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TRANSITION AND FINANCIAL COLLAPSE

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Abstract

One of the many problems facing the countries in transition from socialism to capitalism is the lack of proven entrepreneurial talent in addition to a low initial level of capital. This paper shows that a financial collapse can result, in which young agents are too poor to provide enough collateral for financing a small project to prove their qualities as entrepreneur and no proven middle-aged entrepreneurs are available who can be entrusted with enough funds to run big projects. The economy contracts to an agricultural steady state. Possible remedies are discussed.

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1 Introduction

In an established market economy, one typically finds a pool of capable entrepreneurs who have proven their qualities when young by mainly self-financing and building up a small, but viable company. Funds allocated to these entrepreneurs enable them to build these into large, successful companies and ultimately ensure a high wage level for the entire economy. If such a country is hit by a war and a large fraction of its capital stock is destroyed, it is able to rebuild by lending resources to these entrepreneurs.

By contrast, countries in transition do not have a stock of proven entrepreneurs. A financial collapse can result: since there are no proven middle-aged entrepreneurs worth allocating funds to, the wage level remains low and new young agents entering such an economy are too poor to self-finance a start-up company. Lending to the young is prohibitively costly, given their limited collateral. Thus, there are no proven middle-aged entrepreneurs several years later either. The collapse is perfect.

This paper demonstrates this idea formally in a simple, highly stylized overlapping generations model. In the next section, the model is built. In section 3, the steady states are analyzed. It will be shown, that there are often at least two steady states: a fully industrialized one with many entrepreneurs and another agricultural one without entrepreneurs. In section 4, the dynamic transition process from an initial state with rather low capital will be considered. For some parameter values, it will be shown that with a pool of existing, proven entrepreneurs, the economy rebuilds to the capital-rich steady state, while without them, the economy collapses to the low-capital agricultural situation. In section 5, potential remedies are discussed, such as the creation of inequality, international credit subsidies and joint ventures with foreign companies. We find in particular, that creating inequalities among the young and / or long-term subsidies to young entrepreneurs provide for ways to achieve full industrialization most quickly. Section 6 concludes.

The idea of this paper rests on a potential lemon-problem in credit markets and therefore is related in spirit to Akerlof (1970), Stiglitz and Weiss (1981), Mankiw (1986), Bester and Hellwig (1987) and Gale (1992), although none of these models is used directly. The breakdown of the credit markets comes about due to a combination of adverse selection and the moral hazard problem of misusing allocated funds. Interventions can be desirable, since they can help avoid a credit market failure. This contrasts with e.g. Atkenson and Kehoe (1993), who consider the recent decline of output in the transition countries as an optimal reallocation of managerial talent to new technologies.

2 The Model.

2.1 The Environment.

In each period t = 0, 1, 2 ..., a new generation of agents $i \in [0;1]$ is born. These agents live three periods and care about the sum of their total consumption, $u = c_y + c_m + c_o$, where $c_y, c_m, c_o \geq 0$. Upon birth, a parameter $\gamma_i \geq 0$ characterizing entrepreneurial talent is drawn privately for agent i according to some continuous probability distribution G on $\mathbb{R}_+$ with $E[\gamma_i] < \infty$ and $G(0) = 0$. The draws are independent across agents and time. Agents are endowed with one unit of time, when young, which they supply inelastically as labor. Agents are also endowed with a small amount ot the consumption good $c_a \geq 0$ each period, which we interpret as consumption generated by some agricultural or "low-tech" technology always available to the agent. At $t = 0$, there also is a middle-aged generation, living for one more period, and an old generation living only in period $t = 0$, who again care about their total life-time consumption.

The production function for final output is

$$y = k^\rho (\bar{k} n)^{1-\rho}, \tag{1}$$

where $0 < \rho < 2/3$ and $\bar{k}$ denotes the aggregate capital stock. This externalityexpanded Cobb-Douglas production function has become popular in the endogenous growth literature (e.g. Romer (1986) or Uhlig and Yanagawa (1992)), since it helps in accounting for the stylized fact that capital returns are roughly the same everywhere, but wages are much higher in capital-rich countries. For the model here, it also greatly simplifies the algebra.

Capital for the next period can be produced in two ways. First, young agents can become entrepreneurs and invest resources $x = x_s$ in form of the final good in a "small" project of fixed size $x_s > c_a$. If they do, they receive

$$k = \gamma_i x_s \tag{2}$$

units of capital next period. In that period, k and thus γ_i become public information. Given resources x_s, however, a young agent also has the option of just pretending to invest. Unobserved by anybody in that period except himself or herself, he or she receives utility αx_s. That no capital is created is public information next period, while γ_i remains private. The parameter $0 \leq \alpha \leq 1$ measures the ease with which funds can be misallocated: at $\alpha = 1$, the fake entrepreneur simply consumes the available resources, whereas at $\alpha = 0$ it is impossible to escape the watchful eyes of the lenders and derive any use from the funds other than through genuine investment.

Secondly, middle-aged agents can invest resources $x = x_b > x_s$ in a "big" project and receive

$$k = \gamma_i x_b \tag{3}$$

units of capital, when old. For simplicity, it is assumed that they cannot pretend to invest.

Capital depreciates completely at the end of a period.

2.2 Equilibrium.

We consider the following competitive equilibrium. The production technology for the final output is operated by a competitive industry of firms, buying the capital from the capital owners at a unit price q for that period and hiring labor at a unit price w. The production of the investment good is undertaken, taking the market price for a unit of capital next period as given.

There is free entry into the banking industry. Debt contracts lasting one period with the possibility for default are the only type of contracts offered[1]. We furthermore assume that c_a cannot be contracted upon, i.e. an agent cannot promise to surrender future c_a upon defaulting on a bank loan. Banks choose loan size, interest rates and total credit supplied. Contracts offered to the young demand an interest factor (i.e. 1 + interest rate / 100) of R whereas the interest factor for the middle-aged is denoted by R_m. Contracts can be enforced subject to the constraint that consumption must be nonnegative. A competitive equilibrium is a list of consumption choices, investments/ faking decisions for all agents and all periods, and capital prices, wages and interest rates for all periods, so that all markets clear except the market for savings (see below), so that all agents maximize their utility (concerning the technical issue of aggregating a continuum of random variables as is necessary when spelling out the definition of an equilibrium formally, see Uhlig (1987)).

In equilibria, in which some middle aged agents consume positive amounts, the expected return on any asset must be unity. In particular, $R_m = 1$. Occasionally, candidate equilibria with a safe interest rate of zero result in total investment exceeding maximal total savings. We will nonetheless restrict attention to this interest rate and these equilibria throughout, interpreting the extra borrowing needed to come from credit extended by foreign countries. Thus, an expected return of unity condition for lenders replaces the market clearing condition for savings.

In all competitive equilibria, profit maximization of the competitive output-producing industry and aggregation imply, that $q = \rho$ and $w = (1-\rho)\bar{k}$.

[1]In particular, we exclude lotteries, see subsection 5.1.

2.3 Credit Markets.

Consider now a period with wages w and an interest factor R charged to young would-be entrepreneurs. Suppose furthermore that an entrepreneur who has taken the investment hurdle when young is always able to receive credit for operating the big investment project at an interest factor of unity: this assumption will be justified in equilibrium, since only the high-quality entrepreneurs will invest when young.

If $w + c_a \geq x_s$, a young agent will receive lifetime utility $(\rho\gamma_i - 1)(x_s + x_b) + w + 3c_a$ from investing and will therefore choose to do so if $\rho\gamma_i \geq 1$.

If $w < x_s - c_a$, the agent can either enjoy lifetime utility $w + 3c_a$ from his wages and endowments or attempt to borrow funds $x_s - w - c_a$ from a bank. Given resources x_s, a young agent thus faces the following tradeoff. He or she can either fake to be an investor and receive total lifetime utility $\alpha x_s + 3c_a$. Or he or she can genuinly undertake the project and receive total life time utility $\rho\gamma_i(x_s + x_b) - R(x_s - w - c_a) - x_b + 3c_a$. The third possibility to only invest when young is dominated by these two alternatives and can thus be ignored from now on, since it will turn out that $R \geq 1$, see equation (5).

If $\alpha x_s < w + c_a$, a complete separation takes place at $R = 1$: all young agents with $\rho\gamma_i \geq 1$ will request funds and genuinly invest, whereas all others will not request funds and consume or save their wages. For $\alpha x_s > w + c_a$, all agents will borrow funds. An agent will genuinly invest, iff

$$\gamma_i \geq \gamma_{R,w} \equiv \frac{1}{\rho} + \frac{x_s - w + c_a}{x_s + x_b}\frac{R}{\rho} - \frac{1-\alpha}{\rho}\frac{x_s}{x_s + x_b}. \qquad (4)$$

All other young agents will instead pretend to invest.

Attention is now restricted to the case $\alpha = 1$. Other values are considered again only in subsection 5.5. Banks compete by setting interest rates. If a bank offers an interest rate lower than its competitors, all agents with high γ_i will apply for a loan at this bank. Likewise, agents with a low γ will apply there in order not to reveal that they are different from the high-γ agents. We thus assume, that genuine investors and fake investors are always in fixed proportion in the applicant pool of a bank with that proportion depending on the equilibrium fraction of genuine entrepreneurs, provided fake investors are indifferent between the different contracts offered and weakly prefer them to not applying for a loan at all. Since the expected return on the funds lent by a bank must equal unity in equilibrium, the equilibrium interest factor $R \geq 0$ satisfies[2]

$$R(1 - G(\gamma_{R,w})) = 1 \tag{5}$$

Clearly, any solution R to this equation satisfies $R \geq 1$. In general, there can be zero, one, two or more solutions. The left-hand side of (5) converges to 0 as $R \to 0$ and as $R \to \infty$, since

$$z(1 - G(z)) \leq \int_z^\infty \gamma G(d\gamma) \leq E[\gamma] < \infty \tag{6}$$

for all $z \geq 0$. Thus, there will be an even number of solutions generically in w, see figure 1. If there is at least one solution, the smallest of all solutions must be the equilibrium interest factor (this argument is similar to the one in Mankiw (1986)): consider any other solution $\tilde{R}$. Generically in w, one can then find some $\hat{R} < \tilde{R}$, so that $\hat{R}(1 - G(\gamma_{\hat{R},w})) > 1$. A bank charging $\hat{R}$ could therefore make a profit, a contradiction to free entry into banking. The argument fails only, if the function $R(1 - G(\gamma_{R,w}))$ in figure 1 touches the line at unity at the lowest solution to (5) without exceeding it.

For $w < x_s - c_a$, let $\Psi(w) \equiv R$ be that smallest solution to (5), if it exists, and $\Psi(w) = \infty$, if not. It is easy to check, that if there is a solution for some w, then there must be a solution for any $\tilde{w} > w$, $\tilde{w} < x_s - c_a$ as well. Thus, let $w^* \equiv \min\{w \geq 0 \mid \Psi(w) < \infty\}$ or, equivalently,

$$w^* = \max\{0\,;\, x_s - c_a - (x_s + x_b)M_{G,\rho}\}\,, \tag{7}$$

[2]For the mathematical analysis, it is more convenient to rewrite (5) as

$$\frac{x_s + x_b}{x_s - w - c_a}(\rho\gamma - 1)(1 - G(\gamma)) = 1.$$

A solution to this equation delivers $\gamma_{R,w} = \gamma$ rather than R.

where $M_{G,\rho} = \max_{\gamma \geq 0}(\rho\gamma - 1)(1 - G(\gamma))$. The function Ψ is decreasing, but not necessarily continuous on $[w^*, x_s)$. A sufficient condition for continuity is that $(\rho\gamma - 1)(1 - G(\gamma))$ strictly increases for $\gamma \geq 0$ until reaching $M_{G,\rho}$. Let $\Psi(w) = 1$ for $w \geq x_s$. Define $R^* = \Psi(w^*)$.

As for γ, let $\Gamma(w) \equiv \gamma_{\Psi(w),w}$ for $w < x_s - c_a$ and $\Gamma(w) = 1/\rho$ for $w \geq x_s - c_a$. Define $\gamma^* = \Gamma(w^*)$. Thus, in any given period with prevailing wages w, all projects with $\gamma_i \geq \Gamma(w)$ are undertaken by the young. In particular, if wages w and thus the collateral offered by young agents fall below the critical bound w^*, there will be no young entrepreneurs and therefore no successful middle-aged entrepreneurs next period. The credit market brakes down Akerlof-style (see Akerlof (1970)): raising the interest rate just results in worsening the pool of applicants and the expected return never exceeds the market interest rate on safe assets.

Figure 2 shows a plot of these functions, taking as example the exponential distribution with parameter λ, i.e. $G(\gamma) = 1 - \exp(-\lambda\gamma)$. Equation (5) can be rewritten as

$$\frac{\log(R)}{R} - \frac{\lambda}{\rho}\frac{1}{R} = \frac{x_s - w - c_a}{x_s + x_b}\frac{\lambda}{\rho}. \tag{8}$$

The function on the left hand side of this equation has a unique maximum at $R^* = \exp(1 + \lambda/\rho)$ and equals zero at $R = \exp(\lambda/\rho)$. In between, it is strictly monotonously increasing and $\Psi(w)$ for $w < x_a$ is the inverse of this piece applied to the right hand side of (8). Furthermore,

$$w^* = \max\left\{0\,;\, x_s - c_a - (x_s + x_b)\frac{\rho}{\lambda}\exp(-1 - \lambda/\rho)\right\}, \tag{9}$$

$\Gamma(w) = 1/\lambda \log(\Psi(w))$ for $w < x_s$ and $\gamma^* = 1/\rho + 1/\lambda$. The specific parameter choices for figure 2 are $c_a = 0$, $\lambda = .3$, $x_s = 1$, $x_b = 4$ and $\rho = .3$, so that $w^* = 0.32$.

3 Steady State Analyis.

3.1 The Perfect Information Benchmark.

As a benchmark, consider first a variant of the economy described above, in which all γ_i are public rather than private information. In the competitive steady state equilibrium, $R = 1$ and all projects with $\rho\gamma_i \geq 1$ are funded. The aggregate capital stock is given by

$$\bar{k} = (x_s + x_b) \int_{1/\rho}^{\infty} \gamma G(d\gamma), \tag{10}$$

$$= (x_s + x_b)(1 - G(1/\rho)) E[\gamma \mid \gamma \geq 1/\rho] \tag{11}$$

aggregate output is $\bar{y} = \bar{k}$, aggregate investment is

$$\bar{x} = (x_s + x_b)(1 - G(1/\rho)) \tag{12}$$

and aggregate and thus average lifetime consumption is $\bar{y} - \bar{x} + 3c_a$.

To provide funds sufficient for justifying a market interest factor of unity without the reliance on foreign creditors, maximal total savings need to exceed aggregate investment. Since maximal total savings are given by the sum of funds available to the young and to the middle aged,

$$s_{\max} = 3c_a + 2w + x_s \int_{1/\rho} (\rho\gamma - 1) G(d\gamma) \tag{13}$$

$$\geq 3c_a + 2(1 - \rho)\bar{k} \tag{14}$$

with $\bar{k}$ given in equation (10), the constraint $\bar{x} \leq s_{\max}$ is satisfied, since $\rho \leq 2/3$ and thus $2(1 - \rho)E[\gamma \mid \gamma \geq 1/\rho] \geq 1$. In other words, no borrowing from foreign countries is necessary to support this equilbrium.

It is instructive to calculate the social planners steady state solution as well. Maximizing average welfare or average life time consumption subject to feasibility, i.e. maximizing

$$\bar{c} = 3c_a + (x_s + x_b) \int_{\gamma_{\text{sp}}}^{\infty} (\gamma - 1) G(d\gamma) \tag{15}$$

over γsp yields γsp $= 1$. The underinvestment in the competitive equilibrium compared to this social planners solution is, of course, a result of the externality in the production in final output.

3.2 Steady States in The Asymmetric Information Economy.

There are three types of candidate steady states. The first is a fully industrialized steady state with $w \geq x_s - c_a$, in which all young entrepreneurs can finance their project out of their own funds, if they wish to do so. The second is a partially industrialized steady state with $w^* \leq w < x_s - c_a$, in which all young agents obtain a credit from a bank, but just a fraction turns it into a valuable investment. Finally, there can be an agricultural steady state with $0 = w < w^*$, no capital and without entrepreneurs, in which c_a is the only source of consumption.

The fully industrialized steady state equals the competitive equilibrium in the benchmark, full-information economy. It exists, if

$$x_s - c_a \leq (1-\rho)\bar{k} = (1-\rho)(x_s + x_b)\int_{1/\rho}^{\infty} \gamma G(d\gamma). \tag{16}$$

It suffices to check this condition with c_a replaced by zero. For the exponential distribution example, this yields the condition

$$\left(1 + \frac{x_b}{x_s}\right)(1-\rho)\left(\frac{1}{\rho} + \frac{1}{\lambda}\right)\exp(-\lambda/\rho) \geq 1. \tag{17}$$

This condition is satisfied for example for the parameters used to draw figure 2.

In a partially industrialized steady state with unity as the safe factor of return, all young agents are credit financed. To check existence of a partially industrialized steady state, find a γ_p equal to the right hand side of equation (4) with w replaced by the equilibrium wage on the right hand side of equation (16) and R replaced by $(1 - G(\gamma_p))^{-1}$ according to equation (5). One obtains as a necessary condition for existence of a partially industrialized steady state the existence of a solution γ_p to the equation

$$1 = \frac{1}{\rho\gamma_p} + \frac{1}{\rho\gamma_p(1 - G(\gamma_p))}\left(\frac{x_s - c_a}{x_s + x_b} - (1-\rho)\int_{\gamma_p}^{\infty} \gamma G(d\gamma)\right). \qquad (18)$$

To simplify (18), note that the right hand side of (18) converges to ∞ as $\gamma_p \to \infty$. For $\gamma_p \to 0$, the expression converges to $+\infty$, to $-\infty$ or to 0 with the sign equal to the sign of

$$\Delta \equiv \frac{x_s - c_a}{x_s + x_b} - (1-\rho)E[\gamma] + 1. \qquad (19)$$

If G is continuous, $\Delta \leq 0$ is a sufficient condition for the necessary condition (18). Replacing c_a with zero makes the condition $\Delta \leq 0$ more stringent and results for the exponential distribution example in

$$\left(1 + \frac{x_b}{x_s}\right)^{-1} - \frac{1-\rho}{\lambda} + 1 < 0 \qquad (20)$$

as a sufficient condition for the necessary condition (18). This condition is satisfied for the parameters chosen to draw figure 2.

To check that a solution to (18) indeed delivers a partially industrialized steady state equilibrium with borrowing from foreign countries at a safe factor of unity, one needs to check that $R = (1 - G(\gamma_p))^{-1}$ is not just a solution to (5), but the smallest one, given the equilibrium wage w.

There can also be periodic equilibria. One possibility is that $w_t = w^{(1)} > x_s - c_a$ in all even periods t and $w_t = w^{(2)} < w^*$ in all odd periods. Such an equilibrium exists, if

$$w^{(1)} = (1-\rho)x_b \int_{1/\rho}^{\infty} \gamma G(d\gamma) > x_s - c_a, \qquad (21)$$

and

$$w^{(2)} = (1-\rho)x_s \int_{1/\rho}^{\infty} \gamma G(d\gamma) < w^*, \qquad (22)$$

a condition easy to satisfy with appropriate choices for x_s and x_b. In such an equilibrium, young entrepreneurs arise only every second period, when the wage-level due to the capital generated by investment into big projects is high enough for a self-financed start-up.

4 Dynamic Transition.

4.1 Dynamic Equilibria.

There are two state variables at each date t: aggregate capital $\bar{k}_t$ and middle-aged entrepreneurial talent, characterized by the talent level $\bar{\gamma}_t$, above which all young entrepreneurs have undertaken their project in the previous period.

Calculate wages $w_t = (1-\rho)\bar{k}_t$. If $w_t < w^*$, no young entrepreneurs will operate their project and $\bar{\gamma}_{t+1} = \infty$. If $w^* \le w_t < x_s - c_a$, all young agents receive funding at interest factor $R = \Psi(w_t)$, but only those with $\gamma_i \ge \bar{\gamma}_{t+1} \equiv \Gamma(w_t)$ actually undertake their project, whereas all others consume the borrowed funds. Finally, if $w_t \ge x_s - c_a$, young agents can self-finance the small project, if they care to, and all young agents with $\gamma_i \ge \bar{\gamma}_{t+1} \equiv 1/\rho$ will do so. In short,

$$\bar{\gamma}_{t+1} = \Gamma((1-\rho)k_t). \tag{23}$$

Since all middle aged entrepreneurs are funded to run the big project (provided, $\gamma_i \ge 1/\rho$), capital next period is given by

$$\bar{k}_{t+1} = x_s \int_{\bar{\gamma}_{t+1}}^{\infty} \gamma G(d\gamma) + x_b \int_{\max\{\bar{\gamma}_t, 1/\rho\}}^{\infty} \gamma G(d\gamma). \tag{24}$$

4.2 The Financial Collapse.

A financial collapse results if no young entrepreneur finds funds to operate his or her project for all periods $t \ge \underline{t}$. The economy then collapses to the agricultural steady state in a few periods. For $\underline{t} = 0$, this occurs iff $(1-\rho)\bar{k}_0 < w^*$ and $(1-\rho)\bar{k}_1 < w^*$. Given no young entrepreneurs in period 0, capital in period 1 is the result only of the investment by middle aged entrepreneurs in period 0. Given an initial level of capital $\bar{k}_0$ and a pool of middle-aged entrepreneurial talent at date 0, characterized by $\bar{\gamma}_0$, a financial collapse starting at $\underline{t} = 0$ therefore results, iff

$$\bar{k}_0 < \frac{w^*}{1-\rho} \tag{25}$$

and

$$\int_{\max\{\bar{\gamma}_0, 1/\rho\}}^{\infty} \gamma G(d\gamma) < \frac{w^*}{(1-\rho)x_b}. \tag{26}$$

Some examples of transition paths are shown in figures 3 and 4. The same parameters as for figure 2 are used except that $\lambda = .7$. Figure 3 and figure 4 contain ten sample transition path for different initial states $(\bar{k}_0, \bar{\gamma}_0)$. In figure 3, only the initial capital level and in figure 4 only the pool of available middle aged entrepreneurs has been varied. The parameters for both figures are the same as in figure 2, except that $\lambda = .5$ in figure 3 and $\lambda = .7$ in figure 4. In figure 3, $\bar{\gamma}_0 = 4/\rho$ and $\bar{k}_0 \in [.8; 1.6]$. In figure 4, $\bar{\gamma}_0 \in [4.3; 5.3]$ and $\bar{k}_0 = 1.33$, cmp. figure 3. Note how some of the transition path collapse to the agricultural steady state, some build up to the fully industrialized steady state whereas others settle on a limiting periodic equilibrium with periodicity 2 (we have not checked these convergence claims formally, but they seem obvious).

As is clear from the analysis above as well as in particular from figure 4, it is not just the initial level of capital, which determines the fate of a country, but the pool of successful, middle-aged entrepreneurs as well. Even though an established market economy after a war may start (or has started) from the same initial capital stock as a country in transition from socialism, the established market economy may be able to rebuild to the fully industrialized steady state due to its available pool of successful middle-aged entrepreneurs, whereas a transition country may collapse to the agricultural steady state due to the lack of these entrepreneurs.

5 Remedies.

5.1 Richer Contracts and Market Solutions.

Part of the threat of the financial collapse may be due to the restrictition to debt contracts. Thus consider lotteries and equity contracts.

Since agents are risk-neutral, they cannot loose entering a lottery with their wages and endowment $w + c_a$, where they either receive x_s with probability $(w + c_a)/x_s$ or receive 0 with probability $1 - (w + c_a)/x_s$. Winning agents will proceed to invest in their project if $\rho\gamma_i \geq 1$. Alternatively, suppose that an (arbitrarily) small fee needs to be charged to anybody entering a lottery (either due to a government tax or to a resource input requirement to run the lottery). Agents will then self-select and only those with $\rho\gamma_i$ slightly bigger than 1 will participate. In either case, in addition to the two state variables $\bar{k}_t$ and $\bar{\gamma}_t$, there is a third state variable $\bar{\pi}_t$ equal to the probability of winning the lottery, provided $\rho\gamma_i > 1$. Given the state $(\bar{k}_t, \bar{\gamma}_t, \bar{\pi}_t)$, calculate wages $w_t = (1 - \rho)\bar{k}_t$. Find $\bar{\gamma}_{t+1} = 1/\rho$, $\bar{\pi}_{t+1} = (w_t + c_a)/x_s$ and

$$\bar{k}_{t+1} = k_a + x_s\bar{\pi}_{t+1}\int_{\bar{\gamma}_{t+1}}^{\infty}\gamma G(d\gamma) + x_b\bar{\pi}_t\int_{\max\{\bar{\gamma}_t, 1/\rho\}}^{\infty}\gamma G(d\gamma). \quad (27)$$

Figure 5 shows a sample path for an economy with and without lotteries. The same parameters as for figure 2 are used except that $\lambda = .5$. Starting values are $\bar{k}_0 = 1.0$, $\bar{\gamma}_0 = 3/\rho$ and $\bar{\pi}_0 = 1.0$. Note, how the economy with lotteries avoids the financial collapse, whereas the economy without lotteries falls into it. In practice, such lotteries could be provided privately through legalized gambling. Although beyond the analysis here, it should be evident that a policy recommendation based on gambling on a large scale as a way to jump-start transition economies is probably hard to sell, even if economically desirable.

Equity contracts make repayments on funds allocated to the young conditional on the realized quality of the project in the next period. For example, suppose all banks just offered one type of contract, in which agents pay "dividends" according to the schedule

$$d(\gamma) = \delta \max\{0\,;\,(\rho\gamma - 1)(x_a + x_b)\} \quad (28)$$

for some parameter $0 < \delta < 1$. With $w < x_s - c_a$, all young agents will borrow funds from the bank. Those with $\rho\gamma_i \geq 1$ invest, whereas all others eat the funds allocated to them. If these dividend contracts are the only contracts offered, free entry into banking implies that in equilibrium

$$1/\delta = (x_s + x_b) \int_{1/\rho}^{\infty} (\rho\gamma - 1) G(d\gamma), \tag{29}$$

provided the right hand side of this equation exceeds unity. For the exponential distribution example, the right hand side of (29) equals $(x_a + x_b)\rho/\lambda$ and thus exceeds unity for example for the parameters used to draw figure 2. Investment is as efficient as the full-information competitive equilibrium and a financial collapse cannot result.

However, equity contracts as above do not seem to be the "golden way out", if banks are allowed to offer any kind of contract and not just the contract described above. The contract above as well as the debt contract used in the previous sections work since the losses to the fake entrepreneurs are covered with the returns from genuine investors. Without restrictions on the design of non-randomized contracts, however, a deviating bank can give high-value entrepreneurs with $\gamma_i \in [\tilde{\gamma} - \epsilon, \tilde{\gamma} + \epsilon]$ for some $\tilde{\gamma} > 1/\rho$ and some small $\epsilon > 0$, say, a better deal by lowering the parameter δ for that group, for example, attracting these entrepreneurs away from other banks by self-selection. Any new genuine entrepreneur attracted due to a "sweat deal" brings along a fixed proportion of fake entrepreneurs, since fake entrepreneurs mimick genuine entrepreneurs by assumption (cmp. section 2.3). It follows that in equilibrium, every genuine investor must contribute the same amount to cover the losses resulting from the fake entrepreneurs. In other words, without restrictions on the design of non-randomized contracts and free entry into banking, the contracts offered by banks must be debt contracts, as assumed in the preceeding sections.

Hence if equity contracts shall help to avoid a financial collapse, then restrictions on the type of contracts that banks can offer need to be imposed. By contrast, only lotteries need to be ruled out for debt contracts as analyzed in the previous sections to emerge endogeneously. In other words, requiring by law that financing of investment projects of the young must be done with equity contracts of the type described above and allowing competition only in the parameter δ may indeed be a way for a transition country to avoid a financial collapse. Practical ways in which this may be accomplished at least approximately are subsidized venture capital funds (see subsection 5.3) or joint ventures with foreign investors (see subsection 5.5).

If lenders are allowed to enter randomized contracts, probably lotteries of the type described above are the only contracts that survive competition.

5.2 Creating Inequality.

As shown above, lotteries can help in avoiding a financial collapse. Aside from legalized gambling, redistributions that create inequalities among the young accidentally or by design can be ways to institute such lotteries. One can observe in the transition countries, that governmental programs result in an unequal distribution of the ownership in the initial stock of capital and housing among the young. Likewise, differential access to market opportunities and arbitrage opportunities before the establishment of solid property rights seem to have resulted in the emergence of a few affluent, young "profiteers" in these countries. Some of these agents may be entrepreneurially talented and will turn their wealth into start-up funds for a viable company.

Another possibility is to redistribute wealth from the middle-aged and old to the young, i.e. to create intergenerational redistributions. The point is to raise the funds available to the young from $w = (1-\rho)\bar{k} + c_a$ to $\tilde{w} = \bar{k} + c_a$, the maximal, feasible level. This is particularly effective, if, say, $w < w^*$ and $\tilde{w} \geq x_s$, so that rather than having too little collateral for starting a company when young, young agents are made sufficiently wealthy to start such a company out of their own funds. Such an intergenerational redistribution can take the form of wage subsidies or a distribution of the initial property rights in the ownership of capital in favor of the young. The political difficulties of generating inequality should be evident, but is beyond the analysis of this paper.

5.3 Subsidizing Investment.

There are a variety of schemes to subsidize investment which can be analyzed within this framework. Basically, a government can offer any of the contracts discussed above without the zero profit constraint, financing the shortfall via taxation or debt. The effects of such a policy depend among other things on the type of contract offered, on the competition allowed by private intermediaries and on the tax schedule.

Consider providing the entire difference between $w + c_a$ and x_s free to all young agents. Suppose this is financed by issuing debt to be retired in the next period via a lump-sum tax on income in excess of c_a of middle-aged agents. Since middle-aged agents have income in excess of c_a only if they genuinly invested, they will only do so if their investments yields more than they have to pay in taxes. In other words, the same tradeoff and the same equilibrium as in the debt-contract case discussed in the previous sections emerges.

Suppose instead that the debt is not immediately retired in the next period. Specifically, let $\bar{w}$ be the wage in the fully industrialized steady state and suppose that $\tau \equiv \bar{w} + c_a - x_s > 0$. If the government provides $x_s - w - c_a$ to all young agents for two periods and then collects lump-sum taxes τ of young agents in subsequent periods until the debt is retired, the economy jumps to the fully industrialized steady state within two periods and remains there. In other words, subsidizing young entrepreneurs for two periods (read "fourty years", if the average agent is thought to live for sixty years) and not restarting repaying the debt during that phase is probably the fastest feasible way to jump-start the economy. Slower but cheaper ways involve similarly financing not all but just a fraction of the young would-be entrepreneurs. Repayment of the debt should then be pushed even further into the future if adverse effects on the emergence of young entrepreneurs are to be avoided.

Another scheme one may wish to consider is a government- subsidized venture capital funds with dividend-schedules as in equation (28). We assume that there are private banks as well, offering debt contracts to young agents at some interest factor R. Since in equilibrium, all agents with $\rho\gamma_i \geq 1$ will genuinly invest and since therefore the constant fraction $G(1/\rho)$ of all applicants to an intermediary are genuine entrepreneurs, the equilibrium interest factor is given by $R = 1/G(1/\rho)$. In particular, the operation of a venture capital fund rules out a break-down of the credit market. For any $\delta \in (0;1)$, let

$$\gamma_\delta \equiv \frac{1}{\rho} + \frac{x_s - w}{x_s + x_b} \frac{1}{\delta G(1/\rho)\rho} \tag{30}$$

(cmp. also to equation (4)). All agents with $\rho\gamma_i < 1$ will be fake entrepreneurs, all agents with $1/\rho \leq \gamma_i < \gamma_\delta$ will self-select to the government-run venture capital fund and all agents with $\gamma_i \geq \gamma_\delta$ will prefer the debt contract. The expected return to the venture capital fund is given by

$$v = \delta G(1/\rho)(x_s + x_b) \int_{1/\rho}^{\gamma_\delta} (\rho\gamma - 1) G(d\gamma). \tag{31}$$

Note that $v < 1$ for all δ, since the equity-contract returns less than the debt-contract and the debt contract returns unity in equilibrium. The shortfall needs to be financed by debt or taxation, raising additional issues as discussed above. In the exponential distribution example,

$$v = \frac{\delta\rho}{\lambda}(1-\exp(-\lambda/\rho))(\exp(-\lambda/\rho)-\exp(-\lambda\gamma_\delta))(x_s+x_b)-\exp(-\lambda\gamma_\delta)(x_s-w), \tag{32}$$

which has been plotted in figure 6 for the parameters used for figure 2 at $w = w^*$.

5.4 Foreign Aid.

A benevolent foreign country can aid a transition country in avoiding a financial collapse, using any of the instruments described above. The discussion only differs in that revenues needed to finance such programs need not be raised by taxation or debt within the country under study. Most promising seems to be to endow a fraction of the young agents via a lump-sum transfer with enough resources (i.e. with $x_s - w$), so that they can start their own company, if they wish to do so. Only the fraction $G(1/\rho)$ of these transferred funds will result in genuine investment, the rest will be consumed or wasted immediately. This may make it hard politically to argue in favor of such a program in the donating country.

5.5 Joint Ventures.

Joint ventures between an entrepreneur from an established market economy and some desolate firm in a country in transition were initially often promoted in the public debate to jump-start capitalism in these countries. In considering the advantages and disadvantages, it needs to be carefully clarified, what it is, that a joint venture can provide, that a bank or a government cannot and vice versa. While some possibilities are offered below, the additional assumptions necessary need to be carefully checked in practice.

Within the model here, a joint venture may be either thought of as a project owned by one of the young agents in the transition country and jointly operated by both partners of the joint venture or as a project of a successful middle aged entrepreneur of the foreign country, undertaken in the transition country rather than the home country. The latter is simply foreign direct investment with positive effects on the overall wage level, since it increases the capital available in the transition country. For the former, one may want to assume, that a joint venture offers one of the following advantages as compared to a bank loan:

- A joint venture may take the form of an equity-contract due to some restriction imposed on the type of allowable joint venture contracts by the government of the transition country or by the laws of the foreign country (see the discussion in subsection 5.1). Thus, such a joint venture plays essentially the same role as the venture capital funds described in subsection 5.3.

- The foreign firm may have expertise in evaluating projects that banks do not: in the extreme, the foreign firm can costlessly observe the value γ_i of the young agent to be contracted. Investment for these projects will be the same as in the competitive, full-information benchmark economy.

- The foreign firm may be better in monitoring the investment than a bank. Within the model here, this can be modelled by assuming some value for α smaller than unity for young agents in a joint venture. The lower α, the lower $\gamma_{R,w}$, see equation (4) and the lower the interest factor the foreign company needs to charge its domestic partner in order to receive an expected return of unity. In fact, if monitoring is so good that $\alpha < (w + c_a)/x_s$, monitoring becomes perfect due to self-selection: if the foreign firm demands an interest factor $R = 1$ on its investment in the joint venture, only those young entrepreneurs with $\rho\gamma_i \geq 1$ will accept.

Presumably, joint ventures may also offer benefits beyond those under consideration in the model of this paper. For example, a joint venture may result in a transfer of know-how, which are of use to other entrepreneurs due to some spill-over effect. In practice, joint ventures may have been simply attempts at getting around ill-defined property rights with murky benefits. Further study of this issue is clearly warranted.

6 Conclusions.

It was shown that countries starting from a low level of initial capital as well as a low level of proven entrepreneurial talent such as countries in transition from socialism to capitalism may find themselves in financial collapse. In this case, young wage-earning agents have too little collateral in order to assure themselves credit for operating a small start-up company and thus for proving their entrepreneurial talent. As a result, there are no proven middle aged entrepreneurs around later on to build larger enterprises and pay decent wages. Once in collapse, the economy contracts over time to an agricultural steady state without entrepreneurs.

Different remedies have been considered. Most potent seems to be either to government-subsidize young entrepreneurs for an extended period such as fourty years, repaying the debt after the economy has achieved the fully-industrialized steady state, or to create inequalities among the young, so that a fraction of the young agents find it feasible to start up a company out of their own funds. Related alternatives such as legalized gambling, venture capital funds, subsidized investment, subsidized wages, intergenerational re-distributions, subsidies from abroad and joint ventures have been discussed. We conclude that the collapse is dangerous, but avoidable, if correct policy measures are undertaken.

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FIGURE 1a: Expected Return (w = 0.7)

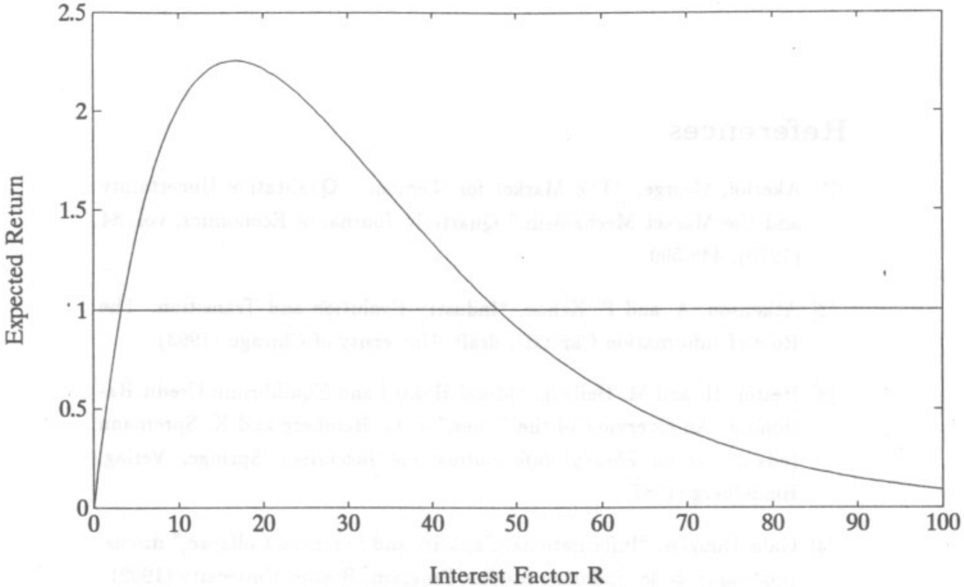


FIGURE 1b: Expected Return (w = 0.7)

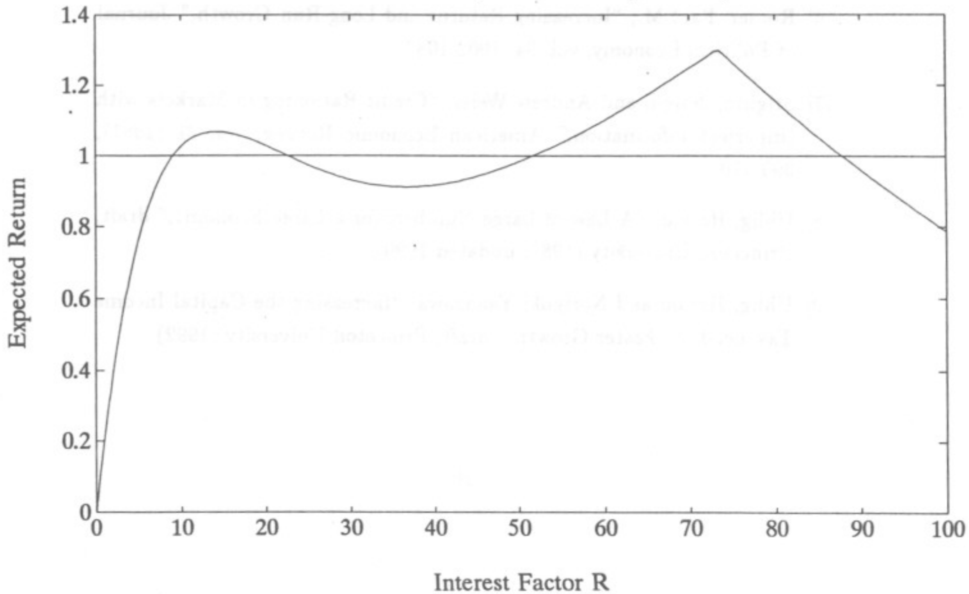


FIGURE 2a: Psi(w)

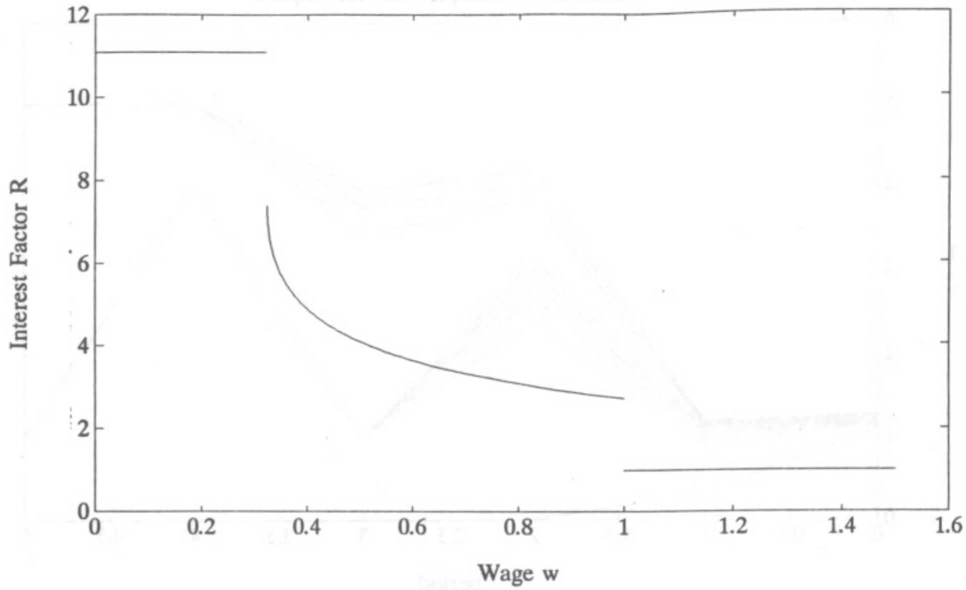


FIGURE 2b: Gamma(w)

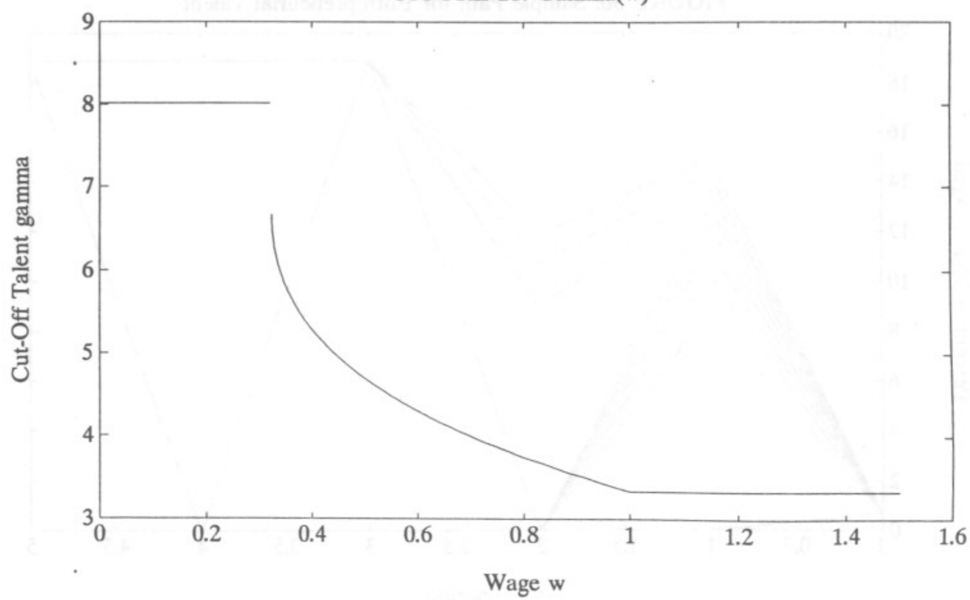


FIGURE 3a: Sample Path for Capital

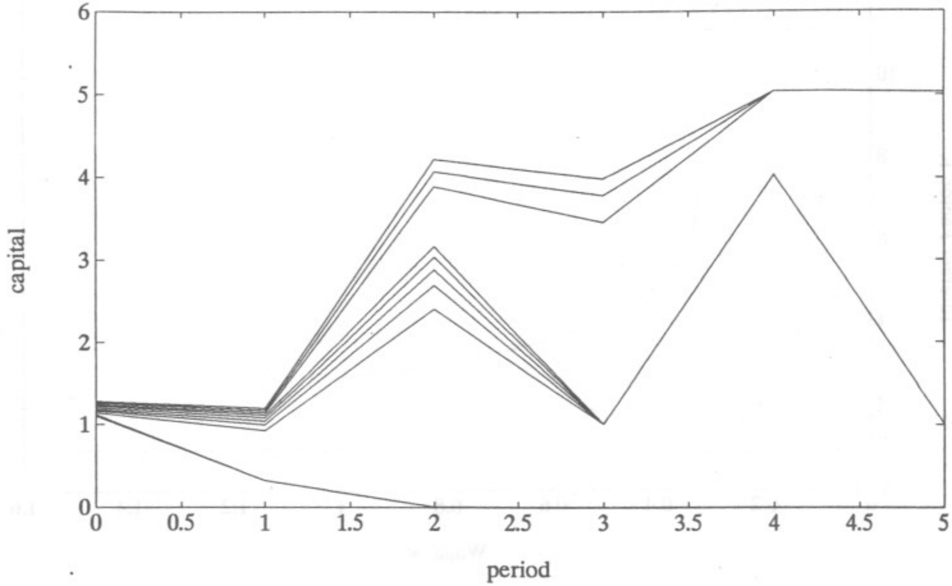


FIGURE 3b: Sample Path for Entrepreneurial Talent

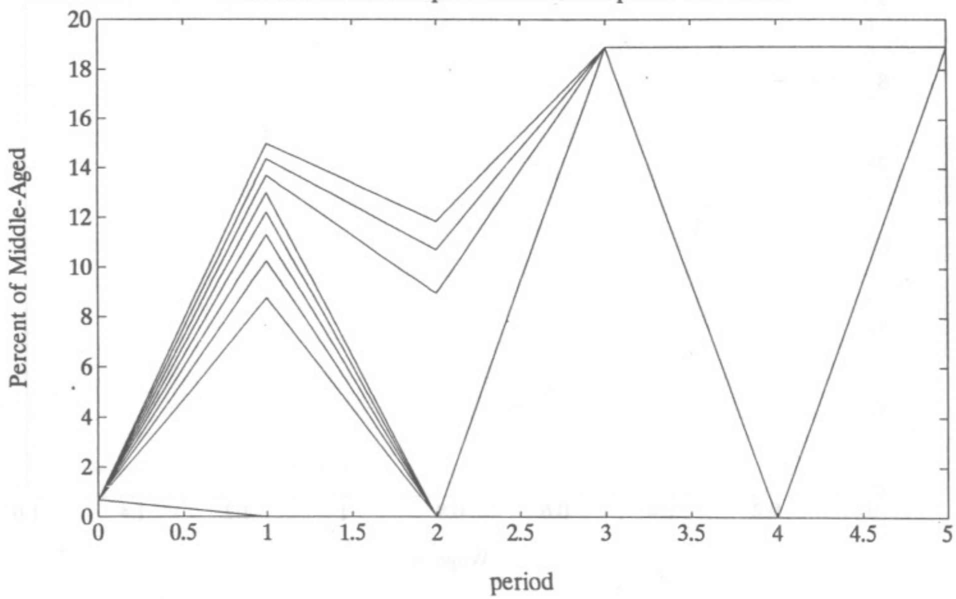


FIGURE 4a: Sample Path for Capital

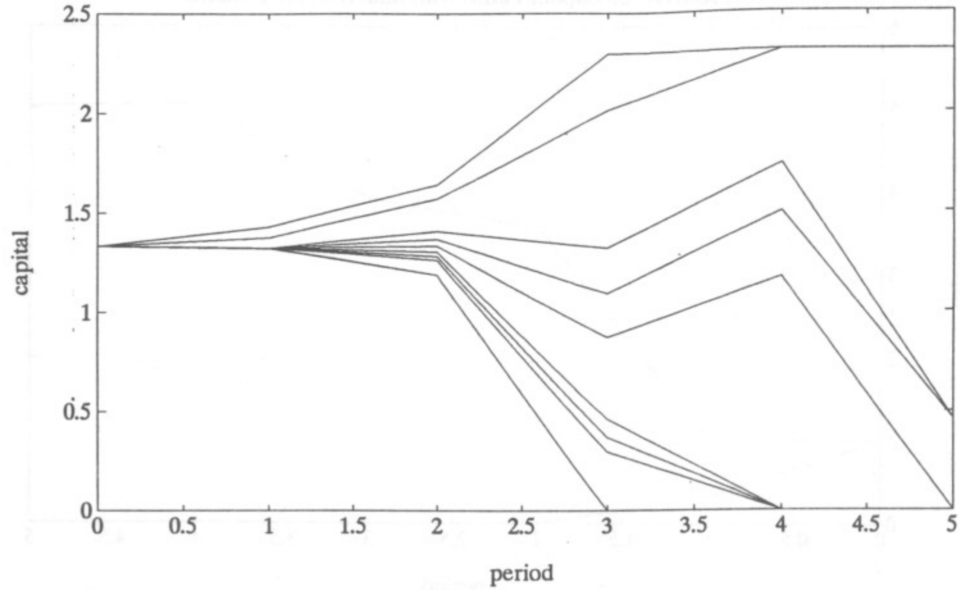


FIGURE 4b: Sample Path for Entrepreneurial Talent

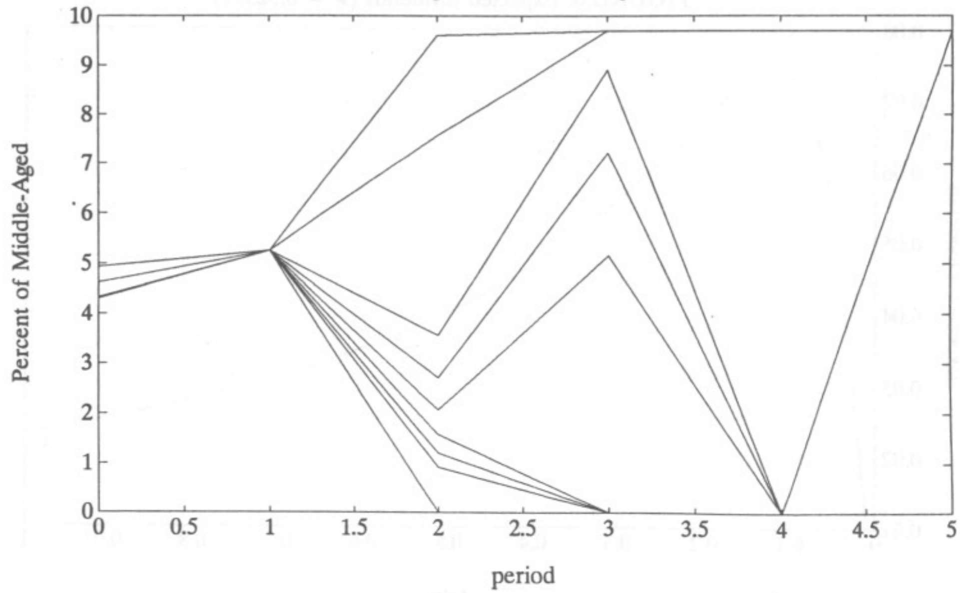


FIGURE 5: Capital Paths With and Without Lotteries

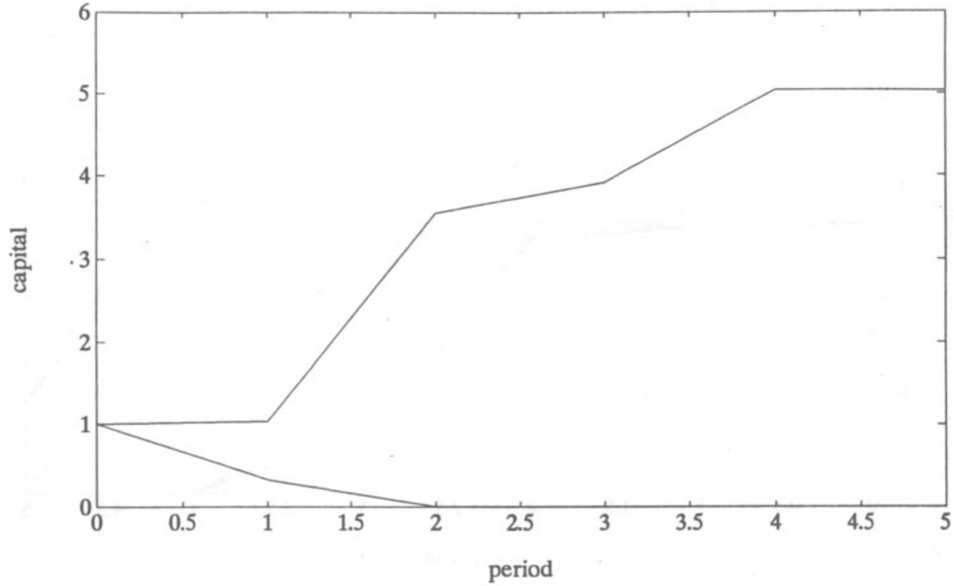
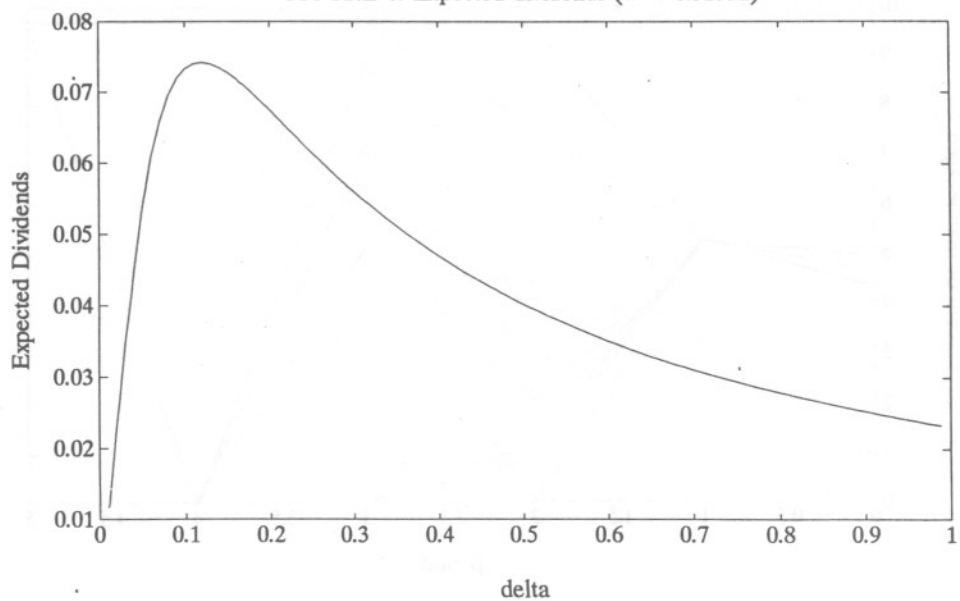


FIGURE 6: Expected dividends (w = 0.32332)



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