ECONOMICS BULLETIN

Foreign equity caps under two types of competition: Bertrand and Cournot

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Abstract

This paper explores foreign equity caps for international joint ventures under different types of competition, i.e., Bertrand and Cournot competition, with product differentiation. We demonstrate that government sets the foreign equity cap at a laxer level under Cournot competition than under Bertrand competition. This result illustrates that the possibility of international joint ventures weakens government's ability to affect firm behavior through the implementation of foreign equity caps.

I would like to thank an anonymous referee of this journal and Eric Bond (Associate Editor) for helpful comments. I also appreciate Colin Davis and Makoto Okamura for their constructive comments and suggestions. All remaining errors are, of course, mine. Financial supports from MEXT. OPEN RESEARCH (2004-2008) and JSPS for Young-Scientist (B) (No.18730178) are gratefully acknowledged.
Citation: Kurata, Hiroshi, (2007) "Foreign equity caps under two types of competition: Bertrand and Cournot." *Economics Bulletin*, Vol. 6, No. 21 pp. 1-11
Submitted: June 21, 2007. **Accepted:** July 17, 2007.
URL: http://economicsbulletin.vanderbilt.edu/2007/volume6/EB-07F10011A.pdf

1 Introduction

The foreign equity cap (FEC) is a policy which imposes a ceiling on foreign ownership shares in international joint ventures (IJV), and historically has been implemented in many developing countries. For example, Thailand limits foreign ownership share to less than 50% for IJVs in 43 industries (JETRO, 2002).

Most of the articles on FECs (*e.g.* Katrak, 1983; Das and Katayama, 2003) consider perfectly competitive markets. However, IJVs are often observed in imperfectly competitive industries such as the automobile industry. Tomoda and Kurata (2004) analyze FECs under imperfect competition. They focus on FEC under homogeneous Cournot (*i.e.* quantity-setting) competition. However, in reality, there is product differentiation in many imperfect competitive industries, and competition between firms is not necessarily quantity-setting. How is policy affected if competition is of a price-setting nature?

The purpose of this note is to examine the optimal level for the FEC under Bertrand (*i.e.* price-setting) and Cournot (*i.e.* quantity-setting) competition with product differentiation. We set up a simple partial equilibrium model based on Tomoda and Kurata (2004), where firms negotiate their ownership shares to form an IJV under the FEC. If negotiations do not succeed, they compete according to either Bertrand or Cournot competition. We explore the optimal (*i.e.* welfare-maximizing) the FEC level endogenously for both types of competition and demonstrate that government chooses a laxer optimal FEC level under Cournot competition than under Bertrand competition.

Our analysis here is related to studies on government's incentive to implement policy (*e.g.* Cheng, 1988; Clarke and Collie, 2006a,b).[1] These studies do not include the possibility that firms may form an IJV. In this note, on the other hand, we allow firms to form an IJV. In reality, trends toward globalization have made it much easier for firms to own foreign plants or form IJVs. In this sense, clarification of the difference in government's policy incentives given the possibility that firms may form IJVs seems worthwhile.

[1] Cheng (1988) focuses on import tariffs and production subsidies, and Clarke and Collie (2006a,b) investigate welfare-maximizing import tariffs and export taxes, and maximum-revenue import tariffs and export taxes. In this note, we deal with a different type of policy. Whereas the above policies affect competition between firms, a FEC affects the ownership shares of an IJV instead of competition. Thus, our result holds under more general settings; *i.e.*, oligopoly with more than three firms.

2 The Model

There are two countries, home and foreign, and two industries, Y and Z. In the Z industry, goods are produced with constant returns to scale, freely traded, and sold in a perfectly competitive market. We aggregate them into one good and regard this as a numeraire.

In contrast, the Y industry has differentiated oligopolistic markets. Each country has one firm, firm 1 (home firm) and firm 2 (foreign firm), that produces differentiated goods. In order to distinguish between products, we denote good i to describe the product of firm i ($i = 1, 2$). We assume that firms only sell their products in the home country – the foreign market is negligible.

The preferences of a representative consumer in the home country are specified with the following quasi-linear utility function:

$$U(\boldsymbol{y}, z) = \sum_{i=1}^{2} \alpha_i y_i - \frac{1}{2} \sum_{i=1}^{2} y_i^2 - \gamma y_1 y_2 + z, \tag{1}$$

where $\alpha_i > 0$ ($i = 1, 2$), $\gamma \in (0, 1)$, and y_i and z are the respective demands for products produced in the Y industry ($i = 1, 2$) and those produced in the Z industry. The parameter $\gamma \in (0, 1)$ describes the degree of substitution between y_1 and y_2; as γ goes to zero (*resp.* one) the products tend to be independent (*resp.* perfect substitutes).

We assume that firm 1 locates in the home country, while firm 2 can change its production location. When firm 2 decides to locate in the home country, it is legally obliged to form an IJV with the local firm. The government implements a FEC, $\theta \in [0, 1]$ that imposes a ceiling on the share of equity the foreign firm can possess.

If firm 2 locates in the home country, an IJV is formed by firms 1 and 2 and both y_1 and y_2 are supplied by a monopolist. On the other hand, if firm 2 chooses to locate in the foreign country, firms noncooperatively supply their products in the market. Thus, in this case, a differentiated duopoly is realized. We distinguish these two cases by calling the former IJV-monopoly and the latter Differentiated-duopoly.

In the IJV-monopoly, firms negotiate their equity shares of the IJV by Nash bargaining under a given level of FEC. We denote β (*resp.* $(1 - \beta)$) as foreign equity share (*resp.* domestic equity share), *i.e.*, the equity share of firm 2 (*resp.* firm 1). Equity shares correspond to each firm's profit share for the IJV. In this case, both firms cooperate to reduce the IJV's production costs. Let c_i be the constant marginal cost of producing good i ($i = 1, 2$). We assume that firm 2 has a lower marginal cost, because of differences in technology; *i.e.*, $c_2 < c_1$. If the IJV is formed, the marginal cost of producing y_1 is reduced from c_1 to $\hat{c}_1$ ($\hat{c}_1 < c_1$) through the application of firm 2's technology.[2] For simplicity, when forming the IJV, firms are assumed to pay any coordination costs.

In differentiated-duopoly, on the other hand, firm i faces a marginal cost c_i ($i = 1, 2$). When firm 2 exports products from the foreign country, it incurs a transport cost, t, per unit of output.

We consider a three-stage game. In the first stage, the home country determines a level of FEC. In the second stage, firms bargain on equity shares. Depending on the outcome of this bargaining either a IJV-monopoly or a differentiated-duopoly is realized. In the third stage, given market structure, firms produce and sell the products. In this stage, Bertrand (price-setting) and Cournot (quantity-setting) competition are considered.[3]

Hereafter, we use superscripts J, B and C to express IJV-monopoly, Differentiated-Bertrand duopoly, and Differentiated-Cournot duopoly, respectively. In IJV-monopoly, the profit of the IJV is given by

$$\Pi^J = (p_1^J - \hat{c}_1)y_1^J + (p_2^J - c_2)y_2^J. \tag{2}$$

In contrast, in differentiated-duopoly, the profits of firm 1 and 2 are

$$\pi_1^l = (p_1^l - c_1)y_1^l \quad \text{and} \quad \pi_2^l = (p_2^l - c_2 - t)y_2^l, \quad l = B, C. \tag{3}$$

3 Analysis

In this section we derive the subgame perfect equilibrium of this game. In the following analysis, we assume parameter values that lead to an interior solution where both firms have positive sales in equilibrium.

We focus on the third stage. The utility function (1) yields the following inverse demand and direct demand functions:

$$p_i = \alpha_i - y_i - \gamma y_j, \tag{4}$$

$$y_i = \frac{1}{G}\left(\alpha_i - \gamma\alpha_j - p_i + \gamma p_j\right), \tag{5}$$

where $G \equiv 1 - \gamma^2$. Based on equations (4) and (5), we can calculate equilibrium prices, outputs, and profits under IJV-monopoly, and Differentiated-

[2]Since this cost reduction occurs through the application of firm 2's technology, the marginal cost of producing good 2 for the IJV is still c_2.

[3]Singh and Xives (1984) consider the situation where firms offer either price or quantity commitments. They includes the case where one firm sets price and the other firm sets quantity. In this paper, we rule out this possibility.

Bertrand and Cournot duopoly in the third stage. These values are summarized in Table 1.

From Table 1, we find that all equilibrium outputs, prices and profits are functions of $(\alpha_i - c_i)$ $(i = 1, 2)$. This implies that many of results in the analysis of monopoly and oligopoly depend on values of $(\alpha_i - c_i)$ (*e.g.* Clarke and Collie, 2006b). It is noteworthy that α_i is the choke price; *i.e.*, the consumer's maximum willingness to pay for firm i's product, and c_i is marginal cost of firm i $(i = 1, 2)$. We thus define $\Omega_i \equiv \alpha_i - c_i$ as the cost-considered choke price.

In IJV-monopoly, the IJV always chooses monopoly outputs and prices, and earns monopoly profits regardless of whether it sets price or quantity. As stated above, the IJV has a cost reduction in the production of good 1. We define

$$\delta \equiv \frac{\alpha_1 - \hat{c}_1}{\alpha_1 - c_1} = \frac{\alpha_1 - \hat{c}_1}{\Omega_1} > 1, \tag{6}$$

in order to measure the cost reduction in terms of the cost-considered choke price. The sign of equation (6) is easily obtained by $\hat{c}_1 < c_1$. The parameter δ represents the degree of effectiveness of cost reduction: how forming the IJV raises the cost-considered choke price for good 1.

On the other hand, in differentiated-duopoly, equilibrium outputs, prices, and profits are different under differentiated Bertrand and Cournot duopolies. It is well known that outputs under Bertrand competition are greater than those under Cournot competition, and thus price under Cournot competition is higher than that under Bertrand competition (*e.g.* Singh and Vives, 1984). Furthermore, since we assume that the differentiated goods are substitutes, we have the following lemma.

Lemma 1 (Singh and Vives, 1984)
If differentiated goods are substitutes, profits under Cournot competition are greater than those under Bertrand competition.

We now consider bargaining between firms 1 and 2 in the second stage. The problem both firms face is

$$\max_{\beta_l} \{(1 - \beta_l)\Pi^J - \pi_1^l\}\{\beta_l \Pi^J - \pi_2^l\}, \tag{7}$$

$$s.t. \qquad (1 - \beta_l)\Pi^J \geqslant \pi_1^l, \tag{8}$$

$$\beta_l \Pi^J \geqslant \pi_2^l, \tag{9}$$

where β_l is the foreign equity share of the IJV for a type of competition l $(l = B, C)$. Constraints (8) and (9) require that the profit distributed to firm i in IJV monopoly be greater than firm i's profit under differentiated duopoly ($i = 1, 2$). If either of these conditions is violated, an IJV is not formed. We thus obtain the threshold ownership shares for firms 1 and 2 as

$$\underline{\beta_l} \equiv \frac{\pi_2^l}{\Pi^J} \quad \text{(for firm 2)} \quad \text{and} \quad \overline{\beta_l} \equiv 1 - \frac{\pi_1^l}{\Pi^J} \quad \text{(for firm 1)} \tag{10}$$

for $l = B, C$. That is, if β_l is under $\underline{\beta_l}$ (*resp.* above $\overline{\beta_l}$), firm 2 (*resp.* firm 1) does not agree to set up a IJV. Let $\tilde{\beta_l}$ be the unconstrained solution of equation (7). Solving equation (7) yields

$$\tilde{\beta_l} \equiv \frac{1}{2} + \frac{\pi_2^l - \pi_1^l}{2\Pi^J}. \tag{11}$$

When both firms agree to form the IJV, $\tilde{\beta_l}$ must be in the interval $(\underline{\beta_l}, \overline{\beta_l})$, which implies that $\Pi^J > \pi_1^l + \pi_2^l$. Note that, in this stage, the level of the FEC is given for both firms. Let θ_l be the FEC level where bargaining is not successful for a given type of competition l. Depending on the level of θ_l, we have three possibilities for the realized market structure and the equilibrium foreign ownership share β_l^*.[4]

Lemma 2
(i)If $\theta_l \in [\tilde{\beta_l}, 1]$, IJV-monopoly is realized and the equilibrium foreign ownership share is $\beta_l^* = \tilde{\beta_l}$.
(ii) If $\theta_l \in [\underline{\beta_l}, \tilde{\beta_l})$, IJV-monopoly is realized and the equilibrium foreign ownership share is $\beta_l^* = \theta_l$.
(iii) If $\theta_l \in [0, \underline{\beta_l})$, Differentiated-duopoly is realized and the equilibrium foreign ownership share is not determined.

In the first stage, the home country determines the level of the FEC to maximize domestic welfare. The home country's welfare is organized as

$$W_l = \begin{cases} W^J = CS^J + (1 - \beta_l)\Pi^J, \\ W^l = CS^l + \pi_1^l, \quad l = B, C, \end{cases} \tag{12}$$

where W_l is the home country's welfare with competition type l, $CS^m = u(\boldsymbol{y}_m^*)m^* - p(\boldsymbol{y}_m^*)\boldsymbol{y}_m^*$ is the consumer surplus in the home country, and $\boldsymbol{y}_m^*$ is the equilibrium output vector under the market structure m ($m = J, B, C$). Note that the consumer surplus is independent of the foreign ownership share

[4]Proofs of upcoming Lemma and Propositions appear in the Appendix.

β_l for all market structures. From Lemma 2, market structures depend on the value of θ_l. Thus, equation (12) is rewritten as

$$W_l = \begin{cases} W^l = CS^l + \pi_1^l & \text{for} \quad \theta_l \in [0, \underline{\beta_l}) \\ W^J = CS^J + (1-\theta_l)\Pi^J & \text{for} \quad \theta_l \in [\underline{\beta_l}, \tilde{\beta}_l] \\ W^J = CS^J + (1-\tilde{\beta}_l)\Pi^J & \text{for} \quad \theta_l \in [\tilde{\beta}_l, 1] \end{cases} \tag{13}$$

under $l = B, C$. We then have two possible solutions for the equilibrium foreign equity cap level θ_l^*.

Proposition 1
If $W^J(\underline{\beta_l}) \geqslant W^l$, the home country chooses $\theta_l^* = \underline{\beta_l}$, and IJV-monopoly is realized. If $W^J(\underline{\beta_l}) < W^l$, the home country chooses $\theta_l^* \in [0, \underline{\beta_l})$ and differentiated-duopoly occurs ($l = B, C$).

Which equilibrium is realized depends on combinations of parameters. In particular, as the degree of effectiveness of cost reduction δ is larger (*resp.* smaller), the possibility of IJV-monopoly (*resp.* Differentiated-duopoly) is higher.[5]

In the following, we focus on the case where δ is sufficiently large such that the IJV is formed in equilibrium. From Lemma 1 and Proposition 1, we have the following result.

Proposition 2
Suppose the IJV is formed under both Bertrand and Cournot competition. Then, the optimal FEC level under Cournot competition is higher than that under Bertrand competition.

Note that a higher (*resp.* lower) FEC level corresponds to a laxer (*resp.* stricter) policy for the foreign firm. Proposition 2 thus shows that the FEC under Differentiated-Cournot duopoly is laxer than that in Differentiated-Bertrand duopoly. Our result here can be considered as a characteristic of the FEC. We allow foreign firm to choose its location for production. The foreign firm decides its location in the second stage and, as shown in equation (9), locates in home country if its receipt of IJV profit is greater than its duopoly profit. Foreign firm does not locate in the home country if the

[5] At $\delta = 1$ (*i.e.*, no cost reduction), $W^l > W^J$ for any $l = B, C$, while if δ is sufficiently large, the sign will be opposite. For example, suppose that $\gamma = 0.5$, $\Omega_1 = 5$, $\Omega_2 = 10$, $t = 0.1$. Under Bertrand competition, $W^J = 16.6615 < W^B = 19.7351$ at $\sigma = 1$, while $W^J = 19.7865 > W^B$ at $\sigma = 1.5$. Under Cournot competition, $W^J = 16.2172 < W^C = 16.468$ at $\sigma = 1$, while $W^J = 19.3422 > W^C$ at $\sigma = 1.5$. Note that W^l is independent of σ ($l = B, C$).

home country government enforces a strict FEC. Then, the home country's government loses a part of welfare, *i.e.*, part of the IJV's profit. Thus, the FEC can be regarded as compensation of profits to attract the foreign firm. Although the home country's government has the ability to affect firm behavior, because it chooses the level of the FEC in the first stage, the ability is not strong in the existence of the compensation of profit. From Lemma 1, profit under Cournot duopoly is larger than that under Bertrand duopoly. The home country's government thus needs to provide more compensation for the foreign firm under Cournot competition than under Bertrand competition. Therefore, the FEC under Cournot competition is laxer than that under Bertrand competition.

4 Conclusions

We have investigated the optimal level of a FEC under Bertrand and Cournot competition. We demonstrated that the optimal level of a FEC under Cournot competition is higher than that under Bertrand competition. This result implies that the host country government implements a laxer policy under Cournot competition. This shows a characteristic of FECs: the compensation of IJV's profit to attract foreign firms. The possibility of forming an IJV weakens government's ability to affect firms' activities.

Appendix

A. Proof of Lemma 2: If $\theta_l > \tilde{\beta}_l$, the unconstrained foreign ownership share satisfies FEC; *i.e.*, FEC is not binding, and thus the equilibrium ownership share is $\beta^* = \tilde{\beta}_l$. If $\theta_l \in [\underline{\beta_l}, \tilde{\beta}_l)$, then FEC is binding, and the equilibrium ownership share is $\beta_l^* = \theta_l$. Finally, if $\theta_l < \underline{\beta_l}$, firm 2 does not agree to form the IJV, and ownership share does not need to be determined. ■

B. Proof of Proposition 1: Note that the home country's welfare is not continuous at $\beta_l = \underline{\beta_l}$ and that it is decreasing in θ_l only for $\theta_l \in [\underline{\beta_l}, \tilde{\beta}_l]$. If $W^l \leqslant W^J(\underline{\beta_l})$, the government maximize domestic welfare by setting $\theta_l^* = \underline{\beta_l}$ and the IJV monopoly is realized (see Figure 1). On the other hand, if $W^l > W^J(\underline{\beta_l})$, the government chooses $\theta_l^* \in [0, \underline{\beta_l})$ and eliminates the possibility of the IJV monopoly (see Figure 2). ■

C. Proof of Proposition 2: From Proposition 1, $\theta_B^* = \underline{\beta_B} = \pi_2^B/\Pi^J$ and $\theta_C^* = \underline{\beta_C} = \pi_2^C/\Pi^J$. Since we have $\pi_2^B < \pi_2^C$ from Lemma 1, we find that $\theta_B^* < \theta_C^*$. ■

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Table 1: Equilibrium outputs, prices, and profits

(i) IJV monopoly

Outputs:	$y_1^J = \frac{1}{2G}(\delta\Omega_1 - \gamma\Omega_2)$
	$y_2^J = \frac{1}{2G}(\Omega_2 - \gamma\delta\Omega_1)$
Prices:	$p_1^J = \frac{1}{2}\delta\Omega_1 + c_1$
	$p_2^J = \frac{1}{2}\Omega_2 + c_2$
Profit:	$\Pi^J = \frac{1}{4G}\left\{(\delta\Omega_1)^2 + \Omega_2^2 - 2\gamma\delta\Omega_1\Omega_2\right\}$

(ii) Differentiated Bertrand duopoly

Outputs:	$y_1^B = \frac{1}{GH}\left\{(2-\gamma^2)\Omega_1 - \gamma(\Omega_2 - t)\right\}$
	$y_2^B = \frac{1}{GH}\left\{(2-\gamma^2)(\Omega_2 - t) - \gamma\Omega_1\right\}$
Prices:	$p_1^B = \frac{1}{H}\left\{(2-\gamma^2)\Omega_1 - \gamma(\Omega_2 - t)\right\} + c_1$
	$p_2^B = \frac{1}{H}\left\{(2-\gamma^2)(\Omega_2 - t) - \gamma\Omega_1\right\} + c_2 + t$
Profits:	$\pi_1^B = \frac{1}{GH^2}\left\{(2-\gamma^2)\Omega_1 - \gamma(\Omega_2 - t)\right\}^2$
	$\pi_2^B = \frac{1}{GH^2}\left\{(2-\gamma^2)(\Omega_2 - t) - \gamma\Omega_1\right\}^2$

(iii) Differentiated Cournot duopoly

Outputs:	$y_1^C = \frac{1}{H}\left\{2\Omega_1 - \gamma(\Omega_2 - t)\right\}$
	$y_2^C = \frac{1}{H}\left\{2(\Omega_2 - t) - \gamma\Omega_1\right\}$
Prices:	$p_1^C = \frac{1}{H}\left\{2\Omega_1 - \gamma(\Omega_2 - t)\right\} + c_1$
	$p_2^C = \frac{1}{H}\left\{2(\Omega_2 - t) - \gamma\Omega_1\right\} + c_2 + t$
Profits:	$\pi_1^C = \frac{1}{H^2}\left\{2\Omega_1 - \gamma(\Omega_2 - t)\right\}^2$
	$\pi_2^C = \frac{1}{H^2}\left\{2(\Omega_2 - t) - \gamma\Omega_1\right\}^2$

Note: $\Omega_1 \equiv \alpha_1 - c_1$, $\Omega_2 \equiv \alpha_2 - c_2$, $G \equiv 1 - \gamma^2$, $H \equiv 4 - \gamma^2$, and $\delta \equiv (\alpha_1 - \hat{c}_1)/\Omega_1$.

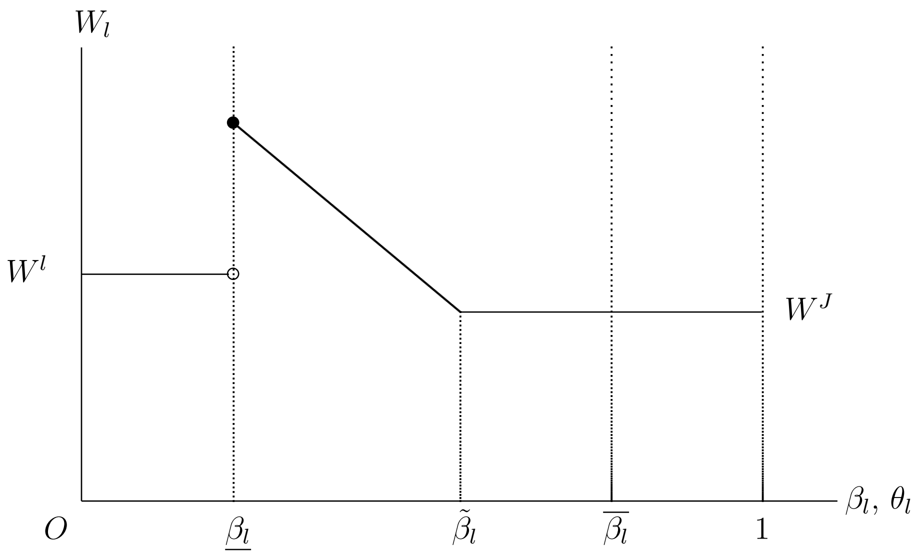

Figure 1: The case of $\theta_l^* = \underline{\beta_l}$

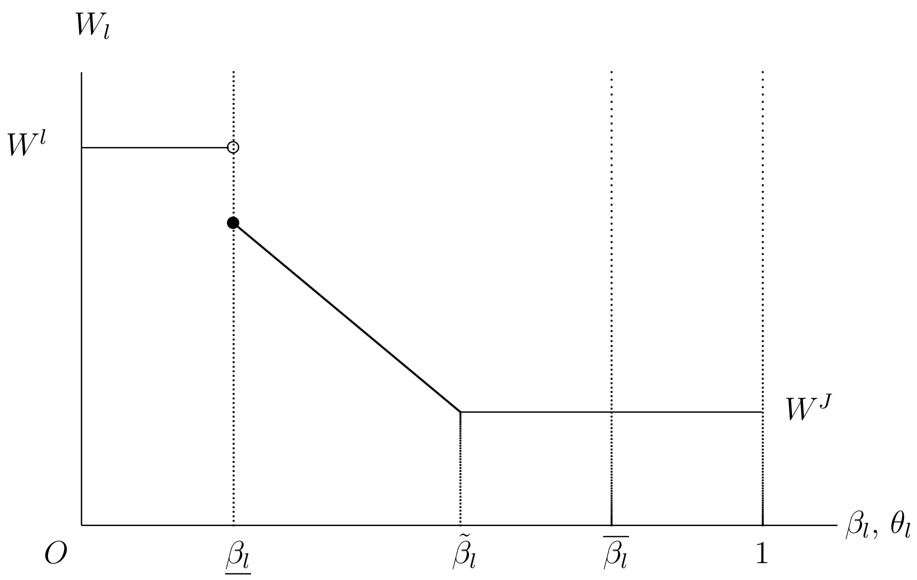

Figure 2: The case of $\theta_l^* \in [0, \underline{\beta_l})$