Outside Ownership as a Factor Input

Yong KIM [*], May 6, 2003 (Preliminary)

Abstract

This paper demonstrates how the outside ownership of assets used in production can improve outcomes. If outside ownership improves outcomes, and assets which implement the gains from outside ownership are scarce, then assets can have value conditional on outside ownership. A framework with a continuous creation and destruction of such assets is developed in a model of firm entry and exit. Assets under outside ownership behave like a factor input which earns a periodic return. By mapping a reduced form version of my model to the canonical Hopenhayn (1992) model of firm entry and exit, a micro-foundation for such a model is provided.

Keywords Borrowing constraints; Self employment; Outside ownership: Firm entry and exit

JEL Classification L2, J3, G3

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1 Introduction

In modern economies, the non-human assets of firms are often owned by outsiders who are not directly involved in the production process. Asset values are assumed to be backed by the stream of incomes accruing to such outside owners. What remains unclear is how, asset ownership, which confers residual control rights to assets, translates into a stream of incomes to outside owners.

This paper develops a theory of outside ownership where firm asset values are conditional on an outside ownership structure. I show how outside ownership of assets can be considered a factor input in the production process.

The first innovation of this paper is a theory of how outside ownership arrangements can improve outcomes. At the heart of this theory are borrowing constraints. Outside owners mitigate the borrowing constraint problem faced by agents undertaking production projects. By default, those who cannot exploit the gains from outside ownership are borrowing constrained. More about this mechanism will be discussed in a little while.

If outside ownership of assets can improve outcomes, and assets which implement the gains from outside ownership are scarce, then assets can have value conditional on outside ownership. The second innovation of this paper considers how such assets are created and when they can be considered scarce inputs. What is required is a dynamic environment where there is a continuous creation and destruction of assets which can implement the gains from outside ownership.

I develop a theory of firm entry and exit where firms undertake specific projects which are repeated over time. In every period, a new set of projects arrives exogenously to the economy. Assets used in new projects

cannot exploit the gains from outside ownership. Assets used in repeated projects can exploit the gains from outside ownership, if they use the assets from previously new projects. As a result, the creation of assets which can exploit the gains from outside ownership is costly since agents undertaking new projects are borrowing constrained.

If costly assets are created continuously, there must also be a process of asset destruction. In the model, this happens because the productivity of projects depreciates over time. New and old projects coexist because of the following trade off: although new projects have higher productivity, older projects can exploit the gains from outside ownership. I show how an endogenous number of project vintages will coexist, and the model describes a process of technology diffusion.

The analysis is compared with existing canonical models of firm entry and exit. Such models assume that firms provide an unspecified factor input which delivers profits to the firm net of hired inputs such as labor. A exogenous entry cost of creating this factor input limits the entry of new firms which earn positive profits once this cost is sunk. A exogenous maintenance cost of this factor input ensures that some firms exit if gross profits are sufficiently small.

The last section of the paper sets up a model of firm entry and exit following Hopenhayn (1992), and demonstrates how a reduced form version of my model coincides exactly with this model. What substitutes for the unspecified factor inputs are assets which can implement the gains from outside ownership. The stream of incomes accruing to such assets determines the asset value conditional on outside ownership. A compensating variation which agents opening new firms receive for facing borrowing constraints, substitutes for the exogenous entry cost. The analog to the exogenous maintenance cost will be discussed in the main

text.

Under my interpretation of the factor input supplied by firms, both the entry cost and maintenance cost are endogenously determined. By showing how assets under outside ownership are interpreted as a factor input, a key lesson of this paper is that broader measures of parameters determining firm entry and exit should be adopted in empirical work.

Intuitively, how does a theory of outside ownership come together? Consider a two period project where two period lived agents acquire project specific skills in period 1 which they can use in period 2. Production also requires the use of a project specific asset in period 2. Agents are much more productive in period 2, but wish to consumption smooth over their lifetimes so want to borrow against their old period earnings when young. Unfortunately, no-one is willing to lend to them because agents cannot commit to repay loans made against their period 2 labor output. So they are borrowing constrained.

Consider what happens when an outsider owns the asset in period 2. In period 2, the owner holds-up the agent just before production is realized and is able to extract part of the agent's labor output. Asset ownership and ex post hold-up allow outsiders to steal part of the agent's period 2 output. Were this the end of the story, outside ownership is actually worse than the absence of borrowing since the agent has to share output with an outside party. But there is another protagonist acting in this drama. Ex ante in period 1, the outside owner has to offer the agent a lifetime earning and implied utility level at least what the agent would get under self ownership. Anticipating the stealing of output in period 2, the agent must be offered a bribe to participate in period 1.

The combination of ex post hold up and ex ante competition to attract the agent implements cash flows from the outside owner to agent

which resembles borrowing. The existence of assets which agents acquire skills specific to, allows outside ownership arrangements to substitute for borrowing. When assets which implement the gains from outside ownership are scarce, they can have value.

Asset ownership, which confers the residual right to confiscate assets, only has economic meaning in a framework where outcomes cannot be completely specified contractually. The analysis of ex post hold-up problems in this context has been developed in papers by Grossman and Hart (1986) and Hart and Moore (1990). The combination of ex post hold-up and ex ante competition has been explored by Felli and Roberts (2002), and in an environment with search frictions by Acemoglu and Shimer (1999) and Kim (1999), as a mechanism to mitigate inefficiencies associated with hold-up. My theory of outside ownership shows how the combination of these forces can actually improve outcomes.

My theory of outside ownership implies a theory of self employment by default. The self employed cannot exploit the gains from outside ownership, and are borrowing constrained. A robust empirical feature of the self employed is that they are borrowing constrained. In particular, a number of studies including Evans and Jovanovic (1989) and Holtz-Eakin, Joulfaian and Rosen (1994) find agents endowed with greater wealth are more likely to become self employed. A series of related papers by Chiu (1998), de Meza and Lockwood (1998) and Rajan and Zingales (1998) provide an alternative theory of outside ownership. There borrowing constraints are not key, and the self employed are not necessarily borrowing constrained.

Besides Hopenhayn (1992), other industry equilibrium models include Ericson and Pakes (1994) and Hopenahyn and Rogerson (1994). Hopenhayn and Rogerson apply the Hopenhayn model to issues of un-

employment benefit and firing costs.

Sections 2 and 3 describe the model and equilibrium. Section 4 discusses some of the implications, and section 5 shows how a reduced form version of the model coincides with the Hopenhayn (1992) model. The last section concludes.

2 Model

Consider a two period overlapping generations economy with a constant population of agents normalized to 2. Ex ante identical agents have preferences over their young and old period consumption c_y and c_0 given by,

$$u = c_y^{\frac{1}{1+\beta}} c_0^{\frac{\beta}{1+\beta}} \qquad 0 < \beta < 1 \tag{1}$$

Given their young and old period labor earnings y_1 and y_2, and the interest factor of the economy R_t, the indirect utility as a function of earnings for a generation born in period t can be expressed as,

$$\begin{aligned} v(y_1, y_2; R) &= \frac{\left(y_1 + \frac{1}{R_t} y_2\right) (\beta R_t)^{\frac{\beta}{1+\beta}}}{1+\beta} \text{ if borrowing constraints do not bind} \\ &= y_1^{\frac{1}{1+\beta}} y_2^{\frac{\beta}{1+\beta}} \text{ if borrowing constraints bind} \end{aligned} \tag{2}$$

2.1 Technology

The technology available has three features: production technology, commitment technology and contractual environment. First consider production technology. In every period a new set of two period projects arrive exogenously to the economy. Projects can be repeated every period so that period 2 of a project and period 1 of its repetition can overlap. Let $\tau \in \{0, 1, ...\}$ index the age or vintage of a project relative to a frontier project. A vintage $\tau - 1$ project in the current period

becomes a vintage τ project in the next period.

For $\tau \geq 1$, within each vintage there are two types of projects. Non-repeated projects which have never been carried out before and repeated projects which have been carried out at least once. Non-repeated projects use "raw" assets in production, and repeated projects use "seasoned" assets in production. By construction all $\tau = 0$ frontier projects are non-repeated projects.

A vintage $\tau - 1$ non-repeated project starting at time $t - 1$ uses one unit of unskilled labor to produce x units of consumption goods plus one unit of project specific skills. In period 2 of this project, one unit of specifically skilled labor plus one unit of a project specific raw asset plus $n_{\tau,t}$ units of unskilled labor produces $\delta^{\tau} f(n_{\tau,t})$ units of consumption goods plus one unit of project specific seasoned assets. The project specific raw asset must be available in period 1 for use in period 2 production. Let the unskilled laborers used in period 2 $n_{\tau,t}$, be referred to as "workers" to distinguish them from the unskilled labor used in period 1 of the project. $\delta \in (0, 1)$ means that project productivities decrease over time. Assume $f(0) = 0$, $f'(\cdot) > 0$, $\lim_{n \to 0} f'(n) = \infty$ and $f''(\cdot) < 0$.

Seasoned assets are raw assets which have been used in projects at least once before. The production technology for a vintage $\tau - 1$ repeated project starting at time $t-1$ is identical to that of a non-repeated project except in period 2, one unit of a seasoned asset is used instead of a raw asset. Again, the seasoned asset must be available in period 1 for use in period 2 production. The requirement that repeated projects must use seasoned assets embodies an assumption that project specific assets cannot be reproduced.

Assets are assumed not to depreciate. The price of raw assets, re-

flecting the raw material costs of assets, is assumed zero $\hat{V}_{\tau,t} = 0 \; \forall \tau, \forall t$.[1] Let $V_{\tau,t} \geq 0$ denote the price of a vintage τ seasoned asset at time t. [Figure 1] shows the timing of events in each period. Agents produce, then conduct asset transactions, and finally consume.

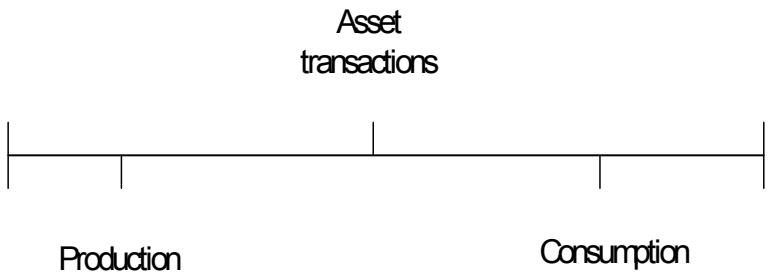

Figure 1: Timeline in period t

The net product of a vintage $\tau - 1$ non-repeated project starting at time $t-1$ is composed of factor outputs and costs in the following way. In period 1, net product $x - \hat{V}_{\tau-1,t-1} = x$ is composed of labor output x and raw asset value $\hat{V}_{\tau-1,t-1} = 0$. In period 2, net product $\delta^{\tau} f(n_{\tau,t}) + V_{\tau,t}$ is composed of skilled labor output $\pi_{\tau}(w_t)$, worker output $n_{\tau,t} w_t$ and the resale value of the seasoned asset $V_{\tau,t}$. w_t is the wage offered to unskilled workers who are homogenous across vintage and are hired from competitive labor markets. $\pi_{\tau}(w_t)$ is maximized output net of worker wages,

$$\pi_{\tau}(w_t) \equiv \max_{n_{\tau,t}} \delta^{\tau} f(n_{\tau,t}) - n_{\tau,t} w_t \tag{3}$$

Since skilled agents are free to provide unskilled labor as workers, we must have $\pi_{\tau}(w_t) \geq w_t \geq x$, for workers to coexist with agents who acquire project specific skills.

[1] This assumption allows the economy to avoid outcomes where new and old projects coexist because the raw material costs of old projects's assets have already been sunk.

The composition of net product of a vintage $\tau - 1$ repeated project starting at time $t-1$ is identical to that of a non-repeated project except in period 1, seasoned asset value $V_{\tau-1,t-1}$ replaces $\hat{V}_{\tau-1,t-1} = 0$. Up to this point, the distinction between non-repeated and repeated projects, and raw and seasoned assets, has only been nominal.

The second component of the technology available is commitment technology. Raw and seasoned assets differ in whether a young agent in period 1 of a project can commit to acquire skills specific to that asset. I assume young agents cannot commit to acquire skills specific to a particular raw asset, but young agents can commit to acquire skills specific to a particular seasoned asset. I refer to agents acquiring skills specific to raw assets as "entrepreneurs", and agents acquiring skills specific to seasoned assets as "managers".

Since commitment is an advantage and nothing else differentiates raw assets from seasoned assets, it can be inferred that no non-repeated projects will be undertaken if repeated projects are available within that vintage. This implies that projects undertaken will be non-repeated projects if and only if they are frontier $\tau = 0$ projects. The lifetime of all projects is summarized in [Figure 2].

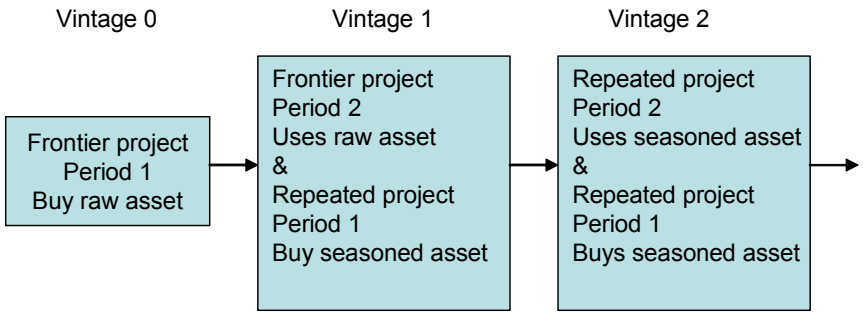

Figure 2: Lifetime of a project

The third component of the technology available is contractual envi-

ronment. I assume that all borrowing must be collateralized by verifiable values, and assume that period 2 project output and skill levels of entrepreneurs and managers are non-verifiable by courts.[2] Contracts contingent on these variables are not enforceable and will not be written. This implies that young entrepreneurs and managers cannot borrow against their second period labor output $\pi_\tau(w_t)$. Young entrepreneurs and managers are only able to borrow against the resale value of seasoned assets $V_{\tau,t} \geq 0$, given market trades are verifiable.

To complete the description of the economy, let $\mu_{\tau,t}$ denote the period t measure of skilled agents in vintage τ.

2.2 Self employment versus outside ownership

The commitment and contractual technology imply different asset ownership structures depending on whether agents acquiring skills use raw or seasoned assets. Ownership of an asset confers residual rights of control to assets in contractually unspecified circumstances. This section compares outcomes under self employment and outside ownership of assets. First, under self employment, for all projects the commitment technology and contractual environment are irrelevant since agents acquiring skills work for themselves, and hire workers from competitive labor markets. Agents receive the net product from projects each period, after paying for workers.

Outcomes under outside ownership differ on the type of project. Consider repeated projects using seasoned assets first. Assume that in any bargaining process any outside owner has full bargaining power (they make a once and for all take-it-or-leave-it-offer). In project period 2, just

[2] The simplest justification for this constraint is that agents can always run away with their skills and project output after production. However they cannot run away with with the assets.

before production, the outside owner holds-up the manager by threatening to confiscate the asset, and extracts the full bilateral surplus output of the match between the asset and specifically skilled worker. The match yields output $\pi_\tau(w_t)$. The outside option of the asset is zero since it cannot be used with any other skilled manager. The outside option of the skilled manager is w_t. Income accruing to the outside owner is the surplus $\pi_\tau(w_t) - w_t$. Given this, in period 1 when the outside owner has to attract a young manager to work for her, an employment wage w_{t-1} has to be offered to make the young manager indifferent between becoming a worker or a manager. In effect, the outside owner provides an up-front payment in excess of a young manager's product equal to $w_{t-1} - x$. The combination of ex post hold-up and ex ante competition to attract the manager results in intertemporal transfers which resembles borrowing.[3][4]

Consider an outside owner who buys a seasoned asset for $V_{\tau-1,t-1}$, and hires a young manager in period $t-1$ who realizes output x for wage w_{t-1}. In period t, the owner bargains over the output to receive a surplus $\pi_\tau(w_t) - w_t$ and then sells the asset for $V_{\tau,t}$. Assuming competitive markets for outside ownership, and positive asset values, the net

[3] This coincides with the analysis of firm specific skills in Becker (1964). Outside asset owners appropriate the gains from asset specific skills and "invest" $(w_t - x)$ in young managers.

[4] During their job tenure, managers's product profiles are steeper than their earnings profiles. This analysis is inconsistent with seniority wages: the phenomenon that during job tenure, wage profiles are steeper than product profiles. While empirical studies have shown measured output is consistent with seniority wages, unmeasured components of output (such as the training provided to young by old) may imply that seniority wages do not hold.

discounted earnings of outside owners must be zero,

$$-V_{\tau-1,t-1}+x-w_{t-1}+\frac{1}{R_{t-1}}\left(\pi_{\tau}\left(w_{t}\right)-w_{t}+V_{\tau,t}\right)=0 \text{ for } \tau-1\geq 1 \quad (4)$$

Rearranging yields an equation for seasoned asset values in terms of the difference between the manager's lifetime product and lifetime employment wages. For $\tau-1\geq 1$,

$$V_{\tau-1,t-1}=\max\left\{0,\left[\left(x+\frac{1}{R_{t-1}}\pi_{\tau}\left(w_{t}\right)\right)-\left(w_{t-1}+\frac{1}{R_{t-1}}w_{t}\right)\right]+\frac{1}{R_{t-1}}V_{\tau,t}\right\} \quad (5)$$

In multi period projects, the correlation between periods when agents have asset specific skills, and agents wish to borrow against product from that period in borrowing constrained economies, implies there are arbitrage opportunities for other agents who can "lend" to such agents. Since outside owners of seasoned assets carry out transfers to managers that resemble borrowing, seasoned assets can have positive value when they are scarce.[5]

Finally, consider outside ownership of raw assets. Since entrepreneurs cannot commit to acquire asset specific skills, outside owners have no guarantee that entrepreneurs can be held-up in period 2. Thus, the potential gains of outside ownership cannot be realized.

Guess that in an equilibrium, entrepreneurs and managers are borrowing constrained under self employment (which will be verified later).

[5]Skills may be general with respect to many assets, but merging such assets can make skills de facto specific. Then, although the technology is constant returns to scale in assets, entrepreneurs/managers and workers, there are increasing returns to merging projects where managers's skills are general. This argument unravels if skills are general throughout all projects in the economy. The single merged asset would implement the ex post hold up of managers, but not the ex ante competition to attract managers. Both the ex post hold up and ex ante competition are essential for justifying the arbitrage role of outside ownership.

Then outside ownership of seasoned assets dominates self employment for managers. For raw assets, self employment for entrepreneurs dominates outside ownership. Under outside ownership, entrepreneurs receive no intertemporal transfers that resemble borrowing from outside owners, and they would be giving up the resale value of newly created seasoned assets $V_{1,t}$.

The earnings experiences across the three occupations can now be summarized. All managers and workers have identical earnings experiences due to the assumption of full bargaining power to outside owners. In particular, managers's earnings are independent of vintage since their outside option (worker wages) is independent of vintage.[6] Entrepreneurs earn x when young and $\pi_1(w_t) + V_{1,t}$ when old. The only borrowing possibilities are those collateralized by seasoned asset values. This means that young entrepreneurs in period $t-1$, can only borrow up to $\frac{1}{R_{t-1}} V_{1,t}$.

3 Equilibrium

A competitive equilibrium requires in every period (i) an ownership structure of assets and (ii) agents's choice of occupation, vintage and consumption to maximize lifetime utility subject to the borrowing constraint, earnings across occupations, the interest factor, labor market clearing condition and asset market clearing condition. I restrict the analysis to steady state outcomes where earnings levels, the interest factor, the distribution of labor across occupations and ownership structure of assets are invariant across time: $w_t = w$, $\pi_\tau(w_t) = \pi_\tau(w)$, $V_{\tau,t} = V_\tau$, $R_t = R$, $\mu_{\tau,t} = \mu_\tau$, $e_{\tau,t} = e_\tau$. Time subscripts are dropped.

Ex ante identical agents become entrepreneurs, managers and work-

[6] Managers and workers are distinguished by the tenure of employment for asset owners. Two periods for managers, one period for workers.

ers if their lifetime utility across occupations is equalized,

$$v\left(x, \pi_1\left(w\right) + V_1(w,R); R\right) = v\left(w, w; R\right) \quad \forall \tau \ where \ e_\tau > 0 \quad (6)$$

The terminal vintage $T \geq 1$ is given by the highest τ such that,

$$\left(x + \frac{1}{R}\pi_T\left(w\right)\right) - \left(w + \frac{1}{R}w\right) \geq 0 \quad (7)$$
$$\left(x + \frac{1}{R}\pi_{T+1}\left(w\right)\right) - \left(w + \frac{1}{R}w\right) < 0$$

Skilled agents coexist in vintages 1 to T. Since older projects are less productive, T is finite and a decreasing function of w and R.

The value of a vintage $\tau - 1$ seasoned asset conditional on outside ownership , is the discounted value of the stream of managers's product net of their employment wages up to the terminal vintage,,

$$V_{\tau-1}(w,R) = \sum_{s=\tau}^{T} \frac{1}{R^{s-\tau}} \left[\left(x + \frac{1}{R}\pi_s\left(w\right)\right) - \left(w + \frac{1}{R}w\right)\right] > 0 \quad for \ 1 \leq \tau - 1 \leq T - 1$$
$$= 0 \quad \text{otherwise} \quad (8)$$

Asset values are strictly falling in vintage τ, the worker wage w, and the interest factor R, and increasing in the age of the terminal vintage T. If entrepreneurs and managers coexist in the economy, $V_1 \geq 0 \Rightarrow x + \frac{1}{R}\pi_1\left(w\right) > w + \frac{1}{R}w$. Given the participation constraint, entrepreneurs can only have higher discounted earnings if they are borrowing constrained.

Given $V_1(w,R)$, the indifference condition across occupations allows us to solve for the equilibrium worker wage as a function of the interest factor, $w^* = w(R)$.

Lemma 1 *Worker wages are falling in the interest factor* $\frac{dw^*}{dR} \leq 0$.

Proof. The indifference condition is,

$$\left(x + \frac{1}{R}V_1(w,R)\right)^{\frac{1}{1+\beta}} \left(\pi_1\left(w\right)\right)^{\frac{\beta}{1+\beta}} = \frac{w\left(1 + \frac{1}{R}\right)\left(\beta R\right)^{\frac{\beta}{1+\beta}}}{1+\beta}$$

Since V_1 is strictly falling in R, entrepreneurs's utility is (weakly) falling in R. Workers's utility is (weakly) rising in R as long as $\left(\beta - \frac{1}{R}\right) \geq 0$. This inequality must hold under asset market clearing in Lemma 2, so the result follows. ■

Since assets cannot be reproduced, and all seasoned assets were previously raw assets, the density of skilled agents across coexisting vintages must be uniform, $\mu_\tau \equiv \mu \ \forall 1 \leq \tau \leq T$.

The labor market clearing condition for old agents is given by,

$$\frac{\mu}{2} \sum_{\tau=1}^{T} n_\tau(w) = 1 - \mu T \tag{9}$$

On the left hand side is the demand for workers by entrepreneurs and managers divided by 2 since only half of the workers are old. On the right hand side is the population of old minus the population of entrepreneurs and managers. Since T and n_τ are falling in w, μ overall is increasing in w.

Using the steady state measures of μ_τ, the asset market clearing condition is given by,[7]

$$\mu \frac{1}{R} V_1 + \mu(T-1) \left[\frac{\sum_{\tau=2}^{T} V_{\tau-1}(w, R)}{T-1} + (w - x) \right] = (1-\mu) \frac{\left(\beta - \frac{1}{R}\right) w}{1+\beta} \tag{10}$$

The left hand side denotes the demand of aggregate savings consisting of the borrowing of entrepreneurs against discounted seasoned asset value V_1, plus the average seasoned asset values and up-front payment to young managers summed across managers . The right hand side denotes the supply of aggregate savings offered by managers and workers at interest

[7] An alternative formulation of the asset market clearing condition is assets are priced by their discounted future resale price and dividend, $\frac{\mu}{R} V_1 + \frac{\mu}{R} \sum_{\tau=2}^{T} \left[V_\tau(w, R) + (\pi_\tau(w) - w) \right]$. The definition of asset values ensures the equivalence of the two formulations.

factor R. Note when there are no managers, $T = 1 \Rightarrow V_1 = 0$, then the left hand side is zero and the equilibrium interest factor is $R^* = \frac{1}{\beta}$.

The asset market clearing condition combined with the labor market clearing condition and asset value equations allows the equilibrium interest factor to be expressed as a function of the unskilled wage $R^* = R(w)$.

Lemma 2 *Entrepreneurs must be borrowing constrained given any interest factor clearing the asset market. The interest factor lies between* $\frac{1}{\beta} \leq R^* < \frac{1}{\beta}\frac{\pi_1(w)}{x}$.

Proof. Suppose not so $R^* \geq \frac{1}{\beta}\frac{\pi_1(w)}{x}$ and $\left(x + \frac{1}{R}\pi_1(w)\right) - \left(w + \frac{1}{R}w\right) = 0 \Rightarrow T = 1 \Rightarrow V_1 = 0$ no assets are traded, and $\mu_\tau = 0 \ \forall \tau \geq 2$ there are no managers. Since there are no asset market transactions the equilibrium interest factor is $R^* = \frac{1}{\beta}$. This is a contradiction. The bounds on the interest factor follow by inspection. ■

Proposition 1 *A steady state equilibrium* $\{w^*, R^*, T^*, \mu^*\}$ exists for this economy.

Proof. Consider the bounds on w^* given the bounds on the interest factor from Lemma 2. The upper bound is given by $\bar{w} \equiv w\left(\frac{1}{\beta}\right)$. The lower bound is given by $\underline{w} \equiv w\left(\beta\frac{x}{\pi_1(\underline{w})}\right)$, and it is known that entrepreneurs are not borrowing constrained, $V_1\left(w, \beta\frac{x}{\pi_1(w)}\right) = 0$. So, $w^* \in (\underline{w}, \bar{w}]$.

From Lemma 2, we know $R^*(\underline{w}) \in \left[\frac{1}{\beta}, \beta\frac{x}{\pi_1(\underline{w})}\right)$ and $R^*(\bar{w}) \in \left[\frac{1}{\beta}, \beta\frac{x}{\pi_1(\bar{w})}\right)$. Consider the following two cases. Case 1: $T\left(\bar{w}, \frac{1}{\beta}\right) = 1 \Rightarrow R^*(\bar{w}) = \frac{1}{\beta}$. Case 2: $T\left(\bar{w}, \frac{1}{\beta}\right) > 1 \Rightarrow R^*(\bar{w}) > \frac{1}{\beta}$ and $R^*(\underline{w}) > \frac{1}{\beta}$. Under case 1, the economy has a solution where $w^* = \bar{w}$, and $R^* = \frac{1}{\beta}$. Under case 2, the economy has a solution where $w^* \in (\underline{w}, \bar{w})$, and $R^* \in \left(\frac{1}{\beta}, \beta\frac{x}{\pi_1(\underline{w})}\right)$. ■

4 Discussion

4.1 Coexistence of Entrepreneurs and Managers

This subsection highlights three necessary assumptions for seasoned assets to have positive value, which occurs if and only if entrepreneurs and managers coexist. First, if there are no borrowing constraints and young agents can freely borrow against their old period earnings, only frontier projects would be undertaken and there would be no managers, $T' = 1$. The present discounted value of earnings would be equal for entrepreneurs and workers. The first best outcome is achieved where the credit market clearing condition is given by,

$$\mu'(w' - x) = \frac{\left(\beta - \frac{1}{R'}\right) w'}{1 + \beta} \tag{11}$$

Substituting in equilibrium μ' this equation becomes,

$$\frac{(w' - x)}{\frac{n_1(w')}{2} + 1} = \frac{\left(\beta - \frac{1}{R'}\right) w'}{1 + \beta} \tag{12}$$

Similarly, if there were borrowing constraints, but young entrepreneurs could commit to acquire skills specific to raw assets, only frontier projects would be undertaken and the present discounted value of earnings would be equal for managers and workers. In such an economy the asset market clearing condition would be identical to the credit market clearing condition above since the price of raw assets is zero.

A third necessary condition is that project productivities depreciate, $\delta < 1$. Consider outcomes in the limit as $\delta \to 1$.[8] From the definition of T, $\delta \to 1 \Rightarrow (i)\ T \to \infty \Rightarrow \mu \to 0$, (ii) asset values converge to a constant independent of $\tau : V_\tau \to V(\hat{w}, \hat{R}) = \frac{\hat{R}}{\hat{R}-1}\left[\left(x + \frac{1}{\hat{R}}\pi(\hat{w})\right) - \left(\hat{w} + \frac{1}{\hat{R}}\hat{w}\right)\right]$,

[8] In a steady state growth economy, this limit corresponds to the growth rate going to zero.

and (iii) input demands for workers are independent of τ : $n_\tau(\hat{w}) \rightarrow n_1(\hat{w})$. The asset market clearing condition at the limit is,

$$\frac{V(\hat{w},\hat{R})+(\hat{w}-x)}{\frac{n_1(\hat{w})}{2}+1}=\frac{\left(\beta-\frac{1}{\hat{R}}\right)\hat{w}}{1+\beta} \tag{13}$$

Agents in equilibrium are indifferent across occupations, but since assets do not depreciate, nobody becomes an entrepreneur.

4.2 Optimal terminal vintage

The main analysis assumed that outside owners have full bargaining power so that skilled managers's earnings are driven down to their outside option: worker wages w. Suppose when bargaining with outside owners, managers can secure a share $0 \leq \theta \leq 1$ of the surplus between his product and outside option. I interpret θ as an exogenous institutional variable which individual agents cannot affect. Let $\varpi_{\tau-1} \geq x$ denote the earnings offered by outside owners to attract young managers who will become skilled in a vintage τ project when old. The modified terminal vintage rule sets $T \geq 1$ as the oldest vintage such that,

$$\begin{aligned}\left(x+\frac{1}{R}\pi_T(w)\right)-\left(\varpi_{T-1}+\frac{1}{R}\left[\theta\left(\pi_T(w)-w\right)+w\right]\right)\geq 0 \\ \left(x+\frac{1}{R}\pi_{T+1}(w)\right)-\left(\varpi_{T}+\frac{1}{R}\left[\theta\left(\pi_{T+1}(w)-w\right)+w\right]\right)< 0\end{aligned} \tag{14}$$

As long as managers remain borrowing unconstrained, they are willing to work for discounted labor earnings equal to that of workers. If they are borrowing constrained, their discounted labour earnings must be higher for them to remain indifferent across occupations.

$$\begin{aligned}\varpi_{T-1} &= w-\frac{1}{R}\left[\theta\left(\pi_T(w)-w\right)\right] \text{ if borrowing unconstrained} \\ &> w-\frac{1}{R}\left[\theta\left(\pi_T(w)-w\right)\right] \text{ if borrowing constrained}\end{aligned} \tag{15}$$

As long as managers are not borrowing constrained (low θ), the terminal vintage rule is optimal. Optimal in the sense that all projects

where the product exceeds the opportunity cost of labor are implemented. Once they are borrowing constrained (high θ), the terminal vintage is younger than the optimum. For instance suppose $\theta = 1$, then $T = 1$, no assets are traded and there are no managers.

An interpretation of this result is that in economies where outside owners's rights are well protected (low θ), no other stakeholder interests need to be protected. In economies where outside owners's interests are poorly protected (high θ), other stakeholder (e.g. managers's) interests need to be considered in the decision to terminate projects.

High θ economies are characterized by a relative scarcity of employment vacancies opened by outside owners. They are also characterized by a relative abundance of self employed entrepreneurs who undertake relatively short lived projects.

5 Outside ownership as a factor input

This section sets up a canonical model of firm entry and exit, and interprets it as a reduced form version of my model. Consider a discrete time economy composed of a continuum of firms which produce a homogenous good. The output of an individual firm which is $\tau \geq 1$ periods old is,

$$\begin{array}{c} \delta^{\tau} f(m_{\tau} - 1) \text{ if } m_{\tau} \geq 1 \\ 0 \text{ if } m < 1 \end{array} \tag{16}$$

$\delta \in (0,1)$, $f(0) = 0, f'(\cdot) > 0$, $\lim_{n \to 0} f'(n) = \infty$ and $f''(\cdot) < 0$. m_{τ} denotes units of homogenous unskilled labor hired from competitive labor markets at wage w.

In each period, a fixed cost c must be incurred to prolong the life of the firm by 1 period. The terminal vintage of a firm is the highest T

such that the discounted profit net of the continuation cost is positive,

$$-c + \frac{1}{R}\left[\delta^T f(m_T - 1) - m_T w\right] \geq 0 \tag{17}$$
$$-c + \frac{1}{R}\left[\delta^{T+1} f(m_{T+1} - 1) - m_{T+1} w\right] < 0$$

The fixed continuation cost is assumed to ensure there is firm exit. If $c = 0$, firm exit would never happen since profits are always non-negative.

The value of a $0 \leq \tau - 1 \leq T - 1$ period old firm (after period τ profits have been distributed) is given by,

$$G_{\tau-1} \equiv \sum_{s=\tau}^{T} \frac{1}{R^{s-\tau}} \left[-c + \frac{1}{R}\delta^s f(m_s - 1) - m_s w\right] \tag{18}$$

New firms are opened at fixed entry cost F, and yield no output until they are 1 period old. New firms will enter until discounted profits net of the entry cost is zero. The equilibrium entry condition is,

$$F = G_0 \tag{19}$$

The fixed entry cost is assumed to limit the entry of new firms. If $F = 0$, firm entry would be unbounded since profits are positive.

This economy almost exactly describes the industry equilibrium of Hopenhayn (1992). The two differences are that (i) incumbent firms incur fixed costs c, to keep firms open in the following period as opposed to the current period, and (ii) one extra unit of labor must be hired in production.

The concavity of the production function with respect to labor means that firms supply a vintage specific factor input such that production is constant returns to scale in labor and this factor input. The profits of the firm are accruing to this input which costs F to create and costs c to maintain each period.

Recall the original economy with entrepreneurs, managers and workers, and consider the following reduced form modifications. Let (i)

$m_\tau = n_\tau + 1$, (ii) $\theta = 0$, (iii) $c = w - x$ the up-front payment to managers, and (iv) $F = \left(x + \frac{1}{R}\left[\pi_1(w) + V_1\right]\right) - \left(w + \frac{1}{R}w\right)$ the difference in discounted earnings which compensates entrepreneurs for facing borrowing constraints. Then, a reduced form version of my original economy has been exactly described above.

Substituting in for c and m_τ and rearranging, firm values and seasoned asset values are equated,

$$G_\tau = V_\tau \quad \text{for } 1 \leq \tau \leq T \tag{20}$$

The value of a firm is equal to the resale value of seasoned assets. These substitutions also ensure that the terminal vintage condition is identical for both economies.

In light of my theory, the assumptions underlying the canonical Hopenhayn model can be interpreted in the following way. Firms undergo changes in their ownership structure during their life-cycle from self employment to outside ownership. Under self employment, borrowing constrained owners need to be compensated to open new firms, and this compensating variation equals the fixed entry cost F in the Hopenhayn model. Since the role of the self employed is to supply the economy with seasoned assets, their compensation for facing borrowing constraints can be interpreted as the entry cost for seasoned assets. The up-front payment offered by outside owners to attract managers into two period projects translates into the continuation cost c of keeping firms open in the Hopenhayn model. This payment is also the cost of prolonging the use of assets under outside ownership. Unlike in the Hopenhayn model, both F and c are endogenous to my model.

The outside ownership of seasoned assets behaves just like a factor input which earns a periodic return. The compensating variation entrepreneurs receive for creating seasoned assets and facing borrowing con-

straints is an entry cost of this factor input. The up-front bribe offered to young managers to continue projects is the periodic maintenance cost of keeping seasoned assets in use. The interpretation of outside ownership as a factor input, emerged endogenously from an economy where agents undertaking multi-period projects faced borrowing constraints.

6 Conclusion

This paper developed a framework in which the outside ownership of assets improves economic outcomes, and can be interpreted as a factor input. The asset value of firms was conditional on an outside ownership structure. By relating the model to an existing canonical model of firm entry and exit, it was possible to interpret assets which can implement the gains from outside ownership as a factor supplied by firms, and which are associated with endogenous creation and maintenance costs. These insights have implications for broadening the parameters determining firm entry and exit in empirical studies.

Several theoretical extensions can be considered. Since agents acquire a fixed level of skills, the model abstracts away from how there may be underinvestment in skills due to the hold-up problem under outside ownership. Such an argument relies on the costs of skills being private to the agent acquiring the skill. Since entrepreneurs unlike managers own the assets they produce with, a richer model could capture the prediction that entrepreneurs accumulate more skills than managers in projects. On the other hand, if investment is costly in output terms, the borrowing constraints facing entrepreneurs could deter skill investment. Different types of skills could be accumulated to different extents depending on whether projects are carried out by entrepreneurs or managers.

Another extension would be to have agents who live for four or more

periods, so they can carry out more than one project in their lifetimes. Such a model would predict that entrepreneurs remain entrepreneurs throughout their lifetimes, and always sell assets upon completion of new projects. Entrepreneurs would have the largest stock of accumulated wealth, and are in the best position to overcome borrowing constraints which characterize entrepreneurship in the current model.

References

[1] Acemoglu, D. and R. Shimer (1999), "Holdups and Efficiency with Search Frictions," *International Economic Review*, 40, pp. 827-851.

[2] Becker, G.S. (1964). "*Human Capital: A Theoretical and Empirical Analysis with Special Reference to Education*," Chicago IL: University of Chicago Press.

[3] Evans, D.S. and B. Jovanovic (1989), "An Estimated Model of Entrepreneurial Choice Under Liquidity Constraints," *Journal of Political Economy*, 97, pp. 808-827.

[4] Grossman, S. and O. Hart (1986), "The Costs and Benefits of Ownership: A Theory of Vertical and Lateral Integration," *Journal of Political Economy*, vol. 94, pp. 691-719.

[5] Hart, O. and J. Moore (1990), "Property Rights and the Nature of the Firm," *Journal of Political Economy*, vol. 98, pp.1119-1158.

[6] Holmes, T.J. and J.A. Schmitz Jr. (1990), "A Theory of Entrepreneurship and Its Application to the Study of Business Transfers," *Journal of Political Economy*, 98, pp. 265-294.

[7] Holtz-Eakin D., D. Joulfaian and H.S. Rosen (1994), "Sticking It Out: Entrepreneurial Survival and Liquidity Constraints," *Journal of Political Economy*, 102, pp. 53-75.

[8] Hopenhayn, H.A. (1992), "Entry, Exit, and Firm Dynamics in Long Run Equilibrium," *Econometrica*, 60, pp. 1127-1150.

[9] Kihlstrom, R.E. and J-J. Laffont (1979), "A General Equilibrium Entrepreneurial Theory of Firm Formation Based on Risk Aversion," *Journal of Political Economy*, 87, pp. 719-748.

[10] Kim, Y. (1999), "Skill Accumulation in the Search Unemployment Model," USC CLEO Research Paper No. C02-26.

[11] Knight, F.H., "*Risk, Uncertainty and Profit*," New York: Houghton Mifflin.

[12] Neher, D.V. (1999), "Staged Financing: An Agency Perspective," *Review of Economic Studies*, 66, pp. 255-274.