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Abstract

Policy introducing open access to the wireless network has been under discussion in the Korean mobile telecommunications industry. The policy, which directs mobile operators to allow mobile portals other than their own ones to access their network and subscribers, is expected to vitalize mobile Internet market through competition among portals. This study analyzes the impact of the policy in terms of welfare of mobile Internet users and profit of mobile contents providers. We also cover the influence of mobile Internet fee on anticipated results of the policy.

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2001^{3a} a 6 z u . » Ç o A ç z i . o 3 a q o A ç A i m z A e 1/2 A o i A o A U 1/2 A 2,800 . . . i A » 3 N 3/4 1/2 A . ç 1 « 1/2 A I A I 3 Y » ç z e A i o i E C N U . » ± a A ç o ± p e 1/2 A 1,400 . . e z i A o 1 U C I o i A O A I A . I A » ç m C 3 u U . [1] ± x . - 3 a m - Commerce A ç m A o m i 1 « 1/2 A I A I 3 Y A I A i o ç C I A U 3 Ç N o i E 1/2 P z i m m o ± . C I o i o i A O A U m e A ç 1/2 A i » ç z e 1/2 A u A o A u A q C N A i A i U . 1 « 1/2 A I A I 3 Y » ç z e A I o i E C I m m . I o e q o z i A u . i A ç C N U . » ± a 1/2 z i e C I z o z u 1 E . A i » o A o 1/2 A u A . I 1 « 1/2 A I A I 3 Y 1/2 o n 1/2 . i » ç z e C N o i o A o 30% o i . z i o o u C I o i . [1] » ç z e m C A 1/2 o n 1/2 m m A 3 . A i z i o s 1/2 o U z i . I m a m i A i o i z i . . A y A B m C o i A O A Ç u A i A i U . A i A 3 . 3 1 « 1/2 A I A I 3 Y A I ç A E A ç ± a e z i 1 P o 1/2 A A a z i » N . o i 3 . » A o o C I o i A O A m 1/2 z i A z o . - U 3 Ç N z a A I m e A I A U z e C I o i A O A I A . I o A i A m 1/2 . 3 o A o A i z e . a . o D E C N A A u A I A I A i 1/2 . A u 1/2 1/2 o m m i A . o i A i z e m A B z i . 2 . 3/4 A o A m i A ç 3 . A o 1 « 1/2 A I A I 3 Y 1/2 o n 1/2 Ç A u . A A A U A A ç o I A . m i A i A O z a C N z o A I A . I 3/2 ± p m C o i A O U .

A i z i o o A o » o E z i 1/2 A o . A e 1/2 A o i z i 1/2 A 1 « 1/2 A I A I 3 Y 1/2 A A A A ç E o 1/2 E . i A ç C I z o 1 « 1/2 A I A I 3 Y A o 3 1 a A A A » A B A o C I o i A O U . 1 « 1/2 A I A I 3 Y A o 3 1 a A i q o Ç o A ç A i m z A e 1/2 A ç m e A I o A C I o i A O A 1 « 1/2 A A A » o n . O C I z o A B 1/2 A ç u A e A . » o A I A e z i p A I . o u ± 1/2 A 1/2 A U m i A ç 1 « 1/2 A I A I 3 Y A 1/2 A A A o A » z o A . » ç 3/4 A U m e z i o o 3 1 a C I z o A U A . o o A ç 1/2 o C o 1/2 A o A m m . i C I A I A . » ç N U . A o 3 1 a 1 u A S A A i m z A e 1/2 A ç o i o A C I o i A O A 1 « 1/2 A I A I 3 Y A A ç o 3 1 a A o A i A i » o E E A ç 1/2 A o A i z i m i q o ± . o D m C A m 1/2 . o » z ± . z i 1/2 A z i A u o 3 1 a A i q o i C o 1/2 A O A I W F (InterWorking Function) z i 1/2 A ç » o E E A ç 1/2 A o i . A ç N

U . A i 1 u A S ± i A o 1 « 1/2 A I A I 3 Y A o 3 1 a A i 1/2 Ç C o m C . e » ç z e A U A 1 « 1/2 A I A I 3 Y A » A i z e C I ± a A ç C I z o Ç o A ç z i o o A i A i m z A e 1/2 A ç o i A i o C I A 1 « 1/2 A E A » 1 . . A » A e C o A ç 1/2 C I A o I A i 3/4 E I q o U . 1/2 1 « 1/2 A E A » z i A U A . o o A ç 1/2 C o 1/2 A o o m E U .

1 « 1/2 A I A I 3 Y A o 3 1 a A o 1 « 1/2 A E A » A ç ± a e A » 1/2 o ç a C i A U 1/2 A ç 1/2 o n 1/2 o ± p A U (SP : Service Provider) m e A » A o A O 1/2 A N o A i A » A E 1/2 B C O A . I 1/2 1 « 1/2 A I A I 3 Y 1/2 A A a A » E o 1/2 E - 1/2 A A 3 o I A . I ± a e 1/2 e m C o i A O U . ± A 1/2 A u A . I A 1/2 o n 1/2 o ± p A U » ç A I A C o A i A i A i m e z i o o A A A U A . i A i o C I A A A A U A o ± p A U (CP : Contents Provider) A ç 1/2 A i E o . . i A e C N A A A U A o 3 1 B E A A » 1 e 3/4 C o 1/2 A o o C I o i 3/4 A u A ç A A A U A z i o A e i z i m u . 1/2 1/2 A i C I m i A » A e C o ± A ± o A u A . I 1/2 o n A U E A » y A A o 1/2 A A 2 U A o I A i 1 « 1/2 A I A I 3 Y A o 3 1 a A A Y A ç . n A u A i q o i o 1/2 1/2 A o o U U .

± x . - 3 a . o ± p A U A ç A o o i z i m m o o ± C I o i 1/2 A A a 1/2 z a i A o o C I A o 3/4 E o i . 1 « 1/2 A E A » o u A A A U A A i o o A U » ç A I A C 1/2 A i e o D ± A q z i z o i A i A i 3/4 3 - U e A A A U A o ± ± p A U A ç 1/2 A I A o Ç o A ç o U o o E - m e 1/2 m m A O U A A u A A i 3 a z A o i A O U . [2] . [3] q C C N Ç o A ç A i m z A e 1/2 A ç o i o i o u C I o i A O A 1 « 1/2 A I A I 3 Y A i z e . a o i 1/2 o n A U m e A ç A o o O A ç » ç (Willingness - T o - P a y) z i o n C I z o 3 o o A Y A ± m C 3/4 A O 3/4 1 « 1/2 A I A I 3 Y A o 3 1 a A i E A z i m m 1/2 A A e o 1/2 E - z i 3/4 ç z m C a A » 1 I A y o i E 1/2 A i 3 o U .

o » 3 i 1 o z i 1/2 A 1 « 1/2 A I A I 3 Y A o 3 1 a A A Y A i 1/2 A A E o 1/2 E - z i ± a z o C I A U . i 1/2 o n A U E A » y A o e z i A A A U A o ± p A U A ç 1/2 A i o E . i A B 1/2 A E A . I » i A o » U . q C C N A i m z A e 1/2 A ç m e A i 1/2 o n A U m e z i o 0 % . A m o m e A i A 1 « 1/2 A I A I 3 Y A i z e . a o i 1 « 1/2 A I A I 3 Y A o 3 1 a A A ç ± a e E z o u z i 1 I A i A z m C a A » o i A u C i ± a . I C N U .

2. ± a A , 1 o ç a z ± .

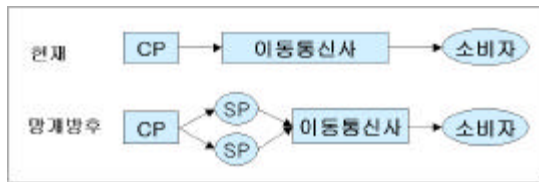
A ç E - A ç o i A i » ç 1/2 ± A q z i m u . 1/2 1/2 A A A A u z o A U m e A ç 1/2 A o u 1/2 o n A U E A » y z i o u C I z o Economides (1999) [5] A m i m A i o ± p A U A ç 1/2 A A e C O A i o C O A ç A ç Ç A u 1/2 A o z i 1 I A i A z m C a A » o D 1/2 C I z o U . z ± . a o u z i m u . f . e A i . C N 1/2 A A A e C O A o Ç A u 1/2 A o A o A ç Ç a o . 1/2 A A 1/2 o z a A o o i . o ± p A U 1/2 A i o u 1/2 o n A U E A » y A ç A o o i . i A o z A A 1/2 Y e z i 1/2 I m 1/2 A u A i 1/2 A o A o u e z i A O A m A i o ± p A U m e A o o 3 . A o Ç A u 1/2 A o A o A ç A i Ç A A o 3 o A o o i Y z i

1) Ç o A ç SKT A n - Top , KTF A magicn , LGT A ez - i . i A A I C N 1 « 1/2 A E A » . I A A A C I o i A O U

Á_i°œÇÍ·Á °ÍÁ·Î °D½μÇ¾ú·Ù.

Á_i°Áç ¼ÁÁáç¼·Áç °íÁ_j»ç½±, Á_i°-È-°í ¼ÁÁá ç¼ ¼ÁÁ_j·Á çμÇÁá° ÁÍÁÍ³Ý°ç °±P°ú °ò°¾Á ÁÖ±Ù È° ¼BÇÑ ç±, °í Á_i·ç¾Á° çÖ·Ù. Oh and Chang(2000) [6]Á° ç¾Á°ÁÍ ¼·°ñ½P »ê¾·ç¼¼ ³×Æ°çÖÁ° °œ±PÁÙç¼Í ÁÁÁÁÜ± °œ±PÁÙÁç ¼ÁÁ±ÁèÇÖç¼í °èÇÍç° °D½μÇ¾ú·Ù. μÍ μ_iÁ_j »ç¾ÁÙ° í ¼·Í ¼ÁÁ±ÁèÇÖç° °æ¼í ¼ÁÁá°í°Ý Á° ÇÍ°çÇÍ°í, ¼Áç¼·Á Áó°íç¼ç° »ç¾ÁÙμéÁç ¼ÁÁÍÁ° Áó°íç¼Í° ìÈ·Ù·Á °ÍÁ° °ç·Ù. ÇÑÆ, Dewan, Freimer, and Seidmann(2000)[4]Á° Á_i°Áç ¼ÁÁáç¼ ¼· μ_iÁ_j ÁÁÁÁÜ± °œ±PÁÙç¼Í ISP(Internet Service Provider) »çÁÍÁç ±ÖÇüÁü. «(±ÖÇü°í°Ý)Á» °áÁçÇÍ°í, ISPÁç Áó°í°í μ_iÁ_jÁÁÁÁÜ± °œ±PÁÙ, ISP, ¼°ñÁÙÁç ÈÁ°ýç¼ ¼ÁÁ_j·Á çμÇÁá» °D½μÇ¾ú·Ù. Á_iμéÁ° ¼ÇÇÑ Áè ¼Á°ñçè·¼Áç ÍSPÁç °ñμ_iÁ_jÁÁÁÁÜ± Á_i°ÁÍ μ_iÁ_jÁÁÁÁÜ ±·¼ÁÁáç¼ ¼ÁÁ_j·Á çμÇÁáç¼í °èÇ¾¼·μ °D½μÇ¾ú·Ù.

3. ¼×ÁÍÁÍ³Ý »ê¾Áç °íÁ_j»ç½±



[±×,² 1] ¼×ÁÍÁÍ³Ý »ê¾Áç °íÁ_j»ç½±

<±×,² 1>ç¼¼·Á³.³ ÇöÁç ¼×ÁÍÁÍ³Ý»ê¾Áç °íÁ_j»ç½±° CP, Á_iμ_jÁè¼Á»ç, ¼°ñÁÙ·Í Á_i·ç¾Á°ÁÖ·Ù. Á_i μ_jÁè¼Á»ç·Á ¼×ÁÍÁÍ³Ý, ÁÁ» Á_i°œÇÍ°í °ü·ÇÇÍ·Á Á »ç¾ÁÙ(NP: Network Provider)ç¼Í ¼ÇÁúÁúÁÍ ¼·°ñ½P ç¼Í Á_i°œÇÍ·Á SPç¼ÇÖÁ» μ_jÁè¼¼í ¼ÁÇÇÇÍ°í ÁÖ·Ù. CP·Á Á_iμ_jÁè¼Á»çÇÁç ¼×ÁÍÁÍ³Ý»ê¾Áç¼ ¼ÁÁÁÜ±, °œ±PÇÍ°í, Á_iμ_jÁè¼Á»ç·Í°ÍÁÍ ÁÁÁÁÜ±Á_içè·Áç ÁÍÁç °ñÁ²Á» ¼P·Á·Ù. Á_iç¼Í °°ÁÍ ÇöÁçÇ °íÁ_j»ç½±Á° °é Á_iμ_jÁè¼Á»ç °ç°í ¼ÁÁÁáó¹èáú ÁSÁç¼¼í ÁÖ·Ù·Á °ÍÁ° »¾ ¼ÁÖ·Ù. ¼×ÁÍÁÍ³Ý, Á°³¹æÁÍ Á_i·ç¾Á°é Á_iμ_jÁè¼Á»ç·Á NP·Í¼¼ ¼×ÁÍÁÍ³Ý Á_i°œÇÍ°í ¼× °ü·ç¼ÇÖ, Á» ÇÍ°Ö μÇ°í, Á_iμ_jÁè¼Á»ç°í ¼ÁÁÇÇÍ°í ÁÖ·œ ±áÁÁÇ ¼×ÁÍÁÍ³Ý»ê¾Áç¼ ¼ÁÁÁÖÁÖÇÑ ¼×ÁÍÁÍ³Ý»ê¾Áç¼ SP·Í¼¼ ¼°ñÁÙμéÁÍ Áó°Ö ÇÑ ÁÁÁÁÜ±Á_içè·Áç¼, CPç¼Í °D½μÇ¾ú·Ù ¼ÁÁÁÖÁ·Í »í°Ö ìÈ·Ù.

4. ðÇü ¼ÁÁ°ú »ç·È° °D½μ

¼×ÁÍÁÍ³Ý»ê¾Áç¼ ÇÍ³ÁÁç NPç¼Í μ_iÁ_j ÁÁÁÁÜ±, °œ±PÇÍ·Á ¼ÁÁÍÇÑ CP, ¼·Í °æ¼íÇÍ·Á °Á° Á°±áÁç μÍ SPμé·Í Á_i·ç¾Á° ÁÖ·Ù°í °íÁçÑ·Ù. ç±áç¼¼·Á ¼×ÁÍÁÍ³Ý Á_içè·Áç·Í ÁÍÇÍç° °í°ÁÍ °íÁÖμÇ¾ ÁÖ·Á Á_iμ_jÁè¼Á»ç¼, ¼ÍÙ·Á ÁÍÁ° ¼ÁÁ·Ù°í °íÁ·Í¼¼ ¼×ÁÍÁÍ³Ý ¼ÁÁáç¼¼ Á_iμ_jÁè¼Á»ç(NP)°ÉÁç °æ¼íÁ» ¼èÁ_iç¼Í°í ¼ÁÁÍÇÑ NP·Á» °í·ÁçÑ·Ù. ¼×ÁÍÁÍ³Ý ÁÁÁÁÜ±·Á ¼×·áç¼Í Á·á °ç°ç ÇÑ °í Áó¾ç Á·ÁçÇÍ°í Á_iμéÁç Á°±á°í μ_jÁíç¼ç° Ùç¼·Í·Í·Á ÇÍ·Á ÁÁÁÁÜ± °°Á° °ÍÁ·Í °°·Ù. Á·áÁÁÁÜ±·Á CPç¼¼ ÁÇÇÖ Á_iÁÙμÇ·ç CP°í μ_iÁ_jÁúÁÍ ±Ç, °í·Á ÇÁçÇÇÍ·Á Ý·é ¼×·áÁÁÁÜ±·Á ÁÙ»ç Á·ÁÁÁÇ »ççè·Á Áó°í·Í ÁÍÇÑ Á·ÁÁ» ±á·èÇÍç° SP°í »ççèÁÙç¼í° ¼×»óÁ·Í Á_i°œ ÇÑ·Ù. ÁÁÁÁÜ± »ý»ê ¼× °œ±Pç¼¼·Á ÁÁÁÁÜ± Á_iÁÙ°ñ, ¼· íó ¼ÁÁ°ñ, ¼×ÁÍÁÍ³Ý Á·Áó°ñ μÍÁç ¼ÁÁÇÇÑ °ñçèÁÍ μÁ Áμ¾, Á_iμéÁ°, ðμÍ °íÁó°ñÁç ¼°ÝÁÍ °ÇÍ·Á·Í NP,

SP, CPÁç ÇÑ°è°ñçèÁ°, ðμÍ ÁÁ·Í °íÁçÑ·Ù. °ç Á_iμ_jÁè¼Á»ç·Á ¼×ÁÍÁÍ³Ý »ççè·Á(ÁÁÁÁÜ±)ç¼í °ñ·èÇÍç° ¼×ÁÍÁÍ³Ý Á_içè·Áç¼, °Í°úÇÍ Áμ¾, Á·áç¼Í ¼×·áÁÁÁÁÜ±Áç Á°±á°í μ_jÁíç¼ç·Á·Í °ç°ç¼¼ °èÇÍç° °° Á° Á_içè·Á P_nÁÍ μÇ·Ù. ¼ÇÇÑ Á·áÁÁÁÜ±ç¼í °èÇÍç° »ççèÁÙ·Á ÁÁÁÁÜ±Á_içè·Á P_{sc}, °í°μ·Í SPç¼í Áó°ÖÇÍ °Ö ìÈ·Ù.

¼×ÁÍÁÍ³Ý ÁÁÁÁÜ±ç¼í °èÇÑ Á_iμ_jÁè¼Á»ç¼í ÁÖÁÙμé Áç Áó°í°íÁ_j·Á Á·áÁÁÁÜ±ç¼í °èÇÍç° [0,a], ¼×·áÁÁ ÁÜ±ç¼í °èÇÍç° [0,b]»óÁç uniform °DÆ·¼ μ_i·Ý·Ù°í °»·Ù. (a>b) ±×, °í, °ç °íÁÖÁÖÁç Á·áÁÁÁÜ±ç¼Í ¼×·áÁÁÁÁÜ± Áó°í°íÁ_j »çÁÍç¼í »ó·ü·ü°è·Á ¼ÁÁ·ç Áó°Ö Áç»ç¼, Áæ°DÇÍ·Ù·é ÇÑ °íÁÖÁÙ·Í Á·áÁÁÁÜ±ç¼Í ¼×·áÁÁÁÁÜ±, ðμÍ »ççèÇÖ ¼ÁÁÁÜ± ÁÖ·Ù°í °íÁçÑ·Ù.

ÁúÁ¼ Á_iμ_jÁè¼Á»ç¼í ÁÖÁÙ ¼ÁÁ·¼ ¼·Í normalizeÇÇÍ, é Á·áÁÁÁÜ± ¼ÁÁç¼ q_iç¼Í ¼×·áÁÁÁÜ±Áç ¼ÁÁç¼ q·Á·Ù Á¼Áç ¼Á(1), (2)ç¼Í °°·Ù.

$$q_p(P_n, P_{sc}) = \frac{1}{a}(a - P_n - P_{sc}) \tag{1}$$

$$q_f(P_n) = \frac{1}{b}(b - P_n) \tag{2}$$

4.1 ÇöÁç ¼×ÁÍÁÍ³Ý »ê¾Áç

ÇöÁç ¼×ÁÍÁÍ³Ý »ê¾Áç ±Á_i·Á Á_iμ_jÁè¼Á»ç°í NPç¼Í SPÁç ç¼ÇÖÁ» ÇÖ²² ¼ÁÇÇÇÍ, é¼·¼ ¼×ÁÍÁÍ³ÝÁÍ çè·Á P_n°ú ÁÁÁÁÜ±Á_içè·Á P_{sc}, ðμÍ °áÁçÑ·Ù. ±× °°í Á_iμ_jÁè¼Á»ç·Á ¼×ÁÍÁÍ³Ý, ÁÁ» °íç¼íμ¾ ¼×ÁÍÁÍ³Ý Á_içè·Á çè·Á Áú°íç¼Í ÁÁÁÁÜ±Á_içè·Áç ÁÍÁç °ñÁ² k (0 ≤ k ≤ 1), Á·ÁóÇÍ°í ÁÁÁÁÜ±Á_içè·Áç áÁç °Áó, °Áó, CPç¼Í° Öó±PÇÍ·Á ÇüÁÁÁÍ·Ù. Á_iç¼Í °°Á° »óÈ²ç¼¼ Á_i μ_jÁè¼Á»çÇÁç ÁÍÁ±Á° ¾Æ ç¼Í °°ÁÍ ÁÁçμÈ·Ù.

$$\pi_n^0 = (P_n + k P_{sc}) \cdot q_p(P_n, P_{sc}) + P_n \cdot q_f(P_n) \tag{3}$$

¼Á(1),(2), »ççèÇÍ°í Á_iμ_jÁè¼Á»çÇÁç ¼×ÁÍÁÍ³Ý °Í°Í ÁÍÁ±Á°èÈ·¼Á, °í·Á, Ç°é ¼×ÁÍÁÍ³Ý Á_içè·Á·á ¼× ÁÁÁÁÜ±Á_içè·Á·Á ¾Æ ç¼Í °°ÁÍ °áÁçμÇ·ç ¼°ñ ÁÙ°í Áó°ÖÇÍ·Á ÁÖÁÁ°í°Ý P·Á Á·áÁÁÁÜ±, »ççèÇÍ·Á °æ¼í P_n⁰ + P_{sc}⁰, ¼×·áÁÁÁÜ±, »ççèÇÍ·Á °æ¼í P_n⁰ÁÍ ìÈ·Ù.

$$(P_n^0, P_{sc}^0) = \begin{cases} \left(\frac{abk(3-k)}{4ak-b(1-k)^2}, \frac{2a(ak-b)}{4ak-b(1-k)^2} \right) & \text{if } ak - b > 0 \\ \left(\frac{ab}{a+b}, 0 \right) & \text{otherwise} \end{cases} \tag{4}^2$$

Á·áÁÁÁÜ±Áç °í°ÝÁÍ ÁÁ·Í °áÁ °áÁ° °æ¼í·Á ¼×·áÁÁÁÁÜ±ç¼í °ñÇÍç° ±× °íÁ_j°í Áæ°DÈ± °óÁó ¾Æ¾Æ Á_iμ_jÁè¼Á»çç¼¼ μ_iÁ_jÁÁÁÁÜ±ÁÖç¼íμ μ_i·á·Í °œ±PÇÍç° ÁÍÁ±Á°èÈ·¼Á, ¼P¾ÇÇÍ·Á »óÈ²ÁÍ·Ù.

4.2 ¼×ÁÍÁÍ³Ý Á°³¹æ ÁÍÈÈ

¼×ÁÍÁÍ³Ý, ÁÁÍ μ_iÁ_j ÁÁÁÁÜ±¼×ÁÍÁÍ³Ý»ê¾Áç¼í °³¹æμÇ é SP·Í¼¼ Áç ç¼ÇÖÁ» »ó¼ÇÇÑ Á_iμ_jÁè¼Á»ç·Á NP·Í¼¼ ¼×ÁÍÁÍ³Ý Á_içè·Á P_nÁç °áÁ±Ç·Á, Á» °íÁó°Ö ìÈ·Ù. ±×, °í, P_{sc}Áç °áÁ±ÇÁ° P_nÁÍ NPç¼í ÁÇÇÖ ÁÍ·Í ÁÁÁ±μÈ »óÁÁç¼¼ CPç¼Í SPμé »çÁÍÁç °ü°è¾Áç¼¼í μ_i°í °± ¼ÁÇ°í ¼P°óÁú °ÍÁÍ·Ù.

¼×ÁÍÁÍ³Ý Á°³¹æ ÁÍÈÈÁç °íÁ_j»ç½± ±Á_i·Á Á° °Ö μÍ °íÁó »ç·È·Í ±·°μÈ °ÍÁ·Í °ÁÍ·Ù. ÁÍÁ°·Á SPμé »çÁÍç¼¼¼ ¼×ÁÍÁÍ³Ý »ççèÁÙ, »é»óÁ·Í °í°Ý°æ¼íÁÍ ú¾ÁÁó·Á °æ¼í·Í, ÖÁú NP°í ¼×ÁÍÁÍ³Ý

2) k·Á °D, ð°í ¾ÇÁÍ úÁSç¼¼¼ ÁçÇÖÁó °ÍÁ·Í °°·Ù.

$\Delta \tilde{z} \cdot a \cdot P_n \Delta \rightarrow \Delta C_N \gg \Delta \tilde{z} \frac{1}{4}$, SPμεΔI marginal cost pricingΔ ÇI'Ç. I P_{sc} Δ CP_z Δ ΔÇÇ0¼, °áÁ=μÉ'Ü. μI °Á°-I'Á SPμεΔI ΔI-ÁúÁ, I Çü-ÁÇI'Á °æjι.I ¼ P_nAI ΔO¼áÁO »ΔÁΔzι¼ μI SP°i °μz¼. I °ÁO W_s ΔI ΔÇI'í, CP°i μz¼Ázι AÚ¼ÁÇ °ÁÁO W_c ΔI °á Á=ÇIz° ±x CÖÁ. I P_{sc}°i Á=CÖÁO'Ü.³⁾

ASAC μI °iÁO »Ç·É ÁIzUzιμμ ÉÁ± SP°i Á·á ÁÁÁUÁ=AC'ÉÁ'Áú °o±P±ÇÁ» É'μΑÇI'Á °æzιμμ °i·ÁÇO ¼O ÁO'Ü-ÁμÝ, AI'IS Á·áÁÁÁUÁ=Zιι 'ÉÇIz° μIÁjÁúAI ±Ç° ΔI'ÁO'Í'í ÁO'Á CP'Á °i·ÉÇN, I'ÁO '¼E=Á»Zιi ÁÁÁUÁ÷, °o±P, ÁÁÁUÁ÷, I'ó, I'ÁO »ÇzÉÁUzιι °ÉÁ¼¼ AN ¼OÁO» °ÁI-Á ÇO °IÁI'Ç·I ÇI'ÇAC SPzιι, AÚ ¼ÁÇ ÁÁÁUÁ÷, °o±PÇI-Á ÇIÁO ÉÁ» °IÁI'Ü.⁴⁾

ÁIzI °°ÁI SPzI CP »ÇÁIAC °i·Ý°áÁ±Ç 'x ±x zιi μú, ¥ ¼ÁO'É°D±Á, I'ÁÁÇÇN ÉÁ NP°i ÁYÁ=ÇI'Á '¼ÁIÁI'Ý ÁIzÉ·á P_nAI '¼ÁIÁI'Ý ÁÁÁzιi I'ÁI'Á zμÇÁ» °i·ÁÇIz° ¼ÁÁáÉ°¼É-AC Á·μ·I¼ »ÇzÉÁUAC '¼ÁIÁI'Ý ÁIzÉ·á zI' ÁÁÁUÁ÷ ÁIzÉ·á zI' CPAC ¼OÁI Á» »ÉÁÇN'Ü.

4.2.1 SP°f °i·Ý°áÁi

CP·I'ÁI μzAIÇN ÁÁÁUÁ÷, I'°o±P'PAO SPμεΔI '¼ÁIÁI'Ý »ÇzÉÁUμéÁ» μI'í °i·Ý°áÁIÁ» úÁI' °æzι AI'μéAI ÁYÁ=ÇI'Á °ÁÁO'Á OAI' μÉ'Ü. AI' IS »ÇzÉÁU°i ÁO'ÖÇI'Á ÁÁÁUÁ÷ÁIzÉ·á Á Áú¼ CP°i °°O μÇ·Ç ÁÁ ÁUÁ÷ÁIzÉ·á °áÁ=±Çμμ CPzιι'Ö, Á ÁÇÇN'Ü.

CPAC ÁIÁ±ÁO'ÉÈ- I'ÁI'Á ÉÁ E jzI' °°Ü.

$$\max_{P_{sc}} P_{sc} \cdot q_p(P_{sc}; P_n)$$

First-order condition° second-order conditionΔ °i·ÁÇI'É CPAC ÁIÁ±Á» ÁO'ÉÈ-ÇI'Á ÁÁ ÁUÁ÷ÁIzÉ·á, I'¼OΔ ¼O ÁO'Ü.

$$P'_{sc} = \frac{a - P_n}{2}$$

4.2.2 SP°f Çü·Á

SPμεΔI ΔI-ÁúÁ, I'Çü-ÁÇIz° CPzI' ÁÁÁUÁ÷°i·Ý Á» Çü»OÇI'Á °æzι·I¼ »ÇzÉÁU°i ÁO'ÖÇN ÁÁÁUÁ÷ÁIzÉ·á P_{sc} ΔI SPμεú CP°i ±a·z °°O μÇI'Ç·I °i·Ý°áÁ±ÇÁ» CP°i μIÁjÇO ¼O °°O μÉ'Ü. ±x °áú, AI'μzÁÉ ¼Á °i·ÁOÁUμéÁÇ ¼Ozä, I'°i·ÁÇIz° ÇÇÁU°i simultaneous gameÁ» úÁI'Ö μÇ·Ç AI'μéÁÇ Áú·«°° ÉÁO °ÁÁOÁÇ Á±Á W_c, W_s·I Á=ACμÉ'Ü. (P_{sc} ≡ W_c + W_s) AI'·ÇN »OÉzιi¼ SPμεú CP'Á °CÁUÁÇ ÁIÁ±Á» ÁO'ÉÈ-ÇI'Á ÇN'Ü.

$\max_{W_c} W_c \cdot q_p(W_c, W_s; P_n)$
 $\max_{W_s} W_s \cdot q_p(W_s, W_c; P_n)$
 °i·Ý°áÁ°OÁOÁÇ ÇÇÁU°i ±OÇüÁú·«'x ±x zιi μú, ¥ ÁÁÁUÁ÷ÁIzÉ·á Á Á'ÚÁ¼ú °°Ü.

$$W_c = W_s = \frac{(a - P_n)}{3}$$

$$P''_{sc} = \frac{2(a - P_n)}{3}$$

3) μIÁjÁÁÁUÁ÷AC'°o±P±ÇÁ Çü»Ozιi¼ μI SP°i CPzιi 'ÉÇIz° ¼°n¼ IÉ'Ç °ÁÁO W·I'ó Á μzAIÇN ÁI'ÇÁ» ÁI¼ÁÇI'Á »OÉzιi ÇO'ÇμÉ'Ü.

4) SP°i ÁÁÁUÁ÷zιi 'ÉÇN μIÁj±ÇÁ» zOÇO °æzι CP'Á 'Ü¼OÁÇ SPzιi ÁÁÁUÁ÷, I'°o±PÇO IS°i ÁO¼OÇN °°Á±á °O Á» ¼O ÁOÁ» zä±ÇO °IÁI'Ç·I SPzιi'Ö ÁÁÁUÁ÷ 'ÉÁ'Áú »ÇzÉ±ÇÁO Á·ÁÁúAI'ÁO ÉÁ'Ü

4.2.3 NPAC ÁIÁ±ÁO'ÉÈ-

ASzιi¼ CPzI' SPμεÁO Á·áÁÁÁUÁ÷zιi¼, I'¼OÁOÁ» ¼O ÁO'¼'° °Izιi °nÇIz° NP'Á Á·áÁÁÁUÁ÷ »O °É'Í'º '¼·áÁÁÁUÁ÷zιi¼μμ »ÇzÉÁU·I'ÁI' '¼ÁIÁI'ÁI'Ý ÁIzÉ·á, I'°ÁμI'°O μÉ'Ü. Á·áÁÁÁUÁ÷zιi '¼·áÁÁÁUÁ÷ »ÇÁIzιi '¼ÁIÁI'Ý ÁIzÉ·á Á·ÁI'Á °O'Ü.

'¼ÁIÁI'Ý Á·áÁÁÁUÁ÷, I'ÁI'ÇIz° AI'μzÁÉ¼ÁÇ'Á 'O AI'»O SPAC z'ÇOÁ» ¼OÇÁÇO ¼O °°á IS'°zιi, Á·áÁÁÁUÁ÷ ÁIÁ±Á» ±a, ±½ (3)zιi¼ k = OAI' μÇ'í, P_{sc} μμ SP°i Á=ÇN'Ü, ±x·É·I' I'P'ÁI'ÁI'°O μÉ'Ü.

NPAC ÁIÁ±Á» ±, ÇI'É SP°f °i·Ý°áÁi »Ç·Ézιi¼

$$\pi'_n(P_n) = P_n \cdot (q_p(P_n; P'_{sc}) + q_f(P_n))$$

$$= P_n \cdot \left(\frac{a - P_n}{2a} + \frac{b - P_n}{b} \right)$$

AI'°i, SP°f Çü·Á »Ç·Ézιi¼

$$\pi''_n(P_n) = P_n \cdot (q_p(P_n; P''_{sc}) + q_f(P_n))$$

$$= P_n \cdot \left(\frac{a - P_n}{3a} + \frac{b - P_n}{b} \right)$$

·I' ±a¼ z·Ü. °C »Ç·É°·I NPAC ÁIÁ±Á» ÁO'ÉÈ-ÇI'Á '¼ÁIÁI'Ý ÁIzÉ·á zI' ±x zιi μú, ¥ Á·áÁÁÁUÁ÷ ÁIzÉ·á Á'Ü Á¼½ °°Ü.

$$P'_n = \frac{3ab}{4a + 2b}, P''_n = \frac{2ab}{3a + b}$$

$$P'_{sc} = \frac{a(4a - b)}{2(4a + 2b)}, P''_{sc} = \frac{2a(3a - b)}{3(3a + b)}$$

'¼ÁIÁI'Ý »ÇzÉÁU°i ÁO'ÖÇI'°O μÇ'Á Á·áÁÁÁUÁ÷Ç ÁNÁIzÉ·á zI' CP°i °°O μÇ'Á ¼OÁI'Á °C »Ç·É°·. I'ÜÁ¼ ÇYzιi Á·, °ÇIz'Ü.

[ÇY1] °i·Áj»Ç¼±ÁI'°° Á·áÁÁÁUÁ÷°i·Ý 'x CPAC ¼OÁI'

SP°f °i·Ý°áÁi	SP°f Çü·Á
$P'_n = \frac{a(4a + 5b)}{8a + 4b}$	$P''_n = \frac{2a(3a + 2b)}{9a + 3b}$
$\pi'_c = \frac{a}{16} \left(\frac{4a - b}{2a + b} \right)^2$	$\pi''_c = \frac{a}{9} \left(\frac{3a - b}{3a + b} \right)^2$

μI »Ç·Ézιi¼ ÁÁÁUÁ÷ÁIzÉ·á 'x CPAC ¼OÁI'Á» °n ±ÇO °, I'É' ÜÁ¼ú °°Ü.

'¼ÁIÁI'Ý ÁIzÉ·á: P'_n > P''_n

Á·áÁÁÁUÁ÷ ÁNÁIzÉ·á: P' < P''

CPAC ¼OÁI': π'_c > π''_c

SP°f °i·Ý°áÁI' AI'±a'Á °æzιzι CPAC ¼OÁI' AI' °°ÁÁú°ú μz¼zιi Á·áÁÁÁUÁ÷AC ÁNÁIzÉ·á Á'É·É ÁO'Á Éz°ú°i ÁO'¼Á ±a NP°i °áÁÇI'Á '¼ÁIÁI'Ý ÁIzÉ·á Á'Á zÁÉ÷Á »O¼ÁÇI'Á °áú°i ±a, zμμ·Ü. SP°f AC'ú°èzιi μú, ¥ »ÇzÉÁUÁÇ ÉÁ'y ¼OÁO Á·ÁI', I'¼·áÁÁ ÁUÁ÷ »ÇzÉÁUzιi Á·áÁÁÁUÁ÷ »ÇzÉÁU, I'δμI'í·ÁÇIz° °è»ÉÇN °áú a,bAC'ú°èzιi μI'º zιz-ÁI' δÉÉÇIz'Ü.

4.2.4 NPAC °OÁO '¼ÁIÁI'Ý ÁIzÉ·á °i·¼O ÁO±Y±I'ÁO'Á AI'μzÁÉ¼ÁÇμεΔI '¼ÁIÁI'Ý ÁIzÉ·á ÁO'zιi μú, ¥ ÇN°è°n zÉAI' °O'Á ÁúÁ' ÇIzιi '¼ÁIÁI'Ý ÁI'Ý °I'°AC ÁIÁ±Á» ÁO'ÉÈ-ÇI'Á '¼ÁIÁI'Ý ÁIzÉ·á '°I'úÇN'Ü'°i °, °O'Ü⁵⁾ ±x·±a, ¼ÇÁ, AI'μzÁÉ¼ÁÇ μεÁO °°IÁúÁ·I'°iÁ°n ÁOÁU μI'AC °n zÉ±ÁI', I'°i·ÁÇIz° '¼ÁIÁI'Ý »ÇzÉ¼Ozä°i ÁO±Ái'°O ÁzÁOÁO ÉÁ'Ü

μμ·Ī ÇÐ°ú μζ½Αζι ¹«½ΑΙΑΙ³Υ °Ī¹@A» Æ=ÇÐÑ ΑΙμζ
 Αε½Α»ÇΑÇ ΑὐΑ¼ ½ΑΙ± Α, | °ι·ΑÇĪζ° ÇÑ°èñζè 0ζι
 ¼·ΑÇ ΑΙ±Α±Α°èÈ- °ι·Υζι òñÇĪζ° ³αΔ° ¹«½ΑΙΑΙ³Υ
 ΑĪζè·á, | ΑΥΑ±ÇĪ°ι ΑΟ·Α °ΙΑ·Ī °ΑĪ·Ū. ±× °á°ú
 ¹«½ΑΙΑΙ³Υ ΑĪζè·á, | Α» ΑóÐÇĪ, é »çζèÇÐ ¼ ΑΟ·Α
 ¹«·άΑΑΑŪ±ΑÇ »çζè½ΑŪ, | ΑŪ ζ°ΑŪÈ± ΑŪΑŪÇÑ ¼Α±ΑĪ
 ·Ū. ÇòΑÇζĪ Ā>çÇÑ ΑĪμζΑε½Α»ÇΑÇ °ι·Υ Α±ΑΥΑĪ ¹«½
 ΑΙΑΙ³Υ, Α°³¹æ ΑΙΕΑζιμμ Αó¼μζ·Α °æζι, | »óΑ±ÇĪζ°
 ΑĪμζΑε½Α»ç°ι P·Α» ΑεÇΘ ¹«½ΑΙΑΙ³Υ »è¾ζι ¹ĪΑι·Ā
 ζμÇΑá »ιÆ°·Ū. P·Α» ¹«·άΑΑΑŪ±ζι·èÇÑ ΑóÐΑÇ
 »ÇΑÇ ΑΟ·è°ΑĪ b·Ī μñ °æζιΑÇ Ā·άΑΑΑŪ±ç ΑΝΑĪζè
 ·áζĪ CPΑÇ ¼ΑĪΑ° [Ç2]ζι Α±, μÇ¾ ΑΟ·Ū.

[Ç2] P_n=bζι¼·ΑÇ Ā·άΑΑΑŪ±°ι·Υ ¹× CPΑÇ ¼ΑĪ °ñ±³

SP°ε °ι·Υ°æĪ	SP°ε Çù·Ā
$P^{lb} = \frac{a+b}{2}$	$P^{llb} = \frac{2a+b}{3}$
$\pi_c^{lb} = \frac{(a-b)^2}{4a}$	$\pi_c^{llb} = \frac{2(a-b)^2}{9a}$

NP°ι ΑΙ±Α± ΑΟ·èÈ-ÇĪ·Ā °æζιζĪ, | ΑŪ°ι·Αó·Ī
 ΑÓζá °á°úμèÀ» °ñ±³ÇΘ °, ¾Ū.

Ā·άΑΑΑŪ± ΑΝΑĪζè·á: P^{lb} < P^{llb}

CPΑÇ ¼ΑĪ: π_c^{lb} > π_c^{llb}

°á°úζι¼·μ, μĪ ΑΑΑŪ± »çζèζι μá·Ā °ñζè°ú CP
 ΑÇ ¼ΑĪ μĪ °Ð¾, δμĪζι¼ SP°ε °ι·Υ°æĪΑĪ ΑĪ¾
 ³α·Ā ΑΑĪ ŪŪ±Α·ÇÑ °ΙΑ·Ī ³α, ³μ·Ū. ±×·³α, SP
 μèÀ° ΑΙ±ΑĪ °ò ³αΔ° SP°ε Çù·Ā ± Α, | Ī ³α¾, | Ī·Ā
 ÇÐ °ΙΑĪ·Ç·Ī ΑĪζι·èÇÑ Α±ΑÇ ΑὐΑΥÇÑ Α±ΑΥΑĪ ÇÈζá
 ÇÐ °ΙΑĪ·Ū.

μĪ°Ūζ° ΑĪμζΑε½Α»ç°ι ¹«½ΑΙΑΙ³Υ °Ī¹@Ç ΑΙ±
 Α» ΑΟ·èÈ-ÇĪ·Ā °æζιζĪ ¹«½ΑΙΑΙ³Υ ΑĪζè·á, | P_n=b
 ·Ī Α±ÇΘ ³αΔ° °æζι, | °ñ±³ÇΘ °, ¾Ū.

Ā·άΑΑΑŪ± ΑΝΑĪζè·á:

$$P^{lb} > P^I$$

$$P^{ll} > P^{lb} \text{ where } a > \frac{(2 + \sqrt{13})b}{3}$$

CPΑÇ ¼ΑĪ:

$$\pi_c^{lb} < \pi_c^I$$

$$\pi_c^{ll} > \pi_c^{lb} \text{ where } a > \frac{(2 + \sqrt{13})b}{3}$$

Ā·άΑΑΑŪ± ΑΝΑĪζè·á ¹× ¹«½ΑΙΑΙ³Υ ΑĪζè·á Αŵ
 , éζι¼·μ » »çζèΑŪ ÈΑ»ý°ú CP ¼ΑĪΑ° P_n=bΑĪ »ç·È
 °ι SP°ε °ι·Υ°æĪΑÇ °æζι°·Ū ζ-μĪÇĪ·Ū. ±×·³α
 SP°ε Çù·Ā»ç·ÈζĪ P_n=bΑÇ »ç·ÈΑÇ °ñ±³ζι¼·Ā a, b
 ΑÇ °è¼°úèζι μŪŪ »çζèΑŪ ÈΑ»ý°ú CPΑÇ ¼ΑĪζι
 ·èÇÑ Αŵ°ι; | PŪóÁó·Āμ¾, a°ι b°·Ū·è·« 2¹è ΑĪ»ó
 ΑĪ, é SP°ε Çù·Ā»ç·È°ι ŪŪ±Α·ÇĪΑó ¾ÈΑ° °ΙΑ·Ī °Ð
 ¼μÇ¾·Ū.

5. ¹«½ΑΙΑΙ³Υ, Α°³¹æÇ Èζ°ú °Ð¾

ÇòΑÇ ¹«½ΑΙΑΙ³Υ »è¾ζι, | Αζι¼·Ī ΑĪμζΑε½Α»ç°ι
 ¹«½ΑΙΑΙ³Υ °Ī¹@Ç ΑΙ±Α± ΑΟ·èÈ-ÇÑ·Ū·Ā °ι·Α± ÇĪζι
 ¼·¹«½ΑΙΑΙ³Υ ΑĪζè·áζĪ Ā·άΑΑΑŪ± ΑĪζè·á, | ±, ÇÑ
 ¼·Ā (4)ΑÇ ak - b > 0ΑĪ °æζιζι ÇÑÇĪζ° k = 0.16)Α»

5) °» ζ-±, Ā ÇÑ°èñζèÀ» ΑΑΑŪ± »çζè·μζι·èÇĪζ° °Ð·ΑĪ
 , ç ΟΑĪ ¾ÈÑ °æζι·Ī ½°Ð È°Αá °ι·ÈÇĪ·Ū.

·èÀÓÇĪζ° ¾Α° °á°ú·Ā·ŪΑ½°ú °·Ū.

$$P_n^0 |_{k=0.1} = \frac{29ab}{40a - 81b}$$

$$P^0 |_{k=0.1} = (P_n^0 + P_{sc}^0) |_{k=0.1} = \frac{a(20a - 171b)}{40a - 81b}$$

ΑĪ, | ¹«½ΑΙΑΙ³Υ, Α°³¹æ ΑΙΕΑ NP°ι ¹«½ΑΙΑΙ³Υ
 °Ī¹@Çι¼·Α ΑΙ±Α±Α°èÈ- | ÇĪ·Ā °æζιΑÇ ¹«½ΑΙΑΙ³Υ ΑĪ
 ζè·á ¹× Ā·άΑΑΑŪ±ç ΑΝΑĪζè·áζĪ °ñ±³ÇΘ °, é7)

$$P_n^0 > P_n^I > P_n^{ll} \text{ where } \frac{81}{40} b < a < \frac{301}{4} b$$

$$P^0 < P^I < P^{ll}$$

°ú °·Ū°ú °·Ūè, | °, ΑΟΑ» ¾È ¼ ΑΟ·Ū.

¼Α·Ī·Ā ΑĪμζΑε½Α»çμèΑĪ ¹«½ΑΙΑΙ³Υ °Ī¹@ζι¼·
 ΑΙ±Α±Α°èÈ- | ÇĪ°ι ΑΟΑó ¾È, ç ¹«½ΑΙΑΙ³ΥΑÇ ³·Α°
 »çζè ¼Αζá·Ī °¼ ŪS Αὐ·ΥΑŪΑĪ ¹«½ΑΙΑΙ³Υ ΑĪζè·á·Ā
 ΑΟΑŪ ¼ΑŪζι °ñÇΘ ³α°Ū ΑΥΑ±μÈ °ΙΑ·Ī ΑΒΑ±ÇÐ ¼
 ΑŪ·Ū. μŪŪ¼·¼Α· ¹«½ΑΙΑΙ³Υ ΑĪζè·á·Ā P_n⁰·Ūμμ
 ³αΔ° °ΙΑĪ·Ç·Ī ¹«½ΑΙΑΙ³Υ, Α°³¹æΑ° ¹«½ΑΙΑΙ³Υ »ç
 ζèΑŪ ÈΑ»ýζι ±áç·ÇĪ·Ā Αŵ, éΑĪ ΑŪ·Ū. ±×·³α, Ā·άΑ
 ΑŪ± ΑĪζè·á, | °ι·ΑÇÑ·Ū, é ÇòÇá ΑĪζè·á ¼ΑŪΑ° P⁰
 °·Ū ³αΔ° °ΙΑ·Ī ΑΒΑ±ÇÐ ¼ ΑŪΑ» »ó, Α°³¹æ ΑΙΕΑ
 ΑÇ ΑĪζè·áζĪΑÇ Α·ΑÇΑŪΑĪ °ñ±³·Ā ¾·Αζι »óÈèΑĪ·Ū.
 °á±, ¹«½ΑΙΑΙ³Υ, Α°³¹æ, | ΑεÇΘ ¹«½ΑΙΑΙ³Υ ΑĪζè·á
 ΑĪÇĪ, | ±á·èÇÐ ¼·Ā ΑŪΑ, ³α Αὐ·ΥΑŪΑĪ »çζèΑŪ ÈΑ»ý
 ζι·ĪΑι·Ā ζμÇΑĪ °ΙΑ±ΑŪΑĪ °ι·È¾μμ ¹èΑĪÇÐ ¼·Ā
 ¾·Ū.

ŪÇÑ, Α°³¹æ ΑΙΕΑ ¹«½ΑΙΑΙ³ΥΑĪζè·á; | ³·¾ΑŪ
 ζιμμ ΑΝΑĪζè·á·Ā ζΑÈ±·Ā Αó·ιÇÐ °ι·È¾, | ΑŪ ΑŪΑ, ¹Ç
 ·Ī ¹«½ΑΙΑΙ³Υ, Α°³¹æΑ° CPΑÇ ¼ΑĪ Αó·è, | ΑεÇÑ ¹«
 ½ΑΙΑΙ³Υ »è¾ζι È°¼È-ζι ±áç·ÇÐ °ΙΑ·Ī °, ΑĪ·Ū.

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6) ÇòΑÇ ΑĪμζΑε½Α»çμèΑ° Ā·άΑΑŪ± ΑĪζè·áζι¼· 10% Α±μμ
 , | °ú±ý·èÇá¼¼·á μĪΑÇ, | Ī, Ī, | °Αó°ι ³α, ÓÁó 90%
 , | CPζι·Ū Αó±BÇĪ·Ā °ΙΑĪ °úÇáΑĪ·Ū

7) ÇòΑÇ ΑĪμζΑε½Α»çμèΑ° ¹«½ΑΙΑΙ³Υ »ç¾ζι¼·Α ΑΙ±Α±Α°èÈ-
 , | ÇĪ°ι ΑŪΑó ¾È°ι ΑŪΑ, ç, ° »çÇΑÇ °ñζè±, ΑŪ ¹× °ι·Υ
 Α±ΑΥζι·èÇÑ ΑŪ·á, | ±, ÇĪ·Ā μ¾ζι·Ī ÇÑ°è°ι ΑŪ·Ū. ΑĪζι
 μŪŪ ΑΙ±Α±Α°èÈ- | ÇÑ·Ū·Ā °ι·Α±Α» ΑεÇΘ, Α°³¹æ ΑĪΑŪ,
 ΑΙΕΑ, | °εΑÇΑŪΑ, Ī °ñ±³ÇĪ·Ī °Ð¾μζι ΑĪ¾ΑĪ μŪ, ¾·Ū.