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Abstract

This paper examines the interaction between two market-opening policies; the relaxation of foreign ownership restriction and the privatization of a domestic public firm. Of particular interest are on the technology spillovers, which could be one of the prominent motivations for introducing foreign investment into the domestic market. Our first result shows that the best response strategy on privatization policy is not monotonous with the changes in the regulation policy on foreign ownership, and vice versa. The second result shows that there exist optimal levels of partial privatization and foreign ownership restriction, which are strongly affected by the magnitude of technology spillovers.

Key words: regulation on foreign investment, technology spillovers, partial privatization, mixed oligopoly

JEL Classification: L1, L3, L5, P2

1 Introduction

In many countries, governments carry out market-opening policies. Among others, the privatization of public-owned firm and the relaxation of regulations on market entry of both domestic and foreign firms are typical agenda. The main purpose of this paper is to obtain a better grasp of the interaction between these policies in the framework of an international mixed oligopoly model.

A notable example is the economic reform in China. Although the pace of market-opening has been quite slow in the initial stages, the Chinese government has been implementing two main policies as market-opening strategies since 1978; the privatization and relaxation of foreign investment regulations. Many foreign firms enter the Chinese market by purchasing stocks of Chinese domestic firms, so that joint-stock firms owned by domestic and foreign investors become common. Entry into the World Trade Organization (WTO) in 2001 has sparked further opening of market to foreign investors, and the joint-stock companies are now a crucially important component of Chinese economy. Recently, however, gradual and partial privatization and restrictive introduction of foreign investment are moving into some industries such as banking, insurance, medicine and airlines. The Chinese government is thus becoming more restrictive towards foreign investment in these fields, and the magnitude of privatization and the level of foreign ownership restriction have become focal issues in policy debates[1].

The present paper attempts to analyze the optimal policy choices of government on privatization and foreign investment regulations by considering two types of mixed ownership. The first is firms owned in both the public sector and the domestic private sector. This type of firm is often called a *semi-* or *partially-privatized* public firm. The second is firms owned

[1]See, for instance, *OECD Observer*, no.260 (pp.19-20), 2007.

by domestic and foreign private investors, which is called an international corporate joint venture. Mixed ownership of public firm has been a feature of government policy in many developed and developing countries, and intensive studies have been conducted to examine the effects of partial privatization on the economic environment. Matsumura (1998) develops a formal model for investigating the effect of partial privatization on social welfare in a domestic mixed oligopoly framework and shows that neither full nationalization nor full privatization, but partial privatization is optimal[2]. The aim of this paper is to complement and generalize the work of Matsumura (1998) by incorporating foreign investment and market-opening policy choices in the international mixed oligopoly framework[3]. While Matsumura (1998) has ignored international aspects of market openings in his domestic mixed duopoly model, the present paper is now able to highlight the interaction of two market-opening policies; the privatization and relaxation of foreign ownership restriction.

One of the significant features that makes our model different from previous mixed oligopoly studies is that we consider technology spillovers. Much of the literature has ignored the technology spillovers in the models of international mixed oligopolies. This is somewhat surprising since the governments have a strong interest in attracting foreign firms to benefit technologically inefficient domestic firms. More specifically, one prominent incentive for the invitation of foreign investment is the presumption that it stimulates aggregate productivity growth either directly through its own higher productivity growth or though indirect technological spillovers. Recent empirical

[2]See Fershtman (1990), Maw (2002), Lee and Hwang (2003), Bennett and Maw (2003), Gupta (2005), Sun, Zhang and Li (2005), Jiang (2006), Chao and Yu (2006), Beladi and Chao (2006), and Kumar and Saha (2007) for the literature on partial privatization in the mixed oligopoly models.

[3]A mixed oligopoly analysis in an international context is conducted by Fjell and Pal (1996), Pal and While (1998), Fjell and Heywood (2002), Matsumura (2003), Barcena-Ruiz and Garzon (2005), Dadpay and Heywood (2006), among others.

studies that address the existence of technology spillovers have documented robust evidence of technology spillovers from foreign direct investment[4]. In this paper, we incorporate productivity spillovers from foreign investment in the domestic market and examine how the optimal degrees of privatization and the optimal level of foreign ownership restriction are affected by the magnitude of technology spillovers.

In a simple international mixed oligopoly model with technology spillovers, we first demonstrate that the best response strategy on privatization is not monotonous with the changes in the relaxation of foreign investment regulation, and vice versa. For instance, the result would imply that when a public firm is less privatized, the promoting the privatization program and relaxation of foreign investment regulations simultaneously improves social welfare. However, the promotion of privatization and the relaxation of foreign ownership restrictions reduce welfare when privatization is sufficient. Tightening regulations on foreign investment is required as an alternative to further privatization in such a case. Second, we derive the optimal level of partial privatization and foreign investment ratio, which are strongly affected by the magnitude of technology spillovers. Encouraging foreign investment is desirable if technology spillover is significant.

The remainder of the paper is organized as follows. We present the basic model in Section 2, and the main results are derived in Section 3. Section 4 concludes the paper.

2 Model

Consider an international mixed oligopoly involving a semi-public firm and a joint-stock private firm, which is owned by domestic and foreign private

[4]See Girma and Wakelin (2002, 2007), Griffith and Redding, and Simpson (2002), Sjoholm (1998). See also Blomstrom and Kokko (1998) and Gorg and Greenway (2004) for extensive reviews of empirical research.

firms. Let firm 0 be the semi-public firm and firm 1 be the joint-stock private firm. Assume that both firms supply homogeneous commodities to the market, in which the inverse demand function could be expressed as $p = a - Q$. We denote $a(> 0)$ as the demand parameter and $Q = q_0 + q_1$, where Q and q_i represent the total output and the output of firm i.

We suppose that foreign firms that invest money in firm 1 have more efficient technology relative to a domestic firm. For tractability, the cost of a *pure* foreign firm is normalized to zero. The cost function of firm i that operates in the domestic market is defined by $c_i = F_i + 0.5k_i q_i^2$, where k_i represents the efficiency of variable cost and F_i denotes the fixed cost of firm i.

To express the essence of technology improvement brought by the foreign capital importation, we suppose that when the foreign investment makes an advance into the market, it brings technology spillovers to the semi-public firm[5]. We also assume that the fixed cost of firm 1, which is partially owned by the foreign investors, will be reduced when the share of foreign capital in firm 1, $1 - \alpha \in [0, 1]$, increases, i.e., $F_1 = F_1(\alpha)$ $[dF_1(\alpha)/d\alpha > 0]$. $\alpha \in [0, 1]$ represents the share of domestic capital in firm 1. We specify the fixed cost of firm 1 as $F_1(\alpha) = \alpha f$. This formulation could be rationalized if we consider the usage of patented technology. Consider that the foreign firm has already conducted R&D investment and has patented technology to produce the product for the market. If firm 1 accepts an investment from a foreign investor, and is partially owned by the foreign firm, it is allowed to use the patented technology so that the firm 1's R&D investment is saved, though a certain share of profits must be relinquished to foreign investors. In the special case that firm 1 is fully owned by the foreign firm, $\alpha = 0$, it does not

[5]There are reasons why foreign investment is an important channel of intra- and inter-firm technology transfer. First, the less-efficient domestic firm observes and imitates more efficient multinational firms. Second, the training of employees by multinational firms and subsequent turnover of labor is a major source of inter-firm spillovers.

have to spend money on R&D and is able to use patented technology fully. In contrast, if it is a pure domestic firm, $\alpha = 1$, the fixed cost of firm 1 is f, which is identical to the domestic public firm, $F_0 = f$.

The technology spillovers are considered in the term k_i. Representing the magnitude of technology spillovers by β, we assume $k_1 = k_1(\alpha)$ and $k_0 = k_0(\alpha, \beta)$, where $dk_1(\alpha)/d\alpha > 0, \partial k_0(\alpha, \beta)/\partial\alpha > 0$, and $\partial k_0(\alpha, \beta)/\partial\beta < 0$. In the following analysis, we specify the efficiency of variable costs as $k_0 = 1-\beta(1-\alpha)$ and $k_1 = \alpha$, where $\beta \in [0, 1]$ represents the technology spillovers emerging from foreign capital inflow. The latter expression indicates that as the share of foreign investments increase in firm 1, the lower firm 1's variable cost. The former formulation shows that if there exists an intra-firm technology spillover, $\beta > 0$, the share of foreign investment in firm 1 affects the variable cost of firm 0. The larger value of β means a larger magnitude of technology spillovers. Specifically, $\beta = 0$ implies no spillovers while $\beta = 1$ implies full spillovers. If no spillovers exist, the variable cost structure of two firms is identical when the foreign investment is not allowed, $\alpha = 1$.

Given the formulation of the cost function, the profit function of firm 0, π_0, can be expressed as

$$\begin{aligned} \pi_0 &= (a - q_0 - q_1)q_0 - 0.5k_0q_0^2 - F_0, \\ &= (a - q_0 - q_1)q_0 - 0.5[1 - \beta(1 - \alpha)]q_0^2 - f. \end{aligned} \tag{1}$$

Similaly, the profit of firm 1 is given by

$$\begin{aligned} \pi_1 &= (a - q_0 - q_1)q_1 - 0.5k_1q_1^2 - F_1, \\ &= (a - q_0 - q_1)q_0 - 0.5\alpha q_1^2 - \alpha f. \end{aligned} \tag{2}$$

The social surplus in the country can be defined as

$$W = \pi_0 + \alpha\pi_1 + CS, \tag{3}$$

where $CS \equiv 0.5Q^2$ is the consumer surplus. In (3), α $(0 \leq \alpha \leq 1)$ represents the extent of domestic ownership of a private firm 1. In this paper, the restrictions on foreign investment are represented by α. When $\alpha = 1$, foreign investments are not allowed so that private firms are owned by domestic residents/consumers. $\alpha = 0$ corresponds to the case in which firm i is a foreign enterprise which is completely owned by foreign investors. If α is positive (but not equal to one), private firms are considered as a joint ownership enterprise. In this case, it is natural to consider that 100α percent of firm 1's profit should be attributed to domestic residents[6].

The government owns a share of $(1 - \theta) \in [0, 1]$ of the public firm. Conversely speaking, θ measures the degree of privatization. The manager of this firm will maximize the weighted average of social welfare and the profit. Following Matsumura (1998), we define the objective function of firm 0 as

$$V = \theta\pi_0 + (1 - \theta)W. \tag{4}$$

Note that the manager of a fully privatized firm $(\theta = 1)$ seeks the firm's profit, while the manager of a fully nationalized firm $(\theta = 0)$ maximizes social welfare.

3 Equilibrium

The game is constructed by two-stage decision-making. The government chooses θ and α, to maximize (3) in the first-stage. Observing θ and α, the firms choose the quantity supplied in the second stage. The private firm 1 maximizes (2) and the manager of firm 0 maximizes (4).

[6]This formulation follows Ogawa and Sanjo (2007).

3.1 Second Stage

For given θ and α, the standard Cournot-Nash equilibrium in the second stage can be derived as

$$\begin{aligned} q_0 &= a(2-\theta+\alpha\theta)/\Lambda, && (5)\\ q_1 &= a[1+\theta+\beta(\alpha-1)]/\Lambda, && (6)\\ p &= a(1+\alpha)[1+\theta+\beta(\alpha-1)]/\Lambda, && (7) \end{aligned}$$

where $\Lambda \equiv 2\alpha\theta+\alpha+\theta+4+\beta(\alpha+2)(\alpha-1) > 0$. Using (5)-(7), the profits of two firms and the consumer surplus can be derived as

$$\begin{aligned} \pi_0 &= \frac{a^2(2-\theta+\alpha\theta)[\alpha\theta+2\alpha+3\theta+\beta(\alpha-1)(2\alpha+\theta-\alpha\theta)]}{2\Lambda^2} - f, && (8)\\ \pi_i &= \frac{a^2(\alpha+2)[(\alpha-1)\beta+1+\theta]^2}{2\Lambda^2} - \alpha f && (9)\\ CS &= \frac{a^2[3+\alpha\theta+\beta(\alpha-1)]^2}{2\Lambda^2}. && (10) \end{aligned}$$

Substitution of (8)-(10) into (3) yields

$$W = \frac{a^2\Omega}{2\Lambda^2} - f(1+\alpha^2), \qquad (11)$$

where $\Omega = (2-\theta+\alpha\theta)[\alpha\theta+2\alpha+3\theta+\beta(\alpha-1)(2\alpha+\theta-\alpha\theta)]+\alpha(\alpha+2)[(\alpha-1)\beta+1+\theta]^2+[3+\alpha\theta+\beta(\alpha-1)]^2$.

3.2 First Stage

The maximization of (11) with respect to θ yields the optimal strategy on the level of privatization as $\theta = \theta(\alpha;\beta)$. Similarly, the maximization of (11) with respect to α gives us the optimal strategy on the level of foreign investment regulation as $\alpha = \alpha(\theta;\beta,f)$. We notice here that while the level of foreign investment regulation depends on the endogenous variable of θ

with given parameters of β and f, the optimal strategy of privatization depends on the endogenous variable of α and given parameters of β, and it does not depend on f.

Owing to the complexity, however, the further analytical comparisons of the optimal policy choices are not feasible even in our simple model settings. In the following analysis, therefore, we employ simulation analyses to obtain comparative reaction of the optimal levels of privatization and the restriction on foreign investment.

By setting $a = 1$, $\beta = 0.2$ and $f = 0.02$, Figure 1 depicts the optimal strategy on α as $\alpha(\theta)$. The strategy on θ is drawn as $\theta(\alpha)$ in this figure. The shapes of the reaction curves do not change drastically even if we take other values of β and f, as long as $\beta > 0$ and $f > 0$. From this simulation result, we observe that the optimal reaction of θ to a change in α is not monotonous. In addition, the reaction of θ to a change in α is not monotonous, either. That is, the optimal reaction to an increase in θ from the low level is to reduce α, and to increase α when θ increases from the high level. The optimal reaction of θ to a change in α is the same as with that of α, but it is less subject to a change in α since it is in the shape of a rod around $\theta = 0.2$. This indicates that the level of foreign investment regulation is strongly affected by the magnitude of domestic privatization, while the domestic privatization is affected less by the magnitude of foreign investment regulation.

We summarize the property of reaction curves as follows:

Proposition 1. The reaction curves, $\alpha(\theta)$ and $\theta(\alpha)$, are not monotonous. The optimal strategy of α has a large variation with θ, while that of θ has just a slight variation with α. $\theta(\alpha)$ is nearly vertical on $\theta = 0.2$.

Figure 1. HERE

In figure 1, the two curves intersect on the point C, and the optimal level of privatization, θ, and foreign investment regulation, α, are 0.175 and 0.360 in this case.

We can provide an intuitive reason that explains the non-monotonous shape of $\theta(\alpha)$ and $\alpha(\theta)$. An increase in the share of foreign investment reduces the cost of the semi-public firm 0 and the firm 1, but a greater share of firm 1's profits outflows from domestic market. These factors are in conflict in increasing social welfare. An increase in the degree of privatization boosts the profit of firm 1, but it reduces the consumer surplus. These two factors also conflict to increase the social welfare. Where the degree of privatization is very low or when the share of foreign investment is large, an increase in the degree of privatization and an increase in the share of foreign investment produces an additional surplus that is greater than the surplus loss. In contrast, when the degree of privatization is high or when the share of foreign investment is small, an increase in the degree of privatization and an increase in the share of foreign investment cause the surplus loss that is greater than the increase in the social surplus.

3.3 Comparative Statics

This subsection presents a numerical comparative statics to show how the optimal policy choices on α and θ are impacted on changes in parameters, β and f. This exercise is quite useful for clarifying the forces required to achieve certain policy choices.

Effects of changes in β. To examine the effects of an increase in β, a stable equilibrium is illustrated in Figure 2 by assuming the following set of parameters: $a = 1$ and $f = 0.02$. From computing the optimal degree of privatization and the level of restriction on foreign investment, we find that they both decrease with an increase in β. We notice that θ

slightly changes in β, but α changes to a large degree, implying that the level of foreign investment regulation is quite sensitive to the magnitude of technology spillovers, β. We summarize the results as follows:

Proposition 2. $\alpha(\theta)$, representing the optimal strategy of foreign investment regulation, shifts down to a large extent with an increase in β. $\theta(\alpha)$, representing the optimal strategy of privatization, shifts slightly to the left with an increase in β. The optimal values of α and θ are monotonously decreased with an increase in β.

An intuition that explains why the government reduces $\alpha(\theta)$ when β becomes large can be given as follows. An increase in β may lead to cost reduction of a semi-public firm, but the impacts of the change in β depend on the value of α. When $\alpha = 1$, an increase in β has no impact on the cost structure of the semi-public firm. In contrast, when α is small, an increase in β reduces the cost to a large extent. Hence, the welfare-maximizing government has more incentive to reduce α to receive a significant benefit of technology spillovers the larger that β is. The government also reduces θ as β increases because an increase in β improves the semi-public firm's cost efficiency. As the semi-public firm can produce more efficiently, the government reduces θ to shift the production from the private firm to the semi-public firm.

Figure 2. HERE

Effects of changes in f. Figure 3 is drawn to examine the effects of changes in f on the optimal policy choices. To examine the effects of an increase in f from 0.02 to 0.06, we take $a = 1$ and $\beta = 0.2$. α decreases monotonously when f increases, irrespective of the magnitude of f. Interestingly, however, the change in f affects the policy choice on θ in a different

way. Whereas an increase in f from 0.02 to 0.04 slightly decreases θ, θ increases from 0.170 to 0.172 as f increases from 0.04 to 0.06. Summarizing the above, we have the following result.

Proposition 3. $\alpha(\theta)$, representing the optimal strategy of foreign investment regulation, shifts down with an increase in f. $\theta(\alpha)$, representing the optimal strategy of privatization, does not shift with any change in f. The optimal value of θ is not a monotonous function of f, while the optimal values of α is monotonously decreased with an increase in f.

We here give an intuitive explanation for this result. An increase in the fixed cost, f, causes a cost increase in a domestic firm. In order to offset this cost increase by reducing the variable cost, the government relaxes restraints on foreign investment to benefit the technology spillovers. Thus, the reaction curve of $\alpha(\theta)$ shifts down as f increases. The reaction curve of $\theta(\alpha)$ is not monotonous, so the impacts of a change in f on the optimal choices of θ and α are ambiguous.

Figure 3. HERE

Effects of changes in a. No graphic illustration is provided for this parameter variation since no essential effects emerge in our model.

The comparative statics results under the simulation method seem remarkably clear-cut, although the analytical solution does not appear practicable. In a wide-ranging simulation exercise, no dramatic changes of the properties of optimal strategy emerge. Neither were there completely different effects of changes in spillovers on the optimal policy choices.

4 Concluding Remarks

Using a simple international mixed oligopoly model with the technology spillovers, this paper has examined the interaction of two market-opening policies; the privatization and relaxation of foreign investment regulations. This paper also analyzes the impacts of technology spillovers on the government's policy choices. We first find that the best response strategy for privatization policy is not monotonous with the changes in the relaxation of foreign investment regulations, and vice versa. This result implies that we cannot simply evaluate the welfare impact of market-openings through promotion of privatization and the relaxation of foreign investment regulations. Second, we derive the optimal level of partial privatization and foreign investment regulations and show that they are strongly affected by the magnitude of technology spillovers. The result indicates that the active market-openings are good choices if the magnitude of technology spillovers is significant.

Finally, we point out some problems that remain unsolved. First, we have only considered a case of mixed duopoly. The extension to include multiple private firms allows us to examine the effects of a change in the number of firms on the optimal choices for market-opening policies. Second, one could easily imagine that the different ways of technology spillover specification should be investigated to check the robustness of the results. These issues are potential topics that will be investigated in future research.

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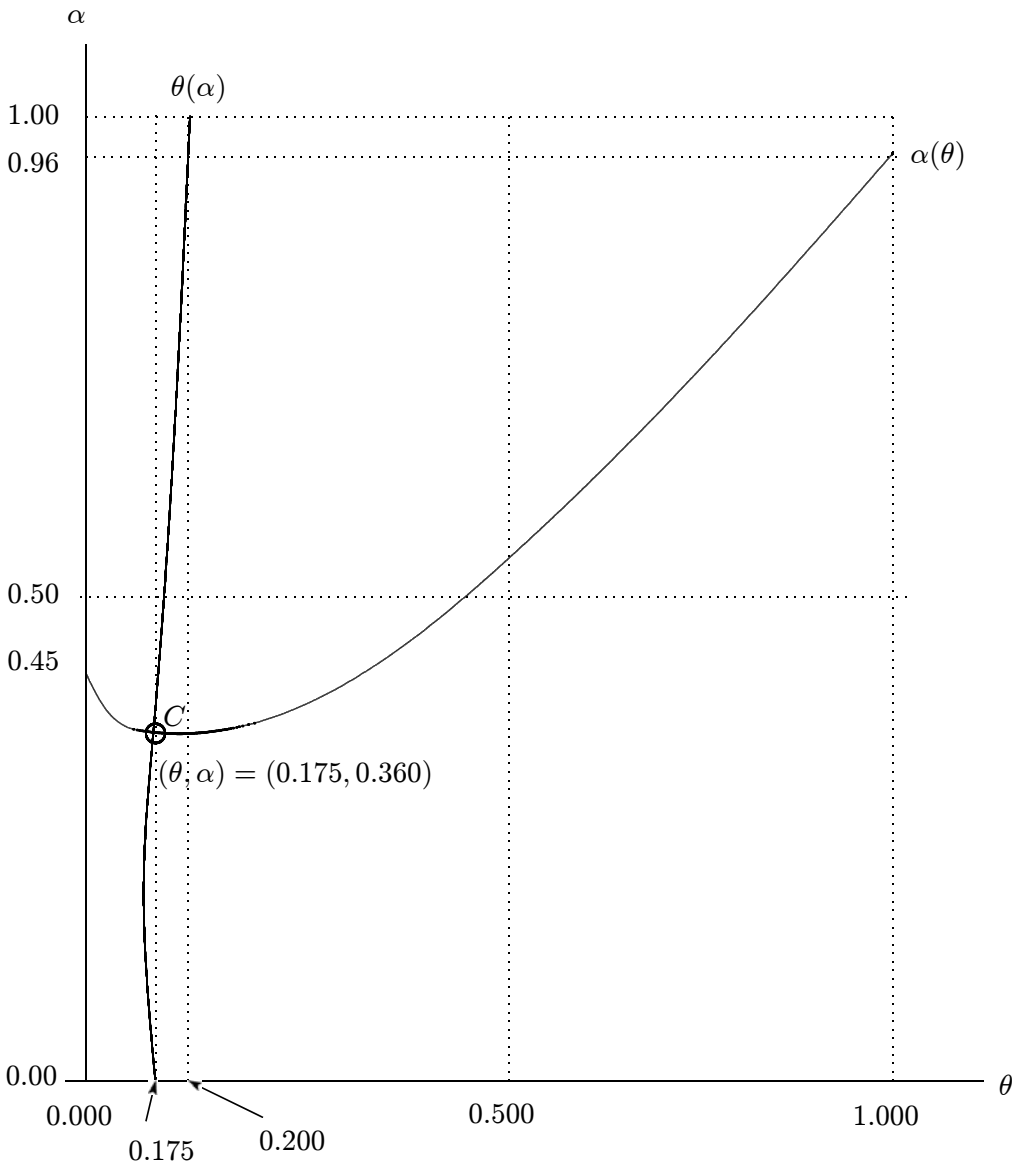

Figure 1. Reaction curves ($\beta = 0.2$ and $f = 0.02$).

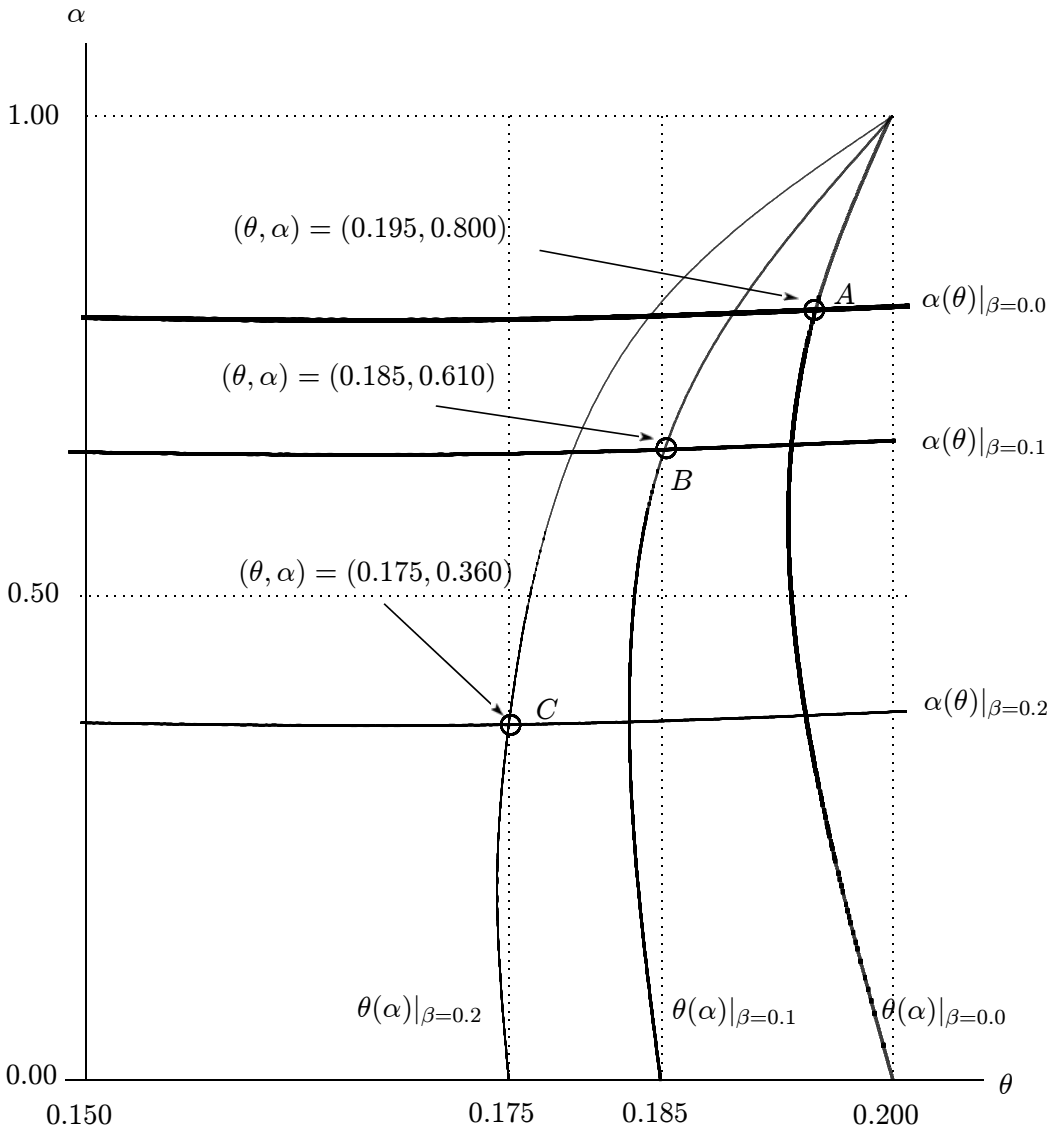

Figure 2. Effects of changes in β ($f = 0.02$).

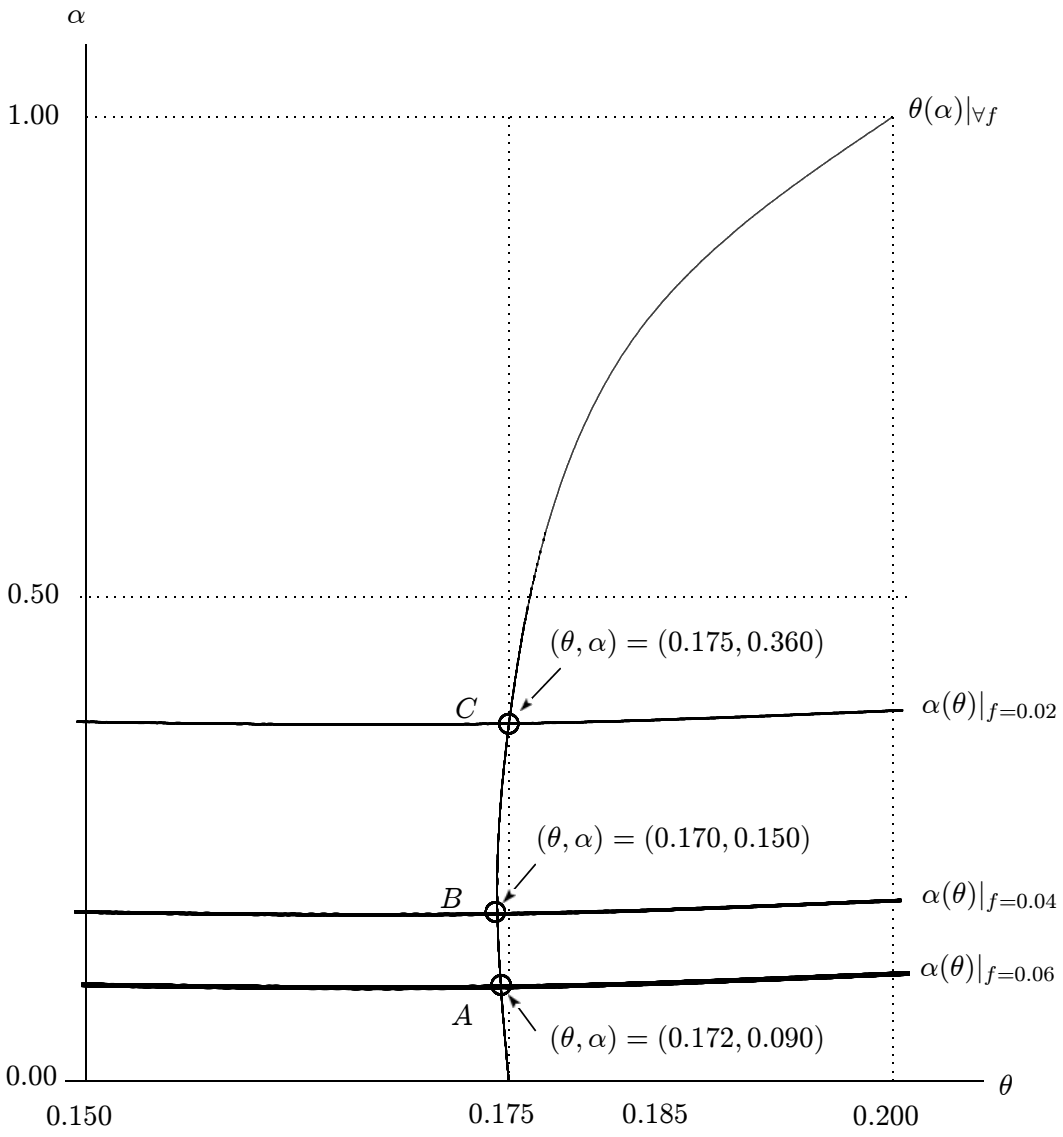

Figure 3. Effects of changes in f ($\beta = 0.02$).