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A Theoretical Analysis of Economic Impacts of Export Credit Insurance and Guarantees

Paul Rienstra-Munnicha
Research Assistant Professor
Center for Agricultural Policy and Trade Studies, North Dakota State University
117D Morrill Hall
Department of Agribusiness and Applied Economics
North Dakota State University
Fargo, North Dakota United States 58105
Email: Paul.Rienstra-Munnicha@ndsu.edu
Telephone: 701-231-5825
Fax: 701-231-7400

Calum Turvey (AAEA)
W. I. Myers Professor of Agricultural Finance
Cornell University
357 Warren Hall
Cornell University
Ithaca, New York United States 14853-7801
E-mail: cgt6@cornell.edu
Telephone: 607.255.5230

Won W. Koo
Professor and Director
Center For agricultural Policy and Trade Studies, North Dakota State University
209B Morrill Hall
Department of Agribusiness and Applied Economics
North Dakota State University
Fargo, North Dakota United States 58105
Email: Won.Koo@ndsu.edu
Telephone: 701-231-7448
Fax: 701-231-7400

Selected Paper prepared for presentation at the American Agricultural Economics Association Annual Meeting, Long Beach California, July 23-26, 2006

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Abstract

This paper developed an economic framework to analyze the economic impacts of an ECP on trade flows within the context of a partial equilibrium approach which assumes that non-payment risks are distinct between selling at home and abroad based on difficulties and expense in recovering non-payments are different in the two markets. A two-country partial equilibrium trade model is developed to analyze the economic impact of the export credit insurance and/or guarantees on trade flows. The results also show that to minimize or recover the efficiency loss, an export credit program can be employed to increase the exported quantity and reduce the excessively high equilibrium price as a result of non-payment risk. The overall net welfare loss of the two countries is smaller than the recovered efficiency loss. From the perspective of recovering efficiency loss, the use of an export credit program is justifiable.

Introduction

Recovering non-payments is an important issue which distinguishes selling at home from selling abroad. If non-payments occur in the home market, sellers can seek legal actions under the judicial system of their country to recover the non-payments. However, if non-payments occur in trading abroad, recovery can be difficult and expensive, depending on legal provisions set up by a particular importing country. Baron (1983) and Posner (1997) explain that the risks of non-payment associated with foreign markets can be due to political and economic conditions as well as the commercial practices of importing countries. Moreover, private sources of insurance and/or guarantee coverage are often reluctant to cover non-payments due to political risks such as wars, revolutions, or civil

disturbance in foreign countries (Celi and Czechowicz, 1985). Rienstra-Munnicha and Turvey (2002) empirically show that there is a negative relationship between export values and credit risks tagged on different importing countries. This implies that the export supply to an importing country with a high credit risk of non-payments is less elastic relative to the export supply to the importing countries with a low credit risk.

Public provisions of export credit programs (ECPs) to assist exporters in increasing exports in risky foreign markets have a long historical development¹. According to Carr (1939), in 1919, the British government was the first to establish its ECPs. Following the lead of the British government, many developed, developing, and other countries established their ECPs². The governments that established these programs considered them useful policy instruments and a means of encouraging their producers to expand and diversify exports. These ECPs were thought necessary to improve their trade balance, increase their foreign exchange reserves, and reduce their national unemployment (Mutharika, 1976). Furthermore, according to the United Nations Conference on Trade and Development (UNCTAD) (1976), it has long been claimed that there are at least three ‘direct benefits’ arising from ECPs to domestic countries that provide them: (i) creating export promotion value by protecting exporters

¹ Many studies seem to provide different names for export credit programs that are partly and/or solely provided by an exporting government’s agency such as ‘officially supported export credit programs’, ‘government-supported export credit programs’, or ‘back-supported export credit programs’. According to the OECD (1998), officially supported export credit programs are programs with the financial and provision involvement of government such as: (i) directly offering credit, (ii) offering interest rate subsidies, (iii) assuming risk for private loans, and (iv) offering supported insurance to private lenders. From here onward, the term of export credit programs (ECPs) used throughout this paper is referred to export credit guarantees and insurance programs that are partly and/or solely provided by an exporting government’s agency for short.

² The first group of followers was developed countries, which included France, Spain, Italy, Japan, the United States, and Canada. After the oil shock of 1970, developing and other countries such as Argentina, Brazil, Columbia, Czechoslovakia, Hong Kong, Hungary, India, Israel, Jamaica, Mexico, Pakistan, Peru, Poland, the Republic of Korea, Uruguay, and Yugoslavia also developed their export credit insurance programs. Their ECPs are different in terms of the degree of each country’s government involvement in providing and financing them (UNCTAD, 1976).

from potential losses due to non-payment risks associated with importing countries (importers), (ii) providing collateral value for exporters in securing export financing from commercial banks or other private financial institutions, and (iii) reducing the cost of collecting information about credit standing of importing markets. In addition, these programs were thought of providing indirect benefits to importing countries which allow them to delay repayments or reduce the cost of import bills. These benefits enable them to import goods and services that were necessary to them even if they had little or did not have hard currencies at hand (UNCTAD, 1976).

The importance of export credits in the trade of manufactured and agricultural goods has been apparent, especially during periods of economic and financial crises in importing countries, such as the oil shock in the 1970's, debt crises in the 1980's, and the financial bubble in the 1990's. For instance, the International Monetary Fund (IMF) recommended that the debt crisis of least-developed and developing countries could be alleviated if the export credit agencies (ECAs) of developed countries resumed their ECPs to those countries that had negotiated their debt payments with the Paris Club and had shown signs of economic recovery³. The ECPs would provide vital short-term liquidity and facilitate the imports of capital goods that were necessary to renew their economic growth, since following their debt crisis, most foreign commercial banks and other financial institutions were reluctant to lend to them (Brau et al., 1986).

However, the flow of export credits to least-developed and developing countries is not free from controversy, and the use of ECPs has become a highly politicized issue in

³ The Paris Club is an informal group of creditor governments that meet on a regular basis in Paris to reschedule bilateral debts. Creditors meet with a debtor country in order to reschedule its debts as part of international support provided to a country that is experiencing debt-servicing difficulties and is pursuing an adjustment program supported by the IMF (Ross and Harmsen, 2001).

trade policy (Abraham and Dewit, 2000). Prior to multilateral agreements among member countries of the OECD to establish benchmarks on credit terms and conditions offered through ECPs, the ECAs of different countries aggressively used their ECPs to underbid their competitors to win export contracts. Favorable credit terms of export credits included lower interest rates or longer repayment periods than the private markets would offer to importing countries. Favorable conditions of export credits included direct loan credits, tied and/or untied aid, and mixed credits offering to importing countries⁴. Consequently, the earlier practices of ECPs were seen as export credit races which became expensive to finance and difficult to control (Fleigsig and Hill, 1984; Fitzgerald and Monson, 1988; and Rodriguez, 1987). They contended that such practices are inefficient use of financial resources to win export contracts because the export credit races give significant power to importing countries to bargain for more favorable credit terms and conditions for their import contracts among different exporting countries. This would limit export opportunities for those exporting countries that have limited financial resources in providing ECPs that are capable to match or underbid offerings in assisting their exporters to win export contracts even though these countries are efficient producers. They concluded that these programs are an implicit form of export subsidies and distort trade flows if ECPs offer lower interest rates and/or longer repay payment periods to importing countries in which the private markets would not offer.

⁴ Tied aid is aid which is in effect tied to the procurement of goods and/or services from the donor country and a limited number of other countries. Untied aid is aid whose proceeds are fully and freely available for procurement of goods and/or services from all OECD countries and substantially from non-OECD countries. A mixed credit is a mixture of the direct loan credit and grant element (or the subsidy on the loan) as foreign aid to produce concessional financing packages having a grant element between official export credits and official development assistance (OECD, 1998).

Thus, the question whether ECPs are an alternative form of export subsidies is overheated and called for the World Trade Organization (WTO) to discipline the use of such trade policies in promoting exports. By integrating the disciplinary guidelines of the OECD, the WTO member countries already agreed on the disciplinary rulings in the use of ECPs for manufactured goods⁵. At the present, disciplinary rulings on the use of ECPs for agricultural products are still part of ongoing negotiations under the Committee on Agriculture of the WTO. In particular, the outcomes are hinged on the agreement of implementing the Article 10.2 of the WTO's Agreement on Agriculture⁶. On August 1, 2004, the WTO General Council reached a decision on the framework to continue with the 'multilateral' trade negotiations under the Doha Development Agenda (DDA). The framework refers to the "July Package", which includes the future elimination of all forms of export subsidies and better disciplines on export credits, food aid, and state trading enterprises. The European Union (EU) has advocated that they are willing to reduce their direct export subsidies if the United States (US) and other countries are willing to reduce their export credits, state trading enterprises, and food aid. In addition, many developing countries who are net food imports expressed their concerns in a fear of high import prices if ECPs are facing out (WTO, 2000, 2001a, and 2001b).

There is a massive literature and numerous text books address trade impacts and welfare effects of export subsidies while there is only a few studies address how an ECP impact on trade flows. This may be due to the fact that it is generally believed that ECPs

⁵ The rulings are codified within the Article 3 of the Subsidies and Countervailing Measures (SCM) Agreement. Two specific disciplinary rulings: item (k) provision regarding interest rate subsidies, and item (j) provision regarding risk premium subsidies.

⁶ Article 10.2 states that, "The WTO member countries undertake the development of internationally agreed upon disciplines to govern the provision of export credits, export credit guarantees, or insurance programmes and, after agreement on such disciplines, to provide export credits, export credit guarantees, or insurance programmes only in conformity therewith", (WTO, 1995).

are an implicit form of export subsidies. However, when analyzing an economic impact of ECPs, the difficulties of recovering non-payments from importing countries as mentioned above are less emphasized. Instead, the economic impact of such programs is commonly analyzed in a manner similar to export subsidies. It is not surprising that common arguments against the use of ECPs programs are closely related to ones made against the use of export subsidies: creating a price gap which raises domestic price and depresses world price and increasing trade volume of the exporting countries whose provide such programs to their producers/exporters. More importantly, the arguments rely on traditional assumptions of international trade theory, which assumes certainty in prices, payments, and full information.

Yet the whole notion that the primary objective of an EPC such as export credit insurance or guarantees is to provide assurance of export payments requires that such an analysis must be taken in the context of default risks associated with the buyers. Thus, the purpose of this paper is to address whether an ECP and export subsidy is an economically identical twin or an economic distance cousin when both direct and indirect benefits of an ECP are taken into account. The problem addressed by this paper is critically important not only from a theoretical point of view, but also a policy point of view. The overall objective of this paper is to develop an economic framework to analyze the economic impacts of an ECP on trade flows within the context of a partial equilibrium approach which assumes that non-payment risks are distinct between selling at home and abroad based on difficulties and expense in recovering non-payments are different in the two markets.

The remainder of the paper is organized as follows. Section two develops the theoretical framework to capture the impacts of an ECP on the import demand and export supply. Section three illustrates the existence of efficiency losses and it can be minimize through an export credit program. Section four concludes the paper. A technical appendix provides mathematical derivations that support the main text.

Theoretical Framework: Impacts of Export Credit Insurance and/or Guarantees on Trade

For our theoretical framework, we consider a two-country trade model and assume that the two countries are of equal size, in the sense that their domestic inverse demands and supplies of the tradable good are negative and positive slopes, respectively. We consider two consumption goods to represent a simple consumption choice model. It is assumed that there is one tradable good, namely good 1. Regarding good 2, we assume each country produces it for domestic consumption; however it is assumed to be substitutable in consumption with good 1. In addition our framework rests on the following assumptions: a homogeneous tradable good, a common currency, no transportation costs, and competitive practices.

The objective of this section is to develop a partial equilibrium model from which the import demands and export supplies are derived by taking account of both direct and indirect benefits of an ECP and effects of non-payment risks. The derivations of the import demand and export supply are not straight forward as a standard partial equilibrium approach. Thus, to lessen the obscurity, the organization of this section is structured as follows. First, the import demand and export supply are derived under two assumptions: (i) certainty setting, and (ii) no production in the importing country and no consumption in the exporting country with regarding to the tradable good. Second, the

assumption of uncertainty setting is relaxed to derive the impacts of an ECP on the import demand and export supply. Lastly, the assumption of no production in the importing country and no consumption in the exporting country is relaxed and the impacts of an ECP derived in (ii) are used to derive import demand and export supply.

Import Demand and Export Supply under Certainty Setting

(i) Import Demand

Suppose that the preference of the representative consumer of the importing country can be represented by a CES utility function such as

$$(1) \quad U(c_1, c_2) = [\alpha c_1^\rho + \beta c_2^\rho]^{1/\rho}$$

It is assumed that $0 < \alpha < 1$, $0 < \beta < 1$, $\alpha + \beta = 1$, and $\rho \leq 1$. With fixed income I , suppose that the consumer faces the prices of good 1 and good 2 such as p_1 and p_2 respectively. Then, the utility maximization of the consumer can be expressed as:

$$(2a) \quad \text{Max}_{c_1, c_2} \{U(c_1, c_2) = [\alpha c_1^\rho + \beta c_2^\rho]^{1/\rho}\}$$

Subject to

$$(2b) \quad p_1 c_1 + p_2 c_2 = I$$

Forming the Lagrange function, deriving the first order conditions, and solving them, the Marshallian demands of goods 1 and 2 can be obtained as:

$$(3) \quad c_1^* = \frac{(\alpha p_2)^\kappa I}{[(\beta p_1)^\kappa p_2 + (\alpha p_2)^\kappa p_1]}$$

$$(4) \quad c_2^* = \frac{(\beta p_1)^\kappa I}{[(\beta p_1)^\kappa p_2 + (\alpha p_2)^\kappa p_1]}$$

Where $\kappa = 1/(1 - \rho)$ representing consumption elasticity of substitution between good 1 and good 2. Let c_1 be the tradable good. Suppose that the importing country is not capable to producing it, thus, its import demand is represented by equation 3.

(ii) Export Supply

With the assumption of certainty setting for payment and full information about productivity and both input and output prices, we apply the standard profit maximization problem derive the short-run supply function of a competitive firm in the exporting country. Suppose that the firm produces a single output, namely good y , by using two inputs x_1 and x_2 , and suppose that its short-run variable cost of the firm is defined as⁷:

$$(5) \quad C(y) = By^2$$

Additionally, let G be the short run fixed cost of the firm. The profit maximization of the firm can be formulated as:

$$(6) \quad \text{Max}_y \{ \Pi(y) = Py - C(y) - G \}$$

Where $C(y) = By^2$ and P is the output price.

Applying standard profit maximization approach and applying Hotelling's lemma, the short-run supply function of the firm can be obtained as,

$$(7) \quad y(P) = \frac{\partial \Pi^*}{\partial P} = \frac{P}{2B}$$

⁷ Rienstra-Munnicha (2004) applied two-input-model of cost minimization to derive the short-run variable cost of the firm as $C(y) = By^2$. Where $\gamma = 1/(\alpha + \beta)$ and both α and β are the parameters of the production function. He further explained that it is reasonable to assume that $\gamma = 2$.

Suppose that there is no domestic demand in the exporting country, thus, its export supply is represented by equation 7.

Impacts of an Export Credit Program and an Effect of Non-Payments

(i) Import Demand in the Presence of Indirect benefits/Cost Savings from an ECP

There are many studies which developed several approaches to calculate the subsidy values of ECPs. The present value approach was developed and applied in several studies such as Baricello and Vercarmen (1994), Baron (1983), Hyberg et al. (1995), Raymand (1992), Skully (1992), and Wilson and Yang (1996). A cost-benefit analysis was conducted by Fleig and Hill (1984). The option-pricing method was used by Dahl, Wilson, and Gustafson (1999), Dierson and Scherrick (1999), and Schich (1997). These studies calculated subsidy values that are associated with government-supported export credits such as subsidized interest rates and provided long period repayments. They considered subsidy values as a cost savings to an importer, which could be interpreted as a price discount on imports. Empirically, the OECD (2000) applied the present value approach to calculate the subsidy values of export credit programs for agricultural goods as a series of price discounts, in terms of their impact on the import demand side.

Alternatively, we contend that if the indirect benefits arise from an export credit program as a cost saving to the representative consumer of importing country, his/her decision on how much to import is likely influenced by the cost saving and together with his/her initial income. Moreover, this study presumes that the cost saving may be viewed as an additional income to the consumer. Alternatively, this study supposes that the indirect benefits of an ECP, received by the consumer, can be represented as a fixed

discount rate ‘ d ’ on his/her import payment. This study uses ‘ d ’ as a general measure to capture the indirect benefits arising from many of the potential policy parameters of export credit programs⁸.

We consider that one possibility is that ‘ d ’ is the difference of two present value streams. The first present value stream (PV_1) is calculated under the scenario of which there is no subsidy element being offered to the consumer while the second present value stream (PV_2) is calculated under the scenario of which there is a subsidy element being offered to the consumer through an export credit program. Thus, the fixed discount rate ‘ d ’ can be calculated as,

$$(8) \quad d = \frac{PV_1 - PV_2}{PV_1} * 100$$

Thus, if the consumer receives secondary benefits from an EPC, his/her budget constraint is likely to be affected due to the cost saving on the import payment. From above discussion, this study presumes that the consumer views his/her cost saving on the import payment as it is being discounted. Thus, his/her budget constraint can be formulized as:

$$(9) \quad \begin{aligned} p_1c_1 - d(p_1c_1) + p_2c_2 &= I \\ \Rightarrow p_1(1-d)c_1 + p_2c_2 &= I \end{aligned}$$

⁸ An example of what ‘ d ’ can capture is the policy parameters that the OECD (2000) uses to calculate the subsidy rates mentioned above. According to the OECD (2000), a subsidy element as the secondary benefits offered to importing countries can arise from an overly favourable offer in comparison to private markets offering: (i) down payments, (ii) annual subsidized or guaranteed interests with the export credits, (iii) annual discount rates (or market rates without export credits), and (iv) payments per year, length of repayments, grace periods, and fee rate which is expressed as per cent of value.

Note that the range of the subsidy element is assumed to take on the value of $0 \leq d < 1$. If $d = 0$, this implies that there is no discount on the import payments; thus, the budget constraint formulized in equation (9) is just the same as the budget constraint in equation (2b). If $d = 1$, then there is a full discount such as for aid relief, which implies that consumption of good 1 is not an optimization choice for the consumer in the importing country. Thus, this study assumes that $d < 1$.

Suppose that the preference of the representative consumer of the importing country can be represented by a utility function expressed in equation 1. Similarly, with the budget constraint expressed in equation 9, the Marshallian demands of goods 1 and 2 can be obtained as:

$$(10) \quad c_1 = \frac{(\alpha p_2)^\kappa I}{(1-d)p_1(\alpha p_2)^\kappa + p_2[\beta(1-d)p_1]^\kappa}$$

$$(11) \quad c_2 = \frac{[\beta(1-d)p_1]^\kappa I}{(1-d)p_1(\alpha p_2)^\kappa + p_2[\beta(1-d)p_1]^\kappa}$$

With the assumption that the importing country is not capable to producing tradable good, its import demand is represented by equation 10 under the scenario that the importing country receives a cost saving from an EPC.

By comparing the two Marshallian demands in equations 3 and 10, we arise the following proposition.

Proposition 1: *When $d < 1$, the Marshallian demand in equation 10 lies above the Marshallian demand in equation 3 for any positive import quantity, which implies that the presence of indirect benefits of an export credit program causes the import demand of the importing country to shift outward.*

It is obvious that the following condition is true if $d < 1$:

$$\frac{(\alpha p_2)^\kappa I}{p_1(\alpha p_2)^\kappa + p_2[\beta p_1]^\kappa} < \frac{(\alpha p_2)^\kappa I}{(1-d)p_1(\alpha p_2)^\kappa + p_2[\beta(1-d)p_1]^\kappa}$$

Based on price elasticities of the two import demands, the demand shifting factor due to the presence of an export credit is obtained as (see full derivation in the appendix):

$$(12) \quad SF_D = \frac{(\kappa + \xi_2)}{(1-d)(\kappa + \xi_1)}$$

where ξ_1 and ξ_2 are the price elasticities derived under equations 3 and 10 respectively.

(ii) Export Supplies in the Presence of an ECP and Presence of Non-Payment Risks

In responding to non-payment risk and if there is no domestic consumption of the exporting country regarding the tradable good y , an export decision of its representative firm can be derived by applying the general certainty-equivalent model. We contend that in perspective of the firm, his/her export supply is likely to be influenced by the absence and presence of his/her country's export credit programs. Thus, this study considers four different scenarios of which the firm of the exporting country can decide how to cover its export payment against the risk of non-payment: to acquire a full guarantee/insurance coverage with and without paying fee/premium, to acquire a partial guarantee/insurance coverage with paying fee/premium, and to be a self-insurer.

Rienstra-Munnicha and Turvey (2002) applied similar approach, but they only considered a single uncertainty condition, namely the risk of non-payment on export sales that is associated with the importing country. They assumed that the risk of not getting paid is directly attached to the price (P) of the exporting good y . Thus, the price of

getting paid is assumed to be a random variable. As a result, P was treated as being embedded in the expected value and variance of the probability distribution of getting paid. To enhance our further analysis, we modify their model. Alternatively, we assume that P is a negotiated price; thus, when an export deal is concluded, P is no longer a stochastic variable. Thus, their equations (2) and (3) are redefined as:

$$(13a) \quad E[PF(\theta)] = PE[F(\theta)] = P\bar{F}$$

$$(13b) \quad Var[PF(\theta)] = E[\{PF(\theta) - E[PF(\theta)]\}^2] = P^2\sigma_\theta^2$$

Additionally, we include the fixed cost (G) and replace their production cost by the variable cost expressed in equation 5 to be comparable the properties of the short-run export supply functions of the firm in the exporting country under certainty-payment and uncertainty-payment cases. With the modification, the stochastic profit function of the firm can be reformulated as:

$$(14) \quad \Pi = yPF(\theta) + ZyP(1 - F(\theta)) - By^2 - \delta W(\bar{F}(\theta), P, Z)y - G$$

Where y represents the choice of exporting quantities in which the firm of the exporting country decides to export. $F(\theta)$ is the cumulative probability distribution function of getting paid, and θ is a credit score that explains non-payment of the export sales. Z is the coverage level from an export insurance or guarantee policy such that $0 \leq Z \leq 1$. δ is a loading factor that reflects the administrative cost of providing the public guarantee or insurance scheme. W is the guarantee fee (or insurance premium rate) per unit of the exporting good Y . Note that in Chapter 3, it was generally assumed that W is a function

of price, coverage level, and the expected value of getting paid such as $W = W(Z, \bar{F}, P)$ with the general properties: $\partial W / \partial P > 0$, $\partial W / \partial Z > 0$, and $\partial W / \partial \bar{F}^9$.

The expected value and variance of the stochastic profit can be rewritten as:

$$(15a) \quad E[\Pi] = yP\bar{F} + ZyP(1 - \bar{F}) - By^2 - \delta Wy - G$$

$$(15b) \quad Var[\Pi] = \sigma_{\Pi}^2 = (1 - Z)^2 \sigma_{\theta}^2 y^2 P^2$$

Assuming the firm is constant absolute risk aversion so that its objective function can be formulized as the certainty equivalent profit maximization (CEPM) and written as:

$$(16) \quad \begin{aligned} & \text{Max}_y \left\{ \Pi_{CE} = E[\Pi] - \frac{\lambda}{2} \sigma_{\Pi}^2 \right\} \\ \Rightarrow & \text{Max}_y \left\{ \Pi_{CE} = yP\bar{F} + ZyP(1 - \bar{F}) - By^2 - \delta Wy - G - \frac{\lambda}{2} (1 - Z)^2 \sigma_{\theta}^2 y^2 P^2 \right\} \end{aligned}$$

Where λ is a constant factor that measures the risk attitude of the representative firm as an average absolute risk-aversion of all competitive firms in the industry of the tradable good y . The higher the value of λ , the more risk averse the representative firm will be in terms of exporting to the importing country due to the non-payment risk.

The first order condition of the above CEPM problem with respect to the export quantity (y) is:

$$(17) \quad P\bar{F} + ZP(1 - \bar{F}) - 2By^* - \delta W - (1 - Z)^2 \lambda \sigma_{\theta}^2 P^2 y^* = 0$$

Note that the superscript ‘*’ refers to the optimal solution that solves the above CEPM problem.

Its second order condition (SOC) is satisfied if the following condition holds true:

⁹ Note that most variables are defined and discuss in detail by Rienstra-Munnicha and Turvey (2002).

$$(18) \quad \Rightarrow 2By^2 + (1-Z)^2 \lambda \sigma_\theta^2 y^2 P^2 > 0$$

It is unambiguously satisfied. Note that the second term of the right hand side of the condition (18) is the variance of the stochastic profit of the firm (see equation (15b)).

Solving equation (17), the optimal export quantity:

$$(19) \quad y^* = \frac{P\bar{F} + ZP(1-\bar{F}) - \delta W}{2B + (1-Z)^2 \lambda \sigma_\theta^2 P^2}$$

From equation (19), the four scenarios of the firm's export supplies can be obtained with additional assumptions. Each scenario of the export supply is discussed below.

(a) A Partial Guarantee/Insurance Coverage with Charging Fee/Premium

Equation (19) can be interpreted as the optimal export quantity for the scenario of which the firm in the exporting country is willing to export if it is able to acquire a partial guarantee/insurance from either private or government to cover its export sale, pays a guarantee fee/premium of W per unit of the exporting good y , and faces a positive loading factor cost δ . Let y_3 be the export supply under this scenario and hereafter referred to the export supply under a partial guarantee/insurance with charged premium (PGCP). Thus, the export supply under a PGCP is defined as,

$$(20) \quad y_3 = \frac{P\bar{F} + ZP(1-\bar{F}) - \delta W}{2B + (1-Z)^2 \lambda \sigma_\theta^2 P^2}$$

(b) A Self-Insurer

From equation (19), the optimal export quantity in the absence of an insurance scheme in which the firm in the exporting country has to or voluntarily choose to be a

self-insurer can be obtained by setting both coverage level and loading factor cost equal to zero: $Z = 0$, and $\delta = 0$. Let y_4 be the export supply under this scenario and hereafter referred to the export supply under a self-insurer (SI). Thus, the export supply under SI is defined as,

$$(21) \quad y_4 = \frac{P\bar{F}}{2B + \lambda\sigma_\theta^2 P^2}$$

(c) A Full Guarantee/Insurance Coverage with Charged Fee/Premium

Similarly, from equation (19) the optimal export quantity under the scenario which the firm is fully guaranteed/insured to receive certainty-payment of its export sale while it is required to pay a fee/premium can be obtained by taking account of different perspectives regarding the expected value and variance of the probability distribution of getting paid. In the perspective of the firm, the full guarantee/insurance coverage of assuring a certainty-payment implies that $\bar{F} = 1$ and $\sigma_\theta^2 = 0$. However, in the perspective of the government agency who provides the guarantee/insurance, $\bar{F} \neq 1$ and $\sigma_\theta^2 \neq 0$ since a default of the export payment is arisen from the importing country and the government agency of the exporting country cannot control or influence the default occurrence. Subsequently, the loading factor and fee/premium charged to the firm under this type of coverage programs are both positive if the government agency does not intend to subsidize the firm. Let y_2 be the export supply of the firm that can acquire this type of a cover. Hereafter it is referred to the export supply under a fully guaranteed/insured with charged premium (FGIP). With the additional assumptions regarding \bar{F} and σ_θ^2 as mentioned above, the export supply under FGIP is defined as:

$$(22) \quad y_2 = \frac{P - \delta W}{2B}$$

(d) A Full Guarantee/Insurance without Charged Fee/Insurance Premium

If full guarantee/insurance coverage of assuring a certainty-payment is offered to the firm without charging any fee/premium, the export supply of the firm can be obtained by using equation (22) and setting the loading cost of the firm equal to zero. Let y_1 be the export supply of the firm that can acquire this type of a guarantee program¹⁰. Hereafter it is referred to the export supply under a fully guaranteed/insured with no premium cost (FGINP). Thus, if $\delta = 0$, the export supply under a FGINP of the firm is,

$$(23) \quad y_1 = \frac{P}{2B}$$

By comparing four export supplies in equations 20, 21, 22, and 23, we arise the following proposition.

Proposition 2: *At any price level, the relationships among the four export supplies are $y_4 < y_3 < y_2 < y_1$. This implies that provisions of coverage levels and charged premium influence decision of the firm to export.*

The proof is provided in the appendix.

In the perspective of the firm, it takes both values of δ and W as given because the guarantor or insurance provider normally sets them. Thus, to avoid the ambiguity, be consistent with the discussion of subsequent sections and focus on the possible decisions

¹⁰ Alternatively, this scenario can be viewed as the premium cost is fully subsidized and export payment is fully guaranteed or insured by the EPC of the government of the exporting country.

of the firm, this study further assumes that the fee/premium W exhibits the following functional form¹¹:

$$(24) \quad W = W(P, Z, \bar{F}) = Z(1 - \bar{F})P$$

With the assumption expressed in equation 24, based on four price elasticities of the export supplies, and used the export supply under FGINP y_1 as the benchmark, three supply shifting factors due to the effects of non-payment risks and presence of an export credit are obtained as follows (see full derivation in the appendix).

(i) Since both y_1 and y_2 exhibit unitary price elasticity, the supply-shifting factor (SF_2) that shifts the export supply y_2 away from the export supply y_1 to reflect how the firm responds to the extra cost of acquiring the full guarantee/insurance to cover its export sale is obtained as:

$$(25) \quad \Rightarrow SF_2 = \{1 - \delta(1 - \bar{F})\}$$

Since the export supply y_3 exhibits non-unitary price elasticity (ψ_3), the supply-shifting factor (SF_3) that shifts the export supply y_3 away from the export supply y_1 to reflect how the firm responds to the extra cost of acquiring the partial guarantee/insurance coverage its export sale. It is obtained as:

$$(26) \quad \Rightarrow SF_3 = \frac{\{\bar{F} + Z(1 - \bar{F}) - \delta Z(1 - \bar{F})\}(1 + \psi_3)}{2}$$

¹¹ Note that the additional assumption in equation (4.51) satisfies the general properties of the function W assumed earlier in Chapter 3: $\partial W / \partial P > 0$; $\partial W / \partial Z > 0$; and $\partial W / \partial \bar{F} < 0$.

Similarly, since y_4 exhibits non-unitary price elasticity (ψ_4), the supply-shifting factor (SF_4) that shifts the export supply y_4 away from the export supply y_1 to reflect how the firm responds to the situation in which it has to or voluntarily chooses to be a self-insurer for its export sale. It is obtained as:

$$(27) \quad \Rightarrow SF_4 = \frac{\bar{F}(1+\psi_4)}{2}$$

Import Demand and Export Supply: Uncertainty-Payment and the Presence of an ECP

(a) Import Demand with Domestic Supply

To consider the domestic production of the importing country, we assume that its representative firm faces similar cost function expressed in equation 5. The difference of production costs of the two countries are assumed to constitute within the term ‘ B ’. Applying similar profit maximization, the short-run supply of the importing country can be obtained as:

$$(28) \quad y_i(P_i) = \frac{P_i}{2B_i}$$

Where the subscript ‘ i ’ represents the importing country.

To distinguish the importing country from the exporting country, we assume that the autarky equilibrium price of tradable good y in the importing country is higher than the autarky price in the exporting country: $P_e^a < P_i^a$. If good y is allowed to trade between the two countries, the excess (import) demand of good y of the importing country is the difference between its domestic demand and supply for any price level P which lies within the range between the two autarky prices P_e^a and P_i^a .

(ai) Import Demand with out Indirect Benefits of an ECP

Without indirect benefits from an export credit program being offered to the representative consumer in the importing country, thus, for any price P such that $P < P_f^a$, the import demands of the importing country is the difference of equations 3 and 28:

$$(29) \quad Q^N = \frac{2B_f I_f (\alpha p_{2f})^\kappa - (\alpha p_{2f})^\kappa P^2 - \beta^\kappa p_{2f} P^{(\kappa+1)}}{2B_f \{(\alpha p_{2f})^\kappa P + \beta^\kappa p_{2f} P^\kappa\}}$$

Note that the introduction of the additional superscript ‘ N ’ refers to the absence of secondary benefits from an export credit program offered by the exporting country. . Thus, Q^N denotes the import demand of good y assumed not receiving indirect benefits of an ECP.

(aii) Import Demand with Indirect Benefits of an ECP

With the assumption that the tradable good y is homogeneous, in the sense that it is impossible to distinguish its source of production, its demand is satisfied from domestic production and imported quantities. If indirect benefits of an ECP are offered to the consumer in the importing country, his/her budget constraint is altered from the case of not receiving such benefits (see equation (9)). It is difficult task to separate out the quantities being discounted on the import payment from those produced domestically¹². However, from the perspective of the consumer in the importing country, his/her

¹² Note that the absence or presence of indirect benefits of an ECP offered by the exporting country to the consumer in the importing country does not affect the production cost nor does it change the condition of getting paid for the firm in the importing country. Subsequently, if it is able to compete with the firm in the exporting country, its supply function is the same whether the exporting country does or does not offer indirect benefits to the consumer in the importing country, except facing a change in price.

consumption of domestic or imported good Y depends on where he/she can purchase the tradable good Y at a cheaper price. This captures by the demand shifting factor derived in equation 12.

When trade opens up, both the consumer and firm in the importing country faces the same effective price. Therefore, by applying proposition 1, we derive the import demand of the importing country in the presence of indirect benefits from an export credit program by replacing price of the import demand expressed in equations (29) by the demand shifting factor price expressed in equation (12). Thus, the import demand of the importing country in the presence of indirect benefits from an export credit program is obtained as:

$$(30) \quad Q^S = \frac{2B_f I_f (\alpha p_{2f})^\kappa \frac{[(1-d)(\kappa + \xi_1)]^{(\kappa+1)}}{(\kappa + \xi_2)^{(\kappa+1)}} - (\alpha p_{2f})^\kappa \frac{[(1-d)(\kappa + \xi_1)]^{(\kappa-1)}}{(\kappa + \xi_2)^{(\kappa-1)}} P^2 - \beta^\kappa p_{2f} P^{(\kappa+1)}}{2B_f \frac{[(1-d)(\kappa + \xi_1)]}{(\kappa + \xi_2)} \left\{ (\alpha p_{2f})^\kappa \frac{[(1-d)(\kappa + \xi_1)]^{(\kappa-1)}}{(\kappa + \xi_2)^{(\kappa-1)}} P + \beta^\kappa p_{2f} P^\kappa \right\}}$$

Note that the superscript ‘ S ’ refers to the presence of secondary benefits from an export credit program offered to the importing country.

(b) Export Supply with Domestic Consumption

To consider the domestic consumption of the exporting country, we assume that its representative consumer’s preference and income are expressed in equations 1 and 2b. Similarly, by applying similar utility maximization, the domestic demands for tradable good 1 of the exporting country can be obtained as¹³:

¹³ Note that the exporting country’s demand for the tradable good y is not affected by whether the exporting country does or does not provide export credit programs as an instrument for its firm to minimize non-payment risk associated with the importing country. The programs are assumed to benefit only its firm

$$(31) \quad c_1 = \frac{(\alpha p_{2e})^\kappa I_e}{[(\beta P_e)^\kappa p_{2e} + (\alpha p_{2e})^\kappa P_e]}$$

Where the subscript ‘e’ represents the exporting country.

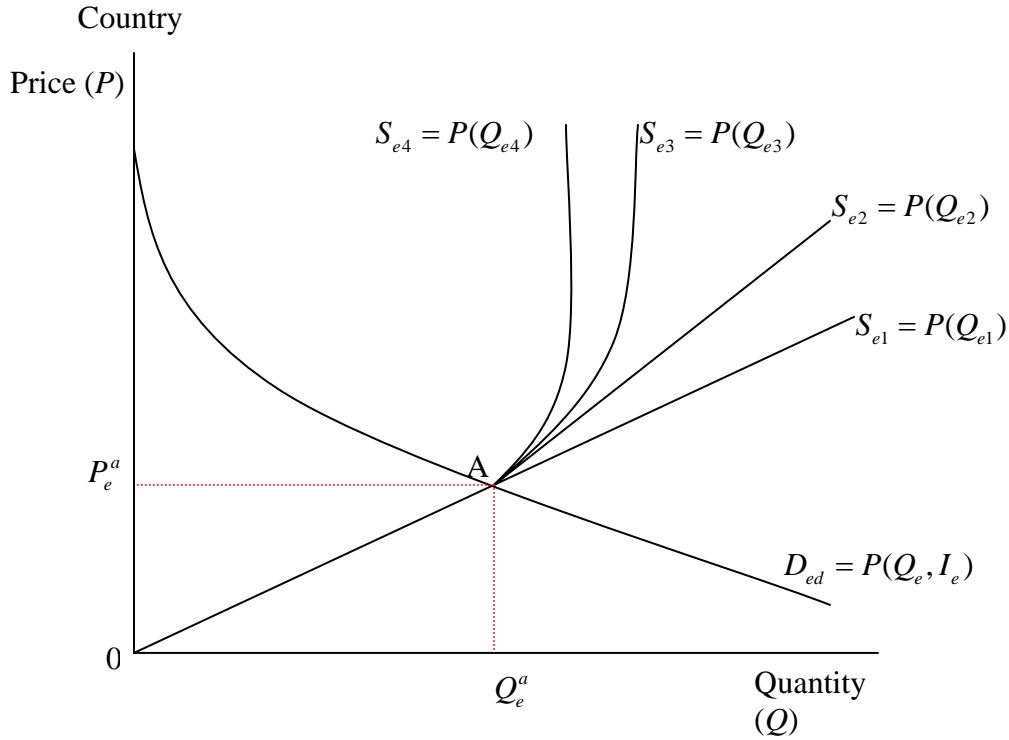
When the assumption of no domestic consumption in the exporting country for the tradable good y is relaxed, its excess supply of good y is the difference between its demand and supply for any price P that is above and below the autarky prices of the exporting and importing countries respectively such as $P_e^a < P < P_f^a$ if the firm in the exporting country faces no risk of non-payment in both markets. However, as discussed earlier, the two markets are distinctive in terms of recover non-payments. Based on the implication of proposition 2, Figure 1 illustrates the domestic supply of the exporting country is kinked at the autarky equilibrium point if the recover non-payments of the domestic and export markets are not compatible.

Figure 1 shows that the firm’s inverse supply to the exporting market is an extension of the supply to the domestic market. It extends out from the autarky price of the exporting country. The general shape of the extending portion depends on the presence and absence of a guarantee/insurance in which the firm can acquire to cover its export sales. It shows that other three scenarios of the supplies to the exporting market bends away from the supply derived under the scenario of which the firm is assured to receive full payment from the exporting market and is not required to pay an additional fee/premium cost. Thus, the domestic demand and supply of the exporting country expressed in equations 31 and 7 are not appropriate ones to use directly deriving the

and/or the consumer of the importing country since the consumer and firm in the exporting country are assumed not to be the same person and the consumer is assumed not own any share of the export sales.

excess supply of the exporting country as one would in analyzing the economic impact of a direct export subsidy.

Figure 1: The Effect of Non-Payment Risk on the Inverse Supply of the Exporting



However, the export supply derived in equation 23 is the same as the domestic short-run supply of the exporting country derived in equation 7. This implies that if the representative firm of the exporting country is assured to receive certainty-payment and is not required to pay an extra cost for such assurance, only then the firm is indifferent to non-payment risks associated with the importing country. Thus, to capture the effects of non-payment risks and impact of an ECP, first, we suppose that the two markets are identical in terms of recover non-payment and use the domestic supply derived in equation as the benchmark to the benchmark export supply. Second, we multiply the benchmark export supply with the three supply shifting factors to obtain other three scenarios of export supplies under PGCP, SI, and FGIP.

(i) *Benchmark Export Supply:*

From equations 7 and 31, for any price $P > P_e^a$, the benchmark export supply is obtained as,

$$(32) \quad Q_{1e} = y_e - c_{1e}$$

$$Q_{1e} = \frac{(\alpha p_{2e})^\kappa P^2 + \beta^\kappa p_{2e} P^{(\kappa+1)} - 2B_e I_e (\alpha p_{2e})^\kappa}{2B_e \{P(\alpha p_{2e})^\kappa + p_{2e} (\beta P)^\kappa\}}$$

Note that from above discussion, this export supply of exporting country can be considered as the export supply that the representative firm is guaranteed/insured certainty payment and fully subsidized.

(ii) *Export Supply under PGCP:*

From equations 26 and 32, for any price $P > P_e^a$, the export supply under PGCP is obtained as,

$$(33) \quad Q_{2e} = Q_{1e} * SF_2$$

$$Q_{2e} = \frac{(\alpha p_{2e})^\kappa P^2 + \beta^\kappa p_{2e} P^{(\kappa+1)} - 2B_e I_e (\alpha p_{2e})^\kappa}{2B_e \{P(\alpha p_{2e})^\kappa + p_{2e} (\beta P)^\kappa\}} * \{1 - \delta(1 - \bar{F})\}$$

(iii) *Export Supply under FGIP:*

From equations 25 and 32, for any price $P > P_e^a$, the export supply under FGIP is obtained as,

$$(34) \quad Q_{3e} = Q_{1e} * SF_3$$

$$Q_{e3} = \frac{(\alpha p_{2e})^\kappa P^2 + \beta^\kappa p_{2e} P^{(\kappa+1)} - 2B_e I_e (\alpha p_{2e})^\kappa}{2B_e \{P(\alpha p_{2e})^\kappa + p_{2e} (\beta P)^\kappa\}} * \frac{\{\bar{F} + Z(1 - \bar{F}) - \delta Z(1 - \bar{F})\}(1 + \psi_3)}{2}$$

(iv) *Export Supply under SI:*

From equations 27 and 32, for any price $P > P_e^a$, the export supply under SI is obtained as,

$$(35) \quad Q_{4e} = Q_{1e} * SF_4$$

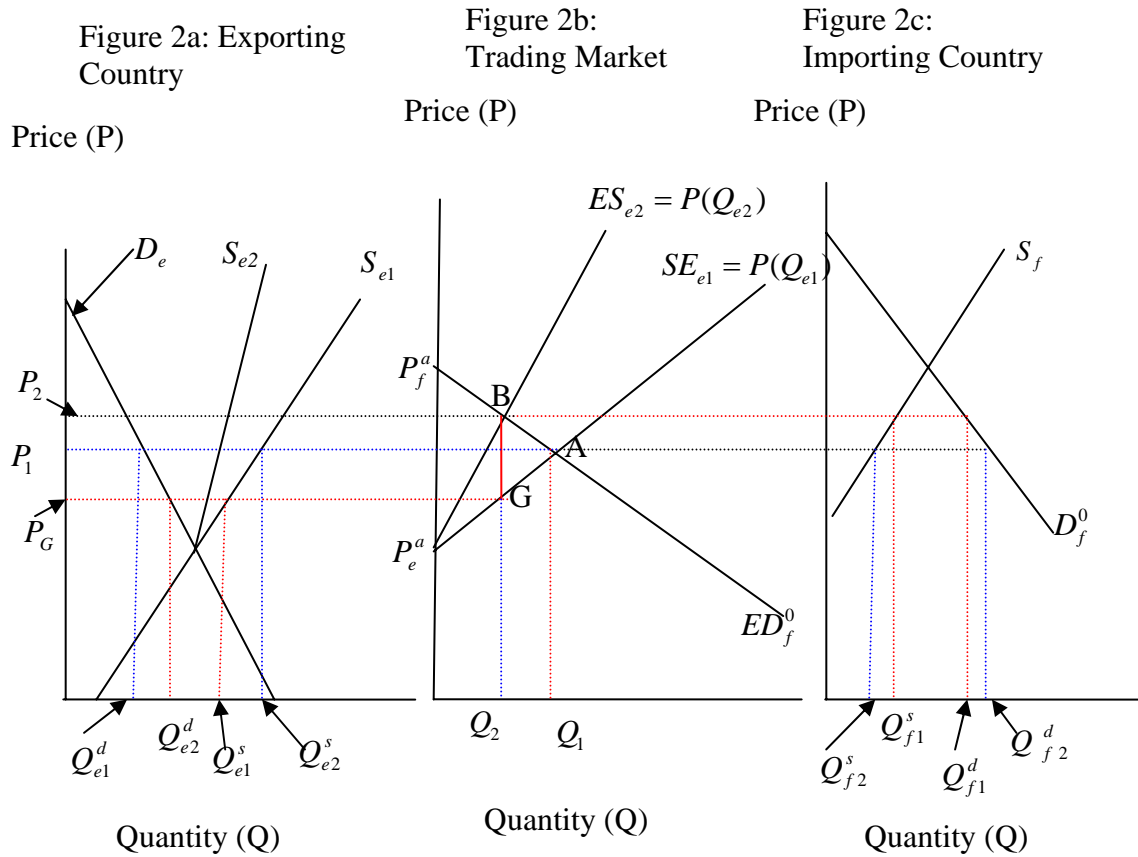
$$Q_{4e} = \frac{(\alpha p_{2e})^\kappa P^2 + \beta^\kappa p_{2e} P^{(\kappa+1)} - 2B_e I_e (\alpha p_{2e})^\kappa}{2B_e \{P(\alpha p_{2e})^\kappa + p_{2e}(\beta P)^\kappa\}} * \frac{\bar{F}(1+\psi_4)}{2}$$

Recovering Efficiency Losses through an ECP

For the purpose of illustration, we consider two inverse excess supplies derived under FGINP and FGIP based on equations 32 and 33 respectively. Let ES_{e_2} refer to the unsubsidized export supply under FGIP. Let ES_{e_1} is referred to as the fully subsidized export supply (see figure 2)¹⁴. Note that ES_{e_1} is also assumed to be the benchmark (or idea) export supply, which is comparable to the scenario of a direct export subsidy, which will be discussed later in of this section, since non-payment risks are not explicitly taken into account by the standard analysis of an export subsidy. Let ED_f^0 represent the import demand of the importing country without the offering of a cost savings. ES_{e_1} , ES_{e_2} , and ED_f^0 are presented in figure 2b of the three-panel-trade diagram of the two-country trade model. Note that Figure 2a is enlarged from figure 2 and only considers the two aforementioned supplies. Figure 2c presents the domestic demand when no cost savings is offered (D_f^0) and its domestic supply (S_f). In figure 2b, the equilibrium price and quantity export under the fully subsidized export supply are P_1 and Q_1 , respectively.

¹⁴ The partial guarantee/insurance and self-insured excess supplies can be examined by an approach similar to the one we use to analyze the full guarantee/insurance excess supply. For short, the term ‘inverse’ excess demand and supply are just referred to import demand and export supply from here onwards.

Figure 2: The Existence of an Efficiency Loss Due to Non-Payment Risks



The equilibrium quantity export under the unsubsidized export supply is Q_2 . The importing country faces the price P_2 , while the consumer in the exporting country faces the price P_G , which is lower than P_2 . This implies that there is a price wedge ($P_2 - P_G$) under the scenario of the unsubsidized export supply. The price wedge creates an efficiency loss due to the non-payment risk. The efficiency loss is represented by the area $P_e^a BA$, which consists of two components. First, the welfare loss due to less quantity exported is represented by the area GBA , which can be interpreted as the dead weight loss. Second, the welfare loss due to higher prices is represented by the area $P_e^a GB$. This arises since, if there is no risk of non-payment, the exporter would charge

the price P_G per unit of export, instead of charging the price P_2 per unit for the quantity export of Q_2 .

(i) The Impact of a Partially Subsidized Export Credit Program without an Offering of a Cost Savings

For the purpose of illustration, suppose that the exporting country decides to minimize their efficiency loss by implementing an export credit program that partially subsidizes the risk premium to its exporter but does not offer any cost savings to the importing country. This will tilt the unsubsidized export supply ES_{e2} toward the fully subsidized export supply ES_{e1} . Let ES_{es} represent the partially subsidized export supply. ES_{e1} , ES_{es} , and ES_{e2} are presented on figure 3b. To avoid cluster, the domestic inverse supply S_{e2} is excluded from figure 3a. Note that the more the subsidized premium cost is offered, the more the SE_{es} will lie closer to ES_{e1} . On the other hand, the lesser the subsidized premium cost is offered, the more SE_{es} will lie closer to ES_{e2} .

Figure 3b shows that the equilibrium point under the partially subsidized export supply occurs at point H, with the equilibrium price and quantity export P_H and Q_H , respectively. Figure 3b shows that $P_1 < P_H < P_2$ and $Q_2 < Q_H < Q_1$ (see equilibrium points A, B, and H). The efficiency loss is reduced from $P_e^a BA$ to $P_e^a HA$. The importing country faces the new equilibrium price at P_H per unit, instead of facing the price P_2 . On the other hand, the consumer in the exporting country faces the price P_g , instead of facing the lower price P_G . This shows that the domestic price of the exporting country is

increasing due to the introduction of the subsidized export credit program; however, its consumer still faces a lower price relative to the benchmark situation: $P_g < P_1$.

Figure 3: The Effect of Partially Subsidized Risk Premium without Offering a Cost Savings to the Importing Country

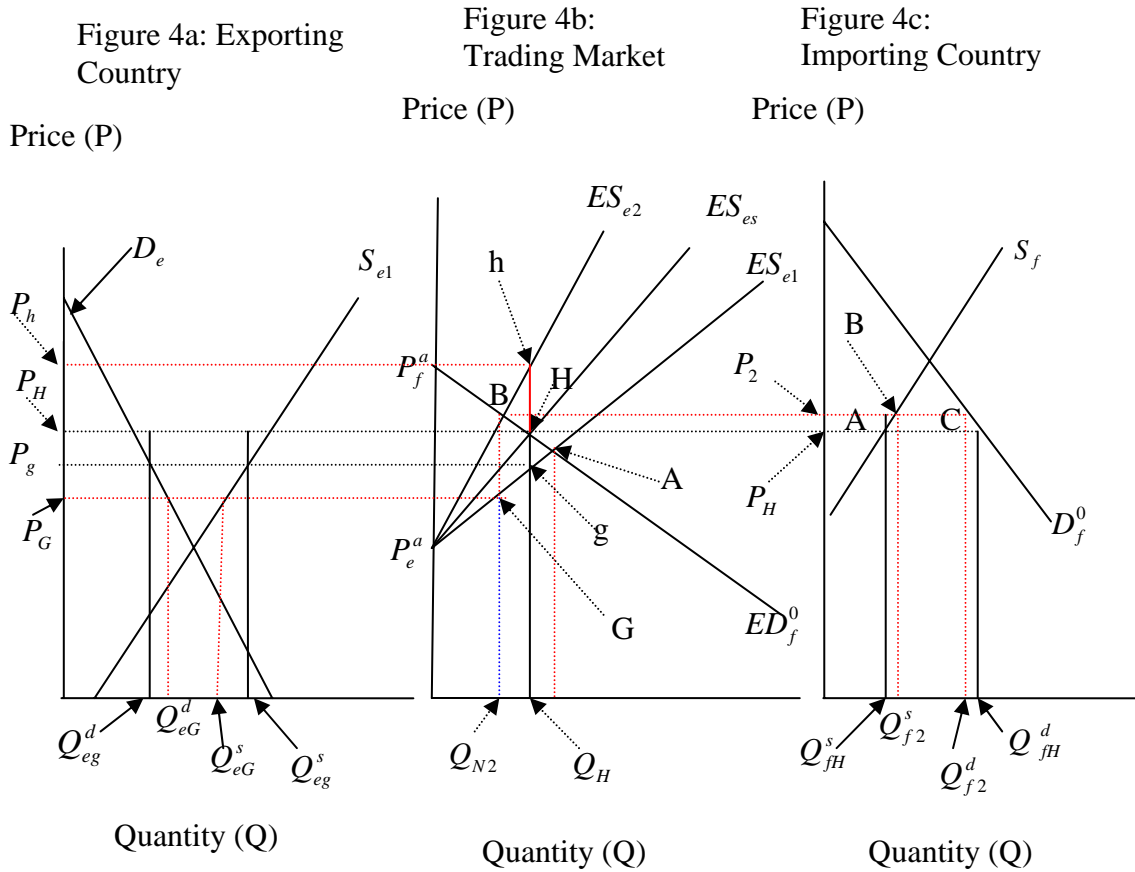


Figure 3b shows that without partially subsidized risk premium cost, the exporter would be willing to export Q_H units if it is able to charge at the price P_h per unit. From the perspective of guaranteeing price at P_h per unit, the cost incurred by the exporting country's government would be $Q_H(P_h - P_H)$. Note that this cost would be a transfer payment to the exporter. However, this cost overestimates the actual cost of the export credit program which partially subsidizes the risk premium cost, since the actual cost of

such an export credit program is the area bounded by the unsubsidized and partially subsidized export supplied and the segment of price differential \overline{Hh} , which is the area of $P_e^a Hh$.

(ii) The Impact of a Partially Subsidized Export Credit Program with an Offering a Cost Savings

Figure 3 can be extended to analyze the impact of an export credit program that partially subsidizes the risk premium to its exporter and also offers a cost savings to the importing country. Let ED_f^1 represent the import demand of the importing country with the offering of a cost savings. As in figure 1, a cost savings means a demand shifter. This implies that if a cost savings is offered to the importing country, its import demand will also shift. Thus, ED_f^1 will lie to the right of ED_f^0 . Figure 4b illustrates how much the exporting country intends to offer such a cost savings to the importing country through its export credit program, which shifts the import demand. Suppose that the exporting country decides to completely eliminate their efficiency loss due to non-payment risks by implementing an export credit program that partially subsidizes risk premium cost and also offers a cost savings to the importing country.

To achieve its twin objectives, the export credit program needs to narrow the price wedge \overline{AE} by setting the fixed discount rate on cost savings as $d = 1 - (P_1 / P_D)$, where P_1 and P_D are equilibrium prices at equilibrium points A and D, respectively. Note that the equilibrium point D occurs at the common intersection point of the export supply SE_{es} , import demand ED_f^1 , and the segment of the price wedge \overline{AE} . Figure 4b shows that the efficiency loss is completely eliminated. Due to receiving the cost savings, the importing

cost of the export credit program, which partially subsidizes the risk premium cost and offers a cost savings to the importing country. The actual cost of the program is the area bounded by the unsubsidized and partially subsidized export supplies and the segment of price wedge \overline{AE} , which is the area of $P_e^a DE$.

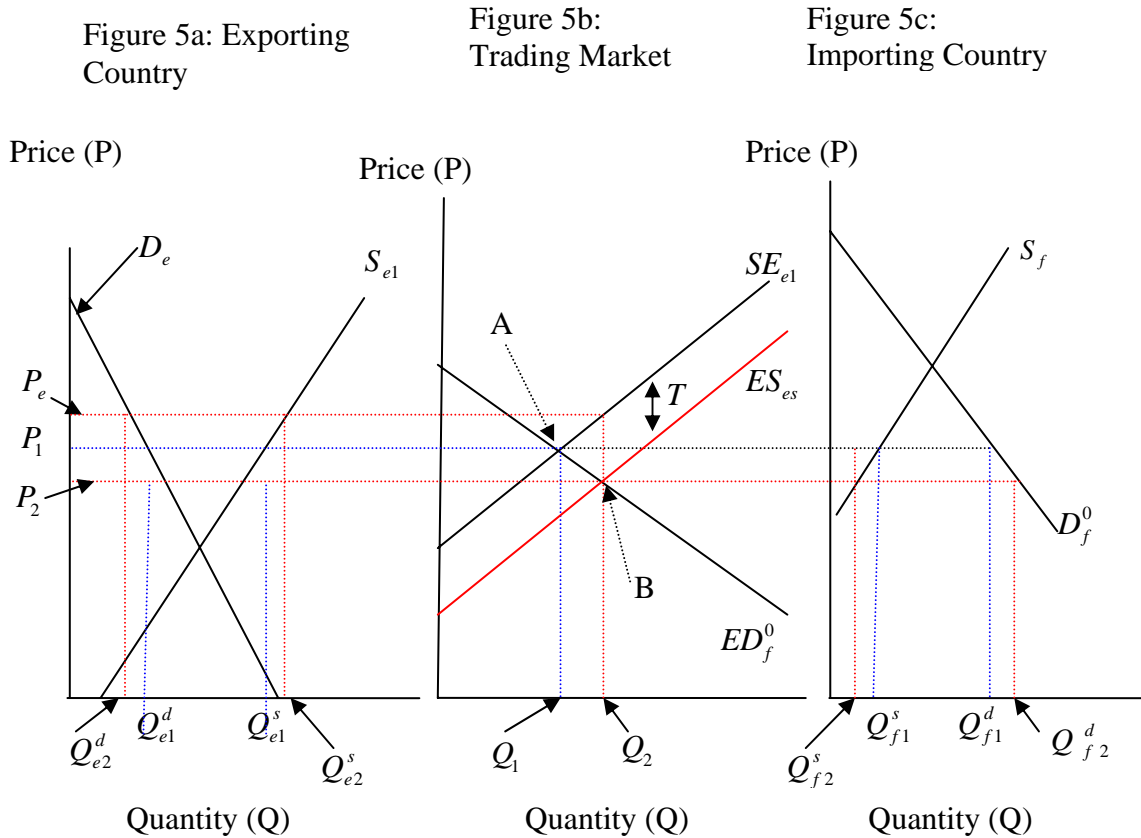
A Graphical Analysis of a Direct Export Subsidy

Following the graphical illustration of Houck (1986) and maintaining the same notations as in the previous section, the framework of a partial equilibrium model of a fixed per-unit export subsidy is presented in figure 6. For the purpose of comparison, let ES_{e1} represents the same benchmark (or idea) export supply of the exporting country prior to the introduction of its fixed per-unit export subsidy program. The initial partial equilibrium point occurs at point A, where the equilibrium price and quantity export are denoted as P_1 and Q_1 , respectively.

Suppose that the exporting country provides a fixed per-unit export subsidy (T) to its exporter. The effect of the fixed per-unit export subsidy is to lower the supply price of export quantities by the value of T per unit. It shifts the export supply of the exporting country vertically downward by the amount of T . The new export supply is denoted as ES_{es} which is located to the right of the export supply without the per unit export subsidy ES_{e1} . The export supply ES_{es} intersects with the import demand ED_f^0 at the lower equilibrium price of P_2 (see equilibrium point B). With a lower equilibrium price, the trade volume increases from Q_1 to Q_2 . This indicates that there is an expansion of trade volume by an amount equal to the distance $\overline{Q_1Q_2}$, and the market equilibrium price declines from P_1 to P_2 . However, the consumer in an exporting

country still has to pay the price $P_e = P_2 + T$. According to Houck, this increase in domestic price in the exporting country occurs because its firm is eager to earn subsidy payments, to expand export sales, and to bid up the domestic price paid by its consumer.

Figure 5: The Partial Equilibrium of the Two-Country Model with a Fixed Per Unit Export Subsidy



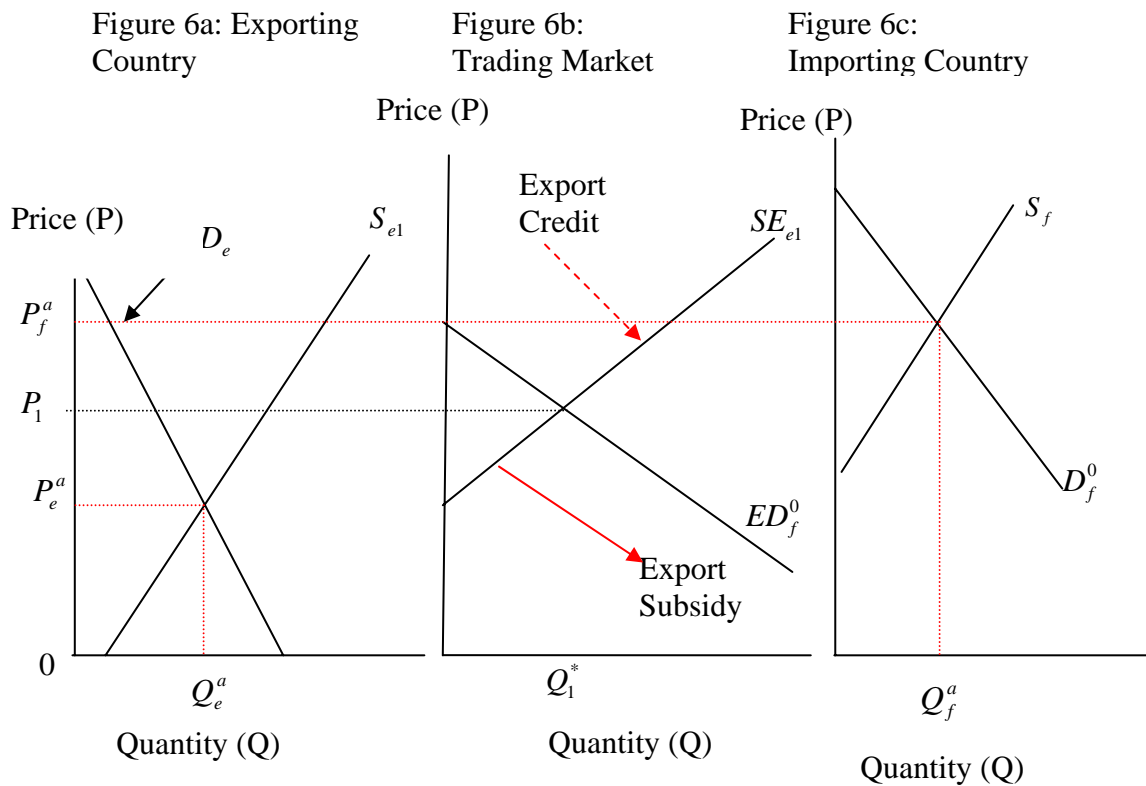
A Comparison between Export Credits and Export Subsidies

By observing figures 3, 4, and 5, one would argue that the trade impact of the export credit program resembles the trade impact of a fixed per-unit export subsidy in terms of lowering import price and increasing the domestic price of the exporting country. As a result, the trade volume increases. Indeed, the export credit program discussed above does lower the import price and does increase the domestic price of the

exporting country. However, the decreasing and increasing prices occur as an adjustment in moving the price towards the benchmark (or idea) equilibrium price P_1 . The trade volume is increased to the benchmark (or idea) equilibrium quantity export of Q_1 .

In contrast, the fixed per-unit export subsidy lowers the import price but moves away from the benchmark equilibrium price P_1 , and the consumer of the exporting country faces higher price P_e . In short, the differential impacts of an export credit program and a direct export subsidy can be summarized in figure 6.

Figure 6: The Partial Equilibrium of the Two-Country-Trade Model in the Settings of an Export Credit and Export Subsidy



When both the cost savings offered to the importing country and non-payment risk are incorporated into the partial equilibrium model, figures 3 and 4 indicate that the operational impact of export credit insurance/guarantees lies in the region above the

benchmark export supply ES_{e1} . By contrast, figure 6 indicates that the operational impact of a fixed per-unit export subsidy lies in the region below the excess supply ES_{e1} .

Summary and Concluding Remarks

A two-country partial equilibrium trade model is developed to analyze the economic impact of the export credit insurance and/or guarantees on trade flows. The framework incorporates both non-payment risks associated with an importing country and secondary benefits (cost saving) that it may receive from an export credit program. The results illustrated the trade impacts of an export credit guarantee/insurance and those of a fixed per-unit export subsidy are not an economically identical twin. Graphically, when both the cost savings offered to the importing country and non-payment risk are incorporated into the partial equilibrium model, the operational impact of export credit insurance/guarantees lies in the region above the benchmarked excess supply. By contrast, the operational impact of a fixed per-unit export subsidy lies in the region below the benchmarked excess supply. This shows that while an export credit program increases quantity export, raises the domestic price in the exporting country, and lowers the price of the importing country, the two prices are adjusted toward the benchmarked equilibrium price. In contrast, the trade impact of a fixed per-unit export subsidy lowers the import price and increases the domestic price of the exporting country beyond the benchmarked equilibrium price. As a result, the trade volume increases beyond the benchmarked equilibrium quantity export. This is the main feature by which an export credit distinguishes itself from a fixed per-unit export subsidy, and it can be used to enhance trade flows in terms of minimizing the efficiency loss due to the effect of non-payment risks.

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Appendix:

The proof of proposition 2:

Assume that

$$(26) \quad W = W(P, Z, \bar{F}) = Z(1 - \bar{F})P$$

(i) Substitute equation 26 into equation 24, any positive quantity of the export supply y_2 implies that $\{1 - \delta(1 - \bar{F})\} > 0$. Subsequently, it implies that $\delta(1 - \bar{F}) < 1$. At a given price P , equations 24 and 25 can be used to show that $y_2 < y_1$.

$$\Rightarrow \frac{P\{1 - \delta(1 - \bar{F})\}}{2B_e} < \frac{P}{2B_e}$$

$$\Rightarrow y_2 < y_1$$

(ii) Substitute equation 26 into both equations 22 and 24, at a given price P , it can be shown that $Y_3 < Y_2$.

For $\lambda \sigma_\theta^2 (1 - Z)^2 P^2 > 0$

$$\Rightarrow \frac{P\{\bar{F} + Z(1 - \bar{F}) - \delta Z(1 - \bar{F})\}}{2B_e + \lambda \sigma_\theta^2 (1 - Z)^2 P^2} < \frac{P\{\bar{F} + Z(1 - \bar{F}) - \delta Z(1 - \bar{F})\}}{2B_e}$$

For $0 < Z < 1$

$$\Rightarrow \bar{F} + Z(1 - \bar{F}) < \bar{F} + (1 - \bar{F})$$

$$\Rightarrow \frac{P\{\bar{F} + Z(1 - \bar{F}) - \delta Z(1 - \bar{F})\}}{2B_e} < \frac{P\{\bar{F} + (1 - \bar{F}) - \delta Z(1 - \bar{F})\}}{2B_e} = \frac{P\{1 - \delta Z(1 - \bar{F})\}}{2B_e}$$

$$\Rightarrow \frac{P\{1 - \delta Z(1 - \bar{F})\}}{2B_e} = \frac{P\{1 - \delta(1 - \bar{F})\}}{2B_e}$$

$$\Rightarrow y_3 < y_2$$

(iii) Similarly, at a given price P , equations (22), (23), and (26) can be used to show that

$$y_4 < y_3.$$

For any $0 < Z < 1$

$$\Rightarrow \lambda \sigma_\theta^2 P^2 > \lambda \sigma_\theta^2 (1-Z)^2 P^2$$

$$\Rightarrow \frac{P\bar{F}}{2B_e + \lambda \sigma_\theta^2 P^2} < \frac{P\bar{F}}{2B_e + \lambda \sigma_\theta^2 (1-Z)^2 P^2}$$

For $\delta < 1$

$$\Rightarrow Z(1-\bar{F}) > \delta Z(1-\bar{F})$$

$$\Rightarrow Z(1-\bar{F}) - \delta Z(1-\bar{F}) > 0$$

$$\Rightarrow \frac{P\bar{F}}{2B_e + \lambda \sigma_\theta^2 (1-Z)^2 P^2} < \frac{P\{\bar{F} + Z(1-\bar{F}) - \delta Z(1-\bar{F})\}}{2B_e + \lambda \sigma_\theta^2 (1-Z)^2 P^2}$$

$$\Rightarrow y_4 < y_3$$