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The Reputation of an Organization and its Dynamics

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Abstract

In our world, an organization derives reputation from its past as if it were a natural person, even though it technically possesses no fixed characteristics (types). Moreover, the reputation of an organization fluctuates with its performance period by period, even though different members are responsible in different periods. To understand the two phenomena, the paper presents an OLG model where an organization is purely a name shared consecutively by its members, each working for one period only, and its reputation is driven by market competition. High quality producers outbid low quality ones for reputed names only if a name has some specific value dynamics with its each period performance. The dynamics in the second best is derived, which has four features: increasing after a success; decreasing after a failure; destroyed totally by it if the value is already low enough; immune to a failure for top names if they set honest prices that tell the quality of the products.

Key words: Brand-names The Reputation of an Organizations Endogenized Value Dynamics

JEL: D23, D82

1 Introduction

Against the wall of Student Service Centre of London School of Economics and Political Science (LSE) there are the pictures of thirteen Nobel Prize Laureates. Having them as students or faculty members is indeed a glory of the school and it has good reason to display the glory. It

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is taken as an indication that LSE is excellent at present, in the same way as the past glories of a natural person indicate his current quality. However there is a chasm between the reputation of an organization and that of an individual. The reputation of an individual is anchored by his *type*, namely the characteristics invariant over time. He derives reputation from his past since it is useful to Bayesian updating the estimate of his type[1]. On contrary, the performance of an organization is decided by the the aggregate quality of its members. The members come and go from time to time and technically there is no guarantee that new members have the same quality as the retired ones. Therefore, an organization *technically* has no fixed characteristics, namely type. Actually the glories displayed on the wall were often created by the members that have nothing physically to do with the organizations now. For example, all the thirteen stars of LSE has left it long ago. And that is a *common knowledge*. Then, the question is, given it has no "type", why does an current organization still derive reputation from the past history, just like a natural person who instead has the type?

Actually, we go further than believing in the meaning of history in the way of personifying organizations. In addition, we make ethical judgements upon them, *as if* it were they that had carried out the "wrong" or "right" deeds, rather than the persons in charge of them. If we are persuaded by advertisements of General Motor to buy an expensive car but disappointedly find the car is not worth the price, we feel being *cheated by the firm,* rather than cheated by its management that is actually on the responsibility. This "fair-trading" concern is always an element of ethical evaluation upon firms. Now according to Financial Times, it is extended to include "fuel-efficient", "recycled", etc[2]. The point is that ethical evaluation, honestly pricing particularly, is a part of an organization's reputation. What is its role in the reputation?

For the two questions, some could argue that the personalization of an organization is, at least partly, supported by some invariant characteristics (type) of the organization that lie outside of individual members. Generally, the magic type of an organization is called "*culture*". I do not say culture does not exist or matter. However, in the paper I will cut off "types" totally and consider the two questions from the angle of economical efficiency. Basically the argument is that if we humans *artificially* believe organizations derive reputation from the history that is not substantially linked with them, the social economical efficiency will be improved; if we moreover *artificially* impose ethical evaluation upon organizations, the efficiency will be improved further. And what we expect occurs in equilibrium. Overall, the message is that, no matter whether there are other roots of personifying organizations in the two senses above, that is a clever creation of

[1] As a simple example, suppose the types are the probability of succeeding in doing something and the prior distribution is uniform on the unit interval. Then reputation is the posterior estimate of the probability. If s successes and f failures are observed for some person, then his reputation is $\frac{s+1}{s+f+2}$.

[2] "Ethical consumption makes mark on branding", *Financial Times*, 20/02/2007, pp24.

our humans – it increases social economical surplus!

Given that an organizations derives reputation from the history without backed by any type, an related question is what is the dynamics of the reputation? For the reputation of an individual, backed by his type, it is trivial to see that it increases with good performance and decreases with the bad one[3]. Without anchored by type, what would the dynamics of an organizations' reputation look like? The reputation of a firm is generally represented by its brand value. Then what will be the dynamics of the brand value? If taking the personalization further, we would expect the dynamics to have the same features as that of an individuals' reputation. But is that true? And if true, for what economical reason?

To address these questions, the paper presents an overlapping generation (OLG) model that has the following two features. For one, an organization are a collect of individuals in the dimension of space and time. Here I abstract the space dimension[4] and let an organization consist of one member in each period. Moreover, I let each member work for just one period. Then it is a common knowledge that the history of an organization is attributed to the past members that have nothing to do with the organization of today, that is, type-like things are cut off totally. Thus in the paper an organization is nothing but a *name* shared consecutively by its members of different periods. For the other feature, the reputation of an organization is driven by market competition. In the paper, producer-sellers are of either high or low quality, which is their private information (their type). High quality sellers succeed in producing valuable goods with higher probability. In the economy, the history of past successes and/or failures attribute some repuation to a name. In equilibrium, High quality producers outbid low quality ones for reputed names, the names having histories of many successes but few or even none failure, when names have some specific value dynamics with respect to their performance of each period, which is influenced by whether and which names are punished for "dishonestly pricing". Actually, different value dynamics leads to different extent of reputed names signalling and sorting out of high quality goods. The more separated are the two types, the higher social surplus is created. The value dynamics leading to the second best is derived. It has the four following features: (1) a name's value increases after a success; (2) it decreases after a failure; (3) it is destroyed totally if the value is already low enough; and (4) it is untouched to a failure for the names that have the top value[5] if they are found pricing honestly. Features (1) and (2) are also found in the dynamics of the reputation of an individual, but (3) and (4) are specific to

[3] See also note 1 above. $\frac{s+1}{s+f+2}$ is increasing with s and decreasing with f.

[4] That makes it different from the literature that focuses on the interaction of the members in a team, like Tirole (1998) and Bar-Isaac (2004).

[5] It is proved that top value exists in any equilibrium.

that of an organization's reputation[6].

Spencer (1973) began the study of cost signalling game. In the literature of signalling games, two innovations here are that the comparative advantage of good sellers in bidding signalling instruments (good names here) is endogenously decided in equilibrium rather than exogenously given, and that signalling does not waste social resource. Kreps (1990) invents the idea of sustaining the reputation of organizations (names) through the resale market in the framework of moral hazard. That paper cannot pin down the reputation's value, which is done here in the optimal equilibria, since it does not use competitive equilibrium framework. And the value does not go up and down in that paper. On the contrary the value dynamics is an essential part of the way for the reputation to work.

The closest work to the paper here is Tadelis (1999, 2002, 2003) (hereinafter Tadelis). They have the merits, besides others, that good names (histories) are traded in all equilibrium and the result robust to very short horizons. However all these merits are driven by the assumption that ownership change of names is unobservable. With probability one half, for each name the owner of yesterday is the owner of today, and thus the performance of yesterday is used to Bayesian update the current owner. So something like types remains and organizations' reputation is partly anchored by it. Actually the merits he claims come from the fact that history has substantial meaning due to this type-like thing. On the contrary, the paper here goes back to Kreps (1990), cutting off types totally[7]. Then as in Kreps (1990) the reputation here is driven by specific equilibrium belief, which is regarded as a disadvantage by Tadelis. However, many, if not most, great creations of our human society are driven by belief, such as money, language[8], laws and authority[9], ethic, and probably, Gods. Thus the first justification of my approach is that our human beings do make great creations through nothing but spreading and coordinating beliefs. Secondly, as pointed out by Hart (2001)[10], in the real world while the chef/owner change of a small restaurant may be unobservable, the owner/manager change of big names is extensively reported and hardly unobservable, and only the big names have significant reputation capital. Thus organizations' reputation is hardly driven by the unobservability of the owner-manager change and the approach with names having no substantial meaning is worth

[6] See also notes 1 and 3. $\frac{s+1}{s+f+2}$ is increasing with s and decreasing with f, but is never to be 0 and never stop decreasing with f.

[7] More generally, as pointed out in Tadelis (2003), any theory on the reputation of organizations (names) has to fall in one of the two categories, either confering names with substantial meaning or driven only by belief.

[8] Bubble is always an equilibrium in any cheap talk game.

[9] Cf. Mailath, Morris and Postlewaite (2001).

[10] "However the idea that a firm's reputation matters only when (a significant fraction of) consumers cannot observe the change in ownership is not that plausible", in Hart (2001).

an attempt. Moreover, the paper here derives the value dynamics of names in the second best, which is empirically testable, whereas though Tadelis gets some dynamics he presents no reason for that dynamics rather than many others to occur so that the dynamics is not ready to be tested.

There is other research about the brand capital such as Klein and Leffler (1981), Shapiro (1983), Choi (1998), Andersson (2000) and Cabral (2000), which exploits the idea of brand names signalling the quality of their products. However in those papers firms are not organizations changing owner-managers from time to time, but real players enjoying the acquired profit. And those papers do not derive value dynamics due to their partial equilibrium framework.

The research on collective reputation, such as Tirole (1996), Levin (2001) and Bar-Isaac (2004), is also relevant since here the reputation is born by an organization rather than the people running it. The difference is that here organizations, which are the collect of the members in time dimension, consist of only one member in each period, whereas in those papers organizations consist of multiple members and the interaction among them is a key element of their models.

The model will consist of two parts, the basic part and its extension. In the basic part, the only private information of sellers are their type, while in the extension they are assumed to have another private information after the widgets are produced, for the purpose of engendering a role to ethic and deriving a more realistic dynamics. Below section 2 is used to set up the model. In section 3, as a benchmark I consider what happens if organizations do not derive reputation from history. Then section 4 presents the second best in the basic model. The extension is made in section 5. Section 6 discusses empirical relevance and concludes. Some proofs are put in appendix.

2 The Basic Model

It is a standard Overlapping Generation (OLG) economy with the constant population. There are infinite periods, 1, 2,... And period t begins at date t and ends at date $t+1$. The loan market is complete and one period discount is $r < 1$[11]. There are two goods, corn (endowment good and numeraire) and widget (production good). The economy is populated with continuum risk neutral sellers and even more buyers. Sellers live for two periods. When they are young, each of them *choose* to produces *one* widget and then sells it for corn (or not); when they are old, they consume the corn. Buyers live for one period, endowed with corn to buy widgets and consuming both.

In each period, young sellers can choose to produce *one* widget at cost c. Each widget is

[11] The risk free interest is $\frac{1}{r} - 1$.

either useful and worth $\overline{v}$ for the buyer, or useless and worth $\underline{v}$. Each young seller is of two types, good and bad. Good sellers (G-sellers) produce a useful widget with probability $\overline{q}$ and the bad sellers (B-sellers) with probability $\underline{q} < \overline{q}$. Without loss of generality I set $\underline{v} = 0$ and $\overline{v} = v$; $\underline{q} = 0$ and $\overline{q} = q < 1$. The share of G-sellers is γ.

Assumption 1: $\gamma qv < c < qv$.

> γqv is the expected value of the widgets if all B-sellers are engaged into production. Imagine an equilibrium in which all sellers, bad and good, go to production. Then rational buyers pay at most γqv for an average widget, which nevertheless costs c. By the first inequality, average sellers will lose, which is impossible in any equilibrium. Therefore the first inequality asserts that in any equilibrium not all bad sellers enter production. Thus bad sellers cannot get strictly positive return from production in any equilibrium. qv is the expected value of the widgets produced by good sellers. The second inequality then says that good sellers averagely generate positive social surplus. On the contrary, bad sellers generate $-c$. Therefore it is socially efficient to allow only good sellers to produce while to exclude B-sellers out of production as possible as we can. The welfare analysis gives the standard of equilibrium selection here, which is absent in Tadelis.

Denote $\pi = qv - c$, the social surplus generated by an average good seller. How to exclude bad sellers is the core problem of the paper. The difficulty of excluding all sellers lies in the information problem as follows.

Information Structure: In each period, at its start a young sellers *privately* knows his type. When buyers are purchasing a widget, they do not observe its quality (being useful or useless). However the quality information of each widget permeates through time so that at the end of the period the quality of all widgets is public information to this and the next period buyers and sellers. Nevertheless,

Assumption 2: This public information is not contractible when the widgets are traded.

> The same assumption is made in Holmstrom (1999) career concern model where a manager works for a specific firm in each period. At the end of the period, his performance is perfectly observed by the labor market. However at the beginning of the period his wage cannot be conditional on the performance. Surely the difference is that in that paper the manager never dies, which is why it is paper about individuals' reputation, whereas in this paper here each seller dies after one period and the reputation is borne by organization

rather than by him personally. A similar assumption is made in Tadelis (1999, 2002, 2003), who justifies it in the way of incomplete contract (Hart & Moore (1990); Hart (1995)), as it normally assumes that some ex post information is not contractible ex ante. And more broadly it conforms with the spirit of Hayek (1945) that there is much information unable to be used by social planners, mechanism designers or judges, but able to used by decentralized markets[12]. In the paper here, the information is used through the name market.

In each period, at the beginning an young seller decides first whether to produce. If he decides to produce, before production he gets a name for his firm, in two possible ways (for any period but the first one). Either he forms a new name costlessly. Or he buys an existing name from an old seller in the name market[13]. After acquiring the name, he produces a widget and sells it in the widget market. This process goes quickly so that the profit from it is not discounted. At the end of the period before he retires, he goes to the name market again to sell the name to some young seller of the next generation. Thus the resale value is discounted by r. After that, he becomes old and consumes what he gets from selling the product and the name. Suppose the price of a young seller's widget is w and he buys the name at price p_0[14] while reselling it at p_1. Then his return is $R = -p_0 + w - c + rp_1$.

A buyer's utility is $E(v) - w$ if she buys a widget at price w.

The reserve utility for the buyers not purchasing a widget and for the sellers not producing is 0. And the only inter-generation link is transactions in the name markets.

A name could be used in several periods. The history of a name is defined as the quality sequence of the widgets produced with the name. Even though the quality of each of these widgets is attributed to a different seller, in the economy, as in our world, people put the qualities together into a sequence and regard it as the "history" of the name as it were the name rather than the sellers holding it that is responsible to the qualities. That probably looks strange. However history is the great creation of the people in the economy as history functions as signalling and sorting instruments so as to improve social welfare if the people believe in the

[12] A more detailed process of information diffusion can be as follows. A widget is experience good. After buying and consuming it, the buyer knows its quality privately. As this knowledge is not directly observable to others even ex post, the attempt to contract upon it cannot overcome the problem of incentivizing the buyer to tell the truth. However the tricky thing is that if nothing affects his interest, as a human being the buyer likes to share honestly his experience of buying and consuming the widget with others whenever possible, and his audience, as human beings, like to share what they have heard with others. So at the end of a period, all buyers and sellers of this and the next periods know the quality of the widget.

[13] In the first period young sellers do not have the option of buying an existing name.

[14] Hereinafter I use term "buy new names at price 0" to mean forming new names.

meaning of history. The basic model of the paper is to show that point. In fact in the names markets, trading names is actually trading their histories as names are totally characterized by their histories. On the other hand, to trade histories people must find something to bag the occurrences composing the histories. Names are the best candidate. Using names to carry and embody histories facilitates personalizing organizations psychologically, which facilitates the acceptance and diffusion of the belief in the meaning of history, since generally natural persons are represented by their names. Thus hereinafter history and name are substitutable to each other.

As the quality of all widgets produced in period t are known to $t+1$ buyers and sellers, they know the whole history of all names at date $t+1$. Below I use "s" to denote success (a useful widget is produced) and "f" to failure (a useless widget is produced). And a typical history is denoted by "h". Then generically h is a sequence consisting of s and f, such as "s", sf", "sssf" etc. And "s^n" is used to denote the history consisting of n consecutive "s" and the empty history (for new names) is denoted by "ϕ". Denote by H^t the set of all histories in date $t+1$name market, or the set of all histories with the length no bigger than t. For example, $H^1 = \{\phi, s, f\}$, $H^2 = H^1 \cup \{ss, sf, fs\}$ etc.

And names (histories) will have the following dynamics. If an h-names is held by a good seller, then with probability q, he will succeed in producing a useful widget and the h-name becomes an hs-name; with probablity $1-q$, he will fail and the name becomes an hf-name. If an h-names is held by a bad seller, then he will definitely fail and the name definitely becomes an hf-name.

I use the concept of competitive equilibrium, which consist of prices and decisions. The prices for widgets are denoted by w_{ht} and the prices for names are denoted by p_{ht}, where subscription h represents the history of the names and t represents date. Only sellers have important decisions to make. First they decide whether to produce, with $e_{Bt}/e_{Gt} \in [0,1]$ denoting the probability (share) of B/G-sellers engaging production at date t. Then they decide which names to buy. I use λ_{ht} to denote the share of good sellers among h-names holders in period t. Let ρ_{ht} denote the mass of h-names in the name market at date t. The total sale value of names in date t name market, which is also the transfer from t-generation of sellers to $t-1$-generation ones, is $V_t = \sum_{h \in H^{t-1}} \rho_{ht} p_{ht}$. Then $\{p_{ht}; w_{ht}\}_{h,t}$ and $\{e_{Bt}/e_{Gt}; \lambda_{ht}\}_{h,t}$ constitute a competitive equilibrium if and only if

Condition 1 *Given the price sequences $\{p_{ht}\}_{h,t}$ and $\{w_{ht}\}_{h,t}$, the optimal decisions of sellers at date t are e_{Bt}/e_{Gt} and λ_{ht}.*

Condition 2 *Given the decisions $\{e_{Bt}/e_{Gt}; \lambda_{ht}\}_{h,t}$, p_{ht} clears the market of h-names at date t.*

Condition 3 *Given the decisions* $\{e_{Bt}/e_{Gt}; \lambda_{ht}\}_{h,t}$*,* w_{ht} *clears the market of widgets produced with h-names at date t.*

Condition 4 *(No Ponzi):* $\lim_{t\to\infty} r^t V_t = 0$.

As the production technology bears stringent capacity constraint and buyers are more numerous than sellers, the prices clearing the widget market must be such that expectedly buyers are indifferent in buying widgets or not. Therefore, buyers have to pay the expected value of the widgets and condition 3 becomes

$$w_{ht} = E(v|h,t) = q\lambda_{ht}v \tag{1}$$

No Ponzi deserves more explanation. Let S_t be the total return of period t sellers and Π_t the total profit of the sellers from selling the widgets. As sellers return equal the sum of the profit from the widgets and the capital gain from the names, we have $S_t = \Pi_t - V_{t-1} + rV_t$. Then if and only if No Ponzi hold, we have

$$\sum_{t\geq 1} r^t S_t = \sum_{t\geq 1} r^t \Pi_t \tag{2}$$

Equation (2), equivalent to No Ponzi, says that the sellers in the economy can borrow and lend, but *in net* the outsiders do not give money to them. Thus No Ponzi is designed to exclude the situation in which in each period all sellers pick easy big money by just buying and selling names, which are actually no more than pieces of papers.

Here I focus on "*stationary equilibria*", where $\{p_{ht}\}$, $\{w_{ht}\}$, e_{Bt}/e_{Gt} and λ_{ht} do not depend on time t. Stationary equilibria describes what happens in the long-run where all finite histories are present. And we will see that in both the basic model and the extension there are only finite states of names and the dynamics are Markovian transformation among the states.

As sellers can create any new names costlessly, $p_\phi = 0$.

The purpose of the basic model is to show that organizations, represented by their names, do derive reputation from their history even though it was created by the sellers that have nothing to do with the current sellers holding the names, in the socially best equilibrium, that is, the equilibrium in which bad sellers are excluded to the most extent. However, before going to figure out the socially best equilibrium, as a benchmark, I demonstrate what happens if names cannot derive reputation from history.

3 Benchmark: "History is Bunk" — Henry Ford

In this section I will consider a benchmark in which organizations do not derive reputation from history. Suppose that the people in the economy are realisticist. As Henry Ford, they believe, correctively in the end, that histories are attributed to the people passing away and mean nothing to the current people. Then in this realistic world, organizations cannot derive reputation from history; actually no history is even composed as the realistic people keep the occurrences of different dates separate. And no young sellers would like to pay for the existing names. Notice that at the end of each period some sellers establish (personal) reputation of being good after the buyers know that their widgets are useful. But this reputation is useless. The reputed sellers do not produce anymore; and the reputation established by them die with them retiring so that in the next period the problem due to adverse selection is as serious as in this period. What happens then in the benchmark?

Proposition 1 *: If people believe that history is bunk, then in all equilibria widgets' price $w = c$ and social surplus is 0.*

Proof. : First the following profile of prices and decisions is an equilibrium. No transaction happens in the name market and names' price is 0, and the price of widgets is $w = c$; sellers of both types enter production with some probability, in such a mix that the expected value of the widget is c. Then given the prices, the return of both types of sellers is $w - c = 0$ so that they are indifferent and their entry decision is optimal; given the decision, by (1) the price of the widgets is c, and surely the price of names is 0 as no young sellers want to pay for existing names.

Here I prove no other kinds of equilibria exist in the situation. Consider the price of widgets, w. If $w < c$, no sellers want to produce. Suppose that $w > c$. Then sellers get positive return and all sellers, both bad and good, will engage in production. Then by (1) the price of widgets is $w = \gamma qv < c$, a contradiction to the supposition that $w > c$. Thus $w = c$ in all equilibria.

In the equilibria, sellers get return 0, and buyers get 0 surplus expectedly as always. So the social surplus is 0. ■

In this realistic world, B-sellers enter production to the degree that all social surplus generated by good sellers is dissipated up. This is very inefficient. The reason is no way to use the ex post information about the widgets' quality. Or in other words, the reputation established by successful sellers is personal and dies with them retiring. The inefficiency is exactly the cost of establishing the reputation. If it dies with the establishers, as what happens in this benchmark, then each generation needs to pay their own cost, leading to a huge cost replication. To improve over it, the economy does not want the reputation to be personal, dieing with the establishers, but want it to survive their irresistable death. How to do it? Attach the reputation not to natural persons, but to the organizations run by them, that is, make organization derive and bear reputation, which prerequires the people believe in the meaning of history. Then the question is, if that is possible, what can be achieved at best? Can all bad sellers be excluded, that is, the first best be obtained? That is the topic for the next section.

4 The Social Best for the Basic Model

Suppose that the people in the economy do believe in the meaning of histories to the current firms. Especially, they believe that the glorious history implies the current excellence for firms as for natural persons. If the belief is rationalized, organizations (firms) do derive reputation from their histories, which function as instruments to signal and sort out good sellers. What is the socially best equilibrium in this case? For this question, first let us construct an equilibrium.

Single Name Equilibrium (SNE): An equilibrium is as follows. There are two kinds of names, new names and success names, denoted by ϕ and s respectively. If a $\phi-$name succeeds, the name becomes an s-name; while if it fails, it remains a worthless name and is replaced by another new name in the next period (which is simplified as "it remains a new name"). If a $s-$name succeeds, it remains a $s-$name; while if it fails, it becomes a new name (being destroyed and replaced by a new name). The dynamics are illustrated as follows:

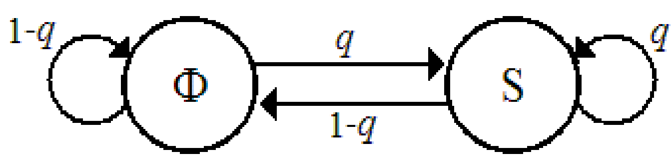

Figure 1: the dynamics in SNE

The prices for SNE are $p_s = \pi; w_s = qv$ and $w_\phi = c$. The decisions are $\lambda_s = 1$ and $\lambda_\phi = \frac{c}{qv}; e_G = 1$ and $e_B = \frac{\gamma(1-q)(qv-c)}{(1-\gamma)c}$. Good sellers hold both types of names while bad sellers enter only through new names. To show the profile of the prices and decisions do form an equilibrium, it suffices to verify conditions 1-4 are to be satisfied. Obviously, (1), equivalent to condition 3, is satisfied. No Ponzi is satisfied obviously since $V_t = q\pi$[15].

For condition 1, it is shown that both types of sellers are indifferent in buying any names and that good sellers get return $R_G = rq\pi$ and bad sellers $R_B = 0$. For good sellers buying $s-$names,

[15] The only valuable names are $s-$names, with mass q and price π.

the profit from selling the widgets is $w_s - c = \pi$; the capital gain from buying and selling the names is $-p_s + r[qp_s + (1-q) \times 0] = -(1-rq)\pi$. Then the return that is the sum of the profit and the capital gain is $R_G = rq\pi$. For good sellers buying $\phi-$names, the profit is $w_\phi - c = 0$; the capital gain is $rqp_s = rq\pi$. Then the return is also $rq\pi$. Hence good sellers are indifferent in buying any names. For bad sellers buying $s-$names, the profit is π, but they incur capital loss π as definitely failing. Then the return is $R_B = 0$. If they buy $\phi-$names, both the profit and the capital gain are 0 and consequently the return is 0. Hence bad sellers are also indifferent. Then the decisions of buying names are justified. Since $R_G > 0$, optimally $e_G = 1$ while since $R_B = 0$, any $e_B \in [0,1]$ is weakly optimal and the value is decided by condition $\lambda_\phi = \frac{c}{qv}$. As there are only $q\gamma$ $s-$names but γ good sellers, $(1-q)\gamma$ good sellers use $\phi-$names. These are only $\frac{c}{qv}$ of the total $\phi-$names by definition of λ_ϕ. Thus $\frac{\gamma(1-q)(qv-c)}{c}$ bad sellers enter through $\phi-$names, which determines $e_B = \frac{\gamma(1-q)(qv-c)}{(1-\gamma)c}$.

For condition 2, given that G-sellers hold both types of names, the market clearing price for $s-$names must be set to make good sellers indifferent in buying any names. Thus $-p_s + w_s - c + rqp_s = -p_\phi + w_\phi - c + rqp_s \Rightarrow p_s = w_s - c = \pi$, as specified by the profile.

Summarily, the profile of decisions and prices really forms an equilibrium. The equilibrium is called "single name equilibrium" (SNE) as there is only one state of non-new names.

In SNE, personalization of names is justified as good names, implied by good histories, are only held by good sellers and have averagely better current performance. In SNE, $R_G = rq\pi$. Contrasting with the benchmark, the social efficiency is improved.

The question is, can we improve over SNE? It looks that we have many reasons to anticipate an equilibrium better than it. For example, in SNE ater a success, s-names becomes s^2-names that have the same price as s-names. But it seems to be better if the price of s^2-names were higher so as to be farther from the danger of being destroyed by failures. For another example, in SNE s-names are destroyed into new names by just one failure. As non-new names are useful to siganl and sort good sellers, why not let s-names die after two or even more failures? More generally it looks like that if in an equilibrium there were more kinds of non-new names for signalling and sorting, then there would be more scope for separating and thus the outcome would be better. Surprisingly these kinds of considerations do not not true! The simple equilibrium, SNE, already reaches the maximum social welfare. For proving this, I need first to show that the prices of name cannot go to infinity.

Lemma 1 *No Ponzi implies that $p_h \leq \frac{\pi}{1-r}$ for any h in any equilibrium.*

Proof. See appendix. ■

Then I can prove the optimality of SNE.

Proposition 2 *SNE generates the maximum social welfare among all equilibria.*

Proof. For the proof, first notice that in any equilibrium bad sellers get 0 (the reserve profit). And buyers averagely obtain 0 since they paid the prices equaling the expected value of the widgets. Therefore social welfare is measured by the return of good sellers for any equilibrium.

In SNE the return of good sellers is $rq\pi$. Thus to prove the proposition it suffices to show that in any equilibrium $R_G \leq rq\pi$.

Given an equilibrium. By lemma 1 above $P = \sup\{p_h | all\ h\}$ is well defined. For any ε such that $0 < \varepsilon < c$, there exist an h^*-name such that $p_{h^*} > P - \varepsilon$. First not all h^*-names are bought by bad sellers. Otherwise, they are a signal of bad sellers. Then $w_{h^*} = 0$. The return of the bad sellers buying the names is $-p_{h^*} + w_{h^*} - c + rp_{h^*f} \leq -p_{h^*} - c + rP < -P + \epsilon - c + rP < 0$. Then bad sellers would not buy the names, contradicting with the supposition that only bad sellers buy the names.

Thus h^*-names are bought by good sellers at least partly. Then let us come to calculate the return of good sellers buying the names. It is $-p_{h^*} + w_{h^*} - c + r[qp_{h^*s} + (1-q)p_{h^*f}] \leq -p_{h^*} + w_{h^*} - c + r[qP + (1-q)p_{h^*f}] = rq(w_{h^*} - c) + rq(P - p_{h^*}) + (1-q)(-p_{h^*} + w_{h^*} - c + rp_{h^*f}) + q(1-r)(-p_{h^*} + w_{h^*} - c)$. Let us check the last sum term by term. For the first two terms, by (1) $w_{h^*} - c = \lambda_{h^*}qv - c \leq \pi$. $P - p_{h^*} < \varepsilon$. As to the third and the fourth terms, consider what bad sellers get if they buy h^*-names also. Their return is $-p_{h^*} + w_{h^*} - c + rp_{h^*f}$, which is no bigger than 0 in equilibrium. Thus the third term is non-positive while the fourth term $-p_{h^*} + w_{h^*} - c \leq -rp_{h^*f} \leq 0$. Therefore the return of good sellers buying h^*-names is no bigger than $rq\pi + rq\varepsilon$ for any ε such that $0 < \varepsilon < c$. Let ε goes to zero, we end the proof. ■

For the intuition of proposition 2 let us consider the extreme case where $r = 1$ and $p_{h^*} = P$. The return of the good sellers buying h^*-names equals the sum of the profit $w_{h^*} - c$ plus the capital gain. As the price of buying them is already at the highest level there is no capital gain in any case. And when the good sellers fail, the capital loss $p_{h^*} - p_{h^*f}$ cannot be smaller than the profit $(w_{h^*} - c)$ in order to deter bad sellers. This loss happens with probability $1 - q$. Therefore the return is no bigger than $q(w_{h^*} - c) \leq q\pi$.

In the basic model the history of a firm (name) is attributed to the past sellers nothing substantial connecting with the firm now. However allowing firms to derive reputation from their histories improve social efficiency, with R_G increased from 0 in the benchmark to $rq\pi$ here. And I have shown that the simple equilibrium, SNE, implements the second best. Moreover, though firms do not have "types" here, in SNE the reputation does go up after a success and down after a failure, similar to the reputation of natural persons. All these are nice.

However two motivations push me to seek a more "complete" theory. First, the dynamics in SNE is not so realistic. It has no memory. A name having one million consecutive successes has the same value as that having only one success, and is destroyed by one failure alone as the later. In real world, the two names are quite different. Equivalently the history of reputed names is too short, just one period. In our real life we can see hundreds years of old brandnames and people remember their whole history, not just the history of the latest decade. Second, the basic model confers upon ethic no role in the reputation of organizations. Nevertheless in real life ethic is indeed a part of the reputation as people do impose ethical evaluations upon *organizations*. Recently, Financial Time, one of most influencial papers, reported ten most ethically perceived brands in France, Germany, Spain, UK and US, which comes from GfK NOP's survey in the respective countries[16]. Especially one ethical consideration is "fair trading", which is about the pricing behaviour of firms. Thus I am seeking a theory of organizations' reputation in which the equilibrium dynamics has long memory and there is a role for this "fair trading". Another nice thing of the basic model is that a small extension on it brings about such a theory, which is the topic of the next section.

5 Extension: Ethic and Long Memory

An extension of the basic model is made in the section to generate a role of ethic in organizations' reputation and a dynamics having long memory. For that purpose I only need to incorporate another dimension of private information to sellers. Then ethic are introduced and the dynamics are studied. In the end some socially best equilibria are constructed.

5.1 The Second Dimension of Private Information

In the basic model the only private information of sellers is their type, which decides the prior probability of their widget. In the extension sellers are assumed to have ex post private information as well. After a widget is produced, the seller *privately* gets a signal, n (nice) or u (useless), about its quality, according to the following distribution:

$\Pr(n|v) = 1; \Pr(n|0) = 1 - \tau$ and $\Pr(u|0) = \tau < 1.$

Therefore here τ measures the preciseness of the signal. And actually the basic model is a special case of the general model in which $\tau = 0$ (ex post signals are uninformative). The

[16] See "Ethical consumption makes mark on branding", *Financial Times*, pp24, Tuesday, Feb., 20, 2007.

distribution means that sellers are over-optimistic about their widget. If it is useful, they know that; even if it is actually useless, they still think it is useful with probability $1-\tau$. The necessity of this second dimension of private information to the role of ethic will be proven later when I show that ethic, as in the sense below, make no difference if $\tau = 0$.

Then timing for each period is then as follows. First young sellers are born and know their type. Then they buy names in the name market. Subsequently they produce widgets and get ex post signals before trading with buyers in the widget market. In the end they sell their name in the name market to the next young sellers.

5.2 Ethic and Social Custom

ethic are the propositions about "right" or "wrong". Notice that if sellers get signal u, they know definitely the widget is useless as $\Pr(0|u) = 1$. But they still want to sell their widget at high prices. However this behavior is attributed to names by the people in the economy.

Definition 1 ***ethic of Names****: a name (not a seller) is considered as cheating if it sets a price* $p > \underline{v} = 0$ *for the useless widget. A "cheating name" is a name ever cheating before.*

The economy, like our world, holds that cheating is wrong for a **name**.

To make the ethic have a bite, the wrong behaviour, cheating must be punished, which does have economic significance. In the economy, bad sellers survive only through cheating. Hence punishing it helps to drive them out of production. Notice that the ethic are upon names, rather than the sellers. Then the way to punish cheating, as in our world, is by distrusting the cheating names[17]! Thus the economy could hold the belief that cheating names keep producing useless widgets and cheating by setting a positive price for them. However this is not what happens in the socially optimal equilibria. The belief destroys cheating names' resale value, which is what we want to punish cheating. Nevertheless, if the value is low the threat of losing it cannot stop cheating, hence not conducive to exclude bad sellers, but does destroy name in equilibrium, hence lowering social efficiency as names are the instruments signalling good sellers. Therefore in the socially best equilibrium, only the names with high enough resale values are destroyed if ever cheating. Then in equilibrium path cheating is deterred and the names are still alive.

The highest price acceptable by buyers is $v^h = E(v|G, n) = \frac{qv}{q+(1-q)(1-\tau)}$. Thus the most a seller can get from cheating is v^h. The resale value of an h-name after a failure is p_{hf}, which is

[17] This idea of letting folk theory work for names rather than real players with the names is attributed to Kreps (1990), while the innovation of the paper here is to incorporate into this pure adverse selection framework an element of moral hazard through "ethics", for the purpose of applying the Krepsian idea.

discounted r. The threat of losing the resale value can stop cheating if and only if $rp_{hf} \geq v^h$. The argument of the last paragraph implies the following social custom:

Definition 2 ***Social Custom****: a cheating h-name with resale value $p_{hf} \geq \frac{v^h}{r}$ keeps producing useless widgets and cheating by setting a positive price for them.*

In the basic model, both types of sellers get same profit from the widgets if holding same h-names. The reason why good sellers outbid bad ones in bidding some good names is that the former can get more capital gain from reselling the names as they succeed with bigger probability and the resale value is higher after a success than after a failure. This effect is called *value-add effect*. In the extension when the ethic and the custom are introduce, buying names with resale value $p_{hf} \geq \frac{v^h}{r}$ is to commit to pricing honestly ex ante, especially setting price 0 when getting signal u. This effect is called *commitment effect*. As ex ante only good sellers are willing to make such a commitment, commitment effect provides another way in which good sellers outbid bad sellers. That is the intuition of how introducing ethic improves social efficiency. The argument leads to the following definition:

Definition 3 *The names with resale value $p_{hf} \geq \frac{v^h}{r}$ are called commitment names. Otherwise, they are "non-commitment" names.*

Only good sellers want to buy commitment names.

5.3 Necessity of Ex Post Information and Long Memory

To show the necessity of ex post information and the long memory of dynamics, I need to decide first the value dynamics of the reputation in equilibria. The dynamics are decided by the two equilibrium conditions (E1): good sellers get R_G from any names they buy in equilibrium path; and (E2): bad sellers get return 0 in equilibrium path and non-positive return in non-equilibrium path[18].

Dynamics: For any h-names, the return of bad sellers buying them is $-p_h+w_h-c+rp_{hf} \leq 0$ by (E2). As $w_h \geq 0$, we have

[18]Suppose otherwise they get positive return in some equilibrium. Then all bad sellers would enter production in each period, and the social surplus is $\gamma qv - c < 0$ by assumption 1. By No Ponzi condition in whole sellers' return comes from the social surplus generated by them. Hence no positive return is possible, contradicting with the supposition that bad sellers get positive return.

$$p_{hf} \leq \frac{p_h + c}{r} \tag{3}$$

If some h-names are only bought by bad sellers, then $w_h = 0$ and (E2) implies

$$p_{hf} = \frac{p_h + c}{r} \tag{4}$$

If h-names are bought by good sellers, what happens depends on whether the names are commitment names. Suppose first that they are not ($p_{hf} < \frac{v^h}{r}$). Then $R_G = -p_h + w_h - c + r[qp_{hs} + (1-q)p_{hf}] = -p_h + w_h - c + rp_{hf} + rq(p_{hs} - p_{hf})$. Then two cases are needed to be considered. If $p_h - rp_{hf} < \pi$ $(= qv - c)$, bad sellers buy the h-names in equilibrium[19]. By condition (E2) $-p_h + w_h - c + rp_{hf} = 0$. Then $R_G = rq(p_{hs} - p_{hf})$. If $p_h - rp_{hf} \geq \pi$, then $\lambda_h = 1$ and $w_h = qv$[20]. Then $R_G = -(p_h - \pi - rp_{hf}) + rq(p_{hs} - p_{hf})$. Let $\Delta_h =: \max\{p_h - rp_{hf} - \pi, 0\}$. Then the two cases are combined together into

$$p_{hs} = p_{hf} + \frac{R_G}{rq} + \frac{1}{rq}\Delta_h \tag{5}$$

(3), (4) and (5) actually describe the dynamics in the basic model. Thus if the dynamics are decided by the three equations, then proposition 2 holds true.

Suppose then that the h-names are commitment names ($p_{hf} \geq \frac{v^h}{r}$). When good sellers holding the names get signal u, with probability $(1-q)\tau$, they will set price 0 honestly so as to keep the names' resale value p_{hf}. When they get signal n, ex ante with probability $q + (1-q)(1-\tau)$, in equilibrium they set price $v^h = E(v|G, n)$ with probability 1[21]. However with probability $\Pr(0|G, n) = \frac{(1-q)(1-\tau)}{q+(1-q)(1-\tau)}$ their widget is actually useless and the commitment names are destroyed since price v^h is regarded as a cheating price; while with the complement probability, the widget is really useful and the names are sold at price p_{hs}. Then $R_G = -p_h - c + [q + (1-q)(1-\tau)][v^h + \frac{q}{q+(1-q)(1-\tau)} rp_{hs}] + (1-q)\tau[0 + rp_{hf}] \Rightarrow$

$$-p_h + \pi + rqp_{hs} + r(1-q)\tau p_{hf} = R_G \tag{6}$$

[19] Otherwise $w_h = qv$ and the return of bad sellers buying the h-names is $-p_h + w_h - c + rp_{hf} = -p_h + \pi + rp_{hf} > 0$, Thus bad sellers should buy the names.

[20] Suppose otherwise $\lambda_h < 1$. Then $w_h < qv$. The return of bad sellers buying the h-names is $-p_h + w_h - c + rp_{hf} < -p_h + \pi + rp_{hf} \leq 0$. That means they should not buy the names, contradictory with $\lambda_h < 1$.

[21] Suppose otherwise, to be concerned with keeping the resale value, they set price 0 with some positive probability μ. Then conditional on price 0 and the h-names, the expected value of the widgets is positive $(E(v|h, w = 0) \propto \lambda_h(q + (1-q)(1-\tau))\mu \cdot v^h)$. In the competitive market, the buyers will push the price of the widgets to equal the expected value, which contradictory with the supposition that the price of the widgets is 0.

Denote by H the set of all possible histories including infinite ones, that is, $H = \{\phi, s, f, ss, sf, fs, ff, ...\} = \bigcup_{t\geq 1} H^t$. Summarily, the equilibrium dynamics are a function $p : H \longrightarrow R^+ \cup 0$ such that $p_\phi = 0$ and (3); and that when h-names are only bought by bad sellers (4) holds; and that when good sellers also buy h-names, (5) if $p_{hf} < \frac{v^h}{r}$, and (6) if $p_{hf} \geq \frac{v^h}{r}$.

Notice that SNE in the last section is still an equilibrium here in which the ethic have no bite. The questions are whether and when ethic *make difference* in equilibrium, which is equivalent to get an equilibrium with $R_G > rq\pi$ by proposition 2. In this subsection I get some necessary conditions for such an equilibrium to exist. Then in the next subsection I construct fully equilibria in which ethic do make difference.

Check the proof of lemma 1 and find that the proof does not depend on any specific dynamics. Therefore lemma 2 still holds in the extension. So $P = \sup\{p_h | all\ h\}$ is well defined for any given equilibrium. If in the equilibrium $R_G > rq\pi$, the $P \geq \frac{v^h}{r}$. Otherwise there are no commitment names and by proposition 2 $R_G \leq rq\pi$. And the upper bound is actually related to the social welfare:

Lemma 2 *In equilibria where* $R_G > rq\pi$, $P \leq \frac{\pi - R_G}{1-rq-r(1-q)\tau}$.

Proof. See appendix. ■

The lemma actually gives out the necessity of ex post information for ethic to make difference.

Corollary 1 *There exists equilibria where ethic makes difference only if* $\tau > \tau_c =: \frac{(qv-r\pi)(1-rq)}{r(1-q)[qv-(1-rq)\pi]} > 0$ *and* $\pi > \frac{(1-r)v}{r(1-rq)}$.

Proof. : If the equilibrium exists, then in it $P \leq \frac{\pi - R_G}{1-rq-r(1-q)\tau}$ by lemma 2 and $P \geq \frac{v^h}{r}$. Thus such a equilibrium exists only if $\frac{\pi - R_G}{1-r+r(1-q)(1-\tau)} \geq \frac{v^h}{r}$. As in the equilibrium $R_G > rq\pi$, $\frac{\pi - R_G}{1-r+r(1-q)(1-\tau)} \geq \frac{v^h}{r} \Rightarrow \frac{\pi - rq\pi}{1-r+r(1-q)(1-\tau)} > \frac{v^h}{r} \Leftrightarrow \tau \geq \tau_c$. As $qv > \pi$, $qv - r\pi > 0$ and $qv - (1-rq)\pi > 0$. Hence $\tau_c > 0$. The second part of the lemma is derived from the requirement that $\tau_c < 1$. ■

The corollary says only if the sellers' ex post knowledge about the quality is precise enough, that is, τ is big enough, ethic can make any difference. Especially in the basic model where $\tau = 0$, there is no role for ethic. From the point of *nominal* view, if sellers do not have "precise" knowledge about the quality of the widgets ($\tau = 0$), it would be "*unfair*" to say that they cheat intentionally by setting a positive price for useless widgets. Therefore the ethic based on such a definition of "cheating" is not "*just*". It is amazing to notice that this simple *ethical* consideration actually has *economical* ground that if $\tau = 0$, the ethic cannot make any difference.

Notice that in equilibria where $R_G > rq\pi$ there are new names. The reason is that the equilibria have commitment names and they are destroyed into new names with probability

$(1-q)(1-\tau)$. From new names there are s-names and f-names one period later. By (3), $rp_f \leq c < qv < v^h$. Then new names are not commitment names. And $\Delta_\phi = \max\{0 - rp_f - \pi, 0\} = 0$. Thus by (5), $R_G = rq(p_s - p_f)$. We come to the problem of long memory of the dynamics in equilibria where $R_G > rq\pi$.

Lemma 3 *$p_s < \frac{v^h}{r}$ in equilibria where $R_G > rq\pi$.*

Proof. Suppose otherwise $p_s \geq \frac{v^h}{r}$. Then $p_s - p_f \geq \frac{v^h - c}{r}$, which implies $R_G \geq q(v^h - c)$. On the other hand, by lemma 2 $R_G \leq -(1 - rq - r(1-q)\tau)P + \pi \leq -(1 - rq - r(1-q)\tau)v^h + \pi$ as in the equilibria $P \geq \frac{v^h}{r}$. Combining the two inequalities, we have $-(1 - rq - r(1-q)\tau)v^h + \pi \geq q(v^h - c) \Leftrightarrow \pi + qc \geq (q + 1 - rq - r(1-q)\tau)v^h$. Notice that $[q + (1-q)(1-\tau)]v^h = qv$ and $q + 1 - rq - r(1-q)\tau = q + (1-q)(1-\tau) + (1-r)[q + (1-q)\tau] > q + (1-q)(1-\tau)$. Therefore $\pi + qc \geq (q + 1 - rq - r(1-q)\tau)v^h \Rightarrow \pi + qc > qv \Leftrightarrow qv - c + qc > qv \Leftrightarrow qc > c$, a contradiction. ■

Corollary 2 *The dynamics have long memory in equilibria where ethic make difference.*

Proof. In the equilibria the highest value $P \geq \frac{v^h}{r}$. And we know $p_f < \frac{v^h}{r}$. By the lemma $\max\{p_s, p_f\} < \frac{v^h}{r}$. Thus the value cannot stop increasing after one period in the equilibria, which means that the dynamics features necessarily long memory for at least two periods. ■

In the next subsection SBE is fully constructed to show that the equilibria where ethic make difference do exist.

5.4 Socially Best Equilibrium (SBE) in the Extension

Suppose some $h-$names take the highest value P. Then the names cannot only be bought by bad sellers[22] and are commitment names[23]. Thus by (6) $R_G = -P + \pi + rqp_{hs} + r(1-q)\tau p_{hf}$. To maximize R_G, we want to increase p_{hs} and p_{hf} as possible as we can. Therefore in SBE, $p_{hs} = p_{hf} = P$, if $p_h = P$. The intuition is that for the commitment names, bad sellers are deterred off buying the names not by capital loss (value-add effect), but by the fact that then they have set the honest price (commitment effect). Therefore we do not want to lower down the names' value after a failure, as that would make the names vulnerable to be killed by failures. Thus $R_G = -(1 - rq - r(1-q)\tau)P + \pi$ in SBE.

[22] Otherwise $p_{hf} = \frac{p_h + c}{r} > P$, contradictory with the definition of P.

[23] Otherwise by (5), as in the proof of lemma 3, $p_{hs} \geq p_h + \frac{p_h - \pi}{r} > P$, contradictory to the definition of P.

In the subsection, to make computations and denotations easier and as $r < 1$ does not matter for the construction of equilibria, I consider only the extreme case where $r = 1$[24]. And let $\beta =: (1-q)(1-\tau)$. Then $v^h = \frac{qv}{q+\beta}$ and the condition in corollary 1 is $\pi > \frac{\beta}{1-q}v^h = (1-\tau)v^h$. And $R_G = -\beta P + \pi$ in SBE. So the problem of finding SBE becomes:

Problem 1 (*) $\min P$ *s.t.* $P \geq v^h$, *and* $P \geq p_h$ *for all* h, *and the dynamics.*

Thus the dynamics in the SBE look like as follows. Beginning from new names with $p_\phi = 0$, the value is increased according to the dynamics given in the last subsection. Then whenever the value of some names is beyond v^h, we want the value to be the highest value P, not varying with respect to additional successes or failures ($p_{hs} = p_{hf} = p_h$) any more. And we want the difference $P - v^h$ as small as possible (up to the constraint that it is non-negative).

The names with the ceiling value are called ceiling names. Thus in SBE, if h-names are ceiling names, then so are hh'-names for any h' and only the ceiling names have commitment effect. The interesting things are what are the first ceiling names and how many stages after which new names could become ceiling names. Then we have the following definition.

Definition 4 *The **Height** of an equilibrium is defined by* $n^s = \min\{n | \ p_h \geq v^h$ *for some* $h \in H^n\}$.

For any equilibrium where $R_G > q\pi$, there are h-names such that $p_h \geq v^h$. Thus n^s is well defined. And by corollary 2 $n^s \geq 2$ in such a equilibrium. I am going to find SBE with the smallest height.

Some SBE could be very "strange". For example, suppose $c = \frac{v^h}{N}$ for some natural number N. Then SBE would be as follows. New names are only held by bad sellers. After the failure, the names become f-names with value $p_f = c$. Then these f-names are only bought by bad sellers again and get $p_{ff} = 2c$. Similarly f^m-names are only bought by bad sellers until $m = N$. Then f^N-names become commitment names as $p_{f^N} = Nc = v^h$ and are only held by good sellers. As $P = v^h$, an optimal solution is found.

The dynamics are very improbable to happen in our world due to two problems, both related to the belief driving the dynamics. Firstly, in the dynamics buyers believe that the names in the first N stages (from new names to f^{N-1}) are the hallmark of bad sellers, whereas that the names in the $N+1$th stage are the hallmark of good sellers, a U-turn about the names' meaning, which

[24] More precisely, the case of r colse to but still less than 1. As everything is continuous in r below, I just consider what happens for $r = 1$.

is very improbable in our world. The second is that in the equilibrium *only* bad sellers produce in the first N stages, which is social *worst*! Suppose the stationary equilibrium is evolved from what happens in the finite periods, as most of the social beliefs are taught by and inherited from our parents. In the first N periods the people would avoid the social worst situation by forming other social beliefs. Thus the strange dynamics can never emerge from the evolution. The first argument is actually explained by the second one, which leads to the following assumption:

Assumption 3: In each finite period the social efficiency is maximized given the names available then and the stationary equilibria are evolved out when the beliefs persist in the way of education and inheritance.

Then such stationary equilibria are called "*Evolvable Equilibria*".

For each period, the people try to make most of the names (histories) existing then to drive out bad seller. Therefore want $p_{hf} \leq \max\{p_h - \pi, 0\}$[25] to deter bad sellers through capital loss, or want $p_{hf} \geq v^h$ to generate commitment effect to deter them. Therefore the assumption implies that in the evolvable equilibria if $p_h < v^h - c$, which implies $p_{hf} \leq p_h + c < v^h$ by (3), then $p_{hf} \leq \max\{p_h - \pi, 0\}$. Especially $p_f = 0$. Then $R_G = qp_s$ and $R_G > q\pi \Leftrightarrow p_s > \pi$.

Lemma 3 says the names' value cannot stop increasing at p_s in SBE where $R_G > q\pi$. In the second stage there are s^2 and sf-names. The proof of lemma 4 actually shows that $p_s - p_f < v^h - c$. Given $p_f = 0$, that means $p_s < v^h - c$. Therefore in the evolvable equilibria $p_{sf} \leq p_s - \pi < v^h$ and only s^2-names could be ceiling names. Then two questions arise.

(Q1): Are s^2-names actually ceiling names under some conditions? Or are two stages of evolution ($n^s = 2$) sufficient to get a SBE? And

(Q2): Is $n^s = 2$ always sufficient to get a SBE? Or more generally what is the upper bound of smallest heights of SBE in all cases? If the upper bound is a finite number N, then we know that the value of the reputation stop increasing after N stages in any case.

I discuss the two questions one by one.

For the first question, suppose $p_{s^2} \geq v^h$ and are the first ceiling names. To find SBE I need to minimize p_{s^2} subject to $p_{s^2} \geq v^h$. Consider what constraints imposed by the dynamics. As $p_{sf} < v^h$, (5) holds for s-names. Thus $p_{s^2} = p_{sf} + \frac{R_G}{q} + \frac{1}{q}\max\{p_s - \pi - p_{sf}, 0\}$. Then for $p_{sf} \leq p_s - \pi$, p_{s^2} is decreasing with respect to p_{sf} while for $p_{sf} \geq p_s - \pi$, it is increasing. Thus p_{s^2} is minimized at $p_{sf} = p_s - \pi$ with the minimum value being

[25] By setting $p_{hf} \leq \max\{p_h - \pi, 0\}$, bad sellers are driven out by the h-names to the most degree. If $p_h \geq \pi$, they are excluded totally from buying the names; if $p_h < \pi$, good sellers buy the names to the most degree as $\lambda_h = \frac{w_h}{qv} = \frac{p_h - p_{hf} + c}{qv} \leq \frac{p_h + c}{qv}$.

$$p_{s^2} = 2p_s - \pi \tag{7}$$

And since $p_{s^2} = P$, $R_G = -\beta p_{s^2} + \pi$. On the other hand $R_G = qp_s$. Combine them, we have

$$-\beta p_{s^2} + \pi = qp_s \tag{8}$$

From (7) and (8), if s^2-names are actually ceiling names, then the minimized $p_{s^2} = \frac{2-q}{q+2\beta}\pi$. If

$$\pi \geq \frac{q+2\beta}{2-q} v^h \tag{9}$$

then the minimized $p_{s^2} \geq v^h$ and we do get a solution of problem (*) with the objective $P = \frac{2-q}{q+2\beta}\pi$. In the solution $p_s = \frac{p_{s^2}+\pi}{2} = \frac{1+\beta}{q+2\beta}\pi > \pi$ and thus $R_G = qp_s > q\pi$, which means ethic do improve social efficiency. And $p_{sf} = p_s - \pi = \frac{(1-q)\tau}{q+2\beta}\pi$. In SBE $p(s^2h) = p_{s^2}$ for any h if the price of the widget is honesty. To fully decide a SBE it suffices to decide $p(sfh)$ for all h-names in the way consistent with the dynamics given in the last subsection and assumption 3.

That actually has some degree of freedom. If $p_{sf} = \frac{(1-q)\tau}{q+2\beta}\pi \leq \pi \Leftrightarrow \tau \leq \frac{2-q}{3-q}$, I set $p_{sff} = 0$ and $p_{sfs} = p_s$. As $p_{sff} < v^h$, the applicable dynamics equation is (5). It holds for the value set here as $p_{sfs} - p_{sff} = p_s = \frac{R_G}{q} + \frac{\max\{p_{sf}-\pi,0\}}{q}$. The whole dynamics in the SBE is illustrated as follows.

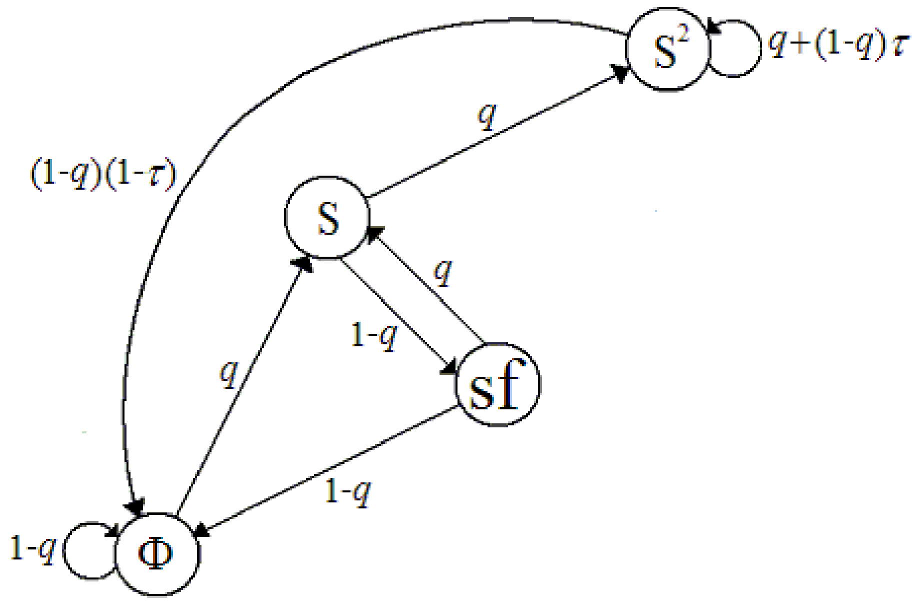

Figure 2: the dynamics in SBE if $\tau \leq \frac{2-q}{3-q}$.

On the other hand, if $p_{sf} > \pi$, I set $p_{sff} = p_{sf}$ and $p_{sfs} = P = p_{s^2}$. Again by the set-up, sf-names are non-commitment names. Thus the applicable dynamics equation is also (5). Now $\Delta_{sf} = \max\{p_{sf} - \pi - p_{sff}, 0\} = 0$. (5) is equivalent to $p_{sfs} - p_{sff} = p_s \Leftrightarrow p_{s^2} - p_{sf} = p_s \Leftrightarrow p_{s^2} = p_s + p_{sf} \Leftrightarrow p_{s^2} = 2p_s - \pi$, which is (7). The dynamics are illustrated below.

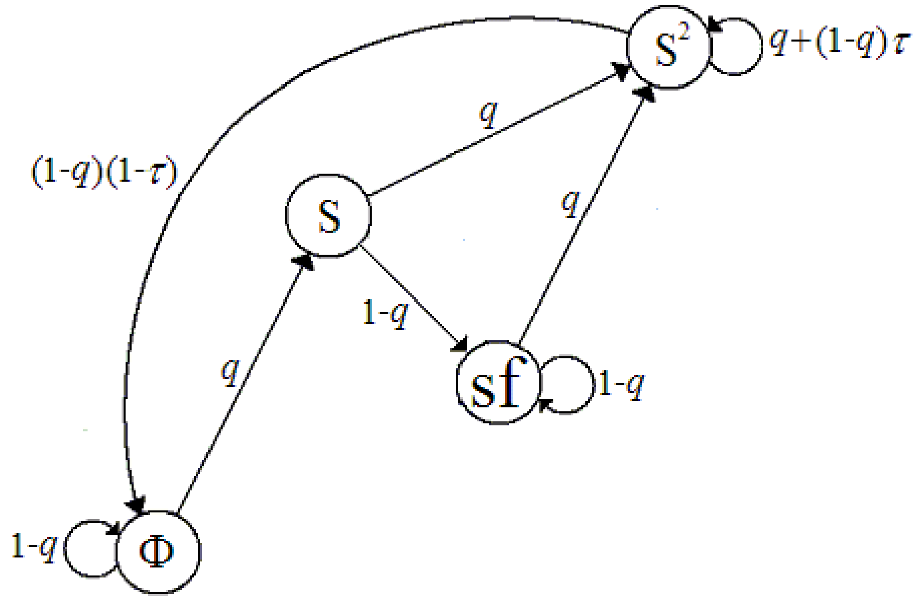

Figure 3: the dynamics in SBE if $\tau > \frac{2-q}{3-q}$

Summarily we have the following:

Proposition 3 *If (9) holds true, the socially best equilibria are as figured out above, in which* $p_s = \frac{1+\beta}{q+2\beta}\pi$*,* $p_{sf} = p_s - \pi$ *and* $p_{s^2} = p_s + p_{sf}$*. And if* $\tau \leq \frac{2-q}{3-q}$ *the dynamics are illustrated in figure 2 and if otherwise are in figure 3. In both dynamics,* $p_{hs} \geq p_s \geq p_{hf}$*, with the strict inequality holding except for new names or commitment names and* $p_{hf} = 0$ *if* $p_h \leq \pi$*. The equilibria are better than SNE.*

The features that $p_{hs} \geq p_s \geq p_{hf}$ and $p_{hf} = 0$ if $p_h \leq \pi$ are natural for the reputation dynamics of natural persons since the successes and failures are used to Bayesian updating the estimation of the persons' types[26]. Amazingly, the dynamics of organizations' reputation also bear the features, which surely reinforces the personalization of organizations.

So far, I have shown that $n^s = 2$ is sufficient if (9) holds and thus answered question (Q1). Now I come to question (Q2), how many stages of evolution are necessarily needed to get a SBE?

[26]see also note 1.

If (9) does not holds, then minimum p_{s^2} is smaller than v^h. That, however, does not necessarily imply that $n^s = 2$ is not sufficient since I can set $p_{sf} < p_s - \pi$[27] to increase p_{s^2} according to (5). The upper bound is achieved at $p_{sf} = 0$, satisfying, by (5) for s-names, $qp_{s^2} + \pi - p_s = R_G = qp_s$. On the other hand $R_G = -\beta p_{s^2} + \pi$ if $p_{s^2} \geq v^h$ and reaches the ceiling level. Combine the equations together. Then the maximum value of s^2-names consistent with the supposition that they are ceiling names is $p_{s^2} = \frac{\pi}{\beta+q^2+q\beta}$. And $\frac{\pi}{\beta+q^2+q\beta} \geq v^h \Leftrightarrow \pi \geq (\beta + q^2 + q\beta)v^h$, while the necessary condition in corollary 1 is $\pi > (1-\tau)v^h$. We know that $\beta+q^2+q\beta = q^2+(1-q^2)(1-\tau) > 1-\tau$. Therefore If $(1-\tau)v^h < \pi < \beta + q^2 + q\beta$, $n^s \geq 3$ is necessary for a SBE.

How many stages are necessary in general? We have the following proposition, the proof of which is put in the appendix:

Proposition 4 *If $(1-\tau)v^h < \pi < \min\{1-\tau+\frac{(1-q)\tau}{q^{-N}-1}, q^{N+1}+(1-q^{N+1})(1-\tau)]v^h$, the height of SBE is bigger than $N+1$. The lower surplus generated by average good sellers (π) is, the more stages are needed for names to evolve from new to the ceiling names.*

As the firms in the high end of markets generally produce higher social surplus than those in the low end, the proposition predicts that the former establishes fully the reputation than the later. This prediction is empirically testable.

6 Empirical Relevance and Conclusion

Reputation is important capital of our world as it helps to relieve the many problems due to asymmetric information. Surely reputation is built by natural persons, who are destined to die. So there arises a problem. Does the reputation built by them die with them? If they do and the new generation has to rebuild reputation of their own, societies have to bear the replicative cost (direct cost of the invested resources and indirect cost of inefficiency due to lack of reputation). Therefore any societies would have interest to avoid this cost replication. As discussed in the paper here, the societies can achieve this by cleverly attaching reputation not to natural persons that are destined to die, but to organizations that technically could live forever.

The mechanism depends on the existence of names market, the market for buying and selling reputation. When attempting to apply the mechanism into the realities, we would ask the question: does this market really exist in our world? Or is the mechanism nothing but a fiction of economists?

[27] By assumption 3, in the evolvable equilibria $p_{sf} \leq p_s - \pi$.

It does! The closest example is the merger and acquisition (M&A) market. Physical capital could be bought and human capital could be hired. Then why do acquirer firms want to buy acquiree firms *as a whole*? And why does the former pay a lot more than what is needed to buy all independently indentifiable assets, both tangible and intangible, of the later? There must be some thing existing sorely in the whole, not among the parts, that the acquirers want to buy and have to pay. This thing is exactly the reputation of the acqirees as a whole[28]. Its value, referred as "goodwill" in M&A accounting, if measured in the "top-down" perspective", equals the difference of the price of the acquirees minus the sum of fair values of all their independently indentifiable assets[29]. Moreover, one of the two core components of goodwill[30] could be "the preexisting goodwill that was ... acquired by it (the acqiree) in a previous business combination"[31]. Thus after a M&A, the reputation of the acquirees, as measured by "goodwill", is indeed kept in the acquirer as a whole. Take AllianceBernstein L.P. as example. When acquiring SCB Inc. on October 2000, it paid approximately $3bn as goodwill. As reported in the condensed consolidated statement of financial conditions as of September 30, 2006, the goodwill is kept almost the same ($2,893m). Furthermore, this M&A market is not confined for economical entities; it could involve any transactions in which entities as a whole are traded. For example, Manchester United, a famous UK football club, was bought by US tycoon Malcolm Glazer. In a word, in the fields where entities can be traded as a whole, we can expect that the literal mechanism fences reputation off the attack from the death of natural persons.

How about other fields of human life in which such trading of entities as a whole does not exist explicitly, like schools? Could the mechanism be applied there? I think the market for reputation is still there, but in implicit form. Take school as an example and consider the following model of schools' reputation. Each teacher works for two periods (young and old) and each school consists of a young and an old teacher, with teacher change observable to the schools' customers (students and their parents). Teachers' quality, high or low, is not observable to the customers, but to the old teachers in charge of recruiting the junior from PhDs. Besides teaching the students, teachers enjoy some business called "research", in pursuing which strong complementarity is present. PhDs want to enter reputed schools that charge high tuition fees and pay high wages. It is straightforward that in equilibrium high quality young teachers enter reputed schools which is under the control of high quality old ones. Here in the job market the potential young teachers (PhDs) bid for reputation, nevertheless not with money as in the literal

[28] Another possibility is that the acquirers pay a premium for the effect of reducing competition. However, if the effect is dominant, the M&A cannot pass anti-trust regulation.

[29] See also pp294, Johnson and Petrone (1998).

[30] This is component 3 in pp295, supra.

[31] pp296, supra.

mechanism, but with their ability to "entertain" old teachers in research.

Overall, the market for reputation exists extensively, even though sometimes implicitly, and the mechanism, as discussed in the paper here, captures the essence of the way in which our human societies make organizations derive and bear reputation, for the purpose of avoiding the cost of rebuilding reputation generation by generation.

In the economy of the paper, as shown in the benchmark, if reputation dies with the people building it, the economy has inefficiently zero social surplus. On the contrary, if organizations, which are no more than names shared by the members of different periods, derive and bear reputation, then the reputed names function as signalling and sorting instruments to exclude the unqualified from production. In addition if we go further in personalizing organizations by imposing ethical evaluations about the pricing behaviour upon them, the social welfare is increased in addition, as then the names of high enough reputation work as the device of committing to pricing the products honestly, which unqualified producers never want to do.

More interestingly, I spell out fully the up and down of the reputation with respect to the organizations' performance in the second best. In the basic part where no ex post signals or ethic are introduced, the simple Single Name Equilibrium implements the second best in which the dynamics of the reputation is a Markovian transformation between two states and has no memory. When the ex post signals and ethic are introduced, the dynamics has long memory and the four features: (1) the reputation increases after a success; (2) it decreases after a failure and is destroyed totally by it if the reputation is already low enough; (3) it has a ceiling level and only names having the ceiling reputation communicate the quality of their products honestly through prices; (4) the ceiling reputation is not swayed by the performance, but is destroyed by dishonest pricing behaviour. And comparatively the lower surplus average good sellers generate, the longer period is needed for the reputation to evolve from none to the ceiling level. All these features of the dynamics and the comparative statics are empirically testable if we have full fledged data of goodwill.

7 Appendix

Some lengthy proofs are put here. Here I also use $p(h)$ for the price of h-names.

7.1 Proof of Lemma 1

Given any h-names, define $W^t(h)$ the total values of the names that the h-names generates after t periods. Formally $W^t(h) = \sum_{h' \in H^t} \rho(h')p(hh')$. Surely $W^0(h) = p_h$ and $W^1(h) = q\lambda_h p(hs) + (1-$

$q\lambda_h)p(hf)$. No Ponzi requires that $r^t W^t(h) \longrightarrow 0$ for any $h-$names.

Claim 1: $W^1(h) \geq \frac{p_h-\pi}{r}$ for any h-names.

Proof: Consider all the sellers of holding the h-names. Up to the multiplier of the names' mass, the sum of their return is $-p_h + \Pi_h + rW^1(h)$, where Π_h is the sum of their profit from selling the widgets. In equilibrium any seller's return is non-negative while his profit is no bigger than π. Thus $-p_h + \Pi_h + rW^1(h) \geq 0$ and $\Pi_h \leq \pi$, which implies claim 1. Q.E.D.

Claim 2: $W^{t+1}(h) \geq \frac{W^t(h)-\pi}{r}$ for any t and any h-name.

Proof: By mathematical induction. For $t = 0$, the claim is exactly claim 1. Suppose the claim is true for $t = k-1$. Then consider the case $t = k$. Remember $W^{k+1}(h) = q\lambda_h W^k(hs)+(1-q\lambda_h)W^k(hf)$. Then by induction hypothesis, $W^{k+1}(h) \geq q\lambda_h \frac{W^{t-1}(hs)-\pi}{r} + (1-q\lambda_h)\frac{W^{t-1}(hf)-\pi}{r} = \frac{q\lambda_h W^{k-1}(hs)+(1-q\lambda_h)W^{k-1}(hf)-\pi}{r} = \frac{W^k(h)-\pi}{r}$. Therefore I have proven it for $t = k$. Q.E.D.

The following claim is used as a technical tool.

Claim 3 (Comparison Lemma): Suppose sequence $\{x_t\}$ is defined as follows. $x_0 = p_h = W^0(h)$ and $x_{t+1} = \frac{x_t-\pi}{r}$ for $t \geq 0$. Then $W^t(h) \geq x_t$ for any $t \geq 0$.

Proof: By mathematical induction. $t = 0$, that is true by assumption. Suppose the claim is true for $t = k-1$. Then consider the case $t = k$. By claim 2, $W^{t+1}(h) \geq \frac{W^t(h)-\pi}{r} \geq \frac{x_t-\pi}{r} = x_{t+1}$, where the second inequality applies the induction hypothesis. Q.E.D.

Then I can prove a first main result here, which is about the upper bound of names' price.

Claim 4: for any h-name, $p_h \leq \frac{\pi}{1-r}$.

Proof: Suppose on the contrary for some h-name, $p_h = W^0(h) > \frac{\pi}{1-r}$. Then compute the sequence defined in claim 3. It is easy to get that $x_t = (\frac{1}{r})^t \frac{p_h(1-r)-\pi}{1-r} + b$ for some b. Then $r^t W^t(h) \geq r^t x_t \longrightarrow \frac{p_h(1-r)-\pi}{1-r} > 0$. Thus No Ponzi condition is violated. Q.E.D.

7.2 Proof of Lemma 2

First $P \geq \frac{v^h}{r} > qv$. Thus $P - \pi > qv - \pi = c$. For any ε such that $0 < \varepsilon < \min\{c, \frac{R_G}{rq} - \pi\}$, find h^*-names such that $p(h^*) > P - \varepsilon$. Then firstly $p(h^*) > \pi$ as $P - \varepsilon > P - c > \pi$. And the names cannot be only bought by bad sellers, since otherwise $p(h^*f) = \frac{p(h^*)+c}{r} > \frac{P}{r} > P$, contradictory to the definition of P. Thirdly, $p(h^*f) \geq \frac{v^h}{r}$. Otherwise by (5), $p(h^*s) = p(h^*f) + \frac{R_G}{rq} + \frac{1}{rq}\Delta_h$, which is a decreasing function of $p(hf)$ if $p(hf) \leq \frac{p_h-\pi}{r}$ and a increasing function if otherwise. Therefore $p(h^*s) \geq p(h^*f) + \frac{R_G}{rq} + \frac{1}{rq}\Delta_h|_{p(h^*f)=\frac{p(h^*)-\pi}{r}} = \frac{p(h^*)-\pi}{r} + \frac{R_G}{rq} > p(h^*) - \pi + \frac{R_G}{rq} > p(h^*) + \varepsilon > P$, a contradiction again. Thus $p(h^*f) \geq \frac{v^h}{r}$ and the names are commitment names.

Then the dynamics are described by (6). Hence $R_G = -p(h^*) + \pi + rqp(h^*s) + r(1-q)\tau p(h^*f) \leq -P + \varepsilon + \pi + [rq + r(1-q)\tau]P \Rightarrow P \leq \frac{\pi - R_G + \varepsilon}{1-rq-r(1-q)\tau}$. Let $\varepsilon \longrightarrow 0$, we get that

$P \leq \frac{\pi - R_G}{1 - rq - r(1-q)\tau}$. Q.E.D.

7.3 Proof of Proposition 4

Two cases are needed to consider, depending on which names are the first ceiling names. In evolvable equilibria if hf-names are not ceiling names, $p_{hf} < p_{hs}$ by (5). Thus in an equilibrium with height $N+1$, $p(s^N) > p(h)$ for all $h \in H^N$. Therefore only $s^N f$ or s^{N+1} names could be the first ceiling names.

Suppose that $s^{N+1}-$names are the first ceiling names. To make the value increase as possible as it can at each stage, I set $p(s^n f) = 0$. Then applying (5) for $h = s^n$, $qp(s^{n+1}) + \pi - p(s^n) = qp_s$ for $1 \leq n \leq N$. Then from the equation, $p(s^{N+1}) = \frac{p_s - \pi}{1-q}(\frac{1}{q})^N + \frac{\pi - qp_s}{1-q}$. And $qp_s = -\beta p(s^{N+1}) + \pi$, from which $p_s = \frac{-\beta p(s^{N+1}) + \pi}{q}$. Substitute that into the equation of $p(s^{N+1})$ and remember $\frac{\beta}{1-q} = 1 - \tau$, then we get $P = p(s^{N+1}) = \frac{\pi}{q^{N+1} + (1-q^{N+1})(1-\tau)}$. If $s^{N+1}-$names are ceiling names as supposed, then $p(s^{N+1}) \geq v^h \Leftrightarrow \pi \geq [q^{N+1} + (1-q^{N+1})(1-\tau)]v^h$. Therefore if $(1-\tau)v^h < \pi < [q^{N+1} + (1-q^{N+1})(1-\tau)]v^h$, $s^{N+1}-$names cannot be the first ceiling names.

Suppose that $s^{N+1}f-$names are the first ceiling names. By (3) for $h = s^N$, $p(s^{N+1}f) \leq p(s^N) + c$. Thus if the supposition is true, $p(s^N) \geq v^h - c$. By the calculation above the maximum $p(s^N) = \frac{p_s - \pi}{1-q}(\frac{1}{q})^{N-1} + \frac{\pi - qp_s}{1-q}$. And $qp_s = R_G \leq -\beta v^h + \pi \Rightarrow p_s \leq \frac{-\beta v^h + \pi}{q}$. Then $p(s^N) \leq q^{-N}\pi - (q^{-N} - 1)(1-\tau)v^h$. Therefore $s^{N+1}f-$names are the first ceiling names only if $q^{-N}\pi - (q^{-N} - 1)(1-\tau)v^h \geq v^h - c$. Remember $c = qv - \pi = (q+\beta)v^h - \pi$. Substitute into the last inequality, then $q^{-N}\pi - (q^{-N} - 1)(1-\tau)v^h \geq v^h - (q+\beta)v^h + \pi$, which is equivalent to $(q^{-N} - 1)\pi \geq [(q^{-N} - 1)(1-\tau) + (1 - q - \beta]v^h \Leftrightarrow \pi \geq [1 - \tau + \frac{(1-q)\tau}{q^{-N} - 1}]v^h$. Therefore if $(1-\tau)v^h < \pi < [1 - \tau + \frac{(1-q)\tau}{q^{-N} - 1}]v^h$, the first ceiling names cannot be $s^N f-$names. Q.E.D.

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