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Dealing With The Non-Marketable

A Unified Pricing Framework for Modifications of Export Credit Insurances

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Minimise risks. Maximise exports.

A whitepaper on export credit insurance pricing by

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Abstract

In this paper we propose a mathematical framework for the pricing of modifications of export credit insurances. First, we briefly introduce Export Credit Agencies and relate their mission to the resulting challenges on pricing their insurances. Next, we review existing models for the pricing of export credit insurances and subsequently address the issue of pricing modifications to those insurances in the absence of any regulatory guidelines. For this purpose, the so-called specific risk premium is introduced as a central concept. It is demonstrated that this quantity standardises the idiosyncratic risks of a unique export business with respect to other export businesses exhibiting unrelated idiosyncratic risks. As a result, our framework allows for a unified and consistent pricing of any insurance modifications across different export business cases with distinct characteristics.

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1 Introduction and Motivation

Challenges in pricing export credit insurances arise from the unique characteristics of every export business case and the inherently illiquid nature of the underlying risks, as they are not traded on financial markets. Export Credit Agencies (ECAs) play a pivotal role in international trade, providing financial support and insurance against the myriad of risks associated with exporting goods and services, especially for payment terms extending beyond two years. They uniquely bridge the gap left by commercial insurers, particularly for risks shunned by the private sector due to high exposure to trade perils. ECAs can be governmental or quasi-governmental entities and offer products such as export credit insurance, loan guarantees, and direct financing. ECAs therefore support exporters by enabling them to compete more effectively on the global stage [1].

Although ECAs' political mandate is to promote export business especially by ensuring transactions to emerging markets, a fundamental aspect of ECA operations is the concept of insurability. ECAs assess the political and economic risks involved in a transaction to determine if it meets their criteria for support. This assessment is critical, as it not only protects the interests of the exporting country but also ensures that support is extended to transactions that have a sound basis for success. Eligibility criteria for ECA support hinges on directives or laws set by respective governments, which are often in alignment with frameworks published by supranational institutions, such as the European Union (EU) and the Organisation for Economic Co-operation and Development (OECD) [2] [3].

The EU promotes the demarcation between marketable and non-marketable risks, especially as defined in the European Commission's communication on export credit insurance. **Marketable risks** are those economic and political risks that commercial insurers are willing to cover, typically involving transactions within developed markets or with a maximum risk duration of less than 24 months. **Non-marketable risks**, on the other hand, are those considered too risky or uncertain for commercial insurers to cover, often involving transactions in less developed or politically unstable regions, or with risk durations exceeding 24 months.	**The EU definitions for export risks**

Figure 1: Definition of marketable and non-marketable risks according to the European Commission.

Because of the insurability and eligibility criteria, ECAs' business models typically result in the assumption of more illiquid risks compared to commercial insurers outside the export business industry. The latter typically mitigate short-term, quantifiable exposures like property, casualty, and health risks. Commercial insurers are supported by the availability of extensive historical data and operate within well-defined, standardised regulatory frameworks, enabling accurate risk assessment and pricing [4]. Risks in traditional insurance markets are more homogeneous and can be easily transferred or hedged in established insurance and reinsurance markets, providing greater liquidity and predictability in managing and mitigating risks. Conversely, ECAs' insurance policies cover illiquid risks stemming from long-term projects, political and sovereign uncertainties, and complex project financing in emerging or less accessible markets. These risks are characterised by their unpredictable and country-specific nature, often tied to political regimes, economic development, and individual structured project arrangements, making them difficult to quantify, assess, and transfer in the open market. This fundamental difference in risk nature necessitates specialised approaches for assessing, managing, and pricing in the export credit insurance sector, highlighting the need for tailored regulatory frameworks and risk assessment methodologies [5].

2 Pricing Framework

2.1 Preliminaries

Before proceeding with the introduction of a regulatory OECD model for the pricing of export credit insurances, the central quantities that enter this model are introduced. These quantities can be categorised according to the three distinct perspectives that an ECA takes on for the pricing of a given export credit insurance, as illustrated in Figure 2.

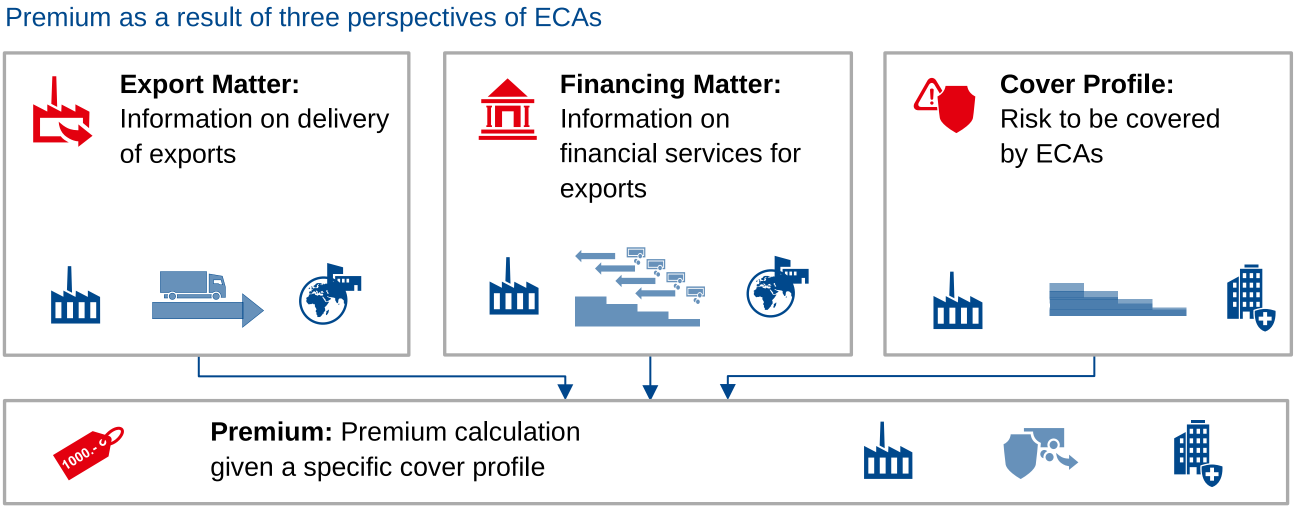

Figure 2: Three perspectives of ECAs on the pricing of a given export credit insurance.

- **Export Matter**: This encompasses all information related to the production or delivery of the exported goods. Relevant factors include the parties involved in the export transaction, dates of deliveries or services provided, and key financial data such as the contract value and the exporter's costs. Consequently, the risks related to the involved parties, the geopolitical context, and specifics of the exported good can be assessed. This assessment can be quantified via letter ratings, OECD country and buyer risk categories attributed to the risk subjects, as well as discounts or premiums due to characteristics specific to the export case.

- **Financing Matter**: This aspect includes all details that characterise the financing of the export transaction, no matter if financing is provided to the exporter themselves (e.g., working capital financing) or to the exporter's clients (e.g., supplier credit or buyer credit).
  First, the "*Disbursement Period*" (DP) is characterised by the time of initial credit usage t_0 and the time t_{SPOC} of the "*Starting Point Of Credit*" ($SPOC$), corresponding to the start of the credit disbursement and the transfer of use of the exported goods, respectively, where the transfer of use also corresponds to the end of the credit disbursement. This is the period where the credit is built up, either via bank credit or a vendor loan. For simplicity, the credit disbursement is modelled linearly over time.
  Furthermore, the repayment profile specifies the N installments CF at times t_i occurring after the SPOC, $RP = \{CF_{t_i}\}_i^N$, during the so-called "*Repayment Period*" (RPP).
  The disbursement period followed by the repayment period constitute the financing profile $FP(t)$.
  Not all export transactions involve financing in terms of loans; however, those that do not (e.g., bonds) can be often modelled as specific instances within the broader category of export cases that include financing matter, where $t_0 = t_{SPOC}$ and $N = 1$.
  In the following, only the more generic cases with disbursement period will be considered, and regular semi-annual repayments will be assumed for simplicity.

- **Cover Profile**: This third perspective introduces the cover ratio μ that determines the portion of the credit that is covered by the ECA

  $$CP(t) = \mu \cdot FP(t)$$

  The OECD considers political and commercial risks as separately insurable, which motivates the introduction of two individual cover ratios μ_p and μ_e , respectively, and the maximum of the two corresponds to the cover ratio μ.

As an example, the financing and cover profile including the disbursement period and the repayment period are illustrated in Figure 3.

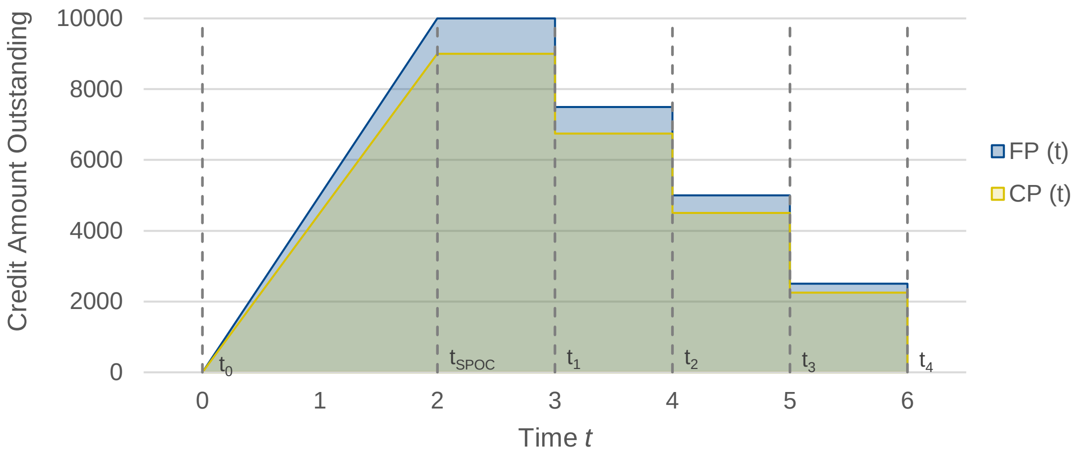

Figure 3: Exemplary profiles of a buyer or a supplier credit, with a linear credit disbursement period DP bounded by the time of initial credit usage $t_0 = 0$ and the starting point of credit $t_{SPOC} = 1$ followed by multiple repayments at times t_i ($t_1 = 3, t_2 = 4, t_3 = 5, t_4 = 6$). The financing profile is overlaid with the corresponding cover profile for a partial credit coverage ($\mu < 1$).

Finally, from the various information provided by the three perspectives introduced above, the associated premium for an export credit insurance can be determined. As will be demonstrated in the following, the premium is naturally influenced by the assessed level of risk, incorporating factors such as country risk classification, duration of credit risk exposure, and the extent of political and commercial risks covered.

2.2 Insurances

2.2.1 Minimum Premium Rates

The OECD Arrangement [6] mandates that the charged premium for an officially supported export credit must not fall below the specified Minimum Premium Rate (MPR) to adequately reflect the associated credit risk. Premiums aim to safeguard against the risk of borrowers' default on export credits. OECD members have agreed upon these minimum rates, which comply with the World Trade Organization (WTO) requirements.

OECD's key principles on export credit pricing	The Organisation for Economic Co-operation and Development (OECD) plays a crucial role in the domain of export credit insurance, through its guidelines and regulatory frameworks that govern how ECAs located in OECD member countries calculate insurance premiums for cases with long-term export credit. By establishing minimum premium rates (MPR) and ensuring that premiums are risk-based, the OECD aims to harmonise practices among ECAs, fostering fair competition and minimising market distortions. These guidelines mandate that premiums reflect the actual cost of insurance, including expected losses and administrative expenses, thereby encouraging responsible risk management, and preventing underpricing that could lead to competitive imbalances.

Figure 4: Key regulatory principles of export credit pricing for OECD member countries.

The current MPR calculations for countries rated within OECD country risk categories 1 to 7 are based on a sophisticated formula detailed in Annex VI of the Arrangement [6]:

$$MPR = \left\{\left[(a_i \cdot HOR + b_i) \cdot \frac{\max(\mu_p, \mu_e)}{0.95}\right] \cdot (1 - LCF) + \left[c_{ij} \cdot \frac{\mu_e}{0.95} \cdot HOR \cdot (1 - CEF)\right]\right\} \cdot QPF_i \cdot PCF_i \cdot BTSF \cdot TCF$$

Quantity	Description
MPR	Minimum premium rate
HOR	Horizon of risk in years
μ_p, μ_e	Cover ratios for political and economic risks, named PCP and PCC in the original OECD formula
a_i	Coefficient for political risk as a function of the OECD country risk category i
b_i	Constant depending on OECD country risk category i
c_{ij}	Buyer risk coefficient as a function of the country risk category i and the OECD buyer risk category j
LCF	Local currency factor
CEF	Credit enhancements factor
QPF_i	Quality of product factor as a function of the OECD country risk category i
PCF_i	Percentage of Cover Factor as a function of the OECD country risk category i, for cover ratios larger than 95%
$BTSF$	Better-than-sovereign factor, for buyer risk category SOV+ ("better than sovereign")
TCF	Term-correction factor for long-term debtors with non-investment-grade rating. =$[1 - min(\lambda \cdot \max(HOR - 10,0), 0.15)]$ with $\lambda = \begin{cases} 0.018, & \text{for rating } BB + \text{or worse} \\ 0, & \text{else} \end{cases}$

Table 1: Overview of variables and parameters entering the MPR formula.

The applicable country risk category i is determined by country risk experts and yields the coefficients a_i, b_i, the quality of product factor QPF_i and percentage of cover factor PCF_i as prescribed in Annex VI [6]. Similarly, the OECD buyer risk category (SOV+, SOV/CC0, CC1 - CC5)) is determined according to the OECD Arrangement and together with the country risk category yields the buyer risk coefficient c_{ij}.

Next, the horizon of risk *HOR* is calculated as sum of half of the disbursement period interval and the repayment period

$$HOR = 0.5 \cdot DP + RPP,$$

for standard repayment profiles (regular semi-annual amortisation), otherwise it corresponds to the sum of half the disbursement period interval and twice the weighted average life of the repayment period offset by a quarter of a year

$$HOR = 0.5 \cdot DP + 2 \cdot [WAL - 0.25], \qquad WAL = \frac{1}{\max[CP(t)]} \cdot \int_{t=t_{SPOC}}^{\infty} CP(t) \cdot dt.$$

Further, the buyer risk credit enhancements CEF is determined in Annex X [6], and the better-than-sovereign factor $BTSF$ is 0.9 for the buyer risk category SOV+, else 1. The local currency factor LCF can take values up to 0.2 for transaction making use of local currency risk mitigation and is 0 otherwise. Finally, the term-correction factor TCF adjusts the premium rate downwards for debtors with long-term horizons of risk (HOR > 10 years) and non-investment-grade rating (BB+ or worse). This adjustment is capped and may not exceed 15%.

In essence, the MPR formula's mathematical structure embodies a sophisticated approach to risk pricing, combining quantifiable risk factors with coefficients published by the OECD. Importantly, the above MPR formula is only applicable to countries rated in the OECD country risk categories CRC1 to CRC7[3] so that for these cases the "*Premium Rate*" (PR) of an export credit insurance is floored by the MPR.

Since the OECD only regulates minimal premiums for transactions with a repayment period longer than two years, ECAs possess the flexibility to adopt alternative models for pricing export credit insurances that fall outside the scope of the OECD Arrangement (e.g., bonds or working capital finance). The absence of a framework and minimum premium rates allows ECAs to include unique aspects and the associated risks of these insurances into their corresponding pricing models.

2.2.2 Specific Risk Premium

Given the premium rate computed from an OECD or any other non-regulatory model, one readily arrives at the total premium as follows:

$$P = B \cdot PR\,,$$

where B denotes the total credit amount, which corresponds to the maximum of the financing profile $FP(t)$.

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[3] For high-income OECD member, CRC0-rated and Eurozone countries, financing in the private market is typically accessible. In these cases, market benchmarking methodologies have to be applied to determine a minimum premium rate for export credit insurances, cf. [7] [8] [9].

The total premium will be decomposed into a "*Risk Premium*" (RP) and an "*Administrative Premium*" (AP) as follows

$$RP = \omega \cdot P, \quad AP = P - RP = (1-\omega) \cdot P\,, \qquad \omega = \ 0.8.$$

The former is a compensation for the export credit risk assumed by the ECA and the latter is attributed to the administrative expenses incurred by the ECA. Upon approval of the application for credit insurance, premiums are typically required to be paid upfront, with coverage becoming effective upon receipt of payment. The administrative premium associated with the total premium is immediately booked, while the (unearned) risk premium, which reflects the portion of the premium that corresponds to the remaining term of the policy, is accounted for as a liability in alignment with the practice of collecting premiums in advance for credit risk coverage extending into the future.

To facilitate the accurate accrual of the earned premium, the so-called specific risk premium SRP, defined as the ratio of risk premium and area of the cover profile A, is introduced

$$SRP = \frac{RP}{A} = \frac{RP}{\int_{t=-\infty}^{\infty} \; CP(t) \cdot dt},$$

which corresponds to the risk premium per time unit and credit amount unit and allows the quantification of the earned risk premium $ERP(t)$ at time t as follows

$$ERP(t) = SRP \cdot \int_{t\prime=-\infty}^{t} CP(t') \cdot dt'.$$

The unearned risk premium $URP(t)$ at time t is the difference of the total risk premium and the amount already earned thereof until time t:

$$URP(t) = RP - ERP(t) = \ SRP \cdot \int_{t\prime=t}^{\infty} CP(t') \cdot dt'.$$

It is noteworthy that the (un)earned risk premium is, in general, not linear with respect to the coverage duration but also accounts for the dynamically varying credit amount.

In summary, the specific risk premium SRP can be interpreted as a risk premium density that standardises the idiosyncratic risks captured by the export matter through quantification of the risk premium that is due for every unit of risk area. As demonstrated in the following, this concept enables the formulation of a unified pricing framework for modifications to the insurances after their inception across the vast range of different export business cases with distinct risk characteristics.

2.3 Modifications of Insurances

2.3.1 General Theory

The applicability of the specific risk premium is not restricted to the accrual of earned risk premium but extends to the pricing of all export credit insurance modifications. Through the lenses of the three perspectives on an export business case (cf. Figure 2), these contractual amendments can be categorised into two classes. First, the export matter specifics may have changed, resulting in an altered financing matter, e.g., a different repayment schedule. Secondly, the insurance policy holder may change the coverage due to an updated risk assessment, which would be reflected by a modified $\widetilde{SRP}$. Crucially, all these cases can be modelled in a unified way via modified cover profiles $\widetilde{CP}(t)$ due to the modification at time t_m.

For simplification, in the following we assume an unchanged risk assessment, corresponding to a constant SRP. In this case, the change in risk premium, ΔRP, entailed by the insurance modification is calculated as the difference of the unearned risk premiums associated with the modified and initial cover profiles, $\widetilde{CP}(t)$ and $CP(t)$, at the modification date t_m as follows

$$\Delta RP = \widetilde{RP} - RP = SRP \cdot \int_{t=-\infty}^{\infty} \left[\widetilde{CP}(t) - CP(t)\right] \cdot dt = SRP \cdot \int_{t=t_m}^{\infty} \left[\widetilde{CP}(t) - CP(t)\right] \cdot dt$$
$$= \widetilde{URP}(t_m) - URP(t_m) = SRP \cdot \left[\tilde{A}(t_m) - A(t_m)\right] = SRP \cdot \Delta A(t_m).$$

Here, $A(t_m)$ and $\tilde{A}(t_m)$ denote the area enclosed by $CP(t_m)$ and $\widetilde{CP}(t_m)$, respectively, where for brevity, we introduced the notation $CP(t_m) \equiv CP(t \geq t_m)$ and $\widetilde{CP}(t_m) \equiv \widetilde{CP}(t \geq t_m)$ for the initial and modified cover profile after the date of the modification t_m, respectively. To derive the total change in premium ΔP, the case of a risk premium surcharge, $\Delta RP > 0$, and risk premium refunding, $\Delta RP < 0$, needs to be distinguished.

For the former, the change in the above-introduced administrative premium, ΔAP, is added to the risk premium surcharge

$$\Delta P = \Delta RP \ + \ \Delta AP,$$

while for the latter the administrative deduction AD is added to the risk refunding

$$\Delta P = \Delta RP \ + AD.$$

In summary, it holds that[4]

$$\Delta P = \begin{cases} \dfrac{\Delta RP}{\omega} & \text{if} \quad \Delta RP > 0 \\ \Omega \cdot \Delta RP & \text{if} \quad \Delta RP < 0 \end{cases}, \qquad \Delta AP \ = \ (1 \ - \ \omega) \cdot \Delta P\,, \qquad AD \ = \ (1 \ - \ \Omega) \cdot |\Delta P|.$$

[4] The administrative reduction is conceptionally different from the change in administrative premium as it only applies for a (risk) premium refunding. The factor Ω specifies the fraction of the absolute value of the total premium change the administrative reduction corresponds to. It is important to note, that the factor Ω is generally different from the above-introduced factor ω.

2.3.2 Premium Financing

The premium surcharge $\Delta P > 0$ can also be insured. Mathematically, this iterative process amounts to adding the computed premium surcharge to the credit amount starting from the date of modification t_m, thereby increasing both the financing and cover profile for times $t \geq t_m$. The new premium surcharge resulting from the increased cover profile area is then recomputed, which in turn further increases the credit amount and this process repeats indefinitely with monotonously decreasing, additional premium surcharges. The result of these iterations is the convergent premium surcharge including the insurance of itself, ΔP_{ins}, and the corresponding modified cover profile area $\tilde{A}_{ins}(t_m)$. These quantities can be formally related to the premium surcharge and modified cover profile area without premium insurance via scaling factors $\kappa_{\Delta P}$ and $\kappa_{\tilde{A}(t_m)}$:

$$\Delta P_{ins} = \kappa_{\Delta P} \cdot \Delta P \; ,$$

$$\tilde{A}_{ins}(t_m) = \kappa_{\tilde{A}(t_m)} \cdot \tilde{A}(t_m) \; .$$

For consistency, it is first required that the specific risk premium does not change under the insurance of the premium surcharge since the intrinsic risks of an export transaction that are encoded in the specific risk premium should be unaffected by the premium insurance. Secondly, by definition, the increase of the total credit amount must be equal to ΔP_{ins}. Using these two boundary conditions, the two-dimensional equation system from above admits a mathematically unambiguous solution

$$\Delta P_{ins} = \frac{1}{1 - \frac{\mu \cdot SRP \, \cdot \, \tilde{A}(t_m)}{\omega \cdot \max\left[\widetilde{CP}(t_m)\right]}} \cdot \Delta P \; \geq \Delta P \; ,$$

$$\tilde{A}_{ins}(t_m) = \left[1 + \kappa_{\Delta P} \cdot \frac{\mu \cdot \Delta P}{\max\left[\widetilde{CP}(t_m)\right]}\right] \cdot \tilde{A}(t_m) \geq \tilde{A}(t_m) \; .$$

We note that in the limiting case $t_m \to -\infty$, where a modification mathematically corresponds to the initial pricing of an insurance, the well-known results [8][9] for the insurance of a premium due at inception of the insurance are recovered

$$P_{ins} = \frac{1}{1 - PR} \cdot P \; \geq P,$$

$$A_{ins} = \frac{1}{1 - PR} \cdot A \geq A.$$

2.3.3 Typical Examples

Following the theoretical exploration of how to price modifications of insurances after their inception, we now proceed with practical examples. This section aims to illustrate the concepts discussed earlier, providing tangible instances of how they are applied in real-world scenarios. To this end, we consider three common cases: The increase of risk coverage of the policy holder (cover perspective), the extension of the repayment period due to a change in the export matter specifics and the premature termination of an insurance due to the availability of alternative financing options such as an early repayment (financing matter).

Increased Risk Coverage

As a simple example, we consider the case of an initial cover profile with an instantaneous disbursement followed by a single repayment. At the modification time $t_m = 3$ the cover profile is elevated from an amount of 9000 to 10000[5] corresponding to a relative increase by 11.11%, as illustrated in Figure 5. Consequently, an additional risk premium is required as an adequate compensation for the increased risk coverage by the ECA.

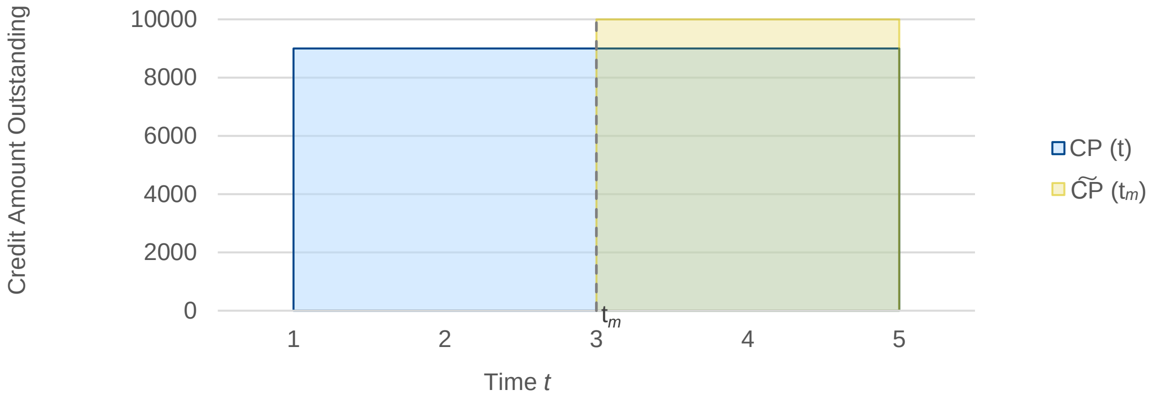

Figure 5: Comparison of the initial cover profile $CP(t)$ and the modified cover profile $\widetilde{CP}(t_m)$ that results from an insurance modification valid from time $t_m = 3$. The modification corresponds to an increased risk coverage from an amount of 9000 to 10000.

Let $SRP = 0.05$, the risk premium due to the modification at t_m then reads

$$\Delta RP = SRP \cdot [\tilde{A}(t_m) - A(t_m)] = 0.05 \cdot (20000 - 18000) = 100,$$

which in turn implies for the total and administrative premium

$$\Delta P = \frac{\Delta RP}{\omega} = \frac{100.0}{0.8} = 125, \qquad \Delta AP = \Delta P - \Delta RP = 25.$$

[5] For simplicity, quantities are considered dimensionless.

Extension of repayment period

Next, we consider a case of increased complexity involving a disbursement period and multiple repayments. In this case, the repayment period is extended by deferring all time-periodic repayments $CF(t_i)$ of amount 2500 at times t_i $(i = 1,2,3,4)$ by one repayment time interval $t_{i+1} - t_i = 1$, as shown in Figure 6. Again, an additional risk premium is required to compensate the ECA for its increasing risk coverage.

Let $SRP = 0.05$, the risk premium due to the modification then reads

$$\Delta RP = SRP \cdot \left[\tilde{A}(t_m) - A(t_m)\right] = 0.05 \cdot (25000 - 15000) = 500,$$

which in turn implies for the total and administrative premium

$$\Delta P = \frac{\Delta RP}{\omega} = \frac{500.0}{0.8} = 625, \qquad \Delta AP = \Delta P - \Delta RP = 125.$$

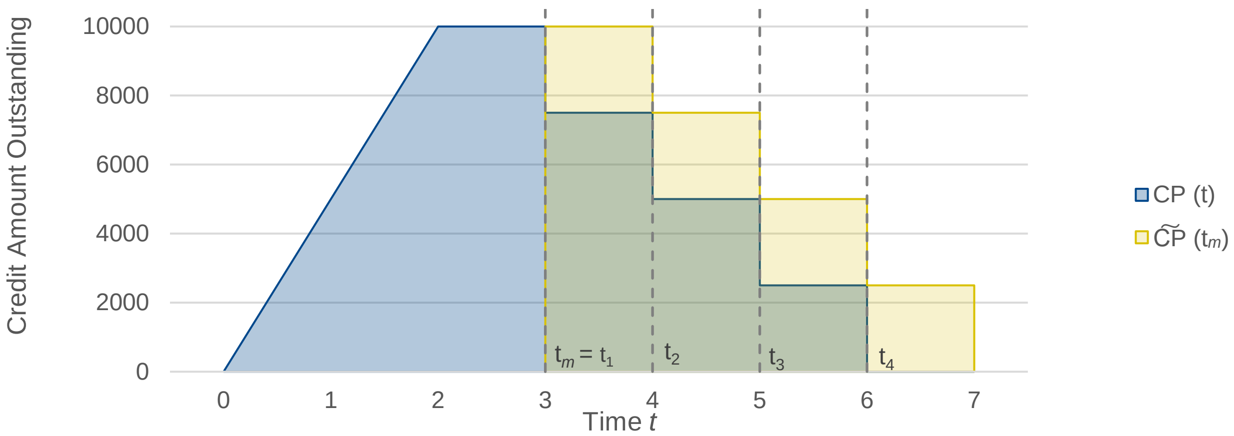

Figure 6: Comparison of the initial cover profile $CP(t)$ and the modified cover profile $\widetilde{CP}(t_m)$ that results from an insurance modification valid from time $t_m = 3$.The modification corresponds to an increased coverage through extension of the repayment period that homogenously defers all time-periodic repayments $CF(t_i)$ of amount 2500 at times $t_i(t_1 = 3, t_2 = 4, t_3 = 5, t_4 = 6)$ by one repayment time interval $t_{i+1} - t_i = 1$.

Premium Insurance. Additionally, let us suppose that for this modification the premium surcharge itself should also be insured. Using the generic formulas from above and assuming a cover ratio of $\mu = 1$, we find for the scaling factors of the premium surcharge and cover profile area, respectively,

$$\kappa_{\Delta P} = \frac{1}{1 - \dfrac{\mu \cdot SRP \cdot \tilde{A}(t_m)}{\omega \cdot \max\left[\widetilde{CP}(t_m)\right]}} = \frac{1}{1 - \dfrac{1.0 \cdot 0.05 \cdot 25000}{0.8 \cdot 10000}} = 1.19,$$

$$\kappa_{\tilde{A}(t_m)} = 1 + \kappa_{\Delta P} \cdot \frac{\mu \cdot \Delta P}{\max\left[\widetilde{CP}(t_m)\right]} = 1 + 1.19 \cdot \frac{1.0 \cdot 625}{10000} = 1.07,$$

which implies for the total premium surcharge including the insurance of itself

$$\Delta P_{ins} = \kappa_{\Delta P} \cdot \Delta P = 625 \cdot 1.19 = 740.74\,.$$

To consistently reflect the increase of the credit amount by total premium surcharge amount, the height of the modified cover profile must be scaled by the scaling factor $\kappa_{\tilde{A}(t_m)}$, as demonstrated in Figure 7.

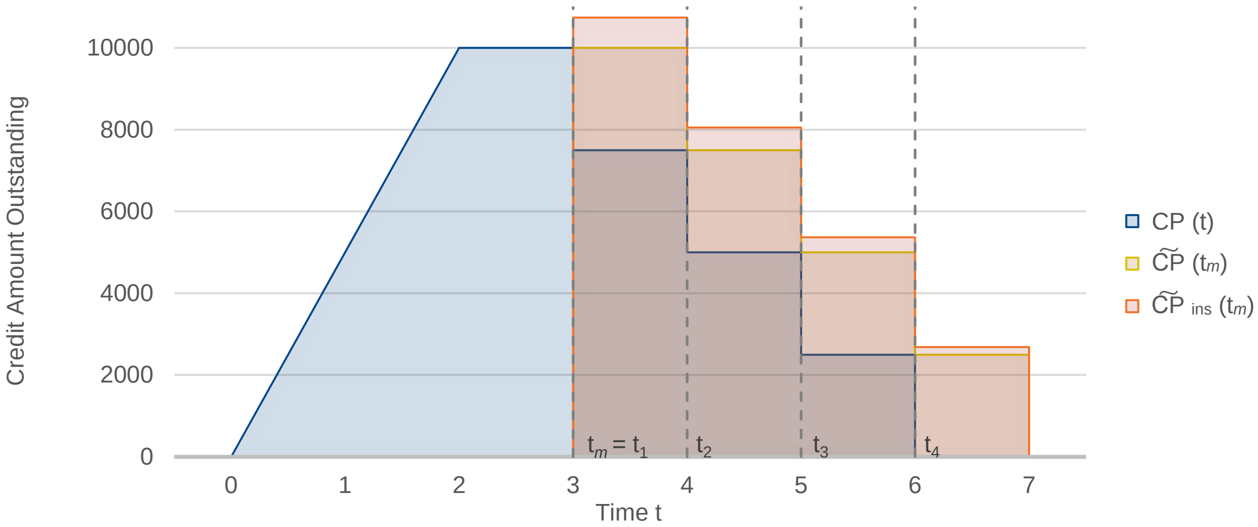

Figure 7: Comparison of the cover profiles from Figure 6 and the modified cover profile including the insurance of the total premium surcharge $\widetilde{CP}_{ins}(t_m)$ due to the modification valid from time $t_m = 3$.

Premature Insurance Termination

Lastly, Figure 8 depicts the termination of an active insurance at time t_m that amounts to a decreased coverage. A risk premium refund for the policy holder is therefore required to adequately reflect the decreased risk coverage by the ECA.

In this case, the risk premium due to the modification then reads

$$\Delta RP = SRP \cdot \left[\tilde{A}(t_m) - A(t_m)\right] = 0.05 \cdot (0 - 11250) = -562.5,$$

which in turn implies for the total premium and the administrative deduction

$$\Delta P = \Omega \cdot \Delta RP \;\; = -450, \qquad AD = \Delta P - \Delta RP = 112.5,$$

where we assumed that $\Omega = 0.8$.

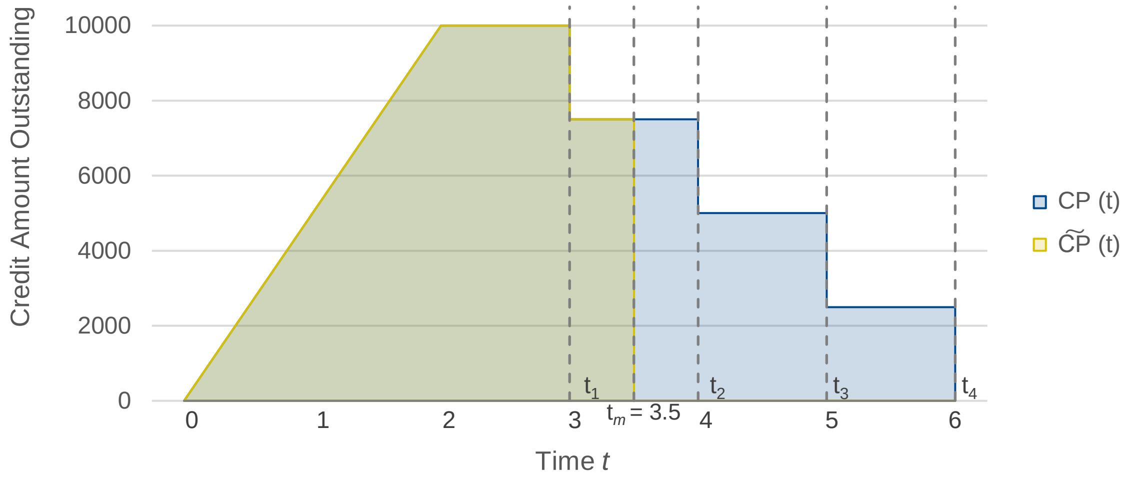

Figure 8: Comparison of the initial cover profile $CP(t)$ and the modified cover profile $\widetilde{CP}(t)$ that results from an insurance modification valid from time $t_m = 3.5$. The modification represents a full repayment of the remaining outstanding credit amount of 7500 at time t_m, corresponding to early repayments of all payments $CF(t_i)$ of amount 2500 at times $t_i(t_2 = 4, t_3 = 5, t_4 = 6)$ at time $t_m = 3.5$.

3 Conclusion and Outlook

This paper explored the intricate problem of ECAs' export credit insurance pricing. We presented a consistent and unified framework to price export credit insurance modifications. Central to the framework is the specific risk premium, a quantity that represents a premium density in the corresponding credit risk coverage space, allowing for a standardised treatment across all types of insurance policies and types of modifications. We hope that this work can contribute to a sound understanding for the challenges export credit agencies face when pricing export credit insurances and provide some guidance of how to navigate through areas where no established regulatory model exists. By laying out a universal framework and showcasing its applicability to real-world scenarios, we aim to advocate for a harmonised approach throughout the ECA world.

We add that a consistent mathematical framework is a prerequisite to build an application to automate the export credit insurance pricing. The integration of such an application into the digital infrastructure of ECAs in turn ensures higher efficiencies and reduced operational risks. As we furthermore look forward, the intersection of finance and technology holds promise for revolutionising how ECAs assess risk and price insurance products. Emerging technologies like data analytics, artificial intelligence, and machine learning stand to offer new insights, enabling more dynamic, responsive, and equitable pricing strategies.

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Tim Herpich has been a consultant in the financial services industry since 2020, holds a PhD in theoretical physics, and has an MBA. He gained insights into the risk assessment methodologies employed at both private and quasi-governmental insurers and brings a wealth of knowledge in the management of market and non-market risks. He successfully led a project at SERV that developed an application specifically designed to automate the pricing of its export credit insurances.

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Aurelio Caliaro, master's in business administration from the University of Zurich, CFA Charterholder, works as Senior Analyst for SERV since 2009.
At the Risk Analysis department, he is responsible for assessing and structuring SME and Project Finance Transactions. With this, he brings a long-term experience with the realities of this market and its challenges. Since 2019, he is also responsible for the conceptual development, evolvement, and technical implementation of the pricing of SERV's export finance insurances and as such developed the framework behind pricing SERV transactions and their changes.

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Heribert Knittlmayer holds a PhD in economics and started his ECA career in 2005 at SERV. He gained comprehensive ECA experience in various positions such as Head International Relations and Chief Insurance Officer with SERV. As Chief Operating Officer, Heribert Knittlmayer initiated SERV's digital strategy and was primarily responsible for a major IT-transformation project.

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