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* Views expressed are those of the author and do not necessarily reflect official positions of De Nederlandsche Bank.

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Loss shocks and the quantity and price of private export credit insurance: Evidence from a global insurer*

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Abstract

Private trade credit insurance - covering the risk of non-payment - plays an important role in facilitating domestic and international trade, especially within Europe. Due to lack of data, however, very little is known about the influence of shocks on the market for private trade credit insurance. This paper studies the influence of claims on the availability and price of export credit insurance, using unique bilateral country-level data covering worldwide insurance underwriting by a global trade credit insurer from 1992 to 2006. Country-pair and time-varying country fixed effects allow me to control for bilateral heterogeneity and country-specific insurance supply-and-demand shocks in both exporting and destination countries. In doing so, I find that a doubling of claims results, on average, in a decline in the share of bilateral exports insured by about 11% and rise in premium level by about 4%. These claims effects increase when the insurer makes a loss and further rise with the size of the loss. I also find evidence indicating that the global trade credit insurer transmits extreme losses across countries by reducing its supply of export credit insurance. Overall, these results help our understanding of potential trade finance constraints in times of crisis, such as during the 2008-09 global trade collapse.

Keywords: trade credit insurance, export credit insurance, claims, international trade.
JEL classifications: F14, G01, G22.

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1 Introduction

For decades, developments in the market for trade credit insurance remained largely unnoticed to policy makers and the wider public. For example, the structural change within the European Union (EU) – where public export credit agencies were restricted and the market for private short-term trade credit insurance developed into a multi-billion business – took place silently since the late 1990s.[1] As a result of this change, export credit insurance covering the risk of non-payment on short-term trade transactions within the EU is now generally provided by private insurers (Morel, 2011). Worldwide, private trade credit insurers – "niche" players within the broader market for trade finance – covered EUR1.97 trillion of international and domestic trade in 2013 (ICISA, 2014).

Developments in trade credit insurance did make it to the global policy agenda during the 2008-09 global trade collapse. In 2008, private trade credit insurers faced a rapidly deteriorating risk environment and a doubling of their claims (Figure 1). As a reaction, they cut back on their insurance supply and raised premium rates. On the demand side, there were opposing influences. The decline in global demand reduced world trade and thereby the need for export credit insurance, while at the same time, there was high demand from exporters for credit insurance protection (Morel, 2011). These circumstances fuelled the debate on a possible gap in the supply of short-term export credit insurance which led to the G-20 call on public export credit agencies to fill the perceived gap.[2] Yet, the extent of the "hard market" – an insurance market characterised by a limited availability of insurance and higher premium rates – in short-term export credit insurance was difficult to assess. Real time figures on the quantity and premium level of private export credit insurance are publicly unavailable and research on the conduct of private trade credit insurers did not exist.[3]

This paper is the first to study the effect of claims incurred by a global trade credit insurer on its quantity and price of export credit insurance. Using a unique bilateral country-level data set on the global insurance underwriting by one of the "Big Three" trade credit insurers, I show that a temporary increase in claims results in a decline in quantity and rise in premium level of export credit insurance. Holding other things constant, on average, a doubling of claims results in a decline in the share of bilateral exports insured of about 11% and rise in premium level of about 4%. The price effect disappears in the year following the claims increase, while the quantity effect persists somewhat longer and dies away in the second year following the rise in claims.

These benchmark findings are consistent with the features of the global private trade credit

insurance market. In general, this market is characterised as an oligopoly where the Big Three global insurers (Euler Hermes, Atradius, and Coface cover 86 percent of the world market) offer relatively homogeneous insurance policies, compete heavily on price, and can (very) easily adjust their exposure (see e.g. Becue, De Smet and Volcke, 2012; Becue, 2013). Indeed, the short-term nature of trade credits covered, in combination with the unique ability to dynamically adjust their potential exposure on *existing* insurance policies (Swiss Re, 2006), allows private trade credit insurers to reduce their exposure quickly and significantly in case of a loss shock.

Subsequently, I find that the benchmark claims effects increase when the insurer is making a loss and further rise with the size of the loss. A doubling of the claims in the subsample of losses is associated with a decline in the share of exports insured of 20% and rise in premium level of 8%; about double the size of the benchmark effects. These claims effects rise even further – to about triple the size of the benchmark effects – when the subsample of losses is limited to only include losses above the median loss amount. Finally, and analogous to international shock transmission by global banks (see i.e. Cetorelli and Goldberg, 2011; De Haas and Horen, 2012), I find evidence indicating that the global trade credit insurer transmits extreme loss shocks – the 97.5^{th} percentile losses – across countries via a reduction in its supply of export credit insurance. Overall, these results support the idea that loss shocks can temporarily reduce the availability and increase the price of private short-term export credit insurance, consistent with a hard market.[4]

The insurance literature provides two possible explanations for the link between claims and the quantity and price of insurance. Capital shock theories formalize the idea that a loss shock negatively affects an insurer's capital, and temporarily constrains the capacity to write coverage until higher premium rates allow capital to be built up again from retained earnings (Winter, 1994; Cummins and Danzon, 1997). Alternatively, Lai et al. (2000) show that an adverse change in expectations about future losses could also cause a hard market. Based on the benchmark results, I cannot assess whether it is changing expectations about future claims or actual losses depleting the trade credit insurer's capital that cause insurance supply to constrict and premiums to rise. The evidence on the international transmission of extreme loss shocks, however, suggests a role for capital constraints.

I use a fixed effects (FEs) approach to examine the claims effect on the quantity and price of private export credit insurance, and separately estimate a quantity and price equation. The data set includes yearly observations on exports covered with export credit insurance, premium income

received, and claims paid, covering 25 exporting and 183 importing countries from 1992 to 2006. These bilateral panel data allow me to identify the claims effect on the insurer's share of bilateral exports insured and premium level of export credit insurance *within* a pair of countries over time (i.e. I include country-pair FEs), while ruling out the influence on insurance underwriting of factors other than claims by including time-varying exporter and importer FEs. Basically, the time-varying FEs sweep out all country-specific insurance supply-and-demand shocks (e.g. those related to business cycle fluctuations) in both exporting and destination countries. Notably, since the demand for export credit insurance *relative* to the total value of bilateral exports tends to increase in adverse economic circumstances (when claims increase), the estimated decline in the share of exports insured in case of a loss shock is likely to be supply-driven.

This study builds on and aims to contribute to the literature on insurance underwriting (see for an overview Weiss, 2007; Harrington, Niehaus and Yu, 2013). The focus on private trade credit insurance is novel. An advantage of examining this line of insurance is that, in addition to claims and premium income, I can also exploit information on the *quantity* of insurance cover. This overcomes a key issue encountered in the existing empirical literature on insurance underwriting, where the insurance package – the price and quantity of coverage – is generally not observed (see i.e. Weiss, 2007).[5] The private export credit insurance data allows me to examine the direct link between claims and both the quantity and price of insurance. That is, I estimate the elasticity between the claims ratio (claims over premium income) and the share of exports insured (insured exports over total exports) on the one hand, and the elasticity between the "claims level" (claims over insured exports) and the premium level (premiums over insured exports) on the other. Doing so, I show that claims influence both the quantity and price of insurance. Moreover, the results suggest that, within the market for private trade credit insurance, the negative quantity effect of a loss shock generally dominates the positive price effect in terms of size and duration.

Finally, this paper relates to the literature that studies the role of trade finance constraints to the 2008-09 global trade collapse. In a key contribution, Amiti and Weinstein (2011) show that banks transmit financial shocks to exporters via a reduction in trade finance. More recently, Niepmann and Schmidt-Eisenlohr (2013) find that shocks to the supply of letters of credit – a bank-intermediated instrument to reduce risk in international trade – affect exports. While the data on private export credit insurance do not cover the period of the global trade collapse, I find that loss shocks (like the

doubling of the industry's claims ratio in 2008) affect the supply of insured exports at all times.[6] Although far from being conclusive, these results hint that a reduction in the availability of private export credit insurance was part of the trade finance constraints during the global trade collapse.

In what follows, I briefly review the literature that explains the economics of insurance markets following a loss shock, and describe how underwriting measures by trade credit insurers in case of a loss shock relate to the general features of the global trade credit insurance market (Section 2). In Section 3, I discuss the empirical strategy and data. The benchmark results on the average effect of claims on the quantity and price of private export credit insurance are discussed in Section 4, followed by sensitivity analysis in Section 5. Section 6 examines the quantity and price effect of losses, and international transmission effects of extreme loss shocks. Section 7 concludes.

2 Loss shocks and insurance underwriting: theoretical notions

I examine the link between claims incurred by a private trade credit insurer and the quantity and price of its supply of export credit insurance. To understand potential mechanisms at work, in this section I first shortly review the literature that explains the economics of insurance markets following a loss shock. Subsequently, I describe some general features of the global trade credit insurance market – in particular the unique ability of private trade credit insurers to dynamically adjust their exposure on existing insurance policies – and how these relate to the underwriting measures taken by trade credit insurers in case of a loss shock.

2.1 Loss shock theories

Several studies within the insurance literature examine the tendency of the quantity of insurance supplied to decline and insurance prices to rise following adverse shocks. So far, this pattern is shown to apply in the market for liability insurance (Gron, 1994; Winter, 1994; Cummins and Danzon, 1997; Lai et al., 2000) and catastrophe reinsurance (Froot and O'Connell, 1999), and perhaps also occurs in the market for private trade credit insurance. The notion that insurance markets can go through periods of limited capacity and higher premium rates – a "hard market" – following a loss shock is theoretically well established. Yet, different theories for the underlying mechanism exist. Cummins and Lewis (2003) postulate that most of the literature assumes that hard markets in response to loss shocks are driven by 'some combination of' three factors: capital market imperfections, probability updating, and correlated losses.

First, Winter (1994) formalizes the idea that an increase in claims – a loss shock – negatively affects an insurer's capital, and temporarily constrains the capacity to write coverage until higher premium rates allow capital to be built up again from retained earnings. In Winter's model, it is assumed that insurers cannot simply raise new capital following a loss shock because external capital is more costly than internal capital (i.e. capital market imperfections). Alternatively, the market value of equity might decline after new capital is raised if it is expected that this new capital is also used to cover unsettled claims on prior policies, on which no additional premiums can be collected.[7]

Second, an unexpected loss shock might also increase the insurer's and potential policy holders' expectation of future losses (i.e. probability updating; Froot and O'Connell, 1999). As a result, Lai et al. (2000) show that insurance supply is restricted while insurance demand increases. While both these changes lead to premium increases, the effect on the quantity of insurance is ambiguous. Froot and O'Connell (1999) find absolute declines in the quantity of reinsurance following a loss shock, showing that supply rather than demand shocks are more important for understanding the effect of losses on prices and quantities in their catastrophe reinsurance pricing study. Notably, a situation of restricted supply and increased demand seems to have been characteristic of the private trade credit insurance market during the 2008-09 global trade collapse (see the Introduction).

Finally, and closely related to probability updating, the extent to which losses are positively correlated exacerbate any changes in the quantity and price of insurance resulting from a loss shock (Froot and O'Connell, 1999; Lai et al., 2000). Positive correlations among losses are likely to be an important driver of developments in private trade credit insurance markets. Claims tend to rise during business cycle downturns (Swiss Re, 2006), which are generally transmitted across, or simultanuously hit, countries and industries.

2.2 Underwriting measures by trade credit insurers in case of a loss shock

The big three global trade credit insurers (Euler Hermes, Atradius, and Coface) have risk portfolios covering several millions of firms, broadly diversified across countries and sectors. In case of a deteriorating risk environment they can take a number of underwriting measures to keep aggregate risk in line with their equity capital and risk tolerance. These measures are targeted at the buyers with whom the policy holders trade (*buyer* underwriting) and the terms and conditions of the insurance policies (*policy* underwriting). The contingency actions aim to limit the rise of the claims ratio during normal business cycle downturns as well as major credit events (e.g. a large scale default) or

a widespread credit crisis. Depending on the shock, the scope of measures can vary from tailor-made adjustments in insurance cover at the individual firm level, to fast and more rigorous cover and policy adjustments across countries and sectors.

The trade credit insurers' key risk management tool is their ability to dynamically manage their maximum potential exposure – the "credit limits" – on individual buyers. Private trade credit insurers generally offer *whole turnover* policies, covering all of a firm's trade receivables, including the good risks.[8] The trade credit insurer, however, retains the right to reduce or cancel a granted limit on any particular buyer at any given time. When a buyer is facing financial difficulties – perceived e.g. by late payments, which the policy holder is obliged to notify to the insurer (Becue, 2013) – a trade credit insurer can immediately reduce the policy holder's credit limit on the buyer to the amount of the outstanding invoices. This way, new orders are no longer covered by the insurance policy.

In combination with the short-term nature of trade credits covered, the ability to set and manage credit limits gives trade credit insurers 'a degree of control over risk exposures that distinghuishes credit insurance from other kinds of insurance and from many other credit instruments (Swiss Re, 2006).' Essentially, dynamic limit management is at the core of contingency measures by trade credit insurers targeted at buyer underwriting. These buyer underwriting measures generally involve: identification and reduction of weak country and sector exposures, exit of bad risks and reduction of weak risks at the individual firm level based on internal buyer ratings, structured review of high exposures, adjustment of the buyer acceptance rate, and improvement of the recovery success rate in key markets.

A second set of measures to limit the rise of the claims ratio is aimed at policy underwriting. These measures involve price increases to reflect hightened risks, cancellation and/or restructuring of loss making policies, strict selection of new clients, and stricter policy conditions when existing contracts are renewed. Aside from premium rate adjustments, trade credit insurers can change a number of other non-price conditions attached to insurance policies, such as the percentage of self-retention, claims deductibles, and aggregate first losses.

Importantly, whereas trade credit insurers can immediately reduce their exposure via credit limit adjustments, the premium rate and other non-price conditions cannot be adjusted in the policy period. Notably, the majority of trade credit insurance policies are renewed on an annual basis (Jones, 2010). Also, even though trade credit insurers can differentiate between the terms and

conditions attached to their insurance policies, they offer relatively homogeneous policies, as e.g. described in a white paper by Becue, De Smet and Volcke (2012, p. 72):

> "Credit insurance has shown the features of a commodity for many years. The differences between the credit insurers have been reduced in such a way that the products are experienced as identical. The commodification only emphasises the price. The credit insurers therefore urgently need to come up with differentiation strategies."

As a result, the scope for a unilateral rise in premium rates to increase an insurer's overall premium income is limited. Indeed, the world trade credit insurance market is generally characterised as an oligopoly with strong price competition (Becue, 2013). Notably, in the two-year period from 2005 to 2007 the average (global) premium rate declined by 29 percent (see Figure 1).

Finally, trade credit insurers smooth the impact of a loss shock by transferring risk through the use of reinsurance, and by the release of reserves. Reinsurance works as a substitute for capital and is heavily used by trade credit insurers. According to Swiss Re (2006), the global insurers cede about half of their business to reinsurers. Losses are also partly absorbed by a release of the equalisation reserve, which is build up in years when an insurer makes a profit.[9] Accounting for reinsurance capacity, the (net) exposure of the global insurers in 2013 was about 200 times the value of their shareholders' equity.[10] The relatively small capital base underlines the importance of dynamic limit management to quickly reduce exposure and so limit the rise of the claims ratio in adverse circumstances.

Overall, the characteristics of the private trade credit insurance market are vividly described in Becue, De Smet and Volcke (2012, p. 54-55):

> "The credit insurance market is characterised by an oligopoly. A few large players cover 85% of the market. They know each other and watch each other like hawks. Strong competition leads to razor sharp prices. That is good in itself but it also removes the important margins. The sector cannot build up sufficient reserves. At the slightest setback the credit insurers get frightened. [...] When the situation is bad, credit limits are withdrawn so that less cover is given. This makes it possible to survive, however at the expense of the client."

Given the general features of the private trade credit insurance market – in particular the unique ability of trade credit insurers to dynamically adjust their potential exposure on existing insurance policies – one would, on average, expect larger quantity than price adjustments in private trade credit insurance in case of a loss shock.

3 Empirical strategy and data

I aim to identify whether an increase in claims paid by a private trade credit insurer leads to a decline in the quantity and rise in the price of its supply of export credit insurance. To absorb the influence on insurance underwriting of factors other than claims, I rely on a fixed effects approach (see i.e. Khwaja and Mian, 2008). Subsequently, I employ the following two specifications:

Quantity equation

$$\ln(ShareExportsInsured_{ijt}) = \alpha_0 + \alpha_1 D_{ij} + \alpha_2 D_{it} + \alpha_3 D_{jt} + \beta_1 \ln(ClaimsRatio_{ijt}) + \varepsilon_{ijt} \quad (1)$$

Price equation

$$\ln(PremiumLevel_{ijt}) = \alpha_4 + \alpha_5 D_{ij} + \alpha_6 D_{it} + \alpha_7 D_{jt} + \beta_2 \ln(ClaimsLevel_{ijt}) + \gamma_{ijt} \quad (2)$$

where i denotes the exporting country, j denotes the importing country, t denotes time in years, ln(.) denotes the natural logarithm operator, and the variables are defined as:

- $ShareExportsInsured$ is calculated as insured exports over FOB exports from i to j, and is referred to as the share of exports insured,
- $ClaimsRatio$ is calculated as claims divided by premiums on insured exports from i to j,
- $PremiumLevel$ is calculated as premiums divided by insured exports from i to j,
- $ClaimsLevel$ is calculated as claims divided by insured exports from i to j,
- D are country-pair (ij), exporter-year (it), and importer-year (jt) dummy variables,
- ε and γ are omitted influences on the share of exports insured and the premium level respectively, assumed to be well behaved.

The parameters of interest are β_1 and β_2. These represent the effect of claims on the quantity and price of private export credit insurance, and are identified within country-pair variation over time. I estimate the equations with OLS, using a robust covariance estimator (clustered by country-pair dyads) to handle heteroskedasticity.

Importantly, the identification strategy hinges on the inclusion of comprehensive sets of fixed effects. For instance, I include a set of country-pair fixed effects (i.e. a mutually exclusive and jointly

exhaustive set of $\{D_{ij}\}$ intercepts) to absorb all time-invariant characteristics that are common to a pair of countries and influence the share of exports insured (such as distance). I also add comprehensive sets of time-varying exporter and importer fixed effects (i.e. sets of $\{D_{it}\}$ and $\{D_{jt}\}$) to sweep out all country-specific insurance supply-and-demand shocks in both exporting and destination countries. Notably, these time-varying country fixed effects account for the influence of the business cycle on insurance underwriting in both exporting and importing countries. This assures that the claims ratio or claims level, which tends to rise (fall) during business cycle downturns (upturns), does not pick up business cycle fluctuations. In this regard, it is also important to note that the dependent variable in the quantity equation measures the *share* of exports insured. Whereas a business cycle downturn in a destination country can be expected to simultaneously lead to a rise in claims and an absolute decline in the need for export credit insurance due to lower import demand from the destination country, this does not influence the share of exports insured since both the numerator (insured exports) and denominator (total exports) decline.

Moreover, the time-varying fixed effects take account of any time-variant country-specific factors that influence insurance underwriting, a number of which have been identified in the literature. For example, the fixed effects capture the influence of efficiency gains on the supply of insurance (Cummins and Outreville, 1987), interest rate shocks (Doherty and Garven, 1995), changes in the financial quality of the insurer (Cummins and Danzon, 1997), general macroeconomic shocks (Guo, Fung and Huang, 2009), and regulatory changes (Berry-Stolze and Born, 2012). Moreover, the time-varying exporter fixed effects capture changes in the insurer's market share in the various exporting countries over time. Finally, the time-varying importer fixed effects account for changes in the capacity of reinsurance available on destination countries, an important determinant of primary market insurance capacity and efficiency (Cummins and Weiss, 2000; Weiss and Chung, 2004). As described in Section 2.2, risk transfer via the purchase of reinsurance is a key risk management tool for private trade credit insurers.

The sources of the data are described in Appendix Table A1. A correlation matrix for the variables used in the regression analysis is presented in Table A2. The countries are listed in Table A3.

3.1 Data on a global trade credit insurer

The data set is unique and includes exports covered with export credit insurance, premium income received, and claims paid by one of the "Big Three" global trade credit insurers which have a combined share of 86 percent of the world market (ICISA, 2014): Euler Hermes (34 percent), Atradius (31 percent) and Coface (21 percent).[11] The raw data consists of an unbalanced panel with bilateral information on 25 exporting countries and 183 importing countries covering the period from 1992 to 2006. The sample used in the regression analysis has a maximum of 4759 annual observations. Summary statistics for the variables are presented in Table 1.

The quantity equation relates changes in the share of bilateral exports insured to changes in the insurer's claims ratio. I use the term "insured exports" to refer to exports that are covered with export credit insurance by the global trade credit insurer. The annual value of insured exports between a pair of countries varies considerably, ranging between EUR 50 thousand and EUR 6.2 billion, with an average of EUR 211 million. In turn, the "share of exports insured" refers to the share of exports between a pair of countries that is covered with export credit insurance by the global trade credit insurer. This annual share of exports insured ranges between (but is not equal to) zero and 98 percent, with a median (mean) value of 5.3 (8.4) percent. In the regression analysis I also show results when accounting for the potential influence of outliers by winsorizing the data.

The claims (or loss) ratio is measured as the ratio of claims over premium income.[12] It is an inverse profitability measure and an important performance indicator for trade credit insurers. The sum of the claims ratio and the expense ratio – total insurance expenses divided by total insurance revenues – is the combined ratio. When this combined ratio exceeds 100%, the insurer makes a loss on its insurance activity.[13] Since the expense ratio is relatively constant over time, claims ratio shocks are the main driver of the overall financial results of a trade credit insurer. Importantly, with expense ratios historically ranging between 20-40%, global trade credit insurers make a loss when the claims ratio exceeds 60-80%.[14] The average (unweighted) claims ratio in the sample equals 352%, which reflects the skewed distribution of claims ratios.[15] In the regression analysis, I correct for this skewness by taking logs. Notably, the sample does not seem to be biased towards observations with a high claims ratio. The median claims ratio is 55%, almost equal to the industry's average claims ratio (on insured domestic and international trade) of 53% in the period from 2001 to 2013 (see Figure 1). Below I also examine whether the claims effect on the share of exports insured differs

when the insurer makes a loss; i.e. when the claims ratio exceeds 80%.

The price equation relates changes in the premium level to changes in the claims level. The premium level is measured as premium per euro of insured exports, and has a median (mean) value of .29% (.43%); in line with the average 2005-2013 premium level in the global trade credit insurance market of .32% (ICISA, 2014).[16] The variable for claims in the price equation is normalized by insured exports instead of premium income. I refer to this ratio as the "claims level". The median (mean) value of the premium level is .16% (1.32%); again close to the average industry's claims level of .17% in the period from 2005-2013 (ICISA, 2014).

4 Benchmark results

This section presents the benchmark results for the *average* effect of claims on the quantity and price of private export credit insurance. First, I estimate the default quantity and price specifications including only contemporaneous claims, and then add lags of claims to examine the duration of the claims effect. The results are presented in Table 2.

Turning to the quantity regressions first, the estimate for the coefficient of the claims ratio is negative and statistically distinguishable from zero at all reasonable significance levels (Table 2, Column 1). Higher claims ratios seem to be related to a lower share of exports insured. To get a sense of magnitudes, suppose that the claims ratio doubles. Since both the share of exports insured and the claims ratio are denoted in logarithms, the estimated coefficient of .11 can be interpreted as an elasticity. Thus, a doubling of the claims ratio on insured exports from country i to country j would lead to an average decline in the share of exports insured from country i to country j of 11%. The results in the second and third column of Table 2.2 indicate that, on average, the negative claims effect on the share of exports insured lasts about a year. The coefficient of the first lag of the claims ratio suggests that this share is about 3% lower one year after a doubling of the claims ratio. The average claims effect dies away after one year.

Importantly, the estimated decline in the share of exports insured results while controlling for country-specific demand shocks. Thus, the decrease in the share of exports insured appears to be due to a decline in the supply of private export credit insurance. The main concern regarding this interpretation is the *relative* demand for insurance on exports from country i to j. If exporters prefer to cover a lower share of exports with private export credit insurance following a rise in claims, this

could also explain the decline in the share of exports insured. As discussed in Section 2, however, the relative demand for insurance tends to rise following an unexpected loss shock due to probability updating of future losses. This makes it unlikely that lower demand explains the quantity decrease. Overall then, these results suggest that the estimated decline in the quantity of private export credit insurance following an increase in the claims ratio is supply-driven.

Table 2 also reports the results from equation (2), where the premium level is the dependent variable and claims are normalized by the quantity of insured exports. The estimate for the claims level is positive and statistically distinguishable from zero at all reasonable significance levels (Table 2, Column 4). The size of the coefficient implies that a doubling of the claims level increases the premium level with about 4%. Thus, the claims effect on the price of insurance is less than half as large as the effect on the quantity of insurance. A possible explanation for the relatively small elasticity between claims and the premium level, aside from strong price competition (see Section 2.2), is that insurers can change a number of other non-price conditions attached to insurance policies. For example, policy holders have a self-retention – a portion of the insurance exposure that the policy holder covers – which can be adjusted in terms of cover percentage, claims deductibles, and aggregate first losses. Contrary to the claims effect on the quantity of export credit insurance, the average claims effect on the premium level seems to disappear in the first year after the increase in claims (Table 2, Columns 5 and 6). The coefficient of the first lag of the claims level is only marginally significant (at the 10 percent level) and small, with a point estimate of .01.

Succinctly, an increase in claims seems to lead to an economically and statistically significant decline in the supply and increase in the price of export credit insurance by this global trade credit insurer, holding other things constant. A doubling of the claims ratio (or claims level) results, on average, in a decline in the share of exports insured of about 11% and a rise in price of export credit insurance of about 4%. The price effect seems to disappear in the year following the claims increase, while the quantity effect persists somewhat longer and dies away in the second year following the rise in claims.

In the remainder of this article, I further test the robustness of these benchmark results to sample changes and omitted variable bias, and examine whether larger claims have proportionately bigger effects than small claims. In particular, I investigate whether the marginal quantity and price effects differ when claims turn into actual losses.

5 Sensitivity analysis

5.1 Sample changes

I start the sensitivity analysis with a number of robustness checks estimating the benchmark quantity and price specifications on various subsamples. The purpose of this examination of reasonable changes to the sample is to show that the results are not due to small parts of the sample. The results are presented in Table 3, Rows 1 to 14. Each of the rows in the table corresponds to a different sensitivity check, while the columns show the results of the claims effect in the quantity and price specification.

Since I am interested in exporter effects, I start by dropping groups of importer countries. First, I delete all observations for industrial importers, and then successively drop observations for developing countries from Latin America or the Caribbean, the Middle East, Asia, Africa, and for (formerly) centrally managed economies.[17] These robustness checks leave the basic claims effect on the quantity and price of export credit insurance largely unchanged. The same goes when dropping poor importers (those with real GDP per capita of less than EUR 1000 per annum) or small importers (defined as a country with fewer than one million people).

Next, I test the robustness of the results by dropping exporter observations. In particular, these checks examine whether the results hold when focusing on insured exports from and to Europe. Although other markets are growing in importance, the majority of exports covered with private export credit insurance are still destined to Europe (Morel, 2011). First, I drop non-European exporters from the sample. The results in Row 9 of Table 3 show that this robustness check does not undermine the findings. Second, I drop all non-European exporters *and* importers, thus focusing on insured exports flows within Europe. Again, the results remain resilient (Table 3, Row 10).

Further, I check whether the benchmark results hold when dropping the observations before 1998. In that year, the European Union restricted public export credit agencies from providing guarantees on short-term export credits to the countries within the European Union and most other OECD countries, leaving these so-called "marketable risk countries" to the private trade credit insurers (see European Commission, 1997). Once more, the results are basically unchanged (Table 3, Row 11).

Continuing, I examine if the quantity and price effects are due to observations where the claims ratio or claims level is relatively high. I do so by dropping all observations above the median value of the claims ratio or level. Again, I find a statistically significant effect of claims on the quantity and premium level of insured exports (Table 3, Row 12). The size of the quantity effect, however, is now

considerably smaller; .07 instead of .11. This suggests that the impact of claims on the quantity of insured exports might be nonlinear. I further go into this issue in Section 6.1 below, where I examine the claims effects when the insurer makes a loss.

Finally, I account for the influence of potential outliers by winsorizing all variables. First, I winsorize the data at the 1% and 99% level; i.e. I replace any data value below the 1^{th} percentile by the 1^{th} percentile and any value above the 99^{th} percentile of the sample data by the 99^{th} percentile. I also check whether the results are robust to winsorizing the data at the 5% and 95% level. The results are presented in Rows 13 and 14 of Table 3. Again, the results are largely unchanged. Only the size of the negative claims effect on the quantity of export credit insurance is marginally smaller with a size of .09 instead of .11.

Overall, I conclude that the finding of a statistically significant claims effect on the quantity and price of private export credit insurance is not due to some subset of the sample and is robust to reasonable sample changes. A rise in claims seems to reduce the quantity and increase the price of private export credit insurance.

5.2 Estimation changes

Following the sample changes, I now examine the sensitivity to changes in the quantity and price equations. These checks test for omitted variable bias. Given the inclusion of a rich set of dummy variables controlling for time-varying exporter and importer as well as time-invariant country-pair characteristics, any potential omitted variable bias would stem from time-varying country-pair characteristics. I control for such candidates suggested in the recent trade finance literature.

First, recent theories of trade finance (Antràs and Foley, 2011; Schmidt-Eisenlohr, 2013) show that cash-in-advance transactions – instead of open account transactions which could be covered with export credit insurance – are expected if financing costs and contract enforcement are high in the exporting country relative to the importing country. In order to account for this possible source of omitted variable bias, I follow Van der Veer (2014) and construct two dummy variables. The first dummy measures the relative financing costs within a country-pair and is equal to one if financing costs (proxied by the net interest margin from Beck et al. 2009) in the exporting country are higher than in the importing country.[18] The second dummy measures relative enforcement (proxied by the "Law and Order" country rates of the International Country Risk Guide) within a country-pair and is equal to one if enforcement in the exporting country is higher than in the importing

country. Notably, both dummy variables are time-varying within country-pairs (only) in part of this subsample; the financing costs variable is time-varying in 230 out the 662 country-pairs, while the relative inforcement dummy varies over time in 102 country-pairs. In line with theory, I find a negative coefficient of both dummies but the effects are not statistically significant.[19] Importantly, the results in Row 15 of Table 3 show that the main findings are robust to introducing relative financing costs and contract enforcement.

Next, recent studies show that shocks to the supply of bank-intermediated trade finance affect exports (Amiti and Weinstein, 2011; Niepmann and Schmidt-Eisenlohr, 2013). This could be a source of omitted variable bias if these shocks influence insured exports differently than total bilateral exports. Since the time-varying country fixed effects capture (domestic) country-specific shocks to bank lending, I test the robustness of the results to changes in cross-border bank lending. As Mora and Powers (2011) note, trade finance is dependent on both domestic and cross-border funding. I add to the quantity and price equations a variable measuring international claims (in log), using the bilateral data on international bank lending from the Bank for International Settlements' Consolidated International Banking Statistics. These international banking claims capture the sum of cross-border lending and local claims extended in foreign currency, and include trade finance claims such as those related to letters of credit. I do not find a statistically significant influence of this measure of cross-border bank lending in either the quantity or price equation. More important, the results in Row 16 of Table 3 again show that the claims effect on the quantity and price of export credit insurance is resilient.

6 Losses, extreme losses and international transmission effects

So far, the focus has been on the *average* effect of claims on the quantity and price of private export credit insurance. In this section, I estimate the claims effect when the insurer is making a loss, and examine if the claims effect increases with the size of the loss. Finally, I examine if the private trade credit insurer transmits extreme loss shocks across countries.

6.1 The claims effect when the insurer makes a loss

The benchmark results show the average effect of an increase in claims on the quantity and price of private export credit insurance. This average effect is based on the full sample of observations, including both (aggregate annual bilateral) observations where the insurer made a profit and where

the insurer incurred a loss; i.e. when the value of claims exceeds 80% of premium income (see Section 3.1). One could argue, however, that the insurer might react differently when it is making a loss.

I now focus on the subsample of loss observations. Again, I estimate the claims effect on the quantity and price of insurance. I examine three different subsamples with a "loss threshold" for the claims ratio (ijt) of respectively 80%, 60% and 100%. The results are presented in Table 4. The negative claims effect on the quantity of private export credit insurance ranges between .17 and .21, about twice as large as the benchmark effect (Table 4, Columns 1 to 3). Likewise, the claims effect on the price of insurance is double the size of the benchmark effect, ranging between .07 and .10.

These results raise the question whether the size of the loss also matters. I examine this by dropping the first and second quartile of the absolute value of claims of the subsample of loss observations. The results in Table 4 show that the claims effect on the quantity and price of private export credit insurance increases with the loss size. The negative claims effect on the quantity of insurance rises up to .36 (Table 4, Column 4); more than three times the size of the benchmark effect. Likewise, the claims effect on the price of insurance rises up to .11 (Table 4, Column 8). Although less pronounced, this claims effect on the premium level is also almost triple the size of the benchmark effect.

Overall, these results suggest that the impact of claims on the quantity and price of private export credit insurance is nonlinear. Larger losses seem to have proportionaly bigger effects than small losses. I further examine this nonlinearity by including quadratic terms in the benchmark specifications; i.e. I add the squared log of the claims ratio to the quantity equation, and the squared log of the claims level to the price equation. The results are presented in Table 5. The first two columns confirm that the claims ratio has a nonlinear effect on the share of exports insured, as captured by the quadratic term. The estimate of the squared log of the claims ratio is statistically highly significant with a negative coefficient of .013 (Table 5, Column 2). Subsequently, the elasticity of the share of exports insured with respect to the claims ratio can be calculated as $2 * -.013 * \ln(ClaimsRatio)$, and thus increases with the claims ratio. For example, the negative elasticity of the share of exports insured with respect to the claims ratio equals .10 at the mean of the log claims ratio (comparable to the benchmark results), but increases up to .23 at the 99^{th} percentile of the log claims ratio.[20] In turn, the results in the third column of Table 5 do not provide further evidence of a nonlinear effect of claims on the premium level of export credit insurance; the estimate for the squared log of the claims level is not statistically significant. Thus, nonlinearity of the claims effect on the premium level, as

suggested by the results in Table 4, may be of a more complex form.

In short, the claims effect on the quantity and price of private export credit insurance increases when the insurer is making a loss. Moreover, the larger the loss, the larger the decline in quantity and rise in price; the effects are up to three times bigger than the benchmark effects. To get a sense of magnitudes, a doubling of the claims ratio (or claims level) – in the subsample of largest losses – results in a decline in quantity of about 36%(!) and rise in price of about 11%. Recall, however, that the benchmark results are not merely driven by the largest losses in the sample. As shown in Section 5.1, claims below the median value also have a statistically significant effect on the quantity and premium level of insured exports.

6.2 Extreme losses and international transmission effects

Global banks have been shown to transmit financial shocks across countries via a reduction in their loan supply (Cetorelli and Goldberg, 2011; De Haas and Horen, 2012). Analogous to global banks, in this section, I examine whether the global trade credit insurer transmits loss shocks across countries via a decline in its supply of export credit insurance. In particular, I test for international transmission effects of the largest – extreme – losses in the sample.

The empirical strategy to identify international transmission effects hinges on the definition of an extreme loss shock. Following the analysis above, I start with the subsample of largest losses (see Table 4, Columns 4 and 8). This subsample includes all observations with a claims ratio above 80% and is further limited to the third and fourth quartile of claims in absolute value terms. From this subsample, I select the 119 observations with the highest claims (ijt) as a percentage of total annual premium income of country i on insured exports to all destinations j, and on insured domestic trade ($\sum_{j \neq i}$Premium Income$_{ijt}$+ Premium Income$_{iit}$). I refer to these 119 loss shocks as "extreme" as they represent the 97.5^{th} percentile of the benchmark sample of 4759 observations. I also show results for a more narrow (the 99^{th} percentile) and widened (the 95^{th} percentile) definition of extreme losses. The extreme losses thus include those losses that are large relative to the insurer's total premium income in country i. Importantly, I use this country i perspective to determine the countries to which the loss shock can be transmitted to, which are defined as all destination countries with insured exports from country i that do not experience a loss shock.

This strategy to examine international transmission effects of a loss shock is visualised in Figure 2. As a hypothetical example, suppose the insurer in Germany (Country $i = k$ in Figure 2) suffers

an extreme loss on insured exports from Germany to France (Country $j = h$). Then there would be international transmission effects if the share of exports insured from Germany to all destination countries – without a loss shock – other than France (all countries $j \neq h$) declines *more strongly* for a given increase in the claims ratio on insured exports to these other destination countries; i.e. the negative elasticity between the claims ratio and the share of exports insured from Germany to all countries (without a loss shock) other than France increases.

Subsequently, to estimate international transmission effects of extreme losses, I add two interaction terms to the benchmark quantity equation. The first interaction term interacts the claims ratio (ijt) with a dummy variable (SHOCK_{ijt}) which is equal to 1 if claims on insured exports from i to j qualify as an extreme loss. The second interaction term interacts the claims ratio (ijt) with a dummy variable (TRANSMIT_{ijt}) which is equal to 1 for all country-pairs with $i = k$, $j \neq h$ if $\text{SHOCK}_{i=k,j=h}$=1. I also add the dummy variables SHOCK_{ijt} and TRANSMIT_{ijt} to the equation to estimate the interaction effects separately from any base effects.

The results are presented in the first column of Table 6. The interaction terms should be interpreted as the additional claims effect on the share of exports insured, on top of the average (benchmark) claims effect. The first interaction effect is statistically significant at the 1 percent level with a negative coefficient of .19. Thus, in case of an extreme loss the decline in the share of exports insured – from the country where the insurer suffers the loss shock to the destination country in which the loss shock originates – is about three times larger (.28 = .09 + .19) than the average claims effect associated with a given rise of the claims ratio. More important, the second interaction effect is also negative and statistically significant at the 1 percent level. The point estimate implies that the share of exports insured – from the exporting country in which the insurer suffers a loss shock to all destination countries other than those in which a loss shock originates – declines by a factor of two (.21 = .09 + .12) more than on average following a given rise of the claims ratio. Thus, there seems to be evidence that the private trade credit insurer transmits extreme loss shocks across countries by reducing its supply of insurance.[21]

In Table 6, Column 2 to 6, I test the robustness of this international transmission effect. First, I narrow down the definition of an extreme loss somewhat. The evidence on the international transmission effect is based on 119 extreme losses that are transmitted via 491 "transmission channels" (i.e. 491 country-pair-year combinations; see first column of Table 6). The second column of Table

6 shows the results when the definition of an extreme loss is narrowed down to include only the 99^{th} percentile instead of the 97.5^{th} percentile of the benchmark sample of 4759 observations. This gives 48 loss shocks and 167 possible transmission channels. Reassuringly, the international transmission effect is negative and of comparable size with a coefficient of .11 (Table 6, Column 2). The estimate is only marginally significant though for this relatively small number of transmission channels. In turn, I stretch the definition of an extreme loss somewhat, including the 95^{th} percentile of losses. Again there is evidence of an international transmission effect; the interaction effect is negative and highly significant (Table 6, Column 3). The size of the international transmission effect is much smaller though (.06 instead of .12), as could be expected when including smaller shocks.

Finally, I perform three more robustness checks using the widened (95^{th} percentile) definition of loss shocks. These checks examine if the international transmission effect is particularly due to those countries that are likely to be economically closely related to the country in which the loss shock originates. If so, the international transmission effect could be picking up a demand effect, although the time-varying country fixed effects already limit this possibility. Each check splits the transmission channels into two groups of destination countries that do or do not share a border, common language, or regional trade agreement with the country in which the loss shock originates. The results in Columns 4 to 6 of Table 6 show that the international transmission effects are not limited to those destination countries that share a border, common language or regional trade agreement with the country in which the loss shock originates.

Succinctly, the private trade credit insurer seems to transmit extreme loss shocks across countries via a reduction in its supply of export credit insurance. In general, for a given rise of the claims ratio, the share of exports insured from the country where the insurer suffers an extreme loss declines by about a factor of two more than average. For example, if a claims ratio doubles, the share of exports insured declines by about 20%, instead of 10%, as a result of the international transmission of an extreme loss shock.

7 Conclusion

This paper examines the link between claims incurred by a global private trade credit insurer and the quantity and price of its supply of export credit insurance. Using a unique data set on the insurer's global insurance underwriting, I find that a doubling of claims results, on average, in a decline in

the share of bilateral exports insured of about 11% and rise in the premium level of 4%. The effect of claims on the premium level is temporary and disappears in the year following the rise in claims, while the decline in quantity is more persistent and dies away one year later. Moreover, these claims effects double in size when the insurer is making a loss and further rise with the value of the loss – up to triple the size of the benchmark effects. Finally, I find that an extreme loss reduces the share of exports insured from the country where the loss is suffered to *all* destination countries. This suggests that the global trade credit insurer transmits extreme loss shocks across countries by temporarily reducing its supply of export credit insurance.

The finding of relatively large quantity adjustments in case of a loss shock is consistent with the general characteristics of the global trade credit insurance market. In particular, the short-term nature of trade credits covered, combined with the unique ability of trade credit insurers to dynamically adjust their potential exposure on existing insurance policies, allows them to quickly and significantly reduce their insurance cover. Also, strong price competition between the Big Three global trade credit insurers generally limits the scope for unilateral price increases to support an insurer's overall premium income in case of a loss shock.

Importantly, all estimated claims effects on the quantity and price of export credit insurance are identified within a pair of countries over time, while absorbing the influence of all country-specific insurance supply-and-demand shocks. That is, the regressions include country-pair and time-varying exporting and importing country fixed effects. Given this empirical strategy, and given that the relative demand for export credit insurance tends to rise in adverse economic circumstances, the estimated quantity declines and price increases in case of a loss shock seem to be supply-driven. As such, the findings are consistent with the idea that the private export credit insurance market can go through a period of limited insurance availability and higher premium rates – a hard market – following a loss shock.

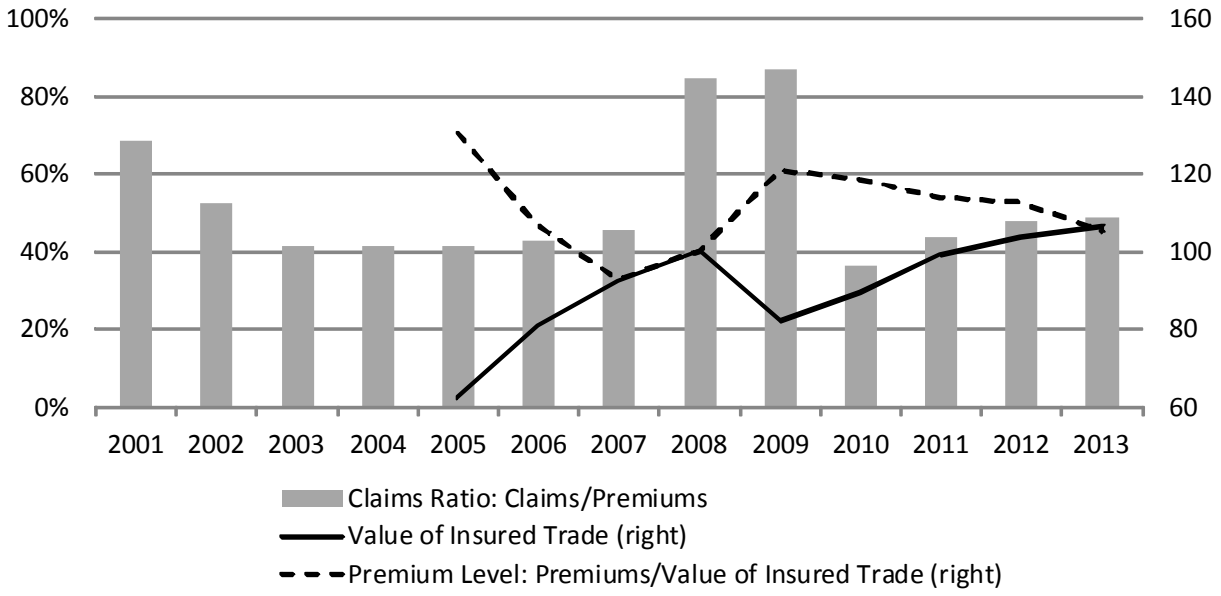
The insurance underwriting literature provides two alternative explanations for the occurrence of hard markets. Capital shock theories show how loss shocks can deplete an insurer's capital base, thereby temporarily constraining the capacity to provide insurance until capital is restored via retained earnings from higher premium rates. Alternatively, a hard market could also follow from rising expectations about future claims. The benchmark results on the claims effect on export credit insurance underwriting do not differentiate between these possible drivers of hard markets, but the

evidence on the international transmission of extreme losses suggests a role for capital constraints in case of extreme events.

Additional research is needed to further explore the potential for hard markets in private trade credit insurance. Information on the insurance underwriting by more than one global trade credit insurer is required to examine to what extent insurers differ in their response to loss shocks. Given the general features of the global trade credit insurance market – in particular the dynamic exposure management by trade credit insurers and their heavy price competition – the pattern of relatively large quantity compared to price adjustments is likely to be common among insurers. The size of adjustments, however, might differ across trade credit insurers and could for example be related to differences in operational efficiency and capitalisation. Also, the results in this paper are based on the period from 1992 to 2006, and thus pre-global financial crisis. A key question remains to what extent reductions in the supply of private trade credit insurance affected trade in the period of the 2008-09 global trade collapse. These research questions are particularly relevant in Europe, where private insurers dominate the market for short-term trade credit insurance.

Figure 1. Claims, Quantity and Price of Private Trade Credit Insurance, 2001-2013*

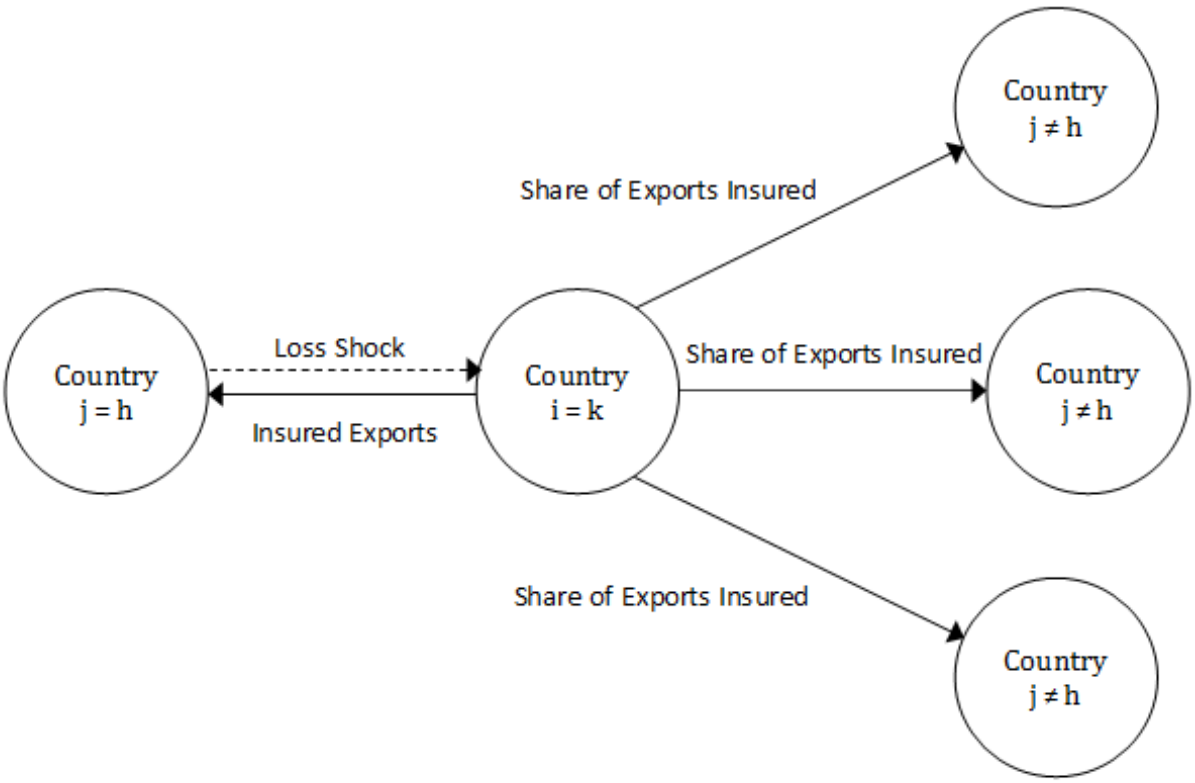
Percent; Index 2008=100



*Figures include domestic and export credit insurance.

Source: International Credit Insurance & Surety Association (ICISA) Yearbook 2014-2015. Figures on the value of insured trade are only available from 2005 onwards.

Figure 2. Identification Strategy of International Transmission of Loss Shock



From the perspective of County i = k, a Loss Shock occurs if claims on insured exports from Country i=k to Country j=h qualify as an extreme loss. Then, "international transmission effects" of this Loss Shock are identified as an increase in the negative elasticity between the claims ratio and the share of exports insured from Country i=k to all Countries j≠h.

Table 1. Summary Statistics for the Variables in the Benchmark Sample

	Mean	Median	Sd	Min	Max
Insured Exports$_{ijt}$ (millions)	211	38	518	0.05	6220
Exports$_{ijt}$ (millions)	4870	1200	12100	0.98	179000
Share of Exports Insured: Insured Exports$_{ijt}$/Exports$_{ijt}$ (%)	8.4	5.3	9.9	0.002	98.0
Claims$_{ijt}$ (millions)	0.409	0.062	1.1	0.001	19.1
Premiums$_{ijt}$ (millions)	0.523	0.126	1.2	0.001	17.6
Claims Ratio$_{ijt}$: Claims$_{ijt}$/Premiums$_{ijt}$ (%)	352	55	1760	0.06	48127
Premium Level$_{ijt}$: Premiums$_{ijt}$/Insured Exports$_{ijt}$ (%)	0.43	0.29	0.44	0.01	10.01
Claims Level$_{ijt}$: Claims$_{ijt}$/Insured Exports$_{ijt}$ (%)	1.32	0.16	6.27	0.0003	99.75

The benchmark sample includes 4759 observations. "i": exporting country, "j": importing country, "t": year.

.

Table 2. Effect of Claims on Quantity and Price of Private Export Credit Insurance

Dependent Variable:	Log Share of Exports Insured$_{ijt}$			Log Premium Level$_{ijt}$		
	(1)	(2)	(3)	(4)	(5)	(6)
Log Claims Ratio$_{ijt}$	$-.11^{***}$	$-.09^{***}$	$-.07^{***}$			
	(.01)	(.01)	(.02)			
Log Claims Ratio$_{ij,t-1}$		$-.03^{**}$	$-.02$			
		(.01)	(.01)			
Log Claims Ratio$_{ij,t-2}$			$-.00$			
			(.01)			
Log Claims Level$_{ijt}$				$.04^{***}$	$.04^{***}$	$.03^{***}$
				(.01)	(.01)	(.01)
Log Claims Level$_{ij,t-1}$					$.01^{*}$	$.00$
					(.01)	(.01)
Log Claims Level$_{ij,t-2}$						$-.00$
						(.01)
R^2	.96	.97	.98	.94	.96	.97
RMSE	.39	.29	.24	.24	.18	.15
Observations	4759	3487	2677	4759	3487	2677

Data set includes annual observations covering 23 exporting and 122 importing countries, 1992 - 2006. The Share of Exports Insured is calculated as Insured Exports$_{ijt}$/Exports$_{ijt}$, Premium Level as Premiums$_{ijt}$/Insured Exports$_{ijt}$, Claims Ratio as Claims$_{ijt}$/Premiums$_{ijt}$, and the Claims Level as Claims$_{ijt}$/Insured Exports$_{ijt}$. All regressions include country-pair (ij), time-varying exporting country (it), and time-varying importing country (jt) fixed effects. Robust standard errors (clustered by country-pairs) in parentheses. Significance: ***1%, **5%, *10%.

Table 3. Sensitivity of Effect of Claims on Quantity and Price of Private Export Credit Insurance

Dependent Variable:	Log Share of Exports Insured$_{ijt}$	Log Premium Level	
	(1)	(2)	
	Log Claims Ratio	Log Claims Level	Obs.
Benchmark Results	−.11*** (.01)	.04*** (.01)	4759
Sample Changes			
1. Drop Industrial Importers	−.10*** (.02)	.04*** (.01)	2370
2. Drop Latin America, Caribbean Importers	−.11*** (.01)	.04*** (.01)	3951
3. Drop Middle Eastern Importers	−.11*** (.01)	.04*** (.01)	4226
4. Drop Asian Importers	−.10*** (.01)	.04*** (.01)	4375
5. Drop African Importers	−.11*** (.01)	.04*** (.01)	4275
6. Drop (Formerly) Centrally Managed Importers	−.11*** (.01)	.04*** (.01)	3961
7. Drop Poor Importers (Real GDP p/c <1000)	−.11*** (.01)	.04*** (.01)	4730
8. Drop Small Importers (Population <1 Million)	−.11*** (.01)	.04*** (.01)	4178
9. Drop Non-European Exporters	−.10*** (.01)	.04*** (.01)	4191
10. Drop Non-European Exporters & Importers	−.11*** (.02)	.03*** (.01)	2336
11. Drop Early Data (Year<1998)	−.10*** (.01)	.04*** (.01)	3901
12. Drop if Claims Ratio (Level) >Median	−.07*** (.02)	.03** (.01)	2379
13. Winsorize data at 1% and 99%	−.10*** (.01)	.04*** (.01)	4759
14. Winsorize data at 5% and 95%	−.09*** (.01)	.04*** (.01)	4759
Estimation Changes			
15. Add Financing Costs & Contract Enforcement	−.11*** (.01)	.03*** (.01)	3370
16. Add Cross-Border Bank Lending	−.10*** (.02)	.05*** (.01)	3382

Data set includes annual observations covering 23 exporting and 122 importing countries, 1992 - 2006. The Share of Exports Insured is calculated as Insured Exports$_{ijt}$/Exports$_{ijt}$, Premium Level as Premiums$_{ijt}$/Insured Exports$_{ijt}$, Claims Ratio as Claims$_{ijt}$/Premiums$_{ijt}$, and the Claims Level as Claims$_{ijt}$/Insured Exports$_{ijt}$. All regressions include country-pair (ij), time-varying exporting country (it), and time-varying importing country (jt) fixed effects. Robust standard errors (clustered by country-pairs) in parentheses. Significance: ***1%, **5%.

Table 4. Effect of Losses on Quantity and Price of Private Export Credit Insurance

Dependent Variable:	Log Share of Exports Insured$_{ijt}$				Log Premium Level$_{ijt}$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Claims Ratio$_{ijt}$	>80%	>60%	>100%	>80% Largest Losses[a]	>80%	>60%	>100%	>80% Largest Losses[a]
Log Claims Ratio$_{ijt}$	$-.20^{***}$ (.07)	$-.17^{***}$ (.04)	$-.21^{***}$ (.08)	$-.36^{***}$ (.13)				
Log Claims Level$_{ijt}$					$.08^{***}$ (.03)	$.07^{***}$ (.02)	$.10^{***}$ (.04)	$.11^{**}$ (.05)
R^2	.98	.98	.99	.99	.98	.97	.98	.99
RMSE	.35	.36	.31	.22	.18	.19	.16	.10
Observations	1916	2276	1635	958	1916	2276	1635	958

Data set includes annual observations covering 23 exporting and 122 importing countries, 1992 - 2006. The Share of Exports Insured is calculated as Insured Exports$_{ijt}$/Exports$_{ijt}$, Premium Level as Premiums$_{ijt}$/Insured Exports$_{ijt}$, Claims Ratio as Claims$_{ijt}$/Premiums$_{ijt}$, and the Claims Level as Claims$_{ijt}$/Insured Exports$_{ijt}$. All regressions include country-pair (ij), time-varying exporting country (it), and time-varying importing country (jt) fixed effects. Robust standard errors (clustered by country-pairs) in parentheses. Significance: ***1%, **5%.
[a]The largest losses are defined as the third and fourth quartile of the absolute value of claims of the subsample of observations with a claims ratio above 80%.

Table 5. Further Evidence on Non-Linear Effects of Claims

Dependent Variable:	Log Share of Exports Insured$_{ijt}$		Log Premium Level$_{ijt}$
	(1)	(2)	(3)
Log Claims Ratio$_{ijt}$	.007		
	(.028)		
Log Claims Ratio$_{ijt}$, Squared	$-.014^{***}$	$-.013^{***}$	
	(.004)	(.001)	
Log Claims Level$_{ijt}$			$.039^{***}$
			(.010)
Log Claims Level$_{ijt}$, Squared			.000
			(.002)
R^2	.96	.96	.94
RMSE	.39	.39	.24
Observations	4759	4759	4759

Data set includes annual observations covering 23 exporting and 122 importing countries, 1992 - 2006. The Share of Exports Insured is calculated as Insured Exports$_{ijt}$/Exports$_{ijt}$, Premium Level as Premiums$_{ijt}$/Insured Exports$_{ijt}$, Claims Ratio as Claims$_{ijt}$/Premiums$_{ijt}$, and the Claims Level as Claims$_{ijt}$/Insured Exports$_{ijt}$. All regressions include country-pair (ij), time-varying exporting country (it), and time-varying importing country (jt) fixed effects. Robust standard errors (clustered by country-pairs) in parentheses. Significance: ***1%.

Table 6. "Extreme" Losses and International Transmission Effects

Dependent Variable: Log Share of Exports Insured$_{ijt}$						
	(1)	(2)	(3)	(4)	(5)	(6)
Loss Shock$_{ijt}$ (SHOCK$_{ijt}$), Percentile:	97.5^{th}	99^{th}	95^{th}	95^{th}	95^{th}	95^{th}
Log Claims Ratio$_{ijt}$ (LCR$_{ijt}$)	$-.09^{***}$	$-.10^{***}$	$-.08^{***}$	$-.08^{***}$	$-.08^{***}$	$-.08^{***}$
	(.01)	(.01)	(.01)	(.01)	(.01)	(.01)
LCR$_{ijt}$*SHOCK$_{ijt}$	$-.19^{***}$	$-.27^{**}$	$-.13^{**}$	$-.13^{**}$	$-.13^{**}$	$-.13^{**}$
	(.06)	(.12)	(.06)	(.06)	(.06)	(.06)
LCR$_{ijt}$*TRANSMIT$_{ijt}$	$-.12^{***}$	$-.11^{*}$	$-.06^{***}$			
	(.03)	(.06)	(.02)			
LCR$_{ijt}$*TRANSMIT$_{ijt}$: Border				$-.05^{**}$		
				(.02)		
LCR$_{ijt}$*TRANSMIT$_{ijt}$: No Border				$-.06^{***}$		
				(.02)		
LCR$_{ijt}$*TRANSMIT$_{ijt}$: Common Language					$-.06^{***}$	
					(.02)	
LCR$_{ijt}$*TRANSMIT$_{ijt}$: No Common Language					$-.06^{***}$	
					(.02)	
LCR$_{ijt}$*TRANSMIT$_{ijt}$: RTA						$-.06^{***}$
						(.02)
LCR$_{ijt}$*TRANSMIT$_{ijt}$: No RTA						$-.05^{***}$
						(.02)
R^2	.96	.96	.98	.96	.96	.96
RMSE	.38	.39	.38	.39	.39	.39
Observations	4759	4759	4759	4759	4759	4759
# SHOCK$_{ijt}$ = 1	119	48	238	238	238	238
# TRANSMIT$_{ijt}$ = 1	491	167	2048	2048	2048	2048
Border with Shock Country				327		
No Border with Shock Country				1721		
Common Language with Shock Country					486	
No Common Language with Shock Country					1562	
RTA with Shock Country						1340
No RTA with Shock Country						708

Data set includes annual observations covering 23 exporting and 122 importing countries, 1992 - 2006. RTA: Regional Trade Agreement. The Share of Exports Insured is calculated as Insured Exports$_{ijt}$/Exports$_{ijt}$, and the Claims Ratio as Claims$_{ijt}$/Premiums$_{ijt}$. All regressions include the dummy variables SHOCK$_{ijt}$ and TRANSMIT$_{ijt}$, and country-pair (ij), time-varying exporting country (it), and time-varying importing country (jt) fixed effects. Robust standard errors (clustered by country-pairs) in parentheses. Significance: ***1%, **5%, *10%.

References

[1] Amiti, M. and D.E. Weinstein, 2011. Exports and Financial Shocks. Quarterly Journal of Economics 126(4), 1841-1877.

[2] Antràs, P. and C.F. Foley 2011, Poultry in Motion: A Study of International Trade Finance, NBER Working Paper 17091.

[3] Beck, T., A. Demirguc-Kunt, and R. Levine, 2009. Financial Institutions and Markets Across Countries and Over Time – Data and Analysis, Policy Research Working Paper Series 4943, TheWorld Bank (May).

[4] Becue, P. 2013. Credit insurance. Lannoo Campus Publishers: Leuven.

[5] Becue, P., E. de Smet and O. Volcke, 2012. Credit or crisis? The future of credit insurance. Ghent: CRiON.

[6] Berry-Stölzle, T.R. and P. Born, 2012. The Effect of Regulation on Insurance Pricing: The Case of Germany. Journal of Risk and Insurance 79(1), 129-164.

[7] Cetorelli, N. and L.S. Goldberg, 2011. Global Banks and International Shock Transmission: Evidence From The Crisis. IMF Economic Review 59(1), 41-76.

[8] Chen, R., K.A. Wong and H.C. Lee, 1999. Underwriting Cycles in Asia. Journal of Risk and Insurance 66(1), 29-47.

[9] Cummins, J.D and P.M. Danzon, 1997. Price, Financial Quality, and Capital Flows in Insurance Markets. Journal of Financial Intermediation 6(1), 3-38.

[10] Cummins, J.D. and J.F. Outreville, 1987. An International Analysis of Underwriting Cycles in Property-Liability Insurance. Journal of Risk and Insurance 54(2), 246-262.

[11] Cummins, J.D. and M.A. Weiss, 2000. The Global Market for Reinsurance: Consolidation, Capacity and Efficiency. The Brookings-Wharton Papers on Financial Services 3, 159-222.

[12] Cummins, J.D. and C.M. Lewis, 2003. Catastrophic Events, Parameter Uncertainty and The Breakdown of Implicit Long-Term Contracting: The Case of Terrorism Insurance. Journal of Risk and Uncertainty 26(2/3), 153-178.

[13] De Haas, R. and N. van Horen, 2012. International Shock Transmission After the Lehman Brothers Collapse: Evidence From Syndicated Lending. American Economic Review, Papers & Proceedings 102(3), 231-237.

[14] Doherty, N. A. and J. R. Garven, 1995. Insurance Cycles: Interest Rates and the Capacity Constraint Model. Journal of Business 68(3), 383-404.

[15] European Commission, 1997. Communication of the Commission to the Member States Pursuant to Article 93 (1) of the EC Treaty Applying Articles 92 and 93 of the Treaty to Short-Term Export-Credit Insurance, Official Journal of the European Communities C281/03: 4-10.

[16] European Union, 2012. Study on Short-Term Trade Finance and Credit Insurance in The European Union. Publications Office of the European Union: Luxembourg.

[17] Froot, K.A. and P.G.J. O'Connell, 1999. The Pricing of U.S. Catastrophe Reinsurance. In: K.A. Froot (Ed.), The Financing of Catastrophe Risk. Chicago: University of Chicago Press.

[18] Gron, A., 1994. Capacity Constraints and Cycles in Property-Casualty Insurance Markets. Rand Journal of Economics 25(1), 110-127.

[19] Guo, F., H.-G. Fung and Y.S. Huang, 2009. The Dynamic Impact of Macro Shocks on Insurance Premiums. Journal of Financial Services Research 35(3), 225-244.

[20] Harrington, S.E., G. Niehaus and T. Yu, 2013. Insurance Price Volatility and Underwriting Cycles. In: G. Dionne, eds., Handbook of Insurance. Springer: New York, p. 647-667.

[21] ICISA, 2014. International Credit Insurance and Surety Association Yearbook 2014-2015. Available at http://www.icisa.org.

[22] Khwaja, A.I. and A. Mian, 2008. Tracing The Impact of Bank Liquidity Shocks: Evidence From an Emerging Market. American Economic Review 98(4), 1414-1442.

[23] Lai, G.C., R.C. Witt, H. Fung, R.D. MacMinn and P.L. Brockett, 2000. Great (And Not So Great) Expectations: An Endogenous Economic Explication of Insurance Cycles and Liability Crises. Journal of Risk and Insurance 67(4), 617-652.

[24] Moody's, 2013. Credit Focus: Euler Hermes, Coface and Atradius: Peer Comparison. London: Moody's Investors Service, Inc.

[25] Mora, J. and W. Powers, 2011. Global Perspectives in the Decline of Trade Finance. In: J. Chauffour and M. Malouche (Eds.), Trade Finance During the Great Trade Collapse, Washington DC: The World Bank, 117-131.

[26] Morel, F. 2011. Credit Insurance in Support of International Trade: Observations Throughout the Crisis. In: J. Chauffour and M. Malouche (Eds.), Trade Finance During the Great Trade Collapse, Washington DC: The World Bank, 337-355.

[27] Niepmann, F. and Tim Schmidt-Eisenlohr, 2013. No Guarantees, No Trade: How Banks Affect Export Patterns. Federal Reserve Bank of New York Staff Reports, No. 659.

[28] Schmidt-Eisenlohr, T., 2013, Towards a Theory of Trade Finance, Journal of International Economics 91(1): 96-112.

[29] Swiss Re, 2006. Credit Insurance and Surety: Solodifying Comments, Sigma 6/2006, Zurich.

[30] van der Veer, K.J.M., 2011. Private Trade Credit Insurers During the Crisis: The Invisible Banks. In: J. Chauffour and M. Malouche (Eds.), Trade Finance During the Great Trade Collapse, Washington DC: The World Bank, 199-212.

[31] van der Veer, K.J.M., 2014. The Private Export Credit Insurance Effect on Trade. Journal of Risk and Insurance, forthcoming. DOI: 10.1111/jori.12034.

[32] Weiss, M.A. and J.-H. Chung, 2004. U.S. Reinsurance Prices, Financial Quality, and Global Capacity. Journal of Risk and Insurance 71(3), 437-467.

[33] Weiss, M.A., 2007. Underwriting Cycles: A Synthesis and Further Directions. Journal of Insurance Issues 30(1), 31-45.

[34] Winter, R.A, 1994. The Dynamics of Competitive Insurance Markets. Journal of Financial Intermediation 3(4), 379-415.

Appendix A. Data Sources, Correlation Matrix, and Country List

Table A1: Data Sources

Insured Exports, Claims, Premium	The trade credit insurance data come from one of the "Big Three" global private trade credit insurers; company details are confidential.
Exports	IFS Direction of Trade Statistics: FOB exports in US dollars. The figures are converted to euros at the average annual exchange rate. Pre-1999 exchange rates were calculated as the weighted bilateral dollar exchange rate of the 11 countries participating at the start of the euro in 1999 (Source: FT/Reuters). All figures are deflated by the Harmonised Index of Consumer Prices (HICP), overall index, taken from Eurostat, 2000=1.

Table A2: Correlation Matrix

	Share of Exports Insured	Claims Ratio	Premium Level	Claims Level
Share of Exports Insured	1.00			
Claims Ratio	−.44	1.00		
Premium Level	.09	−.14	1.00	
Claims Level	−.38	.90	.31	1.00

Data set includes 4759 annual observations covering 23 exporting and 122 importing countries from 1992 - 2006. The Share of Exports Insured is calculated as Insured Exports$_{ijt}$/Exports$_{ijt}$, the Premium Level as Premiums$_{ijt}$/Insured Exports$_{ijt}$, the Claims Ratio as Claims$_{ijt}$/Premium$_{ijt}$, and the Claims Level as Claims$_{ijt}$/Insured Exports$_{ijt}$. All variables are in logs.

Table A3: Country List

Algeria	Djibouti	Korea, Rep	Russian Federation
Antigua & Barbuda	Dominica	Kuwait	Samoa
Argentina	Dominican Republic	Latvia	Saudi Arabia
Australia	Ecuador	Lebanon	Senegal
Austria	Egypt	Lithuania	Seychelles
Bahamas	El Salvador	Luxembourg	Singapore
Bahrain	Estonia	Malawi	Slovak Republic
Bangladesh	Fiji	Malaysia	Slovenia
Barbados	Finland	Maldives	Solomon Islands
Belgium	France	Malta	South Africa
Belize	Gabon	Mauritania	Spain
Benin	Germany	Mauritius	Sri Lanka
Bolivia	Ghana	Mexico	St. Kitts & Nevis
Botswana	Greece	Morocco	St. Lucia
Brazil	Grenada	Netherlands	St. Vincent & Grens
Brunei	Guatemala	Netherlands Antilles	Sweden
Bulgaria	Honduras	New Zealand	Switzerland
Burkina Faso	Hong Kong	Nicaragua	Thailand
Cameroon	Hungary	Norway	Togo
Canada	Iceland	Oman	Trinidad & Tobago
Cape Verde	India	Pakistan	Tunisia
Central African Republic	Indonesia	Panama	Turkey
Chile	Iran	Papua New Guinea	Uganda
China, P.R.: Mainland	Ireland	Paraguay	Ukraine
Colombia	Israel	Peru	United Arab Emirates
Costa Rica	Italy	Philippines	United Kingdom
Cote D'Ivoire	Jamaica	Poland	United States of America
Croatia	Japan	Portugal	Uruguay
Cyprus	Jordan	Qatar	Venezuela
Czech Republic	Kenya	Romania	Zimbabwe
Denmark	Kiribati		

Notes

[1]Since 1998, EU legislation restricted public export credit agencies from providing guarantees covering export credit risks with a maturity of less than two years to the "marketable risk countries", i.e. the countries within the European Union and most other OECD countries (see European Commission, 1997).

[2]Subsequently, fourteen governments within the EU set up various state aid schemes to support the market for short-term export credit insurance (see for an overview van der Veer, 2011).

[3]The Bern Union (BU) provides the most extensive publicly available data on short-term trade credit insurance. A few limitations of these country-level data, however, make it difficult to assess developments in the market for private short-term export credit insurance. First, the data combine short-term export credit insurance provided by private insurers and public export credit agencies (ECAs). This is likely to mask changes in private insurance cover, especially during a crisis when ECAs aim to support the market. Second, the BU collects data by destination country only; thus, no inference can be made on home country developments in insurance coverage. Last but not least, the BU quarterly figures report "credit limits", which refer to the amount of total potential exposure by insurers and do not measure the amount of actual export credit insured.

[4]Note that I cannot prove the existence of a hard market in private export credit insurance following a rise in claims, since the data cover information on only one global trade credit insurer instead of the whole market.

[5]In general, the empirical literature that studies factors influencing insurance underwriting uses the ratio of premiums over claims (inverse loss ratio) to proxy for the price of insurance. The quantity of insurer output is proxied by the present value of losses incurred (see i.e. Froot and O'Connell, 1999).

[6]Notably, the results in van der Veer (2014) suggest that the trade effect of changes in the supply of insured exports is larger than the value of exports insured. In that paper, which is based on the same dataset used in this paper, I estimate a gravity model to test whether private export credit insurance stimulates trade and consistently find a positive and statistically significant effect. Moreover, the results suggest that there is a trade multiplier of private export credit insurance; every euro of insured exports seems to generate more than EUR 1 (about 30 euro cents more) in total exports.

[7]Cummins and Danzon (1997) provide a more general theory, connecting loss shocks, capitalization and premiums by allowing for insurer insolvency and sensitivity of policyholders to the financial quality of the insurer. Their model is more general in the sense that it can also explain a price decrease following a loss shock. Such a decline in price follows if policyholders are sensitive to the financial quality of the insurer and thus lower their demand when an insurer's chance of going bankrupt increases.

[8]Whole turnover policies do not cover intercompany sales, exports to governments, and can exclude (risky) companies the insurer is not willing to cover.

[9]The European Commission has defined four methodes of calculating the equalisation reserve in a particalur year (see EU Directive 87/343/EEG of 22 June 1987).

[10]See Moody's 2013 Credit Opinion reports on Euler Hermes, Atradius and Coface, available at www.moodys.com. Net total exposure to shareholders' equity of Euler Hermes, Atradius, and Coface in 2013 respectively, was 231x, 209x, and 191x. In 2008, the net total exposure to shareholders' equity of the global insurers was around 300x. Shareholders' equity of Euler Hermes, Atradius, and Coface in 2013, valued EUR2.46, EUR1.29, and EUR1.78 billion respectively.

[11]Further company details are confidential.

[12]I use the gross claims ratio which measures claims and premiums including the part that is ceded to reinsurers.

[13]Whether the insurer makes an overall loss also depends on the investment result.

[14]In 2012, Euler Hermes, Atradius and Coface, respectively had a net expense ratio of 23, 28 and 26 percent (see Moody's, 2013).

[15]Notice that the maximum (aggregate annual) claims ratio on insured exports between a pair of countries is 48127 percent(!). In this particular case, total insured exports had a value of EUR 3.2 million, premium income was EUR 5.5 thousand, and claims paid summed up to EUR 2.7 million.

[16]Figures on the value of exports insured, needed to calculate the premium level, are not available before 2005 (see ICISA, 2014).

[17]The various groups of countries are as classified by the IMF's International Financial Statistics' country codes.

[18]The net interest margin is the ratio between the accounting value of the net interest revenues of banks and their total earning assets.

[19]Results not reported. In passing, I note that the coefficient for relative contract enforcement is statistically significant - and with a size of -.34 also economically relevant - when excluding the time-varying country fixed effects.

[20]The negative elasticity of the share of export insured with respect to the claims ratio equals .13, .16, and .18 at the 75th, 90th and 95th percentile of the log claims ratio respectively.

[21]I have also examined whether the private trade credit insurer transmits extreme loss shocks across countries via an increase in the price of insurance, but did not find a statistically significant effect of the interaction term in the price equation. For brevity, these results are not reported.

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