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Entrepreneurs, culture and productivity

>Gonzalo Olcina
Universitat de València, ERI-CES, Spain
>Elena Mas Tur
Eindhoven University of Technology
>Luisa Escriche
Universitat de València, ERI-CES, Spain

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Olcina,G.[†] Tur, EM.[‡] Escriche,L.[§]

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Abstract

This paper contributes to explain the persistence of differences in levels of entrepreneurship within and across countries. We analyse in a dynamic setting the mutual relationship among the distribution of preferences for entrepreneurship in the population, public administration efficiency, and entrepreneurial productivity when preferences and productivity evolve over time. Individuals with entrepreneurial preferences start their own business, while the other individuals join the public and traditional sectors. In each generation, individuals vote on the taxes the entrepreneurs will pay. Under a balanced public budget, the collected taxes are used to pay the civil servants' wages. The effort of civil servants captures the effort made to generate an efficient normative and regulatory environment, and it will affect the probability of success of entrepreneurship. The dynamic of entrepreneurial productivity is determined by the relative proportion of entrepreneurial and non-entrepreneurial individuals among generations.

We show that an economy can reach two different long-run equilibria: a traditional equilibrium, with a low proportion of entrepreneurs, low productivity, high taxes and an inefficient Administration and an entrepreneurial equilibrium with a high proportion of entrepreneurs, a higher productivity and lower taxes but enough to implement an efficient Administration. Our main result is that the equilibrium achieved completely depends on the tax policy followed by the different generations. If decisions are made by majority voting in a myopic way, then the initial conditions of the society become crucial. This result explains persistence: an economy evolves around similar levels of entrepreneurship unless some reforms are implemented.

Keywords: Entrepreneurship, Cultural Transmission, Entrepreneurial Preferences, Tax policy, Public Administration efficiency

JEL classification: J62, L26, M13, J 62

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[†]University of Valencia and ERICES. Corresponding author. Gonzalo.Olcina@uv.es. Faculty of Economics, Avda dels Tarongers s/n, Valencia (Spain). Phone: +34963828241. Fax: +34963828249.

[‡]School of Innovation Sciences, Eindhoven University of Technology; INGENIO (CSIC-UPV), Universitat Politècnica de València; Institute of Innovation and Entrepreneurship, School of Business, Law and Economics, University of GothenburgE.M.Mas.Tur@tue.nl

[§]University of Valencia and ERICES. Luisa.Escriche@uv.es

1 Introduction

Entrepreneurship is a key aspect of economic dynamism as it determines productivity, innovation and economic growth (see Schumpeter, 1934; Wennekers and Thurik, 1999; Minniti, 1999; Audretsch and Thurik, 2001, for example).[1] Reynolds, Hay, and Camp (1999) show that variations in rates of entrepreneurship may account for one-third of the variation in economic growth.

The persistent difference in entrepreneurship within or across countries is a well-known stylized fact. Comparing countries, Freytag and Thurik (2007) show differences that endure for more than four decades, so the ranking between countries is quite stable (Reynolds et al., 2002).[2] Concerning regions, Fritsch and Wyrwich (2014), for example, observe that the regional differences in Germany tend to be persistent as long as periods of eighty years, despite abrupt and drastic changes in the political-economic environment. This is not an isolated case since, as these authors point out, the regional start-up rates tend to be relatively persistent over periods of one or two decades in other regions as the Netherlands (Van Stel and Suddle, 2008), Sweden (Anderson and Koster, 2011), the United Kingdom (Mueller et al., 2008), and the United States (Acs and Mueller, 2008).

This paper presents a theoretical model that explains the persistence of differences in levels of entrepreneurship among economies. Our model takes into account the interaction between intergenerational transmission of entrepreneurial traits (culture), efficiency of the Administration (Institutions) and evolution of productivity on the entrepreneurial sector. We obtain that an economy can achieve two different long-run equilibria. The first one is a traditional economy, with few entrepreneurs, low productivity, high taxes and an inefficient Administration. The second one is an entrepreneurial economy with predominantly entrepreneurial traits, lower taxes, a more efficient Administration and a higher productivity and per capita income. We show that the equilibrium achieved depends completely on the tax policy followed by the different generations.

1.1 Evidence and related literature

Culture and institutions play a crucial role in explaining the level of entrepreneurship and especially the persistence of entrepreneurship (Wennekers and Thurik, 1999; Wennekers et al., 2002, 2005, for instance). As Freytag and Thurik put it (2007, p.121), "the persistent differences between countries point to non-economic causes such as cultural factors, which have a tendency to remain relatively stable over time". We understand culture as the prevailing norms or values of an economy, whereas the institutions refer to the rules and laws of the

[1] See Wennekers and Thurik (1999) for a survey of how economic growth is linked to entrepreneuship.

[2] Freytag and Thurik (2007) present an illustrative figure with the development of the rate of entrepreneurship for six countries of the 23 of the Compendia data set (Stel van, 2005) from 1973 to 2006.

environment where the businesses are conducted.[3]

Entrepreneurship and culture. The values or preferences of an individual affect the decision to become an entrepreneur. These values can be risk tolerance, autonomy, striving for independence, mastery, individualism, or an aggregate trait that we will name as preferences for entrepreneurship. Many studies show that entrepreneurial preferences are transmitted among generations (Chlosta et al., 2012; Dohmen et al., 2011; Laspita et al., 2012). For example, a crucial determinant of entrepreneurship, willingness to take risk, is transmitted from parents to children (Dhomen et al., 2011; De la Paola, 2012, and Leuermann and Necker, 2011). Wyrwich (2015) studies the relationship between entrepreneurship and mastery, in the sense of challenging existing conditions, finding evidence of an intergenerational transmission of values from parents to children. Hundley (2006) provides support for the effects of skills and values that are specifically acquired from exposure to a self-employed parent on the self-employment choice. Lindquist et al. (2015) show that parental entrepreneurship increases the probability of children's entrepreneurship by about 60% and present suggestive evidence in favor of role modelling. Economic theory also provides an extended literature on the intergenerational transmission of values since the pioneering paper by Bisin and Verdier (2001).[4] Recently, Chakrabortya et al., (2016) have also considered this framework to connect culture to entrepreneurship and economic growth.

Entrepreneurship and institutions. Besides culture, another determinant of entrepreneurship is the quality of the institutions (Acs and Amorós, 2008). Institutions are crucial because of their role in ensuring the protection of property rights, the objective resolution of contracts and other legal disputes, and the government´s transparency (van Stel et al. 2005). The OECD-Eurostat Entrepreneurship Indicator Programme (EIP, 2009) indicates that entrepreneurship requires a good, clear and enforceable regulatory framework. Afonso, Schuknecht and Tanzy (2005) elaborate an Administration Opportunity Indicator that takes into account corruption, red tape (concerning regulatory environment), quality of the judiciary (concerning the confidence in the administration of justice) and the size of the shadow economy. The correlation between the entrepreneurship rate and this Administration Opportunity Indicator offers a positive and significant value of 0,42.[5] Klapper et al., (2010) also find a negative and significant relationship between both the "ease of doing business index" and the entry and new firm density rates per country.[6] They estimate that for every 10 percentage

[3] "Relevant institutions include fiscal legislation (tax rates and tax breaks), the social security system influencing the rewards and the risks of entrepreneurship, and the administrative requirements for starting a new business." (Wennekers et al., 2005, p. 300)

[4] See Bisin and Verdier (2011b) for a survey of this literature.

[5] Correlation between Total Entrepreneurial Activity Rate (TEA) and Administration Opportunity Indicator for those countries that appear in both sources of data in 2000. Source: own elaboration based on data from Afonso, A.; Schuknecht, L. and Tanzi, V. (2005) and Global Entrepreneurship Monitor, GEM, (2005). TEA: proportion of adults involved in creation of nascent firms (3 months) and proportion involved in surviving firms (42 months).

[6] The Doing Business Report includes a ranking of this "ease of doing business index". A high position in the ease of doing business ranking means that the regulatory environment is

point decrease in entry costs, density and entry rate increase by about 1 percent.

Entrepreneurship and productivity. Finally, the level of entrepreneurship is also closely related to the level of income and productivity in an economy. The evidence suggests that the effect of entrepreneurial activity on growth depends on the level of per capita income or phases of economic development (Acs and Amorós, 2008; Van Stel et al., 2005; Wennekers et al., 2005, 2010; Porter et al., 2002). Empirical studies obtain a U-shaped relationship between entrepreneurship and economic development (Carree et al., 2000, and Wennekers et al., 2005, 2010) or even an S-shaped relationship if more complex measures are considered (the Global Entrepreneurship and Development Index, GEDI).[7] Therefore, it is clear that two regions will present different levels of entrepreneurship if they are at different stages of economic development. But this factor by itself does not explain why societies like Japan or United States, which are at the stage we could call innovation-driven stage, have such different entrepreneurship rates.[8] It needs to draw upon structural factors (culture and institutions) to try to understand this fact.

1.2 Key features of the model

Our model explicitly analyzes, in a dynamic setting, the interaction among preferences, institutions and productivity when preferences are heterogeneous in the population and evolve over time. In this Section, we describe its key features.

Concerning the first element, preferences, we consider that each adult chooses between becoming an entrepreneur or not, in which case, he will work as a civil servant or as a routine producer. The choice depends on his preferences. Preferences are transmitted among generations during the socialization process. As in Bisin and Verdier (2001b), the model considers that the values or attitudes may be transmitted (at a cost) from parents to children or by society at large, in other words, there exists direct transmission and oblique transmission. Parents try to shape the preferences of their children taking into account the potential gains of the children's occupational choice when they become adults. If parents do not succeed in transmitting their chosen preferences, then children acquire preferences from the social environment where they grow up.

Concerning the second element, the quality of institutions, we consider that the efficiency of the Administration determines the expected profits from entrepreneurial activity. Specifically, if an individual decides to become an entrepreneur and start a risky project, the probability of success will crucially depend crucially on the level of a costly effort exerted by the civil servants. By

more conducive to the starting and operation of a local firm. The index is constructed as the simple average of the countries' percentile rankings on 10 topics: Starting a business, Dealing with licenses, Employing workers, Registering property, Getting credit, Protecting investors, Paying taxes, Trading across borders, Enforcing contracts, and Closing a business.

[7] See Acs and Amorós (2008) for aditional references on this issue and https://thegedi.org

[8] The Total Entrepreneurial Activity (TEA) measures the relative amount of nascent entrepreneurs and business owners of young firms and it was 0.105 for US and 0.018 for Japan in 2002 (see van Stel et al., 2005).

this we mean the effort made to generate a friendly normative and regulatory framework for business, although it can have other alternative interpretations such as the absence of corruption in the public sector. Civil servants will make their decision on effort depending on the wage they are paid. Wages of civil servants are paid with collected taxes: it is assumed that there is a balanced public budget. Specifically, the model assumes that only entrepreneurs are net contributors. Therefore, entrepreneurs face a trade off: high taxes mean that they appropriate a low proportion of their income but it also means that the effort/efficiency of the Administration is high. Consequently, the expected gross profits can be high. The level of taxation is decided by some political process. In this paper it will be chosen by majority voting but obviously we can also make clear predictions to political situations where the decisive political agent is not necessarily the median voter.

The third element in the model is the entrepreneurial productivity. The income obtained by the entrepreneurial activity in case of success, which we take as to the productivity in this activity, is explained by the proportion of entrepreneurs that exists in the society. In particular, we assume that some balance between entrepreneurs and non-entrepreneurs is required to obtain increases in productivity. This is similar to the approach of Ashraf and Galor (2011), who consider that population heterogeneity is a crucial determinant of increases in productivity. In our model, the complementarity we have assumed between the efficiency of the Administration and the success of entrepreneurship implies that a critical mass both of entrepreneurs and of civil servants is needed for technological advancement and innovation. A minimal proportion of civil servants (or a minimum size of the public administration) is necessary to provide a friendly regulatory environment for business and a minimal proportion of entrepreneurs in the population is needed to start technological advancement.

1.3 Main findings

The main result of the paper is that an economy can reach two different long-run equilibria. The first equilibrium is a traditional economy, with a low proportion of entrepreneurs, low productivity, high confiscatory taxes and an inefficient Administration. The second possible equilibrium is an economy with predominantly entrepreneurial traits, lower taxes (but high enough to implement an efficient Administration) and a higher productivity and per capita income. Taxes will be higher and the public sector will be less efficient in a traditional equilibrium, corroborating that high levels of taxation, corruption and bureaucratic obstacles to start a business can discourage entrepreneurship (Lee and Gordon, 2005; Klapper et al., 2006, 2010; Ciccone and Papaioannou, 2007; Cullen and Gordon, 2007; Djankov et al., 2010).

Our model shows that the tax rate on entrepreneurial profits completely determines whether an economy achieves a traditional equilibrium or an entrepreneurial equilibrium. If tax decisions are made by majority voting in a myopic way, then the initial conditions of the economy become crucial. That is, for an economy with an initial majority of non-entrepreneur individuals, the dynamics will move the economy towards the non-entrepreneurial steady state, as they will vote for the highest taxes. Conversely, an economy with a majority of entrepreneurs will set up a moderate tax on entrepreneurial profits just high enough to afford an efficient Administration, and the dynamics will move the economy towards the entrepreneurial steady state. In the end, the ultimate determinant of where the economy establishes in the long run is the initial proportion of entrepreneurs and productivity. This fact explains persistence: an economy evolves around similar levels of entrepreneurship as in the initial situation unless some structural changes are implemented.

In the entrepreneurial equilibrium, both entrepreneurs and non-entrepreneurs obtain a higher payoff than in the traditional one. Thus, if individuals are forward-looking and they are concerned about the welfare of future generations, they might try to implement some tax reform in order to drive the economy towards an entrepreneurial society. The channel to make this happen is through a change in the preferences transmitted among generations and in the Administration efficiency. We discuss different alternatives in order to establish a credible intergenerational commitment to never set confiscatory taxes in the future and to compensate the short run losses for non-entrepreneurs with a subsidy.

The paper is organized as follows. Section 2 introduces the static model, describing the game played by each generation. Section 3 characterizes the different equilibria within a generation. Section 4 introduces the evolution of the proportion of entrepreneurs in the population and the dynamics of productivity over generations. Section 5 describes the dynamical model and analyses its properties. Section 6 obtains the long run equilibria of the dynamical system, while Section 7 compares the levels of income and social welfare obtained in the different steady state equilibria. Finally, section 8 concludes and discusses some policy proposals.

2 The static model

We consider an overlapping generations model, where economic activity takes place over infinite and discrete time. In this section we describe the game played by each generation. The population is a continuum of individuals of mass 1. A proportion $q \in [0,1)$ of the individuals are of entrepreneurial type, and the rest, $(1-q) \in (0,1]$, are of non-entrepreneurial type. These two types, denoted by E (entrepreneurs) and N (non-entrepreneurs), are differentiated by their preferences, explained below. The proportion of individuals of each type evolves over generations, according to the dynamics explained in Section 4.

A proportion $\alpha \in [0,1]$ of the non-entrepreneurial individuals work as civil servants. The rest of non-entrepreneurial individuals $(1-\alpha) \in [0,1]$ work in the traditional sector with a fixed payoff. The civil servants perform an activity involving a costly effort that is necessary for the entrepreneurs' risky activity to be successful. The incentives to exert this effort depend on the wage paid to the civil servants and this wage is collected through taxes.

The timing of each generation's game is as follows. First, the taxation rate

$\tau \in [0,1]$ is decided by majority voting. After voting, the entrepreneurial individuals start their business and the non-entrepreneurial individuals find a job in either the public or the traditional sector. Then, the civil servants decide on the amount of effort they will exert. Finally, all agents receive the payoffs.

2.1 Payoffs

Entrepreneurship is a risky activity. The entrepreneurs' success depends on the effort the civil servants exert. For the sake of simplicity we consider that the effort $e \in [0,1$ of the civil servants is the probability of success of the risky activity. This effort has an associated cuadratic cost, $c(e) = \frac{\beta e^2}{2}$, $\forall e \in [0,1]$. We measure the efficiency of the Administration in terms of the civil servants' effort. The greater this effort, the more efficient the Administration, since the conditions for the entrepreneurial activity are better.

The income from the risky activity is $H > 0$ in case of success and zero in case of failure. The expected gross income of the risky activity is $\pi = eH$. Therefore, H can also be interpreted as the productivity of the entrepreneurial sector. In section 4 it will be assumed that productivity H changes along time, influenced by the current proportion of entrepreneurs. The traditional sector workers will receive a fixed monetary payoff denoted by $R > 0$.

For simplicity, we consider that only entrepreneurs' incomes are taxed. The public budget is balanced: what the entrepreneurs pay is what the civil servants receive as wages. Taxes τ are a proportion of entrepreneurs' incomes. We assume that the collected taxes, $\tau\pi q$, are divided equally among all the civil servants, so each civil servant receives $\frac{\tau\pi q}{(1-q)\alpha}$ as a wage. Hence, the wages for civil servants depend on three factors: (i) the level of taxes τ, (ii) the level of expected profits π which, in turn, depends on their own level of effort and on the productivity H (i.e. $\pi = eH$), and (iii) the ratio of entrepreneurs to civil servants $\frac{q}{(1-q)\alpha}$.

Therefore, the expected monetary payoff of an entrepreneur y_E is his net income after paying taxes as described by equation (1). A civil servant's payoff y_C will be his wage minus the cost of effort as in equation (2):

$$y_E = (1-\tau)\, He, \quad (1)$$

$$y_C = \frac{\tau q H}{(1-q)\alpha} e - c(e) \quad (2)$$

The expected monetary payoff of a non-entreprepreneurial individual is given by $y_N = \alpha y_C + (1-\alpha)R$, where y_C and R are the payoffs as civil servants and routine producers, respectively.

2.2 Preferences

Entrepreneurial traits determine the individuals' type, which is an acquired characteristic derived from the socialization process. In Section 4 we explain in detail how these traits are transmitted.

Entrepreneurial individuals positively value the participation in a risky activity and obtain a psychological payoff denoted by $\gamma > 0$. This nonpecuniary benefit may correspond to social status, the satisfaction of starting your own business, the flexibility and autonomy of self-employment, etc. Moskowitz and Vissing-Jorgensen (2002) estimate that entrepreneurs nonpecuniary benefits amount on average to some 150% of the entrepreneur's annual income. The non-entrepreneurial individuals, in contrast, obtain a psychological disutility $\gamma > 0$ from undertaking a risky activity. This type of individuals has a negative view of things such as taking risks, not having a permanent job, etc.[9]

We use a simple kind of preferences to characterize the types E and N. In particular, we consider that the individuals have a linear utility function that depends on both the expected monetary payoff and on the nonpecuniary benefit they obtain for their activity:

$$\begin{aligned} U_E &= y_E + \gamma 1_E, \\ U_N &= y_N - \gamma 1_E \end{aligned}$$

where y_i, $i \in \{E, N\}$, denotes the expected monetary payoff and 1_E is the indicator function of entrepreneurial activity ($1_E = 0$ if the individual is type N and $1_E = 1$ if he is type E).

A priori, both types could choose to carry out either the risky or the non-risky activity. However, we consider that the individual's type determines the activity he chooses.

We assume that the wage in the traditional sector is low enough to allow the transmission and spread of entrepreneurial preferences, which requires that the payoff as a routine producer satisfies Assumption 1:

$$R < \frac{\gamma}{(1-\alpha)}. \qquad \text{(Assumption 1)}$$

If the wage R is too high, the entrepreneur parents do not have incentive to transmit their own preferences, as we will show in Section 5.

3 Equilibria within a generation

In this section, we characterize the Subgame Perfect Equilibria of the sequential game played in each generation. The game has two stages: in the first stage, the level of taxation is decided by voting and in the second, the civil servants choose the level of effort they will exert. To find the equilibria, we apply backward induction. First we obtain the levels of effort exerted by civil servants for any tax rate. We then calculate the tax rate that each type will vote anticipating these levels of effort.

[9] We assume that the two psychological payoffs are the same. That is, the utility of engaging in the risky activity for the entrepreneurs is the same as the disutility of this activity for the non-entrepreneurs. Although this assumption is not strictly necessary, it simplifies the process of obtaining and interpreting the results.

Let us analyze the civil servants' effort, which represents the efficiency of the Administration. The civil servants choose the effort that maximizes their payoff (2), $y_C = \frac{\tau q H}{(1-q)\alpha} e - \frac{\beta}{2} e^2$. We are interested in situations where the entrepreneurial activity will effectively be a risky activity with a non-null probability of failure. That is, the civil servants' effort will never be the corner solution, $e = 1$. In order to guarantee that the optimal effort is lower than one, $e < 1$, we assume that $lim_{e \to 1} \frac{\partial c(e)}{\partial e} = +\infty$. The following lemma characterizes the optimal level of effort exerted by civil servants for any tax rate.

Lemma 1 *The civil servants' optimal effort is given by*

$$e(\tau) = \tau \frac{qH}{(1-q)\alpha\beta} \in [0, 1).$$

Proof. See Appendix ■

The effort chosen by the civil servants increases with the tax rate τ, since they acquire a higher proportion of the entrepreneurs' profits. The civil servants' payoff will also increase if there is a high proportion q of entrepreneurs, as the proportion of taxpayers will increase. Finally, if the entrepreneurs' productivity H increases, the total amount of taxes collected will increase. In any of these three cases, the civil servants will be willing to make a greater effort because the increase in their wage will compensate for the higher associated cost.

On the other hand, if the proportion of civil servants α increases, the number of recipients also increases: each civil servant receives a smaller fraction of the collected taxes. Therefore, the optimal effort will fall. Likewise, if the cost of the effort, β increases the civil servants' level of effort will also fall.

Second, we analyze the results of the voting process on taxes. Each type votes the tax rate that maximizes his payoff, anticipating the optimal effort exerted by civil servants. Particularly, the non-entrepreneurs vote for the tax rate $\tau \in [0, 1]$ which maximizes their expected payoff $y_N = \alpha y_C + (1 - \alpha)R$. This payoff is increasing with τ and, consequently, the non-entrepreneurs vote for $\tau = 1$. As it can be expected, the non-entrepreneur individuals vote for the maximum level of taxes, that is, confiscatory taxes. On the other hand, the entrepreneurs choose the tax rate that maximizes $y_E = (1 - \tau)\pi = \frac{\tau q H^2 (1-\tau)}{(1-q)\alpha\beta}$. This payoff has a maximum in $\tau = 1/2$.

Lemma 2 *The non-entrepreneurs vote for the tax rate $\tau = 1$, and the entrepreneurs vote for $\tau = 1/2$.*

Notice that entrepreneurs do not vote for $\tau = 0$, since they are aware that some public income is required to finance an Administration which will set up the rules to develop their business. Entrepreneurs face a trade-off: high taxes mean that they appropriate a low proportion of income but it also means that the efficiency of the Administration is high. Consequently, the expected profits can be high. Due to the specific functional forms of the model, they optimally vote for a rate $\tau = 1/2$.

There are two equilibria in the game played by each generation, depending on which of the two types is prevalent in the population. The majority type will decide the taxation rate and, therefore, will determine the level of effort the civil servants exert and the payoffs obtained by each type.[10] The next proposition presents the results.

Proposition 1 *There are two possible equilibria within a generation:*
1. Equilibrium if non-entrepreneurs are the majority, $q < 1/2$, characterized by:

$$\begin{array}{l} \text{a tax rate } \tau = 1, \\ \text{a level of effort } e = \frac{qH}{(1-q)\alpha\beta}, \\ \text{a civil servant monetary payoff } y_C = \frac{q^2H^2}{2(1-q)^2\alpha^2\beta}, \\ \text{an entrepreneurial monetary payoff } y_E = 0. \end{array} \quad (3)$$

2. Equilibrium if entrepreneurs are the majority, $q \geq 1/2$, characterized by:

$$\begin{array}{l} \text{a tax rate } \tau = 1/2, \\ \text{a level of effort } e = \frac{qH}{2(1-q)\alpha\beta}, \\ \text{a civil servant monetary payoff } y_C = \frac{q^2H^2}{8(1-q)^2\alpha^2\beta}, \\ \text{an entrepreneurial monetary payoff } y_E = \frac{qH^2}{4(1-q)\alpha\beta}. \end{array} \quad (4)$$

Proof. The individuals of the majority win the vote on taxes and, in this way, determine the effort values. Once the tax rate and the effort have been established, the payoffs for both types are determined by equations (1) and (2). ■

Therefore, if the non-entrepreneurs win the taxation voting process, taxes will be confiscatory and the entrepreneurs' monetary payoff will be null. Notice that in this case entrepreneurs receive only their psychological payoff. If the entrepreneurs win the vote, taxes will be lower and the monetary profits from entrepreneurship will be shared between the entrepreneurs and the Public Administration.

Figure 1 shows the relation in equilibrium between the proportion of entrepreneurs and the efficiency of the Administration. A generation with a low proportion of entrepreneurs, $q < 1/3$, will have a low performance Administration and, conversely, a generation with a high proportion of entrepreneurs, $q > 2/3$, will have a high performance Administration. Curiously, a generation with a balanced proportion of entrepreneurs, $q \in$ close to $1/2$, will have a more efficient Administration if the non-entrepreneurs are in majority than otherwise. The reason is that when non-entrepreneurs are in the majority, taxes are confiscatory ($\tau = 1$) and civil servants' wage and effort are increasing in taxes.

[10] Notice that in general the equilibria will be determined by the type of the decisive political agent and the latter might not coincide with the majority type, the median voter (see Przeworski, 2015, "Economic Inequality, Political Inequality, and Redistribution." Draft. Department of Politics. New York University.).

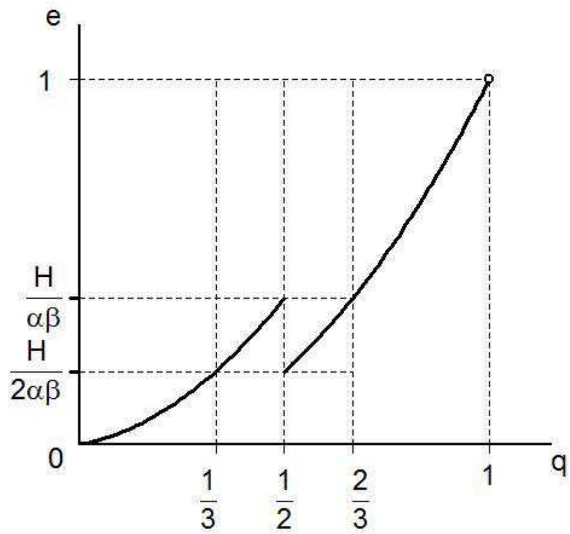

Figure 1: Relation between the proportion of entrepreneurs and the Administration efficiency

4 The evolution of preferences and productivity

As mentioned in previous sections, we consider an overlapping generations model where economic activity takes place over infinite and discrete time. Namely, both the proportion of entrepreneurial individuals in the population q_t and the productivity of the entrepreneurial sector H_t change across generations (the subscript denotes the generation t). Our setting is a two-speed dynamic model. Changes in preferences and productivity are gradual over time, while changes in behavior are instantaneous to maintain equilibrium play. In each generation individuals coordinate in a perfect Bayesian equilibrium of the generation game and assuming adaptive expectations, they believe that this equilibrium will be played by the next generation.

The evolution of an economy, its intergenerational change, is determined by two dynamics: the dynamics of the proportion of individuals with entrepreneurial preferences in the population and the dynamics of the entrepreneurial sector productivity.

4.1 Evolution of the distribution of preferences

We draw from the model of cultural transmission by Bisin and Verdier (2001b) which is the economic version of the anthropological model by Cavalli-Sforza and Feldman (1981). The type of an individual (i.e. entrepreneur or not) will be an acquired trait derived from the socialization process. Individuals will live through two periods: as children and as adults. During their childhood, each individual's preference (to become an entrepreneur or a non-entrepreneur), is shaped by both his parents and the society at large. As an adult, he enters the labor market and becomes part of the productive economy in his generation's game.

Each adult has one child in the second period of his life and tries to transmit the values or preferences that he believes are the most valuable. Therefore each adult makes a decision on a costly socialization effort to influence his child's preferences.

Let $d_t^i \in [0, 1)$ be the socialization effort made by a parent of type i at generation t, $i \in \{E, N\}$. Socialization occurs in two steps. A child is first directly exposed to the parent's preferences and is socialized to these preferences with probability d_t^i (vertical transmission). If this direct socialization is not successful, with probability $1 - d_t^i$, she is socialized to the preferences of a role model picked at random in the population (oblique transmission). The transition probabilities P_t^{ij} that a parent of type i will have a child of type j, if the proportion of entrepreneurs is q_t, are given by the set of equations (5):

$$\begin{aligned} P_t^{EE} &= d_t^E + (1 - d_t^E)q_t \\ P_t^{EN} &= (1 - d_t^E)(1 - q_t) \\ P_t^{NN} &= d_t^N + (1 - d_t^N)(1 - q_t) \\ P_t^{Ne} &= (1 - d_t^N)q_t. \end{aligned} \tag{5}$$

Given the transition probabilities P_t^{ij}, the proportion q_{t+1} of entrepreneurs in period $t + 1$ is described in equation (6) and the dynamic evolution of the distribution of preferences is given by the equation on differences (7):

$$q_{t+1} = q_t + q_t(1 - q_t)(d_t^E - d_t^N), \tag{6}$$

$$\Delta q_t = q_t(1 - q_t)(d_t^E - d_t^N). \tag{7}$$

A long-run equilibrium (steady state of the dynamics) is a situation in which the proportion of entrepreneurs remains constant over time, $\Delta q_t = 0$. This can occur for two reasons. First, in a trivial way, because the society is made of a single type ($q_t = 0$ or $q_t = 1$), although these solutions lack interest because they are not stable. Second, because the socializing efforts of the two types are balanced, $d_t^E - d_t^N = 0$. In this case, the distribution of preferences among the population remains stable.

Notice that the proportion of entrepreneurs will increase from one generation to another if, and only if, the socializing effort of the entrepreneur parents is greater than that of the non-entrepreneur parents (equation 8). Likewise, the proportion of entrepreneurs will fall if, and only if, the socializing effort of the entrepreneur parents is lower than that of the non-entrepreneur parents (equation 9).

$$\Delta q_t > 0 \Longleftrightarrow d_t^E - d_t^N > 0 \tag{8}$$

$$\Delta q_t < 0 \Longleftrightarrow d_t^E - d_t^N < 0 \tag{9}$$

4.1.1 Parents' choice of socialization effort

Parents are imperfect altruists towards their children, according to the notion of "imperfect empathy" described by Bisin and Verdier (2001). That is, they are concerned about their children's welfare, but they evaluate the utility that their children will receive through the lens of their own preferences. We denote V^{ij} the utility a type i parent assigns to a child of type j. This utility will depend on the expectation about the distribution of preferences in the next generation. We will assume that parents have adaptive or backward-looking expectations, believing that the proportion of entrepreneurs will be the same in the next generation as in the current generation.

The socializing effort has a cost: parents have to invest in their children's education, spend time with them, choose the appropriate neighborhood or school, etc. For the sake of simplicity, we consider that the cost is quadratic $c(d_t^i) = \frac{k(d_t^i)^2}{2}$, with $k > 0$, even though the results are qualitatively identical with any increasing convex function. The parents will choose the socializing effort d_t^i at generation t that maximizes the expected utility for the child given the cost (equation 10):

$$\max_{d_t^i} \{P_{tt}^{ii} V^{ii} + P_t^{ij} V^{ij} - c(d_t^i)\}. \tag{10}$$

The first order condition for the solution of (10) is shown in equation (11):

$$\frac{\partial P_t^{ii}}{\partial d_t^i} V^{ii} + \frac{\partial P_t^{ij}}{\partial d_t^i} V^{ij} = k d_t^i. \tag{11}$$

Differentiating the transition probabilities in (5) and substituting in the first order condition (11), we obtain the parents' socialization efforts (equation 12 ans 13):

$$d_t^E = \frac{1}{k}\left(V^{EE} - V^{EN}\right)(1 - q_t) \tag{12}$$

$$d_t^N = \frac{1}{k}\left(V^{NN} - V^{NE}\right) q_t. \tag{13}$$

Hence, parents socialize their children according to their value of cultural assimilation $\Delta V^i = V^{ii} - V^{ij}$. This value of cultural assimilation is the net gain from socializing your child to your own preferences.[11]

Finally, we see how optimal socialization efforts vary according to the distribution of types: $\frac{\partial d_t^E}{\partial q_t} = -\frac{1}{k}\Delta V^E < 0$ and $\frac{\partial d_t^N}{\partial q_t} = -\frac{1}{k}\Delta V^N > 0$ for $\Delta V^i > 0$. That is, the more individuals of a type there are in the society, the lower the effort these parents invest in vertical socialization. Since oblique socialization is not costly, the parents of the predominant type can trust that their children will

[11] In order to guarantee $d_t^i \in [0, 1)$, a sufficient condition is $k > \max\{\Delta V^E, \Delta V^N\}$ i.e., the marginal cost of effort 1 is greater than the value of cultural assimilation. In that case, the marginal cost for parents to ensure that their child acquires the same preferences as their own is too high.

be socialized toward their own type by other individuals in the society. This is a standard property of the Bisin and Verdier (2001) model of transmission of preferences.

Hereafter, to simplify the notation, we do not include this auxiliary parameter k, although it should be remembered that it is implicit in the formulas. When $d_t^E - d_t^N$ is written, one should actually read $k\left(d_t^E - d_t^N\right)$.

4.2 Evolution of productivity in the entrepreneurial sector

In our model not only the distribution of preferences, but also the productivity of the entrepreneurial sector, varies over time. Namely, we assume that in each period the entrepreneurs' productivity H_t depends both on the proportion of entrepreneurs in the population and on the productivity in the previous period, formally:

$$H_{t+1} = (1 + g(q_t))H_t. \tag{14}$$

The proportion of entrepreneurs in the economy might have two different effects on technological advancement and productivity: a direct effect and a an effect through heterogeneity. There is a direct positive effect: the simple presence of more entrepreneurs will positively affect technological advancement; there are spillovers between nascent firms that favour entrepreneurship. Additionally, following Ashraf and Galor (2011), we consider a second determinant for technological advancement: the population heterogeneity. In their model, the population is divided between conformist and nonconformist types. These authors suggest that increases in productivity occur as a tension between cultural assimilation of the existing technological paradigm (due to the existence of conformists) and cultural diffusion (due also to the existence of nonconformists). The cultural assimilation enables the economy to function closer to the production-possibility frontier of the existing technological paradigm. However, cultural diffusion stimulates the likelihood of emergence of new attitudes and ideas favouring the adaptability of society to a new technological paradigm and thereby advancing an economy's technological frontier.

In our model, we assume that the increase of productivity at the entrepreneurial activity requires some balance between entrepreneurs and non-entrepreneurs. A larger fraction of entrepreneurs enhances productivity by contributing to knowledge creation, and a larger fraction of non-entrepreneurs favours the society's ability to transmit its society-specific human capital from one generation to the next and to operate closer to the frontier.

A further reason for the importance of heterogeneity of types is that innovations need a minimum institutional structure in order to become incorporated into the production process. There can be no technological progress if, for instance, nobody registers the patents, resolves legal disputes, or enforces contracts. A minimum proportion of civil servants is needed for technological advancement to occur.

To combine these three effects on technological advancement, we consider a generic differentiable function $g(q_t)$ (given by (15) and (16)), symmetrical with respect to its maximum in $q_t = 1/2$, with a critical value ε that determines both the minimum proportions of entrepreneurs and the minimum proportions of non-entrepreneurs needed for technological advancement to occur and for this technological advancement to be transformed into increased productivity:

$$g(q_t) \begin{cases} > 0 & \text{if} \quad \varepsilon < q_t < 1 - \varepsilon, \\ = 0 & \text{if} \quad q_t = \varepsilon \text{ or } q_t = 1 - \varepsilon, \\ < 0 & \text{if} \quad 0 < q_t < \varepsilon \text{ or } 1 - \varepsilon < q_t < 1, \end{cases} \tag{15}$$

$$\frac{\partial g(q_t)}{\partial q_t} \begin{cases} > 0 & \text{if} \quad 0 < q_t < 1/2, \\ = 0 & \text{if} \quad q_t = 1/2, \\ < 0 & \text{if} \quad 1/2 < q_t < 1. \end{cases} \tag{16}$$

Notice that the symmetry of $g(q_t)$ captures the assumption that the effect of the presence of entrepreneurs and of civil servants on technological advancement are equivalent. Although the qualitative results do not change, the analysis is greatly simplified. We assume for technical reasons that $\varepsilon > 1/3$.[12]

5 The dynamic model: coevolution of entrepreneurial preferences and productivity

The equilibria within a generation depends on the productivity of the entrepreneurial sector and the distribution of preferences among the population (which determines the tax rate and indirectly, the Administration efficiency). But as described in the previous section, these two former factors evolve over time and influence each other.

A schematic illustration of the whole dynamic setting is presented in Figure 2. The state variables of the dynamics are the proportion of entrepreneurs in the population, q_t, and the entrepreneurial productivity H_t in period t. The game played by each generation is consequently characterized by a pair (q_t, H_t). These two variables, jointly with the taxes decided through the voting process, determine the wage of the civil servants and the level of effort they exert, that is, the efficiency of the Administration, which is also the probability of success of the risky entrepreneurial activity. This probability of success with the proportion of entrepreneurs q_t and the entrepreneurial productivity H_t, together determines the monetary income obtained by both types in the population: entrepreneurs and non-entrepreneurs. The different types' revenues, together with the psychological payoff, determine the adults' direct socialization incentives, since they affect the net gains for transmitting your own preferences. Finally, the effect of

[12] Various functions g are therefore valid. For example, we can consider that the effect of heterogeneity behaves as in Ashraf and Galor (2011), according to the form $(1-q_t)$, and that the competition effect (business stealing effect) is quadratic in the number of entrepreneurs aq_t^2 whereas the positive direct effect of the presence of entrepreneurs is linear $a - q_t b$, with a and b being small enough for the dominant effect to be a mixture of types. Thus, technological advancement will be $g(q_t) = q_t(1-q_t) - aq_t^2 + aq_t - b = (1-a)q_t(1-q_t) - b$. This function g satisfies the conditions in equations (15) and (16).

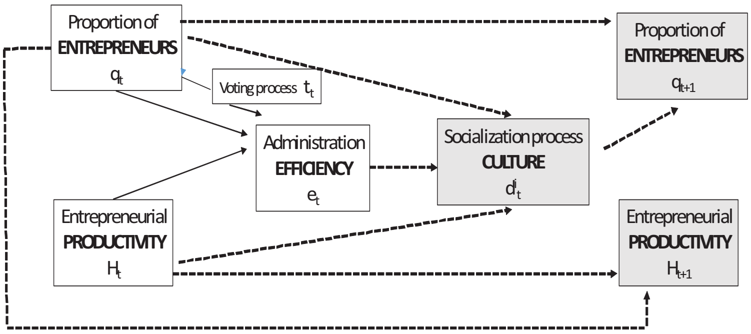

Figure 2: The dynamical links between proportion of entrepreneurs, productivity, Administration efficiency and socialization process

both these direct transmission incentives and the oblique transmission of preferences, captured by the current distribution of preferences q_t, leads to the next generation's proportion of entrepreneurs q_{t+1}. At the same time, the proportion of entrepreneurs (q_t) and entrepreneurial productivity (H_t) lead to the next generation's level of productivity H_{t+1}.[13]

Formally, the coevolution of the distribution of preferences and the entrepreneurial productivity is described by the coupled differences equation system (17):

$$\begin{cases} q_{t+1} = q_t + q_t(1 - q_t)(d_t^E - d_t^N), \\ H_{t+1} = (1 + g(q_t))H_t. \end{cases} \tag{17}$$

The global analysis of the evolution of the economy is based on the phase diagram that describes the evolution of the system in the (q_t, H_t) space. This analysis requires to characterize the HH demarcation curve which denotes the set of all pairs (q_t, H_t) for which the productivity is constant; the qq demarcation curve which denotes the set of pairs (q_t, H_t) for which the distribution of entrepreneurial preferences is constant; and the forces that operate in the system when variables are not constant.

First, we focus on the dynamics of the productivity in the entrepreneurial sector. The results are offered in Lemma 3, and Figure 3 illustrates graphically these dynamics.

Lemma 3 *The dynamics of productivity with respect to the HH demarcation curve are given by*

$$\Delta H_t = H_{t+1} - H_t \begin{cases} > 0 & \text{if} \quad \varepsilon < q_t < 1 - \varepsilon, \\ = 0 & \text{if} \quad q_t = \varepsilon \text{ and } q_t = 1 - \varepsilon, \\ < 0 & \text{if} \quad 0 < q_t < \varepsilon \text{ or } 1 - \varepsilon < q_t < 1, \end{cases}$$

where $q_t = \varepsilon$ and $q_t = 1 - \varepsilon$ are the HH locus.

[13] These two last dynamic interactions are given by equations (6) and (14) and are illustrated in Figure 2 through the arrows addressed to q_{t+1} and H_{t+1}.

Proof. See Appendix ■

The properties of the HH demarcation curves follow directly from our assumptions on the dynamics of productivity. The HH locus, as depicted in Figure 3, are two vertical lines at $q_t = \varepsilon$ and $q_t = 1 - \varepsilon$. The directional arrows indicate the intertemporal movement of H_t. The productivity grows over time when there exists a balanced proportion of entrepreneurs, civil servants and individuals working on the traditional sector (formally, between $q_t = \varepsilon$ and $q_t = 1-\varepsilon$). However the productivity falls if (i) the proportion of entrepreneurs has not reached a critical mass where new ideas can advance (on the left of the locus $q_t = \varepsilon$), or (ii) there are not enough civil servants, because a minimum of bureaucracy is necessary for the success of entrepreneurship (on the right of $q_t = 1 - \varepsilon$).

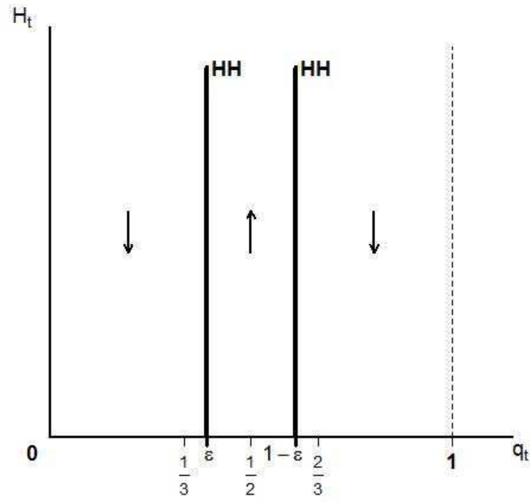

Figure 3: The dynamics of the entrepreneurial productivity

Second, we turn to the dynamics of the distribution of entrepreneurial preferences. The results are presented in the Lemma 4, and Figure 4 illustrates graphically these dynamics.

Lemma 4 *The dynamics of the distribution of preferences with respect to the qq demarcation curve are*
(i) if non-entrepreneurs are majority, $q_t < 1/2$:

$$\Delta q_t = q_{t+1} - q_t \begin{cases} < 0 & if \quad q_t < \tilde{q}(H_t) \\ = 0 & if \quad q_t = \tilde{q}(H_t) \\ > 0 & if \quad q_t > \tilde{q}(H_t), \end{cases}$$

where $\tilde{q}(H_t)$ *denotes the qq locus which is decreasing in* H_t *and solves* $H_t^2 = (\gamma\,(1-2\;\tilde{q}_t) - (1-\alpha)\,R)\,\frac{2(1-\tilde{q}_t)^2\alpha\beta}{\tilde{q}_t^2}$;
(ii) if entrepreneurs are majority, $q_t \geq 1/2$:

$$\Delta q_t = q_{t+1} - q_t \begin{cases} > 0 & \text{if} \quad q_t < \bar{q}(H_t) \\ = 0 & \text{if} \quad q_t = \bar{q}(H_t) \\ < 0 & \text{if} \quad q_t > \bar{q}(H_t), \end{cases}$$

where $\bar{q}(H_t)$ *denotes de qq locus which is increasing in* H_t *and solves* $H_t^2 = (\gamma\,(1-2\;\bar{q}) + (1-\alpha)\,R)\,\frac{8(1-\;\bar{q})^2\alpha\beta}{(2-3\bar{q})\bar{q}}$.

In Figure 4, we can see the direction of changes in the proportion of entrepreneurs for different values of H_t and q_t. The qq demarcation curve is the locus of all pairs (q_t, H_t) for which the proportion of entrepreneurs q_t is in a stationary stat (i.e. $q_{t+1} - q_t = 0$). The arrows show the direction of intergenerational change.

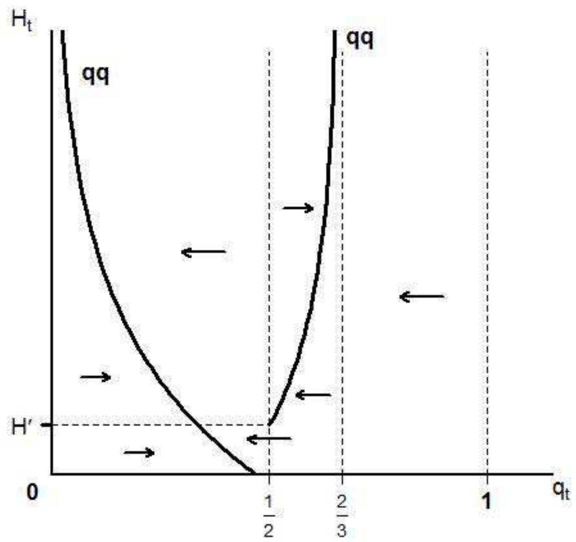

Figure 4: The dynamics of the proportion of entrepreneurs

The dynamics of the proportion of entrepreneurs is crucial in our work so we are going to explain it in detail. As described in the previous Lemma and depicted in Figure 4, the qq demarcation curve consists of two segments: a downward sloping function in the region $q_t < 1/2$ and an upward sloping function in the region $q_t \geq 1/2$. To obtain the qq demarcation curve, we first calculate the parents' socialization effort. According to equations (8) and (9), if the socialization effort of entrepreneurial parents is greater than the effort of non-entrepreneurial, the proportion of entrepreneurial individuals will increase from one generation to another. Along the locus qq the socialization efforts are equal for both types, $d_t^E - d_t^N = 0$. Recall that the optimal socialization efforts are given by (see equations (12) and (13)):

$$\begin{aligned} d_t^E &= \frac{1}{k}\Delta V^E(1-q_t) \\ d_t^N &= \frac{1}{k}\Delta V^N q_t. \end{aligned}$$

Specifically, the parents' socialization effort depends on both the probability of oblique transmission and the value that parents confer to have a child of their own type instead of the other type (ΔV^E and ΔV^N). These values of cultural assimilation are computed in the appendix and are presented here to facilitate the explanation.

The level of cultural assimilation for the different types depends on the fiscal regime which is decided by the majority type in the population. In a non-entrepreneurial economy ($q_t < 1/2$), where the majority of non-entrepreneurs vote for confiscatory taxes $\tau = 1$, the values are:

$$\begin{aligned} \Delta V^E &= \gamma - y^N \rightarrow \Delta V^E = \gamma - \left[\alpha y^C - (1-\alpha)R\right] \\ \Delta V^N &= \gamma + y^N \rightarrow \Delta V^N = \gamma + \left[\alpha y^C - (1-\alpha)R\right], \end{aligned}$$

with $y_C = \frac{q^2H^2}{2(1-q)^2\alpha^2\beta}$.

Notice that $\Delta V^N > \Delta V^E$, that is, the value of cultural assimilation and therefore the incentives for direct socialization are always higher for nonentrepreneurs than for entrepreneurs. The intuition behind this result is quite obvious: non-entrepreneurs hold up all the profits from entrepreneurship through confiscatory taxes and receive them as civil servants' income. Nevertheless, given assumption 1 ($R < \frac{\gamma}{1-\alpha}$), either for low values of the level of entrepreneurship q_t or of entrepreneurial productivity H_t, the income of civil servants will also be very low and so will be the difference $\Delta V^N - \Delta V^E$. On the other hand, non-entrepreneurs trust on oblique transmission and will exert a low socialization effort, while the minority of entrepreneurs will try to compensate the effects of oblique transmission with an increased socialization effort. As a result, for low values of q_t or H_t, the optimal socialization effort of the entrepreneurs d_t^E will be higher than the one of non-entrepreneurs d_t^N, and the share of entrepreneurship preferences will increase in the next generation. For the rest of the non-entrepreneurial region, oblique transmission is not strong enough to compensate for the increasing difference, both in q_t and H_t, on the values of cultural assimilation $\Delta V^N - \Delta V^E$. All the previous discussion explains the directional arrows on Figure 4 for $q_t < 1/2$.

Let us next switch to an entrepreneurial economy ($q_t \geq 1/2$) where the majority of entrepreneurs vote for nonconfiscastory taxes $\tau = 1/2$. The values of cultural assimilation are now given by:

$$\begin{aligned}\Delta V^E &= \gamma + \left[y^E - y^N\right] \rightarrow \Delta V^E = \gamma - (1-\alpha)R + \left[y^E - \alpha y^C\right], \\ \Delta V^N &= \gamma - \left[y^E - y^N\right] \rightarrow \Delta V^N = \gamma + (1-\alpha)R - \left[y^E - \alpha y^C\right],\end{aligned}$$

with $y_C = \frac{q^2 H^2}{8(1-q)^2 \alpha^2 \beta}$ and $y_E = \frac{qH^2}{4(1-q)\alpha\beta}$.

Notice that $\Delta V^E > \Delta V^N$ if and only if $y^E > y^N$. It is easy to check that for high values of q_t the monetary payoff for a non-entrepreneur is greater than the one obtained by an entrepreneur, that is (i.e. $y^N > y^E$). The reason is that in an economy with high levels of entrepreneurship (a high q_t), the few existing civil servants share half of the aggregate profits from entrepreneurship, which are collected through taxes, obtaining very high wages. Moreover, for high values of q_t, oblique transmission also favors the spread of nonentrepreneurial preferences.

For low values of the proportion of entrepreneurs q_t, the relation between $y^E$and y^N and the relative incentives for socialization depend on the level of entrepreneurial productivity H. Let us denote as H' the value of H that equalizes y^E and y^N when $q = 1/2$. Straightforward calculation yields that H' is the solution to $H^2 = 8(1-\alpha)\alpha\beta R$. Therefore, for low levels of productivity, namely, $H < H'$, we have that $y^N > y^E$ for values of q_t close to 1/2, and thus the socialization effort of non-entrepreneurs will be higher than that of entrepreneurs, leading to a decrease in the level of entrepreneurship q_t. But for high enough levels of productivity, $H \geq H'$, and q_t close to 1/2, the income obtained by entrepreneurs will be higher than the income obtained by individuals of the non-entrepreneur type. Consequently, d_t^E will be higher than d_t^N, resulting in an increase in the next generation's proportion of entrepreneurs. Intuitively, only if the productivity of entrepreneurship H is sufficiently high, entrepreneur parents will have stronger incentives to socialize their children than the incentives nonentrepreneurial parents have.

The next step is to obtain the steady state equilibria of the dynamical system (17) which are characterized by the intersections between the qq demarcation curve and the HH demarcation curve.

6 Long run equilibria across generations

Equilibria in the long run are the stable steady states of the dynamical system. The population preferences distribution and the entrepreneurial sector productivity will remain constant over generations. Individuals play according to the equilibrium of the generation game characterized in Section 3.

In Figure 5 we represent the phase diagram of the coupled differences equation system and the steady state equilibria. The qualitative phase diagram analysis yields that there are two steady-state equilibria at the intersection points of the HH demarcation curve and the qq demarcation curve. Proposition 2 presents the results.

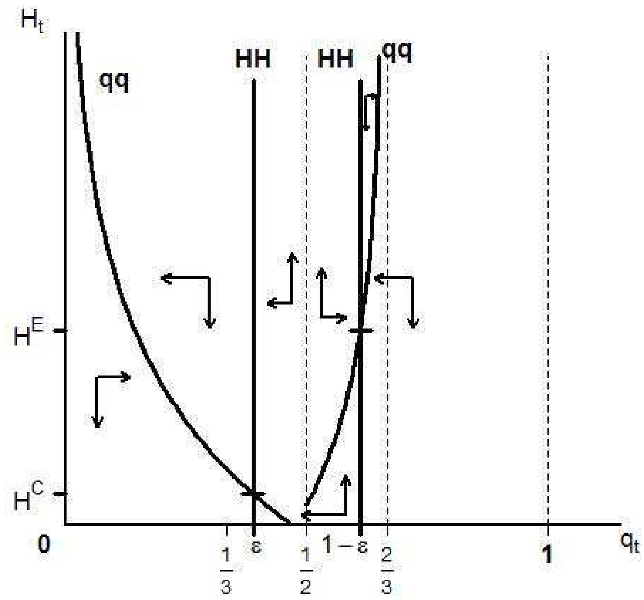

Figure 5: Steady state equilibria

Proposition 2 *The dynamical system (17) has two steady state equilibria, which are asymptotically stable:*
1. A traditional economy (q^c, H^c)*, with a majority of non-entrepreneurs and a tax rate* $\tau = 1$*, characterized by:*

$$\begin{cases} \text{a proportion of entrepreneurs } q^c = \varepsilon < 1/2 \\ \text{a level of productivity } H^c = \sqrt{(\gamma(1-2\varepsilon) - (1-\alpha)R)\frac{2(1-\alpha)^2\alpha\beta}{\varepsilon^2}}, \end{cases} \tag{18}$$

2. An entrepreneurial economy (q^e, H^e)*, with a majority of entrepreneurs and a tax rate* $\tau = 1/2$*, characterized by:*

$$\begin{cases} \text{a proportion of entrepreneurs } q^e = 1-\varepsilon > 1/2 \\ \text{a level of productivity } H^e = \sqrt{((1-\alpha)R + \gamma(1-2\varepsilon)\frac{8\varepsilon^2\alpha\beta}{(3\varepsilon-1)(1-e)}}. \end{cases} \tag{19}$$

Proof. See Appendix ■

We leave the details of the formal proof to the appendix and give a sketch of the main insights in the rest of this Section. First of all, notice from the phase diagram in Figure 5, that the basin of attraction of the steady state (q^c, H^c) is the set formed by all initial pairs (q_0, H_0) such that $q_0 < 1/2$ but also by pairs such that $q_0 \geq 1/2$ and $H_0 < H'$. The basin of attraction of the steady state (q^e, H^e) is the set formed by sufficiently high initial pairs (q_0, H_0), namely, $q_0 \geq 1/2$ and $H_0 \geq H'$.

The ultimate determinant of where the economy establishes in the long run is determined by the initial proportion of entrepreneurs and productivity. This fact explains persistence. If the economy starts with a low proportion q of entrepreneurs in the population, or with initial low levels of productivity H $(H < H')$, then it will get trapped in the long run in a traditional steady state equilibrium (q^c, H^c).

If non-entrepreneurs are the majority in the population they will vote and set confiscatory taxes. The proportion q_t can initially grow because the incentives for costly direct socialization are very low for type N parents. Nonetheless, the socialization effort of nonentrepreneurs d_t^N will eventually become greater than the effort of entrepreneurs d_t^E and the economy will get trapped in the traditional equilibrium. In this equilibrium, productivity is low and invariant and non-entrepreneurs are the majority in the population, $q^e = \varepsilon < 1/2$.

The economy will also converge to the traditional equilibrium even if the initial q_0 reflects a majority of entrepreneurs that vote for nonconfiscatory taxes but the entrepreneurial sector productivity is low, $H_0 < H'$. In this case, the productivity will initially grow, but the proportion of entrepreneurs will decrease given the higher incentives for socializing to non entrepreneur preferences. Eventually, the proportion q will fall below 1/2 and the non-entrepreneur type will become the median voter.

The persistence of high levels of entrepreneurship in an economy can also be explained by our results. If type E are the majority in the population $(q_t > 1/2)$ and the initial productivity is sufficiently high, the economy will settle down in an entrepreneurial equilibrium. Suppose that the economy starts with an entrepreneurial payoff that is sufficient to generate a greater socialization effort of E parents than the effort of N parents. That is, the economy starts above the qq locus in the region $q > 1/2$. As depicted in Figure 5, the socialization efforts will increase the proportion of entrepreneurial individuals and the steady state (q^e, H^e) will be reached. In this equilibrium there is a high level of productivity and a mix in the population with a high share of entrepreneurs, $q^e = 1-\varepsilon > 1/2$.

What are the deep determinants driving the convergence to one steady state equilibrium or the other? The introduction or not of confiscatory taxes in some generation. More precisely, if confiscatory taxes are set by some generation and maintained over time, then the economy converges to the traditional steady state. Alternatively, if nonconfiscatory taxes are implemented by all generations along the trajectory of the dynamics, then the economy converges to the entrepreneurial steady state. In order to see the intuition, let us consider that the same tax policy is implemented for any distribution of preferences in the population. For instance, if confiscatory taxes are set for any q_t in all periods, the upward sloping segment of the qq demarcation curve disappears in the new phase diagram and the traditional equilibrium with $q^c = \varepsilon < 1/2$ becomes the global attractor of the dynamics. That is, for any initial condition of the economy (q_0, H_0) the dynamical system converges to the steady state (q^c, H^c). Similarly, for a permanent nonconfiscatory tax policy $(\tau = 1/2)$, the downward sloping segment of the qq demarcation curve disappears in this phase diagram. Thus, the entrepreneurial equilibrium with $q^c = 1 - \varepsilon > 1/2$ becomes the global attractor of the dynamics. Obviously, an exogenous and permanent change in tax policy can move the economy from one steady state to the other. For instance, suppose that an economy is trapped in a traditional equilibrium because of a confiscatory tax policy. A permanent change to a nonconfiscatory tax policy will drive the economy to an entrepreneurial equilibrium with high levels of productivity and entrepreneurship.

7 Comparison of the traditional and entrepreneurial equilibria

In this Section, we compare the two steady states, focusing on the aggregate income of the economy, as well as the incomes obtained by entrepreneurs and non-entrepreneurs. That is, we will analyze the size and distribution of the aggregate welfare. We use the superscript e to denote the characteristics of the entrepreneurial economy, and the superscript c stands to denote those of the traditional economy at the steady state.

Proposition 3 *1. The Administration is more efficient in the entrepreneurial economy than in the traditional economy:* $e^e > e^c$.
2. Entrepreneurial sector productivity is higher in the entrepreneurial economy than in the traditional economy: $H^e > H^c$.
3. Civil servants' payoff is higher in the entrepreneurial economy than in the traditional economy: $y_C^e > y_C^c$.
4. Entrepreneurs' payoff is higher in the entrepreneurial economy than in the traditional economy: $y_E^e > y_E^c$.

Proof. See Appendix. ■

Thus, in the entrepreneurial equilibrium, the Administration is more efficient, entrepreneurial sector productivity is higher, and the entrepreneurs pay fewer taxes. In addition, payoffs are higher both for entrepreneurs and for civil servants. Since in the traditional sector the payoff R is always the same, per capita incomes are higher in the entrepreneurial equilibrium. Given the choice, both civil servants and entrepreneurs would prefer to be in an entrepreneurial economy. Thus Corollary 1 follows from Proposition 3.

Corollary 1 *Social welfare is higher in the entrepreneurial equilibrium than in the traditional equilibrium.*

The social welfare function is given by the aggregation of the income obtained by each type: $qy_E + (1 - q)(\alpha y_C + (1 - \alpha)R$. Therefore, it easily follows that social welfare is higher in the entrepreneurial economy.

Another issue is the distribution of this welfare among the different types of individuals in each steady state. In the traditional economy non-entrepreneurswill be better off than entrepreneurs because they appropriate all the profits generated by the entrepreneurial sector through confiscatory taxes. The opposite happens in the entrepreneurial equilibrium.

Proposition 4 *In the entrepreneurial economy, entrepreneurs have a higher payoff (i) than non-entrepreneurs:* $y_E^e > y_N^e$*, and (ii) than civil servants if the proportion of civil servants is high enough:* $y_E^e > y_C^e$ *if* $\alpha > \frac{1-\varepsilon}{2\varepsilon}$.

Proof. See Appendix ■

According to this proposition, entrepreneurs obtain a higher expected benefit than non-entrepreneurs in the entrepreneurial economy. This result is in line with the theory of social legitimation (Etzioni, 1987), according to which economies with more entrepreneurs create an environment that is more favorable to entrepreneurship. Notice additionally that, in the entrepreneurial economy, civil servants can have a higher income than entrepreneurs if the number of the former is sufficiently low, since public revenues are shared among a few officials. This second result in the previous proposition illustrates that in an entrepreneurial economy civil servants have to be very well paid. In fact, if the size of the public administration is small (a small α) then civil servants will get a higher monetary income than entrepreneurs. This explains the high levels of efficiency of the public administration in these economies and the high probability of success of risky entrepreneurship.

8 Concluding remarks and discussion

This paper presents a theory that explains the persistence of differences between levels of entrepreneurship across countries or regions. Empirical evidence shows that the ranking of countries by level of entrepreneurship does not change over the years for long periods of time (Thurik, 2007). Our model has shown that an economy can achieve two different long run equilibria. The first equilibrium is a "traditional economy" with fewer individuals with entrepreneurial traits than the "entrepreneurial economy", the second potential equilibrium. In the entrepreneurial equilibrium there is a majority of entrepreneurs in the population and a high level of productivity. The distribution of preferences does not change because the socialization efforts are equal for both types of individuals. The entrepreneur majority implements a tax policy that maximizes their expected profits by giving the appropriate incentives for effort to civil servants. The high net payoff obtained by the entrepreneurial activities provides strong incentives for cultural socialization to entrepreneurship preferences. But in this steady state there are also equally strong incentives for socialization to non-entrepreneur preferences, because the wage for civil servants (designed to sustain their high level of efficiency) is very high. The high levels of income obtained by entrepreneurs and civil servants are sustained by a stationary high level of productivity that corresponds to the balanced mix of types in the population with the lowest proportion of civil servants needed to avoid a decline in productivity.

In the traditional equilibrium there is a majority of non-entrepreneurs in the population and a low level of productivity. The non-entrepreneur majority implements a confiscatory tax policy. The socialization effort of entrepreneur parents and non-entrepreneur parents equalize in this steady state thanks to both oblique cultural transmission and the low income that can be obtained by routine producers (assumption 1). Both factors provide incentives for socialization effort to entrepreneurial preferences. Productivity is stationary but low because it is sustained by the balanced mix of types in the population with the lowest share of entrepreneurs needed to avoid a decline in productivity.

Social welfare is higher in an entrepreneurial economy. In line with studies that link entrepreneurship to economic growth, both the efficiency of the entrepreneurial sector and the per capita income will be higher in the entrepreneurial economy than in the traditional economy.

The main result of the study is that taxes on entrepreneurial profits are crucial to lead an economy towards either an entrepreneurial or a traditional equilibrium. The level of taxes, if decided by majority voting, depends on the proportion of entrepreneurs among the population. Due to the interdependence and the intertemporal reinforcement among taxes, Administration performance, productivity, and transmission of preferences, the economy gets trapped close to the initial situation.

Therefore, if individuals are forward-looking and are concerned about the welfare of future generations, they will try to implement some tax reform in order to drive the economy to an entrepreneurial economy. Namely, a coalition between entrepreneurs and civil servants could be formed to agree on a credible commitment to never set confiscatory taxes in the future and to compensate the short run losses for nonentrepreneurs with a subsidy. Obviously this intergenerational and interclass coalition suffers from the usual time-inconsistency problem. In other words, this commitment or promise is clearly noncredible. However, there are ways to establish credible commitments. For instance, constitutional limits on the tax rate policy and on the civil servants future wages can be established. Alternatively, another way to build credibility is the integration in a supranational organization (international club), for instance the European Union, where confiscatory taxes are not permitted. For different reasons, these mechanisms are very costly to reverse. In case of a constitutional reform, because it requires a qualified majority to do so. In case of the participation in an international club, because exit can be very costly in terms of losing the trading advantages obtained from being a member of the club.

Another mechanism of commitment that operates to guarantee the absence of confiscatory taxes is the degree of external openness of the economy. Notice that in our model a closed economy is implicitly assumed . But if the economy is open (and in particular if it belongs to a supranational economic region with free trade and free movement of persons and capital), then there will be an obvious restriction on the behavior of a non-entrepreneur majority that puts a limit on tax rates: talent and entrepreneurship can migrate to another country. These possible extensions of our model highlight again the crucial role played by taxes on the final long run equilibrium achieved by an economy.

Appendix

The time subscript has been removed in the proofs

Proof of Lemma 1

The civil servants chose the level of effort that maximizes their payoff $y_C = \frac{\tau q H}{(1-q)\alpha\beta} e - \frac{\beta}{2} e^2$. The first order condition is $\frac{\partial y_C}{\partial e} = \frac{\tau q H}{(1-q)\alpha} - \beta e = 0$ and the second order condition is $\frac{\partial^2 y_C}{\partial e^2} = -\beta < 0$, so $e = \frac{\tau q H}{(1-q)\alpha\beta}$ is a maximum. As we assume that $lim_{e\to 1} \frac{\partial c(e)}{\partial e} = +\infty$, the optimal effort is lower than one, $e < 1$.

Proof of Lemma 3

From (14), $\Delta H_t = H_{t+1} - H_t = g(q_t) H_t$. As H_t is the productivity of the entrepreneurial sector, it is positive. Therefore, the sign of ΔH_t is the same as that of $g(q_t)$ described by expression (15)

$$g(q_t) \begin{cases} > 0 & \text{if} \quad \varepsilon < q_t < 1 - \varepsilon \\ = 0 & \text{if} \quad q_t = \varepsilon \ or \ q_t = 1 - \varepsilon \\ < 0 & \text{if} \quad o < q_t < \varepsilon \ or \ 1 - \varepsilon < q_t < 1 \end{cases}$$

Proof of Lemma 4

We begin with the case $q_t < 1/2$ and we obtain de differences between socialization efforts and the demarcation curve.

(i) Non-entrepreneurs are majority, $q < 1/2$.

The difference between the socialization efforts of the two types of parents, if $q < 1/2$, is

$$\begin{aligned} d^E - d^N &= (1-q)\Delta V^E - q\Delta V^N = \Delta V^E - q\left(\Delta V^E + \Delta V^N\right) = \\ &= y_E - \alpha y_C - (1-\alpha)R + \gamma(1-2q). \end{aligned}$$

If $q < 1/2$, the payoffs are $y_C = \frac{q^2 H^2}{2(1-q)^2\alpha\beta}$, $y_E = 0$ (see Proposition 1), therefore

$$d^E - d^N = -\frac{q^2 H^2}{2(1-q)^2\alpha\beta} - (1-\alpha)R + \gamma(1-2q).$$

Concerning the demarcation curve $\tilde{q}(H)$, first we see that this $\tilde{q}(H)$ effectively exists and that is unique for each H. If $q < 1/2$, we have

$$d^E - d^N = \underbrace{-\frac{q^2 H^2}{2(1-q)^2\alpha\beta} - (1-\alpha)R}_{<0} + \underbrace{\gamma(1-2q)}_{>0}$$

and substituting for $q = 1/2$ and $q = 0$, the difference between socialization efforts results:

$$\begin{aligned} d^E - d^N\big|_{q=1/2} &= -\frac{H^2}{2\alpha\beta} - (1-\alpha)R < 0 \\ d^E - d^N\big|_{q=0} &= -(1-\alpha)R + \gamma > 0 \text{ under Assumption 1} \end{aligned}$$

As $d^E - d^N$ is continuous in $[0,1/2]$, $\exists \tilde{q} \in (0,1/2) : d^E - d^N = 0$, and therefore at this point $\Delta q_t = 0$.

In addition, $\frac{\partial \left(d^E - d^N\right)}{\partial q} = -\frac{qH^2}{(1-q)^3 \alpha\beta} - 2\gamma < 0, \forall \tilde{q} \in [0,1/2]$, therefore $d^E - d^N$ is decreasing in $[0,1/2]$. Therefore, this $\tilde{q} \in (0,1/2)$ is unique.

Let us show that $\tilde{q}(H)$ is decreasing in H :

$$\frac{\partial \tilde{q}}{\partial H} = -\frac{\frac{\partial \left(d^E - d^N\right)}{\partial H}}{\frac{\partial \left(d^E - d^N\right)}{\partial q}} = -\frac{-\frac{H^2}{\alpha\beta}\frac{1}{1-q} - 2\gamma}{-\frac{2q^2 H}{2(1-q)^2 \alpha\beta}} = -\frac{-}{-} < 0.$$

We can obtain the explicit form of $\tilde{q}(H)$ in this point, considering $\left(d^E - d^N\right) = 0$ in the above expression.

We follow with the case $q_t \geq 1/2$ and we also obtain de differences between socialization efforts and the demarcation curve.

(ii) Entrepreneurs are majority, $q \geq 1/2$.

The differences between socialization effort, considering (12) and (13) are:

$$\begin{aligned} d^E - d^N &= (1-q)\Delta V^E - q\Delta V^N = \Delta V^E - q\left(\Delta V^E + \Delta V^N\right) = \\ &= y_E - \alpha y_C - (1-\alpha)R + \gamma(1-2q) \end{aligned}$$

If $q \geq 1/2$, the payoffs are $y_C = \frac{q^2 H^2}{8(1-q)^2 \alpha^2 \beta}$, $y_E = \frac{qH^2}{4(1-q)\alpha\beta}$ (see Proposition 1), therefore

$$\begin{aligned} d^E - d^N &= \frac{qH^2}{4(1-q)\alpha\beta} - \alpha\frac{q^2 H^2}{8(1-q)^2 \alpha^2 \beta} - (1-\alpha)R + \gamma(1-2q) = \\ &= \frac{2-3q}{8(1-q)^2 \alpha\beta} qH^2 - (1-\alpha)R + \gamma(1-2q) \end{aligned}$$

Concerning the demarcation curve, we first see that this $\bar{q}(H)$ effectively exists, and that is unique for each H.

If $q > 1/2$, we have

$$d^E - d^N = \frac{2-3q}{8(1-q)^2\alpha\beta} qH^2 \quad \underbrace{-(1-\alpha)R + \gamma(1-2q)}_{<0}$$

If in addition $q < 2/3$:

$$d^E - d^N = \underbrace{\frac{2-3q}{8(1-q)^2\alpha\beta} qH^2}_{>0} \quad \underbrace{-(1-\alpha)R + \gamma(1-2q)}_{<0}$$

Substituting for $q = 1/2$ and $q = 2/3$ in this expression, we have that the difference between socialization efforts can be rewritten as:

$$\begin{aligned} d^E - d^N\big|_{q=1/2} &= \frac{H^2}{8\alpha\beta} - (1-\alpha)R > 0 \\ d^E - d^N\big|_{q=2/3} &= -(1-\alpha)R - \gamma/3 < 0 \end{aligned}$$

As $d^E - d^N$ is continuous in $[1/2, 2/3]$, $\exists \bar{q} \in (1/2, 2/3) : d^E - d^N = 0$, and therefore at this point $\Delta q_t = 0$.

In addition, $\frac{\partial\left(d^E - d^N\right)}{\partial q} = \frac{H^2(1-2q)}{8\alpha\beta(1-q)^3} - 2\gamma < 0 \, \forall q \in [1/2, 2/3]$, therefore $d^E - d^N$ is decreasing in $[1/2, 2/3]$. Therefore, this $\bar{q} \in (1/2, 2/3)$ is unique.

We now see that $\bar{q}(H)$ is increasing in H. From the Implicit Function Theorem, we have that

$$\frac{\partial \bar{q}}{\partial H} = -\frac{\frac{\partial\left(d^E - d^N\right)}{\partial H}}{\frac{\partial(d^E - d^N)}{\partial \bar{q}}} = -\frac{\frac{2(2-3q)qH}{8(1-q)^2\alpha\beta}}{\frac{H^2}{4\alpha\beta} \cdot \frac{1-2q}{(1-q)^3} - 2\gamma} = -\frac{-}{+} > 0.$$

To obtain the explicit form of $\bar{q}(H)$ in this point, we simply solve H^2 from $\left(d^E - d^N\right) = 0$.

Proof of Proposition 2

1. A traditional economy (q^c, H^c)

First, let us prove the existence and uniqueness of the equilibrium when $q < 1/2$.

If the equilibrium exists, it will be at the intersection of the qq and HH demarcation curves.The qq demarcation curve in the non-entrepreneur region is decreasing with respect to H and cross the axis $H = 0$ at $q = \frac{\gamma - (1-\alpha)R}{2\gamma}$, whereas the HH demarcation curve is perpendicular to the axis $q = 0$ at the point $q = \varepsilon$. Therefore, the qq demarcation curves and HH locus intersects if and only if $\varepsilon < \frac{\gamma - (1-\alpha)R}{2\gamma}$.

According to Lemma 4, $H^2 = (\gamma(1-2\varepsilon) - (1-\alpha)R)\frac{2(1-\varepsilon)^2\alpha\beta}{\varepsilon^2}$. In particular, $(\gamma(1-2\varepsilon) - (1-\alpha)R) > 0$, and $\varepsilon < \frac{\gamma-(1-\alpha)R}{2\gamma}$. The demarcation curves intersect at a unique point which is the equilibrium in the non-entrepreneur region (q^c, H^c) defined by

$$\begin{aligned} q^c &= \varepsilon \\ H^c &= \sqrt{(\gamma(1-2\varepsilon) - (1-\alpha)R\frac{2(1-\varepsilon)^2\alpha\beta}{\varepsilon^2}}. \end{aligned}$$

To analyze the stability of the solution, we can approximate the system (17) by linearization. That is, we approximate the non lineal system, around the critical points, through a lineal system with a matrix of constant coefficients equal to the Jacobian matrix evaluated at the critical points. We need the continuous version of the system (17) to calculate de Jacobian of the system

$$\begin{cases} \dot{q} = q(1-q)(d^E - d^N) \\ \dot{H} = g(q)H \end{cases} \tag{20}$$

By substitution of the entrepreneurs efforts $d^E - d^N$, we obtain the following equation system (19):

$$\begin{cases} \dot{q} = q(1-q)(-\frac{q^2H^2}{2(1-q)^2\alpha\beta} - (1-\alpha)R + \gamma(1-2q) \\ \dot{H} = g(q)H \end{cases}$$

The Jacobian of this system is:

$$J(q,H)=\begin{pmatrix} \frac{\partial \dot{q}}{\partial q} & \frac{\partial \dot{q}}{\partial H} \\ \frac{\partial \dot{H}}{\partial q} & \frac{\partial \dot{H}}{\partial H} \end{pmatrix} \tag{21}$$

$$\begin{aligned} \frac{\partial \dot{q}}{\partial q} &= \gamma(6q^2-6q+1)-(1-\alpha)R(1-2q)-\frac{H^2q^2(3-2q)}{2\alpha\beta(1-q)} \\ \frac{\partial \dot{q}}{\partial H} &= -\frac{Hq^3}{\alpha\beta(1-q)} \\ \frac{\partial \dot{H}}{\partial q} &= g\acute{(}q)H \\ \frac{\partial \dot{H}}{\partial H} &= g(q) \end{aligned} \tag{22}$$

Let us evaluate the Jacobian at the equilibrium point. At this point, according to Proposition 2, we have that $q^c=\varepsilon$, and that $H^c=\sqrt{(\gamma(1-2\varepsilon)-(1-\alpha)R)\,\frac{2(1-\varepsilon)^2\alpha\beta}{\varepsilon^2}}$. Additionally, $g(\varepsilon)=0$ from (15) and $g\acute{(}\varepsilon)>0$ from (16). Therefore,

$$J(J(\tilde{q},\tilde{H}))=\begin{pmatrix} 2(1-\alpha)R-2\gamma(1-\varepsilon-\varepsilon^2) & -\sqrt{\frac{\gamma(1-2\varepsilon)-(1-\alpha)R}{\alpha\beta}} \\ g\acute{(}q)H & 0 \end{pmatrix} \tag{23}$$

The equilibrium is asymptotically stable if $tr(J)<0$ and $\det(J)>0$. We have

$$\begin{aligned} tr(J(\tilde{q},\tilde{H})) &= 2(1-\alpha)R-2\gamma(1-\varepsilon-\varepsilon^2)+0<2(1-\alpha)R-\gamma(1-2\varepsilon)<0, \\ \det\ (J(\tilde{q},\tilde{H})) &= \sqrt{\frac{\gamma(1-2\varepsilon)-(1-\alpha)R}{\alpha\beta}}g'(q)H>0. \end{aligned}$$

As $tr(J)<0$ and $\det(J)>0$, the equilibrium in the non entrepreneur region (q^c,H^c) is asymptotically stable.

2. An entrepreneurial economy $(q^e,\ H^e)$.

Firstly, we check the existence and uniqueness of the equilibrium when $q\geq 1/2$. If the equilibrium exists, it will be at the intersection point of the qq and HH demarcation curves. The qq demarcation curve in the entrepreneur region is defined $\forall q\in(1/2,2/3)$, is increasing with respect to H and intersects the $H=0$ axis in $q=\frac{\gamma-(1-\alpha)R}{2\gamma}<1/2$. On the other hand, the HH demarcation curve is perpendicular to the $q=0$ axis at the point $q=(1-\varepsilon)$. Therefore, the qq and HH demarcation curves intersect if, and only if, $1-\varepsilon\in[1/2,2/3]$, what it is verified by the assumption that $\varepsilon>1/3$. Hence, these curves intersect at a unique point which is the equilibrium in the entrepreneurial region (q^e,H^e).

In order to analyze the stability of the solution, we can approximate the system (17) through linearization. That is, we approximate the non-linear system around the critical points through a lineal system with a matrix of constant coefficients equal to the Jacobian matrix evaluated at the critical points. We need the continuum version of the system (17), to calculate the Jacobian of the system. By substitution of the difference between entrepreneurial efforts obtained in Lemma 4, we obtain the following equations system:

$$\begin{cases} \dot{q}=q(1-q)(\frac{2-3q}{8(1-q)^2\alpha\beta}qH^2-(1-\alpha)R+\gamma(1-2q) \\ \dot{H}=g(q)H. \end{cases} \tag{24}$$

Calculating the Jacobian of this dynamical system, we obtain

$$\left\{\begin{array}{lll} \frac{\partial \dot{q}}{\partial q} & = & \frac{H^2 q(1-2q)(4-2q)}{8\alpha\beta(1-q)^2} - (1-\alpha)R(1-2q) - \gamma(1-6q+6q^2) \\ \frac{\partial \dot{q}}{\partial H} & = & -\frac{Hq^2(2-3q)}{4\alpha\beta(1-q)} \\ \frac{\partial \dot{H}}{\partial q} & = & g'(q)H \\ \frac{\partial \dot{H}}{\partial H} & = & g(q) \end{array}\right. \tag{25}$$

Let us evaluate the Jacobian at the equilibrium point (q^e, H^e). At this point, according to Proposition 2, we have that $q^e = 1-\varepsilon$, and that $H^e = \sqrt{(1-\alpha)R + \gamma(1-2\varepsilon)\frac{8\varepsilon^2\alpha\beta}{8\alpha\beta}}$. Additionally, $g(1-\varepsilon) = 0$ from (15), and $g'(1-\varepsilon) < 0$ from (16).

$$J(\bar{q}, \bar{H}) = \begin{pmatrix} & -\sqrt{(1-\alpha)R + \gamma(1-2\varepsilon)\frac{(1-\varepsilon)^3(3\varepsilon-1)}{8\alpha\beta}} \\ g'(1-\varepsilon)H & 0 \end{pmatrix} \tag{26}$$

The equilibrium will be asymptotically stable if $tr(J) < 0$ and $\det(J) > 0$. We have:

$$\begin{aligned} tr(J(\bar{q}, \bar{H})) &= 2\gamma\frac{3\varepsilon^3 - 8\varepsilon^2 + 5\varepsilon - 1}{3\varepsilon - 1} - 2(1-\alpha)R\frac{1-2\varepsilon}{3\varepsilon-1} < 0 < \text{ if } 0 < \varepsilon < 1, \\ \det\ (J(\bar{q}, \bar{H})) &= \sqrt{1-\alpha)R + \gamma(1-2\varepsilon)\frac{(1-\varepsilon)^3(3\varepsilon-1)}{8\alpha\beta}}\, g'(1-\varepsilon)H > 0. \end{aligned}$$

As $tr(J) < 0$ and $\det(J) > 0$, the equilibrium at the entrepreneurial region (q^e, H^e) is asymptotically stable.

Proof of Proposition 3

Taking into account Proposition 1 and the steady state points (q^c, H^c) and (q^e, H^e) from Proposition 2, we calculate the civil servants' effort, civil servants' payoff and entrepreneurs' payoff in each equilibrium. Table 1 provides the results to facilitate the comparison

Traditional economy	Entrepreneurial economy
$e^c = \sqrt{\frac{2}{\alpha\beta}\left[\gamma(1-2\varepsilon) - (1-\alpha)R\right]}$	$e^e = \sqrt{\frac{2(1-\varepsilon)}{(3\varepsilon-1)\alpha\beta}\left[(1-\alpha)R + \gamma(1-2\varepsilon)\right]}$
$y^c_C = \frac{1}{\alpha}\left[\gamma(1-2\varepsilon) - (1-\alpha)R\right]$	$y^e_C = \left[(1-\alpha)R + \gamma(1-2\varepsilon)\right]\frac{1-\varepsilon}{\alpha(3\varepsilon-1)}$
$y^c_E = 0$	$y^e_E = \left[(1-\alpha)R + \gamma(1-2\varepsilon)\right]\frac{2\varepsilon}{3\varepsilon-1}$

Table 1: Efforts and monetary payoffs at the steady state equilibria

1. As $(1-\alpha)R + \gamma(1-2\varepsilon) > \gamma(1-2\varepsilon) - (1-\alpha)R$, and as $\forall\varepsilon < 1/2$, $\frac{2(1-\varepsilon)}{(3\varepsilon-1)\alpha\beta} > \frac{2}{\alpha\beta}$, it follows that:

$$e^e = \sqrt{\frac{2(1-\varepsilon)}{(3\varepsilon-1)\alpha\beta}\left((1-\alpha)R + \gamma(1-2\varepsilon)\right)} > \sqrt{\frac{2}{\alpha\beta}\left(\gamma(1-2\varepsilon) - (1-\alpha)R\right)} = e^c.$$

2. We know that $(1-\alpha)R+\gamma(1-2\varepsilon) > \gamma(1-2\varepsilon)-(1-\alpha)R$, and as $\forall\varepsilon \in R, 0 > (1-\varepsilon)^3(3\varepsilon-1)-4\varepsilon^4 = -7\varepsilon^4+10\varepsilon^3-12\varepsilon^2+6\varepsilon$, we have $\frac{8\varepsilon^2\alpha\beta}{(1-\varepsilon)(3\varepsilon-1)} > \frac{2(1-\varepsilon)^2\alpha\beta}{\varepsilon^2}$. Therefore:

$$H^e = \sqrt{\frac{8\varepsilon^2\alpha\beta}{(1-\varepsilon)(3\varepsilon-1)} 1-\alpha)R+\gamma(1-2\varepsilon)} > \sqrt{\frac{2(1-\varepsilon)^2\alpha\beta}{\varepsilon^2}} (\gamma(1-2\varepsilon)-(1-\alpha)R) = H^c$$

3. As $\gamma(1-2\varepsilon)+(1-\alpha)R > \gamma(1-2\varepsilon)-(1-\alpha)R$ and $\varepsilon < 1/2 \rightarrow \frac{1-\varepsilon}{3\varepsilon-1} > 1$, we have

$$y_C^e = ((1-\alpha)R+\gamma(1-2\varepsilon))\frac{1-\varepsilon}{\alpha(3\varepsilon-1)} > \frac{1}{\alpha}(\gamma(1-2\varepsilon)-(1-\alpha)R) = y_C^c.$$

4. It is trivial because $y^c = 0$, whereas

$$y_E^e = ((1-\alpha)R+\gamma(1-2\varepsilon))\frac{2\varepsilon}{(3\varepsilon-1)} > 0$$

Proof of Proposition 4.

(i) The payoff of entrepreneurs and non entrepreneurs are

$$\begin{aligned} y_E^e &> y_N^e = \alpha y_C^e + (1-\alpha)R \\ [(1-\alpha)R+\gamma(1-2\varepsilon)]\frac{2\varepsilon}{3\varepsilon-1} &> \alpha[(1-\alpha)R+\gamma(1-2\varepsilon)]\frac{1-\varepsilon}{\alpha(3\varepsilon-1)}+(1-\alpha)R \\ \gamma(1-2\varepsilon) &> 0 \end{aligned}$$

(ii) If $\alpha > \frac{1-\varepsilon}{2\varepsilon}$, we have $\frac{2\varepsilon}{3\varepsilon-1} > \frac{1-\varepsilon}{\alpha(3\varepsilon-1)}$, therefore

$$y_E^e = [(1-\alpha)R+\gamma(1-2\varepsilon)]\frac{2\varepsilon}{3\varepsilon-1} > [(1-\alpha)R+\gamma(1-2\varepsilon)]\frac{1-\varepsilon}{\alpha(3\varepsilon-1)} = y_C^e$$

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