Job Turnover and Policy Evaluation: A General Equilibrium Analysis

Hugo Hopenhayn and Richard Rogerson

Prof. Sargent's Reading Group

Motivation

- Hopenhayn and Rogerson extend the model of industry dynamics in Hopenhayn (1992) to a general equilibrium setting
- The aim is to study the implications of government policies that *"..make it costly for firms to adjust their employment level"*
- The focus will be on the characterization of a stationary equilibrium for the economy
- The main result of the paper is that it is very costly to distort the job creation/destruction process

The Model: Technology

- $\pi_t = p_t f(n_t, s_t) - n_t - p_t c_f - g(n_t, n_{t-1})$
- s is a firm specific production shock that follows a first–order markov process described by $F(s, s')$
- $g(n_t, n_{t-1}) = \tau \max(0, n_{t-1} - n_t)$, τ is the fixed payment for each job destroyed
- There is an infinite supply of potential entrants at each time t. They draw the initial s from a distribution v
- $f(n_t, s_t)$ is continuosly differentiable and strictly concave in n for each s and $\lim_{n \to 0} f_1(n, s) = \infty$
- $F(s, s')$ is continuos and decreasing in its first argument and v has a continuous C.D.F.

The Model: Timing

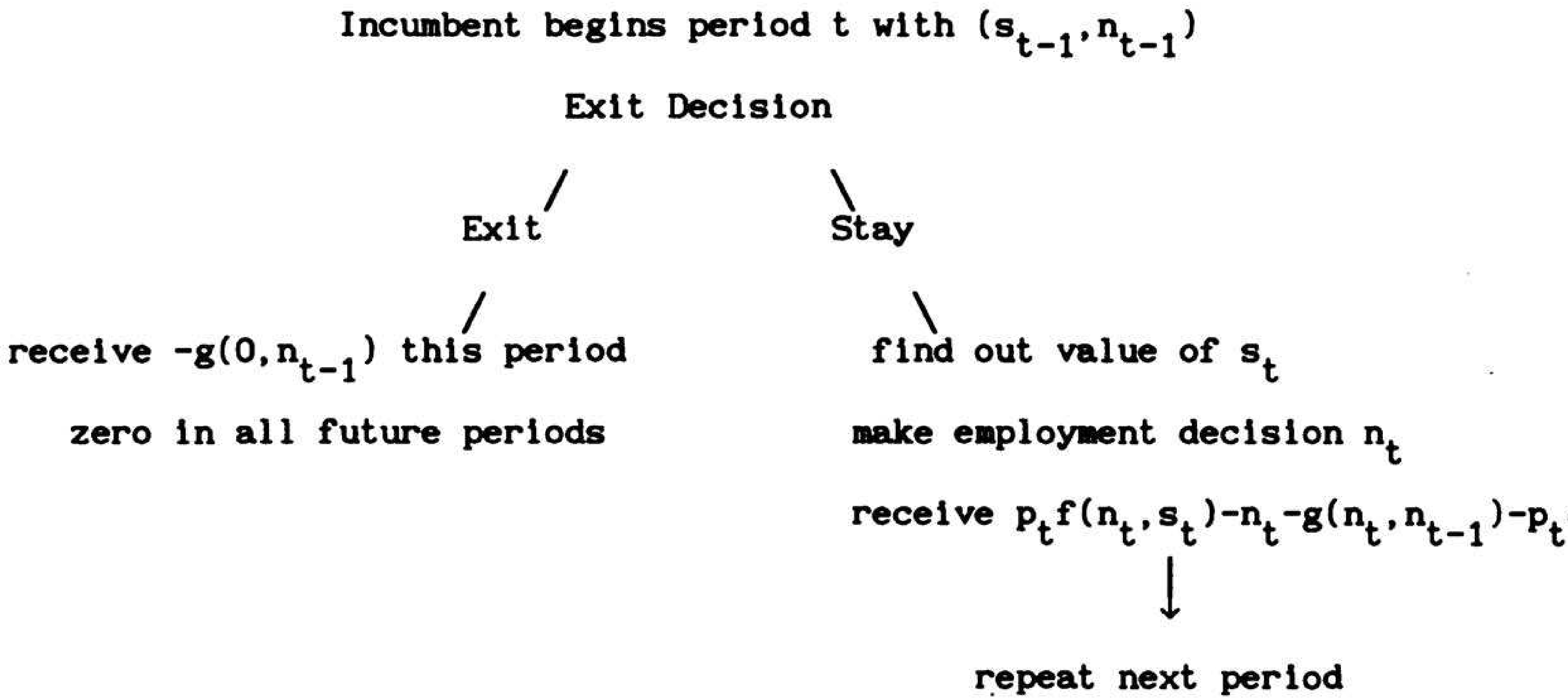

FIG. 1.—Timing of decisions

The Model: Bellman Equation for the Firm's Problem

$$W(s, n; p) = \max_{n' \geq 0} \{ p_t f(n', s) - n' - pc_f - g(n', n) + \quad (1)$$

$$+\beta \max[E_s W(s', n'; p), -g(0, n')]\} \quad (2)$$

The problem for the potential entrants is simply given by:

$$W^e(p) = \int W(s, 0; p) dv(s) \leq c_e \quad (3)$$

- Let (s, n) be the state of an individual firm, then the state of the economy is defined as the distribution of the state variables for all individual firms $\mu(s, n)$
- The transition from μ to μ' is $\mu' = T(\mu, M; p)$. The operator T has a fixed point: $\mu^* = T(\mu^*, M; p)$

The Model: Preferences and Endowments

- There is a continuous of identical agents with utility function:

$$\sum_{t=1}^{\infty} \beta^t [u(c_t) - \kappa(n_t)] \tag{4}$$

- Labor supply $\in \{0, 1\} \Rightarrow$ individual choose employment lotteries $\Rightarrow$ representative agent with preferences $\sum_{t=1}^{\infty} \beta^t [u(c_t) - aN_t]$
- The problem of the household is:

$$\max u(c) - aN \qquad s.t. \qquad pc \leq N + \Pi + R \tag{5}$$

- Π are the profits equally distributed among households and R is the lump–sum transfer from taxation of job destruction
- $L^s(p, \Pi + R)$ is the labor supply. **It is assumed that the income effect on labor supply is negative**

The Model: Equilibrium

$$
\begin{aligned}
L^d(\mu, M; p) &= \int N(s, n; p) d\mu(s, n) + M \int N(s, 0; p) dv(s) \\
Y(\mu, M; p) &= \int [f(N(s, n; p), s) - c_f] d\mu(s, n) + M \int f(N(s, 0; p), s) dv(s) \\
\Pi(\mu, M; p) &= pY(\mu, M; p) - L^d(\mu, M; p) - R(\mu, M; p) - Mpc_e \\
(s, n; p) &= [1 - X(s, n; p)] \int g(N(s', n'; p), n') dF(s', s) + X(s, n; p) g(0, n'
\end{aligned}
$$

A stationary equilibrium *consists of an output price* $p^* \geq 0$*, a mass of entrants* $M^* \geq 0$ *and a measure of incumbent firms* μ^* *such that*

(i) $L^d(\mu^*, M^*, p^*) = L^s(p^*, \Pi(\mu^*, M^*, p^*) + R(\mu^*, M^*, p^*))$

(ii) $\mu^* = T(\mu^*, M; p)$

(iii) $W^e(p^*) \leq p^* c_e$*, with equality if* $M^* > 0$

Computation of the Equilibrium

- **Step 1:** Use the entry condition (3) with equality to pin down an equilibrium price p^*

$$W^e(p) = \int W(s, 0; p) dv(s) = c_e$$

- **Step 2:** Use the fact that the operatot T has a fixed point to find the stationary distribution μ, up to a scale factor M
- **Step 3:** Use the labor market clearing condition for labor to pin down M^*:

$$L^d(M\mu, M, p^*) = L^s(p^*, M(\Pi(\mu, 1, p^*) + R(\mu, 1, p^*)))$$

L^d is linearly homogeneous in M and L^s is strictly decreasing in M $\Rightarrow$ there is a unique value of M that satisfies the above equation

Parametrization

- $f(n,s) = sn^{\theta}$ with $\theta \in [0,1]$
- $g(n_t, n_{t-1}) = 0$ in the benchmark model
  otherwise $g(n_t, n_{t-1}) = \tau \max(0, n_{t-1} - n_t)$
- $\log(s_t) = a + \rho \log(s_{t-1}) + \varepsilon_t$ with $\varepsilon\ N(0, \sigma_\varepsilon^2)$ $a \geq 0$ and $\rho \in [0,1)$
- $u(c) = \log(c)$, $\kappa(n) = An$ with $A > 0$
- in the benchmark model the problem of the firm is static and it implies:

$$\log(n_t) = \frac{1-\rho}{1-\theta}\left(\log\theta + \log\rho + \frac{a}{1-\rho}\right) + \rho\log(n_{t-1}) + (\frac{1}{1-\theta})\varepsilon_t$$

Calibration with 5 years as a unit of time using LRD

- $p^* = 1 \Rightarrow c_e$ is pinned down by the entry condition
- $\theta = 0.64$, $\beta = 0.8$ and A s.t. $\frac{employment}{population} = 0.6$
- ρ and σ_ε^2 are recovered from the regression of $\log(n_t)$ on a constant and $\log(n_{t-1})$
- c_f and a are chosen to match the cross–sectional average of log employment and the 5–years exit rate
- The distribution of v is chosen to match the actual size distribution of firms aged 0-6 years in their first and second periods

LRD Statistics

A. Estimates Derived from the LRD

Serial correlation in log employment (5-year interval, survivors)	.93
Variance in growth rates (log difference, 5-year interval, survivors)	.53
Mean employment	61.7
Exit rate (5-year interval)	37%

B. Size Distribution for Firms Aged 0–6 Years

Employees	Share of Total Firms
1–19	.74
20–99	.18
100–499	.08
500+	.01

Statistics from Benchmark Model

A. SUMMARY STATISTICS FOR BENCHMARK MODEL

Average firm size	61.2
Co-worker mean	747
Variance of growth rates (survivors)	.55
Serial correlation in log n (survivors)	.92
Exit rate of firms	.39
Turnover rate of jobs	.30
Fraction of hiring by new firms	.15
Average size of new firm	7.5
Average size of existing firm	4.9

B. SIZE DISTRIBUTION

	1–19	20–99	100–499	500+
Firms	.52	.37	.10	.01

The effect of a tax on job destruction

Effect of Changes in τ (Benchmark Model)

	$\tau = 0$	$\tau = .1$	$\tau = .2$
Price	1.00	1.026	1.048
Consumption (output)	100	97.5	95.4
Average productivity	100	99.2	97.9
Total employment	100	98.3	97.5
Utility-adjusted consumption	100	98.7	97.2
Average firm size	61.2	61.8	65.1
Layoff costs/wage bill	0	.026	.044
Job turnover rate	.30	.26	.22
Serial correlation in log(n)	.92	.94	.94
Variance in growth rates	.55	.45	.39

- A tax on job destruction reduces long–run employment, reduces average productivity and, as a consequence of this reduction, produces welfare losses