The Economics of Predation: What Drives Pricing When There Is Learning-by-Doing?*

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November 9, 2012

Abstract

[illegible]

*We thank Lanier Benkard, Luis Cabral, Chiara Fumagalli, Dan Gottlieb, Joe Harrington, Ken Hendricks, Ariel Pakes, Mike Riordan, Mark Satterthwaite, and Connan Snider as well as the Editor and two anonymous referees for helpful discussions and suggestions. We also thank participants at the 2010 Searle Center Conference on Antitrust Economics and Competition Policy, the Ninth Annual International Industrial Organization Conference, and the 2011 NYU Stern IO Day for their useful questions and comments. Besanko and Doraszelski gratefully acknowledge financial support from the National Science Foundation under Grant

1 Introduction

[illegible]

2 Model

fi

fi

fi

fi n

fi π_n ; fi

$p_1; p_2$

fi

S_1

$\phi_1(e'; S_1) = \Pr(S_1 \geq S_1(e'))$ $S_1(e')$

$\phi_1(e') = 1 - F_S(S_1(e'))$

$$U_1(e') = E_S[S_1(e') - S_1;$$

$$1 - \phi_1(e')]\beta V_1(e'_1; e'_2) - \phi_2(e') V_1(e'); \phi_2(e') = E_S[S_1 | S_1 \leq S_1(e')];$$

$E_S[S_1 | S_1 \leq S_1(e')]$ [7]

fi

$$V_1 = \max_{p_1} \pi_1(p_1; p_2); \sum_{e'} U_1(e') (e'; D_1(p_1; p_2); D_2(p_1; p_2)):$$

e'; p_1 $\Pi_1(p_1; p_2)$;

$$\Pi_1(p_1; p_2) = \pi_1(p_1; p_2) + U_1 + \sum_{e' \neq e} [U_1(e') - U_1] (e'; D_1(p_1; p_2); D_2(p_1; p_2))$$

fi fi fi

p_1 fi

$$\frac{\partial \pi_1(p_1; p_2)}{\partial p_1} + \sum_{e' \neq e} [U_1(e') - U_1] \frac{\partial (e'; D_1(p_1; p_2); D_2(p_1; p_2))}{\partial q_1} \frac{\partial D_1(p_1; p_2)}{\partial p_1} + \sum_{e' \neq e} [U_1 - U_1(e')] \frac{\partial (e'; D_1(p_1; p_2); D_2(p_1; p_2))}{\partial q_2} \frac{\partial (-D_2(p_1; p_2))}{\partial p_1};$$

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[7] See the Online Appendix for closed-form expressions for $E[X_1 | X_1 \geq X_1(e')]$ in equation (1) and $E_S[S_1 | S_1 \leq S_1(e')]$ in equation (2).

$-D_2(p_1, p_2)$ $D_2(p_1,$

p_1 $D_1(p_1, p_2)$

p_1

$\pi_1(p_1, p_2)$;

p_1

p_1

q_1 p_1 q_2

p_1 q_1

p_1 q_2

2.3 Learning-by-doing

[8]

e_n $; \ldots ; M$

n

$c(e_n)$

$$c(e_n) = \begin{cases} \kappa\rho^{\log_2 e_n} & \le e_n < m, \\ \kappa\rho^{\log_2 m} & m \le e_n \le M, \end{cases}$$

$\kappa >$ ρ $/$;

$-\rho$ %

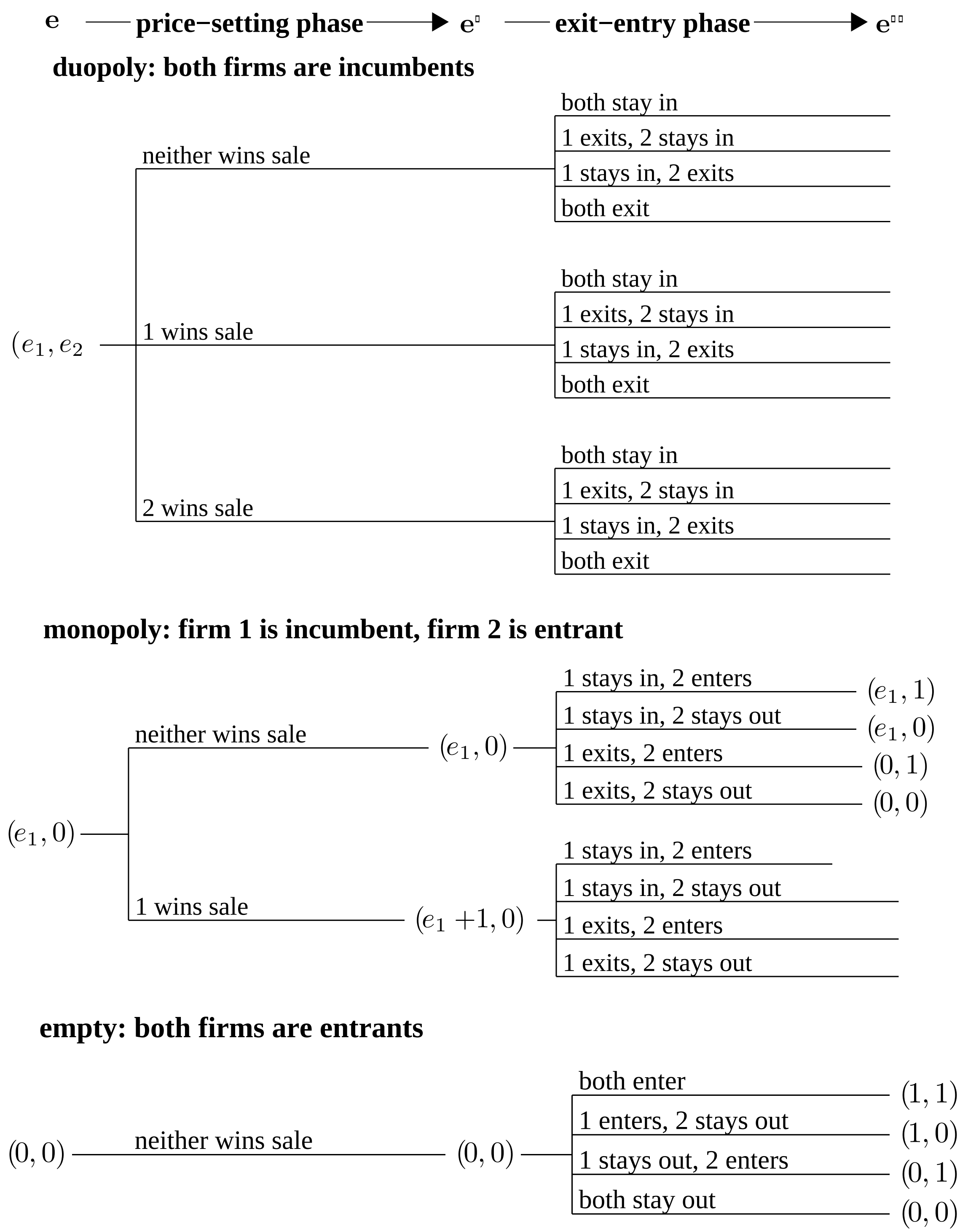
[8] Empirical studies show that organizations can forget the know-how gained through learning-by-doing due to labor turnover, periods of inactivity, and failure to institutionalize tacit knowledge (Argote, Beckman & Epple 1990, Darr, Argote & Epple 1995, Benkard 2000, Shafer, Nembhard & Uzumeri 2001, Thompson 2007). Besanko et al. (2010) show that organizational forgetting predisposes firms to price aggressively. Omitting organizational forgetting from the model therefore \stacks the deck" against finding predation-like behavior.

[9] We obviously have to ensure $e_n \leq M$. To simplify the exposition we abstract from boundary issues in what follows.

[10] Formally, our learning-by-doing model is a special case of the general model with the probability that the industry's state changes from $\mathbf{e}$ to $\mathbf{e}'$ during the price-setting phase set to

$$\Pr\left(\mathbf{e}'|\mathbf{e};\mathbf{q}\right) = \begin{cases} q_1 & \text{if} \quad \mathbf{e}' = (e_1+1; e_2); \\ q_2 & \text{if} \quad \mathbf{e}' = (e_1; e_2+1); \\ 1-q_1-q_2 & \text{if} \quad \mathbf{e}' = \mathbf{e}; \end{cases}$$

where q_n is the probability that incumbent firm n makes the sale as given in equation (6).


e
price−setting phase
e′
exit−entry phase
e′′
duopoly: both firms are incumbents
(e_1, e_2)
neither wins sale
1 wins sale
2 wins sale
both stay in
1 exits, 2 stays in
1 stays in, 2 exits
both exit
monopoly: firm 1 is incumbent, firm 2 is entrant
$(e_1, 0)$
neither wins sale
1 wins sale
$(e_1, 0)$
$(e_1 + 1, 0)$
1 stays in, 2 enters
1 stays in, 2 stays out
1 exits, 2 enters
1 exits, 2 stays out
$(e_1, 1)$
$(e_1, 0)$
$(0, 1)$
$(0, 0)$
empty: both firms are entrants
$(0, 0)$
neither wins sale
$(0, 0)$
both enter
1 enters, 2 stays out
1 stays out, 2 enters
both stay out
$(1, 1)$
$(1, 0)$
$(0, 1)$
$(0, 0)$

$mr_1\ p_1;p_2$ $\bar{p}_1 - \frac{}{1-D_1(p_1;p_2(\mathbf{e}))}$ fi

E

3 Equilibrium and computation

$e_1; e_2$ $e_2; e_1$

$H\ x; !$

x $!$ x

$H\ x; !$ $!$ $H^{-1}\ !$ $x\ H\ x; !$

$H\ x; !$

$H^{-1}\ !$ $x\ H\ x; !$

$x; !$

s $x\ s\ ; !\ s$

$H^{-1}\ !$ $x\ H\ x; !$ $H\ x\ s\ ; !\ s$

$\frac{\partial H(x(s);!(s))}{\partial x} x' s \quad \frac{\partial H(x(s);!(s))}{\partial x} !' s$ $\quad x \; s \; ; \; ! \; s$

ff $\quad x \quad !$

$H \; x; \; !$

ff

$H^{-1} \; ! \quad x; \; ! \quad H \; x; \; ! \quad H \; x; \; !$

$;\omega$

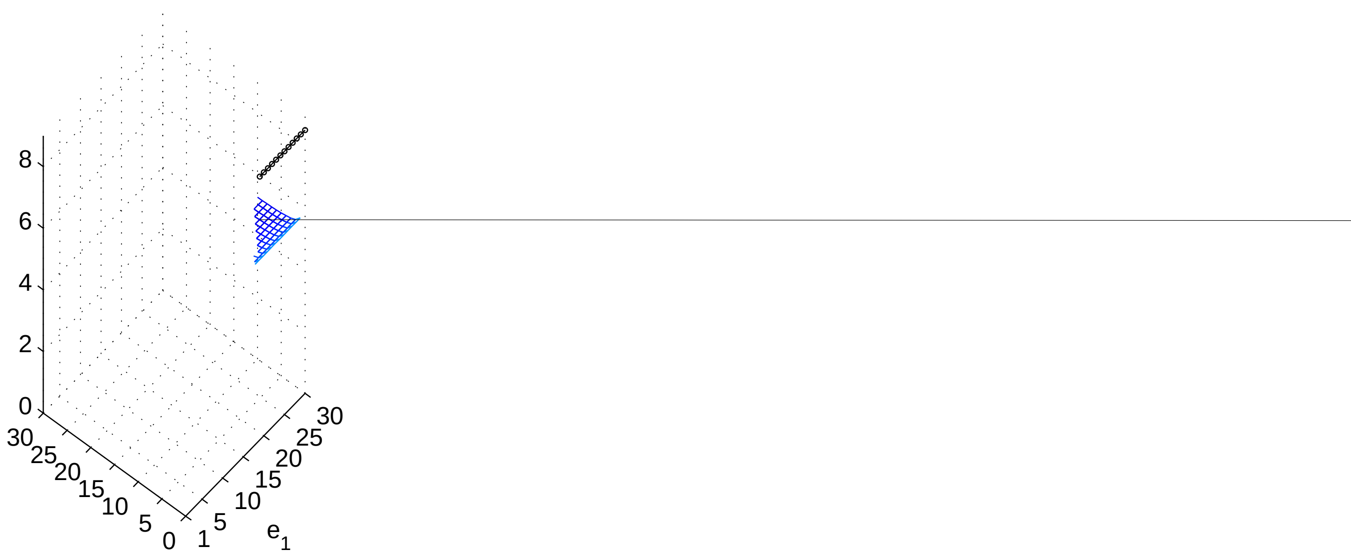
$\mathbf{V}_1; \quad _1; \quad _1; \phi_1$

$\omega \quad \rho; \sigma; \overline{X}; : : : \quad ^{15} \quad ^{-1} \; \omega$

$;\omega$

ρ fi

$\rho \quad ^{-1} \; \rho$


8
6
4
2
0
30
25
20
15
10
5
0
1
5
10
15
20
25
30
e1

assesses its prospects in the industry. In this particular equilibrium, $\phi_2(e_1; 0) = 1{:}00$ for $e_1 \in \{2; :::; 30\}$, so that the potential entrant does not enter if the incumbent firm has moved down from the top of its learning curve.

[19] The multiple closed communicating classes that may arise for a particular equilibrium are conceptually different from multiple equilibria. A closed communicating class is a set of states from which there is no escape once the industry has entered it. The transient distribution in period 1000 accounts for the probability of reaching any one of these classes, starting from state $(1; 1)$ in period 0.

T	p_1	p_2	ϕ_1	ϕ_2	p_1	p_2	ϕ_1	ϕ_2

$$\bar{p} \quad \sum_{n=1}^{2} \frac{D_n \; p_1 \quad ; p_2}{D_1 \; p_1 \quad ; p_2 \qquad D_2 \; p_1 \quad ; p_2} p_n \quad :$$

2 . E :

$$CS^{\infty} \quad \sum_{\mathbf{e}} \mu^{\infty} \quad CS \quad ;$$

CS

E :

$$TS^{\infty} \quad \sum_{\mathbf{e}} \mu^{\infty} \quad \Big] CS \quad \sum_{n=1}^{2} PS_n \quad ;$$

PS_n fi n [20]

E :

$$CS^{NPV} \quad \sum_{T=0}^{\infty} \beta^{T} \sum_{\mathbf{e}} \mu^{T} \quad CS \quad :$$

E :

$$TS^{NPV} \quad \sum_{T=0}^{\infty} \beta^{T} \sum_{\mathbf{e}} \mu^{T} \quad \Big] CS \quad \sum_{n=1}^{2} PS_n \quad :$$

μ^{∞} CS^{∞} TS^{∞}

CS^{NPV} TS^{NPV}

μ^{0} μ^{1} CS^{NPV} TS^{NPV}

fl

fi fl

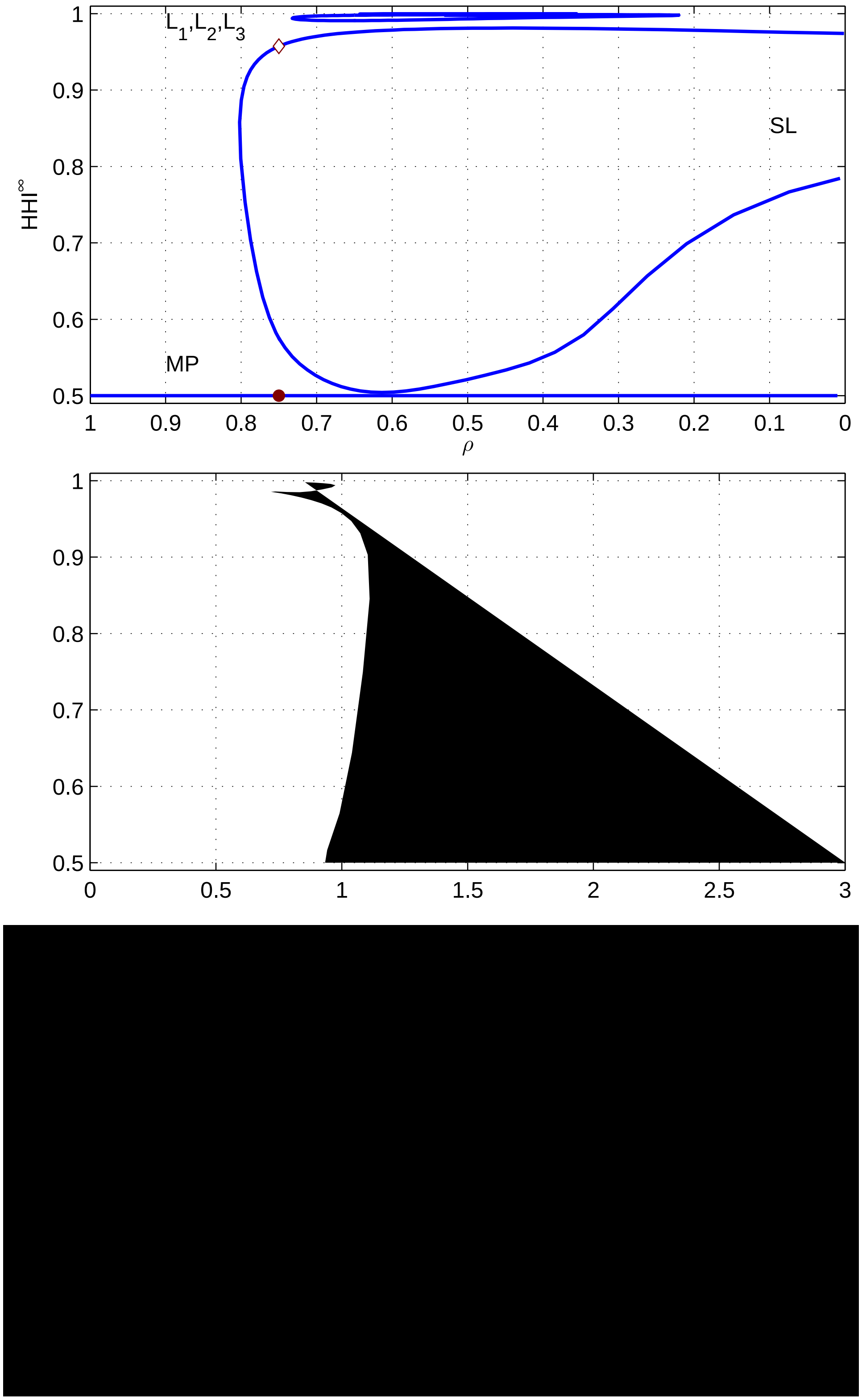
ff

CS^{NPV} CS^{∞}

[20] See the Online Appendix for expressions for $CS(\mathbf{e})$ and $PS_n(\mathbf{e})$.

HHI^{∞}		
$\overline{p}^{\infty}$		
CS^{∞}		
TS^{∞}		
CS^{NPV}		
TS^{NPV}		

4.2 Equilibrium correspondence



fi

ρ / ; σ / ; $\overline{X}$ / − : ; :

ff . HHI^{∞} σ

ff σ fl fi

σ → fi

fi ff σ

σ ^{22}

σ $^{-1}$ σ

MP

5 Isolating predatory incentives

[26]

$\Pi_1(p_1;p_2;)$

$\Pi_1^0(p_1;p_2;)$ $\Omega_1(p_1;p_2;)$ $\Pi_1(p_1;p_2;)$ $-\Pi_1^0(p_1;p_2;)$

$\frac{\partial \Pi_1(p_1(e);p_2(e);e)}{\partial p_1}$

$\frac{\partial \Pi_1^0(p_1(e);p_2(e);e)}{\partial p_1} >$

$$-\frac{\partial \Omega_1(p_1;p_2;)}{\partial p_1} \quad \frac{\partial \Omega_1(p_1;p_2;)}{\partial(-p_1)} > :$$

$\frac{\partial \Omega_1(p_1(e);p_2(e);e)}{\partial(-p_1)}$

$\frac{\partial \Omega_1(p_1(e);p_2(e);e)}{\partial(-p_1)}$

$\frac{\partial \Omega_1(p_1(e);p_2(e);e)}{\partial(-p_1)}$

$\Pi_1^0(p_1;p_2;)$

26

$p_1 - c\ e_1\ \ D_1\ p_1; p_2$ fi fi

$\frac{\partial \Omega_1(p_1(e); p_2(e); e)}{\partial(-p_1)} >$ $U_1\ e_1\ ;e_2\ - U_1$ $\Upsilon\ p_2$ $U_1\ - U_1\ e_1; e_2\ >$

fi fi

fi 1 (*fi* $U_1\ e_1\ ;e_2\ - U_1$ $\Upsilon\ p_2\ U_1\ - U_1\ e_1; e_2$.

fi fi $mr_1\ p_1\ \ ;p_2$

$c\ e_1$ [27] $mr_1\ p_1\ \ ;p_2\ \rightarrow p_1$

$\sigma \rightarrow$ ff

B G

2 **2** . fi

fi ffi

fi

” fi

ff

fi

$c\ e_1\ -\ U_1\ e_1$; $e_2\ -U_1$ $c\ e_1\ -$

$U_1\ e_1$; $e_2\ -U_1$ $c\ m$

$mr_1\ p_1\ ;p_2\ < c\ m\ mr_1\ p_1\ ;p_2\ < c\ e_1\ -\ U_1$

	fi	fi fi
	Γ_1^1 $- \phi_1$ ... $V_1\ e_1\ ;\ e_2\ - V_1$ Γ_1^2 $- \phi_1$ ... $\phi_2\ e_1\ ;\ e_2\ - \phi_2$ $\times\ \beta V_1$ [illegible]	[illegible]

fl Γ

Γ_1^1 ; Γ_1^2 ;

e_1; e_1 ;:::;

Θ_1^1 e_1; Θ_1^2 e_1;

ffi

ffi

fi

e_1; e_1 ;:::; fi

e_1;

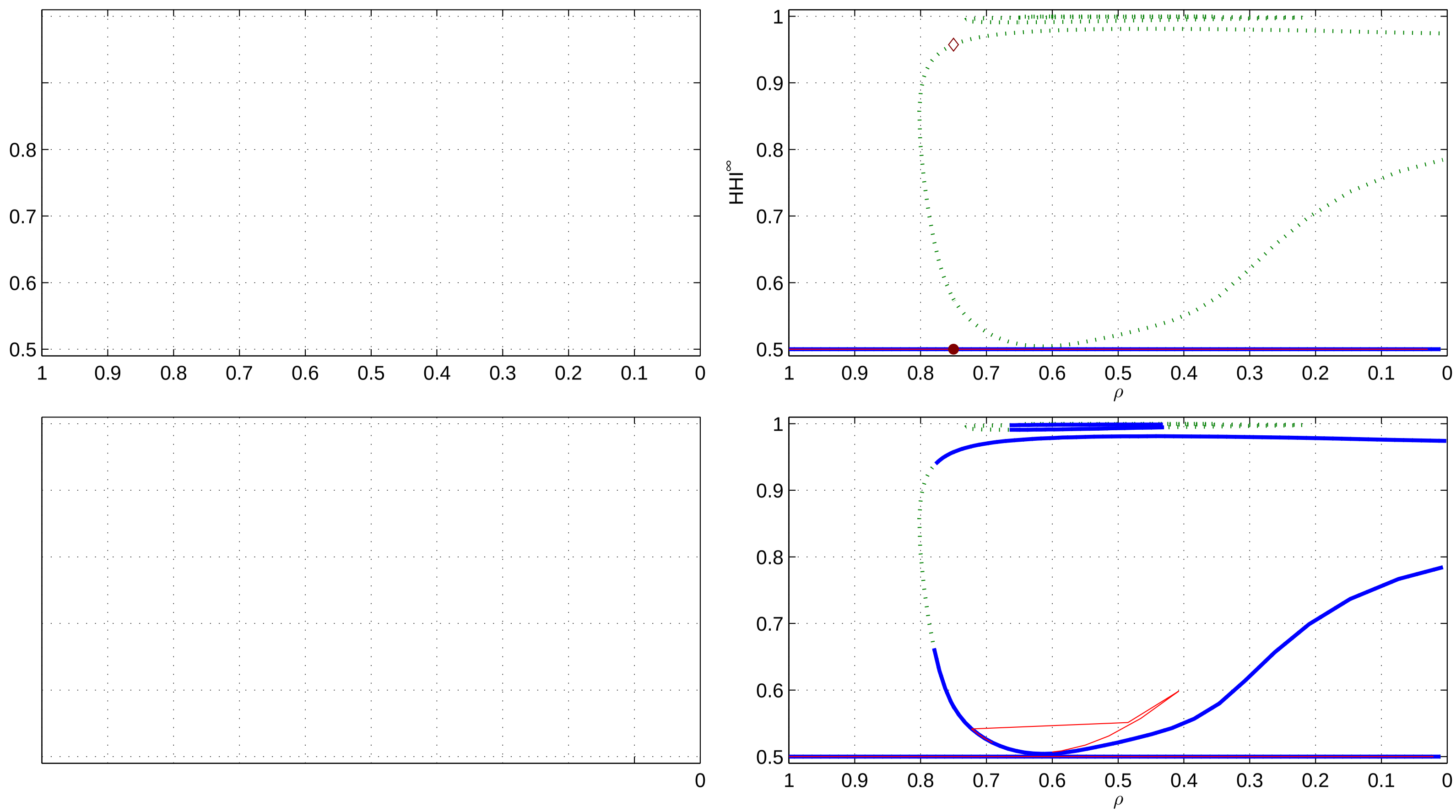
											fi			
p_1	$c\ e_1$	Γ_1^1	Γ_1^2	Γ_1^3	Γ_1^4	Γ_1^5	Θ_1^1	Θ_1^2	Θ_1^3	Θ_1^4	√√	√√	√√	√
											√√	√√	√√	√√
											√√	√√	√√	√√
											√√	√√	√√	√√
											√√	√√	√√	√√

$\sum_{k=1}^{4} \Theta_1^k$ U_1 $- U_1(e_1; e_2)$

$\Xi_1(p_1; p_2)$; $mr_1(p_1; p_2)$ $- c(e_1)$ $\sum_{k=1}^{5} \Gamma_1^k$ $mr_1(p_1; p_2)$ $-$ $c(e_1)$ $U_1(e_1; e_2) - U_1$

6.1 Counterfactual and equilibrium correspondences

$\rho; \sigma$ $\rho; \overline{X}$ $\sigma; \overline{X}$



HHI∞
ρ
ρ

λ [33]

ρ

ρ

HHI^{∞} HHI^{∞}

ρ

HHI^{∞} HHI^{∞}

$\rho; \sigma$ $\rho; \overline{X}$ $\sigma; \overline{X}$

$\rho; \overline{X}$

HHI^{∞}

---

[33]

	$\rho; \sigma$				$\rho; \overline{X}$				$\sigma; \overline{X}$			
	% %	% %	% %	% %	% %	% %	% %	% %	% %	% %	% %	% %
HHI^{∞}												
$\overline{p}^{\infty}$												
CS^{∞}												
TS^{∞}												
CS^{NPV}												
TS^{NPV}												

fi
$\rho; \sigma$: ; : ;:::: : × : ; : ;::::; : $\rho; \overline{X}$: ; : ;:::: : × − : ;− ;::::; :
$\sigma; \overline{X}$: ; : ;:::: : × − : ;− ;::::; :
fi

fi $\rho; \sigma$

	$\rho; \sigma$				$\rho; \overline{X}$				$\sigma; \overline{X}$			
HHI^{∞}	%	%	%	%	%	%	%	%	%	%	%	%

HHI^{∞} $\overline{p}^{\infty}$ CS^{∞} TS^{∞} ρ ρ

35 *Barry Wright Corp. v. ITT Grinnell Corp.*, 724 F.2d 227, 234 (1st Cir. 1983).

fi

fi

fi

fi CS^{∞} TS^{∞} TS^{NPV}

fi CS^{NPV}

fi fi

M **3**

A

L J **2**

D

A

E **0**

E

4

J E

12

E

ff *J* *E* **4**

I *E* **51**

M
41

O *E* *P* **40**

53 [illegible] *J* [illegible] *I* [illegible] *E* [illegible] *C* [illegible] *M* [illegible] *B* [illegible] *P* [illegible] *E* [illegible] *A* [illegible] : *M* [illegible]

A   *L*   *J*   **3**