

A General Equilibrium Theory of Occupational Choice under Optimistic Expectations

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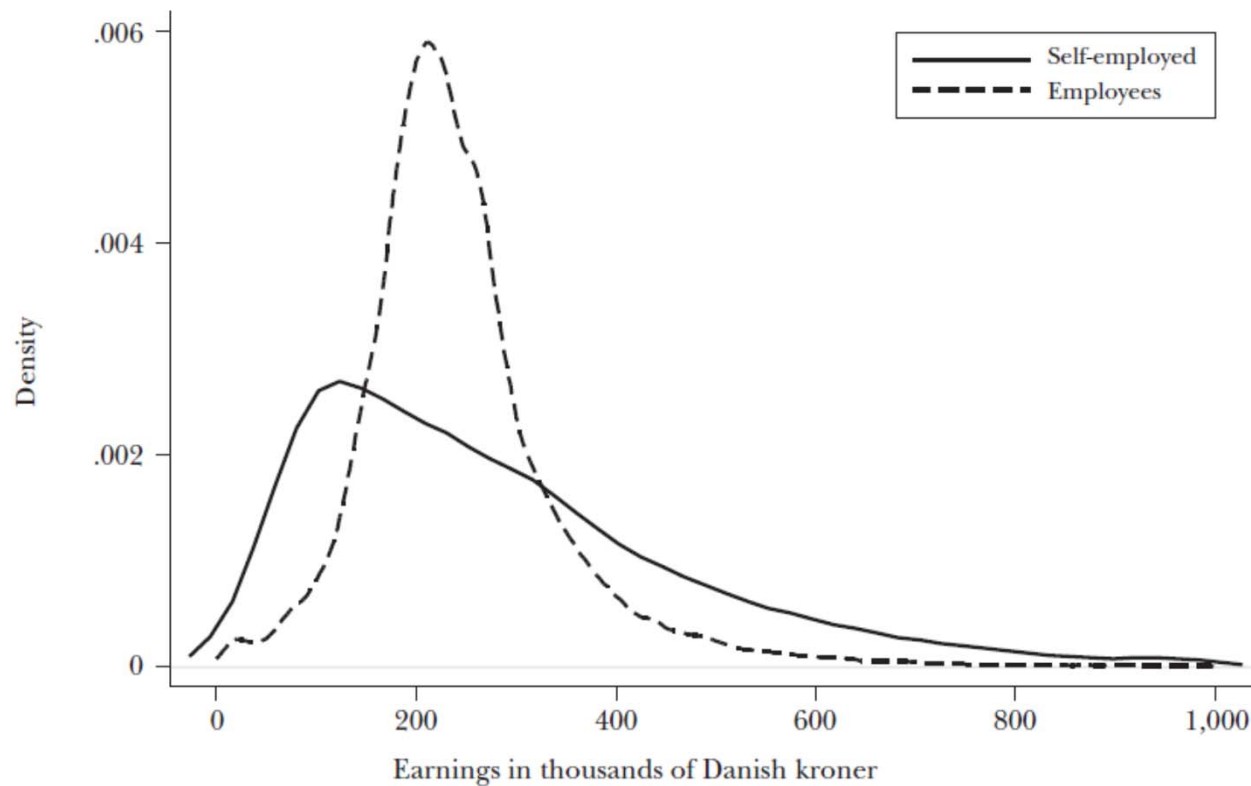
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Motivating Stylized Facts

1. The returns to entrepreneurship are **highly variable**, much more than wages and than returns to public equity.
2. The **average return** to entrepreneurship is **not significantly higher** than average wages or returns to public equity.
3. There is **persistence** in entrepreneurship despite the high risk and low returns. Entrepreneurs receive **non-pecuniary benefits** from self-employment.

Comparison of Wage versus Self-Employment Earnings: Denmark



Source: Authors using data from the Integrated Database for Labor Market Research (IDA). The database is maintained by the Danish government and consists of an annual panel of all individuals, and firms in Denmark.

Comparison of Wage versus Self-Employment Earnings: Denmark

- The analysis is based on a 10-percent random sample of all employees and entrepreneurs in 1995.
- It is then conditioned on individuals whose tenure at their job is at least ten years, individuals who would be presumed to have a good match to their job.
- The pattern cannot be accounted for purely by lack of time for some entrepreneurs to learn they have low ability and exit (as in Jovanovic, 1982).

Motivating Stylized Facts

4. The majority of entrepreneurs are **optimistic** about the chances that their firms will succeed.
5. Optimistic individuals are more likely to become entrepreneurs.
6. Entrepreneurs are more optimistic than wage workers.
7. Realistic entrepreneurs earn more, on average, than optimists.

Contribution

- We develop a fully specified general equilibrium model of occupational choice that can **explain the motivating stylized facts**.
- In our model entrepreneurial **optimism arises endogenously** (instead of being fixed and exogenous) and is **a function of tastes and technology**.
- We generate **new and testable predictions** regarding the impact of optimism on labor market, capital market, and firm formation.

Related Literature

- Occupational choice models:
 - Lucas (1978), Kanbur (1979), Kihlstrom & Laffont (1979), Bewley (1989), Lazear (2005), Campanale (2010), and Poschke (2013)
- Anticipatory Utility:
 - Lowenstein (1978), Caplin & Leahy (2001), Koszegi (2006, 2010), and Brunnermeier & Parker (2005)
- Studies of the effects of entrepreneurial optimism:
 - de Meza & Southey (1996), Manove (2000), Fraser & Greene (2006) and Rigotti et al. (2011)

Preview: theoretical mechanisms

- We extend Lucas' (1978) by assuming that a positive fraction of individuals in the economy derives **anticipatory utility from entrepreneurship**.
- This gives these individuals an incentive to distort their beliefs of entrepreneurial ability.
- If the weight of anticipatory utility is moderate these **individuals endogenously decide to be optimists**.

Preview: theoretical mechanisms

- If ability and inputs (labor and capital) are complementary in production, then **optimistic entrepreneurs demand more inputs than realists**
-> expansion of input demand.
- **Optimists**, by comparison to realists, **find entrepreneurship more attractive than paid work**
-> contraction of labor supply.

Preview: theoretical mechanisms

- The expansion of labor demand and contraction of labor supply **raises the equilibrium wage**.
- The expansion of capital demand **raises the rental rate of capital** (capital supply is fixed and exogenous).
- The higher input prices imply that **optimists crowd out realists** from entrepreneurship.

Preview: theoretical mechanisms

- **Misallocation of talent:** The lowest ability entrepreneurs are less talented at running a firm than the highest ability workers.
- Optimistic individuals are more likely to become entrepreneurs and **entrepreneurs are more optimistic than workers.**
- If the fraction of optimists is high enough, then **the majority of entrepreneurs are optimists.**

Preview: theoretical mechanisms

- Optimism raises the material payoff of workers since it raises the equilibrium wage.
- Optimism lowers the material payoff of realistic entrepreneurs since it raises input prices.
- Optimism lowers the material payoff of optimistic entrepreneurs by: (i) distorting input choices and (ii) raising input prices.

The Model

- Fraction $\lambda \in (0,1]$ of individuals in the economy cares about the material payoff of entrepreneurship and derives **anticipatory utility from entrepreneurship**:

$$f(l, k, \theta_0) - (wl + rk) + s[f(l, k, \theta) - (wl + rk)]$$

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Material
payoff

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$$\underbrace{f(l, k, \theta_0) - (wl + rk)}_{\text{Material payoff}} + s \underbrace{[f(l, k, \theta) - (wl + rk)]}_{\text{Anticipatory payoff}}$$

Material
payoff

Anticipatory
payoff

(non-pecuniary benefit)

The Model

- The remaining fraction $1-\lambda$ of individuals in the economy has **standard preferences** (i.e., only cares about the material payoff of entrepreneurship).
- There is a continuum of both types of individuals ranked by their **entrepreneurial ability, θ_0** , which is distributed on $[0,1]$ according to $G(\theta_0)$.
- Individuals are **risk neutral**.

The Model

- At $t=0$ individuals with anticipatory utility choose their beliefs of entrepreneurial ability for all future periods.
- At $t=1$ individuals become entrepreneurs or workers.
- At $t=2$ entrepreneurs choose labor and capital to maximize their perceived material payoff. Any anticipatory utility from entrepreneurship is realized.
- At $t=3$ entrepreneurs realize the material payoff from running their firms. Workers are paid the market wage.

The Model

- Equilibrium is reached when the labor and capital markets clear (output market clears by Walras' Law).
- An equilibrium is:
 - A partition $\{[0, \hat{\theta}_R], [\hat{\theta}_R, 1]\}$ of realistic individuals
 - A partition $\{[0, \hat{\theta}_O], [\hat{\theta}_O, 1]\}$ of optimal expect. individuals
 - A wage w for which labor demand equals labor supply
 - A rental cost of capital r for which capital demand equals the exogenous capital supply

The Model

- We assume a Cobb-Douglas technology with DRS:

$$f(l, k, \theta_0) = \theta_0 l^\alpha k^\beta, \text{ where } \alpha, \beta > 0 \text{ and } \alpha + \beta = \eta \in (0, 1)$$

- Risk neutrality and $\theta_0 \in [0, 1]$ imply that θ_0 can be interpreted as the probability of success of the firm:

$$\pi = \theta_0 (l^\alpha k^\beta - wl - rk) + (1 - \theta_0)(0 - wl - rk)$$

Optimal Expectations

- At $t=2$ an entrepreneur with an expectation of ability θ and ability θ_0 solves:

$$\max_{l,k} (\theta l^\alpha k^\beta - wl - rk)$$

- The labor and capital demands are equal to:

$$l(w, r, \theta) = \theta^{\frac{1}{1-\eta}} \left(\frac{\alpha}{w} \right)^{\frac{1-\beta}{1-\eta}} \left(\frac{\beta}{r} \right)^{\frac{\beta}{1-\eta}}$$

$$k(w, r, \theta) = \theta^{\frac{1}{1-\eta}} \left(\frac{\alpha}{w} \right)^{\frac{\alpha}{1-\eta}} \left(\frac{\beta}{r} \right)^{\frac{1-\alpha}{1-\eta}}$$

Optimal Expectations

- At $t=0$ the optimal expectation of ability is given by:

$$\max_{\theta \in [0,1]} \left\{ (\theta_0 + s\theta)[l(w, r, \theta)]^\alpha [k(w, r, \theta)]^\beta - (1+s)[wl(w, r, \theta) + rk(w, r, \theta)] \right\}$$

- Substituting the input demands and simplifying terms the above problem is equivalent to:

$$\max_{\theta \in [0,1]} \left[(\theta_0 + s\theta)\theta^{\frac{\eta}{1-\eta}} - (1+s)\eta\theta^{\frac{1}{1-\eta}} \right]$$

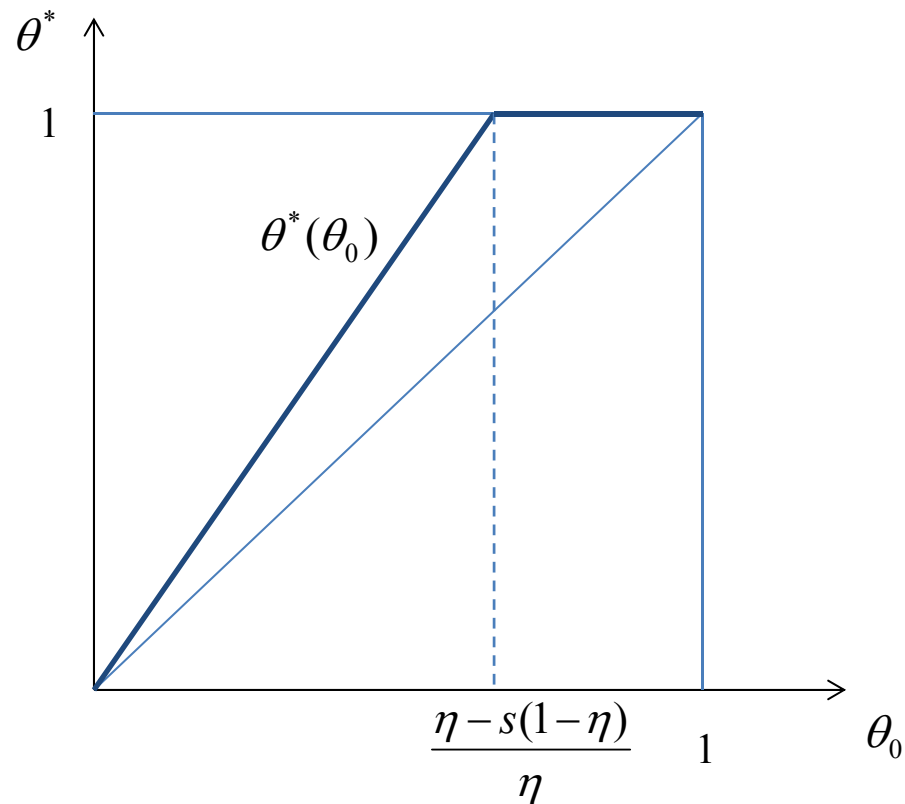
Optimal Expectations

- **Proposition 1:** If $f(l, k, \theta_0) = \theta_0 l^\alpha k^\beta$ and $s < \eta / (1 - \eta)$, then optimal expectations of ability are given by

$$\theta^* = \begin{cases} \frac{\eta}{\eta - s(1 - \eta)} \theta_0 & \text{if } 0 \leq \theta_0 \leq \frac{\eta - s(1 - \eta)}{\eta} \\ 1 & \text{if } \frac{\eta - s(1 - \eta)}{\eta} \leq \theta_0 \leq 1 \end{cases}$$

Optimal Expectations

- Optimal expectations θ^* as a function of ability θ_0 :



Optimal Expectations

- Those with optimal expectations have an incentive to **bias their beliefs to inflate anticipatory benefits.**
- They endogenously **choose to be optimists** about their entrepreneurial ability.
- Being optimist about entrepreneurial ability leads to:
 - **first-order gains due to increased anticipatory payoff** of entrepreneurship;
 - **second-order costs due to reduced material payoff** of entrepreneurship from distorted input choices.

Optimal Expectations Equilibrium

- **Proposition 2:** If $f(l, k, \theta_0) = \theta_0 l^\alpha k^\beta$, θ_0 is uniformly distributed on $[0, 1]$, and $s < \bar{s}$, then there exists a unique optimal expectations equilibrium.
- **Comments:**
 - The equilibrium is well defined as long as the weight of anticipatory utility is relatively small.
 - The equilibrium has closed form solutions.
 - Proposition 3 defines the unique equilibrium when the weight of anticipatory utility is relatively large.

Optimal Expectations Equilibrium

- The **marginal realistic entrepreneur** has ability

$$\hat{\theta}_R = \left[\frac{\alpha}{2 - \beta} \frac{1 + \lambda s / \eta}{1 - \lambda + \lambda \phi(\eta, \beta, s)} \right]^{\frac{1-\eta}{2-\eta}}$$

and the **marginal optimistic entrepreneur** has ability

$$\hat{\theta}_O = \left[\frac{\eta - s(1 - \eta)}{\eta} \right]^\eta \left[\frac{\alpha}{2 - \beta} \frac{1 + \lambda s / \eta}{1 - \lambda + \lambda \phi(\eta, \beta, s)} \right]^{\frac{1-\eta}{2-\eta}}$$

where $\phi(\eta, \beta, s) = \left[1 - \frac{s(1 - \eta)(2 - \eta)}{\eta - s(1 - \eta)} \right] \left[\frac{\eta}{\eta - s(1 - \eta)} \right]^{1-\eta}$

Misallocation of Talent

- **There is a misallocation of talent:** the ablest do not necessarily select into entrepreneurship.
- In equilibrium we have $\hat{\theta}_O < \hat{\theta}_R$: the lowest ability entrepreneurs are less talented at running a firm than the highest ability workers.
- This is an empirically attractive implication of the model since the earnings distributions of workers and entrepreneurs have overlapping supports.

Who is More Optimistic?

- **Proposition 4:** Assume $f(l, k, \theta_0) = \theta_0 l^\alpha k^\beta$, θ_0 is uniformly distributed on $[0, 1]$, and $s < \bar{s}$.
 - (i) Optimists are more likely to become entrepreneurs than realists;
 - (ii) Entrepreneurs are more likely to be optimists than workers;
 - (iii) If the fraction of optimists is high enough, i.e.,

$$\lambda > \left[1 + \frac{1 - \hat{\theta}_R [1 - s(1 - \eta) / \eta]^\eta}{1 - \hat{\theta}_R} \right]^{-1}$$

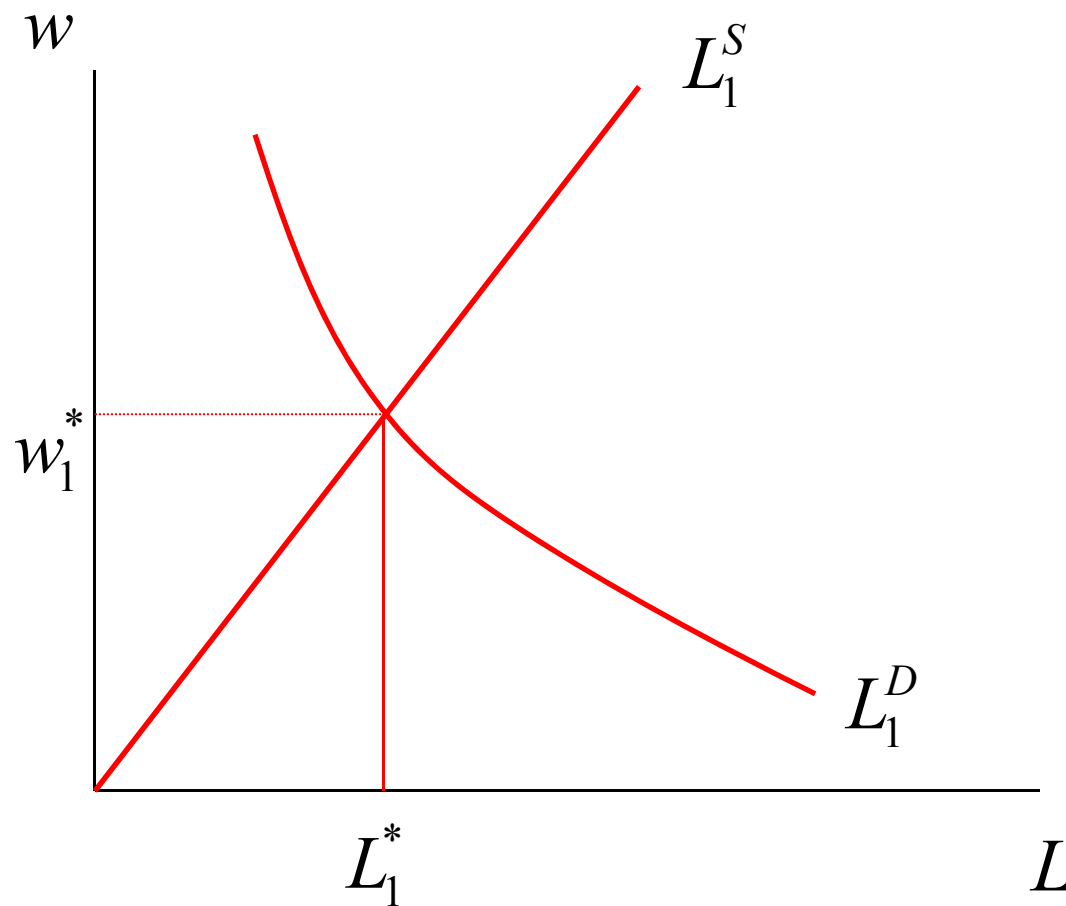
then the majority of entrepreneurs are optimists.

Equilibrium Wage

- Optimism raises the equilibrium wage.
- **Proposition 6:** If $f(l, k, \theta_0) = \theta_0 l^\alpha k^\beta$, θ_0 is uniformly distributed on $[0, 1]$, and $s < \bar{s}$, then an increase in the fraction of optimists λ raises equilibrium wage w^* .

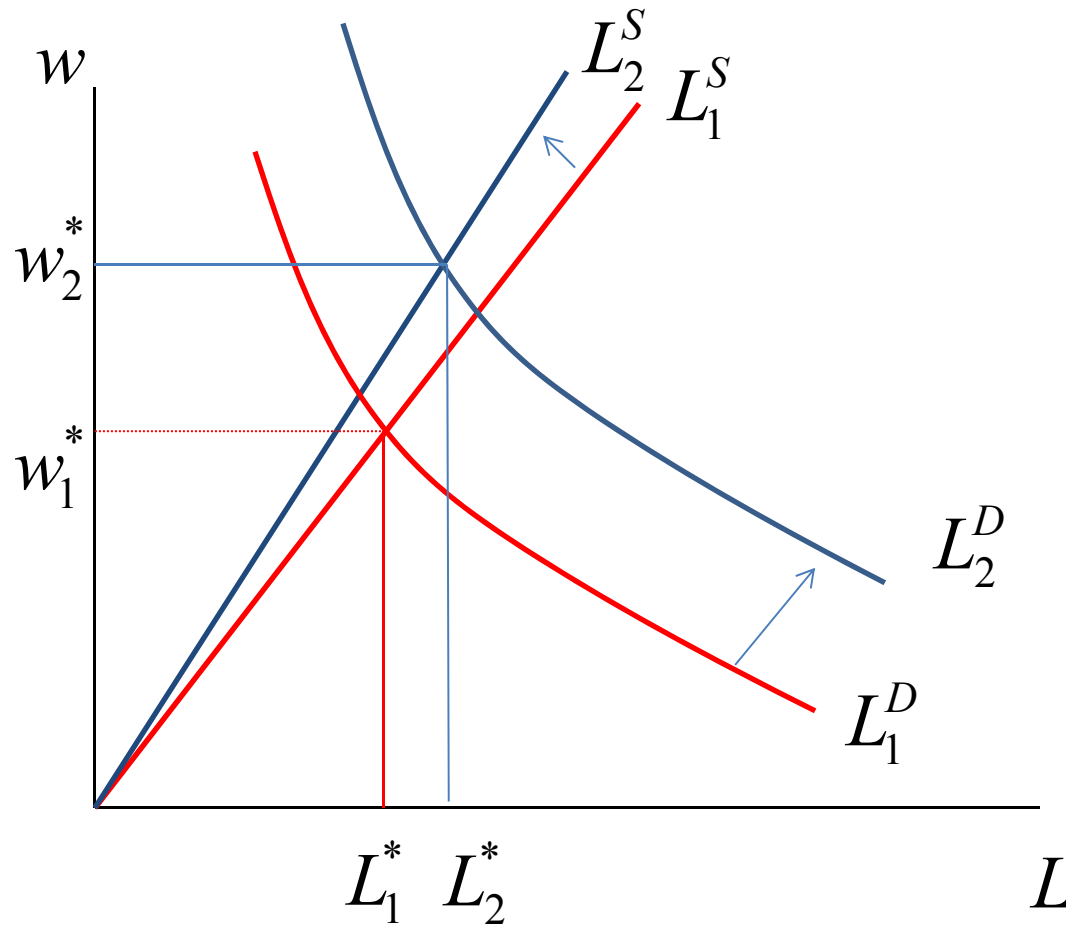
Equilibrium Wage

- Labor market equilibrium without optimism:



Equilibrium Wage

- Labor market equilibrium with optimism:



The Crowding Out Effect

- Optimists crowd out realists from entrepreneurship.
- **Proposition 7 (iii):** If $f(l, k, \theta_0) = \theta_0 l^\alpha k^\beta$, θ_0 is uniformly distributed on $[0, 1]$, and $s < \bar{s}$, then an increase in the fraction of optimists λ lowers the number of realistic entrepreneurs.

Calibration

- The calibration parameterizes the economy to match macro and micro moments from the U.S. manufacturing sector following Alder (2016).

Parameter	Value	Description
η	0.85	DRS (Atkeson and Kehoe, 2005)
α	0.612	labor's income share 0.72×0.85
β	0.238	capital income share 0.28×0.85
K	0.906	capital-output ratio 1.46
λ	0.5	fraction w/ anticipatory utility, (Kocher et al., 2014)
s	0.683	weight of anticipatory utility

Calibration

	Model $\lambda=0$ Lucas (1978)	Model $\lambda=0.5$ and $s=0.683$	Percent Change
Output	0.620	0.612	-1.29
Wage	0.436	0.458	5.05
Rental cost of capital	0.163	0.170	4.29
Mean returns of entrepreneurs	0.722	0.458	-36.58
Mean returns of realists	-	0.630	-
Mean returns of optimists	-	0.376	-
Fraction of workers	0.871	0.867	-0.46
Ability mg realistic entrepreneur	-	0.914	-
Ability mg optimistic entrepreneur	-	0.820	-
Fraction of entrepreneurs	0.129	0.133	3.10
Fraction of entrepreneurs optimists	-	0.677	-
Fraction of workers optimists	-	0.473	-

Policy Intervention

- Entrepreneurial optimism lowers output.
- We show that it is possible to raise output with a revenue-neutral tax-subsidy scheme.
- The scheme consists of a **lump-sum tax** to (optimistic) entrepreneurs with profits below the market clearing wage and a **lump-sum subsidy** to workers.

Policy Intervention

- The tax revenues come only from optimistic entrepreneurs and induce low ability optimists to stay in the labor force.
- The tax revenues are redistributed to workers as a lump-sum subsidy which further induces low ability optimists to stay in the labor force.
- This reverses the crowding-out effect.

Conclusions

- We extend Lucas' (1978) by assuming that a fraction of individuals in an economy derive anticipatory utility from entrepreneurship.
- Individuals with optimal expectations choose to be optimists about their entrepreneurial ability.
- The degree of optimism is increasing with:
 - the weight of anticipatory utility
 - the level of decreasing returns to scale

Conclusions

- Optimism has six main effects:
 1. Misallocation of talent: the lowest ability entrep. are less skilled than the highest ability workers.
 2. Optimists are more likely to become entrepreneurs than realists.
 3. Entrepreneurs are more optimistic than workers
 4. When λ is high enough the majority of entrepreneurs are optimists.
 5. Drives up the wage making workers better off.
 6. Lowers the returns to entrepreneurship.

Optimal Expectations Equilibrium

- **Proposition 2:** If $f(l, k, \theta_0) = \theta_0 l^\alpha k^\beta$, θ_0 is uniformly distributed on $[0, 1]$, and $s < \bar{s}$, then there exists a unique optimal expectations equilibrium where the marginal realistic entrepreneur has ability

$$\hat{\theta}_R = \left[\frac{\alpha}{2 - \beta} \frac{1 + \lambda s / \eta}{1 - \lambda + \lambda \phi(\eta, \beta, s)} \right]^{\frac{1 - \eta}{2 - \eta}}$$

the marginal optimistic entrepreneur has ability

$$\hat{\theta}_O = \psi(\eta, s) \left[\frac{\alpha}{2 - \beta} \frac{1 + \lambda s / \eta}{1 - \lambda + \lambda \phi(\eta, \beta, s)} \right]^{\frac{1 - \eta}{2 - \eta}}$$

Optimal Expectations Equilibrium

- **Proposition 2 (cont.):** the number of workers is

$$L^* = [1 - \lambda + \lambda \psi(\eta, s)] \left[\frac{\alpha}{2 - \beta} \frac{1 + \lambda s / \eta}{1 - \lambda + \lambda \phi(\eta, \beta, s)} \right]^{\frac{1 - \eta}{2 - \eta}}$$

the wage is

$$w^* = \frac{\alpha^\alpha (1 - \eta)^{1 - \eta} \bar{K}^\beta}{[1 - \lambda + \lambda \psi(\eta, s)]^\beta} \left[\frac{\alpha}{2 - \beta} \frac{1 + \lambda s / \eta}{1 - \lambda + \lambda \phi(\eta, \beta, s)} \right]^{\frac{(1 - \eta)(1 - \beta)}{2 - \eta}}$$

the rental cost of capital is

$$r^* = \frac{\beta(1 - \eta)^{1 - \eta}}{\alpha^{1 - \eta} \bar{K}^{1 - \beta}} [1 - \lambda + \lambda \psi(\eta, s)]^{1 - \beta} \left[\frac{\alpha}{2 - \beta} \frac{1 + \lambda s / \eta}{1 - \lambda + \lambda \phi(\eta, \beta, s)} \right]^{\frac{(1 - \eta)(2 - \beta)}{2 - \eta}}$$

Optimal Expectations Equilibrium

- **Proposition 2 (cont.):** where \bar{s} is the solution to

$$\frac{\alpha}{2-\beta} \left(1 + \frac{\lambda \bar{s}}{\eta} \right) = [1 - \lambda + \lambda \phi(\eta, \beta, \bar{s})] \left[\frac{\eta - \bar{s}(1-\eta)}{\eta} \right]^{2-\eta}$$

and

$$\phi(\eta, \beta, s) = \left[1 - \frac{s(1-\eta)(2-\eta)}{\eta - s(1-\eta)} \right] \left[\frac{\eta}{\eta - s(1-\eta)} \right]^{1-\eta}$$

and

$$\psi(\eta, s) = \left[\frac{\eta - s(1-\eta)}{\eta} \right]^\eta$$

Optimal Expectations Equilibrium

- The **marginal realistic entrepreneur** has ability

$$\hat{\theta}_R = \left[\frac{\alpha}{2 - \beta} \frac{1 + \lambda s / \eta}{1 - \lambda + \lambda \phi(\eta, \beta, s)} \right]^{\frac{1 - \eta}{2 - \eta}}$$

and the **marginal optimistic entrepreneur** has ability

$$\hat{\theta}_O = \left[\frac{\eta - s(1 - \eta)}{\eta} \right]^{\eta} \left[\frac{\alpha}{2 - \beta} \frac{1 + \lambda s / \eta}{1 - \lambda + \lambda \phi(\eta, \beta, s)} \right]^{\frac{1 - \eta}{2 - \eta}}$$

where $\phi(\eta, \beta, s) = \left[1 - \frac{s(1 - \eta)(2 - \eta)}{\eta - s(1 - \eta)} \right] \left[\frac{\eta}{\eta - s(1 - \eta)} \right]^{1 - \eta}$

Who Becomes an Entrepreneur? Who is More Optimistic?

- The fraction of entrepreneurs who are optimists is:

$$\gamma_E^* = \frac{\lambda(1 - \hat{\theta}_O)}{\lambda(1 - \hat{\theta}_O) + (1 - \lambda)(1 - \hat{\theta}_R)}$$

- The fraction of workers who are optimists is:

$$\gamma_L^* = \frac{\lambda \hat{\theta}_O}{\lambda \hat{\theta}_O + (1 - \lambda) \hat{\theta}_R}$$

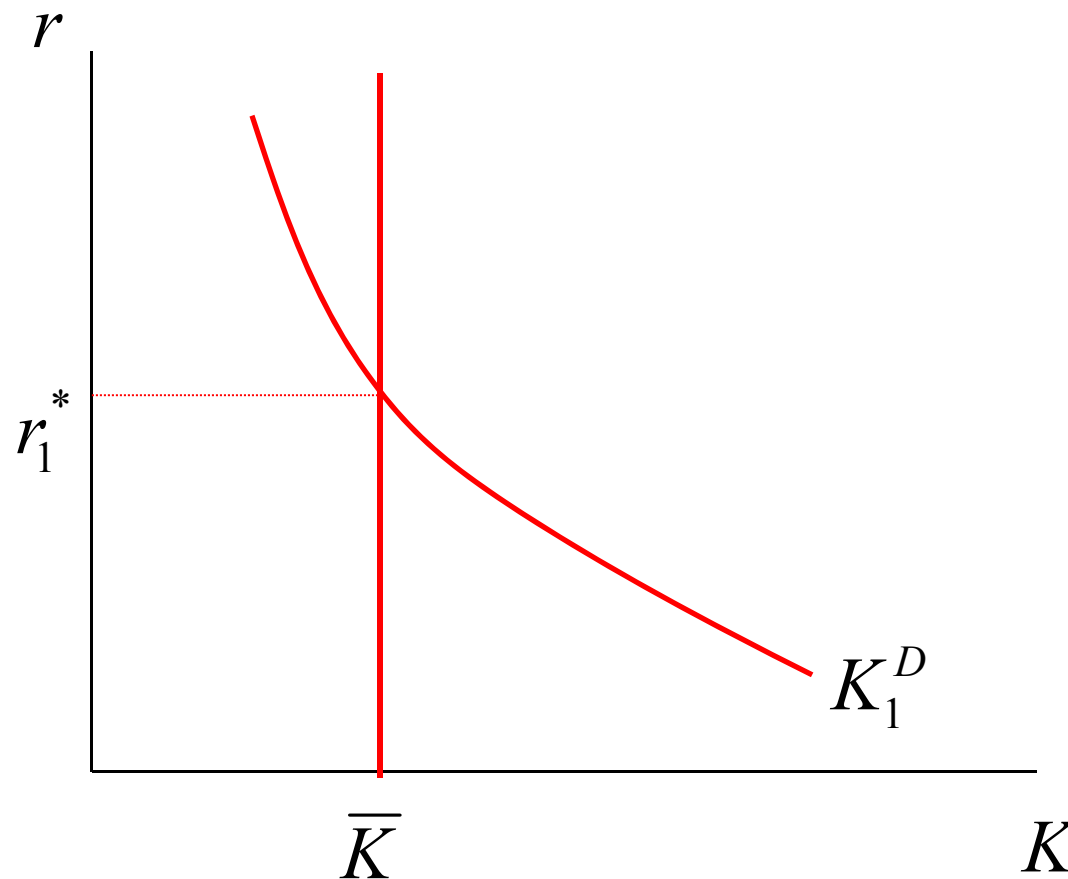
- These two expressions and $\hat{\theta}_O < \hat{\theta}_R$ imply that $\gamma_E^* > \gamma_L^*$, i.e., **entrepreneurs are more optimistic than workers.**

Equilibrium Rental Cost of Capital

- The optimal expectations equilibrium rental cost of capital r^* is higher than the rational expectations equilibrium rental cost of capital.
- The expansion of capital demand **raises the rental rate of capital** (capital supply is fixed and exogenous).
- In equilibrium we have $r^*(\lambda) = \frac{\beta w^*(\lambda) L^*(\lambda)}{\alpha \bar{K}}$.
- **Proposition 10** provides conditions under which an increase in the fraction of optimists λ leads to an increase in the rental cost of capital r^* .

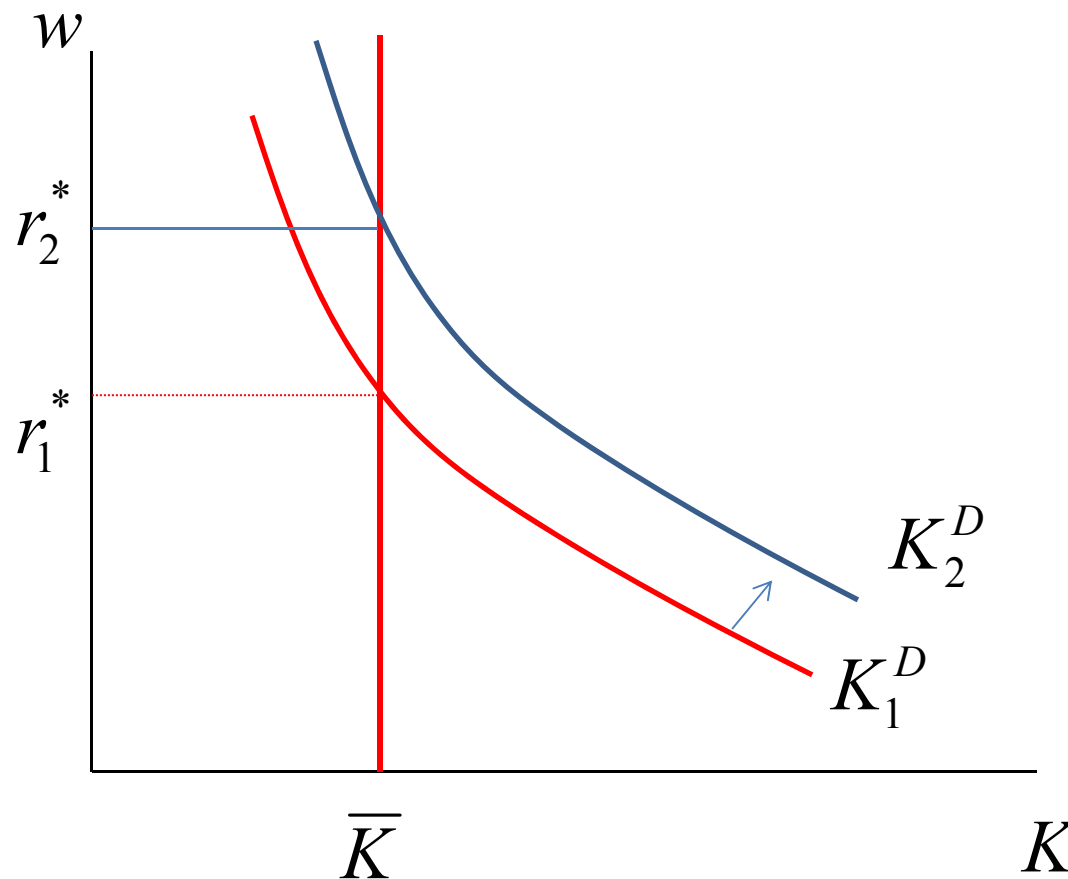
Equilibrium Rental Cost of Capital

- Capital market equilibrium without optimism:



Equilibrium Rental Cost of Capital

- Capital market equilibrium with optimism:

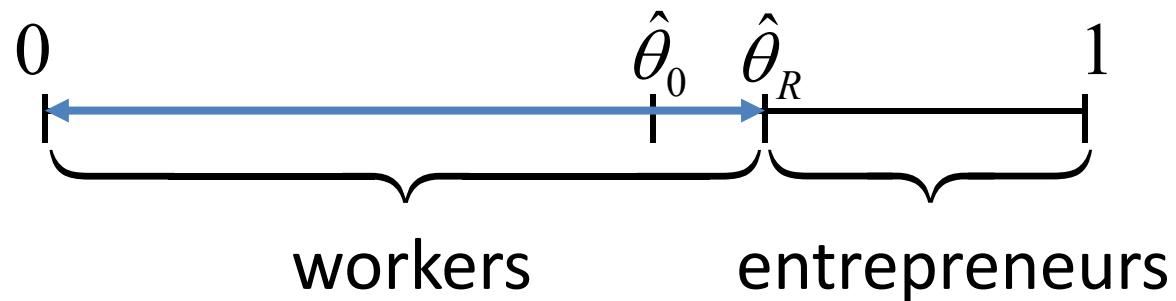


The Number of Entrepreneurs

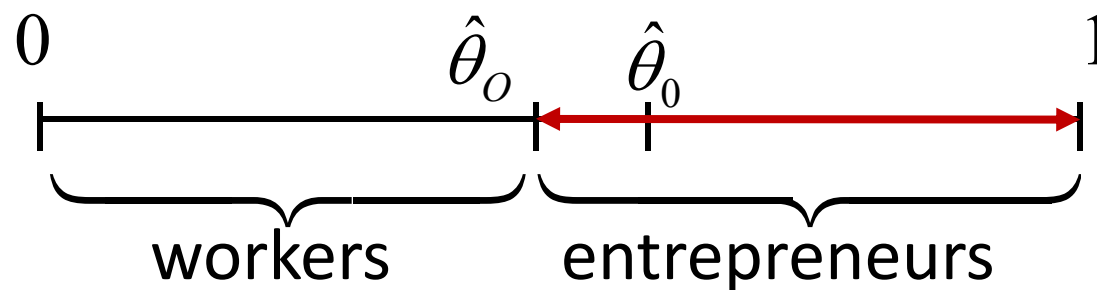
- An increase in the fraction of optimists λ can lower (raise) the number of entrepreneurs (workers).
- This is another result of the crowding out effect.
- An increase in λ lowers the number of realistic entrepreneurs (Prop. 8). A change in λ has an ambiguous effect on the number of optimistic entrepreneurs.
- **Proposition 9** provides conditions under which an increase in λ lowers the number of entrepreneurs.

Crowding Out Effect: Low λ ($\hat{\theta}_O < \hat{\theta}_0 < \hat{\theta}_R$)

- Realistic individuals:

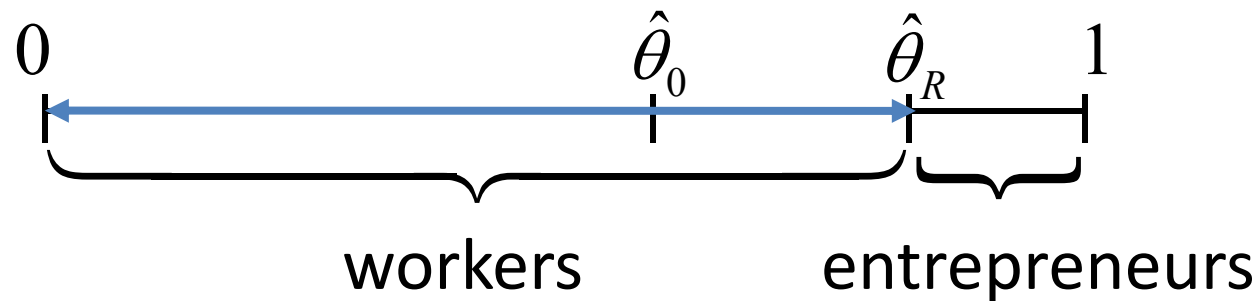


- Optimistic individuals:



Crowding Out Effect: High λ ($\hat{\theta}_0 < \hat{\theta}_O < \hat{\theta}_R$)

- Realistic individuals:



- Optimistic individuals:

