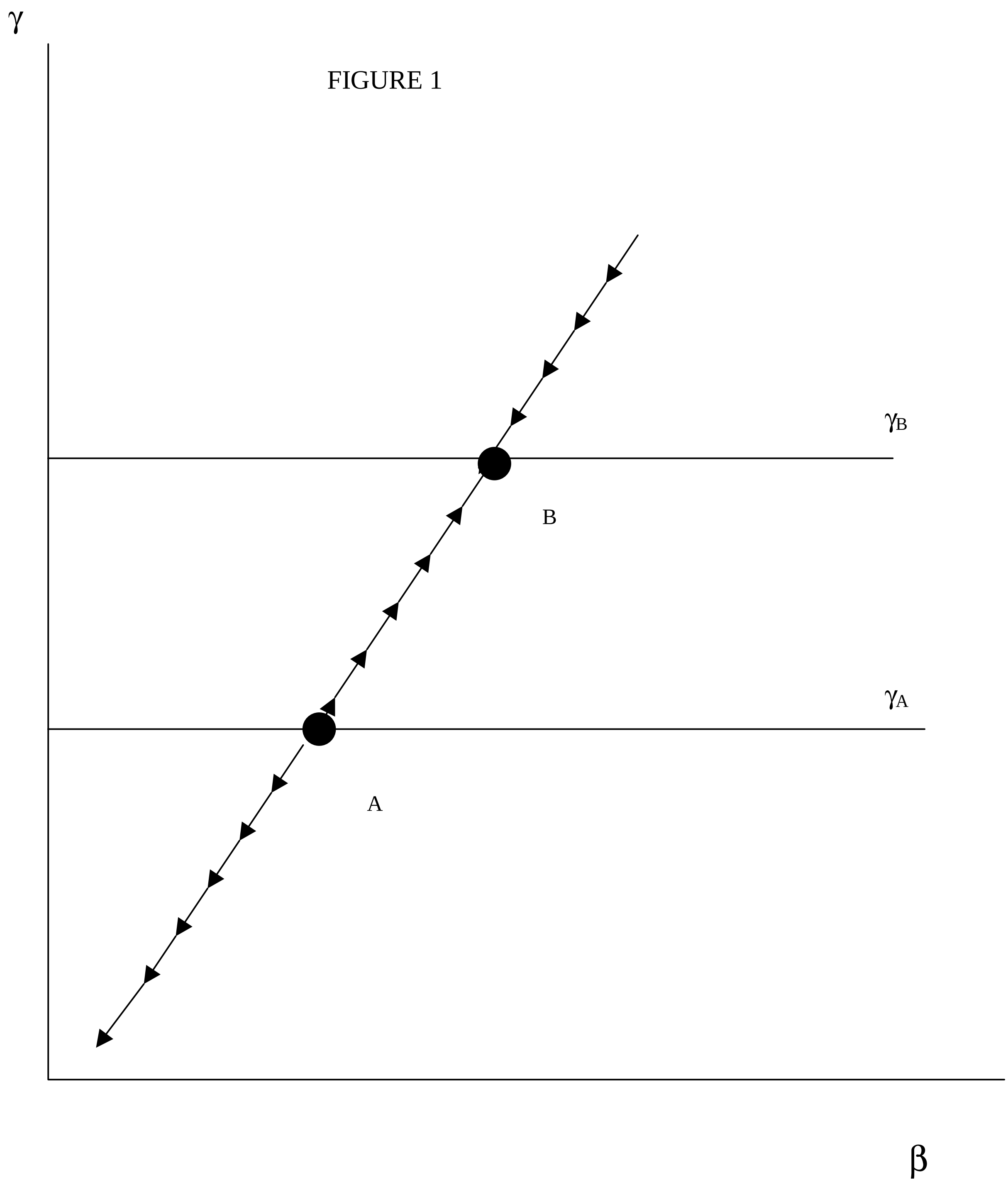
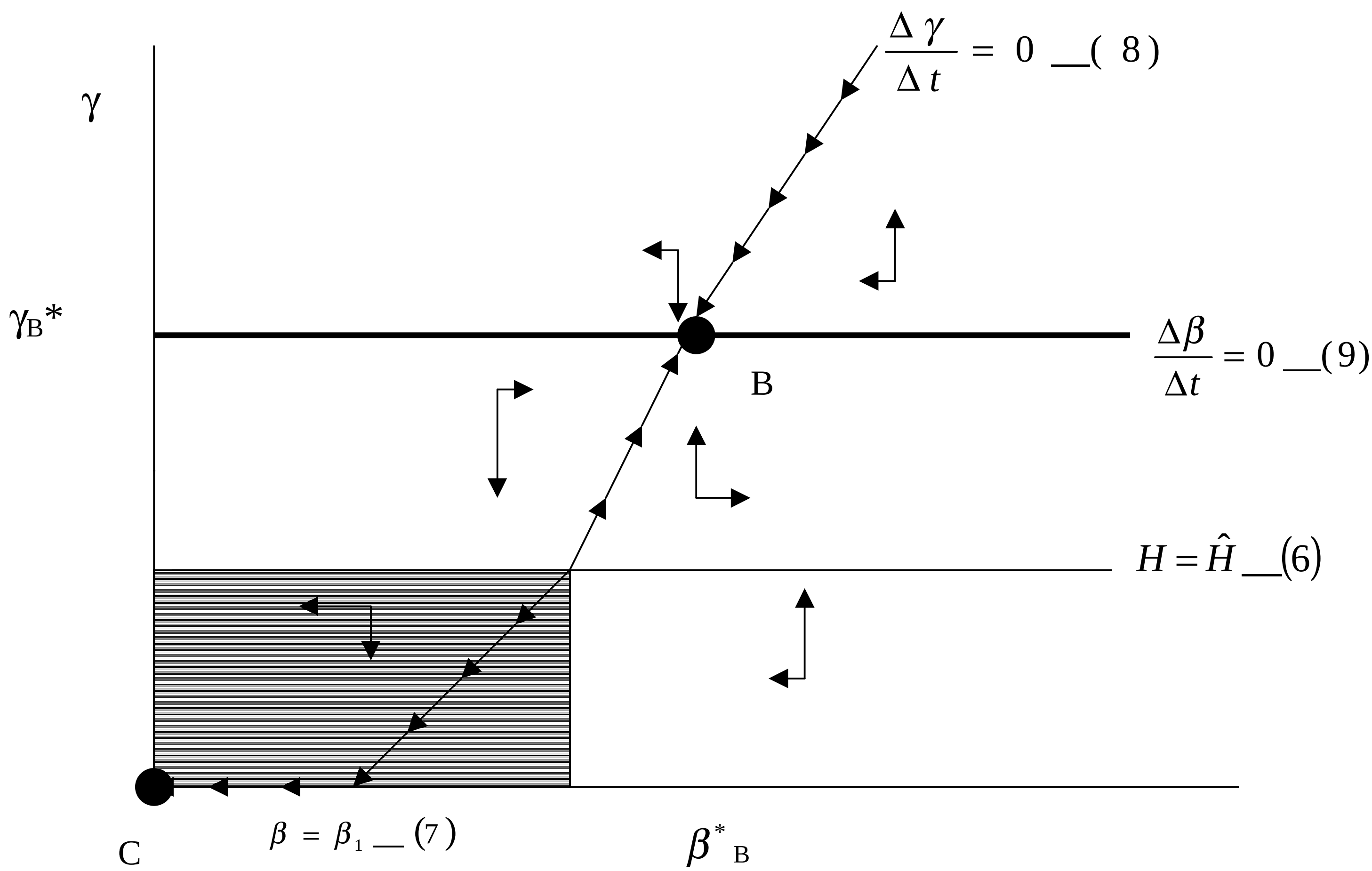
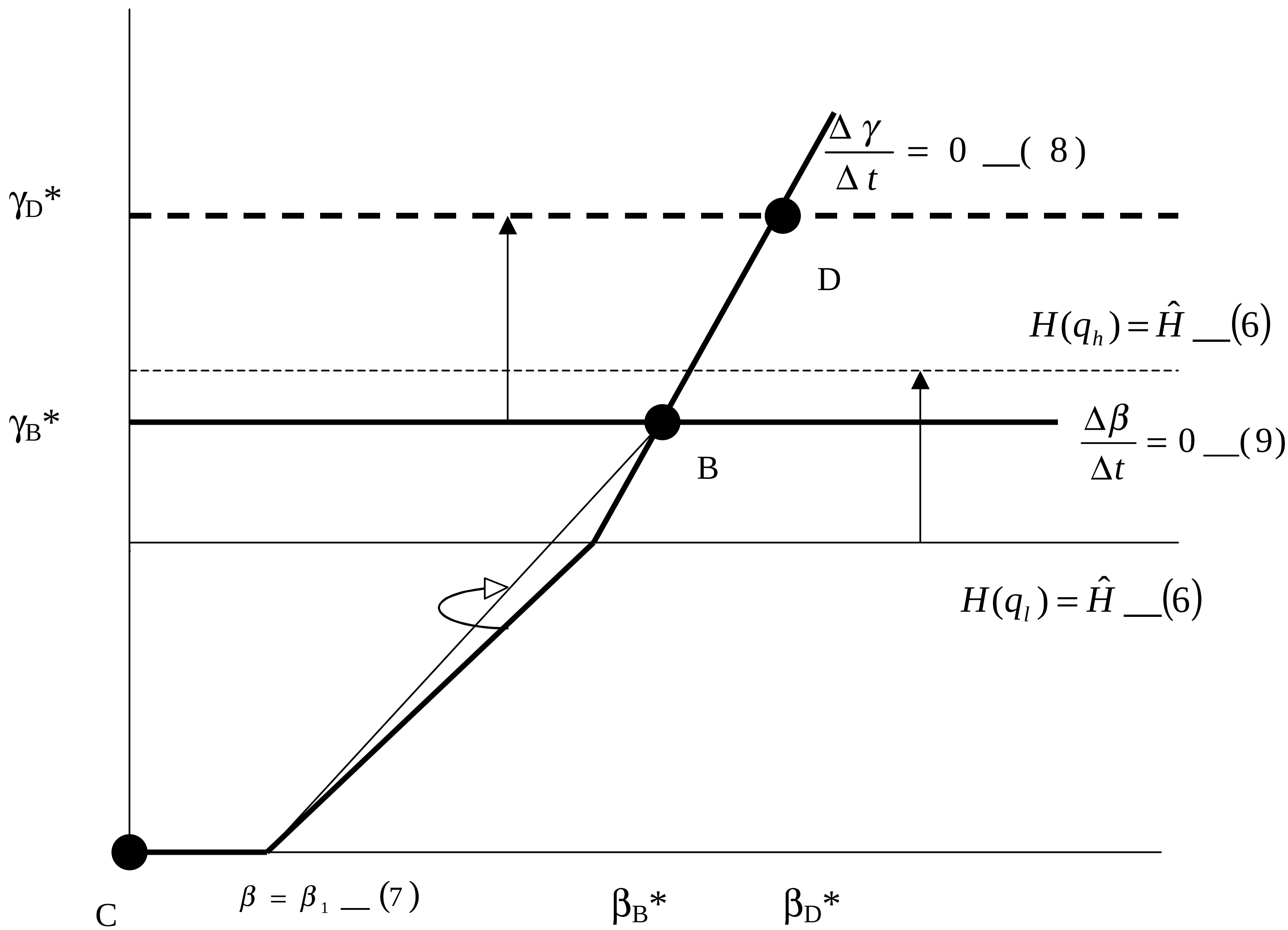


FIGURE 2



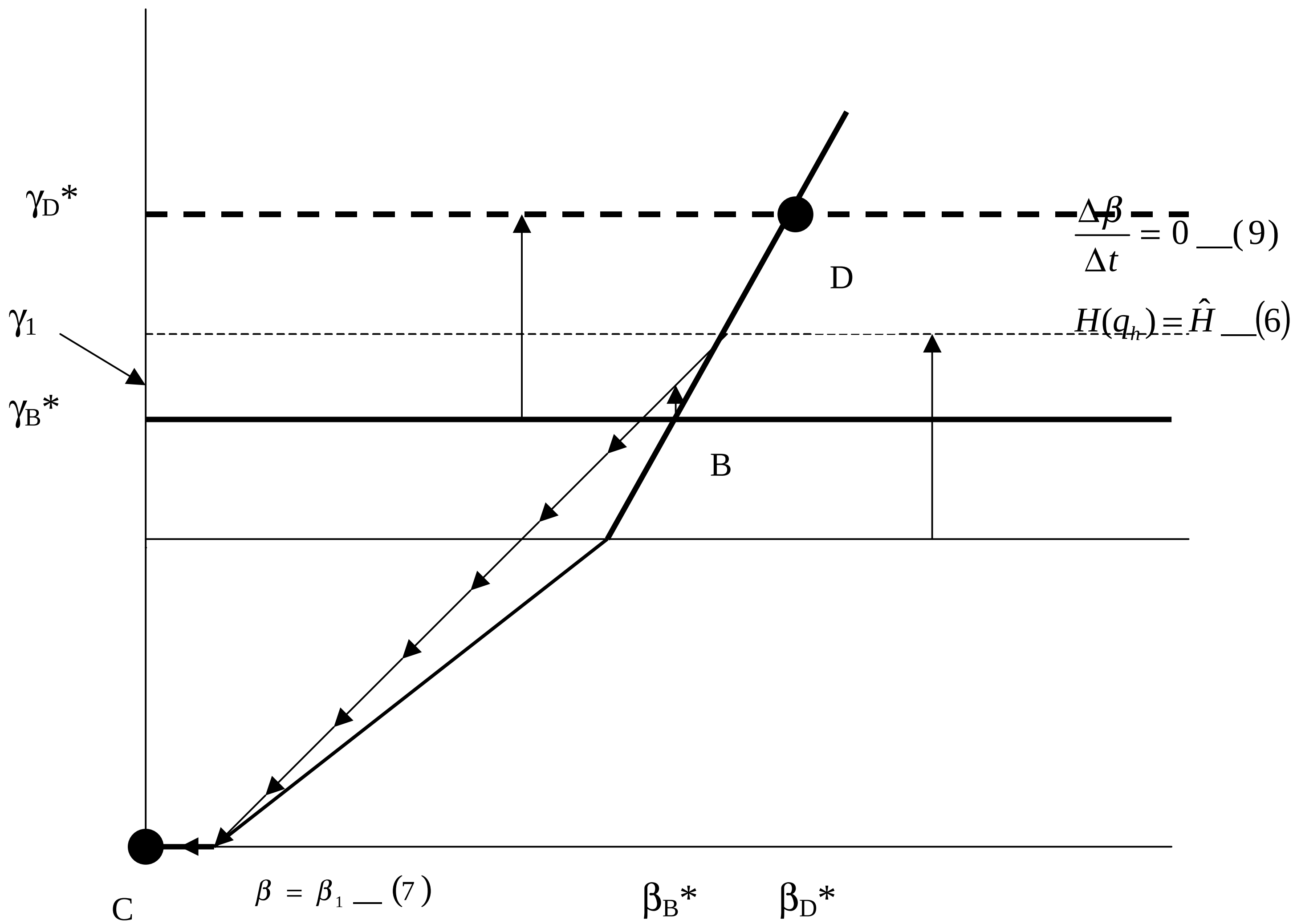
$\frac{\Delta\gamma}{\Delta t} = 0$ __(8)
γ
γ_B*
$\frac{\Delta\beta}{\Delta t} = 0$ __(9)
B
$H = \hat{H}$ __(6)
C
$\beta = \beta_1$ __(7)
$\beta^*{}_B$

FIGURE 3



$\frac{\Delta\gamma}{\Delta t} = 0$ __(8)
γ_D*
D
$H(q_h) = \hat{H}$ __(6)
γ_B*
$\frac{\Delta\beta}{\Delta t} = 0$ __(9)
B
$H(q_l) = \hat{H}$ __(6)
C
$\beta = \beta_1$ __(7)
β_B*
β_D*

FIGURE 4



γ_D*
γ_1
γ_B*
$\frac{\Delta\beta}{\Delta t} = 0$ __(9)
D
$H(q_h) = \hat{H}$ __(6)
B
C
$\beta = \beta_1$ __(7)
β_B*
β_D*