EXPORT INSURANCE SUBSIDISATION AND UNDISTORTED TRADE CREATION

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September 1996

Abstract: Trade activities involving uncertainty tend to be underdeveloped. Incomplete or missing insurance markets often lie at the basis of these unexploited trade opportunities. We argue that, under certain conditions, subsidising a public insurance system is the second-best policy to remove this inefficiency. The paper illustrates this by concentrating on the risk of default and official export insurance. The WTO Subsidy Code explicitly rules out export insurance subsidisation because such a practice is believed to distort trade. We show that insurance contracts can be designed to prevent premium subsidies from distorting competition. What is more, they induce trade creation instead. This form of trade creation is particularly relevant for developing countries, often reputed for a high risk of default.

JEL Classification: D82, F13, O19.

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INTRODUCTION

Due to incomplete insurance markets, trade activities entailing uncertainty tend to be underexploited. Asymmetric information problems often form the basis for this market failure. This paper focuses on the risk of default, mainly faced by firms exporting to developing countries. Still, we believe the analysis to be relevant for any source of risk affecting export decisions of risk averse firms. In most industrialised countries official export agencies provide insurance against the risk of default. What is more, empirical studies (Abraham, 1992) point out that most of these agencies are operating with sustained losses. The WTO Subsidy Code explicitly rules out this form of export subsidisation, dismissing it as a trade distorting practice. Yet, our analysis shows that subsidised export insurance schemes need not always lead to trade distortion. On the contrary, they may prevent it. This is the case if adverse selection forms an impediment to attaining first-best insurance contracts in the private market.

While the notion of undistorting export insurance subsidisation may seem paradoxical, the more general idea that a more efficient allocation of risk than the market outcome may be reached by government intervention is far from being new. Eaton and Grossman (1985) consider the effect of uncertain terms of trade in a small open economy where insurance markets are incomplete. They argue that trade policy could partially substitute for missing insurance markets. In other words, trade intervention may serve as a second-best mechanism for pooling risk. However, Dixit (1990) claims that such policy prescriptions must be advocated with caution. His assertion relies on an argument of fair comparison. This means that the information constraint causing the market failure should be equally imposed on government policy. Only if the advised policy outperforms the market given this information constraint, government intervention may be justified. Dixit concludes that, instead of using the incompleteness of insurance markets as an assumption, the source of the market failure should clearly be identified.

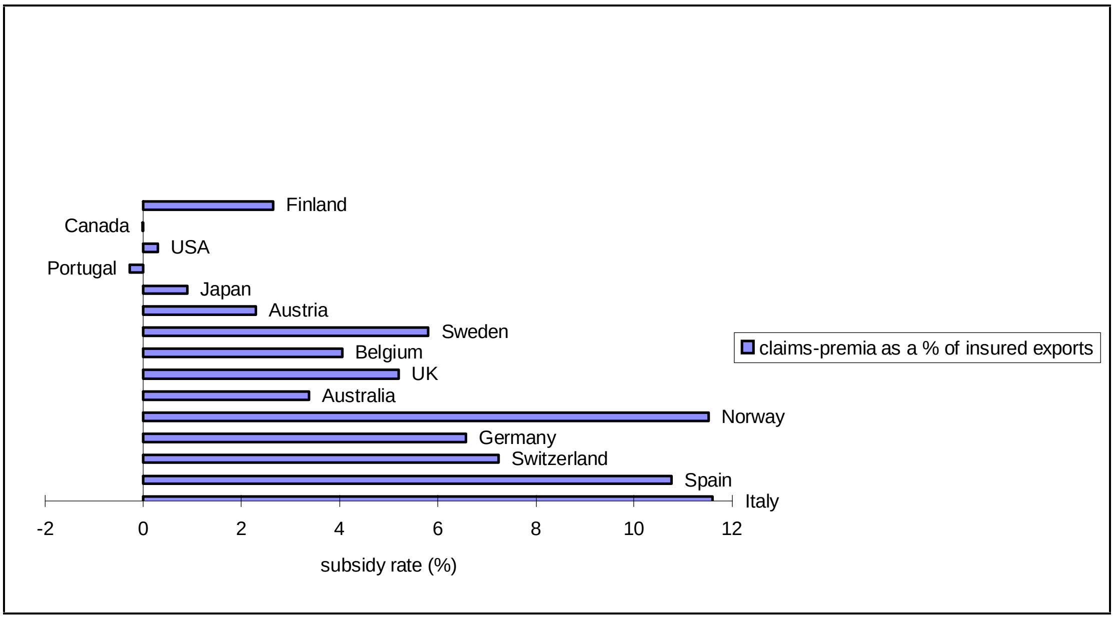
In line with this reasoning we first examine the export insurance contracts provided by a perfectly competitive market and compare those with optimal public insurance policies. In the first section of the paper, some figures on official export insurance are presented. In section two, we start the formal analysis by building a benchmark case with symmetric information. Basically, we concentrate on how exports are affected by the terms of the available insurance policies. Adverse selection is introduced in section three. Here, our attention is drawn to the question whether and to what extent the information asymmetry in the insurance market has an impact on insured firms' competitiveness in the export market. Section four formulates the insurance problem for an official export insurer confronted with the same information problem as private companies. We argue that a public insurance agency can outperform the market in terms of efficiency by granting premium subsidies. Moreover, it is shown that this policy guarantees undistorted trade.

1. SOME FIGURES ON EXPORT INSURANCE SUBSIDISATION

Export credits allowing for defer of payment generate a risk of default. More specifically, the foreign importer may default (part of) the sum stipulated in the export contract at the moment the credit term expires. In spite of the WTO's explicit prohibition of export insurance subsidisation, it is a commonly used practice in OECD-countries (Abraham (1990); Abraham, Couwenberg and Dewit (1992); Dewit (1996)). The WTO Subsidy Code defines export insurance subsidies as a sustained positive difference between claims paid and premia received by official export insurance agencies.

Figure 1 presents subsidy estimates for various industrialised economies during the period 1988-'92. Although there are some exceptions, most countries resort to a policy of subsidisation. Subsidy rates (i.e., subsidies expressed as a percentage of insured exports) are substantial and vary around 5%.

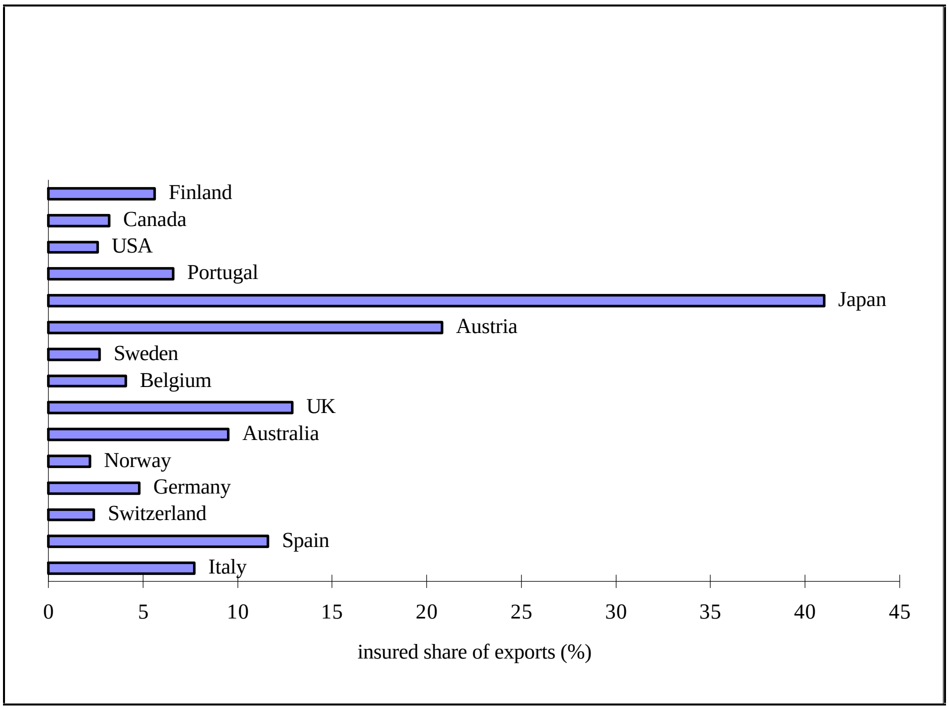
Figure 1: Average international export insurance subsidisation (1988-'92)



Source: Dewit (1996), p.10.

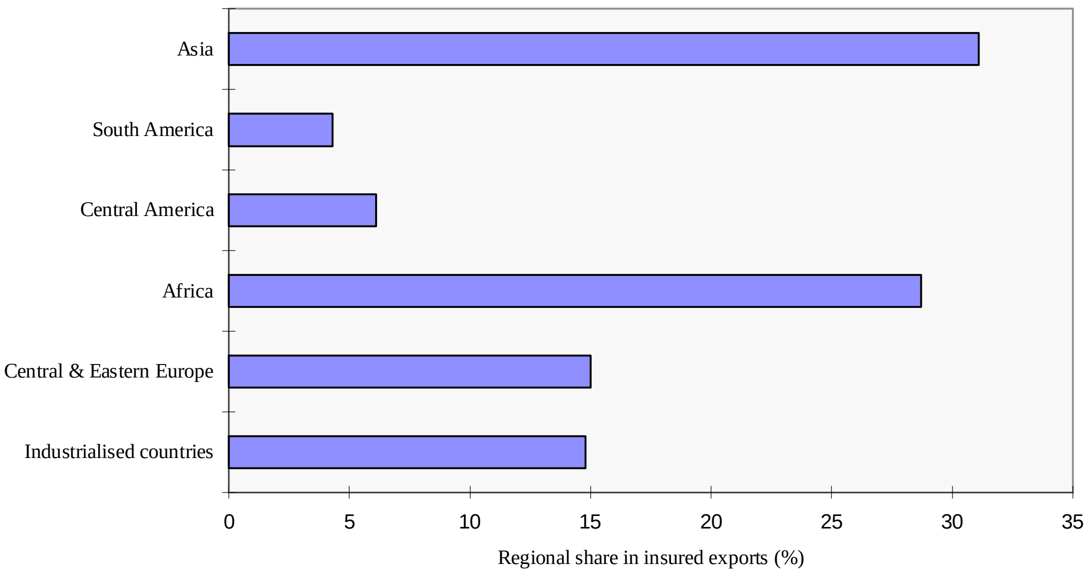
Figure 2 reflects the shares of insured contracts in total exports for the countries selected. Globally speaking, the share of insured contracts is too small to have a distorting effect on overall international competition. Japan and Austria form notable exceptions to this general tendency with firms insuring up to 40 % and 20 % of their exports respectively. Still, the amount of subsidies provided by national insurers may be crucial in establishing or reinforcing trade relations with those (mostly underdeveloped) regions where the occurrence of default is common. This is confirmed by Figure 3 which shows a regional disaggregation of export insurance contracts issued by the Belgian official export insurer. Insured export contracts with African and Asian destinations comprise the bulk of the policies, each accounting for roughly 30 % of the total pool of insurance contracts.

Figure 2: Insured contracts as a % of total exports (1988-'92)



Source: Dewit (1996), p.10.

Figure 3: Regional disaggregation of Belgian export insurance contracts (1984-'93)



Source: Dewit (1996), p. 16.

2. TRADE AND EXPORT INSURANCE WITH SYMMETRIC INFORMATION: THE BENCHMARK CASE

Consider a risk averse domestic firm, exporting to region i where it faces a risk of default. We derive the optimal terms of export insurance contracts covering against such risk. In this section a benchmark framework without any information asymmetries is built. We adopt the following set of assumptions.

(i) The export insurance market is perfectly competitive.
(ii) Insurance agencies are risk neutral.
(iii) The stochastic default variable is captured by a region-specific distribution.
(iv) Insurance companies know the default distributions across export regions, and individual default distributions of exporting firms are assumed to be identical. Therefore, no information asymmetries are present in this base framework.
(v) Apart from being known to the economic agents involved, default distributions are also market independent[1].
(vi) Firms are risk averse and operate in a perfectly competitive product market. This last assumption removes the scope for trade intervention based on strategic arguments.
(vii) In addition, we assume that exporting firms are not serving their domestic market. Marginal costs of production are increasing, allowing us to determine the firm's equilibrium output.

The problem is analysed in a one-period two-stage game. The premium of the insurance policy is set in the first stage of the game by private export insurance companies. In the second stage, a representative risk averse firm decides on the terms of its export contract as well as on the insurance coverage it will take. Solving the model backwards, we start with the firm's decisions in the last stage.

2.1. The export decision of the risk averse firm

We formulate the exporter's optimisation problem using a mean-variance approach[2]. Given a certain degree of variability, risk averse exporting firms maximise expected profits, or

$$\max_{x_i, I_i} EV_i = E\Pi_i - \frac{\beta}{2}\operatorname{var}\Pi_i \qquad s.t. \quad I_i \le p_i x_i \tag{1}$$

EV_i is the firm's certainty-equivalent profit valuation and β stands for the (constant) coefficient of absolute risk aversion. Profits (Π_i) are distributed with mean $E\Pi_i$ and variance var Π_i , equal to

$$E\Pi_i = (1 - E\lambda_i) p_i x_i + (E\lambda_i - r_i) I_i - \frac{1}{2} x_i^2 \tag{2a}$$

$$\operatorname{var}\Pi_i = (p_i x_i - I_i)^2 v_i^2 \tag{2b}$$

[1] Moreover, we ignore the possibility of background risk as analysed in Eeckhoudt (1992).
[2] The more general expected utility formulation (as used in Dewit (1996)) is here explicitly specified by a mean-variance type of profit valuation function.

p_i is the price prevailing in market i while x_i is the firm's export volume to that destination. $E\lambda_i$ and v_i^2 denote the mean and variance of the stochastic payment-loss variable λ_i (with Prob{λ_i<0}=Prob{λ_i>1}=0), representing the share of the export contract defaulted at the expiration date. If the foreign importer is unable to pay (part of) the stipulated sum, the insured exporter can claim payment from its insurance company. Hence, we refer to $E\lambda_i$ as the expected claim rate. I_i symbolises the sum covered by insurance and r_i is the premium rate, i.e., the premium paid per currency unit insured. The premium rating regime is uniform. This means that the premiun rate is independent of how much coverage is purchased. Moreover, the covage level is independent of the size of the loss since we assume that firms cannot influence this variable. The last term in (2a) stands for the production cost function, exhibiting increasing marginal costs. The constraint in (1) reflects the legal prohibition of taking more than full insurance.

Proposition 1: *With symmetric information and exporters choosing insurance coverage, the export volume of a risk averse firm*

(i) is independent of the firm's attitude towards risk as well as of the features of the default distribution;

(ii)is negatively affected by the export insurance premium rate.

Proof:

First order conditions for (1) with respect to x_i and I_i are[3]

$$(1-E\lambda_i)p_i - x_i - \beta(p_i x_i - I_i)p_i v_i^2 + \varphi_i p_i = 0 \tag{3a}$$

$$(E\lambda_i - r_i) + \beta(p_i x_i - I_i)v_i^2 - \varphi_i = 0 \tag{3b}$$

φ_i is the Lagrange multiplier associated with the full coverage constraint. Conditions (3a) and (3b) reduce to

$$x_i = p_i(1-r_i) \tag{4a}$$

$$I_i = \min\left\{ p_i x_i + \frac{E\lambda_i - r_i}{\beta v_i^2}; p_i x_i \right\} \tag{4b}$$

From (4a) it is clear that the firm's optimal export volume is independent of its attitude to risk as well as of the features of the default distribution. While being independent of the coverage taken for the contract, exports are determined by the insurance premium rate.

According to (4b) exporters prefer partial coverage if a premium tax $(r_i > E\lambda_i)$ is charged. A tax feeds back into the quantity they choose to export, which will be lower than the export volume of a risk neutral firm (obtained by setting β equal to zero in (3a))[4]. If export insurance contracts are subsidised, the firm would like to overinsure its export contract. Subsidisation occurs when the premium rate is set below the fair rate, i.e., the expected claim rate (r_i<$E\lambda_i$). In that case the constraint becomes binding

[3] Evidently, these conditions only hold if export insurance is offered at sufficiently attractive terms. This means that premia should not exceed a critical rate at which firms choose not to insure their contracts. Technically, the following participation constraint should not be violated $EV_i(I_i > 0) \geq EV_i(I_i = 0)$. This will be guaranteed by the premia set by the insurance agencies.

[4] This separation theorem was earlier derived by Funatsu (1986).

($\varphi_i = E\lambda_i - r_i > 0$) and $I_i = p_i x_i$. Next, we turn to the first stage, where insurance agencies determine premium rates.

2.2. Optimal export insurance with symmetric information

With perfect competition in the export insurance market, risk neutral insurance companies maximise the objective function of a representative exporter subject to their budgetary break-even constraint. Since the region-specific default distributions are known and independent, the optimisation problem for an export insurance company offering insurance for exports to region i is given by

$$\max_{r_i, \psi_i} EV_i \qquad s.t. \quad (r_i - E\lambda_i) I_i \geq 0 \tag{5}$$

with ψ_i denoting the Lagrange multiplier associated with the company's budget constraint. First order conditions to the problem in (5) are equal to

$$(-1+\psi_i) I_i + EV_{i_{x_i}} \frac{dx_i}{dr_i} + EV_{i_{I_i}} \frac{dI_i}{dr_i} = 0 \tag{6a}$$

$$(r_i - E\lambda_i) I_i = 0 \tag{6b}$$

From the second stage we know that either $EV_{i_{x_i}} = EV_{i_{I_i}} = 0$ (if $\varphi_i = 0$) or $\frac{dx_i}{dr_i} = \frac{dI_i}{dr_i} = 0$ (if $\varphi_i > 0$), hence $\psi_i = 1$. The optimal premium rating rule resulting from (6b) entails fair premium rating ($r_i = E\lambda_i$). This benchmark outcome is not surprising. Since they have the same information about the risk characteristics of the export contracts as the applicants and have no basis for strategic intervention, fiercely competing risk neutral insurance companies charge the zero-profit premium rate.

This implies that with symmetric information risk averse insured firms export exactly the same volume as their risk neutral counterparts. Clearly, the insurance policies provided by the market are Pareto-efficient, ruling out any basis for state intervention in the benchmark case of symmetric information.

3. TRADE AND EXPORT INSURANCE WITH ADVERSE SELECTION

Suppose domestic exporters are no longer identical in the sense that they are facing different default distributions, even though their customers are located in the same export market. This scenario is far from being unrealistic since domestic firms, belonging to different industries, evidently deal with different type of customers. Depending on the nature of the product involved, some firms may be more dependent on risky customers (i.e., industries or individual buyers characterised by a higher default risk) than others[5]. More particularly, the distributions diverge in the sense that they have different means, while their variances are assumed to be the same for the whole region.

[5] We focus on commercial rather than on political risk. While the first type of default is related to an individual importer, the second type is related to the importing country as a whole.

When concluding risky contracts, the firm, being aware of the potential insolvency of its client, has an incentive to hide the true risk nature of the type of contracts it wants to insurance. While they should be classified as highly risky, the firm may misrepresent its contracts to the export insurance company as being low-risk in order to benefit from a lower premium rate. In other words, the company is confronted with a problem of adverse selection[6]. Introducing a screening device in its offered contracts is one way to tackle this problem[7]. More specifically, the insurer should design a special package of policies, containing high- and low-risk contracts and inducing each risk category to select the appropriate contract. The natural candidate for such a self-selecting variable in export insurance is the coverage.

For simplicity, we only distinguish between two risk groups. One group (denoted by h) faces a high default risk ($E\lambda_i^h$), while the other one (symbolised by l) is confronted with a relatively low expected payment-loss ($E\lambda_i^l$, and $E\lambda_i^l < E\lambda_i^h$).

Unlike in the benchmark case, insurance companies link the premium rate for each risk category to a specific coverage level, thereby implementing a non-linear insurance scheme. The resulting equilibrium set of insurance contracts is crucial to the risk averse firm's export decision, taken in the second stage of the game.

3.1. The firm’s export decision with self-selecting insurance contracts

Firms now have to make their export decisions given the available insurance contracts, stipulating a premium rate and associated covered sum for each risk group. Hence, we reformulate the firm’s objective as

$$\max_{x_i^k} EV_i^k = E\Pi_i^k - \frac{\beta}{2}\operatorname{var}\Pi_i^k \qquad k = l,h \tag{7}$$

The first order condition with respect to x_i^k is

$$(1 - E\lambda_i^k)p_i - x_i^k - \beta(p_i x_i^k - I_i^k)p_i v_i^2 = 0 \qquad k = l,h \tag{8}$$

Hence, the optimal export volume for risk class k to region i is equal to:

$$x_i^k = p_i \frac{1 - E\lambda_i^k + \beta v_i^k I_i^k}{1 + \beta p_i^2 v_i^2} \qquad k = l,h \tag{9}$$

Clearly, the firm’s export volume depends on its attitude to risk, the features of the regional default distribution and the coverage available for its risk category. Firms are induced to export more if insurance policies consist of higher coverage levels. At the same time a change in the premium rate is not transmitted into exports under this type of insurance provision.

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[6] The nature of this problem of asymmetric information is totally different from the problem of moral hazard. Whereas firms can influence the probability that default occurs or the size of the payment-loss by its own actions with moral hazard (for an analysis of this problem in export insurance, we refer to Dewit (1996), Chapter 2), firms cannot affect these factors with adverse selection.

[7] It is generally believed that a screening model provides the most natural interpretation of the adverse selection problem in an insurance context (Dionne and Doherty, 1992). The concept of screening refers to the fact that uninformed agents, i.e., private export insurance agencies in our case, move first.

3.2. The optimisation problem of an export insurer with Wilson foresight

In the first stage of the game, the insurer has to set the terms of the insurance contracts for each risk category. The optimal package of insurance policies has to respect the agency's budget constraint on the one hand, and incorporate a self-selection mechanism on the other hand. In other words, insurance contracts for high- and low-risk groups have to be offered at terms which guarantee that exporters select the policy designed for their own risk category. Those conditions are referred to as the incentive compatibility constraints:

$$EV_i^h(r_i^h, I_i^h) \geq EV_i^h(r_i^l, I_i^l) \tag{10a}$$

$$EV_i^l(r_i^l, I_i^l) \geq EV_i^l(r_i^h, I_i^h) \tag{10b}$$

Formulating the optimisation problem in a perfectly competitive insurance market when adverse selection is present, is not trivial. In particular, it requires certain assumptions about the type of anticipatory behaviour among competing insurance agencies.

We assume that the insurance companies possess Wilson foresight. This notion refers to an alternative non-Nash type of equilibrium. Actually, we use a modified version of the Wilson equilibrium (Miyazaki (1977), Spence (1978)), labelled as the Miyazaki-Wilson (MW) equilibrium[8].

This type of equilibrium is characterised by two important elements. First, it only requires that the contract set as a whole respects the insurer's budget constraint. This qualification perfectly complies with the WTO Subsidy Code which identifies a fair provision of export insurance with an overall zero-loss budgetary position. Translated into individual policies, this implies that the agency may lose on some contracts, and make a profit on others. Second, this equilibrium concept is in some sense less myopic than the Nash alternative, as insurance agencies anticipate the reaction of their (potential) competitors when deciding which contracts to offer.

In addition, Crocker and Snow (1985) have proven that the MW-equilibrium yields the second-best outcome in a market where a problem of adverse selection prevails. Since we build this framework to compare it with the optimal contracts offered by a public insurance company, we withhold the private market outcome which renders the best risk allocation for all insured firms. This way, the private insurance market outcome provides a lower bound for the potential welfare improvement a public insurer possibly could engender.

Miyazaki (1977) established that, if the low-risk class is sufficiently large, insurance agencies possessing Wilson-foresight act as if they maximise the objective function of the low-risk type of agents. In other words, maximisation of the objective of the high-

[8] This equilibrium concept is defined by Crocker and Snow (1985; p. 213) as:

"A Miyazaki-Wilson (MW) equilibrium is a set of contract portfolios such that when consumers choose contracts to maximise expected utility (i) each portfolio earns non-negative profit and (ii) there is no portfolio outside the equilibrium set that, if offered, would earn a non-negative profit even after the unprofitable portfolios in the original set have been withdrawn."

risk group is then automatically implied. Still, if high-risk firms account for a share in total policies exceeding a critical value, a different insurance regime prevails. Here, we distinguish between these two cases in our discussion of optimal export insurance provision.

3.2.1. *Optimal export insurance when the high-risk group is small*

First, we cover the case where the share of high-risk contracts in the total pool of policies is relatively low[9]. Then, the insurer's optimisation problem is given by:

$$
\begin{aligned}
&\max_{r_i^k, I_i^k} EV_i^l \qquad\qquad k = l,h \\
&s.t.\quad (i)\ \ \alpha_i^l(r_i^l - E\lambda_i^l)I_i^l + \alpha_i^h(r_i^h - E\lambda_i^h)I_i^h \geq 0 \\
&\qquad\ (ii)\ \ EV_i^h(r_i^h, I_i^h) \geq EV_i^h(r_i^l, I_i^l) \\
&\qquad\qquad\ \ EV_i^l(r_i^l, I_i^l) \geq EV_i^l(r_i^h, I_i^h) \\
&\qquad\ (iii)\ \ I_i^k \leq p_i x_i^k
\end{aligned}
\tag{11}
$$

α_i^l and α_i^h are the proportions of low- and high-risk contracts in total insured exports respectively. These are known by all participants in the insurance market. Since the incentive compatibility constraint for the low-risk group and the full coverage constraints are not necessarily binding, we first solve the problem when the Lagrange multipliers connected to these constraints are zero. Maximising (11) yields the following set of first order conditions

$$(\psi_i \alpha_i^h - \chi_i) I_i^h = 0 \tag{12a}$$

$$(-1 + \psi_i \alpha_i^l + \chi_i) I_i^l = 0 \tag{12b}$$

$$\psi_i \alpha_i^h (r_i^h - E\lambda_i^h) + \chi_i [E\lambda_i^h - r_i^h + \beta(p_i x_i^h - I_i^h)] = 0 \tag{12c}$$

$$
\begin{aligned}
&E\lambda_i^l - r_i^l + \beta(p_i x_i^l - I_i^l)v_i^2 + \psi_i \alpha_i^l (r_i^l - E\lambda_i^l) \\
&\qquad - \chi_i \left[E\lambda_i^h - r_i^l + \beta(p_i x_i^l - I_i^l)v_i^2 + EV_i^h(r_i^l, I_i^l)_{x_i^l} \frac{dx_i^l}{dI_i^l} \right] = 0
\end{aligned}
\tag{12d}
$$

$$\alpha_i^l (r_i^l - E\lambda_i^l) I_i^l + \alpha_i^h (r_i^h - E\lambda_i^h) I_i^h = 0 \tag{12e}$$

$$
\begin{aligned}
&(1 - E\lambda_i^h) p_i x_i^h + (E\lambda_i^h - r_i^h) I_i^h - \frac{1}{2}(x_i^h)^2 = (1 - E\lambda_i^h) p_i x_i^l \\
&\qquad + (E\lambda_i^h - r_i^l) I_i^l - \frac{1}{2}(x_i^l)^2 - \frac{\beta}{2}(p_i x_i^l - I_i^l)^2 v_i^2
\end{aligned}
\tag{12f}
$$

ψ_i and χ_i symbolise the Lagrange multipliers associated with the budget constraint and the incentive compatibility condition respectively. From (12a) and (12b) we calculate the values of these multipliers (ψ_i=1, χ_i=α_i^h).

Furthermore, $EV_i^h(r_i^l, I_i^l)_{x_i^l} = (1 - E\lambda_i^h) p_i - x_i^l - \beta p_i v_i^2 (p_i x_i^l - I_i^l)$ and the export decision in the first stage (expression (9)) implies $\frac{dx_i^l}{dI_i^l} = \frac{\beta p_i v_i^2}{1 + \beta p_i^2 v_i^2}$. Knowing this, rearranging

[9] The term "relatively low " refers to the condition that the proportion of high- to low-risk contracts should not exceed a critical value, which will be determined later.

(12c) and (12d) yield the coverage specified in each risk group's export insurance policy

$$I_i^h = p_i x_i^h = p_i(1 - E\lambda_i^h) \tag{13a}$$

$$I_i^l = p_i^2(1 - E\lambda_i^l) - \frac{\alpha_i^h}{\alpha_i^l}\frac{E\lambda_i^h - E\lambda_i^l}{\beta v_i^2} \tag{13b}$$

So, the covered amount specified in the high-risk contract is the same as would prevail under a completely symmetric information set-up. The low-risk contract, however, merely entails partial coverage ($I_i^l < p_i^2(1 - E\lambda_i^l)$). Hence, this risk class is saddled with the load of the information asymmetry. The uninsured part of the low-risk contract crucially depends on three elements. First, the gap between expected payment-losses for both risk groups influences the uncovered part of the export contract in a positive way. A wide payment-loss gap reflects a larger difference in risk character of both risk types, thereby rendering the adverse selection problem more pronounced, as the cost of mistaking a high-risk firm for a low-risk one is more substantial. This is reflected in a curtailed coverage for low-risk firms, which abates the incentive for high-risk exporters to inappropriately choose the low-risk contract.

Second, the uninsured part of the low-risk contract is small as firms are more risk averse. High-risk firms then tend to have strong preferences for full coverage contracts, allowing the insurer to offer a more attractive policy to the low-risk group.

Third, the effect of the payment-loss differential on the uninsured part of the low-risk contract is weighed by the ratio of high- to low-risk contracts ($\frac{\alpha_i^h}{\alpha_i^l}$). As this ratio increases, the extent to which the adverse selection problem affects the market is magnified, inducing the insurer to enlarge the uninsured part of the low-risk export contract[10].

Furthermore, (13a) and (13b) indicate that the full coverage constraint is not binding for any combination of parameter values.

By solving expressions (12e) and (12f) we obtain the optimal premium rating schedule

$$r_i^h = E\lambda_i^h - \frac{\alpha_i^l}{\alpha_i^h}\frac{(r_i^l - E\lambda_i^l)I_i^l}{I_i^h} \tag{13c}$$

$$r_i^l = \alpha_i^l E\lambda_i^l + \alpha_i^h E\lambda_i^h + \alpha_i^h \frac{p_i(1 - E\lambda_i^h)(x_i^l - x_i^h) - \frac{1}{2}\left[(x_i^l)^2 - (x_i^h)^2\right] - \frac{\beta}{2}(p_i x_i^l - I_i^l)^2 v_i^2}{I_i^l} \tag{13d}$$

The low-risk group is implicitly taxed for the information asymmetry in the insurance market ($r_i^l \geq E\lambda_i^l$). Still, this tax element declines as the low-risk contract involves less coverage. Conversely, the high-risk premium is less than the claim payments expected from the underlying contract ($r_i^h < E\lambda_i^h$). Actually, the premium "tax" low-risk insured firms pay is transferred to their high-risk counterparts. So, there is some

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10 It should be noted that there is no point in forcing the high-risk type away from a full coverage policy, since this would also deteriorate the terms of the low-risk insurance contract in order to preserve the incentive compatible coverage gap.

scope for implicit cross-"subsidisation", in the sense that high-risk policies are charged a premium which is -actuarially speaking- too low, at the expense of the low-risk firms covering the difference. The latter accept to pay this transfer since this allows the agency to offer them a policy with a higher degree of coverage. Although most of the time this second-best set of policies entail separating contracts (i.e., different policies for different risk groups), a pooling equilibrium ($I_i^h = I_i^l = I_i$, $r_i^h = r_i^l = r_i$) may prevail. From (13a) and (13b) we calculate that this occurs for $\frac{\alpha_i^h}{\alpha_i^l} = \beta p_i^2 v_i^2$ [11,12].

The willingness to cross-subsidise on the part of the low-risk insured firms crucially depends on the fact that they sufficiently outnumber high-risk firms. If not, we end up in another policy regime which is discussed next.

3.2.2. Optimal export insurance when the high-risk group is large

If the proportion of the low- to the high-risk group is lower than the critical ratio, maximising low-risk certainty-equivalent profits under the earlier specified constraints in (11) is no longer optimal. In that case, the incentive compatibility constraint lowers the covered amount and associated premium so much that the low-risk premium becomes even smaller than the actuarial low-risk expected default. Hence, according to the premium schedule formulated in (13c) and (13d), the high-risk premium exceeds the related expected claims. This means that maximum certainty-equivalent profits are no longer guaranteed for the high-risk category. To prevent this from happening, another constraint has to be added:

$$EV_i^h(r_i^h, I_i^h) \geq \max_{I_i^{h*}}\{EV_i^h(I_i^{h*}) - (E\lambda_i^h - r_i^h)I_i^h\} \tag{14}$$

This condition ensures that the variability of high-risk contracts is minimised. In other words, the high-risk policy has to imply certainty-equivalent profits which are at least equal to expected profits (net of the difference between expected claims and the charged premium) generated by a full coverage high-risk contract. This is the contract required by the right hand side of condition (14). If $\frac{\alpha_i^h}{\alpha_i^l}$ is sufficiently substantial, this constraint will be binding.

In that case, optimising the problem stated in (11) with the additional constraint in (14) replaces first order conditions (12a) and (12c) by expressions (15a) and (15b), and yields an additional condition (15c)

$$(\psi_i \alpha_i^h - \chi_i - \vartheta_i)I_i^h = 0 \tag{15a}$$

$$\psi_i \alpha_i^h (r_i^h - E\lambda_i^h) + (\chi_i + \vartheta_i)\left[E\lambda_i^h - r_i^h + \beta(p_i x_i^h - I_i^h)\right] = 0 \tag{15b}$$

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[11] Still, the condition that $\beta p_i^2 v_i^2$ should be smaller than the critical ratio of high- to low-risk firms must hold.

[12] In spite of the premium transfer they pay to high-risk insured firms, it can be shown that low-risk exporters always prefer the low-risk policy if $p_i x_i^l - I_i^l > 0$. Hence, the low-risk incentive compatibility constraint is not binding.

$$(1-E\lambda_i^h)p_i x_i^h + (E\lambda_i^h - r_i^h)I_i^h - \frac{1}{2}(x_i^h)^2 = \frac{1}{2}p_i^2(1-E\lambda_i^h)^2 \qquad (15c)$$

with ϑ_i symbolising the Lagrange multiplier associated with (14). From (15a) and (12b) we know $\vartheta_i + \chi_i = \alpha_i^h \psi_i$ and $\chi_i = 1-\psi_i \alpha_i^l$. Expressions (15c) and (12e) now determine premium rates as

$$r_i^k = E\lambda_i^k \qquad k = h,l \qquad (16)$$

In contrast to the case where they were relatively abundant, low-risk exporters are now very reluctant to provide an implicit premium transfer to their high-risk domestic competitors. This reluctance is mirrorred in the premium schedule, which now involves "fair" premium rating for both risk classes. The corresponding coverage amounts are obtained by solving (15b) and (12d) for I_i^h and I_i^l:

$$I_i^h = p_i x_i^h = p_i^2(1-E\lambda_i^h) \qquad (16b)$$

$$I_i^l = p_i^2(1-E\lambda_i^l) + \frac{E\lambda_i^h - E\lambda_i^l}{\beta v_i^2} - \sqrt{\left(\frac{E\lambda_i^h - E\lambda_i^l}{\beta v_i^2} + p_i^2(1-E\lambda_i^l)\right)^2 - \left(\frac{p_i^2(E\lambda_i^h - E\lambda_i^l)^2}{\beta v_i^2} + (I_i^h)^2\right)} \qquad (16c)$$

Again, a full coverage contract is offered to the high-risk group, while only a partial coverage policy is available to the low-risk category. Yet, certainty-equivalent profits are lower under this distribution of high- to low-risk exporters compared to those in the previous situation. Compared to the symmetric information benchmark case, low-risk insured firms are worse off, but still reaching higher certainty-equivalent profits than without insurance coverage. Since the premium is set at the "fair" level, low-risk firms will always prefer some coverage to none at all[13]. Note that the derived MW-equilibrium now coincides with the Nash-equilibrium.

The critical proportion of high- to low-risk firms pins down the point of the policy-regime switch. At this point, both maximisation procedures should yield the same optimal set of policies. So, by letting the low-risk covered amounts derived in (13b) and (16c) be equal to each other, we obtain this particular critical value, $\frac{\alpha_i^{h}}{\alpha_i^l}^*$:

$$\frac{\alpha_i^{h}}{\alpha_i^l}^* = \frac{\beta v_i^2 \sqrt{\left(\frac{E\lambda_i^h - E\lambda_i^l}{\beta v_i^2} + p_i^2(1-E\lambda_i^l)\right)^2 - \left(p_i^2\,\frac{(E\lambda_i^h - E\lambda_i^l)^2}{\beta v_i^2} + (I_i^h)^2\right)}}{E\lambda_i^h - E\lambda_i^l} - 1 \qquad (17)$$

3.3. The effects of adverse selection in the insurance market on export performance in risky markets

[13] Moreover, it can be shown that low-risk firms strictly prefer the low-risk policy to the high-risk one if $\left[p_i^2(1-E\lambda_i^l)\right]^2 + \frac{2p_i^2(1-E\lambda_i^l)(E\lambda_i^h - E\lambda_i^l)}{\beta v_i^2} > \left[p_i^2(1-E\lambda_i^h)\right]^2 + \frac{p_i^2(E\lambda_i^h - E\lambda_i^l)^2}{\beta v_i^2}$. Since $0 < E\lambda_i^l < E\lambda_i^h < 1$, this is always true.

Since the insurance terms of the available policies are different from those prevailing under symmetric information, the firm's export volume will differ as well. In this section we discuss the effects of adverse selection in the insurance market on the firm's export performance.

Efficient export insurance should induce risk averse firms to export as much as their risk neutral domestic competitors. We have shown that this is the case with insurance policies offered under symmetric information. Suppose there are different risk categories among exporters, yet firms are unable to conceal their true risk type. In other words, the payment behaviour of foreign importers is publicly known. Hence, premium rates are fair for all risk groups implying that risk averse and risk neutral firms of risk type k export the same quantities, or

$$x_i^k|_{\beta>0} = x_i^k|_{\beta=0} \qquad k = h,l$$

Also, risky export ($x_i^k|_{\lambda_i^k>0}$) deviates more from the "safe" volume ($x_i^k|_{\lambda_i^k=0} = p_i$) if the expected default rate is high

$$x_i^k|_{\lambda_i^k=0} - x_i^k|_{\lambda_i^k>0} = p_i E\lambda_i^k \qquad k = h,l$$

Moreover, with fair premia for all contracts and firms choosing complete coverage, a low-risk firm always exports more than a high-risk one, or

$$x_i^l - x_i^h = p_i(E\lambda_i^h - E\lambda_i^l)$$

So, the difference between the export volumes of the two risk types basically depends on the gap between the respective average claim rates. Globally speaking, the allocation of products across foreign importers is perfectly in line with sound risk allocation.

Now we show that this is no longer true if problems of adverse selection arise in the export insurance market.

Proposition 2: *Insurance policies preventing adverse selection in the export insurance market*

(i) induce risk averse low-risk firms to export less than risk neutral exporters of the same risk type.

(ii)induce high-risk firms to export as much as risk neutral exporters of the same risk type.

Proof :

Substituting the expressions for I_i^h and I_i^l when the ratio of high- to low-risk contracts is sufficiently low (13a) and (13b) into (9) yields optimal export quantities for each risk group:

$$x_i^h|_{\beta>0} = p_i(1 - E\lambda_i^h) \tag{17a}$$

$$x_i^l|_{\beta>0} = p_i(1 - E\lambda_i^l) - p_i\frac{\alpha_i^h}{\alpha_i^l}(E\lambda_i^h - E\lambda_i^l) \tag{17b}$$

Alternatively, after plugging the values for I_i^h and I_i^l when the proportion of high- to low-risk contracts is relatively high ((16b) and (16c)) into (9), we obtain

$$x_i^h|_{\beta>0} = p_i(1 - E\lambda_i^h) \tag{18a}$$

$$x_i^l|_{\beta>0} = p_i(1-E\lambda_i^l) + p_i \frac{E\lambda_i^h - E\lambda_i^l}{1+\beta p_i^2 v_i^2}$$

$$- p_i \beta v_i^2 \frac{\sqrt{\left[\frac{E\lambda_i^h - E\lambda_i^l}{\beta v_i^2} + p_i^2(1-E\lambda_i^l)\right]^2 - \left[\frac{p_i^2 (E\lambda_i^h - E\lambda_i^l)^2}{\beta v_i^2} + (I_i^h)^2\right]}}{1+\beta p_i^2 v_i^2} \quad (18b)$$

Export volumes of risk neutral firms of the respective risk classes are given by

$$x_i^h|_{\beta=0} = p_i(1-E\lambda_i^h) \quad (19a)$$

$$x_i^l|_{\beta=0} = p_i(1-E\lambda_i^l) \quad (19b)$$

Hence, we have $x_i^h|_{\beta>0} - x_i^h|_{\beta=0} = 0$ and $x_i^l|_{\beta>0} - x_i^l|_{\beta=0} < 0$.

While the exported amount of the high-risk category remains unaffected by the presence of adverse selection, low-risk exporters experience a drop in their exports compared to the symmetric information case (this is true for both the solutions under adverse selection). This loss in competitiveness is more dramatic as the gap between expected payment-losses widens and the proportion of high- to low-risk contracts rises.

Furthermore, the partial coverage contract for the low-risk group distorts competition between domestic high- and low-risk firms since $x_i^l|_{\beta>0} - x_i^h|_{\beta>0} < x_i^l|_{\beta=0} - x_i^h|_{\beta=0}$. The natural competitive advantage low-risk firms possess shrinks as the ratio of high- to low-risk exporters in the domestic market rises. The case where a pooling equilibrium prevails in the insurance market deserves special attention. Although both high- and low-risk firms purchase the same (singly offered) policy, they still differ in terms of export performance, even though low-risk exports are drastically reduced. What is more, for specific parameter values (i.e., for $\frac{\alpha_i^{h^*}}{\alpha_i^l} > \frac{\alpha_i^h}{\alpha_i^l} > 1 + \beta p_i^2 v_i^2$), the insurance policies offered may induce low-risk firms to export even less than high-risk ones, or $x_i^l|_{\beta>0} < x_i^h|_{\beta>0}$. Such a set of insurance policies generates a risk-reversed ranking in export performance. Thanks to the information asymmetry in the insurance market, high-risk firms are relatively more competitive in the targeted market than their low-risk rivals.

The provision of export insurance leads to neutral trade creation in the absence of information asymmetries in the insurance market. Then, underdeveloped trade relations with regions reputedly characterised by a risk of default will expand. Domestic firms concluding risky deals enter the envisaged region in fair competition with their domestic and foreign rivals. Moreover, the share of risky contracts in total exports to that particular market has reached its optimal value. In addition, with local firms in the risky market facing foreign competition, consumer surplus in the foreign market will increase. Yet, once adverse selection enters into the picture, the availability of insurance contracts in the private market inevitably creates a competition bias disfavouring low-risk domestic exporters. Evidently, the set of policies offered by insurers and the export volumes chosen by firms affect the latter's certainty-equivalent profits.

Proposition 3: *Insurance policies preventing adverse selection in the export insurance market causes certainty-equivalent profits of high-risk insured firms to be at least as high compared to the symmetric information framework, while certainty-equivalent profits for low-risk firms are unambiguously lower than in the symmetric information benchmark.*

Proof :

Since, for high-risk firms, coverage levels and export quantities are the same whether adverse selection is present or not, and $r_i^h \leq E\lambda_i^h$ with adverse selection, we know that

$$(EV_i^h)^{adverse\ selection} \geq (EV_i^h)^{symmetric\ information}$$

Furthermore, we know that, at fair premium rating and at any x_i, full coverage is strictly preferred to partial coverage, implying

$$EV_i(I_i = p_i x_i)|_{x_i^+, r_i = E\lambda_i} > EV_i(I_i < p_i x_i)|_{x_i^+, r_i = E\lambda_i}$$

Hence, since only partial coverage policies are available for low-risk firms (at $r_i^l \geq E\lambda_i^l$) when there is a problem of adverse selection, we have

$$(EV_i^l)^{adverse\ selection} < (EV_i^l)^{symmetric\ information}$$

The subsequent section examines whether a single public insurer can prevent this negative side-effect of export insurance, thereby attuning this risk reduction mechanism to its role as an instrument of pure trade creation.

4. TRADE AND PUBLIC EXPORT INSURANCE

Here we concentrate on the question whether it is possible for a public insurance agency to (partly) relieve low-risk firms from the burden of the information asymmetry they are encumbered with?

For the problem formulation of a single public insurance company, we adopt the traditional type of objective function of a government institution. In this particular case, the official export insurer maximises certainty-equivalent profits of risk averse firms facing a risk of default, corrected for the subsidy costs. In other words, the public agency does not face a hard budget constraint. Because no firm should be relatively disadvantaged by the provision of insurance, the public insurer maximises net-benefits from insurance with respect to coverage for each risk category:

$$\max_{I_i^k} EV_i^k - ES_i^k \qquad k = h, l \tag{20}$$

The first order condition for coverage is then

$$E\lambda_i^k - r_i^k + \beta(p_i x_i^k - I_i^k)v_i^2 - (E\lambda_i^k - r_i^k) = 0 \qquad k = h, l \tag{21}$$

implying

$$I_i^k = p_i x_i^k \qquad k = h, l \tag{22}$$

As opposed to the low-risk contract that would be supplied in a private insurance market, a public agency should provide full coverage for both groups' export contracts. Yet, this does not imply that the resulting set of insurance contracts squeezes down to a pooling equilibrium, where the same contract is designed for all risk classes. Both risk types obtain full coverage, but the amount of coverage stipulated in the contract clearly differs, the difference being fully determined by the wedge between expected payment-losses of the different risk categories ($E\lambda_i^h$ - $E\lambda_i^l$). Alternatively, as the low-risk group faces a lower expected payment-loss than its high-risk competitors, its optimal export quantity is higher, in turn implying that the optimal insurance contract has to provide a higher coverage as well ($I_i^l > I_i^h$).

The corresponding premia set is determined in line with the incentive compatibility constraints, given earlier in (10a) and (10b). From the definition of the utility function and from the optimal coverage formula (22), the incentive compatibility conditions reduce to:

$r_i^l \geq 1-(1-r_i^h)\frac{I_i^h}{I_i^l}-\frac{1}{2}\frac{(x_i^l)^2-(x_i^h)^2}{I_i^l}$ and $r_i^l \leq 1-(1-r_i^h)\frac{I_i^h}{I_i^l}-\frac{1}{2}\frac{(x_i^l)^2-(x_i^h)^2}{I_i^l}$.

The only premium pricing scheme which satisfies both conditions is therefore given by:

$$r_i^l = 1-(1-r_i^h)\frac{I_i^h}{I_i^l}-\frac{1}{2}\frac{(x_i^l)^2-(x_i^h)^2}{I_i^l} \tag{23}$$

So, the premium gap is determined by the difference in coverage on the one hand and by the wedge in production costs (i.e., the second term of expression (23)) on the other hand. The optimal premium wedge has to be interpreted as a trade-off between the relative benefits of the provided coverage to risk averse exporters, and the difference in production costs they induce. Although the low-risk group receives a higher level of coverage, and therefore has to be charged a higher premium, it also incurs a higher cost of production, precisely because the higher coverage encourages this risk class to export more. The latter effect narrows down the premium difference. Note that the low-risk premium should not be set too high since then low-risk exporters will prefer high-risk contracts (i.e., the low-risk incentive compatibility constraint now becomes binding).

Expression (23) does, however, not indicate at what precise levels premia have to be set. If the public agency taxes low-risk policies, private insurers may become active, only offering low-risk contracts. Hence, some low-risk firms will take insurance in the private market, leaving all high-risk contracts to be insured by the public agency. To prevent this from happening, the public insurer sets low-risk premia at the zero-profit level, i.e., a fair premium ($r_i^l = E\lambda_i^l\ I_i^l$). By pinning down the low-risk premium, the premium schedule specified in (23) also allows us to calculate the premium for the high-risk category. After having derived premia for both risk groups, it is straightforward to calculate the subsidies incorporated in this menu of insurance policies for exports to region i:

$$ES_i = n_i^l(E\lambda_i^l - r_i^l)I_i^l + n_i^h(E\lambda_i^h - r_i^h)I_i^h \tag{24}$$

with n_i^k representing the number of risk-k contracts (or firms) in the total pool of underwritten policies. Having substituted the optimal values for I_i^k and r_i^k into expression (24), we obtain

$$ES_i = n_i^l\frac{1}{2}\left[p_i(1-E\lambda_i^l)^2 - p_i(1-E\lambda_i^h)^2\right] > 0 \tag{25}$$

This result clearly indicates that the presence of adverse selection in the insurance market provides a rationale for a public insurer to subsidise its export insurance schemes. What is more, the optimal amount of subsidies augments as the number of high-risk contracts increases and the gap between expected payment-losses of the risk groups widens. Intuitively, this is perfectly reasonable as the negative impact of the asymmetric information is magnified if the features of the risk groups become more pronounced, and if the number of (high-risk) firms which benefit from this second-best world increases.

How efficient is this outcome compared to the equilibrium that would be attained in a perfectly competitive private export insurance market?

Proposition 4 : *With adverse selection, the terms of insurance policies set by a public insurer, maximising certainty-equivalent profits of insured exporters net of subsidy costs, are related to the private market outcome in the following way:*

(i) $x_i^{l\ private} \leq x_i^{l\ public}$, $x_i^{h\ private} = x_i^{h\ public}$;

(ii) $EV_i^k\,(r_i^k\,,\,I_i^k)^{public} \geq EV_i^k\,(r_i^k\,,\,I_i^k)^{private}$, $k=h,l.$

Proof :

From expressions (13c), (13d), (16a), (23) and (25), we know that $r_i^{k\ private} \geq r_i^{k\ public}$ and from (13a),(13b), (16b), (16c) and (22) , it is clear that $I_i^{k\ private} \leq I_i^{k\ public}$. Hence, *(ii)* is proven.

Moreover, since $I_i^{l\ private} \leq I_i^{l\ public}$ and $I_i^{h\ private} = I_i^{h\ public}$, we know from expression (9) that *(i)* $x_i^{l\ private} \leq x_i^{l\ public}$ and $x_i^{h\ private} = x_i^{h\ public}$.

Summarising, in the private insurance market, the low-risk export group would only be offered a partial insurance contract, generating low-risk certainty-equivalent profits which are significantly lower compared to a situation where insurance is provided by a single official export insurer. This reduction in certainty-equivalent profits for the low-risk class is especially drastic if high-risk contracts are abundant compared to low-risk ones. With public insurance, this market failure is translated in subsidisation. Hence, while the cost of asymmetric information is incurred by the low-risk exporting firms in the case of private insurance, it is now entirely transferred to the public insurer. Second, high-risk exporters also gain from the provision of export insurance by a public insurance agency as opposed to the market, in the form of a higher premium subsidy. Although the private market outcome implies that they are cross-subsidised by low-risk firms (provided that the latter are sufficiently abundant), the high-risk premium subsidy required to induce firms to choose the appropriate contract is higher under the public insurance system. Since the public low-risk insurance contract is more attractive than the corresponding private one, preventing the high-risk exporters from choosing this policy has to be associated with an even lower high-risk premium.

Proposition 5: *With public insurance contracts preventing adverse selection*

(i) risk averse exporters export as much as under risk neutrality;

(ii)certainty-equivalent profits are equal for all risk categories.

Proof:

When substituting (22) in (9) we obtain (i) $x_i^k\,|_{\beta>0}^{public} = x_i^k\,|_{\beta=0}$, $k = h,l$.

Given (9) and (22), plugging (25) into the certainty-equivalent function of the high-risk group yields $EV_i^h = \frac{1}{2} p_i^2 (1 - E\lambda_i^l)^2 = p_i x_i^l (1 - E\lambda_i^l) - \frac{1}{2}(x_i^l)^2 = EV_i^l$.

Hence, *(ii)* $EV_i^l = EV_i^h = EV_i$.

An important advantage of these insurance schemes lies in the fact that both domestic firms and foreign consumers benefit from it. First, the relative export performance of domestic low-risk exporters versus high-risk firms is no longer harmed. Meanwhile, the given export insurance subsidies are of the lump sum type, implying that export quantities remain unaffected by the premium subsidies (see expression (9)). The latter only increase certainty-equivalent profit income in a direct way. The reason why a public insurance company can provide more efficient policies than the private sector mainly hinges on the fact that there is only a "soft" budget constraint for the public agency (see expression (20)). The issue of financing the official agency's activities, however, rises beyond the scope of this paper.

Second, more goods from industrialised countries are now traded with developing countries. If the domestic economy is important enough in the importing country's trade relations, consumers in the risky market may benefit from a considerable decrease in prices of imported goods.

CONCLUSION

In spite of the explicit prohibition of export insurance subsidisation by the WTO Subsidy Code, empirical studies reveal that several industrialised economies recur to this practice. While the WTO's position is based on a concern for trade distortion caused by such subsidies, we claim that under specific circumstances the latter may even prevent competitive distortions and lead to unbiased trade creation instead. More particularly, the validity of this statement rests on two conditions. First, the official insurance agency must face a problem of adverse selection. Second, the terms of insurance contracts must be determined by a non-linear premium rating scheme.

The benefits of this type of insurance are clear. Premium rates are codetermined with coverage levels which are fixed for all risk categories. Hence, a premium subsidy merely constitutes a lump sum transfer from the agency's budget to insured exporters without changing the volume of trade. As a result trade relations between domestic and foreign firms competing in the envisaged market remain undistorted. At the same time, the export performance of low-risk domestic exporters is not harmed by the information asymmetry as would be the case with private sector export insurance. Hence, under these conditions export insurance subsidies ensure that trade relations with markets characterised by a risk of default, like most poor economies, are fully developed.

One limitation of the paper is the neglect of moral hazard. Because the nature of optimal insurance contracts under this type of information asymmetry differs substantially from the policies discussed here, we have not included this issue into our analysis. Yet, this does not alter our main conclusion that the current regulation of export insurance subsidies reveals a lack of insight into the specific features of insurance as a trade policy instrument. Prohibiting export insurance subsidisation should be conditional on the type of insurance policies provided. With a system of uniform premium rating leaving firms free in their coverage choice, subsidies unavoidably lead to trade distortion and should therefore rightfully be restricted. Yet, such a restriction will impede the development of trade relations with risky markets if official export insurance is provided using non-linear premium rating to avoid adverse selection.

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