

# ÐEFF K +ý0Í : ÐEF î : æE " Æ\*T À QD'E•=x f\$@ B † 4 2 ¼

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Y \* 21\$ # UÐ63-3UÐ630.8 ³(Z 3@ò-- UA ³0 4B # UÐ672-8106(2022)04-0076-11

## 一、引 言

ÐEF µ " [ ~C ÐEF!ç)2+° & %âK MÄ U•C D'E•+° 4" «\*T T ' S/7 Ò 66)Ky z ÐEF µ " .  
q(³ (Ü Ê\*K" g YUú .(Û 3ë EKC öP EKC P Ó+° À QD'E• ñ ñ F f ÐEF î : æ+° 9 • V  
æ=x f0u Ê =xE " Æ\*T Uç="(Ü Ž ; g>- 5 P.ù U•.ù [LŠ2S Q ñ á 7 T À QD'E• 6=xOç Už [   
LŠ2S Q ñ á 7 T À QD'E• 6 ^D' U%UÄ .j FD'D²E " Æ\*T À QD'E• F (7 2S Q ñ á ý\*K "\*) ( À  
Q ^\*T K| Uñ á QFù " UE F •ù /7 }K• "K^ } g\*Ã } Ð0u À Q . Í+° 0)2 • Uç?  
ÐEF î : æ , ÐEFF K T 5K|)2 S • " 7+° ß0, U%? ß À QD'E•=xE " Æ\*TK MÄ 5Fù>- ; u  
X ³ A '\$@ B † 4)2@æ+°,\$ Ÿ á" 'E =x-@/ç 7 ú Maynard 0u<sup>U%UÄ</sup> 51 ü & ²E B/\_ Æ0,\*  
(Evolutionary Stable StrategyUESS)U\$@ B † 4)2@æ ] «" À\*T ° k È : - F+°0,\*E5 -@/ç Y U%-UÄ  
T ÐEFM² U\$@ B † 4)2@æ g>-Kò YDü\*T T ÐEF î : æ &=x â ;+°0,\*E5 k È % - FE " =x f+°  
+ý0Í0u-@/ç<sup>U%UÄ</sup> P{ i8 0u<sup>U%UÄ</sup> (2018) & ° † 4)2@æ â" Uf æD' b/- \$@ B â =+° »>îA/ Ó ü Ç)2@æ Ž  
4 .ý0u<sup>U%UÄ</sup> (2015) &/÷ ² " =x4+%,+°,\$ y , 7 ,,\$ y f5€, +° 4 ^ † 4 Ó b M . Uç ü & ² & ° ù&"  
" +° ^D' "K FóKò â" T À QD'E•+°-@/ç YUg>- [ 2 ¼ À QD'D² % ú .E•C ÐEF"m+° •ù<sup>U%UÄ</sup> , À  
Q\*» •C 3ëK MÄ<sup>U%0-1UÄ</sup> % ° Æ\*TD'E•(ÜA•Ug>-Kò Y °D'E• Æ\*T % ú .E•C EF=x6) Ç+° •ù<sup>U%UÄ-1UÄ</sup> ð Ð  
EFF K b Æ F Ö é • . ' ì fP EK ~C À QD'E•0Í)2<sup>U%UÄ</sup> 58QÈ 5 '51# '-@/çD'E• Æ\*T=x f ý\*K  
y+°\$@ B † 4 ÐEF î : æ , ÐEFF K [ ÐEF /7 Y+°Fù>- U+ö g • ö d ï,\$ Ÿ51 U• • U# '-@/ç  
,51+°\$@ B † 4=x f m 2 ñ>-

G ° • U× ³ A ' ÐEF î : æ , ÐEFF K \$@ B † 4 M . U8 "5/; }0X 5 â ~ C j Ñ \*a | +ý Ó ç ù

OX K '(\p(p ouUÐEFF K +ý0Í : ÐEF î : æE " Æ\*T À QD'E•=x f\$@ B † 4 2 ¼

0u 2L % ÐEF î : æ+°+ý,• ^\*T , % ÐEFF K +°D± Õ ^\*T UŦ Ç ° fE " Æ\*T À QD'E•M² +°-@/¢ ü Ç Ü+° IC UŦ ÐEFF K +° 4)2 ß0, ü Ç & @Ú Uú58 ü s ~C À QD'E• ÐEF µ "¡ç)2 t È

Ë4 Ë ] \$ ' ! " ò 4 Û y

T-@/¢ ÐEF î : æE " Æ\*T À QD'E•K MÃ " UÐEFF K , ÐEF î : æ 2 W ^ f † 4Dó/7 Y+°+ý 0Í51 ,=x+ý0Í51 % ° ÐEF î : æ E " Æ\*T À QD'E• B 9 Æ\*T À QD'E•U• ö ÐEFF K E5 g Ô+ý0Í B =x Ô+ý0Í +°0,\*'E5 U• >ò ^ , V)2 S • " 7+° Ô - † 4Dó/7 ø å T 0.ù 9 -š Æ+° 2L 7 Uðã +° › 9 , U% " •+°E5 0,\*' " E =x-š Æ P Û Uš- Ž < ø å+°/\_ Æ † 40,\*' UŁ,-E =x ù 9+°\$@ B † 4 UŦ@Ô • ù ç0,\*'E5 +° • ù 2L f &/÷\$@ B † 4 M • U† & 7 s@ê U•

s@ê @ê! f ÐEFF K 0E " Æ\*T À QD'E•+° b+ö g>- 1 0E " Æ\*T+°4† j UŽ f ÐEF F K g Ô+ý0Í < X Uŕ>- 1 @'D' EgDó/7 Ó\*K+°!â5C < X "K < X0u UŽ f ÐEFF K =x Ô+ý0Í < XUŦ8ã Ã@í š öFó +ý0Í=x Ô Ó\*K+° < X UŦ %E " Æ\*T j Ñ51+° , Ý < X d Ê j Ñ ›+° < X Ñ \ j Ñ : ç -(Ü f+°!â5C < X "K < X0u

s@ê @ê0 f ÐEFF K g Ô+ý0Í < Ë(³ UŦ 3 < Ë 0E " Æ\*T À QD'E•+° ®(³ UÐ [ ÐEFF K =x Ô+ý0Í < Ë(³ UŦ 3 ÐEFF K Ñ \0X 5 á j Ñ \*a | +ý Ó ç ù : U< Ë 0E " Æ\*T À QD'E•+° ®(³ UŽ f0X 5 á j Ñ(³ UŽ f\*a | +ý Ó ç ù(³

s@ê @ê=x Ô+ý0Í < X>- S ° g Ô+ý0Í < X U¾À +ý0Í < X " # , \$ À+ý0Í < Ë(³ 0 0 < •, \$ ŸUŸ 0 # 0

s@ê @ê\$ f ÐEF î : æE " Æ\*T À QD'E• l8ã Ã+° b+ö UŦ E " Æ\*T À QD'E•7®, -+° " K !â5CUŽf ÐEF î : æE " Æ\*T À QD'E•=x 0 l \+° 4† UŦ 4† j • 2 ö=x f ç Ĩ 6) (7 +° 97>=x f3Ö • \*...0uUŽ f ÐEF î : æ=x 0 :+°Fy 4A/ < X U® "K < X UŽ f ÐEF î : æ 9E " Æ\*T "+°Fy 4 < X U®P EK ~C Es ÐEF a "+°E5 9E " Æ\*T580u ±+° "K < X0u

s@ê † 4 ø å+°0,\*'E5 UÐEF î : æ\$@ B † 40,\*' fE " Æ\*T : 9 Æ\*T À QD'E• UÐEFF K f %E " Æ\*T À QD'E•=x fE =x g Ô+ý0Í :=x Ô+ý0Í @ê T ÐEF î : 4Ð • Y U6 Xl +° ÐEF î : æ • y7 Cx U+ö , S B fNÂ>-, 358E5 E " Æ\*TD'E• UŽ ... Ò XÉ .+° ÐEF î : æE5 9 Æ\*TD'E•UÐEFF K E5 g Ô+ý0Í+° ®(³ f Ušx Ô+ý0Í+° ®(³ Ò YÉ ç Y Ux Ys f "K +° ) œ

EFDó g3UŦ & î œ Æ u=">í="

= " î œ Æ u="

î œ	W u
!	ÐEFF K 0E " Æ*T À QD'E•+° b+ö
"	ÐEFF K g Ô+ý0Í < X
#	ÐEFF K =x Ô+ý0Í < X
0	ÐEFF K g Ô+ý0Í < Ë(³
0	ÐEFF K =x Ô+ý0Í < Ë(³
l	OX 5 á j Ñ(³
\$	*a   +ý Ó ç ù(³
%	ÐEF î : æE " Æ*T À QD'E• l8ã Ã+° b+ö
&	ÐEF î : æE " Æ*T À QD'E•=x 0 l \+° 4†
,	ÐEF î : æ=x 0 :+°Fy 4A/ < X
	ÐEF î : æ 9E " Æ*T "+°Fy 4 < X

» Ë / À À / % Â å Ð ï , 4 Ë k a

e š 6 M · ° & y ü ö & X s @ê UÃ \ DEFF K +ý0Í : DEF î : æE " Æ\*T À QD'E•=x f\$@ B  
† 4 b+ö- Ka Uí="

=" DEFF K , DEF î : æ † 4+° b+ö- Ka

		DEFF K									
		g Ô+ý0Í Y					=x Ô+ý0Í Y				
DEF î : æ	E " Æ*T X	\$	0	%	& U0 ! "	\$	0	%	& I	I U• I	I 0 ! #
	9 Æ*T X				' U• "				' U• I	I #	

" U• 6- Ka Y l 5 î æ œ h s f • h

U, UDEF î : æ\$@ B † 40,\*'

&amp; °=" † 4+° b+ö- Ka U% DEFF K \$@ B † 40,\*'E =x 2 ¼

• DEF î : æE " Æ\*T À QD'E• U b+ö=" .f f

5 Y Ê\$ 0 % &amp; Ë Y Ê\$ 0 I I % &amp; Ë

• DEF î : æ 9 Æ\*T À QD'E• U b+ö=" .f f

5 Y Ò ' É Y Ò ' É

4( 6 UDEF î : æ Y s b+ö f

5 X5 X 5

DEF î : æ 9 b Ô - â/7 U% UÄ=" .f f

&<sub>x</sub>  $\frac{D_x}{D_t}$  X X 5 5 X X » Ê\$ ' 0 I I % & Ë  
 » % & Ê 0 0 I I Ë

A ' ASB UÃ \ &<sub>x</sub> X X A BY ASB="Dê ; 2 W f

A \$ ' 0 I I % &  
 B % & Ê 0 0 I I Ë

Af DEF î : æ T=x Ô+ý0Í ñ á 7E " Æ\*T À QD'E•,\$ % ° 9 Æ\*T+°MÉ B b+ö U Bf DEF î : æE  
 " Æ\*TD'E• T=x Ô+ý0Í,\$ % ° g Ô+ý0Í ñ á 78ã Ä+°MÉ B b+ö

Y  $\frac{A}{B}$  U&<sub>x</sub> U† 40,\*'/\_ Æ Y\*  $\frac{A}{B}$  U• @ ñ • X B X " U&<sub>x</sub>

• " U\$@ B/\_ Æ0,\*' Ô%33 Ê L,\$ Bß

&<sub>x</sub> á X A BY

7@Ô@æ: BT 9 8 h+°\$@ B/\_ Æ0,\*' Uí="

=" DEF î : æ\$@ B/\_ Æ0,\*'

• "	%33	• "	%33
A B	X	A U B	X
B A	X	A B	X
A B Y $\frac{A}{B}$	X	B A U Y $\frac{A}{B}$	X
A B Y $\frac{A}{B}$	X	B A U Y $\frac{A}{B}$	X

Ä Ä• A B B A" UÄ : DEF î : æ=x Ô+ý0Í , g Ô+ý0Í ñ á 7E " Æ\*T À QD'E•  
 , \$! 9 Æ\*TF) 6) 8ã ÄB±MÉ b+ö 9@æ DEFF K Fót g Ô+ý0Í [ =x Ô+ý0Í UDEF î : æF) F j = °E  
 " Æ\*TD'E• E) !n7 Cx3û"z U+ö , S B U B c U• A U B B A B A : DEF î : æ=x Ô+ý0Í  
 , g Ô+ý0Í ñ á 7E " Æ\*T À QD'E•,\$! 9 Æ\*TF) 96) 8ã ÄB±MÉ b+ö U• • UDEF î : æ F j = °7

OX K

'(p(p OuUÐEFF K +ý0Í : ÐEF î : æE " Æ\*T À QD'E•=x f\$@ B † 4 2 ¼

>ðEj ´ ÐEF>ð EUÐE " Æ\*T À QD'E•

Ä Å A BJE ; Ý,I ÐEF î : æE " Æ\*T À QD'E• T=x Ô+ý0Í " 5MÉ B b+ö U† g Ô+ý0Í "  
!Í 5MÉ B b+ö 8 Y  $\frac{A}{B}$ UA : ÐEFF K g Ô+ý0Í! ·D<sup>-</sup> S UÐEF î : æL,>- « ñD<sup>-</sup> S+°MúK• 5/; \

6) „ T+°MúK• UÐEF î : æ , Æ/7 Ò 6 FE5 9 Æ\*T À QD'E• , \$ ù U8 Y  $\frac{A}{B}$ UE ; Ý,I ÐEFF K  
g Ô+ý0Í! ·D<sup>-</sup> ; UÐEF î : æ 6) „ T Ñ ¨ ï)2 UE5 E " Æ\*T À QD'E• 8 B A UÒL,>-5/  
;B±MÉ b+ö : g=x Ô+ý0Í! · 2 ¼ B0,

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ÐEF î : æ+°0,\*'E5 g>- g =x Ô+ý0Í 7UE " Æ\*T À QD'E•,\$ % ° 9 Æ\*T l8ã Ã+°B±MÉ b  
+ö f B0, É š L,>- { 85/;} ÐEF î : æ T=x Ô+ý0Í 7E " Æ\*T À QD'E•+° b+ö A Ê\$ '  
0 l l % & Ë ÐEF î : æ Æ\*T À QD'E• " =x Ô+ý0Í : g Ô+ý0Í+° b+ö w B %  
& Ê 0 l l Ë

£ •58?, U5/;} ASB+° h UÐEF î : æ l8ã Ã+°B±MÉ b+ö : 7 C 2L 5 Ý UE " Æ\*T7®, -+° "K  
!â5C0u b+ö \$U† j • 2 ö=x f ¢ Ĭ 6) (7 +° 97>=x f3Ö • \*...0u 4† %Ux 0 :+°Fy 4A/  
< X ® "K < X &UX 5 å j Ñ(³ l \*a | +ý Ó ç ù(³ g =x Ô+ý0Í < Ê(³ 0 0 UÐE " Æ\*T "P EK  
~C Es ÐEF a "L,0u ±+° "K < X0uFy 4 < X '

U†, UÐEFF K \$@ B † 40,\*'

& °=" † 4+° b+ö- Ka U°% ÐEFF K \$@ B † 40,\*'E =x 2 ¼

• ÐEFF K g Ô+ý0Í U b+ö=" .f f

5 xÒ ! " É x Ò " É

• ÐEFF K =x Ô+ý0Í U b+ö=" .f f

5 xÈÒ l ÉÒ ! #ÉE x Ê Ò l É#Ë

4( 6 UÐEFF K Ý s b+ö f

5 Y5 Y 5

ÐEFF K +° 9 b Ô - â/7=" .f f

&y  $\frac{D_r}{D_t}$  Y Y 5 5 Y Y »! Ê ò l l o ËxÂ  
» Ê ò l l #Ë Â

A ' CSDJ\ &y Y Y D\_x C CSD="Dê ; 2 W f

C " l l #  
D ! Ê l l o Ë

α ÐEFF K g Ô+ý0Í :=x Ô+ý0Í < X w U†f ÐEF î : æE " Æ\*T À QD'E• " ÐEFF K g Ô+ý  
0Í :=x Ô+ý0Í+° b+ö w

X  $\frac{C}{D}$ U&y U† 40,\*'/\_ Æ X\*  $\frac{C}{D}$ U• @ ñ • Y B Y " U&y

• " UÐEFF K +ý0Í+°\$@ B/\_ Æ0,\*'U% UÊ L,\$ Bß

&y á Y DX C

\*] ° ÐEF î : æE " Æ\*T À QD'E• " UÐEFF K g Ô+ý0Í :=x Ô+ý0Í < X w C , ÐEFF K  
g Ô+ý0Í :=x Ô+ý0Í+° b ' w D 96) 8 " </÷ U† UñL, @Ô@SD. # "+°\$@ B/\_ Æ0,\*' U•  
>í="

Ä Å• C " UÐEFDüDçF K E5 g Ô+ý0Í0,\*' • "0X 5 å j Ñ(³ D<sup>-</sup> ; \*a | +ý Ó ç ù(³ lD<sup>-</sup>  
z U8 " UÐEFDüDçF K %E " Æ\*T j Ñ51+°, Ý < X d Ê j Ñ › B d %\*a | +ý Ó+° < X Ñ \ j  
Ñ : ç ¬(Ü f+°!â5C < X "K < XBe\*TD<sup>-</sup>P U• • Ux Ô+ý0Í(³ b+ö z58 < XD<sup>-</sup>P

C Ø ðEF S ' ' Ñ Ä.j F.ý 't Ä

=" ðEFF K \$@ B/_ Æ0,*'	
• "	%33
C UÐ	Y
C UÐ	Y

Ä Å• C " UðEFF K E5 =x Ô+yÓÍ0,\*' • " UØX 5 å j Ñ(³ D⁻ S \*a |+ý Ó ç ù(³ ID⁻P U•  
=x Ô+yÓÍ8ã Ä+° b+öD⁻P UØ • " =x Ô+yÓÍ < XD⁻ z UØb+ö 2E , ' Ê S

3ÿ @æU•

ðEFF K +°\$@ B † 40,\*'B• ° b+ö , S B Ê E , < X , z Ê E U• g =x Ô+yÓÍ 7 < X w C  
" I I # f B0, Ê š

£ •58?, Uḡ:- ðEFF K g Ô+yÓÍ < X " =x Ô+yÓÍ < X # 0X 5 å j Ñ(³ \*a |+ý Ó ç ù(³ I5  
ÿ " IB¶; #B¶ SUðEFF K B¶ j = ° g Ô+yÓÍ ù w UEB¶ j = ° =x Ô+yÓÍ

U<5Uḡ@ B † 4 M • 2 ¼

E , ' @Ô @æ Ô -2'4 +°\$@ B f b<sup>U%</sup> U<sup>Ä</sup>e š XJY+° h U<sup>Ä</sup>\ ðEFF K , ðEF î : æ T † 4Dó/7  
Y „ T V 9 b Ô - s=°å f U• U• U• U• U• U• U• XU<sup>Y</sup> e šKñ w! - Ka+°=x C ; ,E% U•  
P ÛE V 9 b Ô - s=°å+°\$@ B/\_ Æ S •Kñ w! - Ka+°=x C ;+° h f • h E% fBK h " U\$ Bß  
>-!n

ðEFF K : ðEF î : æ † 42'4 +°Kñ w! - Ka=" .f f

+ X A BY X X B Ä  
Y Y D Y DX C Ä

R ' ASBSCSD+° h U<sup>Ä</sup>\Kñ w! - Ka f

+ X »\$ ' Ê0 I I % & Ä  
Y % & Ê0 0 I I Ä X X % & Ê0 0 I I Ä  
Y! Y Ê0 0 I I Ê Y »! xÊ0 0 I I Ä  
Y Ê # I I Ê Ä Ä

Kñ w! - Ka+°=x C ; DET+=".f f

DET+ X Y A BY DX C XYBD X Y

Kñ w! - Ka+°E% TR+=".f f

TR+ X A BY Y DX C

2 6E V Ÿ=°å R 'Kñ w! - Ka+°=x C ; DET+ ,E% TR+ YU• Ä \,\$ % Ä+° s=°å/\_ Æ S 2 ¼  
3ÿ ÈUí=" Ä ç Y =" .f=x C ;+°0R # " -š Æ Ä

Ä Å• A B" UA : ðEF î : æ T=x Ô+yÓÍ 7E " Æ\*T Ä QD'E•6)8ã ÄB±MÉ b+ö 8 C U•  
A : =x Ô+yÓÍ < XD⁻ z U• " UðEFF K Fó\*T=x Ô+yÓÍ 6) SD⁻ S UðEF î : æE5 E " Æ\*T Ä QD'

E• • " U•I I  $\frac{0}{\#}$  U• U• , 0 B¶ S 0 B¶ ; UB¶ å ?\$ BßA 90u ; , \$ ù UØ C UÐ

EFF K Fó\*T g Ô+yÓÍ 6) SD⁻ S UØ " UðEF î : æE5 9 Æ\*T Ä QD'E•

Ä Å• A U•B B B A" UA : ðEF î : æ T=x Ô+yÓÍ ñ á 7 Æ\*T D'E•6)8ã ÄB±MÉ  
b+öBß K SUØ0Í C B [ C UðEF î : æF) F Æ\*T D'E• E) !n7 Cx , S3û"z U+ö • " U•  
ðEFF K EFDó Ê S B'Ky z ðEF î : 51+°E " =x f Ô f U¶ f g Ô+yÓÍ ì S 4† Ç Ò % Ê  
ì ðEF î : æ=x 0 "+°Fy 4 < X & Ê ì0X 5 å ~ C j Ñ(³ B Ê ì\*a |+ý Ó ç ù(³ I'Dê \  
, +°

0X K 'ᵢ(ᵑ(ᵑ 0uUÐEFF K +ý0Í : ÐEF î : æE " Æ\*T À QD'E•=x f\$@ B † 4 2 ¼

=" 0 Ÿ=•%â/_ Æ S 2 ¼3Ÿ È							
'â -			Ÿ=•%â				XU•Y
			Ä U•Ä	Ä U•Ä	Ä U•Ä	Ä U•Ä	
A U•B C U•D	DET+	Ü			Ü	Ü	
	TR+				Ü		
	3Ÿ È	R	R	%33	R		L¹%â
A U•B C U•D	DET+		Ü	Ü		Ü	
	TR+					Ü	
	3Ÿ È	R	R	R	%33		L¹%â
A B C U•D	DET+	Ü	Ü		Ü		
	TR+			Ü			
	3Ÿ È	R	R	%33	R		L¹%â
A B C U•D	DET+			Ü	Ü		
	TR+		Ü				
	3Ÿ È	R	%33	R	R		L¹%â
B A C U•D	DET+	Ü			Ü	Ü	
	TR+			Ü			
	3Ÿ È	R	R	%33	R		L¹%â
B A C U•D	DET+		Ü	Ü		Ü	
	TR+					Ü	
	3Ÿ È	R	R	R	%33		L¹%â
A U•B C U•D	DET+		Ü	Ü			
	TR+	Ü					
	3Ÿ È	%33	R	R	R		L¹%â
A U•B C U•D	DET+	Ü			Ü	Ü	
	TR+		Ü				
	3Ÿ È	R	%33	R	R		L¹%â
B A C U•D	DET+			Ü	Ü		
	TR+	Ü					
	3Ÿ È	%33	R	R	R		L¹%â
B A C U•D	DET+	Ü	Ü			Ü	
	TR+					Ü	
	3Ÿ È	R	R	R	%33		L¹%â
A B C U•D	DET+		Ü	Ü			
	TR+	Ü					
	3Ÿ È	%33	R	R	R		L¹%â
A B C U•D	DET+	Ü				Ü	
	TR+		Ü				
	3Ÿ È	R	%33	R	R		L¹%â

} Èâ Ð 6 Ÿ • " " K = k a

Uᵢ, Uᵢᵢ B/\_ Æ0,\*  
T yLŽ\$@ B † 4 M •+° &-l 6 Uᵢ, ' A ' \* Y \* Y ' 2 ¼ ÐEFF K , ÐEF î : æ+°  
† 4=x f ö ¢\$@ B/\_ Æ0,\* \* \* 2 W =" ÐEFF K g Ô+ý0Í ,=x Ô+ý0Í ñ Ž " UᵢÐEF î : æE "  
Æ\*T+°, \$ % b+ö :, \$ % ‹ ]+°! h Uᵢᵢ u f b+ö ‹ ]! \* \* ="Dê ; 2 W f

$$* \frac{\$}{\%} \frac{'}{\&} U^* \frac{\$}{\%} \frac{'}{\&} \frac{0}{\&} \frac{É}{\&}$$

3ÿ 4Kñ ! - Ka UÉ , ' % DEFF K , DEF î : æ\$@ B/\_ Æ0,\* 2 ¼ Uí="

= " DEFF K , DEF î : æ\$@ B/\_ Æ0,\* 2 ¼

2 ¼ • "	%33	2 ¼ • "	%33
0 I I 0 *	Ä U•Ä	* I I 0 0	Ä U•Ä
I I 0 0 *	Ä U•Ä	0 * I I 0	
* 0 I I 0	Ä U•Ä	I I 0 * 0	

Ä Å• 0 I I 0 \* B51 I I 0 0 \* " UDEF î : æE5 E " À QD'E• U•  
• " U× U•Y UŽX U•Y

% ° DEF î : æ58?, UTE P.ù ñ á 7 Æ\*T À QD'E•=x fM½ ý • " Æ\*T À QD'E• I R '+° b+ö  
F)>- S ° 9 Æ\*T À QD'E•+° b+ö U• • UDEFF K @æFó g Ô+yÓÍ B=x Ô+yÓÍF) 96) 5 t b Ž Æ\*T  
À QD'E•=x f

% ° DEFF K 58?, U• I ÷ • " f 0 I I 0 \* " U 0 °=x Ô+yÓÍâ - UÄ ö "A/  
f g Ô+yÓÍ0,\* UÉ ì ø ~ Ç , - } Ç UŦ , Æ/7 Ò 66)Ky z DEF î : æE " Æ\*T À QD'E•+° ®(³  
• I ÷ • " f I I 0 0 \* " U•DEFF K ÀA D~ oí)2 IC Uú7 Cx & ý ì f+yÓÍ Ç Ò U%  
°j FD'D² Æ\*T À QD'E•=x fFó Q µ+° 04† Ö é Uú b Ò nLŽ Ê ì+yÓÍ+° - } Ç É • 'A UEF  
Dó ì S 4† Ç Ò Ä Ÿ Ê ì %Ä Ê S DEF î : æ=x 0 "+°Fy 4 < X Ä Ê S &Ä• FK» w û = U•Dê \Ky  
z DEF î : æ Æ\*T À QD'E• K G b+ö+°, +° UK» w DEF î : æ Æ\*T À QD'E•+° j = ‹ FKy z • B U•  
E ì S DEF µ " İ L Ç Ò Uü s0X 5 â ~ C j Ñ ;@ò Ä Ê S ÄÊ ì\*a | +y Ó æFû Ä Ê S İÄq 2 U  
\*T0X 5 â ö\*a |@' +°+ý, • ^\*T

Ä Å• \* 0 I I 0 B51 \* I I 0 0 " UDEF î : æE5 9 Æ\*T À QD'  
E•U• " U× U•Y UŽX U•Y

DEF î : æ TE P.ù ñ á 7MúK• S ° b+ö UÆ\*T À QD'E• 9 F R 'MÉ B b+ö Uî>î ñ á 7 & °)2  
S • " U F j = °Ej ' DEF>ð E UÍ 5¥ ¶ ñ á 9 F Æ\*T À QD'E•

DEFF K @æFó g Ô+yÓÍ B=x Ô+yÓÍF)6) 5 t+yÓÍLŠ" Æ\*T À QD'E•=x f 8 Fó g Ô+yÓÍ  
0,\* U• T 5K|+yÓÍ < X ±Dê \ 5 t+°>ð8/ +ý, • t È UÆ Fó =x Ô+yÓÍ0,\* U• 7@3Ò g Ô+yÓÍ  
< X Uó6) üP 0 < È(³ U 6 " % § DEF î : æ+° ' " ;@ò

Ä Å• 0 \* I I 0 B51 I I 0 \* 0 " U 0 á † 4 " Ä \-š Æ3ÿ È U@  
ø á+°0,\*E5 , \$ ¼ Ÿ5€ U• " UDEFF K Ä • 2Kb áFó 9 8+° k0, Ö é ' 5 tÓÍ b.j FD'D² Æ\*T  
À QD'E•=x f

3ÿ @æJ•

• 0 \* I I 0 " UDEFF K À" Fù ° ü s g Ô+yÓÍ+° < È(³ 0 üP 4† Ç Ò Ä Ÿ Ê  
ì %Ä Ê S DEF î : æ=x 0 "+°Fy 4 < X Ä Ê S &Ä• 5 t(³ \+ý, • 0Í b.j FD'D² Æ\*T À QD'E•  
=x f

• I I 0 \* 0 " UDEFF K À ì S DEF µ " İ L Ç Ò Uü s0X 5 â ~ C j Ñ ;@ò Ä Ê  
S ÄÊ ì\*a | +y Ó æFû Ä Ê S İÄq 2 U\*T0X 5 â ö\*a |@' +°+ý, • ^\*T Uú58 üP =x Ô+yÓÍ t(³  
Uç, UÇ,K 2 ¼

e š DEF î : æ 9 b Ô - á/7 UÄ \ Y  $\frac{\$}{\%} \frac{'}{\&} \frac{0}{\&} \frac{I}{\&} \frac{I}{\&} \frac{\%}{\&} \frac{\&}{\&} \frac{É}{\&} \frac{0}{\&} \frac{I}{\&} \frac{É}{\&}$  ' DEFF K g Ô

OX K '(p(p ouUÐEFF K +ý0Í : ÐEF î : æE " Æ\*T À QD'E•=x f\$@ B † 4 2 ¼

+ý0Í " ÐEF î : æE " Æ\*T+° b+ö ‹ ]! \*  $\frac{\$}{\% \&}$  U~~Ä~~ \ Y  $\frac{0}{0 \mid \mid 0}$  \* 2 ¼ T

\* I 0 0 2 W B " U% ° ÐEFF K +ý0Í\$@ B3ÿ È+° • ù

Ä Å I ÷ â - 7 ÐEFF K g Ô+ý0Í < Ë(³ 0 U~~x~~ Ô+ý0Í < Ë(³P ° g Ô+ý0Í < Ë(³ U@ê Æ  
f 0 e š " >ð UÐEF î : æE " Æ\*T À QD'E•=x 0 \+° 4† %f4† j o U• 2 U~~58~~ Ð  
EF î : æ=x 0 :+° Fy 4A/ < X Ä ® "K < X Å& ÐEF î : æE " Æ\*T À QD'E•8ã Ã+° b+ö \$ ÐEF  
î : æ 9E " Æ\*T "+° Fy 4 < X ' 9 ?Fû B U• • U~~E5~~ Æ 5 VD⁻ fE. Y+° b+ö ‹ ]! \*  $\frac{\$}{\% \&}$

\*  $\frac{\$}{\% \&}$  \*  $\frac{\$}{\% \&}$  & ° 4( 45/; } U@ê Æ OX 5 â ~ C j Ñ(³ I ÷ h f

e š 6 î œ h U~~M~~ T 9 8 b+ö ‹ ]! 7 U~~a~~ | +ý Ó ¿ ù(³ I B % ÐEFF K +ý0Í\$@ B3ÿ  
È+° • ù

3ÿ @æJ•

Dü\*TD› " 2 ¼ Ä \ \* U~~T~~ b+ö ‹ ]! \* , Æ " U~~K~~», I\*a | +ý Ó ¿ ù(³ I Ê S U~~Y~~ E<#< û ; UA : Ð  
EFF K j = °E5 =x Ô+ý0Í0,\* U~~T~~7®3Ò < X+° 8 "8ã ÃD⁻P +° 0 < Ë(³ U~~7~~ b+ö ‹ ]! \* E<#<  
û ; +° Dó/7 Y U~~a~~ | +ý Ó ¿ ù(³ I % Y+° { K ÒE<#< Ê S UA : • ÐEF î : æ b+ö ‹ ]! \* û ; " UÐ  
EFF K B~~¶~~B• = °E5 =x Ô+ý0Í «7 Cx U+ö , S B

\* 9 8 b+ö ‹ ]! 7\*a | +ý Ó ¿ ù(³ % ÐEFF K +ý0Í\$@ B3ÿ È+° • ù

\*] °\*a | +ý Ó ¿ ù(³ I :OX 5 â j Ñ(³ T="Dê ; Y  $\frac{0}{0 \mid \mid 0}$  \* Y y4š,\$ 8 U~~8~~)2

Ä \ 9 8 b+ö ‹ ]! 7OX 5 â j Ñ(³ B " % ÐEFF K E5 g Ô+ý0Í+° ®(³ Y+° • ù , \*  
,\$ 8 U~~b~~+ö ‹ ]! \* û ; " U• % Y+° BK,\$ Ÿ • ù ÇB~~¶~~ S U~~8~~ " U~~K~~», I +° Ê S UÐEFF K j = °E5  
=x Ô+ý0Í0,\*

Ä ÅM 9 8 g Ô+ý0Í < Ë(³ 0 =x Ô+ý0Í < Ë(³ 0 7 U~~a~~ | +ý Ó ¿ ù(³ I B % ÐEFF K +ý  
0Í\$@ B3ÿ È+° • ù 4( 45/; } : U~~s~~ Æ 0 î œ h h 2 W f U\* U~~0~~ 0,\$ Å 53ð  
h 2 W f 0 U~~0~~ U~~ð~~ U~~0~~ U~~ð~~ U~~0~~ DÜ\*TD› " 2 ¼ Ä \ \*

3ÿ @æJ•

%! \* Y 0 U~~0~~ , 0 U~~0~~ P.ù ñ á U• g Ô+ý0Í < Ë(³,\$ 8 " U~~x~~ Ô+ý0Í  
< Ë(³B~~¶~~P UÐEFF K B~~¶~~ j = °=x Ô+ý0Í &b5~~U~~%! \* Y 0 U~~0~~ , 0 U~~0~~ P.ù  
ñ á U•=x Ô+ý0Í < Ë(³,\$ 8 " U~~Ÿ~~ « g Ô+ý0Í < Ë(³P UÐEFF K ù&b j = °E5 =x Ô+ý0Í0,\*



E [ f=x Ô+y0Í < Ě(³D⁻P @ ÷3ðP ° g Ô+y0Í < Ě(³ UðEFF K )2 S ß0, Uᵀ @íD⁻P +y0Í < Ě  
(³ y ü 7 U• j = °7@3Ò g Ô+y0Í < X « Ä b+ö , S B Uú58E5 =x Ô+y0Í0,\* , : UK»,l H° Ê S U•  
3ëE<#<LœDý VWA :\*a |+ý Ó ĺ ù(³B¶P UðEFF K B¶ j = °E5 =x Ô+y0Í 63ÿ Ê=" : U•y0Í  
< Ě(³B¶P \*a |+ý Ó ĺ ù(³B¶P UðEFF K B¶ j = °Fó =x Ô+y0Í0,\*

\* 9 8+y0Í < Ě(³ 7\*a |+ý Ó ĺ ù(³ % ðEFF K +y0Í\$@ B3ÿ Ê+° • ù

ĚF v " h ç

U<, UQ>--@/ç3ÿ@æ

X ³l' %.j FD'D²E " œ\*T À QD'E•K MÄ U• & ² ðEFF K , ðEF î : æ wK +°\$@ B † 4 M • U•  
EFDó\$@ B/\_ Æ0,\* 2 ¼ ö +,K 2 ¼UÄ \ 9 8 ñ Ž 7 ðEFF K , ðEF î : æ+°\$@ B/\_ Æ0,\* Uöÿ Ê  
=" : U•

ðEFF K : ðEF î : æ+° ß0, Ê š sB• = ° b+ö , S B Ě E B < X , z Ě E

ðEF î : æ g =x Ô+y0Í 7UĚ " œ\*T À QD'E•,\$ % ° 9 œ\*T l8ã Ä+°B±MÉ b+ö f ß0, Ê š UŸ  
b+ö , S B Ě E UðEFF K g =x Ô+y0Í 7 < X w f ß0, Ê š UŸ < X , z Ě E

0X 5 å j Ñ(³B¶ S \*a |+ý Ó ĺ ù(³B¶ S b+ö < j! B¶ ; UðEFF K B¶B• = °=x Ô+y0Í

• b+ö < j! , Æ " U0X 5 å j Ñ(³ Ê S \*a |+ý Ó ĺ ù(³ Ê S UðEFF K =x Ô+y0Í < Ě(³ ] F Ê  
S Uj j = ° q 2 U\*T0X 5 å ö\*a |@' +°+ý,• ^\*T8ã ÄD⁻P +° 0 < Ě(³ T b+ö < j! E<#<  
û ;+°Dó/7 Y UðEF î : æB±MÉ b+öKy zUĚ " œ\*T À QD'E•+° Ô f û j UðEFF K j = °7@3Ò < X  
« Ä U+ö , S B

=x 0 " ðEF î : æ \+° 4† Ç ÒB¶ S Fy 4A/ < XB¶P UðEFF K g Ô+y0Í < Ě(³B¶P

•E " œ\*T À QD'E•=x 0 "+° 4† Fy 4A/ < X Ê S " UðEF î : æ8ã Ä+° K G b+öKy z UĚ  
" œ\*T À QD'E•+° j =Ky z UðEFF K g Ô+y0Í < Ě(³ üP

ðEFF K T @íD⁻P +y0Í < Ě(³ y ü 7 U• j = °E5 =x Ô+y0Í0,\*

\*j °=x Ô+y0Í < Ě(³D⁻P @ ÷3ðP ° g Ô+y0Í < Ě(³ UðEFF K )2 S ß0, Uᵀ @íD⁻P +y0Í < Ě  
(³ y ü 7 U• j = °7@3Ò g Ô+y0Í < X Uú58E5 =x Ô+y0Í0,\*

U<, UQEf

8 « Ä ø å † 40,\* l,l 5 U ° ðEFF K +y0Í+° å = ý • UðEFF K ú 7 5 åLŽ ' w U•

Fó\*T Ü ¬ [Ky X Ê t ðEFF K 5/;} g =x Ô+y0Í 7 < X w f ß0, Ê š UŸ Fó\*T < X  
, z Ě E UKy z+y0Í < X ! @ T7@s 0u ? a "K Uóó\*T æ f7V ù+° Ü ¬ [ UŸ "J- ÆP EK ~C  
ðEF a f Uç ùE " œ\*T À QD'E•=x f

M (~ C/ - j Ñ 0X 5 å j Ñ(³B¶ S Ux Ô+y0Í < Ě(³B¶P • UðEFF K NÂ t À/ - Ĩ  
L À QD'E• [2S Q • q ý\*K "+° \*K @D'E•U•üP ~ C+°Fù>ð/7 Ò Už MU• @ê/÷ 5 t , Ý f b Uĭ  
« ~ C «" î :j F+ý,•

OX K '(p(p ouUÐEFF K +ý0Í : ÐEF î : æE " Æ\*T À QD'E•=x f\$@ B † 4 2 ¼

f B+ý0Í 04† Ç Ò \*a |+ý Ó ¿ ù(³B¶ S U•x Ô+ý0Í < Ë(³B¶P U•4† Ç ÒB¶ S Fy 4A/ <  
XB¶P Ug Ô+ý0Í < Ë(³B¶P • UÐEFF K À «" /@ê\*a |+ý Ó U8 " U5/;) T ? a f Ê@ê\*a  
|+ý Ó U@ê4š æ „ 9 Æ " î Uì SE " =x f 0(³ UžP 4† Ç Ò Ê S ÐEF î : æ=x 0 "+°  
Fy 4 < X U@ Ì S ÐEF î : æ=x 0 " ' Æ Ð>ð+° "K Uí f B+ý0Í 04† Ç Ò+°>þ Ò ü s g =x Ô+ý  
0Í < Ë(³

î5/³(Z U•

U¾UÀ"L^99 U¾ S)\_ ;!©D'EF = ~• ÐEFD~/f\$@ B † 4 2 ¼ U¾UÀC Ø ÐEF S ' ' Ñ U• U• Ä Å• Ü

U¾UÀ-!9.!2\$ 3-)4( \* 4HE THEORY OF GAMES AND THE EVOLUTORY DYNAMICS OF COLLECTIVE ACTION

4HEORETICAL BIOLOGY

U¾UÀF L...:UÀ '• U• ;" Uou & ° f B { ^ † 4 â " +° øD'E•## 4 ÐEF"m¥ S U¾UÀ8"z S ' ' Ñ Ä7 &b.ý 't Å•  
U• Ä Å• Ü

U¾UÀz.›)V U6)/÷ \$ì Ý S , 4† S ÐEF aç)2 k0,+°! Dˉ ÿ ÿ & ° Ô -f\$@ B † 4 M • ö +,K 2 ¼ U¾UÀÝ )0Í)2.ý  
' U• U• Ä Å• Ü

U¾UÀ5 # ( ) 9! - ! . 4! . ) ' 5 # ( ) % ! 3TUDY OF THE EFFECT OF CHOICE -MODEL BASED ON EVOLUTIONARY  
DYNAMICS ON THE SOCIAL AND ECONOMIC BEHAVIOUR OF INDIVIDUALS

U¾UÀ¼8âU•LL ± U% L\*Lj5ø › 7 k Ê+ý0Í : ÐEF - F z-ß=x f\$@ B † 4 U¾UÀ2'4 0Í)2 ' Ñ U• U• Ä Å• Ü  
Ü

U¾UÀP{i8 U@> xUz H8â & °\$@ B † 4@æ+°=x æ : f ÔD' p/-f\$@ B f)2-@/çU¾UÀ)2 ' Ñ U• U• Ä Å• Ü

U¾UÀž4.ý UÐ\$EU•K & °,\$Eç,\$ y 4 ^ † 4+° • # Ð ð Ê "\$ Ô DB & M , +,K U¾UÀ~C ÐEF.ý ¬ U• U•  
Ä Å• Ü

U¾UÀ.!2!.'! 3(!)\*5! \* %VOLUTIONARY STABILITY OF POLYMORPHISM IN SYSTEMS  
'AMES AND POPULATIONS

U¾UÀ# (%.' \* 3)'/.' ' ' U•,) " 9 #OOOPERATION STRATEGY OF TECHNOLOGY UPDATING BASED  
ON THE ANALYSIS OF PERFORMANCES OF SEVERAL

U¾UÀ.)¼ U•M! f UAN6) F & °6;6d † 4 M •+° æD'C /«B¶=x f-@/ç U¾UÀ)2 ' Ñ U• U• Ä Å• Ü

U¾UÀL•L U•MÂ æQ! Ò £Uou D'E•=x Æ\*T % ú .E•C EF=x6) Ç+° • ùU¾UÀ•` S ' ' Ñ Ä7 &b.ý 't Å• U•  
Ä Å• Ü

U¾UÀ0).!3# / \* 0 #!24!")! - 2 3!).4)%2 ! 'AME 4HEORETIC -MODEL OF THE DYNAMICS OF DISTRIBUTION  
'AMES AND POPULATIONS

U¾UÀ'(!4!+! -5+(%2\*%% \$!/+! 3PATIAL 'AME 4HEORETIC ANALYSIS OF CONFLICT  
COMPUTATIONAL COMPLEXITY

U¾UÀ' U6•K U•çç Uou & °D'E• & M+° f À Q\*» •C °>ð> U¾UÀÐEFDüD¿ /7' Ñ U• U• Ä Å• Ü

U¾UÀ' â U•• Ê UÐ [L Uou & ° , " › F æ Ô - † 4+°D'E•E5 M • U¾UÀ@í0Ä f /7 : Ä\*T U• U• Ä Å• Ü  
Ü

U¾UÀBIM "QU• »' 5 Ä QD'D² • ù+° FD'E• ÐEF"m o6 7 Ô f M • U¾UÀ)2 ' Ñ U• U• Ä Å• Ü

U¾UÀ' U77ýU•L - & °\$@ B † 4@æ+°!©D' • x :.í âD' † 4-@/ç U¾UÀÐEF › :µ" U• U• Ä Å• Ü

U¾UÀÄ ; ± UÉá Q. »U¾ } % Uou EF=x k0, (= 77@ s &=x3ÿ ° Ô -f\$@ B † 4 U¾UÀC Ø ÐEF S ' ' Ñ U• U• Ä Å• Ü  
Ü

U¾UÀL Æ ÝU• < j U73ù' Uou ú . ~• ÐEF+ý0Í † 4 & M : +,K U¾UÀð @\$ F S ' ' Ñ U• U• Ä Å• Ü

U¾UÀ' ÷ Ý UzL3U•...+¿ ² =f f ž=x ÐEF 2 ñFû+° † 4M°"w â" U¾UÀÝ )~C ' Ñ U• U• Ä Å• Ü

U¾UÀz '³ U¾ i4Ð ú .D'E• ÐEFDü9Q t(³@ð # ÿ ÿ & ° eE +° † 4 Ð ð t(³ â" U¾UÀ2'4 /7)2@æ : ÊC! U• U•  
Ä Å• Ü

# (AME "NALYSIS OF 4RAFFIC %EPARTMENT 3UP & VOLUTION OF 4RAFFIC LIACTIC OIPOUNTATION O & MERGY -ANE

- 5 ,IN GLIN 65 \*IATIN 65 9IFAN

Ä 3CHOOL OF %CONOMIC S (ABDEI 5NAGERMSENY CÉ4 K/ENCJH NOÈ#CHG M A  
#OLLEGE OF 0UBLIC (D MZIN 3N 6 5NIO 6RSITY OF 3 CÉ7EUNICAENA (NUB E EÈ#HIN 1A OGY  
#OLLEGE OF -ANAGEMENT TANND N% CNOÈM 6ANSJTNV È#HIN A

"BSTRACTING AT ILLEGAL OCCUPATION OF EMERGENCY LANE BY SOCIAL V  
EXPRESSWAY AND THE EVOLUTIONARY GAME MODEL BETWEEN TRAFFIC PART  
IS CONSTRUCTED BY CONSIDERING THE SUPPLY AND DEMAND REPORTS BY  
MONITORING ESTABLISHING THE REPLICATION AND COOPERATION STRATEG  
DEPARTMENT AND TRAFFIC PARTICIPANTS ARE OBTAINED THROUGH EVOLU  
ANALYSIS THIS RESEARCH SHOWS THAT THE DEPARTMENT AND  
TENDS TO OBSERVE THE PRINCIPLE OF MAXIMIZATION OF BENEFIT TO THE  
THIRD PARTY REPORTING RATE AND ELECTRONIC MONITORING CONDITIONS  
MORE LIKELY THE TRAFFIC DEPARTMENT SET OF REGULATORY MEASURES  
HIGHER THE COST OF COOPERATION WHETHER THE STIGMA RATE OF ACTIVE  
TRAFFIC DEPARTMENT THE PREMISE OF ENSURING A HIGHEST UTILITY DEPART  
TENDS TO CHOOSE PASSIVE STRATEGY IT IS SUGGESTED THAT TRAFFIC DEPAR  
NEW TECHNOLOGY TO REDUCE COST AND INCREASE BENEFIT TO EFFECTIVELY R  
OCCUPATIONS AND STRENGTHEN SUPERVISION AND PUNISHMENT TO PRO  
DEVELOP IN THE DIRECTION CONDUCTIVE TO THE SUPERVISION OF TRAFFIC  
KEY WORDS TRAFFIC ENGINEERING EVOLUTIONARY GAME DEPARTMENT  
PARTICIPANTS

ÄBO '4BD 14LKñ.÷ Å