Three Essays in the Economics of Globalization

Viet Dung Do

Department of Economics
McGill University
Montreal, Quebec, Canada
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Abstract

This thesis consists of three essays which explore different economic issues emerging in today's globalized world economy. Using a model of outsourcing by monopolistically competitive firms, the first essay shows that, even in the case of flexible domestic wages, international outsourcing (and/or re-location of plants to a low-wage economy) by home firms may worsen the welfare of the home country and reduce the profits of all firms in the industry, even though it is individually rational for each firm to choose to outsource. It shows that if a social planner for the home country can choose the extent of international outsourcing, his optimal choice will not coincide with the equilibrium outcome under laissez-faire. A wage subsidy may improve welfare. When the wage in the home country is rigid we show that outsourcing is welfare-improving for the home country if and only if the sum of the "trade creation" effect and the "exploitation effect" exceeds the "trade diversion" effect of the access to the low-wage labour in the foreign country. The essay also assesses the model in a two-period framework, where each domestic firm faces the choice between outsourcing (or re-location) in the first period, or in the second period. Delaying outsourcing can be gainful because the fixed cost of outsourcing may fall over time. On the other hand, delaying means the firm's variable production cost in period 1 will be higher than that of rivals who are outsourcing. The equilibrium of this two-period game may involve some firms outsourcing in period 1, while others will outsource in period 2, even though ex-ante they are identical firms. Under monopolistic competition, in equilibrium, the sum of discounted profits is identical for all firms. Again, a social planner for the home country may choose a different speed of outsourcing than the speed achieved by an industry under laissez-faire.

The second essay explores the market for fair-trade products. It employs a duopoly model involving a firm producing a fair-trade product in competition against a conventional firm producing a standard product. The concept of "economic identity" (Akerlof and Kranton, 2000) is used to model consumers' demand for fair-trade products. The essay shows how, in the short run, the parameters of the identity function can impact the equilibrium prices, and in the medium run, how they impact the conventional firm's choice of its position in the product space. In the long run, however, the fair-trade firm may be able to influence the parameters of the identity function, for its own advantage.

The last essay uses the contest model (Tullock, 1980, Rowley et al., 1988, Hillman and Riley, 1989, Nitzan, 1994) to assess welfare effects of bilateral liberalization of government procurement. It shows that there exists a single condition that ensures active participations of all firms in all contests. When this condition is violated, i.e. under a dominant-country case, the dominating country always gains from trade liberalization, while welfare of the dominated country improves only if its corporate tax is sufficiently high. Under full participation of all firms, i.e. no country dominates the markets, and countries are partially symmetric, there exist conditions where bilateral liberalization is mutually beneficial to both countries. When countries are completely asymmetric, it is showed that a country may gain from bilateral trade liberalization if its tax rate is sufficiently high, while the tax rate of the other country is sufficiently low. The results obtained in this essay have shed lights on the current position of negotiations on liberalizing government procurement within the WTO. They suggest plurilateral agreements on government procurement could be formed among countries with similar economic conditions. Such agreements, however, are hard to reach between countries with a large degree of economic asymmetry.

Résumé

Cette thèse se compose de trois essais qui explorent les différentes questions économiques émergeant dans la mondialisation économique. À l'aide d'un modèle de contrat de sous-traitance établi par les firmes monopolistiques, le premier essai montre que, même dans le cas de la flexibilité des salaires domestiques, la sous-traitance internationale (et/ou transfert des équipements vers une économie à bas salaire) provenant des firmes domestiques peut aggraver le bien-être du pays d'origine et réduire les profits de toutes les entreprises de l'industrie, même s'il est individuellement rationnel pour chaque entreprise de choisir d'externaliser. Celui-ci montre que si un planificateur social du pays d'origine peut choisir la quantité de la sous-traitance internationale, son choix optimal ne coïncidera pas avec le résultat à l'équilibre du laissez-faire. Une subvention salariale peut améliorer le bien-être social. Lorsque les salaires domestiques sont rigides, nous montrons que la sous-traitance est l'amélioration du bien-être du pays d'origine si et seulement si l'effet total de la «création commerciale" et de "l'exploitation" dépasse l'effet du "détournement commercial" bénéficié de la faible rémunération du travail dans le pays étranger. Cet essai évalue également le modèle à deux périodes auquel chaque entreprise domestique doit faire face à ses choix entre la sous-traitance à la première période et celle à la deuxième période. Une firme retardant la sous-traitance peut être lucrative car le coût fixe de la sous-traitance peut diminuer au fil du temps. D'autre part, cela signifie que le coût variable de production en période 1 sera supérieur à celui des rivaux qui sont en train d'externaliser. L'équilibre de ce modèle peut entraîner certaines firmes externalisant en première période 1 tandis que d'autres le feront en deuxième période, même si elles sont ex-ante identiques. Sous l'hypothèse de concurrence monopolistique, à l'équilibre, la somme des profits escomptés est identique pour toutes les firmes. Dans ce cas, un planificateur social domestique peut de nouveau choisir une autre vitesse d'externalisation au lieu de la vitesse achevée par une industrie au titre de laissez-faire.

Le deuxième essai explore le marché des produits équitables. Celui-ci utilise un modèle de duopole qui inclut une firme fabriquant un bien équitable en compétition contre une autre firme conventionnelle produisant un bien standard. La notion de l'"identité économique" (Akerlof et Kranton, 2000) sera empruntée pour modéliser la demande de biens équitables. Ce travail montre, à court terme, comment les paramètres de la fonction d'identité peuvent avoir un impact sur les prix d'équilibre, et à moyen terme, quel est leur effet sur le choix de sa production qu'une entreprise standard désire. À long terme, l'entreprise équitable peut toutefois être en mesure d'influencer les paramètres de la fonction d'identité, pour son propre avantage.

Le dernier essai utilise le modèle conteste (Tullock, 1980, Rowley et al., 1988, Hillman et Riley, 1989, Nitzan, 1994) pour évaluer les effets de bien-être sur la libéralisation bilatérale des marchés publics. Celui-ci montre qu'il existe une seule condition qui assure les participations actives de toutes les entreprises dans toutes les compétitions. Lorsque celle dernière est violée, c'est-à-dire dans le cas de pays dominant, le pays dominateur ramasse toujours les gains de la libéralisation commerciale tandis que le bien-être des pays soumis n'améliore que si leur taxe collective demeure suffisamment élevée. En vertu de la pleine participation de toutes les entreprises, c'est-à-dire aucun pays ne domine les marchés et les pays sont partiellement symétriques, il existe des conditions où la libéralisation bilatérale est réciproquement rentable pour les deux pays. Lorsque les pays sont complètement asymétriques, il est montré qu'un pays peut bénéficier de la libéralisation bilatérale si son taux d'impôt est convenablement haut et celui de l'autre pays reste raisonnablement faible. Les résultats obtenus dans cet essai ont permis de mettre en lumière la position actuelle des négociations sur la libéralisation des marchés publics au sein de l'OMC. Ceux-ci suggèrent que des accords plurilatéraux pourraient être formés entre les pays ayant les mêmes conditions économiques. Ces accords sont toutefois difficiles à atteindre entre les pays ayant grand degré d'asymétrie économique.

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Contributions of Authors

The first and the second chapter of this thesis are coauthored with my Ph.D. supervisor, Professor Ngo Van Long. In the first chapter, he initiated the ideas while I participated in analyzing the model and carried out the numerical work. In the second chapter, I am responsible for the model formulation and most of the analytical work, making use of Professor Long's suggestions on dynamic analysis. We both reviewed the literature relating to the first two chapters and made revisions according to referees' comments.

A version of the first chapter has appeared as Do, V. and N.V. Long, "International Outsourcing Under Monopolistic Competition: Winners and Losers", Chapter 18 in Sugata Marjit & Eden Yu (editors), *Contemporary and Emerging Issues in Trade Theory and Policy*, which is Volume 4 of the series *Frontiers of Economics and Globalization*, 2008, Emerald Press, U.K., pp. 345-366.

A version of the second chapter has appeared as Do, V. and N.V. Long, "Fair Trade Goods Versus Conventional Goods: Some Theoretical Considerations", *Trade and Development Review*, 2008, Vol. 1 (1), pp. 21-39.

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Preface

Globalization has become an irreversible trend in our modern world. Generally, it is an ongoing process of greater interdependence among countries and their citizens. As such, globalization is inherently complex and multifaceted. While bringing about prosperity and opportunities to various parts of the world, it poses many challenges such as income distribution gaps among countries, poverty, environmental damages, clashes of cultures and ideologies, and international violence and terrorism. These problems have been widely pointed out by critics of globalization[1]. While many of them relate to economics, others relate to non-economic, but no less important, aspects of life.

From the economic perspective, globalization is the ongoing process of greater economic interdependence among countries. This process is reflected in the increasing amount of cross-border trade in goods and services, the increasing volume of international portfolio and direct investments, and increasing flows of labor. As the world enters into an era of deep economic integration, it is legitimate for every nation to raise a question of how to protect and improve national welfare while keeping pace with the accelerating process of globalization. Of course, there is no comprehensive answer to this question. Instead, it requires governments to study and response to each economic problem with an appropriate policy framework. In the current thesis, we address three economic issues that have

[1] Using the Google search engine, the key word "globalization" returns about 23.2 millions links. A refined search of "anti-globalization" brings up 600,000 entries. If we type in "globalization and inequality", there are above 250,000 links. Likewise, about 8.3 million references relate to "globalization and environment"; approximately 440,000 links to "globalization and labor standards"; 2.2 million references to "globalization and multinationals"; and 550,000 references to "globalization and cultural diversity". Although these numbers do not show any insight of the issue, they demonstrate a large volume of discussion on both opportunities and challenges of globalization. Search results were obtained on November 28th, 2008.

emerged from today's globalized world economy. These include international outsourcing, fair trade and liberalization of government procurement.

International outsourcing refers to the process where a firm from home country shifts parts or the whole of its production to another country to take advantages of less costly resources available in the later. As liberalization of trades and investments continues to make substantial progress, the volume of international outsourcing has become larger than ever. Nevertheless, the welfare effect of international outsourcing is still one of the many difficult economic puzzles, especially for the outsourcing country. In the first essay, using a model of outsourcing by monopolistically competitive firms, we show that, even in the case of flexible domestic wages, international outsourcing (and/or re-location of plants to a low-wage economy) by home firms may worsen the welfare of the home country and reduce the profits of all firms in the industry, even though it is individually rational for each firm to choose to outsource. We show that if a social planner for the home country can choose the extent of international outsourcing, his optimal choice will not coincide with the equilibrium outcome under laissez-faire. A wage subsidy may improve welfare. When the wage in the home country is rigid we show that outsourcing is welfare-improving for the home country if and only if the sum of the "trade creation" effect and the "exploitation effect" exceeds the "trade diversion" effect of the access to the low-wage labor in the foreign country. In the first essay, we also assess the model in a two-period framework, where each domestic firm faces the choice between outsourcing (or re-location) in the first period, or in the second period. Delaying outsourcing can be gainful because the fixed cost of outsourcing may fall over time. On the other hand, delaying means the firm's variable production cost in period 1 will be higher than that of rivals who are outsourcing. The equilibrium of this two-period game may involve some firms outsourcing in period 1, while others will outsource in period 2, even though ex-ante they are identical firms. Under monopolistic competition, in equilibrium, the sum of discounted profits is identical for all firms. Again, a social planner for the home country may choose a different speed of outsourcing than the speed achieved by an industry under laissez-faire.

While globalization has brought prosperity to a large proportion of our population, we have to admit the fact that workers in many parts of the world still live in poverty due to their low wages and poor working conditions. Over the past decade, this has become one of the biggest challenges faced by the process of globalization. The Fair Trade movement has emerged as a viable solution to this problem. The second essay explores the fair-trade market by employing a duopoly model which involves a firm producing a fair-trade product in competition against a conventional firm producing a standard product. The concept of "economic identity" (Akerlof and Kranton, 2000) is used to model consumers' demand for fair-trade products. We show how, in the short run, the parameters of the identity function can impact the equilibrium prices, and in the medium run, how they impact the conventional firm's choice of its position in the product space. In the long run, however, the fair-trade firm may be able to influence the parameters of the identity function, for its own advantage.

The last essay addresses economic issues relating to liberalization of government procurements. While world-wide negotiations on liberalizing government procurements made virtually no progress in the past few decades, a small group of WTO members has managed to agree on a common set of rules which govern purchasing activities of their public entities.

As the result, the Government Procurement Agreement (GPA) came into effect in 1979 and was subsequently amended in 1987 and 1994. This raises two interesting questions: what is the primary source that brings a selected group of WTO members to the GPA? And why is it difficult to expand the coverage of the Agreement to other WTO members, especially to developing nations where public procurements still play an extraordinarily important role in the development of domestic basic infrastructure systems? To answer these questions, we use the contest model (Tullock, 1980, Rowley et al., 1988, Hillman and Riley, 1989, Nitzan, 1994) to assess welfare effects of bilateral liberalization of government procurements. We show that there exists a single condition that ensures active participation of all firms in all contests. When this condition is violated, i.e. under a dominant-country case, the dominating country always gains from trade liberalization, while welfare of the dominated country improves only if its corporate tax is sufficiently high. Under full participation of all firms, i.e. no country dominates the markets, and countries are partially symmetric, there exist conditions where bilateral liberalization is mutually beneficial to both countries. When countries are completely asymmetric, it is showed that a country may gain from bilateral trade liberalization if its tax rate is sufficiently high, while the tax rate of the other country is sufficiently low. The results obtained in this last essay have shed lights on the current position of negotiations on liberalizing government procurements within the WTO. They suggest plurilateral agreements on government procurements could be formed among countries with similar economic conditions. Such agreements, however, are hard to reach between countries with a large degree of economic asymmetry.

Chapter 1

Outsourcing under Monopolistic Competition: Winners and Losers

1.1 Introduction

International outsourcing has become an increasingly common phenomenon in advanced economies. Sinn (2004) reports that no fewer than 60% of German small and medium enterprises (SMEs) have established plants outside the old EU. He argues that outsourcing and offshoring have gone too far. Firms that relocate all or parts of their production in low-wage economies have contributed to a rising pool of unemployed workers. Due to wage inflexibility, globalization "creates unemployment instead of gains from trade" (Sinn, 2004, p. 117). The main losers are obviously the low-skilled manufacturing workers in advanced economies. What can be said about the winners? In popular discussions, many people would think that the winners of globalization are owners of firms that outsource. This view however is implicitly based on the assumption that either outsourcing does not involve a fixed cost, or the outsourcing firm is a monopolist. When outsourcing firms have rivals, and fixed costs of outsourcing are non-negligible, it is not clear that the firms always come out as winners.

In this chapter, using a model of outsourcing by monopolistically competitive firms, we show that, even in the case of flexible domestic wages, international outsourcing (and/or re-location of plants to a low-wage economy) by home firms may worsen the welfare of the home country and reduce the profits of all firms in the industry, even though it is individually rational for each firm to choose to outsource. If a social planner for the home country can choose the extent of international outsourcing, his optimal choice will not coincide with the equilibrium outcome under laissez-faire. A wage subsidy may reduce the extent of outsourcing and improve welfare. This confirms Sinn's perception that "Wage subsidies make the state into a partner. They do not establish minimum wage demands and create the very flexibility in wage setting that is required for reaping the gains from trade." (Sinn, 2004, p. 119)

When the wage in the Home country is rigid we show that outsourcing is welfare-improving for the home country if and only if the sum of the "trade creation" effect and the "exploitation" effect exceeds the "trade diversion" effect of the access to the low-wage labour in the foreign country.

We also extend the model to a two-period framework, where each domestic firm faces the choice between beginning outsourcing (or re-location) in the first period, or in the second period. Delaying outsourcing can be gainful because the fixed cost of outsourcing may fall over time. On the other hand, delaying means the firm's variable production cost in period 1 will be higher than that of rivals who are outsourcing. The equilibrium of this two-period game may involve some firms outsourcing in period 1, while others will outsource in period 2, even though ex-ante they are identical firms. Under monopolistic competition with homogeneous costs, in equilibrium, the sum of discounted profits is identical for all firms. Again, a social planner for the home country may choose a different speed of outsourcing than the speed achieved by an industry under laissez-faire.

Before proceeding, we would like to make some remarks on the literature on international outsourcing. The impacts of outsourcing on wages and profits have been subjected to empirical studies (Feenstra and Hanson, 1999, Kimura, 2002, Görzig and Stephen, 2002, Görg and Hanley, 2004), as well as theoretical analysis (see, for example, Glass and Saggi, 2001, Grossman and Helpman, 2002, 2003, 2005, Grossman and Rossi-Hansberg, 2006a, 2006b, Jones, 2004, Long, 2005, and a special issue of the *International Review of Economics and Finance,* 2005). A related literature is the theory of fragmentation; see Jones and Kierzkowski (1990, 2001a, 2001b), Long, Riezman, and Soubeyran, (2005).

1.2 The Model

1.2.1 The basic assumptions

This is basically a partial equilibrium model. We are concerned with international outsourcing decisions of firms in an advanced economy (called the Home country, or H for short), and their impact on wages, profits, consumers surplus, and social welfare. We also want to find out if the gainers in H can compensate the losers in H, and how such compensation may take place.

The structure of the economy of H is simple. There are two industries, producing two goods. The numeraire good is produced by a perfectly competitive industry. The second good is a differentiated good, which consists of many varieties. It is produced by an imperfectly competitive industry consisting of a continuum of monopolistically-competitive firms, indexed by z, where $z \in [0, 1]$. Each of these firms produces a unique variety. The varieties are imperfect substitutes. The price of a unit of variety z is denoted by $p(z)$.Each firm has a constant marginal cost of production, and has incurred a fixed cost (e.g., it bought the patent for the variety it produces). We take the number of firms as fixed, because we wish to focus on the short run issues. (In this respect, we follow the approach of Obstfeld and Rogoff, 1995).

The foreign country is a low-wage economy. It does not have any differentiated-product firms of its own. Any variety produced in the foreign country is made possible only by a firm in H that sets up a factory abroad to take advantage of the low wage. Thus we do not treat the two countries symmetrically, in contrast to the standard literature on trade under monopolistic competition, as exemplified by the work of Helpman and Krugman (1985),Venables (1987), and others.[2]

Consumers

Let $c(z)$ be the quantity of variety z consumed by the representative consumer. The sub-utility obtained from consuming the differentiated good is assumed to be homogeneous of degree one and increasing in the quantities $c(z)$:

$$C \equiv \left[\int_0^1 c(z)^{\frac{\theta-1}{\theta}} dz \right]^{\frac{\theta}{\theta-1}} \quad \text{where } \theta > 1$$

For any given sub-utility level $C \geq 0$, the consumer chooses the amounts of consumption of the varieties so as to minimize the cost of achieving C. It is as if she solved the problem

$$\min \int_0^1 p(z)c(z)dz$$

[2] Tariff policies under monopolistic competition are discussed in Gross (1987), Venables (1982), Markusen (1990), Hertel (1994), Sen et al. (1997).

subject to

$$\left[\int_0^1 c(z)^{\frac{\theta-1}{\theta}} dz\right]^{\frac{\theta}{\theta-1}} = C$$

The solution to this problem is

$$c(z) = \left[\frac{p(z)}{P}\right]^{-\theta} C \tag{1.1}$$

where P is defined by

$$P \equiv \left[\int_0^1 p(z)^{1-\theta} dz\right]^{\frac{1}{1-\theta}}$$

We call P the price index for the differentiated good. It is the cost of achieving one unit of sub-utility.

The utility function of the representative consumer is assumed to be quasi-linear: it is linear in X and non-linear in C

$$U = v(C) + X$$

where X is her consumption of the numeraire good. We assume that $v(C)$ is a strictly concave function, with $v(0) = 0$ and $v'(0) > 0$.

Suppose the consumer i has a budget B_i to be allocated between the two goods. The optimal allocation is the solution of the utility-maximization problem

$$\max v(C_i) + X_i$$

subject to

$$PC_i + X_i = B_i$$

and $X_i \geq 0$, $C_i \geq 0$.

For any given $P < v'(0)$, let C^* be the solution of the equation

$$v'(C^*) = P$$

That is,

$$C^* \equiv v'^{-1}(P) \tag{1.2}$$

It can be shown that if $PC^*(P) < B_i$, then both goods will be consumed in strictly positive quantities (i.e., we have an interior solution). In what follows we assume that, for all consumer i, the budget B_i is big enough so that the solution of the consumer's allocation problem is interior.

Concerning the labour market, we assume that there are two types of workers: skilled workers and unskilled workers. The population consists of a continuum of individuals, indexed by $i \in [0,1]$. This continuum is the union of two continuums, $[0,n)$ and $[n,1]$ where $n < 1$ is the fraction of population that is unskilled (denoted by the subscript u). Skilled workers (denoted by the subscript s) work only in the numeraire good sector. They earn a fixed wage W_s (for example, their marginal product is a constant). Unskilled workers work only in the differentiated good sector. Their wage rate is denoted by W. Each unskilled worker is willing to offer $\overline{L}$ units of labour time, as long as the wage rate W exceeds their reservation wage $W_r = \gamma$. If $W = \gamma$ then they are indifferent between offering $\overline{L}$ or zero unit of labour (or any $L_u \in (0, \overline{L})$). We may interpret γ as the disutility of work.

This labour supply behavior of unskilled individuals may be rationalized by postulating the following overall utility function of the unskilled worker

$$\widehat{U}(C_u, X_u, L_u) = v(C_u) + X_u - \gamma L_u \text{ where } 0 \leq L_u \leq \overline{L}$$

where $\overline{L}$ is his fixed endowment of (unskilled) labour.

The total supply of unskilled labour in this economy is then $n\overline{L}$.

The disposable income of an unskilled worker that supplies L_u units of (unskilled) labour is

$$Y_u = WL_u + T_u$$

where T_u is the real transfer from the government. We assume that $Y_u > PC^*(P)$ so that all individuals consume the same quantity of differentiated good. Let T_s represent real transfer from the government to skilled workers, it is assumed that the aggregate real transfer is zero:

$$\int_0^n T_u du + \int_n^1 T_s ds = 0$$

The welfare of the unskilled worker is calculated as follows. Given P, his demand for the differentiated good is $C^*(P)$. The excess of Y_u over $PC^*(P)$ is used to buy the numeraire good: $X_u = Y_u - PC^*(P)$. His welfare level is therefore

$$\widehat{U_u} = v(C^*(P)) + [Y_u - PC^*(P)] - \gamma L_u$$

where $L_u = \overline{L}$ as long as $W > \gamma$.

Firms

Let $q(z)$ denote the output of firm z. We define the aggregate output of the differentiated good industry by

$$Q \equiv \left[\int_0^1 q(z)^{\frac{\theta-1}{\theta}} dz\right]^{\frac{\theta}{\theta-1}} \quad \text{where } \theta > 1$$

Each firm z in the differentiated good industry faces the demand function

$$q(z) = \left[\frac{p(z)}{P}\right]^{-\theta} C^*(P)$$

The firm that produces variety z takes P and $C^*(P)$ as given, and thus perceives the following demand function for its output

$$q(z) = p(z)^{-\theta} P^{\theta} C^*(P) = p(z)^{-\theta} P^{\theta} v'^{-1}(P)$$

The perceived elasticity of demand for firm z's output is

$$-\frac{d \ln q(z)}{d \ln p(z)} = \theta > 1$$

The perceived marginal revenue is

$$MR = p(z)\left[1 - \frac{1}{\theta}\right] = \left(\frac{\theta - 1}{\theta}\right) p(z)$$

Suppose the firm uses unskilled labour as the only input, and each additional unit of output requires 1 unit of unskilled labour. Then marginal cost is

$$MC = W$$

where W is the wage rate in terms of good X. Equating MR to MC, the firm sets its price at

$$\widehat{p}(z) = \frac{\theta}{\theta - 1} W \equiv \mu W \text{ where } \mu > 1$$

We call $\mu - 1$ the constant mark-up on cost.

The profits of firms are redistributed to individuals who are their owners. We denote by Π the aggregate profit of the differentiated good sector. We assume for simplicity that only skilled workers are owners of firms. The disposable income of the representative skilled worker is then

$$Y_s = W_s\overline{L}_s + (1-n)\Pi + T_s$$

and her welfare level is

$$\widehat{U}_s = v(C^*(P)) + [Y_s - PC^*(P)] - \gamma_s L_s$$

1.2.2 Equilibrium output and equilibrium profit

In what follows, we assume that

$$v(C_i) = \frac{1}{\alpha}C_i^{\alpha} \text{ where } 0 < \alpha < 1$$

Then

$$P = v' = C_i^{\alpha-1} > 0$$

$$C_i = v'^{-1}(P) = P^{-\beta} \text{ where } 1 < \beta \equiv \frac{1}{1-\alpha} < \theta$$

The demand function for variety z is then

$$q(z) = p(z)^{-\theta}P^{\theta-\beta} \equiv q(p(z), P)$$

The firm maximizes $\pi(z) = (p(z) - W)q(z)$.

From the firm's first order condition, we obtain a useful relationship between its equilibrium output, $\widehat{q}(z)$, and its equilibrium profit, $\widehat{\pi}(z)$.

$$\frac{d\pi(z)}{dp(z)} = (p(z) - W)\frac{\partial q(z)}{\partial p(z)} + q(z) = 0$$

$$p(z) - W = \frac{\widehat{q}(z)}{-\frac{\partial q(z)}{\partial p(z)}}$$

So, with $\widehat{\pi}(z) = (\widehat{p}(z) - W)\,\widehat{q}(z)$,

$$\widehat{\pi}(z) = \frac{1}{\left(-\frac{\partial q(z)}{\partial p(z)}\right)}(\widehat{q}(z))^2$$

In our case, with CES preference for varieties,

$$-\frac{\partial q(z)}{\partial p(z)} = \theta \widehat{p}(z)^{-\theta-1} P^{\theta-\beta} = \theta \widehat{p}^{-1} \widehat{q}(z)$$

So the following expressions for the equilibrium profit are equivalent

$$\widehat{\pi}(z) = \frac{\widehat{p}(z)}{\theta} \widehat{q}(z) = \frac{\mu W}{\theta} \widehat{q}(z) = \frac{W}{\theta - 1} \widehat{q}(z) = (\mu - 1) W \widehat{q}(z)$$

$$= \left(\frac{\widehat{p}(z)}{\theta} \right) \widehat{p}(z)^{-\theta} P^{\theta-\beta} = \frac{P^{\theta-\beta}}{\theta \widehat{p}(z)^{\theta-1}} \tag{1.3}$$

This implies that for a given $\widehat{p}(z)$, the higher is the industry price index P, the higher is firm z's equilibrium profit. When all firms charge the same price, equilibrium profit is

$$\widehat{\pi}(z) = \frac{1}{\theta} \widehat{p}(z)^{1-\beta} = \frac{1}{\theta} \left[\mu W \right]^{1-\beta} \text{ where } \beta > 1 \tag{1.4}$$

Since $\beta > 1$, an increase in W will reduce the equilibrium profit.

1.2.3 The closed economy: equilibrium and welfare

Suppose the supply of unskilled labour is fixed at $n\overline{L}$. If the wage is flexible, full employment will prevail and this implies that the output of the differentiated-product sector is

$$\overline{Q} = \overline{C} = n\overline{L}$$

and the equilibrium price is

$$\overline{P} = v'(\overline{C}) = \left(\overline{C} \right)^{\alpha-1}$$

$$\overline{P} = \left(n\overline{L} \right)^{\alpha-1}$$

Note that, in our model with no fixed cost, output and price under monopolistic competition are *identical* to those under perfect competition. The wage rate under monopolistic competition is **lower** than under perfect competition.

The equilibrium wage rate is

$$W = \overline{W} = \frac{\overline{P}}{\mu} = \frac{\left(n\overline{L}\right)^{\alpha-1}}{\mu}$$

As long as $\overline{W} > \gamma$, the total employment of unskilled workers is $n\overline{L}$.

Consumer surplus is

$$CS = \int_0^{\overline{Q}} v'(Q)dQ - \overline{PQ} = v(\overline{Q}) - \overline{PQ} =$$

$$\frac{\left(n\overline{L}\right)^{\alpha}}{\alpha} - \left(n\overline{L}\right)^{\alpha-1} n\overline{L} = \frac{(1-\alpha)\left(n\overline{L}\right)^{\alpha}}{\alpha}$$

which is identical to that under perfect competition.

The aggregate profit of the differentiated good industry is

$$\Pi = (\overline{P} - \overline{W})\overline{Q} = \frac{\mu\overline{W}}{\theta}\overline{Q}$$

$$= \frac{\overline{W}}{\theta - 1} n\overline{L} = \frac{1}{\theta - 1}\left[\frac{\left(n\overline{L}\right)^{\alpha-1}}{\mu}\right] n\overline{L} = \frac{\left(n\overline{L}\right)^{\alpha}}{\theta}$$

which is a constant fraction, $1/\theta$, of the value of sales. Aggregate unskilled workers' surplus, denoted by ω, is

$$\omega = \left(\overline{W} - \gamma\right) n\overline{L} = n(\overline{WL} - \gamma\overline{L}) = \left(\overline{W} - \gamma\right)\overline{Q}$$

Social welfare in the closed economy is then

$$\overline{\Omega} = CS + \Pi + \omega = \left[v(\overline{Q}) - \overline{PQ}\right] + \left[(\overline{P} - \overline{W})\overline{Q}\right] + \left(\overline{W} - \gamma\right) n\overline{L} = v(\overline{Q}) - \gamma n\overline{L}$$

Note: The overall utility of the representative unskilled worker is

$$\widehat{U}_u = v(\overline{Q}) + \left[Y_u - \overline{PQ}\right] - \gamma L_u = v(\overline{Q}) - \overline{PQ} + \left[\overline{W} - \gamma\right] L_u + T_u$$

Example 1.2.1: Let $\alpha = 1/3$, and $\theta = 2$. Then $\mu = 2$ and $\beta = 1.5$. Assume $n\overline{L} = 1/(2\sqrt{2})$. Then full-employment output is $\overline{Q} = 1/(2\sqrt{2})$, and thus $\overline{P} = 2$ and $\overline{W} = 1$. It follows that aggregate profit is $\Pi = 1/(2\sqrt{2}) = 0.353\,55$. Consumers' surplus is 1.4142. Workers' surplus is $\omega = (\overline{W} - \gamma)\overline{Q} = (1 - \gamma)\ (0.353\,55)$. Social welfare is

$$\Omega = 1.4142 + 0.353\,55 + (1 - \gamma)(0.353\,55)$$

1.3 International Outsourcing: the Case of zero Fixed Cost of Outsourcing

Now let us open the economy to trade. To focus on outsourcing, we assume that the foreign country is a low-wage economy, with surplus labour available at the reservation wage $W^f < \overline{W}$. Assume residents of the low-wage economy consume only the numeraire good. In this section, we assume that home firms can relocate their plants to the low-wage economy **costlessly**. The outputs of re-located differentiated-good firms are exported back to the Home country (H), where they are sold at the price p^f per unit, where

$$p^f = \mu W^f$$

Let s be the fraction of Home firms that are relocated to the low-wage economy, and let $\widehat{q}^f$ be the equilibrium output of the representative re-located firm. By assumption, all the outputs are re-exported to Home. The value of exports from the low-wage economy (Foreign) to Home is then $sp^f\widehat{q}^f = s\mu W^f\widehat{q}^f$. The profits of the re-located firms, $s(\mu - 1)W^f\widehat{q}^f$, are repatriated to Home. The difference between Foreign's export revenue and the re-patriated profit is $sW^f\widehat{q}^f$, which is used to buy the numeraire good from Home. The current account of each country is therefore balanced. It is as if the relocated firms themselves ship the quantity $sW^f\widehat{q}^f$ of the numeraire good to pay labour in Foreign and ship their output back to H.

We now consider the simplest scenario, where outsourcing does not involve any fixed cost. Under this scenario, all firms would want to relocate, unless the wage rate in home falls to W^f.

1.3.1 Case 1: flexible wage in the Home country

Assume $\overline{W} > W^f \geq \gamma$. All firms would want to relocate to the low-wage economy, unless the wage rate in H falls to W^f. In this sub-section, we assume that the threat of relocation and hence of unemployment in H is sufficient to cause the wage rate in H to fall to W^f. The price falls to

$$P^f = \mu W^f < \mu \overline{W} = v'(\overline{Q})$$

So output of the differentiated good expands to $\widetilde{Q} > \overline{Q}$, where

$$v'\left(\widetilde{Q}\right) = P^f$$

Of the total output $\widetilde{Q}$, the quantity $\overline{Q}$ is produced in Home. The difference $\widetilde{Q} - \overline{Q}$ is produced in the low-wage country. Home's social welfare is then

$$\Omega^1 = v(\widetilde{Q}) - W^f L^f - \gamma \overline{Q}$$

Proposition 1.1: *If the wage rate in the Home country is flexible, outsourcing will expand industry output, lower the price, and increase H's aggregate welfare.*

Proof: To show that the change in aggregate welfare in H is positive, note that, from the strict concavity of the function $v(Q)$,

$$v(\widetilde{Q}) - v(\overline{Q}) > v'\left(\widetilde{Q}\right)\left[\widetilde{Q} - \overline{Q}\right]$$

We can then define

$$R(\widetilde{Q}, \overline{Q}) \equiv v(\widetilde{Q}) - v(\overline{Q}) - v'\left(\widetilde{Q}\right)\left[\widetilde{Q} - \overline{Q}\right] > 0$$

The change in welfare is then

$$\Omega^1 - \overline{\Omega} = v(\widetilde{Q}) - v(\overline{Q}) - W^f L^f =$$

$$R(\widetilde{Q}, \overline{Q}) + v'\left(\widetilde{Q}\right)\left[\widetilde{Q} - \overline{Q}\right] - W^f L^f =$$

$$R(\widetilde{Q}, \overline{Q}) + (\mu W^f)\left[\widetilde{Q} - \overline{Q}\right] - W^f L^f = R(\widetilde{Q}, \overline{Q}) + (\mu - 1) W^f L^f > 0$$

where $R(\widetilde{Q}, \overline{Q}) > 0$ because of the strict concavity of $v(Q)$. ■

Of course, home unskilled workers receive a lower wage income. Their gains in consumer surplus may not be sufficient to offset the fall in wage income. But the gainers (the capitalists and the consumers) can compensate the losers.

1.3.2 Case 2: wage rigidity in the Home country

Consider now the opposite extreme where unskilled wage is fixed at $\overline{W} > W^f$. All workers in H will become unemployed, even though individually each would be willing to work at any wage $W \geq \gamma$. All the differentiated product firms re-locate to the low-wage country, and since their prices are now $p^f = \mu W^f$, the industry output is $\widetilde{Q}$, where $v'\left(\widetilde{Q}\right) = \mu W^f$. They employ L^f units of foreign labour, where $L^f = \widetilde{Q}$.

Who gain and who lose ?

Under outsourcing, consumer's surplus is

$$\text{CS} = v(\widetilde{Q}) - p^f \widetilde{Q}$$

Firms' aggregate profits are

$$\Pi = \left[p^f - W^f\right]\widetilde{Q} = \frac{1}{\theta}\left(\mu W^f\right)^{1-\beta} > \frac{1}{\theta}\left(\mu \overline{W}\right)^{1-\beta} \text{ as } \beta > 1$$

Since the unskilled workers are now unemployed, they lose all their worker's surplus.

The social welfare of the Home country under outsourcing is thus

$$\Omega^2 = \text{CS} + \Pi = v(\widetilde{Q}) - W^f \widetilde{L}^f = v(\widetilde{Q}) - W^f \widetilde{Q} =$$

$$v(\widetilde{Q}) - \frac{1}{\mu} v'\left(\widetilde{Q}\right)\widetilde{Q}$$

The change in welfare is

$$\Omega^2 - \overline{\Omega} = \left[v(\widetilde{Q}) - v(\overline{Q})\right] - \left\{\frac{v'\left(\widetilde{Q}\right)}{\mu}\widetilde{Q} - \gamma\overline{Q}\right\}$$

$$= \left[v(\widetilde{Q}) - v(\overline{Q})\right] - W^f\left[\widetilde{Q} - \overline{Q}\right] - \left\{W^f\overline{Q} - \gamma\overline{Q}\right\}$$

$$= \left[v(\widetilde{Q}) - v(\overline{Q}) - \mu W^f\left(\widetilde{Q} - \overline{Q}\right)\right] - \left\{W^f\overline{Q} - \gamma\overline{Q}\right\} + (\mu - 1)W^f\left[\widetilde{Q} - \overline{Q}\right] \quad (1.5)$$

The first term, $v(\widetilde{Q}) - v(\overline{Q}) - \mu W^f\left(\widetilde{Q} - \overline{Q}\right)$, which is positive, may be called the "**trade creation**" effect of the access to low-wage foreign labour: consumers in H buy more of the differentiated good, because the price is now lower. This term can be represented by the familiar Harberger triangle (see Figure 1.1.). The second term, $W^f\overline{Q} - \gamma\overline{Q}$, may

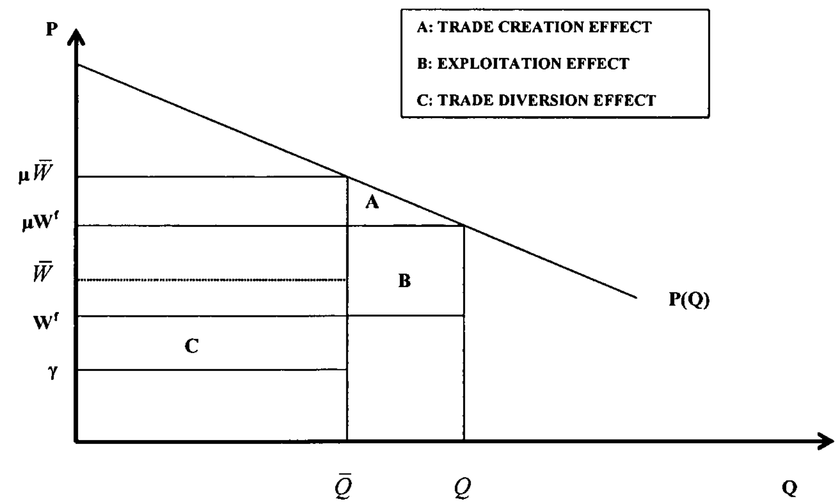

FIGURE 1.1: Decomposition of gains and losses

called "**trade diversion**" effect: Home producers are diverted to the foreign labour market because of the lower wage there. But from the point of view of Home's welfare, the true cost of H's labour is only γ per unit, not the fixed wage $\overline{W} > W^f$. The expression $W^f\overline{Q} - \gamma\overline{Q}$ is positive if the reservation wage γ in H is lower than the foreign wage W^f. The third term, $(\mu - 1)W^f\left[\tilde{Q} - \overline{Q}\right]$ is called the "**exploitation**" effect: Foreign labour is paid W^f but the price of what they produce is μW^f. The change in social welfare of the Home country is therefore *ambiguous;* it is positive if the sum of the trade creation effect and the exploitation effect exceeds the adverse trade diversion effect. A (overly) sufficient condition for this is $\gamma \geq W^f$.

Proposition 1.2: *If the wage rate in the home country does not fall to the foreign level W^f, unemployment will result, and the effect of outsourcing on social welfare of the*

Home country is ambiguous, depending on whether the sum of the "trade creation" effect and the "exploitation" effect dominates the "trade diversion" effect.

Corollary 1.2: (Welfare-enhancing Wage Subsidies) *Assume* $W^f > \gamma$. *To avoid the "trade diversion" effect, the government of the Home country can introduce a wage-subsidy scheme: for each unit of home labour employed, the firms need to pay only* W^f, *and the government pays the difference,* $\overline{W} - W^f$. *In our model, this subsidy is non-distorting. Under this wage subsidy scheme, social welfare is higher, because the "trade diversion" effect of outsourcing is avoided.*

We provide below some numerical examples of changes in welfare as the result of the "trade creation" effect, the "trade diversion" effect and the "exploitation" effect.

Example 1.3.1: outsourcing resulting in a decrease in welfare

Let $\alpha = 1/3$, and $\theta = 2$. Then $\mu = 2$ and $\beta = 1.5$. Assume $n\overline{L} = 1/(2\sqrt{2})$. Then full-employment output is $\overline{Q} = 1/(2\sqrt{2})$, and thus $\overline{P} = 2$ and $\overline{W} = 1$. Assume wage rigidity: the home wage is fixed at $\overline{W} = 1$ both before and after outsourcing. The reservation wage in the Home country is $\gamma = 0.1$ and foreign wage is $W^f = 0.9$. The price levels before and after outsourcing are $\overline{P} = \mu\overline{W} = 2$ and $P^f = \mu W^f = 1.8$ respectively. Since $Q = v'^{-1}(P) = P^{\frac{1}{\alpha-1}}$, we have $\overline{Q} = (2)^{-1.5}$ and $\widetilde{Q} = (1.8)^{-1.5}$. The change in welfare, from equation (5), is:

$$\begin{aligned}\Omega^2 - \overline{\Omega} &= \left[v(\widetilde{Q}) - v(\overline{Q}) - \mu W^f\left(\widetilde{Q} - \overline{Q}\right)\right] - \left\{W^f\overline{Q} - \gamma\overline{Q}\right\} + (\mu - 1)W^f\left[\widetilde{Q} - \overline{Q}\right] \\ &= \left[3\widetilde{Q}^{\frac{1}{3}} - 3\overline{Q}^{\frac{1}{3}} - 1.8\left(\widetilde{Q} - \overline{Q}\right)\right] - \left\{0.9\overline{Q} - 0.1\overline{Q}\right\} + 0.9\left[\widetilde{Q} - \overline{Q}\right] \\ &= 0.0057877 - 0.28284 + 0.05448 \\ &= -0.22257 < 0\end{aligned}$$

The "trade diversion" effect in this example dominates the sum of the "trade creation" effect and the "exploitation" effect. As the result, the net change in welfare is negative, i.e., a welfare reduction. The intuition is clear: when the foreign wage falls bellow the home wage, all firms have the incentive to outsource in order to maximize their profits. However, if the wage difference between the foreign country and home country is small, and the reservation wage at home is low, the social welfare will fall. This is because the increase in firm's profits and the increase in consumer's surplus are not large enough to compensate for the loss in worker's surplus at home.

Example 1.3.2: outsourcing resulting in an increase in welfare

In this example, the parameters take the same values as in the above example, except now the foreign wage is much lower than the wage rate at home, but still above the home country's reservation wage. Assume $W^f = 0.7$. The price levels before and after outsourcing are: $\overline{P} = \mu\overline{W} = 2$; $P^f = \mu W^f = 1.4$; $\overline{Q} = (2)^{-1.5}$; and $\widetilde{Q} = (0.6)^{-1.5}$. The change in welfare, from equation (1.5), is

$$\begin{aligned}\Omega^2 - \overline{\Omega} &= [0.063963] - \{0.21213\} + [0.17509] \\ &= 0.026923 > 0\end{aligned}$$

If the foreign wage falls further bellow the home wage, say $W^f = 0.3$, then the welfare improves by a larger amount:

$$\begin{aligned} \Omega^2 - \overline{\Omega} &= [0.6728] - \{0.070711\} + [0.53943] \\ &= 1.1415 > 0 \end{aligned}$$

Clearly, when the foreign wage is very low, both the "trade creation" effect and the "exploitation" effect are very large relative to the "trade diversion" effect. In this example, not only firms, but the society as a whole gains from outsourcing.

While outsourcing may result in lower welfare, it remains true that, *given that outsourcing takes place*, a lower W^f always increases welfare.

Proposition 1.3: *Given that outsourcing takes place and there is no fixed cost, a lower W^f always increases welfare.*

Proof: It suffices to show that

$$\frac{d\Omega^2}{dW^f} < 0$$

Now

$$\frac{d\Omega^2}{dW^f} = \left[v'(\widetilde{Q}) - \frac{v'(\widetilde{Q})}{\mu} - \frac{\widetilde{Q}}{\mu} v''(\widetilde{Q}) \right] \frac{d\widetilde{Q}}{dW^f} < 0$$

because $v'' < 0$ and $\mu > 1$.

1.4 Outsourcing with Homogeneous Fixed Costs

Now suppose that outsourcing involves a fixed cost $F(z) > 0$ for firm z. In this section, we assume $F(z) = F$ for all $z \in [0, 1]$. In a later section, we will allow for heterogeneity in

$F(z)$ across firms. A firm will choose to outsource only if the gain in gross profit (relative to keeping production in H) is sufficient to compensate for the fixed cost of outsourcing that must be incurred.

We now determine the equilibrium fraction of firms that choose to outsource.

1.4.1 Equilibrium profit under outsourcing

Suppose that only a fraction δ of firms outsource. Suppose the wage in Home, in the equilibrium with outsourcing, is rigid and fixed at some level W^h(for example, $W^h = \overline{W}$, the equilibrium wage before outsourcing takes place). Foreign wage is $W^f < W^h$. The price of the varieties produced at home is $p^h = \mu W^h$ and the price of the varieties that are outsourced is $p^f = \mu W^f < p^h$. The price index becomes

$$P = \left[(1-\delta)(\mu W^h)^{1-\theta} + \delta(\mu W^f)^{1-\theta}\right]^{1/(1-\theta)} \equiv P(\delta, W^f, W^h)$$

Let

$$K \equiv \left[(1-\delta)(\mu W^h)^{1-\theta} + \delta(\mu W^f)^{1-\theta}\right]$$

Clearly, the price index $P(\delta, W^f, W^h)$ falls as the fraction δ rises:

$$\frac{dP}{d\delta} = \frac{1}{1-\theta} K^{\theta/(1-\theta)} \left[(\mu W^f)^{1-\theta} - (\mu W^h)^{1-\theta}\right]$$
$$= \frac{1}{1-\theta} P^{\theta} \left[\frac{1}{(\mu W^f)^{\theta-1}} - \frac{1}{(\mu W^h)^{\theta-1}}\right] < 0$$

The equilibrium output of a home-produced variety is

$$q^h = (\mu W^h)^{-\theta} P^{\theta-\beta}$$

while that of an outsourced variety is

$$q^f = (\mu W^f)^{-\theta} P^{\theta-\beta}$$

The gross profit of the non-outsourcing firm is

$$\pi^h = q^h [\mu - 1] W^h = (\mu W^h)^{-\theta} P^{\theta-\beta} (\mu - 1) W^h$$

$$= \frac{1}{\theta(\mu W^h)^{\theta-1}} P^{\theta-\beta} \tag{1.6}$$

and that of the outsourcing firm is

$$\pi^f = \frac{1}{\theta(\mu W^f)^{\theta-1}} P^{\theta-\beta}$$

Given the outsourcing fraction δ, the gain in **gross profit** by an outsourcing firm (as compared with the alternative of producing in H) is

$$g(\delta) \equiv \pi^h - \pi^f = \frac{1}{\theta}\left[\frac{1}{(\mu W^f)^{\theta-1}} - \frac{1}{(\mu W^h)^{\theta-1}}\right]\left[P(\delta; W^f, W^h)\right]^{\theta-\beta} > 0$$

Clearly $g(\delta)$ is a decreasing function of δ.

Suppose there exists a number $\delta^* \in (0, 1)$ that satisfies the equation

$$F = \frac{1}{\theta}\left[\frac{1}{(\mu W^f)^{\theta-1}} - \frac{1}{(\mu W^h)^{\theta-1}}\right]\left[P(\delta^*; W^f, W^h)\right]^{\theta-\beta} \tag{1.7}$$

then in equilibrium, δ^* is the fraction of the industry that chooses to outsource. At the price $P(\delta^*; W^f, W^h)$, any individual firm is indifferent between remaining in the Home country, and re-locating to the low-wage economy.

The RHS of equation (1.7) is a positive and decreasing function of δ and the LHS is a positive constant. If F is neither too large nor too small, the equation (1.7) will identify a unique $\delta^* \in (0, 1)$ which is the equilibrium fraction of the industry that choose to outsource.

In fact, we can determine exactly the range (F_L, F_H) that F must belong to in order to generate an equilibrium with fractional outsourcing of the industry. We define

$$F_L \equiv \frac{1}{\theta}\left[\frac{1}{(\mu W^f)^{\theta-1}} - \frac{1}{(\mu W^h)^{\theta-1}}\right]\left[P(1; W^f, W^h)\right]^{\theta-\beta} = g(1) < g(\delta)$$

If the fixed cost F of outsourcing is lower than F_L, every firm will find that outsourcing is better than keeping production in H, regardless of how many firms it thinks will outsource (i.e. regardless of its conjectured δ value).

Next define

$$F_H \equiv \frac{1}{\theta}\left[\frac{1}{(\mu W^f)^{\theta-1}} - \frac{1}{(\mu W^h)^{\theta-1}}\right]\left[P(0; W^f, W^h)\right]^{\theta-\beta} = g(0) > g(\delta)$$

With $F > F_H$, every firm will find that outsourcing is inferior to keeping production in H, regardless of how many firms it thinks will outsource. Note that the upper and lower threshold levels F_L and F_H are functions of the parameters (W^h, W^f).

Example 1.4.1: upper and lower threshold levels of fixed cost, given wage rates in the Home and Foreign countries

Assume, again, $n\overline{L} = 1/(2\sqrt{2})$, $\theta = 2$ and $\alpha = \frac{1}{3}$. Then $\mu = 2$ and $\beta = 1.5$. Assume the wage rate at home is $W^h = 1$ and the wage rate in the foreign country is $W^f = 0.7$. When every firm chooses to outsource, i.e. $\delta = 1$, the price index will only includes foreign prices and $P_{\delta=1} = \mu W^f = 1.4$. Similarly, when every firm chooses keep production at home, i.e. $\delta = 0$, the price index only include home prices and $P_{\delta=0} = \mu W^h = 2$. Then, the upper and lower threshold levels of fixed cost that generate an equilibrium with fractional outsourcing of the industry are

$$F_L = \frac{1}{\theta}\left[\frac{1}{(\mu W^f)^{\theta-1}} - \frac{1}{(\mu W^h)^{\theta-1}}\right] P_{\delta=1}^{\theta-\beta}$$
$$= 0.12677$$
$$F_H = \frac{1}{\theta}\left[\frac{1}{(\mu W^f)^{\theta-1}} - \frac{1}{(\mu W^h)^{\theta-1}}\right] P_{\delta=0}^{\theta-\beta}$$
$$= 0.15152$$

Therefore, when $0.12677 < F < 0.15152$, we expect a positive fraction of firm will choose to relocate to the foreign country where cheap labour is available. For example, when $F = 0.14$, $\delta^* = 0.4$, i.e. 40% of the firms choose to shift production to the foreign country. As the foreign wage rate falls, we expect both threshold levels of the fixed cost of outsourcing to increase and the gap between them to widen. For example, when the foreign wage is $W^f = 0.5$, $F_L = 0.25$ and $F_H = 0.35355$.

Is it possible that the net profit under outsourcing is smaller than the net profit when outsourcing is not an available option? The answer is yes.

Proposition 1.4: *If the fixed cost F of outsourcing is within the range (F_L, F_H), in equilibrium only a fraction $\delta^* \in (0,1)$ will outsource. The outsourcing firms and the non-outsourcing firms earn the same profit in equilibrium. This profit may be lower than what firms earn when outsourcing is not available. It is definitely lower, if $W^h = \overline{W}$.*

Proof: Suppose $W^h = \overline{W}$, and assume that $F \in (F_L, F_H)$. Then a positive fraction δ of the industry will outsource, and the remaining fraction, $1 - \delta$, will keep production at home. Since no individual firm has any influence on industry price and output, and firms do not differ in cost characteristics, at the equilibrium, the net profit of an outsourcing firm is equal to that of a non-outsourcing firm. Now, since the price index P falls (relative to the closed economy level) with outsourcing, while p^h remains at $\mu\overline{W}$, the demand q^h and is now lower, and the profit π^h is also lower (as compared with the closed economy case), see equation (1.6). From this result, and the fact that at the outsourcing equilibrium with $\delta \in (0,1)$, all firms earn the same profit level, irrespective of their outsourcing status, it follows that all firms earn less profit when a fraction of the industry outsource in equilibrium. By continuity, if W^h is marginally lower than $\overline{W}$, outsourcing can reduce the profits of all firms. ■

Example 1.4.2: reduced profit under complete outsourcing

Assume, again, $n\overline{L} = 1/(2\sqrt{2})$, $\theta = 2$ and $\alpha = \frac{1}{3}$. Then $\mu = 2$ and $\beta = 1.5$. Assume that both before and after outsourcing, the home wage is fixed at $\overline{W} = 1$. In the closed economy, the price is $\overline{P} = \mu\overline{W} = 2$, and the profit of each firm is, from equation (1.4)

$$\widehat{\pi}_{closed} = \frac{1}{\theta}p(z)^{1-\beta} = \frac{1}{\theta}\left[\mu\overline{W}\right]^{1-\beta} = \frac{1}{2\sqrt{2}}$$

Suppose now outsourcing is available at some wage $W^f < 1$. Suppose that the fixed cost is F_L so that every firm finds that outsourcing is better than keeping production at H, regardless of how many firms it believes to choose to outsource. Therefore all firms will outsource, and the gross profit under outsourcing is

$$\widehat{\pi}_{out} = \frac{1}{\theta}\left[\mu W^f\right]^{1-\beta} = \frac{1}{2\sqrt{2W^f}} > \frac{1}{2\sqrt{2}}$$

The net profit from outsourcing is

$$\widehat{\pi}_{out}^{net} = \widehat{\pi}_{out} - F_L = \frac{1}{2\sqrt{2}\sqrt{W^f}} - 2^{-2}\left[\frac{1}{W^f} - 1\right]\left(2W^f\right)^{0.5}$$

$$= \frac{1}{2\sqrt{2}\sqrt{W^f}}\left[1-(1-W^f)\right] > 0$$

Clearly, since $W^f < \sqrt{W^f}$ when $W^f < 1$, the following inequality holds:

$$\widehat{\pi}_{out}^{net} < \widehat{\pi}_{closed}$$

It follows that, given $F = F_L$, the net profit from outsourcing is smaller than the profit that each firm makes when outsourcing is not available.

Corollary 1.4: *If $W^h = \overline{W}$, and fractional outsourcing takes place (i.e., $\delta \in (0,1)$), then employment in H will fall.*

Proof: Since q^h falls relative to the output of the representative firm in the closed economy case, the total employment in H falls from $n\overline{L}$ to δq^h. ■

Remark 1.4.1: Let us consider a given $F > 0$. At the initial closed economy equilibrium, the output is $\overline{Q} \equiv n\overline{L}$, the price is $\overline{P} = (n\overline{L})^{-1/\beta}$, and the wage rate is $\overline{W} = \overline{P}/\mu$. If W^f is just marginally lower than $\overline{W}$, there will be no outsourcing, because the saving in variable cost is not sufficient to outweigh the fixed cost of outsourcing. Outsourcing begins only when W^f falls below the *critical* threshold value W^{fc} (which is a function of F and $\overline{W}$) defined by

$$F = \frac{1}{\theta}\left[\frac{1}{(\mu W^{fc})^{\theta-1}} - \frac{1}{(\mu\overline{W})^{\theta-1}}\right]\left[P(0; W^{fc}, \overline{W})\right]^{\theta-\beta}$$

i.e.

$$\mu W^{fc} = \left[\frac{\left(\mu\overline{W}\right)^{\theta-\beta}}{\theta F + \left(\mu\overline{W}\right)^{1-\beta}}\right]^{\frac{1}{\theta-1}}$$

Further falls in W^f will lead to a positive δ. If W^h remains fixed at $\overline{W}$ due to institutional wage rigidity, the employment level in H will fall, as described in Corollary 1.4 above.

Example 1.4.3: critical level of foreign wage, given fixed cost of outsourcing

Assume the parameters take the same values as in Example 1.3.1, except now there is a fixed cost of outsourcing, $F = 0.3$. Given this fixed cost, firms will relocate only if the foreign wage falls bellow a critical level W^{fc} which satisfies

$$\begin{aligned} \mu W^{fc} &= \left[\frac{\left(\mu \overline{W}\right)^{\theta-\beta}}{\theta F + \left(\mu \overline{W}\right)^{1-\beta}} \right]^{\frac{1}{\theta-1}} \\ W^{fc} &= 0.54097 \end{aligned}$$

As the fixed cost becomes larger, say $F = 1.0$, this critical level of foreign wage falls to $W^{fc} = 0.2612$. The fall in foreign wage is necessary to compensate for a large cost of relocating production facilities.

Remark 1.4.2: (On the simultaneous determination of the extent of outsourcing and post-outsourcing domestic wage).

Now assume W^h is **flexible**. Then it will fall to preserve full employment in H. In that case, we have the following two conditions that simultaneously determine the equilibrium value of δ and W^h, denoted by δ^* and W^{h^*}:

$$(1-\delta)q^h = n\overline{L} \tag{1.8}$$

and

$$F = \frac{1}{\theta}\left[\frac{1}{(\mu W^f)^{\theta-1}} - \frac{1}{(\mu W^{h^*})^{\theta-1}}\right]\left[P(\delta; W^f, W^{h*})\right]^{\theta-\beta} \tag{1.9}$$

where

$$q^h = (\mu W^{h*})^{-\theta}\left[P(\delta; W^f, W^{h*})\right]^{\theta-\beta}$$

We can then compute the gains in consumer surplus, the loss in worker's surplus, the gains (or losses) in net profits, the net welfare gains, etc., associated with a given pair (F, W^f) where W^f is assumed to be below the *critical* threshold value W^{fc}.

1.4.2 Possibility of welfare loss under outsourcing with fixed cost, with or without domestic wage flexibility

We know that if (i) the fixed cost is zero, and (ii) $\gamma = W^f$, then the socially optimal extent of outsourcing is $\delta^{so} = 1$, and this coincides with the equilibrium extent of outsourcing. However, with positive fixed cost of outsourcing, it is possible to construct numerical examples where the gains from increased consumer surplus is not enough to compensate for the reduction in profits caused by outsourcing.

Remark 1.4.3: (On consumer's surplus under fractional outsourcing and flexible domestic wage). Before outsourcing, the consumer's surplus is

$$\overline{CS} = v(\overline{Q}) - \overline{PQ}$$

where

$$\overline{Q} = \left(\overline{P}\right)^{-\beta} = \left(\mu\overline{W}\right)^{-\beta} \text{ or } \overline{P} = \left(\overline{Q}\right)^{\alpha-1}$$

Thus

$$\overline{CS} = \frac{1}{\alpha}\left(\overline{Q}\right)^{\alpha} - \left(\overline{Q}\right)^{\alpha} = \left(\overline{Q}\right)^{\alpha}\left[\frac{1}{\alpha} - 1\right] = \left(\mu\overline{W}\right)^{-\alpha\beta}\left(\frac{1-\alpha}{\alpha}\right)$$

After outsourcing, with δ^* being the fraction of firms that outsource, the price level is

$$P(\delta^*; W^f, W^{h*})$$

and the associated consumption index is

$$\widehat{Q} = \left[P(\delta^*; W^f, W^{h*})\right]^{-\beta} \tag{1.10}$$

The CS after outsourcing is

$$\widehat{CS} = \frac{1}{\alpha}\left(\widehat{Q}\right)^{\alpha} - \left(\widehat{Q}\right)^{\alpha} = \left(\widehat{Q}\right)^{\alpha}\left[\frac{1}{\alpha} - 1\right] = \left[P(\delta^*; W^f, W^{h*})\right]^{-\alpha\beta}\left(\frac{1-\alpha}{\alpha}\right)$$

Example 1.4.4: Welfare loss under fractional outsourcing with fixed cost and flexible domestic wage

As before, we assume $n\overline{L} = 1/(2\sqrt{2})$, $\theta = 2$ and $\alpha = \frac{1}{3}$, then $\mu = 2$ and $\beta = 1.5$. Assume the home wage rate before outsourcing is $\overline{W} = 1$. Assume the fixed cost of production relocation is $F = 0.3$. As shown in example 1.4.3, the critical value of foreign wage is $W^{fc} = 0.54097$. As the foreign wage falls bellow this critical level, a fraction of firm will choose to outsource their production. Assume foreign wage is $W^f = 0.5$. We first calculate the level of consumer's surplus before outsourcing. This quantity is given by

$$\begin{aligned}\overline{CS} &= \frac{1}{\alpha}\left(\overline{Q}\right)^{\alpha} - \left(\overline{Q}\right)^{\alpha} = \left(\overline{Q}\right)^{\alpha}\left[\frac{1}{\alpha} - 1\right] = \left(\mu\overline{W}\right)^{-\alpha\beta}\left(\frac{1-\alpha}{\alpha}\right) \\ &= 1.4142\end{aligned}$$

The profit and worker surplus (assuming $\gamma = 0$) in the closed economy case are

$$\begin{aligned}\pi_{closed} &= 0.35355 \\ \omega_{closed} &= 0.35355\end{aligned}$$

Assume the home wage rate is **flexible**, then W^h will fall bellow $\overline{W}$ to preserve full employment in home country. The equilibrium values δ^* and W^{h^*} can be obtained from the systems of equation (1.8) and (1.9):

$$\begin{aligned}(1-\delta^*)q^h &= n\overline{L} = \overline{Q} = (\mu\overline{W})^{-\beta} \\ F &= \frac{1}{\theta}\left[\frac{1}{(\mu W^f)^{\theta-1}} - \frac{1}{(\mu W^{h^*})^{\theta-1}}\right]\left[P(\delta^*, W^f, W^{h*})\right]^{\theta-\beta}\end{aligned}$$

where

$$
\begin{aligned}
q^h &= (\mu W^{h*})^{-\theta} \left[P(\delta; W^{fc}, W^{h*})\right]^{\theta-\beta} \\
P(\delta^*, W^f, W^{h^*}) &= \left[(1-\delta^*)(\mu W^{h^*})^{1-\theta} + \delta^*(\mu W^f)^{1-\theta}\right]^{\frac{1}{1-\theta}}
\end{aligned}
$$

Substituting the parameter values in the above equations and solve for equilibrium values, we have $\delta^* = 0.084504$ and $W^{h^*} = 0.9215$. The price level after outsourcing is $P(\delta^*, W^f, W^{h^*}) = 1.7204$ and the associated consumption index is $\widehat{Q} = \left[P(\delta^*, W^f, W^{h^*})\right]^{-\beta} = 0.44316$. Therefore, the CS after outsourcing is

$$
\begin{aligned}
\widehat{CS} &= \frac{1}{\alpha}\left(\widehat{Q}\right)^{\alpha} - \left(\widehat{Q}\right)^{\alpha} = \left(\widehat{Q}\right)^{\alpha}\left[\frac{1}{\alpha} - 1\right] \\
&= 1.5248
\end{aligned}
$$

The profit and worker surplus (assuming $\gamma = 0$) in the fractional outsourcing case are

$$
\begin{aligned}
\pi_{out} &= 0.368\,3 - 0.3 = 0.0683 \\
\omega_{out} &= 0.325\,80
\end{aligned}
$$

This example shows a net fall in welfare (by the amount 0.2033) when outsourcing takes place: $\widehat{CS} + \pi_{out} + \omega_{out} < \overline{CS} + \pi_{closed} + \omega_{closed}$.

1.5 Outsourcing under Heterogeneous Fixed Costs

Assume that firms differ with respect to fixed cost of outsourcing. Rank them in the increasing order of fixed costs, and assume that $F(0) = 0$ and $F(1) = \infty$.

We now determine the equilibrium fraction of firms that choose to outsource when fixed costs differ across firms.

1.5.1 Equilibrium fractional outsourcing: the pivot firm

Suppose that only a fraction δ of firms outsource. Suppose the wage in Home is rather rigid and is **fixed** at W^h.

Taking into account the fixed cost of outsourcing, there is a "pivot firm", say firm z^*, that is indifferent between outsourcing and keeping production at home. Clearly z^* satisfies the equation

$$F(z) = \frac{1}{\theta}\left[\frac{1}{(\mu W^f)^{\theta-1}} - \frac{1}{(\mu W^h)^{\theta-1}}\right]\left[P(z, W^f, W^h)\right]^{\theta-\beta} \tag{1.11}$$

Assume $\theta > \beta$. Then the RHS of equation (1.11) is a positive and decreasing function of z^* and the LHS is increasing in z^*. Since $F(z^*)$ is increasing in z^*, there is a unique z^*(which depends on the fixed W^h and W^f).

Lemma 1.5.1 : *Given* (W^h, W^f), *the equilibrium fraction of firms that choose to outsource is unique, and satisfies equation* (1.11).

Comparative statics: For a fixed W^h, a **decrease** in W^f will shift the RHS of equation (1.11) up , leading to a larger z^*, as expected. More formally, define

$$\psi(z^*, W^f) = F(z^*) - \frac{1}{\theta}\left[\frac{1}{(\mu W^f)^{\theta-1}} - \frac{1}{(\mu W^h)^{\theta-1}}\right]\left[P(z^*, W^f, W^h)\right]^{\theta-\beta} = 0$$

We want to show that

$$\frac{dz^*}{dW^f} = \frac{\left[\frac{\partial\psi}{\partial W^f}\right]}{\left[-\frac{\partial\psi}{\partial z}\right]} < 0$$

where

$$P(z^*; W^f, W^h) = \left[(1-z^*)(\mu W^h)^{1-\theta} + z^*(\mu W^f)^{1-\theta}\right]^{\theta/(1-\theta)}$$

The denominator $\left[-\frac{\partial\psi}{\partial z}\right]$ is negative, because $F' > 0$ and $\partial P(z^*; W^f, W^h)/\partial z < 0$ for $W^f < W^h$. The numerator is positive because $0 < \frac{\partial P(z^*;W^f)}{\partial W^f}\frac{W^f}{P} < 1$.

Lemma 1.5.2: *An increase in W^f will reduce z^*.*

Suppose the wage in H is fixed at W^h. Does outsourcing decrease employment at home?

Before outsourcing, employment at home is $n\overline{L}$.

$$n\overline{L} = (\mu W^h)^{-\theta} \left[P(0, W^f, W^h)\right]^{\theta-\beta}$$

Now, after outsourcing, employment at home is

$$(1 - z^*)q^h = (1 - z^*)(\mu W^h)^{-\theta} \left[P(z^*, W^f, W^h)\right]^{\theta-\beta} \tag{1.12}$$

The RHS of equation (1.12) is decreasing in z^*. So **employment falls,** if W^h is fixed at $\overline{W}$.

The quantity of foreign labour employed by firms that outsource abroad is

$$L^f = z^*(\mu W^f)^{-\theta} \left[P(z^*)\right]^{\theta-\beta}$$

Assume all workers prefer being employed at wage W^h to being unemployed with assistance payment W_A. Then the labour market allocates the fixed number of jobs at random.

1.5.2 Welfare under heterogeneous fixed costs

Social welfare consists of the utility of consuming the quantity Q (all output are consumed at home) minus (i) the effort cost of home labour, $\gamma(nL_u)$, where $nL_u = (1 - z^*)q^h \leq n\overline{L}$, and (ii) the value of all payments to foreign factors of production. Note that (ii) is the sum of fixed costs and variable costs:

$$\int_0^{z^*} F(z)dz + W^f \left[z^* q^f\right] =$$

$$\Phi(z^*) + z^* W^f (\mu W^f)^{-\theta} P(z^*, W^f, \overline{W})^{\theta-\beta}$$

Recall that

$$Q = C \equiv \left[\int_0^1 c(z)^{\frac{\theta-1}{\theta}} dz\right]^{\frac{\theta}{\theta-1}} = \left[\int_0^1 q(z)^{\frac{\theta-1}{\theta}} dz\right]^{\frac{\theta}{\theta-1}} =$$

$$\left[\int_0^{z^*} q^f(z)^{\frac{\theta-1}{\theta}} dz + \int_{z^*}^1 q^h(z)^{\frac{\theta-1}{\theta}} dz\right]^{\frac{\theta}{\theta-1}} =$$

$$\left[z^* \left(q^f\right)^{\frac{\theta-1}{\theta}} + (1-z^*) \left(q^h\right)^{\frac{\theta-1}{\theta}}\right]^{\frac{\theta}{\theta-1}}$$

where

$$q^f = (\mu W^f)^{-\theta} \left[P(z^*, W^f, \overline{W})\right]^{\theta-\beta}$$

$$q^h = (\mu W^h)^{-\theta} \left[P(z^*, W^f, \overline{W})\right]^{\theta-\beta}$$

Welfare under outsourcing is

$$\widehat{\Omega} = v(\widehat{Q}) - \gamma(1-z^*)(\mu W^h)^{-\theta} \left[P(z^*, W^f, \overline{W})\right]^{\theta-\beta} - \Phi(z^*) - z^* W^f (\mu W^f)^{-\theta} P(z^*, W^f, \overline{W})^{\theta-\beta}$$

where, using a modified version of equation (1.10),

$$\widehat{Q} = \left[P(z^*; W^f, \overline{W})\right]^{-\beta} \tag{1.13}$$

$$v(\widehat{Q}) = \frac{1}{\alpha} \left[P(z^*; W^f, \overline{W})\right]^{-\alpha\beta}$$

The net gain (or loss) due to outsourcing is

$$\widehat{\Omega} - \overline{\Omega} = \left[v(\widehat{Q}) - v\left(\overline{Q}\right)\right] - \left\{\gamma(1-z^*)q^h + z^* W^f q^f - \gamma\overline{Q}\right\} - \Phi(z^*)$$

Again, this expression is ambiguous in sign. It can be negative if $W^f - \gamma$ is sufficiently large.

Example 1.5.1: heterogeneous fixed cost and positive welfare change

Assume the same set of parameter values, i.e. $\theta = 2$ and $\alpha = \frac{1}{3}$, then $\mu = 2$ and $\beta = 1.5$. The home wage rate is assumed to be fixed at $W^h = \overline{W} = 1$, the foreign wage is $W^f = 0.5$ and the reservation wage at home is $\gamma = 0.2$. Assume the "pivot firm" has the fixed cost of outsourcing $F(z^*) = 0.27$. By substituting $F(z^*)$ into $F(z^*) = \frac{1}{\theta}\left[\frac{1}{(\mu W^f)^{\theta-1}} - \frac{1}{(\mu W^h)^{\theta-1}}\right]\left[P(z^*, W^h, W^f\right]^{\theta-\beta}$, we can calculate the value of $z^* = 0.71468$. Given the value of z^*, the price index is $P\left(z^*, W^h, W^f\right) = 1.1664$. The price index before outsourcing is $P(0, W^h, W^f) = 2$. To facilitate the calculation of welfare change, we calculate the following quantities

$$
\begin{aligned}
q^h &= (\mu W^h)^{-\theta}\left[P(z^*, W^f, \overline{W})\right]^{\theta-\beta} = 0.27 \\
q^f &= (\mu W^f)^{-\theta}\left[P(z^*, W^f, \overline{W})\right]^{\theta-\beta} = 1.08 \\
\overline{Q} &= \left[P(0, W^h, W^f\right]^{-\beta} = 2^{-1.5} \\
\widehat{Q} &= \left[P(z^*, W^h, W^f\right]^{-\beta} = 1.1664^{-1.5} \\
v(\overline{Q}) &= \frac{1}{\alpha}\overline{Q}^{\alpha} = 3(2)^{-0.5} \\
v(\widehat{Q}) &= \frac{1}{\alpha}\widehat{Q}^{\alpha} = 3(1.1664)^{-0.5} \\
\Phi(z^*) &= \int_0^{z^*} F(z)dz < z^* F(z^*)
\end{aligned}
$$

Using the above quantities, we calculate the change in welfare when outsourcing is allowed, given heterogeneous fixed costs of relocation:

$$
\begin{aligned}
\widehat{\Omega} - \overline{\Omega} &= \left[v(\widehat{Q}) - v\left(\overline{Q}\right)\right] - \left\{\gamma(1-z^*)q^h + z^* W^f q^f - \gamma\overline{Q}\right\} - \Phi(z^*) \\
&\geq [0.65646] - \{0.33062\} - 0.19296 > 0
\end{aligned}
$$

In this example, the positive change in CS is sufficient large to offset variable costs and fixed costs of outsourcing, resulting in a net positive change in social welfare.

Example 1.5.2: heterogeneous fixed cost and negative welfare change

Assume the same set of parameter values, i.e. $\theta = 2$ and $\alpha = \frac{1}{3}$, then $\mu = 2$ and $\beta = 1.5$. The home wage rate is assumed to be fixed at $W^h = \overline{W} = 5$, the foreign wage is $W^f = 4$ and the reservation wage at home is $\gamma = 0.2$. Assume the "pivot firm" has the fixed cost of outsourcing $F(z^*) = 0.0355$. By substituting $F(z^*)$ into $F(z^*) = \frac{1}{\theta}\left[\frac{1}{(\mu W^f)^{\theta-1}} - \frac{1}{(\mu W^h)^{\theta-1}}\right]\left[P(z^*, W^h, W^f\right]^{\theta-\beta}$, we can calculate the value of $z^* = 0.95933$. Given the value of z^*, the price index is $P\left(z^*, W^h, W^f\right) = 8.0656$. The price index before outsourcing is $P(0, W^h, W^f) = 10$. To facilitate the calculation of welfare change, we calculate the following quantities

$$
\begin{aligned}
q^h &= (\mu W^h)^{-\theta}\left[P(z^*, W^f, \overline{W})\right]^{\theta-\beta} = 0.011111 \\
q^f &= (\mu W^f)^{-\theta}\left[P(z^*, W^f, \overline{W})\right]^{\theta-\beta} = 1.1111 \\
\overline{Q} &= \left[P(0, W^h, W^f\right]^{-\beta} = 10^{-1.5} \\
\widehat{Q} &= \left[P(z^*, W^h, W^f\right]^{-\beta} = 8.0656^{-1.5} \\
v(\overline{Q}) &= \frac{1}{\alpha}\overline{Q}^{\alpha} = 3(10)^{-0.5} \\
v(\widehat{Q}) &= \frac{1}{\alpha}\widehat{Q}^{\alpha} = 3(8.0656)^{-0.5} \\
\Phi(z^*) &= \int_0^{z^*} F(z)dz < z^* F(z^*) = 0.20833
\end{aligned}
$$

Using the above quantities, we calculate the change in welfare when outsourcing is allowed, given heterogeneous fixed costs of relocation:

$$\begin{aligned}\widehat{\Omega}-\overline{\Omega} &= \left[v(\widehat{Q})-v\left(\overline{Q}\right)\right]-\left\{\gamma(1-z^{*})q^{h}+z^{*}W^{f}q^{f}-\gamma\overline{Q}\right\}-\Phi(z^{*})\\ &= [0.10765]-\{0.16419\}-\Phi(z^{*})\ <0\end{aligned}$$

In this example, the positive change in CS is not sufficient large to offset variable costs and fixed costs of outsourcing, resulting in a net fall in social welfare.

1.6 Optimal Outsourcing vs. Equilibrium Outsourcing

Suppose the government can influence the fraction of firms that outsource, e.g., by subsidizing the fixed costs of outsourcing. What is the optimal z? This depends on whether W^h is fixed (which implies an increase in unemployment when there is an increase in outsourcing), or W^h is flexible (so that full employment is maintained at home).

Let us consider the case where the wage rate in H is rigid. Social welfare consists of gross consumer surplus, minus the payments of fixed costs (to foreigners), minus the disutility of work of home workers.

$$\Omega = v(Q) - W^f z q^f - \int_0^z F(s)ds - \gamma(1-z)q^h$$

We take W^f and W^h as given, possibly with $W^h = \overline{W}$.

Differentiating Ω with respect to z, we obtain the FOC

$$v'(Q)\frac{dQ}{dz} + \gamma q^h - \gamma(1-z)\frac{dq^h}{dz} - W^f q^f - W^f z\frac{dq^f}{dz} - F(z) = 0$$

Now $v'(Q) = P$ and

$$Q = P^{-\beta}$$

So

$$\frac{dQ}{dz} = -\beta P^{-\beta-1}\frac{dP}{dz} = -\beta P^{-\beta-1}\frac{1}{1-\theta}K^{\theta/(1-\theta)}\left[\frac{1}{(\mu W^f)^{\theta-1}} - \frac{1}{(\mu W^h)^{\theta-1}}\right]$$
$$= -\beta P^{-\beta-1}\frac{1}{1-\theta}P^{\theta}\left[\frac{1}{(\mu W^f)^{\theta-1}} - \frac{1}{(\mu W^h)^{\theta-1}}\right]$$
$$v'(Q)\frac{dQ}{dz} = P^{\theta-\beta}\frac{\beta}{\theta-1}\left[\frac{1}{(\mu W^f)^{\theta-1}} - \frac{1}{(\mu W^h)^{\theta-1}}\right] > 0$$

Let z^{so} be the socially optimal fraction of the industry to outsource. Then z^{so} satisfies equation:

$$F(z^{so}) = P^{\theta-\beta}\frac{\beta}{\theta-1}\left[\frac{1}{(\mu W^f)^{\theta-1}} - \frac{1}{(\mu W^h)^{\theta-1}}\right] - W^f\left[(\mu W^f)^{-\theta}P^{\theta-\beta}\right] - W^f z^{so}\frac{dq^f}{dz} \tag{1.14}$$

where

$$W^f\frac{dq^f}{dz} = W^f(\mu W^f)^{-\theta}(\theta-\beta)\,P^{\theta-\beta-1}\frac{dP}{dz}$$
$$= W^f(\mu W^f)^{-\theta}(\theta-\beta)\,P^{\theta-\beta-1}\frac{1}{1-\theta}P^{\theta}\left[\frac{1}{(\mu W^f)^{\theta-1}} - \frac{1}{(\mu W^h)^{\theta-1}}\right] < 0$$

So equation (1.14) becomes

$$\frac{1}{P^{\theta-\beta}}F(z^{so}) = \frac{\beta}{\theta-1}\left[\frac{1}{(\mu W^f)^{\theta-1}} - \frac{1}{(\mu W^h)^{\theta-1}}\right] -$$

$$W^f(\mu W^f)^{-\theta}\left\{1 - z\frac{(\theta-\beta)}{(1-\theta)}P^{\theta-1}\left[\frac{1}{(\mu W^f)^{\theta-1}} - \frac{1}{(\mu W^h)^{\theta-1}}\right]\right\} \tag{1.15}$$

On the other hand, under laissez-faire, the equilibrium fraction of firms that outsource, denoted by z^*, satisfies the equation

$$\frac{1}{P^{\theta-\beta}}F(z^*) = \frac{1}{\theta}\left[\frac{1}{(\mu W^f)^{\theta-1}} - \frac{1}{(\mu W^h)^{\theta-1}}\right] \tag{1.16}$$

Thus we can have $z^{so} = z^*$ if and only if

$$\left[\frac{1}{(\mu W^f)^{\theta-1}} - \frac{1}{(\mu W^h)^{\theta-1}}\right] \left\{ \left(\frac{\beta\theta - \theta + 1}{\theta}\right) \mu^\theta (W^f)^{\theta-1} - (\theta - \beta) z^* P^{\theta-1} \right\} = 1 \quad (1.17)$$

Proposition 1.5: *In general, the equilibrium extent of outsourcing, z^*, does not coincide with the socially optimal extent, z^{so}. A necessary and sufficient condition for the two values to coincide is that the equality (1.17) holds.*

Since z^* depends on the function $F(.)$, while condition (1.17) does not, we conclude that generically $z^{so} \neq z^*$.

1.7 A Two-period Model

Now consider an extension of the model to a two-period framework. Assume that any firm that outsources incurs the fixed cost only once. (For example, the cost of setting up a plant.) We suppose that $F_1 > F_2$. By delaying outsourcing to the second period, a firm can save on the fixed cost, but at the same time, it cannot take advantage of the low wage in period 1.

There are three strategies that a firm can adopt. We denote by (f, f) the strategy of outsourcing in both periods (and thus incurring the fixed cost in period 1). The strategy (h, f) means producing in H in period 1, and outsourcing in period 2. Finally, the strategy (h, h) means to keep production in H in both periods.

Let us consider the case where firms are ex-ante identical, i.e., the fixed cost of outsourcing is the same for all. Let F_t be the fixed cost that a firm must pay if it begins outsourcing in period t. Let z_1 denote the measure of firms that choose (f, f), $z_2 - z_1$ denote the measure of firms that choose (h, f), and $1 - z_2$ denote the measure of firms that choose (h, h). Let W^f be the wage in the foreign country, which we assume to be the same in both periods. Let $\overline{W}$ be the fixed wage in H.

The price index for the differentiated good in period 1 is

$$P_1 = P(z_1, W^f, \overline{W}) = \left[(1 - z_1)(\mu W^h)^{1-\theta} + z_1(\mu W^f)^{1-\theta}\right]^{1/(1-\theta)} \tag{1.18}$$

and for period 2,

$$P_2 = P(z_2, W^f, \overline{W}) = \left[(1 - z_2)(\mu W^h)^{1-\theta} + z_2(\mu W^f)^{1-\theta}\right]^{1/(1-\theta)} < P_1 \tag{1.19}$$

The period-1 demand and period-2 demand for the output of the firm that chooses (f, f) are

$$q_1(f, f) = (\mu W^f)^{-\theta} \left[P(z_1, W^f, \overline{W})\right]^{\theta-\beta}$$

$$q_2(f, f) = (\mu W^f)^{-\theta} \left[P(z_2, W^f, \overline{W})\right]^{\theta-\beta}$$

The period-1 demand and period-2 demand for the output of the firm that chooses (h, f) are

$$q_1(h, f) = (\mu \overline{W})^{-\theta} \left[P(z_1, W^f, \overline{W})\right]^{\theta-\beta}$$

$$q_2(h, f) = (\mu W^f)^{-\theta} \left[P(z_2, W^f, \overline{W})\right]^{\theta-\beta} = q_2(f, f)$$

The period-1 demand and period-2 demand for the output of the firm that chooses (h, h) are

$$q_1(h, h) = (\mu \overline{W})^{-\theta} \left[P(z_1, W^f, \overline{W})\right]^{\theta-\beta} = q_1(h, f)$$

$$q_2(h, h) = (\mu \overline{W})^{-\theta} \left[P(z_2, W^f, \overline{W})\right]^{\theta-\beta} < q_1(h, h)$$

Let $r > 0$ denote the interest rate. Define $R = (1 + r)$. The present value of net profits of a representative firm of type (f, f) is

$$V(f,f) = \frac{1}{\theta}(\mu W^f)^{1-\theta}\left[P(z_1, W^f, \overline{W})\right]^{\theta-\beta} - F_1 + \frac{1}{\theta}R^{-1}(\mu W^f)^{-\theta}\left[P(z_2, W^f, \overline{W})\right]^{\theta-\beta} \tag{1.20}$$

That of a representative firm of type (h, f) is

$$V(h,f) = \frac{1}{\theta}(\mu\overline{W})^{1-\theta}\left[P(z_1, W^f, \overline{W})\right]^{\theta-\beta} - R^{-1}F_2 + \frac{1}{\theta}R^{-1}(\mu W^f)^{-\theta}\left[P(z_2, W^f, \overline{W})\right]^{\theta-\beta} \tag{1.21}$$

and that of a representative firm of type (h, h) is

$$V(h,h) = \frac{1}{\theta}(\mu\overline{W})^{1-\theta}\left[P(z_1, W^f, \overline{W})\right]^{\theta-\beta} + \frac{1}{\theta}R^{-1}(\mu\overline{W})^{-\theta}\left[P(z_2, W^f, \overline{W})\right]^{\theta-\beta} \tag{1.22}$$

All three types of firms coexist in equilibrium if and only if there are values $z_1^* \in (0, 1)$ and $z_2^* \in (z_1^*, 1)$ that satisfy the following pair of equations:

$$V(f,f) = V(h,f) \tag{1.23}$$

$$V(f,f) = V(h,h) \tag{1.24}$$

In this case, all firms earn the same present value of net profits, and they all make less profit than in the closed economy equilibrium. (Of course, lower profits do not necessarily mean lower welfare; the gain in consumer's surplus may dominates the fall in profits.)

Example 1.7.1: Fractional outsourcing in a two period model

We assume $\theta = 2$ and $\alpha = \frac{1}{3}$, then $\mu = 2$ and $\beta = 1.5$. Assume the home wage rate is rigid and stays at $\overline{W} = 1$ both before and after outsourcing. Assume foreign wage is

$W^f = 0.5$. Firms can choose to outsource in period 1, when the fixed cost of outsourcing is $F_1 = 0.55$. If they wait until period 2, the fixed cost of outsourcing falls to $F_2 = 0.27$. Assume a discount rate $r = 0.1$, then $R = 1.1$. We're interested in finding out the proportion of firms that decide to outsource in the first period, and the corresponding proportion in the second period. It is straight forward to solve the system of equations (23) and (24) given

$$\begin{aligned}
V(f,f) &= \frac{1}{2}(1)^{-1}P_1^{0.5} - 0.55 + (1.1)^{-1}\frac{1}{2}(1)^{-1}P_2^{0.5} \\
V(h,f) &= \frac{1}{2}(2)^{-1}P_1^{0.5} - (1.1)^{-1}0.27 + (1.1)^{-1}\frac{1}{2}(1)^{-1}P_2^{0.5} \\
V(h,h) &= \frac{1}{2}(2)^{-1}P_1^{0.5} + (1.1)^{-1}\frac{1}{2}(2)^{-1}P_2^{0.5} \\
P_1 &= \left[(1-z_1)(2)^{-1} + z_1(1)^{-1}\right]^{-1} \\
P_2 &= \left[(1-z_2)(2)^{-1} + z_2(1)^{-1}\right]^{-1}
\end{aligned}$$

The equilibrium values are $z_1^* = 0.34771$ and $z_2^* = 0.71468$.

1.8 Concluding Remarks

We have developed a theoretical model to evaluate the effects of outsourcing on consumer surplus, profits, worker's surplus, and welfare. One of the conclusions is that outsourcing is not necessarily profit-enhancing in equilibrium, even though it is individually rational for each firm to choose to outsource. This is because firms do not internalize the effect of their outsourcing decision on the industry price level. With a sufficiently large fall in price, the benefits of the low wage in the foreign country turns out to be a curse. Another source of welfare loss from outsourcing is the "trade diversion" effect of access to the foreign labour pool. Firms prefer foreign labour to domestic labour because of the low foreign wage rate. However, from the perspective of social welfare of the advanced economy, the true labour cost in the home country is not the high wage there, but only the disutility of work. In general, outsourcing need not be welfare improving.

We have also indicated that the extent and the speed of outsourcing in a laissez-faire equilibrium may not be socially optimal. Under certain conditions, a slowing down of the speed of outsourcing can improve welfare.

In this chapter, we have abstracted from a number of considerations. For example, does a minimum wage in Europe has any impact on the wage level in the US?. Davis (1998) argued that European unemployment props up American wages. His model relies on factor price equalization[3] and yields some implications that seem contrary to available evidence. For example, his theory implies that the immigration of Mexican workers into the US would have no effect on US wages, which are determined by the minimum wage in Europe. This is contrary to the evidence presented by Borjas et al. (1997). A recent note by Meckl (2006) disputes Davis's results, by allowing for heterogeneity among workers and for skill-upgrading[4]. In Meckl's model, the minimum hourly real wage, if it binds, corresponds to the real wage of the lowest-ability *employed* worker (who is not at the lowest point of the ability range, and who therefore provides more than an effective labor-hour). Thus the real cost of an effective labour hour is endogenously determined. Therefore, unlike Davis's model, in Meckl's model, setting a minimum hourly real wage does not tie down all relative prices. One possible extension of our model of outsourcing under monopolistic

[3] This reliance has been criticized by Atkinson (2001) and Oslington (2002).

[4] For an alternative model of skill-upgrading, see Long et al. (2007).

competition is to allow for the endogenous determination of the cut-off ability level, and for interdependence among advanced economies (such as Europe and the USA).

Chapter 2

Fair Trade Goods versus Conventional Goods: Some Theoretical Considerations.

2.1 Introduction

Fair trade products are becoming more and more popular, especially in OECD countries. In addition to specialized shops (SS) offering fair trade products exclusively, fair trade goods are also available in over 55,000 supermarkets across Europe (Krier, 2005). The Fair Trade Federation (FTF) reported a total fair trade sale of $2.6 billion in 2006. Although this represents a small share of the total world trade volume, the sale growth rates of several fair trade products are impressive. For example, in 2006, the Fair Trade Labeling Organizations International (FLO) reported a 93% growth in the global fair trade cocoa sector, while coffee had grown by 53%, tea by 41% and banana by 31%. The range of fair trade products has also been widened considerably over the past decade to include flowers, coffee, tea, banana, honey, wine, handicrafts, sport balls, and cosmetics among others.

Although fair trade is not a new concept[5], there is still no widely accepted definition of fair trade in the academic world. According to FINE[6], fair trade is defined as "a trading partnership, based on dialogue, transparency and respect, which seeks greater equity in international trade. It contributes to sustainable development by offering better trading

[5] The concept of fair trade can be traced back to 1860 with Multatuli's (1987) book that reports injustices in the coffee trade between Indonesia and the Netherlands.

[6] FINE is an informal ubrella group of the four main international fair trade networks: (F) Fairtrade Labeling Organizations International; (I) International Federation for Alternative Trade; (N) Network of European Shops; and (E) European Fair Trade Association.

conditions to, and securing the rights of, marginalized producers and workers, especially in the South" (FINE, 2001). While it appears to be simple that the primary goal of fair trade initiatives, as suggested by this definition, is to foster "equity" or "fairness" in international trade, matters are much more complex when one tries to understand consumers' motives for purchasing a particular fair trade product. Ferran and Grunert (2007) outline a number of heterogeneous motives and values of fair trade coffee consumers. These include (i) a desire for equality between humans and in human relationships through participation in the alternative economy; (ii) a desire for hedonism by the consumption of high-quality products; and (iii) a wish to protect oneself and the environment. In addition to these motives, Shaw et al. (2000) suggest that "self-identity" and ethical obligation play an important role in socially responsible consumer decision-making. In reference to fair trade, they stress that "while many consumers acting in a rational self-motivated manner may select coffee on the basis of factors such as price and taste, those concerned about ethical issues may be guided by a sense of obligation to others and identification with ethical issues, where concerns such as providing a fair price for fair trade producers take priority" (p. 889). Identity, therefore, was suggested to be an important motive for the consumption of fair trade products.

While there are plenty of general discussion material on fair trade, the academic modelling of fair trade has been scarce. Two prominent exceptions are the papers by Becchetti and Andriani (2002) and Richardson and Stähler (2007). The former paper considers a good produced in the South where the conventional firms acts as a monopsonist, and the emergence of a fair trade (FT) firms forces the monopsonist to increase wages to Southern workers. The latter paper offers a formal model of rivalry between two firms: a fair trade firm, which obtains the raw material (coffee beans) from cooperative producers (fair trade growers of coffee beans), and a conventional profit-maximizing firm that buy coffee beans from a competitive spot market. It analyzes how the FT firm's gain from offering a higher wages (as consumers values the FT product more, the higher is the wage it pays to Southern workers) is partly offset by the moral hazard problems associated with cooperative farming.

In this chapter, we propose an alternative approach to modeling the attractiveness of FT products and the rivalry between a FT firm and a conventional firm. We use the concept of "economic identity" introduced by Akerlof and Kranton (2000, 2002, 2005), and apply it to the analysis of competition between a FT firm and a conventional firm. In our model, products are differentiated on the basis of their "ethical" or "social- responsibility" attributes. In particular, we assume that consumers have special valuation of a fair trade (FT) product in contrast to its ordinary counterpart. We argue that the consumption of FT product would distinguish the FT consumers from the rest of the population, therefore giving them a special economic identity. By incorporating this economic identity into the utility functions, we can assess the incentives of firms to be different in their choice of product attributes and prices.

Our analysis is based on the perceptive remark made by Akerlof and Kranton, namely, "our desires are fundamentally affected not just by who we are, but also by who we feel we ought to be". We introduce the economic identity function into our model, and show how the parameters of this function impact the equilibrium prices of the FT product and of the conventional counterpart. We also show how the conventional firm may react by positioning itself in a point in the product space. Finally, we formulate a dynamic model where the FT firm can manipulate the identity function by dissemination of information.

2.2 The Basic Model

2.2.1 The social responsibility standard space

Let us consider two firms, denoted by A and B, selling two horizontally differentiated products z_a and z_b respectively. The two products z_a and z_b are identical in quality, except for their "social responsibility" attributes. While z_a has zero or low "social responsibility" standard (e.g. ordinary coffee), z_b is assumed to have a high standard (e.g. FT coffee).

The potential market for both firms is assumed to be a line segment with the length of 1. In the traditional horizontal product differentiation models, the line segment is sometimes interpreted as the physical space within which firms are located. As firms deliver products to consumers, they incur transportation costs, which are determined by the distances between the firms and the consumers. Transportation costs are assumed to be symmetric, i.e. the costs are the same for the same distances, regardless of relative positions of firms and consumers (i.e. it does not matter whether consumers are located to the left or to the right of the firms).

In our model, we provide a different interpretation for the line segment. It represents the space of "social responsibility" standards. Firms having zero or low "social responsibility" standard, such as firm A, would position themselves on the left end of the segment. On the other hand, firms with high standards, such as firm B, would take positions on the right end of the segment. Let a and b denote the positions of firm A and firm B on the market segment respectively, then the values of a and b determine the firms' "social responsibility" standards. In what follows, for simplicity, we assume that while firm A is located a a point a near zero, firm B is located at point $b = 1$.

We assume there is a continuum of consumers uniformly distributed on the same market segment previously described. Let x_i be the position of consumer i on the line. Then $x_i \in [0, 1]$ represents consumer i's "social responsibility" standard regarding the consumption of FT products. For simplicity, we assume each consumer demands only one unit of the product: hence she either buys one unit of z_a, or one unit of z_b (or, if the prices are too high, she does not purchase the product.)

If consumer x_i chooses to consume z_b, he belongs to a "select group", which yields an added utility. We assume this added utility depends on the size (denoted by $1 - \gamma$) of the select group. A consumers' net surplus of consuming a product z (either z_a or z_b) is equal to the excess of her individual valuation of the product over the paid price. Therefore, for any consumer i, having social responsibility standard x_i, her net surplus is represented by

$$U_i = V^a(x_i) - p_a \text{ if she choose to consume } z_a \qquad (2.1)$$

$$U_i = V^b(x_i, \gamma) - p_b \text{ if she chooses to consume } z_b \qquad (2.2)$$

where $V_i(\cdot)$ is the gross valuation of a product z, and p_a and p_b are prices of z_a and z_b respectively.

To sharpen our analysis, we assume the following specific functional forms. For good z_a, consumers value its physical attributes (e.g. taste, texture) at $\widetilde{V}$. In addition, however, since z_a exhibits a low level of social responsibility standard, its consumption would cause a loss in consumers' utility. This utility loss accrues to any consumer who has a higher social responsibility standard than a. The gross valuation of z_a, therefore, can be represented by

$$V^a(x_i) = \begin{cases} \widetilde{V} - (x_i - a)L_s & \text{if } a \leq x_i \leq 1 \\ \widetilde{V} & \text{if } 0 \leq x_i < a \end{cases}. \tag{2.3}$$

Here $L_s > 0$ is a parameter that represents the loss of utility if consumer i buys a good with a standard that falls short her personal standard x_i. (The subscript s in L_s stands for "self" because the loss is resulted from the consumer's own action). For consumers whose personal standards are lower than a, there is no utility loss. We assume that $\widetilde{V} - L_s > 0$. This implies that, if $p_a = 0$, any consumer would prefer buying a unit of z_a for any $a \in (0, 1)$ when good z_b is not available.

Suppose for the moment that good z_b is not available, so that firm A is the monopolist. Then, if $p_a \leq \widetilde{V} - (1 - a)L_s$, all consumers will buy a unit of good z_a, i.e., the market size for this product is $x = 1$. If $p_a = \widetilde{V}$, then the market size for this good is $x = a$. If $p_a > \widetilde{V}$, no one will buy the product. Thus firm A's inverse demand function is $p_a = P(x)$ where $P = \widetilde{V}$ for all $x \in [0, a]$, $P(x) = \widetilde{V} - (x - a)L_s$ for $a < x < 1$. For $x = 1$, $P(x) \leq \widetilde{V} - (1 - a)L_s$. The marginal revenue at $x = 1$ is $MR(1) = P'(1) + P(1) = \widetilde{V} - (2 - a)L_s$. We assume that $MR(1) > c_a$, where c_a is the marginal cost. When $c_a = 0$ and $a = 0$,this assumption is simply $\widetilde{V} > 2L_s$. Under this assumption, the monopolist will serve the whole market, i.e., $x = 1$, and charges the monopoly price $P(1) = \widetilde{V} - (1 - a)L_s$.We now introduce competition from a fair-trade (FT) firm.

The valuation of the FT product, z_b, includes several components. First, we assume that consumers also value the physical attributes of z_b at $\widetilde{V}$. This is because, except for the FT feature, z_a and z_b are assumed to be identical (e.g. FT coffees are very much the same as ordinary coffees, in terms of taste and texture).

Second, the consumption of the FT product can have several psychological effects. Some authors argued that consumers are willing to pay a premium for FT product because of a “warm glow” effect. That is, consumers feel that they pay a "fair" price and that the premium will pass through the system to ensure the living standards of FT workers. This "warm glow" effect has been discussed in Richardson and Stähler (2007). In our model, we look at the psychological effects from a different perspective. We assume that the consumption of FT products gives consumers a sense of pride for belonging to the "socially responsible" group of FT advocates. The membership of this group gives consumers an unique economic "identity", which increases their utility from consuming FT products. This utility enhancement results from the fact that "our desires and personal satisfactions are fundamentally affected not just by who we are, but also by who we feel we ought to be" [Akerlof and Kranton (2000)].

Identity was first introduced into consumers' utility function by Akerlof and Kranton (2000). In their model, consumers associate themselves with different social categories, each with its own prescriptions regarding members' appropriate behaviors. Consumers gain utilities by conforming with the prescribed standards of the group or category to which they belong. Any deviation from such standards by the consumers themselves or by other members of the society would cause a fall in utility levels.

Adapting the general framework developed by Akerlof and Kranton (2000), we assume that consumers in our model obtain a value $\widetilde{I}$ for their economic identity when consuming FT products. This value is in addition to $\widetilde{V}$ which represents satisfaction derived from physical characteristics of the products. Moreover, we also assume that individuals care about other individuals' choices, which affect an individual identity function. In particular, since the consumption of FT product is a "norm" for FT advocates, they would suffer from "identity loss" if other consumers deviate from the norm. We assume that each non-FT consumer would cause the gross valuation of a FT consumer to fall by an amount $L_o > 0$.Then, if γ is the market share of the non-FT product, the utility of a consumer of the FT product is

$$V^b(x_i, \gamma) = \widetilde{V} + \left[\widetilde{I} - \gamma L_o\right] \tag{2.4}$$

The term inside the square brackets represent the added utility of belonging to the select group of FT consumers. The smaller is γ, the larger is this added utility. Thus $-\gamma L_0$ reflects the "identity loss" mentioned above. The expression $\left[\widetilde{I} - \gamma L_o\right]$ will be referred to as the "identity function". If practically everyone consumes the non-FT good, i.e. $\gamma = 1$, the "lone consumer" of the FT good will get a gross utility of $\widetilde{V} + \left[\widetilde{I} - L_o\right]$.

We assume that $\widetilde{I} - L_o + L_s > 0$, so that the consumer with $x = 1$ will strictly prefer the FT product if the two prices are equal. In fact it would be reasonable to assume $\widetilde{I} - L_o > 0$.

2.2.2 The pivotal consumer

We assume that firms can not practise discriminatory pricing. Each firm sets the price for its product, regardless of who is buying it. In what follows, we will focus on the case where, in equilibrium, each of the two rival products is consumed by a positive proportion of the population.

We define the pivotal consumer as the one who is indifferent between consuming the FT product and the non-FT product. The consumers who are on the left of the pivotal consumer chooses to consumer the non-FT product z_a, while those on the right opt for the FT product z_b. Let x^* be position of the pivotal consumer. Since this pivotal consumer is indifferent between consuming z_a and z_b,her net surplus must be the same for both products:

$$V^a(x^*) - p_a = V^b(x^*, \gamma) - p_b \tag{2.5}$$

In equilibrium it must be the case that $\gamma = x^*$.The solution to equation (2.5) with $\gamma = x^*$ would determine x^* and therefore determine the market shares for firm A and firm B. Both firms will supply some positive quantity if x^* falls in the $(0, 1)$ interval. In such a case, the market share for A is x^* and for B is $(1 - x^*)$. When $x^* \leq 0$, firm B supplies the entire market. Conversely, firm A supplies the whole market when $x^* \geq 1$.

2.2.3 Price competition in the absence of the identity function

Let us first consider the simplest scenario, where the identity function is identically zero. In this scenario, consumers only incur utility losses for consuming a product that has a social responsibility standard below their own standards (as represented in equation 2.3). They, however, do not gain from consuming FT products that exceed their social responsibility standards. Assume the positions of firm A and firm B are fixed at $a = 0$ and $b = 1$ respectively. It is also assumed that firms have constant marginal costs, denoted by c_a and c_b, and firm B incurs a higher cost due to its commitment to maintain high social responsibility standards. Let us normalize $c_a = 0$. We assume the firms compete in prices (Bertrand rivalry), and prices are never set above the value $\widetilde{V}$.

In the space (p_b, p_a), where p_b is measured along the horizontal axis, and p_a on the vertical axis, we consider the box, denoted by D, with four corners described by the coordinates $(0, 0)$, $(\widetilde{V} + \widetilde{I}, 0)$, $(\widetilde{V} + \widetilde{I}, \widetilde{V})$ and $(0, \widetilde{V})$. We will restrict attention to prices within this box, because no one will buy good z_b at a price above $\widetilde{V} + \widetilde{I}$, nor good z_a at a price above $\widetilde{V}$. As before, we assume $\widetilde{V} > 2L_s$.

When consideration for identity is not taken into account, the pivotal consumer is identified by the condition

$$\begin{aligned} \widetilde{V} - x^* L_s - p_a &= \widetilde{V} - p_b \\ x^* &= \frac{p_b - p_a}{L_s} \end{aligned} \tag{2.6}$$

It follows that if

$$0 < p_b - p_a < L_s \tag{2.7}$$

then both firms have a positive market share. Within the box D, if $p_b - p_a > L_s$, then no one will buy the fair trade product. Conversely, if $p_a > p_b$ then no one will buy the conventional product.

Equation (2.6) can be used to determine the market share m_a for firm A and the market share m_b for firm B, as follows. For any real number y, we define

$$mid\,\{0, y, 1\} = \begin{cases} 0 & \text{if } y \leq 0 \\ y & \text{if } 0 < y < 1 \\ 1 & \text{if } y \geq 1 \end{cases}. \tag{2.8}$$

Then the market share if firm A is

$$m_a(p_a, p_b) \equiv mid\left\{0, \frac{p_b - p_a}{L_s}, 1\right\}$$

and the market share if firm B is

$$m_b(p_a, p_b) \equiv mid\left\{0, 1 - \frac{p_b - p_a}{L_s}, 1\right\}$$

Within the box D, the market share of A is $m_a = 1$ along the line $p_a = p_b - L_s$, and $m_a = 0$ along the line $p_a = p_b$. Hence the reaction functions must be within the band S defined by these two lines. Above the line $p_a = p_b$, the FT product is cheaper, and everyone will prefer it to the conventional product. Below the line $p_a = p_b - L_s$, even the consumer with the highest standard of social responsibility will prefer to buy the conventional product. The intersection of the band S and the box D is the set of all relevant prices. See Figure 2.1 for an illustration of the box D.

Given price $p_b \geq 0$ set by the FT firm B, firm A chooses $p_a \geq 0$ to solve its profit maximization problem:

$$\max_{p_a} \Pi_a = p_a m_a(p_a, p_b)$$

The solution to this maximization problem determines firm A's reaction function:

$$p_a = R^a(p_b) = \begin{cases} 0 & \text{if } p_b = 0 \\ \frac{1}{2}p_b & \text{if } 0 < p_b < 2L_s \\ p_b - L_s & \text{if } p_b \geq 2L_s \end{cases}. \tag{2.9}$$

Similarly, firm B chooses its price p_b to maximize its profit, given p_a.

$$\max_{p_b} \Pi_b = (p_b - c_b) m_b(p_a, p_b)$$

The reaction function of firm B is

$$p_b = R^b(p_a) = \begin{cases} \frac{L_s + c_b}{2} & \text{if } p_a = 0 \\ \frac{1}{2}(p_a + c_b + L_s) & \text{if } 0 < p_a < L_s + c_b \\ p_a & \text{if } p_a \geq L_s + c_b \end{cases} . \quad (2.10)$$

If the two reaction functions (2.9) and (2.10) intersect in the interior of the band S, the equilibrium prices for z_a and z_b are

$$\begin{aligned} p_a^* &= \frac{1}{3}(c_b + L_s) \\ p_b^* &= \frac{2}{3}(c_b + L_s) \end{aligned} \quad (2.11)$$

The market share of each firm is positive if and only if

$$L_s > \frac{1}{2} c_b \quad (2.12)$$

This condition is necessary and sufficient for the two reaction functions to intersect each other in the interior of the band S.

Remarks: (i) When the personal value-loss, L_s, is sufficiently large, both firm A and B supply positive quantities with prices above their respective marginal costs, and therefore earn positive profits. (ii) When L_s is relatively small ($0 < L_s < \frac{1}{2} c_b$), firm A takes over the entire market.

2.2.4 Price competition when consumers' economic identity matters

Now consider the case where identity matters. Let us assume $\widetilde{V} > 2L_s$ as before. In addition, assume $\widetilde{V} + \widetilde{I} - L_o > \widetilde{V} - L_s$, so that the consumer with $x = 1$ will prefer the FT

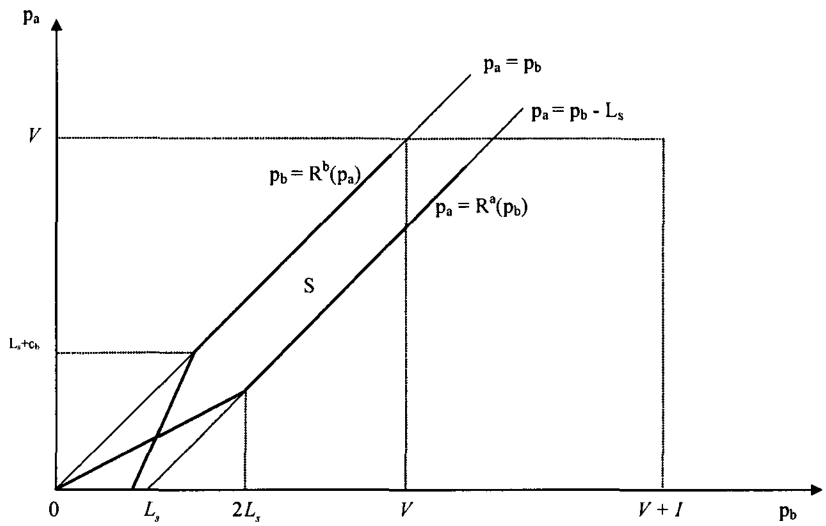

Figure 2.1: Box D with Two Reaction Functions Intersecting in the Interior of Band S

product to the non-FT product, if the prices are equal. When consumers' economic identity maters, to determine the position of the pivotal consumer, we use

$$\widetilde{V} - (x^* - a)L_s - p_a = \widetilde{V} + \widetilde{I} - x^* L_0 - p_b \quad (2.13)$$

$$x^* = \frac{(p_b - p_a) - \widetilde{I} + aL_s}{L_s - L_o} \quad (2.14)$$

To focus on the effects of price competition between two firms, we assume their positions are fixed at $a = 0$ and $b = 1$. Then

$$x^* = \frac{(p_b - p_a) - \widetilde{I}}{L_s - L_o} \quad (2.15)$$

Thus, if $x^* \in (0, 1)$,the market share for the FT firm B equals to $1 - x^*$. For x^* to fall within the $(0, 1)$ interval, we impose a number of restrictions such that the following inequalities hold:

$$p_b - p_a > \widetilde{I} > 0 \tag{2.16}$$

$$L_s - L_o > 0 \tag{2.17}$$

$$(p_b - p_a) - \widetilde{I} < L_s - L_o \tag{2.18}$$

Interpretations of the three conditions are straight-forward. We require the price of z_b to be larger than the price of z_a. This is because the speciality of FT-products makes it more expensive than the normal products. We assume in condition (2.17) that the personal "self" utility loss from consuming a product with low social responsibility standard is larger than utility loss to a FT product consumer, caused by a “marginal defection” of others to the camp of consumers of non-FT products.

Again, in the space (p_b, p_a), where p_b is measured along the horizontal axis, and p_a on the vertical axis, we consider the box, denoted by D^*, with four corners described by the coordinates $(0,0)$, $(\widetilde{V}+\widetilde{I},0)$, $(\widetilde{V}+\widetilde{I},\widetilde{V})$ and $(0,\widetilde{V})$. Within the box D^*, if $(p_b - \widetilde{I}) - p_a > (L_s - L_o)$, then no one will buy the fair trade product. Conversely, if $p_a > (p_b - \widetilde{I})$ then no one will buy the conventional product. Within the box D^*, the market share of A is $m_a = 1$ along the line $p_a = (p_b + \widetilde{I}) - (L_s - L_o)$, and $m_a = 0$ along the line $p_a = p_b - \widetilde{I}$. These two lines define a band S^* within which the reaction functions must lie. The intersection of the band S^* and the box D^* is the set of all relevant prices. See Figure 2.2 for an illustration of the box D^*.

Generally, the market share of firm A is

$$m_a(p_a, p_b) = mid\left\{0, \frac{(p_b - p_a) - \widetilde{I}}{L_s - L_o}, 1\right\}$$

and that of firm B is

$$m_b(p_a,p_b) = mid\left\{0, 1 - \frac{(p_b - p_a) - \widetilde{I}}{L_s - L_o}, 1\right\}$$

As in the previous section, we assume firm A and firm B have constant marginal costs of c_a and c_b respectively, where $c_b > c_a = 0$. Under Bertrand competition, given the price p_b set by firm B, firm A chooses $p_a \geq 0$ to solve its profit maximization problem

$$\max_{p_a} \Pi_a = p_a m_a(p_a, p_b)$$

which gives firm $A's$ reaction function

$$p_a = R^a(p_b) = \begin{cases} 0 & \text{if } p_b \leq \widetilde{I} \\ \frac{1}{2}(p_b - \widetilde{I}) & \text{if } \widetilde{I} < p_b < \widetilde{I} + 2(L_s - L_0) \\ p_b - (L_s + \widetilde{I} - L_0) & \text{if } p_b \geq \widetilde{I} + 2(L_s - L_0) \end{cases} . \quad (2.19)$$

The intersection of the line $p_a = \frac{1}{2}(p_b - \widetilde{I})$ with the line $m_a = 1$ of the set S^* yields the point $(p_b, p_a) = (2L_s - 2L_o + \widetilde{I}, L_s - L_o)$ at which the reaction function $p_a = R^a(p_b)$ has a kink. Compared with the case without the identity function, we see that the function $p_a = R^a(p_b)$ is shifted to the right by the distance $\widetilde{I}$.

Similarly, given p_a, firm B solves

$$\max_{p_b} \Pi_b = (p_b - c_b) m_b(p_a, p_b)$$

The solution to this problem gives a price reaction function for firm B :

$$p_b = R^b(p_a) = \begin{cases} \frac{1}{2}\left[(L_s - L_o) + \widetilde{I} + c_b\right] & \text{if } p_a = 0 \\ \frac{1}{2}\left[(L_s - L_o) + \widetilde{I} + c_b + p_a\right] & \text{if } 0 < p_a < \widetilde{I} + c_b + L_s - L_0 \\ p_a + \widetilde{I} & \text{if } p_b \geq \widetilde{I} + c_b + L_s - L_0 \end{cases} \quad (2.20)$$

The intersection of the line $p_b = \frac{1}{2}\left[(L_s - L_o) + \widetilde{I} + c_b + p_a\right]$ with the line $m_b = 1$ (i.e., the line $p_a = p_b - \widetilde{I}$) of the set S^* yields the point $(p_b, p_a) = (2\widetilde{I} + c_b + L_s - L_0, \widetilde{I} + c_b + L_s - L_0)$ at which the reaction function $p_b = R^b(p_a)$ has a kink. Compared with the case without the identity function, we see that the function $p_b = R^b(p_a)$ is shifted to the right by the distance $0.5(\widetilde{I} - L_o)$. Since this horizontal displacement is less than the horizontal displacement of the reaction function $p_a = R^a(p_b)$,the equilibrium price p_a must fall (relative to the case without the identity function).

From (2.19) and (2.20), assuming both firms have a positive market share, we derive equilibrium prices:

$$\begin{aligned} p_a^* &= \frac{1}{3}\left[(L_s - L_o) + c_b - \widetilde{I}\right] \\ p_b^* &= \frac{2}{3}\left[(L_s - L_o) + c_b + \frac{1}{2}\widetilde{I}\right] \end{aligned} \tag{2.21}$$

These equilibrium prices satisfy the conditions (2.16), (2.17) and (2.18) if and only if

$$c_b > \widetilde{I} - (L_s - L_o) \tag{2.22}$$

$$c_b < \widetilde{I} + 2(L_s - L_o) \tag{2.23}$$

Under the conditions (2.22) and (2.23), optimal profits for firm A and B are

$$\begin{aligned} \Pi_a^* &= p_a^* x^*(p_a^*, p_b^*) = \frac{1}{9}\frac{\left[(L_s - L_o) + c_b - \widetilde{I}\right]^2}{L_s - L_o} \\ \Pi_b^* &= (p_b^* - c_b)\left[1 - x^*(p_a^*, p_b^*)\right] = \frac{1}{9}\frac{\left[2(L_s - L_o) - c_b + \widetilde{I}\right]^2}{L_s - L_o} \end{aligned} \tag{2.24}$$

Proposition 2.1:

1. *Both firms have positive productions and earn positive profit if only if c_b falls within the interval $\left(\widetilde{I} - L_s + L_o, \widetilde{I} + 2L_s - 2L_o\right)$. Firm A's market share is zero (respectively, one) if c_b equals the lower (respectively, upper) bound of the interval.*

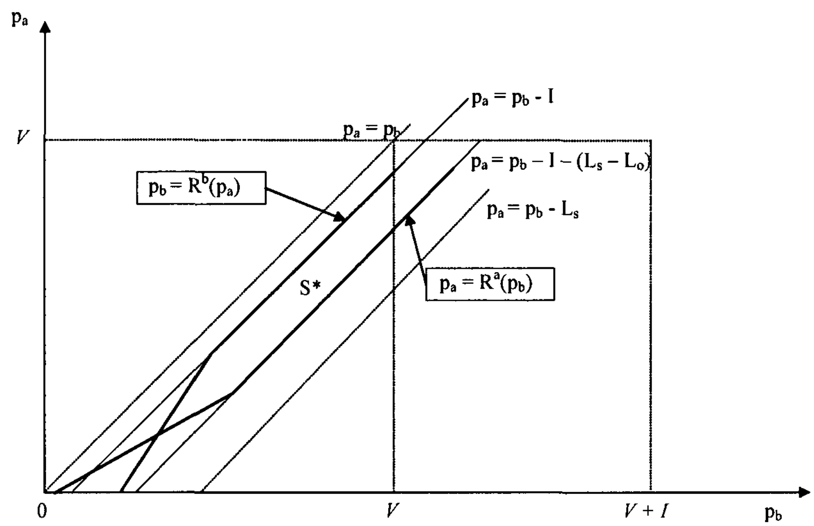

Figure 2.2: Box D^* with Two Reaction Functions Intersecting in the Interior of Band S^*

2. *If consumers do not care for their economic identity, i.e.* $L_o = 0$ *and* $\widetilde{I} = 0$, *then equilibrium prices in (2.21) are exactly the same as prices in (2.11).*

3. *Compare to the case where economic identity does not matter, firm A charges a lower price, while the price of* z_b *might be lower or higher depending on whether* $\widetilde{I} < 2L_o$ *or* $\widetilde{I} > 2L_o$ *respectively.*

The intuition behind the above proposition is as follows. Consumers are heterogeneous with respect to their valuation of the conventional product. The valuation schedule for this product is a downward sloping line, beginning at the value $\widetilde{V}$ for the consumer with index $x_i = 0$, and ending at the value $\widetilde{V} - L_s > 0$ for the consumer with index $x_i = 1$. On the other hand, all consumers have the same valuation of the FT product, and their valuation depends on the market size of this product. If $c_b = \widetilde{I} - L_s + L_o$(which is smaller than $\widetilde{I}$), then, even if $p_a = 0$, firm B can charge a price $p_b = \widetilde{I}$ and take over the whole market. Its profit would then be

$$\Pi_b^* = (L_s - L_o)$$

In this low cost case, the reaction function of firm B coincides with the line $m_b = 1$. Now consider the other extreme case. If $c_b = \widetilde{I} + 2L_s - 2L_o$, firm A will charge a price $p_a = L_s - L_o$, and firm B will go out of business. The intuition is as follows. At any given p_b, the identity awareness of FT consumers causes firm A to cut its price (i.e., firm B's reaction function shifts downward, by $\widetilde{I}/2$). At the same time, for any given p_a, firm B can afford to raise its price as a result of the identity awareness (i.e. firm A's reaction function shifts downward, by a smaller amount $\left(\widetilde{I} - L_o\right)/2)$. Thus the equilibrium price p_a necessarily falls. On the other hand, p_b would rise only if $\widetilde{I}$ is sufficiently greater than marginal identity loss L_o.

2.3 Strategic Choice of Social Responsibility Standard

We now turn our attention to firms' strategic choice of social responsibility standards. In the previous section, we assume that firm A maintains the zero standard and B maintains the highest one. On the product social responsibility standard space, this assumption implies that firm A is positioned at $a = 0$ and B is positioned at $b = 1$. We will now relax this assumption. We continue to assume that B is still positioned at $b = 1$, but now allow A to choose its position in the product space, i.e. $a > 0$.

The two firms engage in a two-stage game. In the first stage, given that firm B's position is fixed at $b = 1$, firm A chooses its position $a > 0$. In the second stage, given their positions, firm compete in price to maximize their profits. We solve the game backwards.

Suppose firm A has chosen to set its social responsibility standard at $a > 0$. We're interested in finding a potential position of the pivotal consumer, x^*.

Suppose now the pivotal consumer is in the interval $[a, 1]$. With B fixed at $b = 1$, the position of this consumer is determined by (2.14):

$$x^* = \frac{(p_b - p_a) - \widetilde{I} + aL_s}{L_s - L_o} \tag{2.25}$$

Again, we will specify a number of conditions to ensure x^* falls within the $[a, 1]$ interval:

$$p_b - p_a - \widetilde{I} + aL_s \quad < \quad L_s - L_o \tag{2.26}$$

$$p_b - p_a - \widetilde{I} + aL_s \quad > \quad a(L_s - L_o) \tag{2.27}$$

When firm A chooses to move away from its 0 social responsibility standard, its cost will will increase from zero to some positive level, $c_a > 0$. We assume this cost depends on firm $A's$ choice of social responsibility standard is given by

$$c_a = ka^2$$

where $k > 0$. Given positions of both firms and price of z_b, firm A chooses its price to maximize profit

$$\max_{p_a} \Pi_a = (p_a - ka^2)\frac{(p_b - p_a) - \widetilde{I} + aL_s}{L_s - L_o}$$

The solution to the maximization problem gives firm $A's$ price reaction function:

$$p_a = \frac{1}{2}(p_b - \widetilde{I} + aL_s + ka^2) \tag{2.28}$$

Similarly, firm B solves its profit maximization problem

$$\max_{p_b}(p_b - c_b)\left(1 - \frac{(p_b - p_a) - \widetilde{I} + aL_s}{L_s - L_o}\right)$$

which gives firm $B's$ price reaction function:

$$p_b = \frac{1}{2}\left[(L_s - L_o) + \widetilde{I} + c_b + p_a - aL_s\right] \tag{2.29}$$

From (2.28) and (2.29), we derive equilibrium prices and profits for firm A and firm B :

$$p_a = \frac{1}{3}\left[(L_s - L_o) - \widetilde{I} + c_b + aL_s + 2ka^2\right] \tag{2.30}$$

$$p_b = \frac{1}{3}\left[2(L_s - L_o) + \widetilde{I} + 2c_b - aL_s + ka^2\right] \tag{2.31}$$

$$\Pi_a = \frac{1}{9}\frac{\left[(L_s - L_o) - \widetilde{I} + c_b + aL_s - ka^2\right]^2}{L_s - L_o} \tag{2.32}$$

$$\Pi_b = \frac{1}{9}\frac{\left[2(L_s - L_o) + \widetilde{I} - c_b - aL_s + ka^2\right]^2}{L_s - L_o} \tag{2.33}$$

$$x^* = \frac{1}{3}\frac{\left[(L_s - L_o) - \widetilde{I} + c_b + aL_s - ka^2\right]}{L_s - L_o} \tag{2.34}$$

In the first stage of the game, firm A strategically chooses its social responsibility standards. For any given position a of firm A, its optimal profit level is specified in (2.32). Firm $A's$ problem is to choose a to maximize

$$\Pi_a = \frac{1}{9}\frac{\left[(L_s - L_o) - \widetilde{I} + c_b + aL_s - ka^2\right]^2}{L_s - L_o} \tag{2.35}$$

The first order condition is

$$\frac{\partial \Pi_a}{\partial a} = \frac{2}{9(L_s - L_o)}\left[(L_s - L_o) - \widetilde{I} + c_b + aL_s - ka^2\right][L_s - 2ka] = 0 \tag{2.36}$$

Since we require the pivotal consumer to be located within the $(0, 1)$ interval, it is necessary that $x^* = \frac{1}{3}\frac{\left[(L_s - L_o) - \widetilde{I} + c_b + aL_s - ka^2\right]}{L_s - L_o} > 0$. We have previously assumed that $L_s > L_o$. Therefore the numerator of x^* must be non negative, i.e. $\left[(L_s - L_o) - \widetilde{I} + c_b + aL_s - ka^2\right] > 0$. The first order condition (2.36) is reduced to

$$L_s - 2ka = 0 \tag{2.37}$$

$$a^* = \frac{L_s}{2k} \tag{2.38}$$

For a^* to be in the $(0,1)$ interval, it is necessary that $0 < L_s < 2k$.

Let $h(a) = \frac{\partial \Pi_a}{\partial a}$. The sufficient conditions for Π_a to reach its maximum at $a^* = \frac{L_s}{2k}$ are (i) $h(a)$ is continuous in the interval $a = [0,1]$; (ii) $h(0) > 0$ for $0 \le a < \frac{L_s}{2k}$; and (iii) $h(1) < 0$ for $\frac{L_s}{2k} < a \le 1$. Since $h(a)$ is continuously differentiable in $[0,1]$, these sufficient conditions are also satisfied when $0 < L_s < 2k$.

When $a^* = \frac{L_s}{2k}$, the corresponding prices and profits for firm A and firm B are

$$p_a = \frac{1}{3}\left[(L_s - L_o) - \widetilde{I} + c_b + \frac{L_s^2}{k}\right]$$

$$p_b = \frac{1}{3}\left[2(L_s - L_o) + \widetilde{I} + 2c_b - \frac{L_s^2}{4k}\right]$$

$$\Pi_a = \frac{1}{9}\frac{\left[(L_s - L_o) - \widetilde{I} + c_b + \frac{L_s^2}{4k}\right]^2}{L_s - L_o}$$

$$\Pi_b = \frac{1}{9}\frac{\left[2(L_s - L_o) + \widetilde{I} - c_b - \frac{L_s^2}{4k}\right]^2}{L_s - L_o}$$

$$x^* = \frac{1}{3}\frac{\left[(L_s - L_o) - \widetilde{I} + c_b + \frac{L_s^2}{4k}\right]}{L_s - L_o}$$

These prices and corresponding profits and market shares are consistent with conditions (2.26) and (2.27) when

$$\begin{aligned} c_b^L &< c_b < c_b^H \\ c_b^L &= (3\frac{L_s}{2k} - 1)(L_s - L_o) + \widetilde{I} - \frac{L_s^2}{4k} \\ c_b^H &= 2(L_s - L_o) + \widetilde{I} - \frac{L_s^2}{4k} \end{aligned}$$

Proposition 2.2: *If $k > \frac{L_s}{2}$ and the cost of FT-firm c_b falls within the $\left(c_b^L, c_b^H\right)$ interval, it is beneficial for non-FT firm to deviate from its zero social responsibility standard. The optimal social responsibility standard for non-FT firm is $a^* = \frac{L_s}{2k}$. It is however not optimal for non-FT firm to comply with the FT standard (i.e. choosing $a = 1$) and therefore minimum product differentiation does not occur.*

Remarks: (i) Our result is different from those obtained from traditional horizontal product differentiation model. This is because in traditional model, firms can move costlessly within the product space. Since improving products' standard is costly ($k > 0$), it is never optimal for firm A to completely comply with the FT standards. (ii) Both firms earn positive profits in equilibrium.

2.4 Dynamic Manipulation of the Identity Function

In the preceding analysis, we have assumed that the identity function $\widetilde{I} - \gamma L_o$ has $\widetilde{I}$ and L_o as exogenous parameter. In reality, it is possible to manipulate these parameters by creating consumer awareness. In this section, we assume that $\widetilde{I}$ changes over time. Suppose its rate of change is given by

$$\frac{d\widetilde{I}(t)}{dt} = J(t) - \frac{\delta}{2}\widetilde{I}(t)^2 \tag{2.39}$$

where $J(t)$ is information dissemination (called advertising intensity for short), and $\delta > 0$ is the an indicator of the depreciation of the stock $\widetilde{I}$. The FT firm now faces the problem of optimal advertising intensity. It chooses the time path of $J(t)$ to maximize the value of the discounted stream of profit, net of advertising costs $\frac{\omega}{2}J(t)^2$, where ω is a positive constant. (Here we assume that $a = 0$ for simplicity). The objective function is then:

$$\int_0^\infty e^{-rt}\left\{\frac{1}{9}\frac{\left[2(L_s - L_o) - c_b + \widetilde{I}(t)\right]^2}{L_s - L_o} - \frac{\omega}{2}J(t)^2\right\} dt$$

The Hamiltonian for this problem is

$$H = \frac{1}{9}\frac{\left[2(L_s - L_o) - c_b + \widetilde{I}(t)\right]^2}{L_s - L_o} - \frac{\omega}{2}J(t)^2 + \psi(t)\left[J(t) - \frac{\delta}{2}\widetilde{I}(t)^2\right]$$

where ψ is the shadow price of the stock $\widetilde{I}(t)$.

The necessary conditions are

$$\frac{\partial H}{\partial J} = -\omega J + \psi = 0 \tag{2.40}$$

$$\dot{\psi} = r\psi - \frac{\partial H}{\partial \widetilde{I}} = \psi(r + \delta\widetilde{I}) - \frac{2\left[2(L_s - L_o) - c_b + \widetilde{I}\right]}{9(L_s - L_o)} \tag{2.41}$$

and (2.39). The transversality condition is

$$\lim_{t\to\infty} e^{-rt}\psi(t) \geq 0 \text{ and } \lim_{t\to\infty} e^{-rt}\psi(t)\widetilde{I}(t) = 0$$

Let us focus on an interior steady state with $\left(\widetilde{I}_\infty, \psi_\infty\right) > (0,0)$. The corresponding steady-state advertising intensity is $J_\infty = \frac{\delta}{2}\widetilde{I}_\infty = \frac{1}{\omega}\psi_\infty$.

At the steady state, setting $\dot{\psi} = 0$ in equation '(2.41), we get

$$\psi_\infty = \frac{2\left[2(L_s - L_o) - c_b + \widetilde{I}_\infty\right]}{9(L_s - L_o)(r + \delta \widetilde{I}_\infty)} \tag{2.42}$$

On the other hand, equation (2.40) gives

$$\psi_\infty = \omega J_\infty = \omega \frac{\delta}{2} \widetilde{I}_\infty^2 \tag{2.43}$$

Using (2.42) and (2.43) we get a cubic equation in $\widetilde{I}_\infty$

$$(r + \delta \widetilde{I}_\infty)\widetilde{I}_\infty^2 = \frac{4}{9\delta\omega(L_s - L_o)}\left[2(L_s - L_o) - c_b + \widetilde{I}_\infty\right]$$

Hence

$$\delta \widetilde{I}_\infty^3 + r\widetilde{I}_\infty^2 - \frac{4}{9\delta\omega(L_s - L_o)}\widetilde{I}_\infty = \frac{4\left[2(L_s - L_o) - c_b\right]}{9\delta\omega(L_s - L_o)} \equiv \phi \tag{2.44}$$

Let us assume that c_b is small, so that ϕ is positive. Now consider the left-hand side of (2.44). Let $y \equiv \widetilde{I}_\infty$ and $\frac{4}{9\delta\omega(L_s - L_o)} \equiv \mu > 0$. Consider the polynomial

$$f(y) \equiv \delta y^3 + ry - \mu y$$

Obviously, $0 =$ is a root of this polynomial, and $f'(0) < 0$, so that $f(0^-) > 0$ and $f(0^+) < 0$. Observe that $f(-\infty) = -\infty$ and $f(\infty) = \infty$. Hence we conclude that this polynomial has three roots, $y_1 < 0$, $y_2 = 0$ and $y_3 > 0$. It follows that the equation (2.44) has exactly one (and only one) positive solution $\widetilde{I}_\infty$ and it is greater than y_3. This is then the steady state of our optimal control problem.

The above analysis leads to the following proposition.

Proposition 2.3: *There exists a unique steady state. The lower is c_b, the higher is the steady state $\widetilde{I}_\infty$. Similarly, the higher is δ or ω, or r, the lower is the steady state. If $c_b = 0$, then the higher is L_s the lower is the steady state.*

2.5 Concluding Remarks

We have formulated a duopoly model involving a firm producing a fair-trade product in competition against a conventional firm producing a standard product. We made use of the concept of "economic identity" introduced by Akerlof and Kranton. We show how, in the short run, the parameters of the identity function can impact the equilibrium prices, and in the medium run, how they impact the conventional firm's choice of its position in the product space. In the long run, however, the fair-trade firm may be able to influence the parameters of the identity function, for its own advantage.

There are several directions along which the model can be extended. First, there might be a proliferation of different brand names of fair trade products, and perhaps a model of monopolistic competition among fair-trade firms as well as conventional firms may better capture some salient features of fair trade products. Second, the parameters of the identity function may be affected by market shares. If this is the case, firms would choose prices not to maximize current profits, but the long-run profits.

Chapter 3

Bilateral Liberalization of Government Procurement: A Contest Model

3.1 Introduction

Government procurement (GP) refers to the public purchase of goods and services from the private sector. In spite of privatization and the tendency toward a smaller government, public procurement budgets remain quite substantial in modern economies. In the developed world, procurements by governments and by state-owned enterprises account for about 10-15 percent of GDP, though in many industrial countries, this figure can reach 20 percent of GDP (in US, Europe, Canada) (Weiss and Thurbon, 2006). In developing countries, the GP share of GDP can be even higher. For example, in 2007, the budget of the Government of Vietnam accounts for as much as 28 percent of GDP. Approximately 30 percent of this expenditure was spent on infrastructure and other major development projects (Ministry of Finance Annual Fiscal Report, 2007).

Given the substantial share of GDP, GP plays a significant role in domestic economies. Traditionally, governments deploy their purchasing power as a tool for developing major domestic industries and national infrastructure, from highways, airports, sea-ports, power systems of the nineteenth and twentieth centuries to the information and communication superhighways of the twenty-first century. In high-technology sectors, public procurements may involve aircrafts, telecommunications equipment, software and computers. As the current global economic recession starts to unfold, governments around the world have announced significant fiscal packages to stimulate domestic economies. Large parts of these public expenditures are channeled toward domestic industries to create new jobs or toward various social service systems such as health care and education.

Despite its importance, GP has been effectively omitted from the scope of multilateral trade rules under the WTO in the areas of both goods and services. In the General Agreement on Tariffs and Trade (GATT, 1947), government procurement was explicitly excluded from the key provision of national treatment. During the Tokyo Round of Trade Negotiations (1976) members of the GATT started to negotiate on the possibility of bringing GP under internationally agreed trade rules. This attempt resulted in the 1979 Agreement on Government Procurement (GPA), which was subsequently amended in 1987. Among other issues, the GPA (1979) encompasses provisions relating to national treatment and non-discrimination for the suppliers of Parties to the Agreement with respect to public procurement of covered goods, services and construction services as set out in each Party's schedules and subject to various exceptions and exclusions (e.g. procurement relating to national defense and security). It also contains provisions regulating transparency and procedural aspects of the procurement process. In general, these provisions are designed to ensure that covered procurement under the Agreement is carried out in a transparent and competitive manner which does not discriminate against the goods, services or suppliers of other Parties.

In parallel with the Uruguay Round, signatories of the GPA held negotiations to extend the scope and coverage of the Agreement. The new Agreement on Government Procurement was signed in Marrakesh in April 1994 – at the same time as the Agreement Establishing the WTO – and entered into force in January 1996. The GPA (1994) is one of the plurilateral agreements included in Annex 4 to the Agreement Establishing the WTO, signifying that not all WTO members are bound by it. Currently, 40 WTO members, mostly OECD countries, are covered by the GPA (1994). Nineteen other WTO members have observer status under the Agreement.

Since only a third of the WTO members are covered by the GPA, it has become a common practice for governments to give strict preferences to domestic agents or at least more protection for public procurement agencies than for private firms (Trionfetti, 2000). As Miyagiwa (1991) puts it, "governments typically wield their purchases as a policy tool, favoring domestic over foreign suppliers. By doing so, they aim to return tax money to domestic residents, create more jobs at home, and reduce imports". While this practice can serve certain domestic political agendas, it can have notable impact on international trade in goods and services. To tackle this problem, the WTO, in preparation for the Doha Round of Trade Negotiations, had established a Working Group on Transparency in Government Procurement in order to enhance transparency in public procurement decisions and prepare an international agreement. However, the Working Group was never successful in reaching an agreement among the WTO members on the launch of negotiations in 2003. The WTO General Council later decided in 2004 that the issue should not be taken any further and should not form part of the Doha Round Programme. The Working Group has been suspended since 2004.

Given this background, it is fair to assume that public procurement rules are still largely unregulated and based on national interests. This leads to two interesting questions: what is the primary source that brings a selected group of WTO members to the GPA? And why is it difficult to expand the coverage of the Agreement to other WTO members, especially to developing nations where public procurements still play an extraordinarily important role in the development of domestic basic infrastructure systems? In this chapter, we aim at answering these two questions. To do so, we employ a modified version of the Tullock model of rent contests (Tullock, 1980, Rowley et al., 1988, Hillman and Riley, 1989, Nitzan, 1994). In his model, rent-seeking agents compete by exerting efforts in order to win a contest with a fixed prize value. If selected, the return to an agent equals the prize value net of costs associated with her exerted effort. Tullock assumes that the probability that any given agent wins the contest depends on the ratio of her own effort to the sum of the efforts exerted by all agents. He also assumes that agents are homogeneous: (i) they have equal valuations of the prize, and (ii) their efforts have equal effectiveness. In our model, we study how domestic and foreign (if permitted by the host country) firms to determine their lobbying efforts in a contest for a government procurement contract. While still assuming that their efforts are equally effective, we relax the assumption on homogeneous valuation of the contract. As the result, the rent associated with winning a procurement contract depends on the firm's production cost. If foreign firms have lower production costs than domestic firms, their valuations of the "prize" will be higher.

Our choice of Tullock contest model is justified because we do not often observe the mechanism by which government officials select the contractor for a public procurement project. Different from conventional auctions, public contracts are not necessarily awarded to the highest bidder. This is because there can be other relevant dimensions that are not easily quantifiable. These include concerns such as whether a bidder has sufficient financial resources or expertise to carry out the project, or whether it has a good safety record. In the case involving international trade, governments may also raise concerns about domestic sanitary standards, national cultures and customs, national defense and security, etc. Governments typically do not announce how these relevant dimensions affect their selection of contract awardees. Therefore, even when identities of the bidders are public knowledge, it is quite difficult to predict who the winner will be.

While assessing the welfare effects of liberalizing public procurements, several factors should be taken into account. First, we do not include consumer surplus in a country's social welfare function. This is because we only focus on the change in social welfare as the result of liberalization. It is also reasonable to assume that regardless of who carries out the government procurement contract (i.e. either domestic contractor or foreign contractor), the level of consumer surplus stays the same. Second, while the profit of foreign firms should not be counted as social welfare, if a domestic bidder wins, its after-tax rent should be included as part of the welfare gain. Third, we consider all the resource costs in rent-seeking by domestic firms to be "wasteful" and therefore be subtracted from the social welfare. On the other hand, the resource costs in rent-seeking incurred by foreign firms are not part of the social cost. This is because either the foreign firms use foreign resources or hire domestic resources, whose earnings should be consider as export revenue. Likewise, lobbying expenditures incurred by domestic firms when bidding for public procurements abroad will not be counted as part of the domestic social welfare function. Fourth, when foreign firms are allowed to compete for government procurements, the equilibrium lobbying effort levels of all domestic firms change. Finally, the probability that a given firm wins will be affected by adjustments in lobbying intensities of all firms.

The literature on rent-seeking in general, and on public procurement discrimination in particular, is vast[7]. Before proceeding further, we briefly review a selected number of works that are closely relevant to our model. McAfee and McMillan (1989) model the bidding for a government procurement contract in which there is imperfect competition. In their model, each bidder is better informed about his own costs than either his rival bidder or the government. Moreover, the distribution of the domestic firms' costs differs from that of foreign firms. They found that when the bidding process takes the form of an auction, the exclusion of foreign firms may enhance competition among domestic firms, and can thus be welfare improving. Branco (1994) and Vagstad (1995) extend the Brander-Spencer (1981) analysis to government procurements. In both papers, the authors study the rationale for giving preference to domestic firms in the award of public contracts when the regulator is interested in maximizing domestic welfare. They show that, in the absence of comparative advantages, the regulator should discriminate in favor of the domestic firms, because foreign firms' profits do not enter in domestic welfare.

Long and Stähler (2008) were the firsts to apply the Tullock's contest model to public procurement. Their model, however, only focuses on welfare implications for a single

[7] For a review of literature on rent seeking, see Congleton et al. (2008). An overview of literature on discriminations in public procurement can be found in Evenett and Hoekman (2005), and Mougeot and Naegelen (2005). Asymmetry in abilities among contestants is discussed in Nti (2002) and Stein (1999). Cornes and Hartley (2005) discuss general asymmetric contests.

country when trade liberalization is allowed. When extending Long and Stähler (2008) model to include two countries in the welfare analysis, we show that there exists a single condition that ensures active participations of all firms in all contests. When this condition is violated, i.e. under a dominant-country case, the dominating country always gains from trade liberalization, while welfare of the dominated country improves only if its corporate tax is sufficiently high. Under full participation of all firms, i.e. no country dominates the markets, and countries are partially symmetric, there exist conditions where bilateral liberalization is mutually beneficial to both countries. When countries are completely asymmetric, we show that a country may gain from bilateral trade liberalization if its tax rate is sufficiently high, while the tax rate of the other country must be sufficiently low.

The rest of the chapter is organized as follows. The second section describes the basic model. The third section assesses welfare implications of bilateral liberalization of government procurements when firms from one country dominate those from the other. Both Section 4 and Section 5 concern with the non-dominant country case. While the former focuses on unilateral liberalization, the later examines reciprocal liberalization between the two countries. Section 6 concludes.

3.2 The Model

3.2.1 The basic assumptions

Let there be two countries, denoted by A and B. The government of each country offers a project to its potential contestants at home and abroad. We assume that the two projects have identical characteristics. The numbers of contestants in the two countries A and B are n_i and n_j respectively, where the subscript i (j) is the index of contestants of nationality A (B), with $i = 1, 2, 3, ..., n_i$ and $j = 1, 2, 3, ..., n_j$. We assume n_i and n_j are exogenously given. The contestants can compete for the government project offered in their own country, and also in the other country in the case of liberalization. Let s_{ai} (s_{aj}) be the lobbying effort exerted by firm i (j) when competing in country A (the contest is held in A); and its effort is s_{bi} (s_{bj}) when it competes in country B (the contest is held in B). Following Tullock's (1980) framework, we assume the probability that firm i (j) is the winner in the contest in either country depends on its lobbying intensity relative to the total effort exerted by all contestants. Let p_{ai} (p_{aj}) denote the probabilities that firm i (j) is the winner in country A, and p_{bi} (p_{bj}) are the probabilities that it is the winner in country B, then

$$\begin{aligned} p_{ai} &= \frac{s_{ai}}{S_{ai} + S_{aj}}\,;\, p_{aj} = \frac{s_{aj}}{S_{ai} + S_{aj}} \\ p_{bi} &= \frac{s_{bi}}{S_{bi} + S_{bj}}\,;\, p_{bj} = \frac{s_{bj}}{S_{bi} + S_{bj}} \end{aligned}$$

where $S_{ai} = \sum_{i=1}^{n_i} s_{ai}$, $S_{aj} = \sum_{j=1}^{n_j} s_{aj}$, $S_{bi} = \sum_{i=1}^{n_i} s_{bi}$, and $S_{bj} = \sum_{j=1}^{n_j} s_{bj}$.

The winning firm in each contest (either held in country A, or country B) generates a gross surplus from the project. We assume the value of this surplus is homogeneous among the firms belonging to the same country, but is heterogeneous between the two countries. This heterogeneity reflects the fact that firms in the two countries have different abilities in carrying out the project (e.g. they have different production costs). Let's assume V_i (V_j) be the gross surplus generated by firm i (j) when it is selected as the winning contestant. It should be noted that the valuation of the surplus only depends on firm $i's$ $(j's)$ ability, and does not depend on whether the project is offered by country A or by country B. Net expected profits for firm i and j when the contest is held in A are

$$\Pi_{ai} = p_{ai}(1-t_a)V_i - s_{ai} = \frac{s_{ai}}{S_{ai}+S_{aj}}(1-t_a)V_i - s_{ai} \tag{3.1}$$

$$\Pi_{aj} = p_{aj}(1-t_a)V_j - s_{aj} = \frac{s_{aj}}{S_{ai}+S_{aj}}(1-t_a)V_j - s_{aj} \tag{3.2}$$

and the net expected profits for firm i and j when the contest is held in B are

$$\Pi_{bi} = p_{bi}(1-t_b)V_i - s_{bi} = \frac{s_{bi}}{S_{bi}+S_{bj}}(1-t_b)V_i - s_{bi} \tag{3.3}$$

$$\Pi_{bj} = p_{bj}(1-t_b)V_j - s_{bi} = \frac{s_{bj}}{S_{bi}+S_{bj}}(1-t_b)V_j - s_{bj} \tag{3.4}$$

where t_a and t_b are exogenous tax rates set in country A and B respectively. Profits are taxed at their sources.

Let us now focus on the case where the project is offered in country A and foreign firms from B can participate in the contest. We assume all firms i and j are active in the contest (i.e. $s_{ai} > 0$; $s_{aj} > 0$). We will specify necessary conditions on parameter values for this assumption to hold, and will relax the active participation assumption in later sections. Firm i (j) takes lobbying efforts of other contestants as given and chooses s_{ai} (s_{aj}) to maximize its expected profit, as specified in equation (3.1) [respectively, (3.2)]. The first order conditions for the problems are

$$(1-t_a)V_i\frac{(S_{ai}+S_{aj})-s_{ai}}{(S_{ai}+S_{aj})^2} - 1 = 0 \tag{3.5}$$

$$(1-t_a)V_j\frac{(S_{ai}+S_{aj})-s_{aj}}{(S_{ai}+S_{aj})^2} - 1 = 0 \tag{3.6}$$

Solving the FOCs for s_{ai} and s_{aj} and summing up the individual lobbying efforts, we have equilibrium total effort of all firms i and j competing for the project in country A :

$$S_{ai} + S_{aj} = \frac{(n_i + n_j - 1)(1 - t_a) V_i V_j}{n_i V_j + n_j V_i} \tag{3.7}$$

Substituting the total effort into the FOC conditions, we derive individual lobbying intensities, given all firm i and j are active in the competition:

$$s_{ai} = \frac{(n_i + n_j - 1)(1 - t_a) V_i V_j \left[n_j V_i - (n_j - 1) V_j\right]}{(n_i V_j + n_j V_i)^2} \tag{3.8}$$

$$s_{aj} = \frac{(n_i + n_j - 1)(1 - t_a) V_i V_j \left[n_i V_j - (n_i - 1) V_i\right]}{(n_i V_j + n_j V_i)^2} \tag{3.9}$$

Obviously, when firm i (j) chooses not to participate in the contest, its lobbying effort is zero. By symmetry within each group of firms, this implies all firm i (j) will exert zero effort. Individual lobbying intensities in such a case will be

$$s_{ai} = \frac{(n_i - 1)(1 - t_a) V_i}{n_i^2} \text{ if } s_{aj} = 0 \tag{3.10}$$

$$s_{aj} = \frac{(n_j - 1)(1 - t_a) V_j}{n_j^2} \text{ if } s_{ai} = 0 \tag{3.11}$$

A similar analysis can be extended to the case where the project is offered by the government of country B. In such a case, individual lobbying efforts, given that all firms choose to be active, are:

$$s_{bi} = \frac{(n_i + n_j - 1)(1 - t_b) V_i V_j \left[n_j V_i - (n_j - 1) V_j\right]}{(n_i V_j + n_j V_i)^2} \text{ if } s_{bj} > 0 \tag{3.12}$$

$$s_{bj} = \frac{(n_i + n_j - 1)(1 - t_b) V_i V_j \left[n_i V_j - (n_i - 1) V_i\right]}{(n_i V_j + n_j V_i)^2} \text{ if } s_{bi} > 0 \tag{3.13}$$

When either all firms i or all firms j choose to be inactive:

$$s_{bi} = \frac{(n_i - 1)(1 - t_b) V_i}{n_i^2} \text{ if } s_{bj} = 0 \tag{3.14}$$

$$s_{bj} = \frac{(n_j - 1)(1 - t_b) V_j}{n_j^2} \text{ if } s_{bi} = 0 \tag{3.15}$$

The total effort exerted by all firms i and j is

$$S_{bi} + S_{bj} = \frac{(n_i + n_j - 1)(1 - t_b) V_i V_j}{n_i V_j + n_j V_i} \tag{3.16}$$

3.2.2 The welfare functions

The welfare of a country A (B) is equal to the sum of expected net profit of all firms i (j) and expected tax revenues remitted by all firms participating in a contest. Without liberalization, firms i (j) are allowed to compete only in their own country A (B). This implies $s_{bi} = 0$ for all i, and $s_{aj} = 0$ for all j. We take this as a benchmark case in each country and denote it with the superscript AU (autarky). Autarky welfare for country A and B are respectively

$$W_a^{AU} = V_i - S_{ai} = \frac{[(n_i - 1)t_a + 1] V_i}{n_i} \tag{3.17}$$

$$W_b^{AU} = V_j - S_{bj} = \frac{[(n_j - 1) t_b + 1] V_j}{n_j} \tag{3.18}$$

The tax revenues do not appear in the welfare functions (3.17) and (3.18) since they only represent transfers from the private sector to the public sector. Total lobbying efforts are subtracted from a country welfare because they are wasteful uses of resources.

When unilateral liberalization takes place, assuming all firms i and j are active in contests, the welfare levels of country A and B are

$$W_a^{UNA} = n_i\left[p_{ai}V_i\right] - S_{ai} + n_j\left[t_a p_{aj}V_j\right] \tag{3.19}$$

$$W_b^{UNA} = W_b^{AU} + n_j\left[\left(1-t_a\right)p_{aj}V_j\right] \tag{3.20}$$

$$W_b^{UNB} = n_j\left[p_{bj}V_j\right] - S_{bj} + n_i\left[t_b p_{bi}V_i\right] \tag{3.21}$$

$$W_a^{UNB} = W_a^{AU} + n_i\left[\left(1-t_b\right)p_{bi}V_i\right] \tag{3.22}$$

Equations (3.19) and (3.20) are welfare levels of country A and B when A unilaterally liberalizes its market for government procurement. In this situation, only firms j of country B benefit from full access to $A's$ market, while firms i are only limited to their domestic market in A. In trade negotiations, many developed countries extend full market access to its developing trading partners and do not require reciprocal treatments. Unilateral liberalization initiatives are common in the world trading system and are often followed by full bilateral or multilateral liberalization at a later stage. Interpretations of equations (3.19) and (3.20) are straightforward. From country A's perspective, the first term on the RHS of (3.19) is the total expected profit of all domestic firms i ; the second term is total real domestic resources spent on lobbying activities; and the third term is the total expected tax revenue collected from all foreign firms j. From country $B's$ perspective, the first term on the RHS of (3.20) is its autarkic welfare level. This is because B does not open its market for foreign firms. Country B, however, has access to $A's$ market, and therefore its welfare includes total expected after-tax profit earned in country A. This portion of country $B's$ welfare is represented by the second term on the RHS of equation (3.20). Similar interpretations apply to equations (3.21) and (3.22) where unilateral liberalization is assumed to take place in country B.

Bilateral liberalization allows all firms i and j to participate in contests in both countries. Assuming all firms are active, welfare of the two countries in this case are

$$W_a^{BL} = n_i [p_{ai} V_i] - S_{ai} + n_j [t_a p_{aj} V_j] + n_i [p_{bi}(1 - t_b) V_i] \tag{3.23}$$

$$W_b^{BL} = n_j [p_{bj} V_j] - S_{bj} + n_i [t_b p_{bi} V_i] + n_j [p_{aj} (1 - t_a) V_j] \tag{3.24}$$

The first three terms on the right-hand side (RHS) of equations (3.23) and (3.24) have the same interpretations as those of equations (3.19) and (3.21) , respectively. The last term of (3.23) [(3.24)] is the total expected after-tax profit of all firm i $[j]$ earned in country B $[A]$ and remitted to the firms' home country A $[B]$. From country $A's$ $[B's]$ perspective, the total lobbying effort spent by all firms i $[j]$ in country B $[A]$ is considered to be imports of services and therefore is not included in the country's welfare.

3.3 A Dominant Country Case

3.3.1 Necessary conditions

In the previous section, we assume all countries i and j are active in contests. We will now specify necessary conditions for this assumption. Let us first focus on country A. Given all firms j are active, firm i finds it profitable to participate, and therefore exerts some positive lobbying effort, if its marginal profit evaluated at $s_{ai} = 0$ is positive. Taking (3.5) into account, we have

$$\frac{\partial \Pi_{ai}}{\partial s_{ai}}|_{s_{ai}=0} = \frac{V_i n_j}{(n_j-1)\,V_j} - 1 > 0$$
$$\Longleftrightarrow \quad V_j < \frac{n_j}{n_j-1} V_i \tag{3.25}$$

Condition (3.25) ensures that firm i **is** active when the contest takes place in country A. When $V_j \geq \frac{n_j}{n_j-1} V_i$, all firms i choose not to lobby, and firms j of country B are dominating the market in country A.

Similarly, when the contest is held in country A, given all firms i are active, firm j will choose to participate if its marginal profit evaluated at $s_{aj} = 0$ is positive. Taking (3.6) into account, we have

$$\frac{\partial \Pi_{aj}}{\partial s_{aj}}|_{s_{aj}=0} = \frac{V_j n_i}{(n_i-1)V_i} - 1 > 0$$
$$\Longleftrightarrow \quad V_j > \frac{n_i-1}{n_i} V_i \tag{3.26}$$

Condition (3.26) ensures that firm j is active when the contest takes place in country A. When $V_j \leq \frac{n_i-1}{n_i} V_i$, all firms j are out of business and firms i of country A are dominating their home market.

Putting (3.25) and (3.26) together, we derive the necessary condition for both firms i and j to be active when the contest takes place in country A

$$\frac{n_i-1}{n_i} V_i < V_j < \frac{n_j}{n_{j-1}} V_i \tag{3.27}$$

Let us now consider the other case where the contest is held in country B. A similar analysis leads to the following results. All firms i will choose to participate if

$$V_i > \frac{n_j-1}{n_j} V_j \tag{3.28}$$

All firms j will choose to be active if

$$V_i < \frac{n_i}{n_i - 1} V_j \tag{3.29}$$

and therefore all firms i and j are active in country $B's$ contest if

$$\frac{n_j - 1}{n_j} V_j < V_i < \frac{n_i}{n_i - 1} V_j \tag{3.30}$$

Proposition 3.1:

1. *When firms dominate their home market, they will also dominate the foreign market if liberalization takes place. Country A's firms* i *dominate both markets if* $V_i \geq V_i^H \equiv \frac{n_i}{n_{i-1}} V_j$, *while country B's firms* j *become dominant if* $V_i \leq V_i^L \equiv \frac{n_j - 1}{n_j} V_j$.

2. *There exists a single necessary condition that allows all firms of both countries to participate in contests held in the two markets. This condition is* $V_i^L < V_i < V_i^H$.

Proof: The proof of Proposition 3.1 is straight-forward. Let us first consider country A. Taking condition (3.26) into account, country $A's$ domestic firms i dominate their home market if $V_j \leq \frac{n_i - 1}{n_i} V_i$. This is equivalent to $V_i \geq \frac{n_i}{n_i - 1} V_j$, which violates condition (3.29) and implies firms i also dominate the contest taking place in the foreign country B. Similarly, in country B, its domestic firms j dominate home market if (3.28) is violated, i.e. $V_i \leq \frac{n_j - 1}{n_j} V_j \Leftrightarrow V_j \geq \frac{n_j}{n_j - 1} V_i$. This leads to the violation of condition (3.25) and implies firms j also dominate the market in country A. This proves the first part of Proposition 3.1.

A simple transformation of condition (3.27) leads to the equivalent condition (3.30), which implies there exists a single necessary condition that ensures participation of all firms i and j in all contests held in both countries A and B. This completes the proof of Proposition 3.1.■

3.3.2 Welfare implications

We will now assess the welfare implications of the dominant country case. Country A (B) is defined to be a dominant country if its firms i (j) dominate the contest market both at home and abroad. Therefore, as Proposition 1 suggests, A is a dominant country when $V_i \geq V_i^H \equiv \frac{n_i}{n_i-1}V_j$; and B is a dominant country if $V_i \leq V_i^L \equiv \frac{n_j-1}{n_j}V_j$.

Let us first assume a dominant country A. This implies firms j of country B would not have an interest in participating in country $A's$ contest. Moreover, in their home country B, all firms j would be dominated if firms i are allowed to bid for the contract. Therefore, trade liberalization would have different implications for the two countries and we assess them bellows.

In the dominant country A, its pre-liberalization welfare level is specified in (3.17). After liberalization, the country's welfare is

$$\widehat{W}_a = \frac{[(n_i - 1)t_a + 1]\,V_i}{n_i} + (1 - t_b)\,V_i \tag{3.31}$$

The first term on the RHS of (3.31) is the expected welfare that all firms i generate from the project offered in country A. This exactly equals the autarkic level of welfare for country A since all firm j are unable to compete with firms i in A. The second term is the after-tax expected welfare that all firms i generate from the project offered in country B. We do not subtract firms is' lobbying efforts since these are considered as import of services from country $A's$ perspective. Since the second term of (3.31) is positive $(t_b \leq 1)$,it is obvious that the dominant country (country A in this case) gains from trade liberalization.

In the dominated country B, its pre-liberalization welfare level is specified in (3.18). After liberalization, all domestic firms j are out of business and the country's welfare equals the tax revenue collected from foreign firms i :

$$\widehat{W}_b = t_b V_i \tag{3.32}$$

Therefore, country B gains in welfare if and only if

$$\begin{aligned} \widehat{W}_b &> W_b^{AU} \\ t_b V_i &> \frac{[(n_j - 1) t_b + 1] V_j}{n_j} \end{aligned}$$

Given $V_i \geq V_i^H \equiv \frac{n_i}{n_i - 1} V_j$, this condition holds if the tax rate in country B is sufficiently high

$$t_b > t_b^{(1)} \equiv \frac{n_i - 1}{(n_i - 1) + n_j} \tag{3.33}$$

Similarly, when firms j of country B become dominant, i.e. $V_i \leq V_i^L \equiv \frac{n_j - 1}{n_j} V_j$, country B always gains from trade liberalization while country A only allows liberalization if it can set a sufficiently high tax rate

$$t_a > t_a^{(1)} \equiv \frac{n_j - 1}{(n_j - 1) + n_i} \tag{3.34}$$

The preceding analysis leads to Proposition 3.2.

Proposition 3.2: *In a two-country case with asymmetric valuations, the dominant country always has welfare gains under bilateral liberalization of government procurement. The dominated country has welfare gains only if it is able to establish a sufficiently* *high domestic tax rate. The threshold level of tax rate to obtain welfare gains for country A is $t_a^{(1)}$ and that for country B is $t_b^{(1)}$, where $t_a^{(1)} \equiv \frac{n_j-1}{n_i+(n_j-1)}$ and $t_b^{(1)} \equiv \frac{n_i-1}{(n_i-1)+n_j}$.*

The intuition behind Proposition 3.2 is simple. When a country has a dominating power, its domestic market is not affected by bilateral liberalization. Its domestic welfare, however, increases with liberalization because domestic firms have access to the foreign market and therefore can capture some positive expected profit from operations abroad, unless the foreign tax rate is 100 percent. The welfare of the dominated country, on the other hand, can and improve with bilateral liberalization partially because its domestic waste of lobbying resources is reduced. However, net positive welfare improvement can only be obtained if the dominated country can set a sufficiently high tax rate to limit the risk of rent being shifted to foreign firms.

3.4 A Non-dominant Country Case with Unilateral Liberalization

In this section and those to follow, we are interested a situation where firms from both countries are active in all contest markets. Proposition 3.1 suggests this happens if and only if gross surplus of firm i falls in the non-empty range (V_i^L, V_i^H) where $V_i^L \equiv \frac{n_j-1}{n_j}V_j$ and $V_i^H \equiv \frac{n_i}{n_i-1}V_j$. This condition is equivalent to the following

$$\frac{n_i-1}{n_i}V_i \equiv V_j^L < V_j < V_j^H \equiv \frac{n_j}{n_j-1}V_i \tag{3.35}$$

We will first assess the case where country A unilaterally allows foreign firms to participate in its contest. In our two-country case, this implies firms j of country B have full access to country A's market, while firms i of country A are limited to their home market.

The welfare of the two countries are specified in equations (3.19) and (3.20) . Given that all firms i and j actively compete for the project offered in A, their individual lobbying efforts are specified in (3.8) and (3.9) respectively. With symmetry among firms i and among firms j, we have $S_{ai} = \sum_{i=1}^{n_i} s_{ai} = n_i s_{ai}$ and $S_{aj} = \sum_{j=1}^{nj} s_{aj} = n_j s_{aj}$. Therefore, with respect to the project offered by A, the total efforts exerted by all firms is given by (3.7) and the probability that an individual firm i and j wins the contract $p_{ai} = \frac{s_{ai}}{S_{ai}+S_{aj}} = \frac{n_jV_i-(n_j-1)V_j}{n_iV_j+n_jV_i}$ and $p_{aj} = \frac{s_{aj}}{S_{ai}+S_{aj}} = \frac{n_iV_j-(n_i-1)V_i}{n_iV_j+n_jV_i}$ respectively. From country A perspective, the probability that the contestant is a domestic country is $n_i p_{ai} = n_i \frac{n_jV_i-(n_j-1)V_j}{n_iV_j+n_jV_i}$ and that the contestant is a foreign country is $n_j p_{aj} = n_j \frac{n_iV_j-(n_i-1)V_i}{n_iV_j+n_jV_i}$. Substitution of these values into the welfare functions (3.19) and (3.20) yields

$$W_a^{UNA} = P_{ai} - S_{ai} + t_a P_{aj} \tag{3.36}$$

$$W_b^{UNA} = W_b^{AU} + (1 - t_a) P_{aj} \tag{3.37}$$

where B_{ai} is the total expected profits of firm i

$$P_{ai} \equiv n_i \frac{n_jV_i - (n_j - 1)V_j}{n_iV_j + n_jV_i} V_i$$

S_{ai} is the total expenditure spent by firm i on lobbying activities

$$S_{ai} = n_i \frac{(n_i + n_j - 1)(1 - t_a)V_iV_j\left[n_jV_i - (n_j - 1)V_j\right]}{(n_iV_j + n_jV_i)^2}$$

$t_a P_{aj}$ is the total tax revenue collected from firms j, with P_{aj} is the total expected profit earned in country A by firms j

$$P_{aj} \equiv n_j \frac{n_iV_j - (n_i - 1)V_i}{n_iV_j + n_jV_i} V_j$$

W_b^{AU} is the autarky welfare level of country B and $(1-t_a)P_{aj}$ is the total expected after-tax profit earned by all firm j and repatriated back to their home country.

The welfare analysis for country B in this case is straight forward. Since B does not allow foreign firms to participate in its domestic contest, it can preserve its autarky level of welfare. Its domestic firms j, however, have full access to the market of country A. Therefore, welfare of country B is increased by the amount of expected after-tax profit $(1-t_a)P_{aj}$.

From country A perspective, it is better off if the difference between its unilateral-liberalization welfare and the autarky welfare is positive. Subtracting (3.17) from (3.36) yields

$$\begin{aligned} \Delta_a^{UNA}(V_j) &= W_a^{UNA} - W_a^{AU} \\ &= C_a^{UNA}(V_j)\Phi_a^{UNA}(V_j) \end{aligned}$$

where

$$\begin{aligned} C_a^{UNA}(V_j) &\equiv \frac{n_j\left[n_i V_j - (n_i-1)V_i\right]}{n_i\left(n_j V_i + n_i V_j\right)^2} n_i^2 t_a \\ \Phi_a^{UNA}(V_j) &\equiv V_j^2 - \frac{2n_i(1-t_a) - n_i n_j + n_i^2 t_a}{n_i^2 t_a} V_i V_j - \frac{n_j(1-t_a) + n_i n_j}{n_i^2 t_a} V_i^2 \end{aligned}$$

Proposition 3.3: *Assume that firms of both countries actively lobby for government procurement contracts, i.e. the condition* $\frac{n_i-1}{n_i}V_i \equiv V_j^L < V_j < V_j^H = \frac{n_j}{n_j-1}V_i$ *is satisfied; and assume that country A unilaterally liberalizes trade.*

1. *The non-liberalizing country (country B) always gains from unilateral access to the liberalizing country (country A).*

2. *From the liberalizing country's perspective, unilateral liberalization results in a negative domestic welfare change if foreign contestants produce the same or less surplus* $\left(V_j^L < V_j \leq V_i\right)$.

3. *When the tax rate of the liberalizing country is small,* $t_a \leq \frac{n_j - 1}{n_i + n_j - 1}$, *unilateral liberalization also results in negative domestic welfare change even if foreign contestant produce more surplus* $\left(V_i < V_j < V_j^H\right)$.

4. *When the tax rate of the liberalizing country is sufficiently large,* $t_a > \frac{n_j - 1}{n_i + n_j - 1}$, *there exists a critical surplus level* V_j^*, *where* $V_i < V_j^* < V_j^H$, *and*

(a) *unilateral liberalization results in negative domestic welfare change if* $V_i < V_j < V_j^*$

(b) *unilateral liberalization results in positive domestic welfare change if* $V_j^* \leq V_j < V_j^H$.

Proof: The first part of Proposition 3.3 follows our previous analysis.

Under condition (3.35), $C_a^{UNA}(V_j) > 0$ for all positive values of n_i, n_j, V_i, V_j and t_a. Therefore, whether the welfare change function $\Delta_a^{UNA}(V_j)$ is negative or positive depends only on the value of function $\Phi_a^{UNA}(V_j)$. Consider the quadratic equation in V_j

$$\Phi_a^{UNA}(V_j) = V_j^2 + mV_j + c = 0 \tag{3.38}$$

with $m = -\frac{2n_i(1-t_a) - n_i n_j + n_i^2 t_a}{n_i^2 t_a} V_i$ and $c = -\frac{n_j(1-t_a) + n_i n_j}{n_i^2 t_a} V_i^2$. For a small value of the tax rate t_a, i.e. $0 \leq t_a \leq 1$, $c < 0$. Therefore, the discriminant of the quadratic equation (3.38) must be positive: $m^2 - 4c > 0$. Since $\Phi_a^{UNA}(V_j = 0) = c < 0$, it follows that the equation must have two real non-zero roots. Let $V_j^{(1)}$ and $V_j^{(2)}$ be the two roots of this equation.

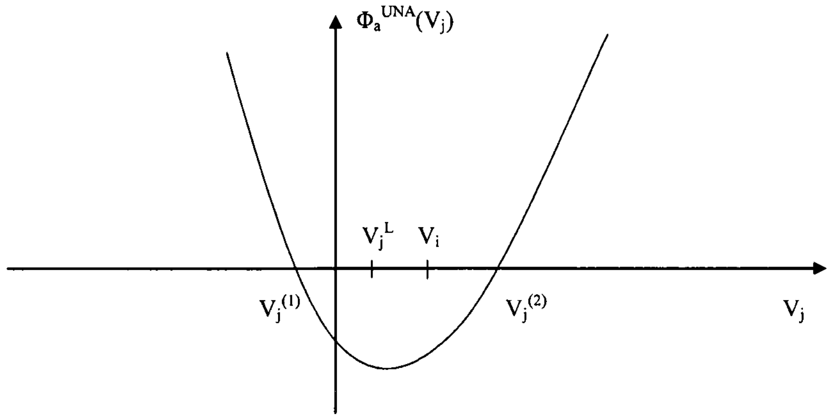

Figure 3.1: Characteristics of Function $\Phi_a^{UNA}(V_j)$

According to the Viète's formulas, we have

$$V_j^{(1)} V_j^{(2)} = \frac{c}{1} = -\frac{n_j(1-t_a) + n_i n_j}{n_i^2 t_a} V_i^2 < 0$$

Therefore, one of the roots must be negative and the other must be positive. Let $V_j^{(1)} < 0$ and $V_j^{(2)} > 0$.

Next, consider the second derivative of the quadratic function $\Phi_a^{UNA}(V_j)$ with respect to V_j : $\frac{\partial^2 \Phi_a^{UNA}(V_j)}{\partial V_j^2} = 2 > 0$. Therefore, this function must have a minimum at $V_j = V_j^{\min}$, where $V_j^{\min}$ solves the equation $\frac{\partial \Phi_a^{UNA}(V_j)}{\partial V_j} = 0$. It also follows that the value of the function Φ_a^{UNA} must be negative when $V_j \in \left(V_j^{(1)}, V_j^{(2)}\right)$, and be non-negative for $V_j \leq V_j^{(1)}$ or $V_j \geq V_j^{(2)}$. Figure 3.1 demonstrates the characteristics of the function Φ_a^{UNA} under condition (3.35).

At $V_j = V_i$, the function $\Phi_a^{UNA}(V_j)$ takes a negative value:

$$\Phi_a^{UNA}(V_j = V_i) = -V_i^2 \left[\frac{(1-t_a)(2n_i + n_j)}{n_i^2 t_a}\right] < 0$$

Since the function $\Phi_a^{UNA}(V_j)$ only takes negative values when $V_j^{(1)} < V_j < V_j^{(2)}$, it follows that V_i must also be in the range $\left(V_j^{(1)}, V_j^{(2)}\right)$. Moreover, because $0 < V_j^L = \frac{n_i-1}{n_i}V_i < V_i$ for $n_i \geq 1$, it is clear that V_j^L is also included in the range $\left(V_j^{(1)}, V_j^{(2)}\right)$. Therefore, we conclude that $\Phi_a^{UNA} < 0$ for $V_j^L < V_j \leq V_i$. This proves the second part of Proposition 3.3.

We will now consider the behavior of function $\Phi_a^{UNA}(V_j)$ when V_j is in the range $\left(V_i, V_j^H \equiv \frac{n_j}{n_j-1}V_i\right)$. Consider the value of function $\Phi_a^{UNA}(V_j)$ at V_j^H :

$$\Phi_a^{UNA}(V_j = V_j^H) = \frac{V_i^2 n_j(n_i + n_j - 1)\left[(n_i + n_j - 1)\, t_a - (n_j - 1)\right]}{n_i^2\,(n_j - 1)^2\, t_a}$$

With $n_i > 1$ and $n_j > 1$, it is clear that $\Phi_a^{UNA}(V_j = V_j^H) \leq 0$ if $t_a \leq \frac{n_j-1}{n_i+n_j-1}$. In such a case, V_j^H must be in the range $(V_j^{(1)}, V_j^{(2)}]$ and therefore, under condition (3.35), $V_j^{(2)}$ becomes irrelevant unless $t_a = \frac{n_j-1}{n_i+n_j-1} \iff V_j^H = V_j^{(2)}$. Since the function $\Phi_a^{UNA}(V_j)$ is continuous in V_j, we conclude that it takes negative values for $V_i < V_j < V_j^H \equiv \frac{n_j}{n_j-1}V_i$. This proves the third part of Proposition 3.3.

Lastly, consider a large tax rate in country A, i.e. $t_a > \frac{n_j-1}{n_i+n_j-1}$. With this tax rate, the function $\Phi_a^{UNA}(V_j)$ is positive when evaluated at $V_j = V_j^H > 0$. It follows that V_j^H must be in the range $\left(V_j^{(2)}, +\infty\right)$. Therefore, $\Phi_a^{UNA}(V_j) < 0$ for $V_i < V_j < V_j^{(2)}$ and $\Phi_a^{UNA}(V_j) \geq 0$ for $V_j^{(2)} \leq V_j < V_j^H \equiv \frac{n_j}{n_j-1}V_i$. From country $A's$ perspective, the critical level of foreign firms' surplus is

$$\begin{aligned} V_j^* &= V_j^{(2)} \equiv \frac{-m + \sqrt{m^2 - 4c}}{2} \\ &= \frac{V_i}{2n_i t_a}\left[\sqrt{\left[(n_j - 2) - (n_i - 2)t_a\right]^2 + 4n_j t_a\,(n_i + 1 - t_a)} - (n_j - 2) + (n_i - 2)t_a\right] \end{aligned}$$

This proves the last part of Proposition 3.3.■

The intuition of Proposition 3.3 is straight forward. As we mentioned earlier, welfare of country A $[B]$ comes from two sources: expected domestic profit and expected tax revenue collected from foreign firms j $[i]$. Since domestic lobbying activities takes away real resources, they reduce domestic welfare. When a country unilaterally liberalizes its market, domestic welfare declines (as stated in part 2 and 3 of Proposition 3.3), because the reduced waste of lobbying resources from lower domestic lobbying is small relative to the amount of rent being shifted to foreign firms. The last part of Proposition 3.3 demonstrates the fact that domestic welfare declines with unilateral liberalization when the gross surplus level of foreign firm V_j is not very large. However, a sufficiently large V_j will guarantee a positive domestic welfare effect. It should be noted that the fact V_j is large in relativity to V_i implies domestic firms i are less efficient than foreign firms j. In such a case, country A can only gain from unilateral liberalization if it can set a high tax rate to capture a large proportion of efficiency coming from foreign firms (i.e. from firms j, in this case).

3.5 A Non-dominant Country Case with Bilateral Liberalization

In the preceding section, we assumed that a country (country A in particular) unilaterally liberalizes trade. This country extends market access to the other country and does not require reciprocal treatment. In this section, we discuss the case of bilateral liberalization where both countries allow foreign contestants to access their domestic markets. We will determine whether bilateral liberalization is mutually beneficial and if not, under what condition it will be. Since firms have full access to all markets, welfare for countries A and

B are determined in (3.23) and (3.24). We assess welfare implications for each country separately.

In country A, the total effort exerted by all firms i and j is specified in (3.7), while firms' individual efforts are specified in (3.8) and (3.9). By symmetry, the total efforts of all firm i $[j]$ is $S_{ai} = n_i s_{ai}$. $[S_{aj} = n_j s_{aj}]$. The probability that firm i $[j]$ wins the contract in country A is $p_{ai} = \frac{n_j V_i - (n_j - 1) V_j}{n_i V_j + n_j V_i}$ $\left[p_{aj} = \frac{n_i V_j - (n_i - 1) V_i}{n_i V_j + n_j V_i}\right]$. Similarly, in country B, the total efforts exerted by all firms i and j is (3.16) and individual firms' efforts are (3.12) and (3.13) respectively. We also have $S_{bi} = n_i s_{bi}$ and $S_{bj} = n_j s_{bj}$. The probability that firm i $[j]$ wins the contract in country B is $p_{bi} = \frac{n_j V_i - (n_j - 1) V_j}{n_i V_j + n_j V_i}$ $\left[p_{bj} = \frac{n_i V_j - (n_i - 1) V_i}{n_i V_j + n_j V_i}\right]$.

Substituting these values into (3.23) we have

$$W_a^{BL} = P_{ai} - S_{ai} + t_a P_{aj} + (1 - t_b) P_{bi}$$

$$W_b^{BL} = P_{bj} - S_{bj} + t_b P_{bi} + (1 - t_a) P_{aj}$$

where P_{ai}, S_{ai}, P_{aj} were specified in the previous section; S_{bj} is the total efforts of all firms j when lobbying in their home country B :

$$S_{bj} = n_j \frac{(n_i + n_j - 1)(1 - t_b) V_i V_j \left[n_i V_j - (n_i - 1) V_i\right]}{(n_i V_j + n_j V_i)^2}$$

P_{bj} is the total expected profit earned by firms j in their home country B

$$P_{bj} = \frac{n_i V_j - (n_i - 1) V_i}{n_i V_j + n_j V_i} n_j V_j$$

and P_{bi} is the total expected profit earned by firms i in the foreign country B

$$P_{bi} = \frac{n_j V_i - (n_j - 1) V_j}{n_i V_j + n_j V_i} n_i V_i$$

It should be noted that due to symmetry, we have $p_{ai} = p_{bi}$ and $p_{aj} = p_{bj}$, i.e. the probability of winning a contract is the same for firm i $[j]$ regardless where the contest is organized. As a consequence, the total expected profits of firms i $[j]$ are the same in both countries: $P_{ai} = P_{bi}\left[P_{aj} = P_{bj}\right]$.

Country A is better off if and only if its bilateral-liberalization welfare level $W_a^{BL})$ exceeds its autarky welfare level $\left(W_a^{AU}\right)$. Let Δ_a^{BL} be the difference between the two welfare levels

$$\begin{aligned}
\Delta_a^{BL} &= P_{ai} - S_{ai} + t_a P_{aj} + (1-t_b)\,P_{bi} - W_a^{AU} \\
&= \Delta_a^{UNA} + (1-t_b)P_{bi} = \Delta_a^{UNA} + (1-t_b)\frac{n_j V_i - (n_j-1)\,V_j}{n_i V_j + n_j V_i} n_i V_i \\
&= \frac{1}{n_i(n_i V_j + n_j V_i)^2} F_a^{BL}(V_j) \qquad (3.39)
\end{aligned}$$

where $F_a^{BL}(V_j)$ is a cube function in V_j

$$F_a^{BL}(V_j) = n_j[n_i V_j - (n_i-1)V_i] n_i^2 t_a \Phi_a^{UNA}(V_j) + (1-t_b) n_i^2 V_i [n_j V_i - (n_j-1)V_j](n_i V_j + n_j V_i) \qquad (3.40)$$

Since $n_i(n_i V_j + n_j V_i)^2 > 0$, the sign of Δ_a^{BL} depends on the sign of $F_a^{BL}(V_j)$.

Likewise, country B is better off if and only iff its bilateral-liberalization welfare level (W_b^{BL}) exceeds its autarky welfare level (W_b^{AU}). Let Δ_b^{BL} be the difference between the two welfare levels

$$\Delta_b^{BL} = \frac{1}{n_j(n_i V_j + n_j V_i)^2} F_b^{BL}(V_i) \qquad (3.41)$$

where $F_b^{BL}(V_i)$ is a cube function in V_i

$$\begin{aligned}
F_b^{BL}(V_i) &= n_i[n_j V_i - (n_j-1)V_j] n_j^2 t_b \Phi_b^{UNB}(V_i) + (1-t_a) n_j^2 V_j \left[n_i V_j - (n_i-1)V_i\right](n_i V_j + n_j V_i) \\
\Phi_b^{UNB} &= V_i^2 - \frac{2n_j(1-t_b) - n_i n_j + n_j^2 t_b}{n_j^2 t_b} V_j V_i - \frac{n_i(1-t_b) + n_i n_j}{n_j^2 t_b} V_j^2
\end{aligned}$$

Again, the sign of Δ_b^{BL} depends on the sign of $F_b^{BL}(V_i)$ since $n_j(n_iV_j + n_jV_i)^2 > 0$.

3.5.1 The single firm case

In this subsection, we consider a special case where there is only one firm in each country, i.e. $n_i = n_j = 1$. In this case bilateral liberalization always encourages firms to join the contest, regardless of their net surplus levels. It is obvious that if either firm decides not to participate in a contest, the other firm would exert zero lobbying effort because the probability of winning the contract for the remaining firm in the contest is 1. On the other hand, if either firm exerts some positive level of lobbying effort, the remaining firm will find it beneficial to join the contest to improve its expected profit from 0 to some positive value. We therefore assume that when $n_i = n_j = 1$, all firms are active in contests held in both countries. The welfare changes from the autarky levels for the two countries are

$$\Delta_a^{BL} = \frac{1}{(V_j + V_i)^2} F_a^{BL}(V_j) \quad (3.42)$$

$$\Delta_b^{BL} = \frac{1}{(V_j + V_i)^2} F_b^{BL}(V_i) \quad (3.43)$$

where

$$F_a^{BL}(V_j) = t_a V_j^3 - (1 - t_a)V_i V_j^2 - (1 - t_a + t_b)V_i^2 V_j + (1 - t_b)V_i^3$$

$$F_b^{BL}(V_i) = t_b V_i^3 - (1 - t_b)V_j V_i^2 - (1 - t_b + t_a)V_j^2 V_i + (1 - t_a)V_j^3$$

We will assess two special sub-cases. Firstly, assume the two countries are completely symmetric, i.e. $V_i = V_j \equiv V$ and $t_a = t_b \equiv t$. We then have $F_a^{BL}(V) = F_b^{BL}(V) = V^3(t-1) \leq 0$ for all $0 \leq t \leq 1$. This implies both countries are worse off as the result of bilateral liberalization. The fall in welfare in both countries is due to the fact that as soon as the foreign firm is allowed into the country, the probability of wining the contract of domestic firm falls bellow unity. Expected domestic profit therefore falls. On the other hand, domestic lobbying expenditure increases sharply from zero to some positive level, and so does the expected profit captured by the foreign firm. Since the gain from expected profit earned abroad is not sufficient to offset these welfare losses, the overall level of welfare change is negative for both countries.

Secondly, assume the two firms have the same net surplus, i.e. $V_i = V_j = V$, but the two countries maintain asymmetric tax rates, i.e. $t_a \neq t_b$. Again, the welfare changes from the autarky levels for the two countries are (3.42) and (3.43), where

$$F_a^{BL} = V^3(3t_a - 2t_b - 1)$$

$$F_b^{BL} = V^3(3t_b - 2t_a - 1)$$

Whether country A (B) gain from bilateral liberalization depends on relative values of t_a and t_b. Set $3t_a - 2t_b - 1 = 0$, we have $t_a = \frac{2}{3}t_b + \frac{1}{3}$. Therefore $F_a^{BL} \geq 0$ when $t_a \geq \frac{2}{3}t_b + \frac{1}{3}$, and $F_a^{BL} < 0$ if $t_a < \frac{2}{3}t_b + \frac{1}{3}$. Similarly, set $3t_b - 2t_a - 1 = 0$, we have $t_a = \frac{3}{2}t_b - \frac{1}{2}$, and as the result, $F_b^{BL} < 0$ if $t_a > \frac{3}{2}t_b - \frac{1}{2}$; $F_b^{BL} \geq 0$ if $t_a \leq \frac{3}{2}t_b - \frac{1}{2}$. Note that $\frac{2}{3}t_b + \frac{1}{3} \geq \frac{3}{2}t_b - \frac{1}{2}$ for all $0 \leq t_b \leq 1$.We summarize these results in Figure 3.2.

Note in Figure 3.2 that the set of feasible combinations of tax rates is bounded by the horizontal dotted line going through $(0, 1)$ and the vertical dotted line going through $(1, 0)$. Two straight lines, where the upper one depicts $t_a = \frac{2}{3}t_b + \frac{1}{3}$ and the lower one depicts $t_a = \frac{3}{2}t_b - \frac{1}{2}$, intersect at $(1, 1)$. These two lines divide the feasible set of tax rates into three sections. In the upper section, country A is better off while country B is worse

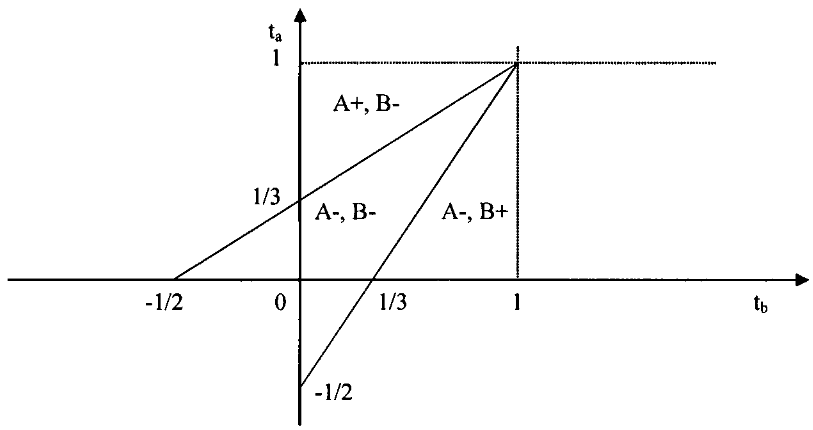

Figure 3.2: Welfare Change – Single Firm with Asymmetric Tax Rates

off. In the middle section, both countries are worse off. In the lower section, country B is better off while country A is worse off.

Several observations can be made from Figure 3.2. First, there does not exist a pair of tax rates that ensures both countries are better off. Second, when tax rates t_a and t_b are sufficiently closed, i.e. $\frac{3}{2}t_b - \frac{1}{2} < t_a < \frac{2}{3}t_b + \frac{1}{3}$, both countries are worse off when bilateral liberalization is allowed. And third, given tax rate of country B, t_b, country A only gains from bilateral trade liberalization if its tax rate is sufficiently high, i.e. $t_a \geq \frac{2}{3}t_b + \frac{1}{3}$.

Although the single firm case is trivial, it highlights an interesting fact that when there is a single firm lobbying for contracts in each country and the firms have similar capacity (or production costs), it is impossible for the two governments to negotiate on tax policies that guarantee mutual benefit. This situation likely happens when the scale of a project is large and there is only a single domestic firm capable of carrying out the contract.

3.5.2 The multiple firm case

In this subsection, we deviate from the single firm assumption and assume the number of potential contestants in each country is at least 2, i.e. $n_i \geq 2$ and $n_j \geq 2$. We will assess several special cases to examine the effects of surplus levels, number of contestants and tax rates separately. We will also assess the general case where the two countries are completely asymmetric and we will determine conditions under which bilateral liberalization is beneficial for each country. We begin with the simplest case where the two countries are completely symmetric, i.e. $n_i = n_j \equiv n$, $V_i = V_j \equiv V$, and $t_a = t_b \equiv t$. In this case the welfare changes from autarky levels of the two countries are

$$\begin{aligned} \Delta_a^{BL} &= \frac{1}{4n^3V^2}F_a^{BL}(V) \\ \Delta_b^{BL} &= \frac{1}{4n^3V^2}F_b^{BL}(V) \end{aligned}$$

where

$$F_a^{BL} = F_b^{BL} = n^2(2n-3)\,(1-t)\,V^3$$

Since $n_i = n_j = n \geq 2$ and $0 \leq t \leq 1$, $(2n-3) > 0$ and $(1-t) \geq 0$. Therefore $\Delta_a^{BL} = \Delta_b^{BL} \geq 0$, which implies both countries are better off as the result of bilateral liberalization. This result sharply contradicts that of the single firm case. It is because domestic lobbying expenditure exits even if no liberalization is allowed. As the country allows for foreign participation in its domestic project, domestic firms' lobbying efforts actually decrease due to fall in expected profit. This fall, together with the rise in expected profit captured from the foreign market, help to improve domestic welfare. Although this simple case is trivial, it partially explains the facts that there exists only one plurilateral government procurement agreement (GPA) since the establishment of the GATT/WTO, and that signatories to the agreement are mostly developed OECD countries. As we would expect, with similar economic capacities and tax policies, member states of the GPA can easily find a common ground when negotiating on liberalization of government procurement. We will assess two other special cases where the countries are only partially symmetric.

Asymmetric numbers of contestants

In this special case, we assume the two countries maintain the same level of tax rates, and firms have the same capacities, i.e. $t_a = t_b \equiv t$ and $V_i = V_j \equiv V$, but the numbers of potential contestants in each country are asymmetric, i.e. $n_i \neq n_j$. Note that this assumption satisfies condition (3.35) for the non-dominant country case. The welfare changes from autarky levels of the two countries are

$$\begin{aligned} \Delta_a^{BL} &= \frac{1}{n_i(n_i+n_j)^2V^2}F_a^{BL}(V) \\ \Delta_b^{BL} &= \frac{1}{n_j(n_i+n_j)^2V^2}F_b^{BL}(V) \end{aligned}$$

where

$$\begin{aligned} F_a^{BL}(V) &= (1-t)V^3[n_i^3+n_in_j(n_i-2)-n_j^2] \\ F_b^{BL}(V) &= (1-t)V^3[n_j^3+n_in_j(n_j-2)-n_i^2] \end{aligned}$$

Let's $N_a(n_j) \equiv n_i^3 + n_in_j(n_i-2) - n_j^2$ and $N_b(n_i) \equiv n_j^3 + n_in_j(n_j-2) - n_i^2$. The signs of Δ_a^{BL} and Δ_b^{BL} will now depend on the signs of $N_a(n_j)$ and $N_b(n_i)$, which are both quadratic functions in n_j and n_i respectively. Note that each of the two quadratic equations $N_a(n_j) = 0$ and $N_b(n_i) = 0$ has two roots of opposite signs for all $n_i \geq 2$ and $n_j \geq 2$.

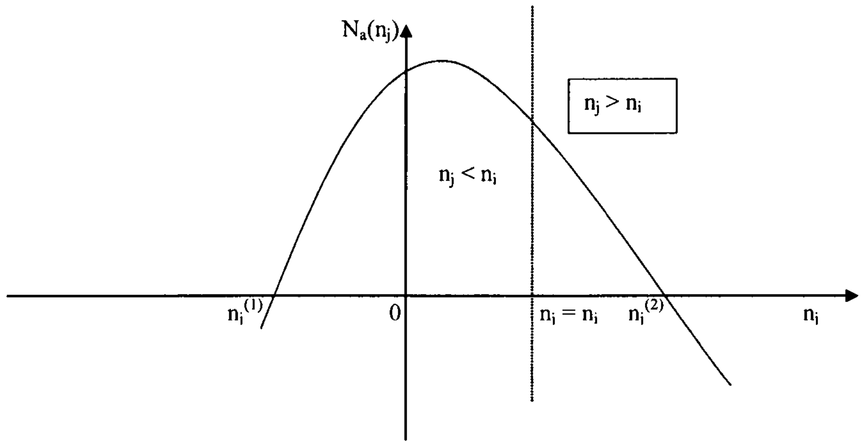

Figure 3.3: Behaviour of quadratic function $N_a(n_j)$

Let $n_j^{(1)}$ and $n_j^{(2)}$ be the two roots of equation $N_a(n_j) = 0$; $n_i^{(1)}$ and $n_i^{(2)}$ be the two roots of equation $N_b(n_i) = 0$. Assume $n_j^{(1)} < 0 < n_j^{(2)}$ and $n_i^{(1)} < 0 < n_i^{(2)}$. We then have $n_j^{(2)} = \frac{n_i}{2} \left[(n_i - 2) + \sqrt{n_i^2 + 4}\right]$ and $n_i^{(2)} = \frac{n_j}{2} \left[(n_j - 2) + \sqrt{n_j^2 + 4}\right]$. We also have $n_j^{(2)} > n_i$ for all $n_i \geq 2$ and $n_i^{(2)} > n_j$ for all $n_j \geq 2$. Behavior of the two functions $N_a(n_j)$ and $N_b(n_i)$ can be represented by the two Figure 3.3 and Figure 3.4 respectively.

The signs of two quadratic functions $N_a(n_j)$ and $N_b(n_i)$ change in accordance with relative values of n_i and n_j. We summarize the results in Table 3.1.

The preceding analysis leads to Proposition 3.4.

Proposition 3.4: *Assume firms i and firms j are symmetric in their gross surplus levels, i.e. $V_i = V_j \equiv V$, and the two countries mutually allow for trade liberalization and apply the same tax rate, i.e. $t_a = t_b \equiv t$,*

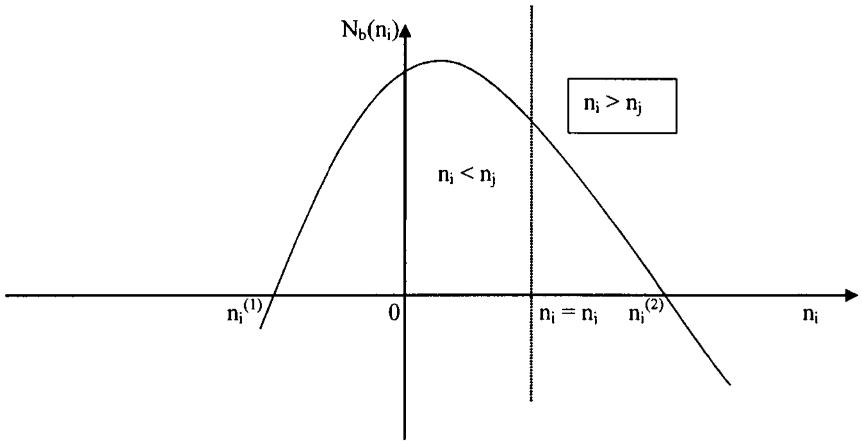

Figure 3.4: Behaviour of quadratic function $N_b(n_i)$

Case	n_i , n_j	$N_a(n_j)$	$N_b(n_i)$
1.1	$n_i \leq n_j \leq n_j^{(2)} \equiv \frac{n_i}{2}\left[(n_i - 2) + \sqrt{n_i^2 + 4}\right]$	Positive	Positive
1.2	$n_i < n_j^{(2)} \equiv \frac{n_i}{2}\left[(n_i - 2) + \sqrt{n_i^2 + 4}\right] < n_j$	Negative	Positive
2.1	$n_j \leq n_i \leq n_i^{(2)} \equiv \frac{n_j}{2}\left[(n_j - 2) + \sqrt{n_j^2 + 4}\right]$	Positive	Positive
2.2	$n_j < n_i^{(2)} \equiv \frac{n_j}{2}\left[(n_j - 2) + \sqrt{n_j^2 + 4}\right] < n_i$	Positive	Negative

Table 3.1: Welfare change when $t_a = t_b = t$; $V_i = V_j = V$; $n_i \geq 2$; $n_j \geq 2$

1. *A country always gains from bilateral liberalization if its domestic firms outnumber foreign firms.*

2. *Given the number of domestic firms, the outnumbered country can still gain from bilateral liberalization if the number of foreign contestants is smaller than a threshold. In such a case, both countries benefit from bilateral liberalization of government procurement.*

As we can see in case 1.1 and 1.2 of Table 3.1, country B always gains from bilateral liberalization as long as its number of firm is larger than that of country A. Similar result applies to country A as in case 2.1 and 2.2 of Table 3.1. However, even if firms from country A are outnumbered by those from country B, i.e. $n_i \leq n_j$, it can still gain from bilateral liberalization if the number of firms from country B is bellow a threshold, i.e. if $n_j \leq n_j^{(2)} = \frac{n_i}{2}\left[(n_i - 2) + \sqrt{n_i^2 + 4}\right]$. This happens in case 1.1 of Table 3.1, where both countries are better off as the result of bilateral liberalization. Similar interpretation applies to case 2.2 of Table 3.1. This result reinforces our observation of the current plurilateral Agreement on Government Procurement (GPA). As members of the GPA are mostly developed countries and have similar economic capacity and tax regimes, they often find it mutually beneficial to liberalize government procurement, even if the numbers of potential contractors in each country could be slightly different.

Asymmetric tax rates

In this special case, we assume firms from the two countries are symmetric in their gross valuations, i.e. $V_i = V_j \equiv V$. The numbers of potential contestants from the two countries are also assumed to be equal, i.e. $n_i = n_j \equiv n$. However, the two governments set different tax rates. These assumptions satisfy the non-dominant country condition specified in (3.35). The levels of welfare change for the two countries are

$$\Delta_a^{BL} = \frac{1}{4n^3V^2}F_a^{BL}(V)$$
$$\Delta_b^{BL} = \frac{1}{4n^3V^2}F_b^{BL}(V)$$

where

$$F_a^{BL}(V) = n^2V^3(3t_a - 3 + 2n - 2nt_b)$$
$$F_b^{BL}(V) = n^2V^3(3t_b - 3 + 2n - 2nt_a)$$

Proposition 3.5: *Assume firms i and firms j are symmetric in their gross surplus levels, i.e. $V_i = V_j \equiv V$, the numbers of potential contestants in each country are equal, i.e. $n_i = n_j \equiv n$, and the two countries mutually allow for trade liberalization but apply asymmetric tax rates, i.e. $t_a \neq t_b$,*

1. *Country A gains from bilateral liberalization of government procurement if its tax rate is sufficiently large, in relativity to the tax rate of country B; it loses from bilateral liberalization if its tax rate is sufficiently small, in relativity to the tax rate of country B.*

2. *Given the tax rate of country B, both countries can gain from bilateral liberalization of government procurement if the tax rate of country A is in a critical range of value. When the tax rate of country A is outside this range, bilateral liberalization has opposite welfare effects on the two countries.*

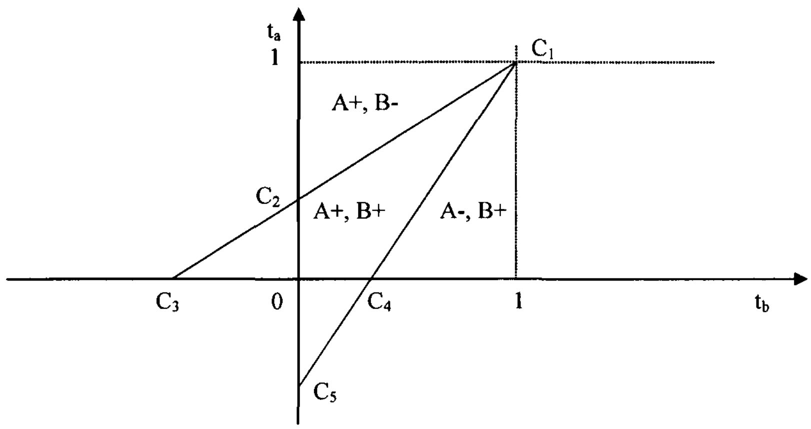

Figure 3.5: Welfare Change – Multiple Firms With Assymetric Tax Rates

Proof: The proof of Proposition 3.5 is simple. The signs of Δ_a^{BL} and Δ_b^{BL} depends on the value of t_a relative to the value of t_b. Set $3t_a - 3 + 2n - 2nt_b = 0$, we have $t_a = \frac{2n}{3}t_b + 1 - \frac{2n}{3}$. Therefore, $\Delta_a^{BL} \geq 0$ if and only if $t_a \geq \frac{2n}{3}t_b + 1 - \frac{2n}{3}$ and $\Delta_a^{BL} < 0$ iff $t_a < \frac{2n}{3}t_b + 1 - \frac{2n}{3}$. Similarly, set $3t_b - 3 + 2n - 2nt_a = 0$, we have $t_a = \frac{3}{2n}t_b + 1 - \frac{3}{2n}$. Therefore, $\Delta_b^{BL} < 0$ iff $t_a > \frac{3}{2n}t_b + 1 - \frac{3}{2n}$, and $\Delta_b^{BL} \geq 0$ iff $t_a \leq \frac{3}{2n}t_b + 1 - \frac{3}{2n}$. This proves the first part of Proposition 3.5.

In the $t_a 0 t_b$ space where t_a is measured along the vertical axis and t_b is measured along the horizontal axis, we can draw two straight lines C_1C_5 and C_1C_3 depicting two equations $t_a = \frac{2n}{3}t_b + 1 - \frac{2n}{3}$ and $t_a = \frac{3}{2n}t_b + 1 - \frac{3}{2n}$ respectively. The two lines are shown in Figure 3.5.

In Figure 3.5, the coordinates of points C_1, C_2, C_3, C_4 and C_5 are $(1,1)$, $\left(0, 1 - \frac{3}{2n}\right)$, $\left(1 - \frac{2n}{3}, 0\right)$, $\left(1 - \frac{3}{2n}, 0\right)$ and $\left(0, 1 - \frac{2n}{3}\right)$ respectively. Since $n \geq 2$, we have $0 < 1 - \frac{3}{2n} < 1$ and $1 - \frac{2n}{3} < 0$. It should be noted in Figure 3.5 that the two straight lines intersect at C_1. Since the tax rates t_a and t_b only take values in $[0, 1]$, the set of feasible tax-rate combinations is bounded by the box $C_1 101$. Within this box, line C_1C_3 lies above C_1C_5 because $\frac{3}{2n}t_b+1-\frac{3}{2n} > \frac{2n}{3}t_b+1-\frac{2n}{3}$ for all $0 \leq t_b \leq 1$ and $n \geq 2$. In previous analysis, we showed that $\Delta_a^{BL} \geq 0$ iff $t_a \geq \frac{2n}{3}t_b+1-\frac{2n}{3}$ and $\Delta_b^{BL} \geq 0$ iff $t_a \leq \frac{3}{2n}t_b+1-\frac{3}{2n}$. Therefore C_1C_3 and C_1C_5 divide the box $C_1 101$ into three sections. When the tax rates of the two countries fall in the central section $C_1C_2 0C_4$, i.e. $t_a \in \left[\frac{2n}{3}t_b + 1 - \frac{2n}{3}, \frac{3}{2n}t_b + 1 - \frac{3}{2n}\right]$, both countries gain from bilateral liberalization of government procurement. In the upper section $C_1C_2 1$, country A gains from bilateral liberalization, while the welfare effect on country B is negative. In the lower section $C_1C_4 1$, the welfare effect of bilateral liberalization on country A is negative, and that on country B is positive. This completes the proof of Proposition 3.5.■

The intuition of Proposition 3.5 is straightforward. When the number of firms i and j are equal, and the firms are symmetric in their gross valuations, the welfare effect of bilateral liberalization solely depends on tax polities of the two governments. If the tax rate of a country is high in relativity to the tax rate of the foreign country, it can capture a large part of foreign firms' profit through tax. On the other hand, it can retain a large part of its profit earned from foreign operations because the tax rate set by the foreign government is relatively low. The net effect on the country's welfare is therefore positive. The opposite effect applies to the foreign country. It is interesting to note that the negative effect of different tax rates tends to disappear as the number of potential contestants becomes large. In Figure 3.5, this can be seen as an expansion of the central section of the box $C_1 101$. Indeed, as n becomes large, C_2 and C_4 approach $(0, 1)$ and $(1, 0)$ respectively and therefore the central section $C_1C_2 0C_4$ expands. At the limit when $n \to +\infty$, this section completely covers box $C_1 101$. In such a case, tax policies become irrelevant since any feasible combination of tax rates will make both country better off after bilateral liberalization is allowed. This result, one more time, sheds lights on the sole existence of the GPA whose members are more likely to be homogeneous in terms of economic capacity.

Complete asymmetry

In this section, we relax all assumptions on the symmetry between the two countries, i.e. firms i and j have different gross valuations, their numbers are unequal and the tax rates set by two governments are uneven. We still assume the numbers of potential contestants in each country is at least two, and all firms are willing to enter contests in all markets, i.e. condition (3.35) holds. We will assess whether bilateral liberalization is desirable by each single country. Let us take the case of country A. Its welfare change (from the autarky level) as the result of bilateral liberalization is (3.39). We reproduce function $\Delta_a^{BL}(V_j)$ here to facilitate the proof of our next proposition.

$$\Delta_a^{BL}(V_j) = \frac{1}{n_i(n_iV_j + n_jV_i)^2} F_a^{BL}(V_j)$$

where

$$\begin{aligned} F_a^{BL}(V_j) &= n_j[n_iV_j - (n_i-1)V_i]n_i^2 t_a \Phi_a^{UNA}(V_j) + (1-t_b)n_i^2 V_i[n_jV_i - (n_j-1)V_j](n_iV_j + n_jV_i) \\ \Phi_a^{UNA}(V_j) &= V_j^2 - \frac{2n_i(1-t_a) - n_in_j + n_i^2 t_a}{n_i^2 t_a} V_iV_j - \frac{n_j(1-t_a) + n_in_j}{n_i^2 t_a} V_i^2 \end{aligned}$$

Proposition 3.6. *Assume active participation of firms in both countries, i.e.* $V_j^L < V_j < V_j^H$, *and the two countries mutually allow for trade liberalization,*

1. *When the tax rate of country A is less than the threshold level* $\widehat{t}_a$, *i.e.* $t_a < t_a^{(1)} \equiv \frac{n_j-1}{n_i+n_j-1}$, *there exists a critical surplus level* V^{**}, *where* $V_j^L < V^{**} < V_j^H$ *and*

(a) *bilateral liberalization results in zero or positive domestic welfare change for country A if* $V_j^L < V_j < V^{**}$;

(b) *bilateral liberalization results in negative domestic welfare change for country A if* $V^{**} \leq V_j < V_j^H$.

2. *When the tax rate of country A equals or exceeds the threshold level* $t_a^{(1)}$, *i.e.* $t_a \geq t_a^{(1)} = \frac{n_j-1}{n_i+n_j-1}$, *bilateral liberalization results in zero or positive domestic welfare change for country A for all surplus value* $V_j \in \left(V_j^L, V_j^H\right)$ *if the tax rate of country* B, t_b, *is sufficiently low.*

Proof: Expand function $F_a^{BL}(V_j)$ specified in (3.40) and collect V_j, we have a cube function in V_j of the following form

$$
\begin{aligned}
F_a^{BL}(V_j) &= M_1 V_j^3 + M_2 V_j^2 + M_3 V_j + M_4 \\
M_1 &= n_i^3 n_j t_a \\
M_2 &= n_i^2[n_j(n_j + 3t_a - 2) - n_i(n_j(1 + 2t_a - t_b) + t_b - 1)]V_i \\
M_3 &= n_i n_j[(n_j + 2)t_a + n_i^2(1 + t_a - t_b) + n_i\{n_j(t_b - 3) + 3(1 - t_a) - t_b\} - 2]V_i^2 \\
M_4 &= n_j^2[n_i^2(2 - t_b) - n_i t_a + (t_a - 1)]V_i^3
\end{aligned}
$$

Let us first examine the case where $t_a < t_a^{(1)} = \frac{n_j-1}{n_i+n_j-1}$.Since $M_1 = n_i^3 n_j t_a > 0$, $F_a^{BL}(V_j) \to -\infty$ as $V_j \to -\infty$, and $F_a^{BL}(V_j) \to +\infty$ as $V_j \to +\infty$.Note that $F_a^{BL}(V_j = 0) = n_j^2[n_i^2(2 - t_b) - n_i t_a + (t_a - 1)]V_i^3 > 0$ for $n_i \geq 2$, $n_j \geq 2$, $0 < t_a < 1$, and $0 < t_b < 1$;and $F_a^{BL}(V_j = V_j^L) = (1 - t_b)n_i(n_i + n_j - 1)^2 V_i^3 > 0$. Furthermore, we proved in Section 4 that $\Phi_a^{UNA}(V_j = V_j^H) < 0$ when $t_a < t_a^{(1)}$. Therefore, $F_a^{BL}(V_j = V_j^H) = n_j[n_i V_j - (n_i - 1)V_i]n_i^2 t_a \Phi_a^{UNA}(V_j) < 0$. This leads to a conclusion that the equation $F_a^{BL}(V_j) = 0$ must have three roots, one of which is negative and the other two are positive. Let $V_j^{(3)} < V_j^{(4)} < V_j^{(5)}$ are the three roots of the equation $F_a^{BL}(V_j = 0)$. Then $V_j^{(3)} < 0$; and $V_j^{(5)} > V_j^{(4)} > 0$. Because the function $F_a^{BL}(V_j)$ is continuous in V_j, and $F_a^{BL}(V_j = V_j^L) > 0$; $F_a^{BL}(V_j = V_j^H) < 0$, it follows that at least one positive root must be in the range $\left(V_j^L, V_j^H\right)$. Similarly, since $F_a^{BL}(V_j = V_j^H) < 0$ and the function $F_a^{BL}(V_j)$ tends to positive infinity as V_j tends to positive infinity, it is clear that the equation $F_a^{BL}(V_j) = 0$ must have at least one positive root in the range $[V_j^H, +\infty)$. This leads to a conclusion that $V_j^{(4)}$ must be in the range $\left(V_j^L, V_j^H\right)$, while $V_j^{(5)}$ must be in the range $[V_j^H, +\infty)$. It follows that $F_a^{BL}(V_j)$ is non negative when $V_j^L < V_j \leq V_j^{(4)}$, and $F_a^{BL}(V_j)$ is negative when $V_j^{(4)} < V_j < V_j^H$. The critical level of surplus V_j^{**} then equals to $V_j^{(4)}$. This proves the first part of Proposition 3.6. Figure 3.6 illustrates the behavior of $\Delta_a^{BL}(V_j)$ and $\Delta_a^{UNA}(V_j)$ when the tax rate of country A is bellow the threshold level $t_a^{(1)} = \frac{n_j - 1}{n_i + n_j - 1}$.

Next, consider the second case where the tax rate of country A exceeds the threshold level $t_a^{(1)} = \frac{n_j - 1}{n_i + n_j - 1}$. As before, we observe that $F_a^{BL}(V_j = V_j^L) > 0$. As we proved in the previous section, when $t_a \geq t_a^{(1)}$, we have $V_j^{(2)} \leq V_j^H$, where $V_j^{(2)}$ is the positive root of the equation $\Phi_a^{UNA}(V_j) = 0$. We also proved that $\Phi_a^{UNA}(V_j = V_j^H) > 0$ when $t_a \geq t_a^{(1)}$. Therefore, it is straightforward that $F_a^{BL}(V_j = V_j^{(2)}) > 0$ and $F_a^{BL}(V_j = V_j^H) > 0$. Observe that $\frac{\partial F_a^{BL}(V_j)}{\partial V_j}(V_j = V_j^L) = -n_i V_i^2 (n_i + n_j - 1)[n_j(2 - t_a) + n_i(n_j - 2)(1 - t_b)] < 0$ for $n_i \geq 2$, $n_j \geq 2$. Because the function $F_a^{BL}(V_j)$ tends to positive infinity as V_j

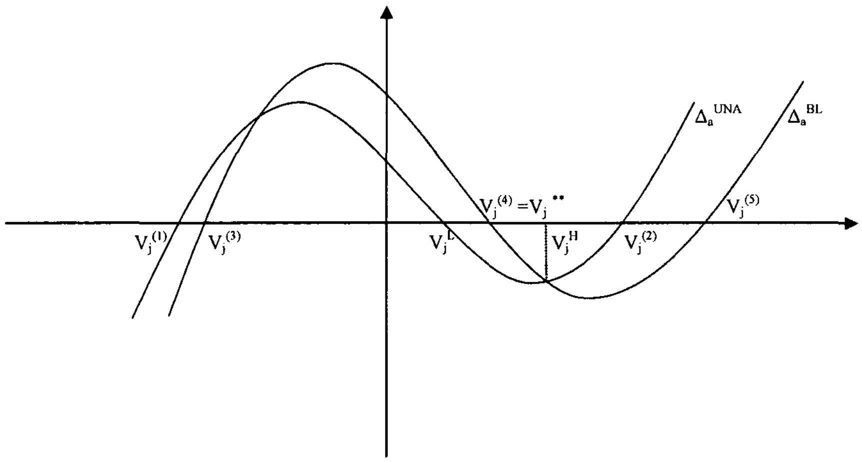

Figure 3.6: Country A's welfare change under bilateral liberalization – Low t_a

tends to positive infinity, its local minium must occur at some V_j greater than V_j^L. We are interested in finding out whether this local minium occurs in the interval $V_j^L < V_j < V_j^H$. It turns out that this will depends on the sign of $\frac{\partial F_a^{BL}(V_j)}{\partial V_j}(V_j)$ evaluated at $V_j = V_j^H$. If $\frac{\partial F_a^{BL}(V_j)}{\partial V_j}(V_j = V_j^H) < 0$, the function $F_a^{BL}(V_j)$ continuously decreases, but remains positive, over the entire interval $V_j^L < V_j < V_j^H$. This implies welfare improvement, $\Delta_a^{BL}(V_j) > 0$ for all $V_j \in (V_j^L, V_j^H)$, which proves the second part of Proposition 3.6. If $\frac{\partial F_a^{BL}(V_j)}{\partial V_j}(V_j = V_j^H) > 0$, the local minimum of function $F_a^{BL}(V_j)$ must occur in the range $V_j^L < V_j < V_j^H$. In what follows, we specify conditions on the parameters under which $\frac{\partial F_a^{BL}(V_j)}{\partial V_j}(V_j = V_j^H)$ is negative or positive.

Substituting $V_j = V_j^H$ into $\frac{\partial F_a^{BL}(V_j)}{\partial V_j}$ and collect terms for t_a, we have

$$\frac{\partial F_a^{BL}(V_j)}{\partial V_j}(V_j = V_j^H) = \frac{n_i n_j (n_i + n_j - 1) V_i^2}{(n_j - 1)^2} \left[\tau_1 t_a - \tau_2 \right]$$

Case	n_i / n_j	$t_b^{(2)}$, $t_b^{(3)}$	t_b	t_a	$\frac{\delta F_a^{BL}(V_j)}{\delta V_j}(V_j = V_j^H)$
1	$n_i = 2, n_j = 2$	$t_b^{(2)} < t_b^{(3)} < 0$	$0 \le t_b \le 1$	$t_a^{(1)} \le t_a \le 1$	Positive
2	$\{n_j = 2, n_i \ge 3\}$ $\{3 \le n_j \le 4, n_i \ge 2\}$ $\{n_j \ge 5, 2 \le n_i \le n_i^{(1)}\}$	$t_b^{(2)} < 0 < t_b^{(3)}$			
2.1			$0 \le t_b \le t_b^{(3)}$		
2.1.1				$t_a^{(1)} \le t_a \le t_a^{(2)}$	Negative or Zero
2.1.2				$t_a^{(2)} < t_a \le 1$	Positive
2.2			$t_b^{(3)} < t_b \le 1$	$t_a^{(1)} \le t_a \le 1$	Positive
3	$\{n_j \ge 5, n_i > n_i^{(1)}\}$	$0 < t_b^{(2)} < t_b^{(3)}$			
3.1			$0 \le t_b \le t_b^{(2)}$	$t_a^{(1)} \le t_a \le 1$	Negative or Zero
3.2			$t_b^{(2)} \le t_b \le t_b^{(3)}$		
3.2.1				$t_a^{(1)} \le t_a \le t_a^{(2)}$	Negative or Zero
3.2.2				$t_a^{(2)} \le t_a \le 1$	Positive
3.3			$t_b^{(3)} < t_b \le 1$	$t_a^{(1)} \le t_a \le 1$	Positive

Table 3.2: Sign of $\frac{\delta F_a^{BL}(V_j)}{\delta V_j}(V_j = V_j^H)$ conditioning on parameters' values

where $\tau_1 = [n_j^2 + 2n_i n_j + (n_i + n_j - 2)] > 0$ and $\tau_2 = 2(n_j - 1) + n_i(n_j - 1)^2(1 - t_b) > 0$. Since $\frac{n_i n_j (n_i + n_j - 1) V_i^2}{(n_j - 1)^2} > 0$, we will be interested in the sign of function $T_a^{BL}(t_a) \equiv \tau_1 t_a - \tau_2$, which is an increasing function in t_a. Set $T_a^{BL}(t_a) = 0$ and solve for t_a, we have $t_a = t_a^{(2)} \equiv \frac{\tau_2}{\tau_1}$. Therefore $T_a^{BL}(t_a) \le 0$ if $t_a \le t_a^{(2)}$ and $T_a^{BL}(t_a) > 0$ if $t_a > t_a^{(2)}$. Recall that we currently examine the case where $\frac{n_j - 1}{n_i + n_j 1} \equiv t_a^{(1)} \le t_a \le 1$, and note that the values of $t_a^{(1)}$ and $t_a^{(2)}$ depend on n_i, n_j and t_b. Therefore, our next step is to determine the value ranking of three terms $t_a^{(1)}$, $t_a^{(2)}$ and 1 conditioning on admissible domains of n_i, n_j, and t_b, and from there we can determine the value range of t_a that ensure the positivity or the negativity of $\frac{\partial F_a^{BL}(V_j)}{\partial V_j}(V_j = V_j^H)$. The detail proof is provided in Appendix 3.A. We summarize the results in Table 3.2.

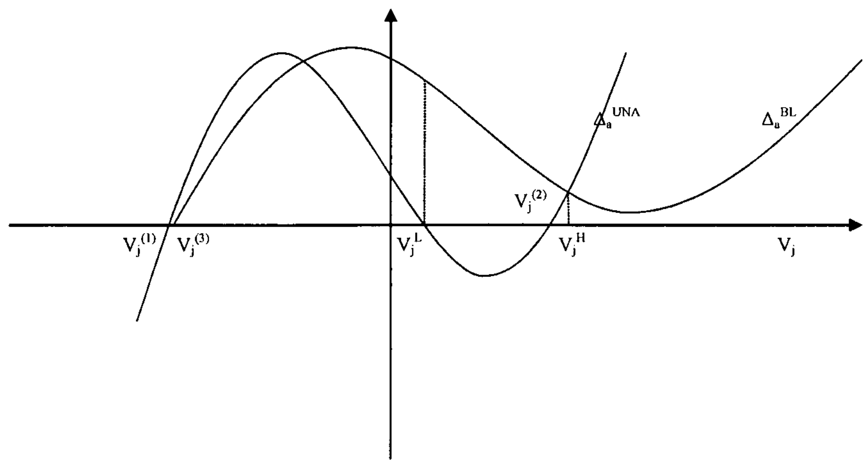

Figure 3.7: Country A's welfare change under bilateral liberalization

High t_a and $\frac{\partial F_a^{BL}(V_j)}{\partial V_j}(V_j = V_j^H) < 0$

In Table 3.2, the values of $n_i^{(1)}$, $t_b^{(2)}$, $t_b^{(3)}$, $t_a^{(1)}$, and $t_a^{(2)}$ are

$$
\begin{aligned}
n_i^{(1)} &= \frac{n_j - 1}{n_j - 4} \\
t_b^{(2)} &= \frac{n_j\left[n_i(n_j - 4) - (n_j - 1)\right]}{n_i(n_j - 1)^2} \\
t_b^{(3)} &= \frac{(n_j - 1)n_i^2 + \left(n_j^2 - 4n_j + 2\right)n_i - n_j(n_j - 1)}{n_i\left(n_j - 1\right)\left(n_i + n_j - 1\right)} \\
t_a^{(1)} &= \frac{n_j - 1}{n_i + n_j - 1} \\
t_a^{(2)} &= \frac{2(n_j - 1) + n_i(n_j - 1)^2(1 - t_b)}{n_j^2 + 2n_i n_j + (n_i + n_j - 2)}
\end{aligned}
$$

Figures 3.7 and 3.8 demonstrate the two scenarios where $\frac{\partial F_a^{BL}(V_j)}{\partial V_j}(V_j = V_j^H)$ takes negative and positive values respectively.

In Figure 3.7, function $\Delta_a^{BL}(V_j)$ continuously decreases but remains positive over the entire range $\left(V_j^L, V_j^H\right)$. This happens when t_a remains high while t_b remains low as shown

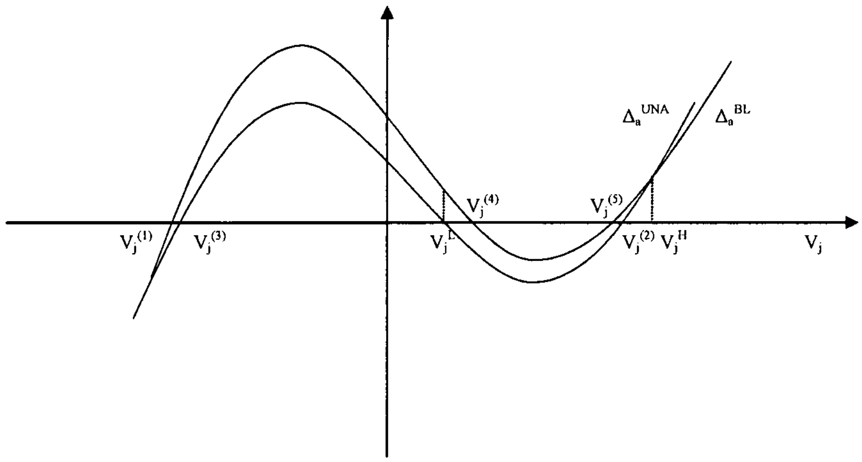

Figure 3. 8: Country A's welfare change under bilateral liberalization

Hight t_a and $\frac{\partial F_a^{BL}(V_j)}{\partial V_j}\left(V_j = V_j^H\right) > 0$

in three cases (2.1.1), (3.1) and (3.2.1) from Table 3.2. Note that in all these three cases t_b remains below a threshold level $t_b^{(3)}$. This completes the proof of Proposition 3.6.■

In comparison to the welfare level under unilateral liberalization, country A gains an additional amount of welfare, which equals to the expected profit obtained from its firms' operations in foreign country (country B). This welfare improvement is resulted from bilateral liberalization, under which country A does not only allow for foreign entry, but also gains access to country $B's$ market. The additional profit helps to shift $\Delta_a^{UNA}(V_j)$ upward. In all Figure 3.6, Figure 3.7 and Figure 3.8, we can see $\Delta_a^{BL}(V_j)$ lies above $\Delta_a^{UNA}(V_j)$ for the entire admissible range of V_j, i.e. for $V_j \in \left(V_j^L, V_j^H\right)$. Recall from part 2 & 3 of Proposition 3.3 that the welfare effect of unilateral liberalization on country A is negative for $V_j \in \left(V_j^L, V_j^H\right)$ when the tax rate t_a is bellow the threshold level $t_a^{(1)} \equiv$

$\frac{n_j-1}{n_i+n_j-1}$. The additional profit resulted from bilateral liberalization helps to shrink the range of V_j within which the welfare effect on country A is negative. This range, under bilateral liberalization, is $\left(V_j^{**}, V_j^H\right)$. For $V_j \in \left(V_j^L, V^{**}\right)$, country A has a net gain from bilateral liberalization.

When the tax rate of country A is above the threshold level $t_a^{(1)}$, the large tax revenue helps to partially offset the negative welfare effect of domestic firms' inefficiency. Given the tax rate of country B is relatively low, the additional profit resulted from bilateral liberalization can be large enough to completely offset any welfare loss due to inefficiency of firms i in country A. As the result, the difference in the levels of gross valuation between firms i and firms j can become irrelevant and country A has net positive welfare effect over the entire admissible range of V_j $\left[\text{i.e., for all } V_j \in \left(V_j^L, V_j^H\right)\right]$. Given the conditions that ensure positive welfare effect for country A, a question arises whether these conditions create a win-win solution for both countries. Obviously, in order to gain from bilateral liberalization, country B would want to raise it own tax rate. This, however, would negatively affect country $A's$ welfare and could make country A become worse off. Therefore, when countries are fully asymmetric, it could be difficult, if not impossible reach a mutually beneficial position when bilateral liberalization is allowed.

3.6 Concluding Remarks

Over the past few decades, members of the GATT (1947) and the WTO (1994) have been successful in expanding the coverage of liberalization in trade and services through rounds of negotiations. They, however, have not been able to effectively bring government procurements under a comprehensive set of international regulations. As the result, the current Agreement on Government Procurement only covers about a third of the WTO members and is still subject to many exceptions and exclusions. In this chapter, using Tullock's model of rent-seeking, we show that bilateral liberalization of government procurement might not always be mutually beneficial. When countries are partially symmetric in terms of economic capacity and tax policy, there exist conditions where bilateral liberalization becomes a win-win solution for the parties involved. However, when countries are completely asymmetric, we show that a country may gain from bilateral trade liberalization if its tax rate is sufficiently high, while the tax rate of the other country must be sufficiently low. The results obtained in this chapter have shed lights on the current position of negotiations on liberalizing government procurement within the WTO. They suggest plurilateral agreements on government procurement could be formed among countries with similar economic conditions. Such agreements, however, are hard to reach between countries with a large degree of economic asymmetry.

Our model can be extended to allow for comparative advantage in lobbying efforts exerted by firms participating in contests for government contracts. It could be argued that foreign firms' rent seeking efforts may not be as effective as those of domestic firms. This is because the later group may have advantages in terms of information on channels by which a government's decision can be influenced. The incorporation of comparative advantage in lobbying into our model could raise barrier for foreign firms to bid for domestic public procurements. This can lead to a reduction in the range of conditions that ensure mutual benefits of parties involved in bilateral liberalization of government procurements.

Appendices to Chapter 3

3.A The sign of $\frac{\partial F_a^{BL}(V_j)}{\partial V_j}(V_j = V_j^H)$ conditioning on parameters' values

Define $T_b^{BL(1)}(t_b) \equiv t_a^{(2)} - 1$. Observe that $T_b^{BL(1)}(t_b)$ is a decrease function in t_b. Set $T_b^{BL(1)}(t_b) = 0$ and solve for t_b, we have $t_b = t_b^{(2)} \equiv \frac{n_j[n_i(n_j-4)-(n_j-1)]}{n_i(n_j-1)^2}$. Therefore $T_b^{BL(1)}(t_b) > 0 \Leftrightarrow t_a^{(2)} > 1$ iff $0 \leq t_b < t_b^{(2)}$; and $T_b^{BL(1)}(t_b) \leq 0 \Leftrightarrow t_a^{(2)} \leq 1$ iff $t_b^{(2)} \leq t_b \leq 1$. Note that $t_b^{(2)} < 1$ for all $n_i \geq 2$ and $n_j \geq 2$. Further, $t_b^{(2)} \leq 0$ for $\{2 \leq n_j \leq 4, n_i \geq 2\}$ and for $\left\{n_j \geq 5, 2 \leq n_i \leq \frac{n_j-1}{n_j-4} \equiv n_i^{(1)}\right\}$; $0 < t_b^{(2)} < 1$ for $\left\{n_j \geq 5, n_i > \frac{n_j-1}{n_j-4} \equiv n_i^{(1)}\right\}$.

Define $T_b^{BL(2)}(t_b) \equiv t_a^{(2)} - t_a^{(1)}$. $T_b^{BL(2)}(t_b)$ is also a decrease function in t_b. Set $T_b^{BL(2)}(t_b) = 0$ and solve for t_b, we have $t_b = t_b^{(3)} \equiv \frac{(n_j-1)n_i^2+(n_j^2-4n_j+2)n_i-n_j(n_j-1)}{n_i(n_j-1)(n_i+n_j-1)}$. As before, $T_b^{BL(2)}(t_b) > 0 \Leftrightarrow t_a^{(2)} > t_a^{(1)}$ iff $0 \leq t_b < t_b^{(3)}$; and $T_b^{BL(2)}(t_b) \leq 0 \Leftrightarrow t_a^{(2)} \leq t_a^{(1)}$ iff $t_b^{(3)} \leq t_b \leq 1$. Note that $t_b^{(2)} < t_b^{(3)} < 1$ for all $n_i \geq 2$ and $n_j \geq 2$. Further, $t_b^{(3)} < 0$ only when $\{n_j = 2, n_i = 2\}$; $t_b^{(3)} > 0$ for all other combinations of n_i and n_j, i.e. for $\{n_j = 2, n_i \geq 3\}$ and $\{n_j \geq 3, n_i \geq 2\}$. It is also easy to prove that $t_b^{(2)} < t_b^{(3)} < 1$ for all $\{n_i \geq 2, n_j \geq 2\}$.

We now examine three cases.

Case 1: $t_b^{(2)} < t_b^{(3)} < 0$. This case happens only when $\{n_i = 2, n_j = 2\}$. Since t_b can only take any value in the range $[0,1]$, we have $t_b > t_b^{(3)} > t_b^{(2)}$ for any $t_b \in [0,1]$. Therefore we have $T_b^{BL(1)}(t_b) \leq 0 \Leftrightarrow t_a^{(2)} \leq 1$ and $T_b^{BL(2)}(t_b) \leq 0 \Leftrightarrow t_a^{(2)} \leq t_a^{(1)}$, which lead to $t_a^{(2)} \leq t_a^{(1)} \leq 1$. Consequently, $t_a > t_a^{(2)} \Leftrightarrow T_a^{BL}(t_a) > 0 \Leftrightarrow \frac{\partial F_a^{BL}(V_j)}{\partial V_j}(V_j = V_j^H) > 0$ for all $t_a \in \left[t_a^{(1)}, 1\right]$.

Case 2: $t_b^{(2)} < 0 < t_b^{(3)}$. This case happens when $\{n_j = 2, n_i \geq 3\}$ or $\{3 \leq n_j \leq 4, n_i \geq 2\}$ or $\left\{n_j \geq 5, \leq 2n_i \leq n_i^{(1)} \equiv \frac{n_j-1}{n_j-4}\right\}$. Since $t_b \in [0,1]$, we have two sub-cases:

- Case 2.1: $t_b^{(2)} < 0 \leq t_b \leq t_b^{(3)}$. In this case, we have $t_a^{(1)} \leq t_a^{(2)} < 1$. Therefore, $\frac{\partial F_a^{BL}(V_j)}{\partial V_j}(V_j = V_j^H) \leq 0$ for $t_a^{(1)} < t_a \leq t_a^{(2)}$ and $\frac{\partial F_a^{BL}(V_j)}{\partial V_j}(V_j = V_j^H) > 0$ for $t_a^{(2)} < t_a \leq 1$.

- Case 2.2: $t_b^{(2)} < 0 < t_b^{(3)} < t_b \leq 1$. In this case, we have $t_a^{(2)} \leq t_a^{(1)} \leq 1$ and consequently have the same results as in Case 1.

Case 3: $0 < t_b^{(2)} < t_b^{(3)}$. This case happens when $\left\{n_j \geq 5, n_i > n_i^{(1)} \equiv \frac{n_j-1}{n_j-4}\right\}$. We have three sub-cases

- Case 3.1: $0 \leq t_b \leq t_b^{(2)} < t_b^{(3)}$. In this case, we have $t_a^{(1)} < 1 < t_a^{(2)}$. Therefore, $\frac{\partial F_a^{BL}(V_j)}{\partial V_j}(V_j = V_j^H) \leq 0$ for all $t_a \in \left[t_a^{(1)}, 1\right]$.

- Case 3.2: $0 < t_b^{(2)} < t_b \leq t_b^{(3)}$. In this case, we have $t_a^{(1)} \leq t_a^{(2)} < 1$ and consequently have the same results as in case 2.1.

- Case 3.3: $0 < t_b^{(2)} < t_b^{(3)} < t_b \leq 1$. In this case, we have $t_a^{(2)} < t_a^{(1)} < 1$ and consequently have the same results as in case 1.

Conclusion

In this thesis, we address three important economic issues that have emerged in today's globalized world economy. These include international outsourcing, fair trade and liberalization of government procurement. In the first essay, using a model of outsourcing by monopolistically competitive firms, we show that, even in the case of flexible domestic wages, international outsourcing (and/or re-location of plants to a low-wage economy) by home firms may worsen the welfare of the home country and reduce the profits of all firms in the industry, even though it is individually rational for each firm to choose to outsource. We show that if a social planner for the home country can choose the extent of international outsourcing, his optimal choice will not coincide with the equilibrium outcome under laissez-faire. A wage subsidy may improve welfare. When the wage in the home country is rigid we show that outsourcing is welfare-improving for the home country if and only if the sum of the "trade creation" effect and the "exploitation effect" exceeds the "trade diversion" effect of the access to the low-wage labor in the foreign country. The essay also assesses the model in a two-period framework, where each domestic firm faces the choice between outsourcing (or re-location) in the first period, or in the second period. Delaying outsourcing can be gainful because the fixed cost of outsourcing may fall over time. On the other hand, delaying means the firm's variable production cost in period 1 will be higher than that of rivals who are outsourcing. The equilibrium of this two-period game may involve some firms outsourcing in period 1, while others will outsource in period 2, even though ex-ante they are identical firms. Under monopolistic competition, in equilibrium, the sum of discounted profits is identical for all firms. Again, a social planner for the home country may choose a different speed of outsourcing than the speed achieved by an industry under laissez-faire.

The second essay explores the market for fair-trade products. It employs a duopoly model involving a firm producing a fair-trade product in competition against a conventional firm producing a standard product. The concept of "economic identity" (Akerlof and Kranton, 2000) is used to model consumers' demand for fair-trade products. The essay shows how, in the short run, the parameters of the identity function can impact the equilibrium prices, and in the medium run, how they impact the conventional firm's choice of its position in the product space. In the long run, however, the fair-trade firm may be able to influence the parameters of the identity function, for its own advantage.

The last essay uses the contest model (Tullock, 1980, Rowley et al., 1988, Hillman and Riley, 1989, Nitzan, 1994) to assess welfare effects of bilateral liberalization of government procurement. It shows that there exists a single condition that ensures active participations of all firms in all contests. When this condition is violated, i.e. under a dominant-country case, the dominating country always gains from trade liberalization, while welfare of the dominated country improves only if its corporate tax is sufficiently high. Under full participation of all firms, i.e. no country dominates the markets, and countries are partially symmetric, there exist conditions where bilateral liberalization is mutually beneficial to both countries. When countries are completely asymmetric, it is showed that a country may gain from bilateral trade liberalization if its tax rate is sufficiently high, while the tax rate of the other country is sufficiently low. The results obtained in this essay have shed lights on the current position of negotiations on liberalizing government procurement within the WTO. They suggest plurilateral agreements on government procurement could be formed among countries with similar economic conditions. Such agreements, however, are hard to reach between countries with a large degree of economic asymmetry.

The process of economic globalization is not only irreversible but also continues to accelerate. It is therefore important for each country to decide on what should be the best way to take advantage of the opportunities that globalization has brought about, and at the same time to protect and improve its own national welfare. This, however, is not an easy task. It requires good understandings of current economic problems that come along with the ongoing integration process. Our studies of the three economic issues presented in this thesis are by no mean complete. Improvements on and extensions of our models will not only contribute to a better understanding of the issues, but also help making appropriate policy recommendations to enhance the economic benefits of today's globalization process.

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