Export Market Risk and the Role of State Credit Guarantees

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Abstract

Many countries offer state credit guarantees to support credit-constrained exporters. In the case of Germany, accumulated returns to the scheme deriving from risk-compensating premia have outweighed accumulated losses over the past 60 years. Why do private financial agents not step in? We build a simple model with heterogeneous firms that rationalizes demand for state guarantees with financial frictions. We test the model's predictions with detailed firm-level data and find supportive evidence: State credit guarantees in Germany increase firms' exports. This effect is stronger for firms that are dependent on external finance, if the value at risk is large, and at times when refinancing conditions are tight.

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1 Introduction

In light of the "great trade collapse" following the financial crisis 2008, there has been increased interest in the role of finance for export business and there is now ample evidence that exports are more vulnerable to financing conditions than domestic sales.[1] Most countries have state credit guarantee programs to improve access to finance for exporting firms. Recent literature analyzes the effectiveness of such schemes as a means of stimulating exports, value added, and employment. Felbermayr et al. (2012) estimate that state export credit guarantees in Germany, the so-called "Hermes guarantees," increase firms' sales growth by about 4.5% percentage points in the year of the grant, supporting previous evidence of a positive relationship at the aggregate level.[2] However, evidence on the underlying mechanism is scarce. This is surprising, given that policy makers often refer to financial market frictions to justify the need for state credit guarantees. Moreover, the welfare implications of the state intervention depend crucially on the channels through which Hermes guarantees manifest their effects. In this paper, we aim to understand *why* Hermes guarantees work. Our empirical analysis is guided by a simple theoretical model of heterogeneous exporters that face uncertainty about export revenues and differ with respect to their need for and access to external finance. Based on a unique transaction level data set, we analyze whether and, if so, what kind of financial market frictions can be mitigated by state export credit guarantees.

In our theoretical model with heterogeneous exporters, external finance, and an optional credit guarantee scheme, we show how financial market conditions determine exporters' costs of finance, optimal sales, and the decision to enter into foreign markets. We borrow the basic set-up from Manova (2013), but consider default risk on the side of the importer rather than imperfect contract enforcement in the exporting country. In Manova (2013), as well as in Matsuyama (2008), Muûls (2008), and Feenstra et al. (2011), credit constraints - defined as a firm not being able to obtain finance for projects with positive expected values - are due to moral hazard. In our model, credit constraints arise from transaction costs of risk diversification in the financial sector. In line with existing literature, we consider banks to be exposed to a constant risk of illiquidity that is due to the maturity mismatch of their assets and liabilities (Diamond and Dybvig, 1983) or market-based valuation of assets (Allen and Gale, 1998) and makes them prone to runs. Bank runs entail costly early liquidation of long-term assets and, potentially, insolvency. Regulatory standards are enacted to reduce the probability of those events by forcing banks to engage in (costly) measures of risk diversification and contribute to deposit insurance schemes.[3] Risk neutralization in banks

[1] For studies at the firm-level see e.g. Greenaway et al. (2007) (United Kingdom), Muûls (2008) (Belgium), Manova et al. (2011) (China), Amiti and Weinstein (2011) (Japan) and Minetti and Zhu (2011) (Italy). Chor and Manova (2012) look at sectoral US imports during the financial crisis.

[2] Felbermayr and Yalcin (2013) find a positive relationship between sectoral exports and Hermes guarantees that is particularly strong for sectors that depend more on external finance. Moser et al. (2008) also find a positive effect in a country-level study. For Austria, Egger and Url (2006) and Badinger and Url (2013) report positive effects, as do Janda et al. (2013) for the Czech Republic. Auboin and Engemann (2014) find a strong positive effect of export credit insurance on bilateral trade, based on an extensive dataset covering more than 70 countries and public as well as private insurers.

[3] Current regulation requires banks to hold regulatory capital in an amount such as to achieve a constant solvency

can be accomplished by various means, including portfolio management, hedging, holding cash, and issuing subordinate debt or equity.[4] These costs of holding risk might be considered as a measure of financial market effectiveness. In an Arrow-Debreu world with complete contingent markets and costless transactions, they would be zero. If, at the other extreme, the risk was not at all diversifiable, banks obliged to maintain a solvency probability of almost one would need to hold the full amount at risk in liquid assets, with costs then reflecting foregone interest. In our model, perfectly competitive banks pass on transaction costs to firms by way of charging interest on loans for risky projects that is higher than the actuarially fair compensation for the risk involved. Consequently, some projects with positive expected values cannot be profitably financed. Credit constraints thus derive from the threat of illiquidity with its detrimental consequences and the limited ability of private financial markets to diversify risk.

Credit guarantees can attenuate this problem, but only to the extent that the guarantor is more efficient at dealing with risk than the lender. Accordingly, a state credit guarantee scheme mitigates financial constraints only if the government can provide guarantees at lower costs than private agents. Of course, the government could achieve a similar effect on firms' financing cost by subsidizing risk premia. However, in the case of Germany's Hermes guarantees, observable profits and losses associated with the guarantee scheme indicate that, on average, revenues earned from risk premia and fees overcompensate expenses from payment of claims and administration costs.[5] The realized cumulative profits for the period 1950 to 2010 amount to 2 billion Euro, suggesting that the premia adhere to a profitability constraint.[6] We propose three possible sources of market imperfection that might explain why the government can offer credit guarantees at premia lower or equal to market prices without violating the profitability constraint. First, if there are *costs to diversifying risk* for private agents, the government's "deep pocket" will give it a cost advantage in financing or insuring projects with large values at risk.[7] Second, if *coordination of creditors* in case of payment default comes at a cost, then the government as a single actor will also have a cost advantage when it comes to asserting claims.[8] And third, we argue that the government has *greater bargaining power* in debt renegotiations with entities in foreign countries, which, as we discuss below, often involve other foreign governments. Under any of these conditions, the government can offer guarantees for specific types of projects at lower premia than private capital markets without incurring losses in the long run.

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probability. Gordy and Howells (2006) show that for the Internal Ratings Based Approach of Basel II, the targeted one-year solvency probability was 99.9 percent.

[4] See Kashyap et al. (2002) for a quantitative assessment of the costs associated with such buffer stocks for U.S. banks.

[5] German state export credit guarantees are administered by a private consortium made up of *Euler Hermes Deutschland AG* and *PriceWaterhousecoopers AG*, acting on behalf of the federal government. For a detailed description of the guarantee program see Moser et al. (2008)

[6] Numbers stem from the Annual Report 2010 of Euler Hermes. The report is available at http://www.agaportal.de/en /aga/downloads/jahresberichte.html.

[7] As is often argued, this lender-of-last-resort property provides a rationale for the government playing an active role as loan guarantor or deposit insurer; see e.g. Merton (1977), Diamond and Dybvig (1983).

[8] Transaction costs of this sort have been proposed as one reason for the existence of banks; see Mayer (1988), Sharpe (1990).

In the empirical part of the paper, we take the predictions of our model to the data and assess the validity of the hypothesized cost advantages. Our empirical analysis draws on an exceptional dataset which is a combination of all project-specific guarantees issued by Euler Hermes between 2000 and 2010 with monthly survey data on German manufacturing firms from the Ifo Institute's Business Cycle Survey. The dataset brings together information on contract size, duration, and riskiness of the publicly insured transactions with firms' individual assessments of their export situation and their demand and financing conditions, as well as employment and balance sheet information. Given the ordinal nature of our variable of interest – firms' qualitative assessment of the stock of foreign orders – and the structure of our empirical model, we use a binary choice model to estimate the effect of Hermes guarantees and analyze how it varies with characteristics specific to the contract, the importer, the exporter, or the time of the grant.

To preview our results, we confirm the finding in the extant literature that participation in a state export credit guarantee scheme has a positive effect on exports. Furthermore, consistent with our model's predictions, we find that there is systematic heterogeneity of the effect. We can single out characteristics of the exporting firm and the contract for which the positive effect is particularly strong: Hermes guarantees particularly benefit small firms and firms that are dependent on external finance, and the effect is stronger for projects with large values at risk or during periods when financing conditions on the private capital market are tight. Our results lend support to the hypothesis that the state credit guarantee scheme mitigates frictions on private capital markets by exploiting the government's cost advantages.

In the following section we present the model, derive testable predictions, and discuss in more detail the hypotheses regarding the government's cost advantages. In Section 3 we discuss our data sources, explain our empirical strategy, and present the results. Section 4 concludes.

2 The Model

In this section we develop a partial equilibrium model of international trade with heterogeneous firms that are confronted with uncertainty about the success of export transactions. Our model builds on Manova (2013), who analyzes heterogeneity in firms' need for and access to external finance in a framework based on Melitz (2003). We introduce importer default risk into the model, allow the refinancing conditions of the banking sector to vary, and derive conditions under which the use of credit guarantees affects the extensive and intensive margin of firms' exports.

2.1 Demand

Demand for variety a of a differentiated good that is imported by firm j is derived from a symmetric CES utility function over a set of differentiated varieties and results as

$$q_j[a] = p_j[a]^{-\varepsilon} A_j, \tag{1}$$

where $p_j[a]$ is the price of variety a that importer j faces and A_j is a demand shifter. $\varepsilon > 1$ is the elasticity of substitution between any two varieties. Due to fixed costs of production, any variety is produced by only one firm, hence a subsumes the exporter index. In the following, we always consider a specific transaction between a pair (a, j), for ease of notation we drop the importer index j.

2.2 Firm Behavior

Differentiated varieties in each country are produced by an exogenously given number of firms. To produce, ship, and sell q to a foreign country, firms have to pay fixed costs f and variable costs a per unit of q.[9] We assume that firms differ with respect to productivity, that is, they face different unit costs of production a, where $a \in [a_L, a_H]$ and $a_H > a_L > 0$.[10] Fixed and variable costs must be paid upfront before payment from the importer is received. We assume that firms have an amount k of liquid funds available to cover these upfront costs. Furthermore, they can borrow from a competitive banking sector. Payment for exported goods is uncertain due to the possibility of importer default, which occurs with probability $1 - \lambda$. We assume that the firm has no other sources of revenue; hence, if the importer defaults, the firm is forced to default on its debt.[11] The importer's default risk will thus be reflected in the costs of external finance. Firms can lower the interest rate on the loan by contracting a credit guarantee. Before we discuss the financial sector in detail, we first derive firms' optimal export behavior for exogenously given costs of external finance.

In this monopolistic competition framework, firms set prices, choose how much to borrow, and how much to cover with a guarantee. Whenever the costs of external finance exceed the firm's opportunity costs of its own liquid funds, the firm will use external finance only after its internally available funds have been exhausted. Furthermore, if the firm's liquid funds are small relative to the size of the project, in particular if it has to rely on external finance no matter how much it is going to sell because its liquid funds k are smaller than the *fixed* set-up costs f, then the choice of the optimal price is independent of k. To keep the model as simple as possible, we proceed under the assumptions that external finance is more costly than internal finance and that the amount of liquid funds is small, so that $k < f$. Appendix B shows that our results are qualitatively the same in the general case.

Let R^o denote the costs of external finance for a given project, with $o \in [B, G]$ indicating whether the firm finances the export project only through a bank (B) or with the help of a credit guarantee (G) to eliminate default risk. Furthermore, let $\bar{R}$ denote the gross return to the firm's alternative investment. For a given financing mode o, the firm then only chooses its price to maximize expected

[9] Costs are expressed in terms of the price of a fixed input bundle. We scale units such that this price is normalized to 1. Without loss of generality we set variable trade costs to zero.

[10] We use a to denote both the variety and the productivity level of the firm. Assuming that a corresponds to a draw from a continuous distribution over the interval $[a_L, a_H]$, no two firms can have the same productivity level.

[11] We make this assumption for the sake of simplicity. The qualitative results of our model do not change as long as the exporter's default risk is positively associated with the importer's default risk.

profits given by

$$\max_p \lambda pq - \bar{R}k - \lambda R^o(aq + f - k) \qquad o \in [B, G], \tag{2}$$

subject to demand as in Equation (1). Expected profits consist of the uncertain payment λpq, minus the firm's opportunity costs of investing its liquid funds k and the costs of borrowing the remaining part of the investment $aq + f - k$ at R^o. The latter are, however, incurred only if the project is successful. Optimal prices and quantities result as

$$p^*[a] = \frac{R^o a}{\theta} \quad \text{with} \quad \frac{1}{\theta} = \frac{\varepsilon}{\varepsilon - 1}, \tag{3}$$

$$q^*[a] = \left(\frac{R^o a}{\theta}\right)^{-\varepsilon} A. \tag{4}$$

Let

$$r[a] = p[a]^* q[a]^* = \left(\frac{R^o a}{\theta}\right)^{1-\varepsilon} A \tag{5}$$

denote the optimum revenue of the firm. Maximum expected profits are then given by

$$\pi^*[a] = \frac{\lambda}{\varepsilon} r[a] - \bar{R}k - \lambda R^o(f - k). \tag{6}$$

The first term on the right-hand side of Equation (6) denotes operating profits, which are proportional to the firm's revenue, as in Melitz (2003). The remaining terms summarize the effective set-up costs on which the firm spends all its liquid funds k, and the amount $f - k$ that is borrowed at the gross interest rate R^o and repaid only with probability λ. Higher costs of external finance R^o lead to lower expected profits by increasing both the marginal costs as well as the fixed set-up costs. Optimal expected revenue increases in productivity $1/a$; hence, conditional on the demand and financing conditions, a firm needs to be sufficiently productive in order to break even. The break-even productivity level $1/\bar{a}^o$ results implicitly from the zero-profit condition $\pi^*[a] = 0$, which, in accordance with Equation (6), follows as

$$\frac{\lambda}{\varepsilon} r[\bar{a}^o] = \lambda R^o(f - k) + \bar{R}k. \tag{7}$$

Accordingly, both the intensive and the extensive margin of the firm's exports are affected by the costs of external finance. We summarize the relationship between R^o and the firm's export decisions in Result 1.

Result 1. *An increase in the costs of external finance $R^{o'}$ with $o' \in [B, G]$ weakly increases the profitability threshold $1/\bar{a}^{o'}$ and weakly decreases the firm's optimal level of sales for a given export transaction. The effect on the profitability threshold is stronger for firms with small liquid funds.*

Proof: The result follows from differentiating and cross-differentiating $r[a]$ and the right-hand-side of Equation (7) with respect to $R^{o'}$ and $1/\bar{a}^{o'}$, for $o' \in (B, G)$. Due to the fact that the firm may be operating under the alternative financing mode $o \neq o'$ and is thus not affected, Result 1 describes weak inequalities. Details are found in Appendix A. ■

We next describe the banking sector and the credit guarantee scheme and derive the firm's financing costs R^B and R^G for the two available financing modes: pure bank finance (B) or bank finance with a credit guarantee (G).

2.3 The Banking Sector

We assume that the banking sector is perfectly competitive and banks can refinance themselves at an exogenous (gross) interest rate $\bar{R} \geq 1$.[12] Banks are risk-neutral, but obliged to hedge the risk in their balance sheet to prevent runs.[13] We take a parsimonious approach to modeling the hedging; we assume banks to bear constant costs $c^B \in \left[0, \frac{\bar{R}-1}{\bar{R}}\right]$ per unit of the value at risk in their balance sheet to ensure liquidity at any point in time. We assume that c^B reflects the bank's cost-minimizing choice among the possible means of doing so, including portfolio management, hedging, insurance, or holding buffer stocks in the form of equity, securities, or cash. $c^B = \frac{\bar{R}-1}{\bar{R}}$ corresponds to the most expensive case where banks must hoard cash. Furthermore, suppose that in the event of borrower default a fraction $b^B \in [0, 1]$ of the claim can be recovered from the trade partner in the destination country as part of insolvency proceedings.[14] We summarize the parameters characterizing the financing environment in the set $\mathcal{B} = \{\bar{R}, b^B, c^B\}$. Then, the gross interest rate that a bank facing financing conditions $\mathcal{B}$ and perfect competition can offer on a loan of amount L with default risk $1 - \lambda$ is given by the following no-arbitrage condition:

$$\lambda R^B L + (1-\lambda) b^B R^B L = \bar{R} L + \bar{R} c^B (1-\lambda)(1-b^B) R^B L, \tag{8}$$

subject to a financing profitability constraint

$$\lambda + (1-\lambda) b^B > \bar{R} c^B (1-\lambda)(1-b^B).$$

The no-arbitrage condition (8) requires that the expected return – consisting of the borrower's payment $R^B L$ that arrives with probability λ and the amount $b^B R^B L$ that is recovered in case of default – equal the refinancing costs of the bank $\bar{R} L$ plus the costs of hedging the value at risk $\bar{R} c^B (1-\lambda)(1-b^B) R^B L$. Note that if the costs of hedging the risk are sufficiently high, the expected

[12] Opportunity costs of money are normalized to unity in the second period in which profits are realized and banks are repaid (or not).

[13] Assuming that all banks comply with this obligation, a bank run, which we could think of as a case of prohibitively high refinancing costs, is ruled out. This justifies our normalization assumption (see previous footnote).

[14] We can consider b^B as the outcome of the bank's cost-minimization problem with respect to the effort expended on recovering claims or corporate rescues, thus capturing both the costs of coordination of creditors and the bargaining power in debt renegotiations.

return to financing the project becomes negative and the financing profitability constraint is violated. This is more likely the smaller λ or b^R or the higher $\bar{R}$. We set $R^B = \infty$ in this case, assuming that banks do not offer finance for projects with negative expected values. If the financing profitability constraint is met we can solve Equation (8) for R^B, which yields

$$R^B := R^B[\lambda, \mathcal{B}] = \frac{\bar{R}}{\rho^B} \quad \text{with} \quad \rho^B = \lambda + (1-\lambda)b^B - \bar{R}c^B(1-\lambda)(1-b^B). \tag{9}$$

Hence, the interest rate is determined by the bank's refinancing costs and a project-specific risk adjustment factor ρ^B. In a world without payment uncertainty (either λ or b^B equal one), banks would simply pass through their refinancing costs $\bar{R}$ to firms. Suppose for expositional purposes but without loss of generality that $b^B = 0$. Then, in an Arrow-Debreu world with costless risk diversification ($c^B = 0$), firms would face an interest rate $\frac{\bar{R}}{\lambda}$ reflecting banks' refinancing costs augmented by an actuarially fair risk premium. If in this case $\bar{R}$ reflects the true opportunity costs of finance in the economy, then it can be seen from the firms' profit-maximization problem that private marginal costs are perfectly aligned with social marginal costs.[15]

In general, it holds that in a competitive financial market transaction costs are passed on to the borrowing firms. To what extent these costs matter depends on characteristics of the project and the banks' refinancing conditions. We summarize the relationship between financial market conditions and the project-specific interest rate in Result 2.

Result 2. *The project-specific costs of external finance with pure bank financing, R^B, are high if refinancing costs $\bar{R}$, the costs of risk diversification c^B, or the probability of default $1-\lambda$ are high, or if the recovery rate b^B is low. The effect of higher costs of diversification or a lower recovery rate is stronger if refinancing costs or the probability of default are high.*

Proof: See Appendix A. ■

2.4 The Credit Guarantee Scheme

Suppose that firms can insure themselves against default risk by means of a guarantee or an insurance that pays out in the event of importer default. The main difference between these two instruments is that the guarantor takes over the claim against the contract partner in case of default, which the insurer does not. From the firm's point of view, both schemes are ceteris paribus identical in their

[15] Note that in contrast to the work by Matsuyama (2008), Manova (2013), and Feenstra et al. (2011), moral hazard is absent from our model. Furthermore, even when there are frictions on financial markets in terms of $c > 0$, the incentives of the bank and the firm are well aligned, and the bank's participation constraint, that is key in the aforementioned models (sometimes referred to as "cash-flow constraint" or "financing constraint"), is never more restrictive than the firm's participation constraint (break-even condition) (7). This result holds for the case where external finance is more costly than internal finance. In the general case that we treat in the Appendix, the borrowing constraint becomes relevant again.

effect since we have (implicitly) set its own recovery rate equal to zero.[16] Thus, we can describe an insurance as a special case of a guarantee, namely, the single case where the recovery rate of the guarantor b^G is zero.[17]

We assume that the guarantor (potentially the government, but not necessarily so) offers the following financing terms: It guarantees to pay the amount $G \leq pq$ in the event of default, in exchange for a premium payment of γG. In the event of default, the guarantor assumes the part G of the claim against the importer and is able to recover a share $b^G \in [0,1]$. Furthermore, just like for banks, the guarantor has to hedge risk in its balance sheet, for which it incurs $c^G \in [0, \frac{\bar{R}-1}{\bar{R}}]$ per unit of value at risk. We summarize the guarantor's financing conditions in $\mathcal{G} = \{\bar{R}, b^G, c^G\}$. Except for $\bar{R}$, we allow them the potential to be different from the bank's parameters $\mathcal{B}$, reflecting differences in the guarantor's ability to diversify risk or recover claims. In a competitive insurance market, the premium γ is then determined by the following no-arbitrage condition

$$\gamma G \bar{R} + (1-\lambda) b^G G = (1-\lambda) G + c^G \bar{R}(1-\lambda)(1-b^G) G, \tag{10}$$

subject to a profitability constraint

$$\lambda + (1-\lambda) b^G > \bar{R} c^G (1-\lambda)(1-b^G).$$

The no-arbitrage condition of the guarantor states that the return from the premium γG, that can be invested immediately at rate $\bar{R}$, and the return from acquiring the claim in the event of default $(1-\lambda) b^G G$ equal the expected payment $(1-\lambda) G$ plus the costs of hedging the value at risk in the balance sheet. Similar to the case of the bank, the guarantor is faced with a profitability constraint that requires the expected return to exceed the costs, which is more likely if c^G is small, λ or b^G are high, or $\bar{R}$ is small. If the constraint fails to holds, we set $\gamma = \infty$. Otherwise, we can solve Equation (10) for γ to obtain

$$\gamma := \gamma[\lambda, \mathcal{G}] = \frac{(1-\lambda) - (1-\lambda) b^G + c\bar{R}(1-\lambda)(1-b^G)}{\bar{R}}. \tag{11}$$

With the guarantee in hand, firms can obtain credit from the bank at the "risk-free" rate $\bar{R}$. To show how the firm's costs of external finance under bank financing with a credit guarantee are determined, we consider again the firm's profit-maximization problem. Clearly, for the risk-neutral firm any coverage is profitable only if it decreases the costs of external finance; hence, a guarantee will not be purchased if $R^G > R^B$. It is straightforward to show that firms will want to cover exactly the share of

[16] Note that we can do this without loss of generality as long as the recovery rate of the firm is smaller than that of the bank or guarantor, as we can think of λ as reflecting two factors: the repayment probability and the firm's recovery rate.

[17] Another difference between the two instruments is that the guarantee cannot cover more than the value of the contract, whereas, potentially, the insured amount can exceed the loss associated with the actual default. This would become relevant if the insurer was able to offer a premium that is actuarially fair or favorable from the point of view of the firm, even though the recovery rate of the insurer is zero. We neglect this possibility, since, as will become clear below, arbitrarily small transaction costs are sufficient to render the insurance premium non-favorable when $b = 0$.

the transaction that they finance externally when $R^G < R^B$; see Appendix B. Under the assumption that external finance is more costly than internal finance, the share of the investment that is financed externally is given by $\ell = aq + f - k$. However, if the firm decides to purchase a guarantee, it needs additional funds in the first period. The total amount borrowed from the bank is thus $L = \ell + \gamma G$. Furthermore, to fully eliminate the default risk for the bank, the guarantee must cover not only the loan but also the associated interest payment. That is, if the firm chooses to fully cover the loan L, it needs to purchase a guarantee in the amount $G = \bar{R}L$. G is thus given by $G = \frac{\bar{R}}{\bar{R}-1}(aq + f - k)$. With such a guarantee, the bank's credit risk is eliminated and hence the competitive interest rate for the covered loan is equal to $\bar{R}$. The firm's expected profit-maximization problem is then

$$\begin{aligned} \max_p \quad & \lambda pq + (1-\lambda)G - \bar{R}k - G \\ & = \lambda pq + (1-\lambda)\frac{\bar{R}}{1-\bar{R}\gamma}(aq + f - k) - \bar{R}k - \frac{\bar{R}}{1-\bar{R}\gamma}(aq + f - k). \end{aligned} \tag{12}$$

With probability λ the firm receives the value of its sales from the importer, with probability $1-\lambda$ the guarantee pays off in the amount G. With certainty, all liquid funds k, which have opportunity costs of $\bar{R}$, are invested and the loan plus interest $G = \bar{R}L$ is repaid. Rearranging Equation (12) shows that expected profits are given by Equation (6) with

$$R^G = \frac{\bar{R}}{\rho^G} \quad \text{and} \quad \rho^G = 1 - \bar{R}\gamma = \lambda + (1-\lambda)b^G - c\bar{R}(1-\lambda)(1-b^G). \tag{13}$$

In analogy to Result 2 we can establish how financial market conditions affect the financing cost of firms using credit guarantees. This is summarized in Result 3.

Result 3. *The project-specific costs of external finance under the financing scheme with a credit guarantee R^G are high if refinancing costs $\bar{R}$, the costs of risk diversification c^G, or the probability of default $1-\lambda$ are high, or if the recovery rate b^G is low. The effect of higher costs of diversification or a lower recovery rate is stronger if refinancing costs or the probability of default are high.*

Proof: See Appendix A. ■

Comparing the costs of external finance under both financing schemes (Equations (9) and (13), observing Equation (11)) shows that they are similar if risk diversification costs and the recovery rates of the bank and the guarantor do not differ for a given export transaction, that is, if $c^B = c^G$ and $b^B = b^G$ so that $\rho^B = \rho^G$. This is a direct implication of the risk-neutrality assumption. From Equation (2) it is immediate that expected profits with and without a guarantee are equivalent if the financing costs with a guarantee R^G equal the costs of pure bank financing R^B.

2.5 Testable Hypotheses about the Effects of State Export Credit Guarantees

Suppose firms have chosen the financing mode which minimizes their costs of external finance given financing conditions of competitive banks, $\mathcal{B}$, and competitive guarantors, $\mathcal{G}$. Then, credit guarantees provided by a public agency that makes non-negative profits, or, in other words, observes a similar no-arbitrage pricing condition as private agents on competitive markets (cp. Equations (8) and (10)), will be used only if the government has a cost advantage. Suppose this is true, for example, due to stronger bargaining power or because the government faces lower (no) costs of risk diversification. Then, firms using state credit guarantees will face lower cost of external finance, have higher optimal sales for a given export transaction, and are more likely to cross the profitability threshold. The same effects, of course, would arise if the government was subsidizing the guarantees. Yet, the empirical fact that the German state credit guarantee scheme has yielded non-negative cumulative profits over a period of 60 years strongly suggests that the premia charged by Euler Hermes adhere to a profitability constraint.

As discussed in the introduction to this paper, the government might have a cost advantage in providing guarantees for projects with large values at risk because, thanks to its "deep pocket," it does not have to engage in costly risk diversification. Looking at yearly profit and loss accounts of Euler Hermes shows that the cumulative gain masks substantial variation in annual results. For example, between 1982 and 1998, repeated annual losses were incurred, involving amounts up to 2.5 billion. In 1999, annual results turned positive and have remained so to date.[18] With its largely unrestricted refinancing capacity the state can withstand repeated periodic losses associated with large risky projects, for which the positive expected value materializes only in the very long run. Of course, a perfectly functioning capital market should be able to diversify those types of risks equally well. However, in the presence of diversification or coordination costs, the above reasoning could explain a government cost advantage that is pronounced for very large and very risky projects.[19]

Furthermore, the government is likely to have an advantage in asserting claims in foreign countries thanks to more bargaining power and because, in contrast to a dispersed set of agents that jointly finance projects through the capital market, it does not have to incur coordination costs when it comes to debt renegotiation. Since a substantial number of defaults can be attributed to political events, bargaining power seems to be very important. In 2006, about 50 percent of the total amount of claims (292.9 million Euro) were political risk claims.[20] Many outstanding claims, particularly

[18] Interestingly, as Dewit (2001) points out, in 1995 the WTO Agreement on Subsidies and Countervailing Measures came into force, which significantly strengthened the rules for provision of state export credit guarantees. In particular premia policies yielding long–term losses were outlawed and countries supposedly suffering from those policies were granted access to the Dispute Settlement System.

[19] Of course, the refinancing capacity of the government is not unlimited in practice. However, it seems reasonable to assume that it exceeds the capacity of private agents on financial markets significantly. Moreover, the total amount of risk covered with Hermes guarantees at a given point in time is limited and small compared to Germany's GDP. In 2010, this so-called "statutory maximum exposure limit" was 120 Billion Euro (less than 5% of GDP).

[20] For a detailed description of events that are classified as political risks see *http://www.agaportal.de/en/aga/grundzuege/gedeckte_risiken.html*. All numbers in this section are from the Euler Hermes Annual Report 2010, unless stated otherwise. The report is available at *http://www.agaportal.de/en/aga/downloads/jahresberichte.html*.

those from developing countries, are handled by the Paris Club as part of multilateral negotiations on debt restructuring.[21] In 2010, the German federal government held claims of 4.25 billion Euro, of which 1.67 billion were regulated under official rescheduling agreements. Also, the largest part of the cumulative losses before 2006 can be attributed to the Russian economic crisis that occurred in the aftermath of the Soviet Union's collapse. In 2005 and 2006, Russia paid back about 13.6 million Euro,[22] resulting in large positive annual gains and rendering the cumulative result positive. Negotiations with Russia were also conducted by the Paris Club. Based on those facts, we hypothesize that the government has a higher recovery rate in default cases where bargaining power matters.

Presupposing that the government has lower diversification costs and higher recovery rates in case of default, we can derive the following testable hypotheses based on Results 1 and 3:

Testable predictions. *With financial markets characterized by conditions $\mathcal{B}$, $\mathcal{G}$ and firms having chosen profit-maximizing financing modes according to Equation* (2)*, the presence of a state credit guarantee scheme possessed of cost advantages has the following effects:*
(i) It reduces firms' financing costs and thus leads firms to conduct more export transactions and increase the volume of sales for a given transaction.
(ii) The effects are stronger when refinancing conditions in private markets are tight.
(iii) Small firms and firms with high demand for external finance or small liquid funds benefit more from the presence of such a scheme.

Furthermore, we look for evidence of the presupposed cost advantages by testing the following hypothesis:

(iv) The government's cost advantage is more pronounced for export transactions involving large values at risk and/or a foreign public agency as guarantor of the importer.

3 Empirics

3.1 Data

Euler Hermes provided us with a dataset including all covered export transactions between 2000-2010, of which we use all single transaction policies. Guarantees of this type cover specific transactions, that is, the type of good, the importer, the value, and the duration are specified.[23] After merging

[21] The Paris Club is a non-institutionalized association of creditor countries that was formed to facilitate multilateral debt renegotiation, restructuring, and cancellation agreements with indebted countries. The Paris Club regularly agrees to reschedule debt in favor of developing countries. In 2010, for example, Germany agreed to a total debt forgiveness of 643 million Euro under the HIPC (Heavily Indebted Poor Countries)- Initiative of the Paris Club. This, strengthens the case for the program itself being operated at non-negative returns.

[22] See the Annual Report of Euler Hermes 2006.

[23] Single transaction policies make up the largest part of the total volume of covered exports. Other types are whole turnover policies, which are provided for a specific product and one (or sometimes more than one) destination market in a given period of time without specifying the importer, and revolving policies, which can be used for repeated similar

the guarantee data with the Ifo Business Survey we are left with 2,659 covered transactions among 684 firms in a total pool of 5,530 firms that we observe over the period from January 2000 to December 2010. The use of lagged values in our preferred estimation specification somewhat reduces our estimation sample. For each covered transaction the dates of the first and the last shipment are registered. We consider a firm as "treated" with a guarantee during the period spanned by those two observations. Furthermore, the guarantee data contains Euler Hermes' risk rating of importers which is based on the class of the importer's guarantor (state, bank, private, no guarantor) and a rating on a numerical scale within each class. Since the number of observations in many bins is small, we collapse the risk rating into four categories: 1 "no guarantor/unknown," 2 "private guarantor," 3 "foreign bank," and 4 "foreign state/foreign central bank." When firms have multiple insured transactions at the same time, we pool the covered volumes together, assigning all respective types of guarantors to this one observation.

Table 1: Summary Statistics of Estimation Sample

Estimation sample		Obs	Mean	Std. Dev.	Min	Max
Stock of for. orders	binary	210,371	0.10	0.30	0	1
Demand	ordinal	210,371	1.99	0.64	1	3
Employment		210,371	2,706	16,845	1	200,000
ExpectExp	ordinal	210,371	2.06	0.53	1	3
Unconstrained	binary	210,371	1.61	0.29	1	2
Ibrate	in %	210371	2.96	1.32	0.64	5.11
WorkingCap	in bn. EUR	60,695	42.2	141	-1,290	2,550
CashFlow	in bn. EUR	53,379	34.2	183	-1,080	4,670
Tangibles	in bn. EUR	65,382	49.8	246	0	6,260
ContractSize	in mn. EUR	2,659	3.25	16.2	0	445
# Firms		3,964				
Estimation sample - Hermes firms						
Stock of for. orders	binary	36,375	0.14	0.35	0	1
Demand	ordinal	36,375	2.01	0.63	1	3
Employment		36,375	2,162	10,600	3	191,200
ExpectExp	ordinal	36,375	2.11	0.54	1	3
Unconstrained	binary	36,354	1.63	.28	1	2
Ibrate	in %	36,375	2.97	1.30	0.64	5.11
WorkingCap	in bn. EUR	13,133	53.8	98.7	-58.6	719
CashFlow	in bn. EUR	12,538	24.3	109	-1,080	1,240
Tangibles	in bn. EUR	13,384	50.8	130	0	1,810
ContractSize	in mn. EUR	2,659	3.25	16.2	0	445
# Firms		521				

This table presents summary statistics for major variables used in the following estimations. The data originates from the Ifo Institute's Business Survey and a data set which comprises the universe of state export credit guarantee transactions provided by Euler Hermes.

The Ifo Business Survey covers about 7,000 firms which are surveyed on a monthly basis. In the questionnaire, firms are asked to appraise their own business conditions and the economic environment

transactions. The latter are quantitatively only of marginal importance.

in general, choosing between three or four possible answers usually coded as 1 "better than usual," 2 "as usual," 3 "worse than usual," and, occasionally, 4 "does not apply."[24] For some variables, such as *employment*, the survey asks for the actual numbers.[25] We use firms' assessment of their *stock of foreign orders* as dependent variable in our estimation. The respective survey question refers to the current stock of *settled* deals and the variable takes on the four values described above. Since we primarily estimate a binary choice model, we collapse the categories "as usual," "worse than usual," and "no exports/does not apply" into one. Moreover, we use firms' assessment of *expected exports* (1 "decrease" 2 "stay the same" 3 "increase") and the general *demand* situation (1 "worsened" 2 "unchanged" 3 "improved"), as well as the indicator variable *Unconstrained*, reflecting firms' assessment of production constraints (1 "yes" 2 "no"), as independent variables. Table C.2 in the Appendix contains the relevant survey questions.[26] We obtain yearly data on firms' stock of *tangible assets*, the amount of *working capital*, and their *cash flow* from the Amadeus database. This information is available only for a subsample of firms. Furthermore, from Thomson Reuters Datastream we obtain monthly averages of the *interbanking rate* (Euribor) charged on inter-bank loans with a duration of three months. Table 1 summarizes the data for the estimation sample used in our preferred specification.[27] Since we use six lags, observations start in July 2000.

3.2 From Theory to Empirics

Our estimation equations derive directly from the model presented above. Let $\ln y^*_{it} := \ln(\lambda r_{it}) = \ln\lambda - (\varepsilon-1)\ln R_{it} - (\varepsilon-1)\ln(\frac{a}{\theta}) + \ln A_{it}$ be the expected export sales of firm i at time t as derived in Subsection 2.2. Then, denoting with $\Delta x_{it} := \ln x_{it} - \ln \underline{x}_i$ a deviation from the firm's usual conditions $\underline{x}_i$ and assuming that the firm's productivity, the demand elasticity, and the riskiness of the project are constant, deviations in expected export sales result as

$$\Delta y^*_{it} = -(\varepsilon-1)\Delta\bar{R}_t + (\varepsilon-1)\Delta\rho_{it} + \Delta A_{it}. \tag{14}$$

Hence, changes in expected export sales arise from changes in financing conditions induced by changes in the banking sector's refinancing costs $\bar{R}$ and changes in the contract-specific risk premium $1/\rho$, as well as changes in demand conditions A.

Furthermore, let, in accordance with Equation (7), $\ln\bar{y}_{it} = \ln\varepsilon + \ln\kappa_{it}$ denote the threshold level of expected sales required to break even, with $\kappa_{it} = \lambda R_{it}(f_i - k_i) + \bar{R}_t k_i$ summarizing the firm's effective costs. Positive changes in expected exports are observed only if the new level of expected sales is at least as high as the break-even level, that is, if $\ln y^*_{it} \geq \ln\bar{y}_{it}$. Using the definition of Δ

[24] For ease of interpretation, we recoded the variables so that 3 "higher," 2 "as usual," 1 "lower."

[25] The survey is actually conducted at the product level, although only some questions are product specific. The number of products per firm is small and equals 1 in the majority of cases. Furthermore, survey answers within firms across products are very strongly correlated; hence, we feel safe dropping multiple products randomly.

[26] The original questions and answers can be found at *http://www.cesifo-group.de/ifoHome/facts/EBDC/Ifo-DataPool/EBDC-Ifo-Business-Survey-Industry/ebdc-ibs-ind-2012b/main/02/variablesDocBinary/ebdc-ibs-ind-2012b-de.pdf.*

[27] Table C.1 in the Appendix sets out summary statistics for the full sample: they do not reveal any remarkable differences.

from above and holding constant the riskiness and the fixed costs of the project, as well as the liquid funds of the firm, we can rewrite this relationship in terms of Δy^*_{it} and $\Delta\kappa_{it}$, obtaining

$$\Delta y^*_{it} \geq \ln\varepsilon + \Delta\kappa_{it} + \ln\underline{\kappa}_i - \ln\underline{\bar{y}}_i \qquad \text{with} \qquad \Delta\kappa_{it} = \Delta\bar{R}_t - \Delta\rho_{it} + \frac{k_i}{\lambda/\rho_i(f_i - k_i) + k_i}\Delta\rho_{it}. \quad (15)$$

3.3 Empirical Model

Since our data are qualitative in nature, meaning that we observe the direction of the deviation in a firm's export sales but not the magnitude, the structure of the model lends itself to estimation by a categorical choice model. Our observed variable is the firm's assessment of its *stock of foreign orders* relative to usual conditions[28]:

$$\Delta y_{it} = \begin{cases} 1 \text{ ``larger than usual''} & \text{if} \quad \Delta y^*_{it} \geq \ln\varepsilon + \Delta\kappa_{it} + \ln\underline{\kappa}_i - \ln\underline{\bar{y}}_i \\ 0 \text{ ``as usual''/``worse that usual''/``no exports''} & \text{else} \end{cases}$$

The latter three answering possibilities have been collapsed into one since, for reasons outlined below, the binary choice model is our preferred estimation strategy. The probability that firm i reports a larger than usual stock of foreign orders at time t is then given by

$$\mathrm{P}[\Delta y_{it} = 1|\xi_{it}] = \mathrm{P}[\Delta y^*_{it} \geq \ln\varepsilon + \Delta\kappa_{it} + \ln\underline{\kappa}_i - \ln\underline{y}_i]. \quad (16)$$

where $\xi_{it} = [\epsilon, \kappa_{it}, \underline{\kappa}_i, \underline{\bar{y}}_i]$. Our empirical counterpart to Equation (14) is

$$\begin{aligned}\Delta y^*_{it} = {} & \alpha_{1t} + \beta_1 Hermes_{it} + \beta_{11} Hermes_{it} \times Ibrate_t + \\ & + \beta_{12} Hermes_{it} \times (\ln\ ContractSize)^2_{it} + \beta_{13} Hermes_{it} \times Guarantor_{it} + \\ & + \beta_{20} Demand_{it} + \beta_{21} Demand_{i,t-1} + ... + \beta_{2l} Demand_{i,t-l} + \\ & + \beta_{30} ExpectExp_{it} + \beta_{31} ExpectExp_{i,t-1} + ... + \beta_{3m} ExpectExp_{i,t-m} + \epsilon_{it} \end{aligned} \quad (17)$$

where α_{1t} captures, among other things, the direct effect of changes in refinancing conditions that are common to all firms. In line with Result 3, we expect that the grant of a Hermes guarantee implies $\Delta\rho_{it} > 0$, because it lowers the project-specific risk premium demanded by the firm's bank. We use a dummy variable, $Hermes_{it}$, that indicates whether a firm utilizes a guarantee at time t, to assess this prediction. The model furthermore predicts that the change in the risk premium due to the grant of a guarantee should be stronger if refinancing conditions are tight, or if the government's cost advantages are particularly important, because the transaction's risk is difficult to diversify or because bargaining power in debt renegotiation is of crucial importance. The role of refinancing conditions is captured by interacting the $Hermes_{it}$ dummy with $Ibrate_{it}$, the inter-bank interest rate. Regarding the costs of risk diversification and coordination, we have to work with a proxy argument since direct measures

[28] Ideally, we would perform the empirical analysis at the transaction level. However, linking the guarantee data to the survey is possible only at the firm level. We still expect to see the effects in the firm's assessment of its total export sales, albeit perhaps less pronounced.

are not observable. We use the squared size of the covered loan $(\ln \ ContractSize)^2_{it}$ to assess whether lower costs of risk diversification or lower coordination costs in the case of renegotiation matter, assuming that these costs are higher when the amount involved is larger. For the bargaining power channel we use the importer's type of $Guarantor_{it}$ as a proxy for the relative importance of the government's bargaining advantage. We expect that this advantage will be particularly strong if the foreign government or the foreign central bank is involved.

$Demand_{it}$ is the firm's assessment of its demand conditions, as described in the data section. To account for its categorical nature, we include it in the form of binary indicator variables for positive and negative changes. Coefficients on these indicators are thus to be interpreted as effects relative to the baseline category of "no change (demand as usual)." We include l lags of the demand variable to capture demand shocks in the past. Since the demand variable is not specific to the firm's export situation, we also include its assessment of future exports ($ExpectExp_{it}$) and m lags thereof to capture export-specific demand shocks. Our preferred estimation equation sets $l, m = 6$. We experiment with a greater number of lags, which turns out not to affect the results but does reduce the size of the estimation sample. Finally, ϵ_{it} captures unobserved effects on changes in the firm's export sales.

Our empirical model for the threshold equation is based on Equation (15). We use the same empirical specification for $\Delta\bar{R}_t$ and $\Delta\rho_{it}$ as above. Furthermore, k_i is used as an approximation to $\frac{k_i}{\lambda/\rho_i(f_i-k_i)+k_i}$, which is an increasing but non-linear function of k_i. The firm's average level of exports and financing costs, $\ln \underline{y}_i$ and $\ln \underline{\kappa}_i$, as well as the demand elasticity, $\ln\varepsilon$, are captured with a firm fixed effect c_i. Thus, we arrive at

$$\begin{aligned}\Delta y^*_{it} \geq\ & c_i + \alpha_{2t} + \delta_1 Hermes_{it} + \delta_{11} Hermes_{it} \times Ibrate_t + \delta_{12} Hermes_{it} \times (\ln \ ContractSize)^2_{it} + \\ & + \delta_{13} Hermes_{it} \times Guarantor_{it} + \delta_{14} Hermes_{it} \times LiquidFunds_{it} + \\ & + \delta_2 \Delta Ibrate_t \times LiquidFunds_{it} + e_{it}. \end{aligned} \tag{18}$$

To proxy the firm's endowment with liquid funds, $LiquidFunds_{it}$, we use the average level of its working capital, or, alternatively, its cash flow, over the sample period, assuming that this reflects a technological characteristic of the firm. In contrast to the stock at time t, the average level of working capital is not (or much less) reversely affected by changes in the stock of foreign orders. As further proxies for $LiquidFunds_{it}$ we use the firm's size, measured by $\ln Employment_{it}$, and the stock of tangible assets, $\ln \ Tangibles_{it}$, expecting that a larger stock reduces the firm's demand for *risky* credit. Arguably, the more of its loans the firm can cover with collateral, the less important becomes the availability of internal means of finance.

In the empirical model for the export sales equation (17) we have subsumed the effect of a change in the interbanking rate in a time fixed effect. Equations (9), respectively (13), and (15) suggest, that the strength of the indirect effect of banks' refinancing conditions running through $\Delta\rho_{it}$ depends on k_i as well.[29] Therefore, we also interact $\Delta Ibrate_t$, the deviation of the interbanking rate at time

[29] The result that the direct effect is independent of the level of k owes to the assumption that firms' opportunity costs of investment are the same as the refinancing rate of banks. Imperfect correlation between the two, which might be reasonable empirically, would imply that k_i matters also for the direct effect.

t from the sample average, with the proxies for $LiquidFunds_{it}$. Finally, e_{it} captures unobserved determinants of the profitability threshold.

Combining Equations (17) and (18) yields our estimation equation

$$\mathrm{P}[\Delta y_{it} = 1 | \mathbf{x}_{it}, c_i] = \Gamma[\mathbf{x}_{it}'\tilde{\boldsymbol{\beta}} - c_i], \tag{19}$$

where

$$\begin{aligned}\mathbf{x}_{it}'\tilde{\boldsymbol{\beta}} =& (\beta_1 - \delta_1)Hermes_{it} - \delta_{14}Hermes_{it} \times LiquidFunds_{it} + (\beta_{11} - \delta_{11})Hermes_{it} \times Ibrate_t + \\ &+ (\beta_{12} - \delta_{12})Hermes_{it} \times (\ln\ ContractSize)_{it}^2 + (\beta_{13} - \delta_{13})Hermes_{it} \times Guarantor_{it} \\ &+ \delta_2 \Delta Ibrate_t \times LiquidFunds_{it} + \beta_{20}Demand_{it} + \beta_{21}Demand_{i,t-1} + ... + \\ &+ \beta_{2l}Demand_{i,t-l} + \beta_{30}ExpectExp_{it} + \beta_{31}ExpectExp_{i,t-1} + ... + \beta_{3m}ExpectExp_{i,t-m} + \alpha_t.\end{aligned}$$

Γ denotes the distribution function of the combined error term $u = e - \epsilon$ and $\alpha_t = \alpha_{1t} + \alpha_{2t}$. To estimate Equation (19) parametrically, we make assumptions about the distributions of e and ϵ.

3.4 Estimation Strategies

Assuming that e and ε are independent normally distributed yields a probit model. The probit model requires for consistency that the firm fixed effects are uncorrelated with the regressors, thus implying a random effects model. It is possible to relax this assumption to some extent if the correlation can be specified explicitly. For example, if the fixed effects correlate only with the means of the regressors, then a Mundlak-Chamberlain-type probit model yields consistent parameter estimates.[30] The corresponding assumption on the distribution of the firm fixed effect is

$$c_i | \mathbf{x}_i \sim N(\psi^s + \bar{\mathbf{z}}_i'\mathbf{b}, \sigma_c^2) \tag{20}$$

where $\bar{\mathbf{z}}_i$ denotes a vector of firm averages of the independent variables $Hermes_{it}$, $Demand_{it}$, and $ExpectExp_{it}$ over the sample period. We also include averages of $\ln Employment_i$ and $Unconstrained_i$ as we expect them to partly explain the firm's position relative to the threshold. ψ^s is a sector-specific constant. Under the assumption of normality of u and the conditional normal distribution of the c_i's, pooled probit estimation of Δy_{it} on $\mathbf{x}_{it}, \bar{\mathbf{z}}_i$ and a vector of sector dummies yields consistent estimates of scaled coefficients, $\tilde{\boldsymbol{\beta}}_{\boldsymbol{a}} = \tilde{\boldsymbol{\beta}} \frac{1}{(\sigma_c^2 + \sigma_u^2)^{-1/2}}$, $\boldsymbol{b}_{\boldsymbol{a}} = \boldsymbol{b} \frac{1}{(\sigma_c^2 + \sigma_u^2)^{-1/2}}$ and $\boldsymbol{\psi}_{\boldsymbol{a}}^{\boldsymbol{s}} = \boldsymbol{\psi}^s \frac{1}{(\sigma_c^2 + \sigma_u^2)^{-1/2}}$. These scaled coefficients are sufficient to compute average partial effects and predicted probabilities, which are described in greater detail in Appendix C.1.[31] Robust standard errors are computed to account for serial correlation due to the presence of latent heterogeneity.[32]

We employ the conditional logit model as an alternative estimation strategy. This model rests on

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[30] C.p. Wooldridge's (2002) version of the approach proposed by Mundlak (1978) and generalized by Chamberlain (1980).

[31] C.p. also Wooldridge (2002) [p. 488] for a detailed discussion. σ_c^2, σ_u^2 denote the conditional variance of c, u, respectively.

[32] C.p. expression (15.53) in Wooldridge (2002).

the assumption that the error terms in the latent variable specification and the threshold equation are independent type I extreme value distributed, so that the composite error term $u = e - \epsilon$ follows a logistic distribution. An important advantage of this model over the previous one is that it allows for unrestricted correlation of the unobserved fixed effect and the explanatory variables. However, it has disadvantages as well. Namely, for consistency, it requires that scores are uncorrelated over time. Another drawback that the logit model has in common with linear fixed effect estimation is that only firms exhibiting variation in y_{it} over time are included. In contrast to the linear case, this presents us with an additional problem when we intend to compute average partial effects or partial effects evaluated at sample means of the covariates, as this requires estimates of the c_i's for all firms in the sample.[33] We thus view the results from the conditional logit estimation as robustness checks for the signs of our parameter estimates with respect to the orthogonality assumption, but do not compute partial effects.

Finally, as a further robustness check we estimate a linear probability model (LPM) with fixed effects. Here, the presence of arbitrary correlation between the c_i's and the explanatory variables, as well as serial dependence of scores, does not affect consistency of the parameter estimates. Cluster-robust standard errors can be obtained for inference.

3.5 Identification

Equation (19) rest on the assumption that the distribution of the joint error term is independent of firm characteristics x_{it}, c_i. A concern about this assumption being violated might arise from the fact that both the decision to export and to apply for a guarantee are in parts jointly determined by demand conditions. In fact, for the type of guarantees considered here, firms apply on the basis of a well-defined project. Randomness of treatment is achieved by the fact that the total volume of guarantees granted by the government per year is limited by caps on the amount of risk assumed per country and in total and thus some applications are rejected.[34] A natural counterfactual would thus be the firms whose applications have been rejected but, unfortunately, this information is not available.[35] Instead, we look at within-firm variation. Fortunately, the Ifo Business Survey is unique in that it includes firms' monthly appraisal of demand conditions and export expectations. Hence, we are able to control for firms' demand situation with contemporary and lagged demand indicators and thus we can attribute the effect of our treatment indicator to a genuine effect of Hermes guarantees on exports.

Another potential issue is selection based on time-varying financial vulnerability of the firm. As

[33] In principle, the c_i's can be backed out based on the data and consistent estimates of the other parameters. However, this is possible only for the firms included in the estimation. Hence, partial effects at the mean can be computed only at the mean value of the c_i's for the included firms. Computation of average partial effects would require specifying a distribution of the c_i's. Given that we explicitly allow for correlation between the c_i's and the right-hand-side variables, computations based on the mean or the empirical distribution of the c_i's of the included firms only do not constitute a satisfactory solution to this problem.

[34] For the period 2000 to 2010, only about two thirds of the total value of coverage applications was granted.

[35] Furthermore, we would need to observe everything that was observable to the agency when making the decision, at least as far as it is related to the feasibility and success rate of the project, which is not very realistic either.

the model suggests, guarantees are particularly effective for firms facing tight credit conditions, which makes them more likely to apply. The firm's financial situation, however, impacts export performance through the costs of finance and credit constraints. Since such an effect would lead to a downward bias of the effect of Hermes, our estimates are conservative in this respect.

For these reasons, we are confident that the sign of our estimated coefficient is indicative for the average effect of Hermes guarantees on exports. Moreover, the interaction terms enhance the credibility of the estimated average effect as they allow to reveal channels through which Hermes guarantees unfold their effect. However, to make sure that the economic interpretation of the interaction terms is meaningful, we have to rule out reverse influences of Hermes guarantees on the interaction variables. A concern regarding the interactions with the liquid assets proxies is that unusually high exports due to more beneficial financing conditions could adversely affect the firm's stock of liquid funds. To circumvent this reverse influence, which is a temporary effect, we use within-firm averages over the sample period. For our alternative proxies, $\ln Employment_{it}$ and $\ln Tangibles_{it}$, we would expect that these variable are, if at all, positively affected by higher than usual exports. Hence, a reverse influence would work in the opposite direction as our hypothesized relationships.

3.6 Results

3.6.1 Baseline Estimations

Table 2 contains the results of our baseline model for assessing the impact of a Hermes guarantee on the probability that firms report their stock of foreign orders to be "larger than usual." Results are based on Equations (19) and (20), except for the interaction terms that we add in a second step below. The results in Column 1 are based on the most parsimonious specification to which we subsequently add further explanatory variables. Except for the *avg. Unconstrained* variable, we find significant estimates which point into the expected directions throughout the different specifications. The grant of a state credit guarantee has a positive effect on the probability that firms report higher than usual exports. Higher (lower) demand and export expectations today are associated with a higher (lower) than usual stock of foreign orders. When we add lags of those two variables (6 in Columns 2, 4-8 and 12 in Column 3), we find similar and statistically significant effects of demand conditions in the past.[36] The effect of $Hermes$ is very stable, notwithstanding the significant drop in observations that occurs due to the use of more lags. The effect remains positive and significant if we use the log of the volume covered by the guarantee, $\ln\ ContractSize$, instead of the indicator variable, as shown in Column 5.[37] We also estimate an ordered probit model with three categories of the variable *stock of foreign orders* ("better than usual", "as usual," and "worse than usual"). The results presented in Column 6 are very similar. Even though this specification uses more of the available information than

[36] For brevity's sake, these estimates are omitted from the table, but are available from the authors upon request.

[37] Since we know only the duration of the coverage and the total volume, but not the volume per month, we distribute the total volume evenly across the months with coverage. Furthermore, we add a 1 to all observations exhibiting zero guaranteed volumns before taking logs. Due to these major but necessary modifications, this is not our preferred left-hand-side variable.

does the binary probit, we still prefer the latter because a brant test leads us to reject the parallel lines assumption underlying the ordered model.

Regarding the role of the profitability threshold, we find that larger firms are more likely to report higher stocks of foreign orders, which, according to the model, is due to the fact that they are more likely to have passed the threshold. The effect of the average number of periods in which firms report being unconstrained in production is not stable, at times even negative. When we extend the threshold equation to include the average values of our independent variables (Column 4), the estimated effect of $Hermes$ becomes much smaller. The coefficient on the contemporaneous effect drops from .3 to .08 and the average of the $Hermes$ indicator is strongly significant. This suggests that firms using Hermes grants more often are more likely to have passed the threshold, thus enabling them to translate demand shocks into actual export transactions more frequently, even in periods when they do not receive a grant. This is well in line with the finding of related empirical research that even among the group of exporters, firms using Hermes guarantees are more productive (c.f. Felbermayr et al. (2012)). Hence, the average number of periods with coverage might well pick up the effect of productivity (which we do not observe). This highlights that firm fixed effects are important for capturing firm characteristics that determine both the firm's position relative to the profitability threshold and its potential selection into the guarantee scheme. In Columns 7 and 8 we present the results of the conditional logit estimation and the linear probability model with fixed effects, respectively. While the conditional logit model yields a highly significant and positive effect for $Hermes$, the LPM estimate is marginally not significant.

As pointed out above, pooled probit estimation of Equations (19) and (20) yields estimates of scaled coefficients. To assess the magnitude and economic significance of the effects we compute average partial effects as specified in Equations (C.2) and (C.3). Results for our preferred estimation specification (Column 4) are reported in Column 9. We find that the grant of a Hermes guarantee is associated with a 1.2 percentage point increase in the probability of reporting a higher stock of foreign orders. The average effect of better than usual demand conditions is 4.4 percentage points; a similar result holds for better than usual export expectations.

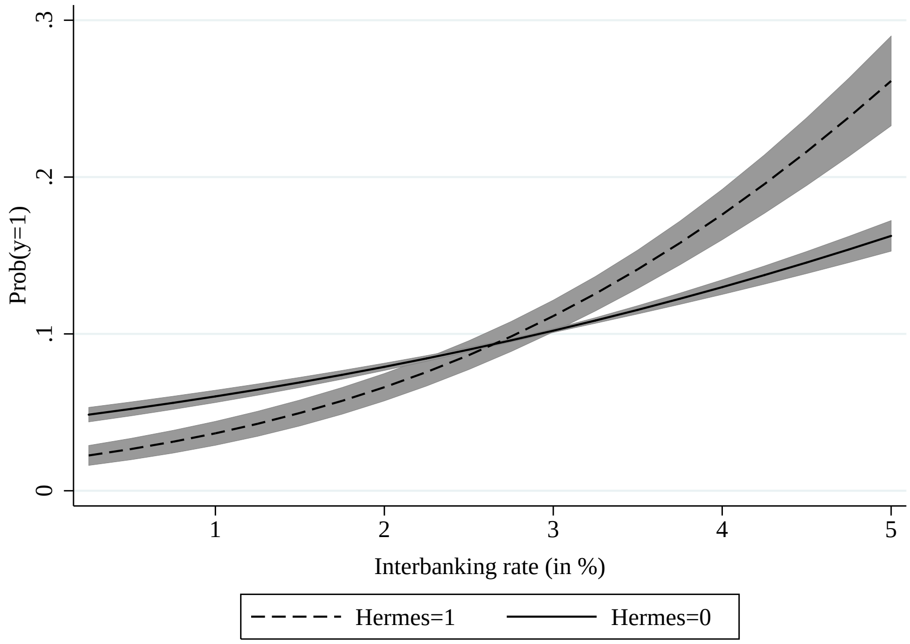
Taking our results together, we find support for a positive relationship between the use of guarantees and positive deviations from firms' normal stock of foreign orders that is in line with the model. To understand where the positive effect of Hermes guarantees comes from, we next assess the model's predictions about the systematic heterogeneity of the effect.

Table 2: Coefficient Estimates of Baseline Model

Dep. variable: *Stock of foreign orders*									
Model:	Mundlak-Chamberlain Probit					OProbit	Clogit	LPM	APE
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Hermes	0.300***	0.293***	0.318***	0.087**		0.100*	0.259***	0.0270	0.012**
	(.027)	(.030)	(.032)	(.041)		(.055)	(.081)	(.021)	(.006)
ExpectExp (−)	-0.290***	-0.138***	-0.131***	-0.138***	-0.138***	-0.721***	-0.371***	-0.005**	-0.017***
	(.017)	(.023)	(.027)	(.023)	(.023)	(.021)	(.056)	(.002)	(.003)
ExpectExp (+)	0.615***	0.306***	0.283***	0.309***	0.309***	0.280***	0.656***	0.067***	0.049***
	(.008)	(.012)	(.014)	(.013)	(.013)	(.016)	(.025)	(.004)	(.002)
Demand (−)	-0.355***	-0.263***	-0.267***	-0.247***	-0.247***	-0.527***	-0.689***	-0.025***	-0.030***
	(.012)	(.015)	(.017)	(.015)	(.015)	(.014)	(.035)	(.002)	(.002)
Demand (+)	0.417***	0.299***	0.296***	0.278***	0.278***	0.422***	0.655***	0.053***	0.044***
	(.008)	(.011)	(.012)	(.011)	(.011)	(.013)	(.023)	(.003)	(.002)
avg. *Unconstrained*	0.070***	-0.001	-0.028	-0.028*	-0.029*	1.182***			-0.004*
	(.012)	(.016)	(.018)	(.016)	(.016)	(.018)			(.002)
avg. ln *Emp*	0.047***	0.040***	0.029***	0.037***	0.036***	0.135***			0.005***
	(.002)	(.003)	(.003)	(.003)	(.003)	(.003)			(.0003)
avg. *ExpectExp*				-0.124***	-0.124***	-0.271***			-0.017***
				(.026)	(.026)	(.030)			(.004)
avg. *Demand*				0.492***	0.491***	0.837***			0.069***
				(.031)	(.031)	(.035)			(.004)
avg. *Hermes*				0.524***		0.298***			0.074***
				(.064)		(.090)			(.009)
ln *ContractSize*					0.007**				
					(.003)				
avg. ln *ContractSize*					0.038***				
					(.004)				
# lags	0	6	12	6	6	6	6	6	6
N	290,113	210,258	168,076	210,258	210,258	210,244	137,940	211,063	210,258
(Pseudo) R^2	.20	.45	.57	.45	.45	.19	.21	.13	

LPM denotes linear probability model. Average Partial Effects (APE) based on Column 4. Standard errors in parenthesis. *,** ,*** indicate significance on the 10,5, and 1% significance level. S.e. in probit (LPM) estimation are (cluster-) robust. All estimations include year × month dummies and sector dummies. # lags refers to lags of the categorical variables *ExpectExp* and *Demand*. Coefficients of lagged variables, time effects, and sector effects not shown. Pseudo R^2s in Columns 1-7, adjusted R^2 in Column 8.

Figure 1: Interbanking rate



Note: The figure shows the mean of predicted probabilities and 90% confidence intervals computed at various levels of the interbanking rate.

3.6.2 Heterogeneity of the Effect of Hermes

Table 3 presents the results for parameter estimates of the interactions in our preferred baseline model as in Table 2, Column 4. We find significant interaction terms with the expected signs for all financial variables of interest. However, assessing the qualitative and quantitative effect as well as statistical significance of interacted variables in non-linear models is not straightforward, see, e.g., Ai and Norton (2003) and Greene (2010). As Greene (2010) points out, the sign of the interacted variable's coefficient is not necessarily the same as the sign of the actual interaction effect. Furthermore, regarding inference, $\tilde{\beta}_{1k} = 0$ is not sufficient for the interaction effect to be zero. In fact, various combinations of estimated parameters and the data can equate it to zero. Hence, the standard statistical inference results for marginal effects are difficult to interpret economically. Greene (2010) suggests looking at predicted probabilities at different values of the covariates instead. We follow his advice and assess the heterogeneity of the effect of *Hermes* by graphically analyzing differences in predicted probabilities between firms with and without a guarantee at different levels of the covariates.[38]

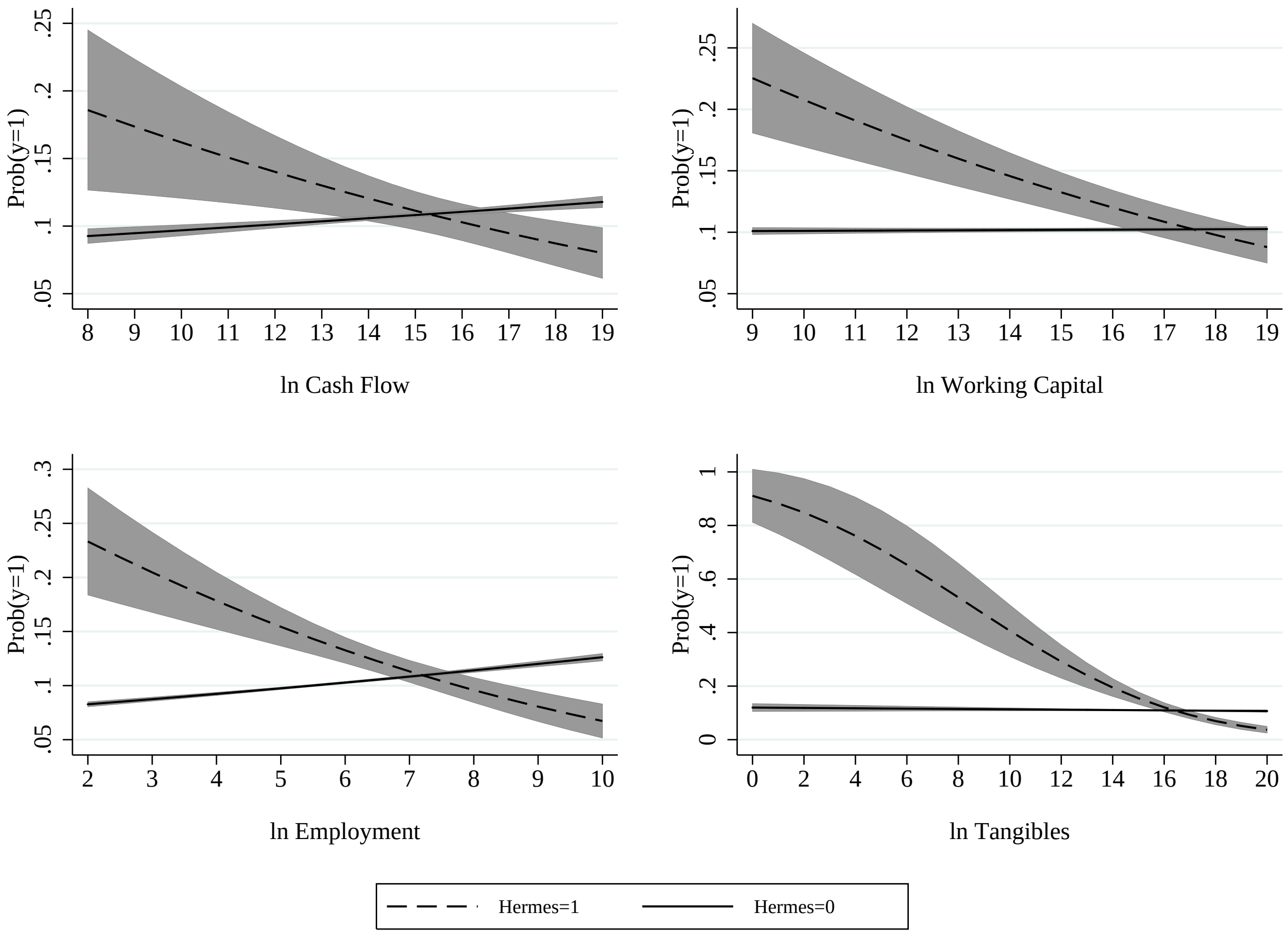
[38] Significance of the coefficient estimates is, of course, still important as it influences the precision of the predicted probabilities.

Table 3: Interaction Terms, Coefficient Estimates

Dependent variable: *Stock of foreign orders*						
	Model: Mundlak-Chamberlain Probit					
	(1)	(2)	(3)	(4)	(5)	(6)
Hermes	1.102***	-0.491***	1.204***	1.131***	3.106***	
	(0.167)	(.095)	(0.228)	(0.336)	(0.456)	
× ln *Emp*	-0.152***					
	(0.024)					
× *Ibrate*		0.184***				
		(.026)				
× avg. ln *WorkingCap*			-0.068***			
			(0.013)			
× avg. ln *CashFlow*				-0.074***		
				(.022)		
× ln *Tangibles*					-0.189***	
					(0.028)	
Δ*Ibrate*						
× ln *Emp*	0.018***					
	(0.002)					
× avg. ln *WorkingCap*			0.007***			
			(0.001)			
× avg. ln *CashFlow*				-0.005**		
				(0.002)		
× ln *Tangibles*					-0.003	
					(0.002)	
avg. ln *Emp*	0.035***	0.036***	0.036***	0.001	0.040***	0.037***
	(0.003)	(.003)	(.004)	(.005)	(.006)	(.003)
avg. ln *WorkingCap*			0.0002			
			(0.002)			
avg. ln *CashFlow*				0.017***		
				(0.004)		
ln *Tangibles*					-0.004	
					(0.004)	
ln *ContractSize*						-0.076***
						(.019)
× ln *ContractSize*						0.006***
						(.001)
N	210,258	210,258	114,209	92,989	65,352	210,258
Pseudo R^2	.45	.45	.70	.75	.82	.45

Estimations are based on the specification in Table 2, Column 4. Robust standard errors in parenthesis. *,** ,*** indicate significance on the 10,5, and 1% significance level. Coefficients of lagged variables, firm averages (except for direct effects of interacted variables), time and sector FE not shown.

Figure 2: Liquid Funds

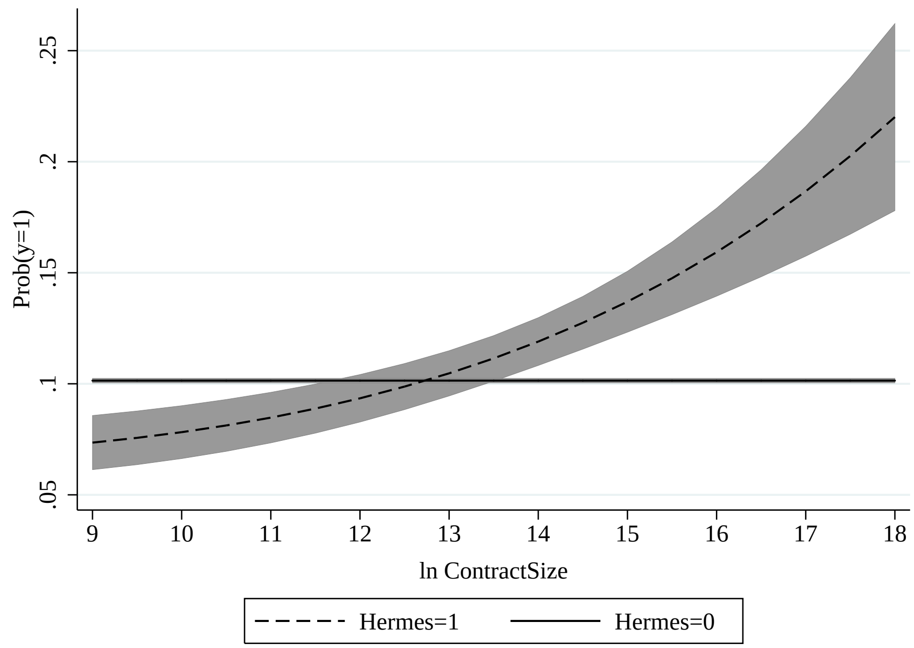


Note: The figure shows means of predicted probabilities and 90% confidence intervals computed at various levels of four measures of liquid funds.

The role of financing conditions. We first analyze the role played by the banking sector's refinancing conditions. We find support for the hypothesis that *Hermes* guarantees have a stronger effect when refinancing costs for banks are high. Figure 1 plots the predicted probabilities of reporting a higher than usual stock of foreign orders for firms with and without a guarantee. The difference between the two reflects the marginal effect of *Hermes*. As the figure shows, this difference becomes larger (in absolute terms) for higher values of the interbanking rate. Shaded bands reflect 90 percent confidence intervals. At first glance, it might be puzzling that both probabilities are upward sloping. However, note that the direct effect of the interbanking rate is absorbed in the time fixed effects and thus does not feature in our predictions.

Next, we consider how the need for external finance interacts with the *Hermes* variable. The theoretical model suggests that firms with little cash in hand benefit more from a favorable public guarantee scheme as this could move them above the profitability threshold. As detailed above, we use information on cash flow, working capital, firm size measured by employment, and tangible assets to test this prediction. For all measures of demand for external finance, we find the expected interaction effects. As the respective panels in Figure 2 illustrate, the effect of a Hermes guarantee is stronger for small firms and firms with little working capital, small average cash flows, and small stocks of tangible assets.

Figure 3: Contract size



Note: The figure shows the mean of predicted probabilities and 90% confidence intervals computed at various levels of the log contracted guarantee volumes.

A further testable result of the theoretical model is that changes in the banks' refinancing conditions affect firms with high demand for external finance more. We test this prediction by interacting $\Delta Ibrate$ with the proxies for firms' liquid funds. We find positive interaction effects for employment and working capital, suggesting that larger firms and firms with more liquid funds cope better with tighter refinancing conditions. See Figure C.1 in the Appendix for plots of the predicted probabilities across different levels of the external finance variables at the 25th, 50th, and 75th percentile of Δ *Ibrate*. Significantly positive interactions for all the proxies are confirmed by LPM-estimates that we present below. Those results highlight the sensitivity of firms' exports to lending conditions on private financial markets and thus lend support to our model.

Characteristics of the insured contract. To evaluate the hypothesized cost advantages of the public agency in providing credit guarantees we assess the effect of the covered volume and, in particular, its non-linearity. We expect that both the costs of risk diversification and the coordination costs of private financiers are higher for larger values at risk. Hence, we expect the public agency's cost advantage to be particularly pronounced for large contracted volumes. To test this presumption we add the squared volume of the coverage $(\ln\ ContractSize)^2$ and look at predicted probabilities for Hermes firms at different contract sizes (Figure 3). The horizontal line depicts the predicted probabilities for firms without Hermes. For firms with guarantees, the predicted probability is increasing in contract size, reflecting the direct effect. The interesting finding is the convexity, implying that the marginal effect of a larger covered loan is increasing.

Table 4: Type of the Importer's Guarantor

	$\widehat{\Pr}(y=1\|X)$	90% CI	# obs
$Hermes = 0$	**.102**	[.101;.103]	207712
$Hermes = 1$			
$State$	**.079**	[.045;.112]	59
$Bank$	**.121**	[.095;.148]	199
$Private$	**.164**	[.138;.191]	361
$None$	**.105**	[.095;.116]	2,695

Predicted probabilities, based on the specification in Table 2, Column 4.

Another source of government cost advantage is its stronger bargaining power in the event that debt renegotiation becomes necessary. We use information on the importer's type of guarantor to assess this prediction, assuming that bargaining power is particularly important for contracts where the importer's guarantor is the foreign government or a central bank. Table 4 presents the results: We find no support for this hypothesis. Only in the case of a private guarantor is the predicted probability significantly different from a firm without a guarantee; for state or central bank guaranteed transactions we find no effects.[39]

3.6.3 Robustness

As robustness analysis, we estimate the interactions in a linear probability model, where the coefficients on the interaction terms are straightforwardly interpreted as interaction effects. The estimated coefficients are presented in Table 5. We find our results from the Mundlak-Chamberlain probit model confirmed in regards to the signs of the interactions effects, although significance is weaker. The interactions with $\ln WorkingCapital$, $\ln Tangibles$, and $(\ln\ ContractSize)^2$ are no longer significant. For the interactions with $\Delta Ibrate$ we find significant interaction effects for all the financial variables. Furthermore, we estimate a conditional logit model and find significant parameter estimates throughout, confirming the signs of the coefficient estimates for the direct effect and the interactions terms. Table C.3 in the Appendix presents the results.

[39] Estimation of these interactions is likely hampered by our pooling of guaranteed transactions with potentially different guarantor types that take place at the same point in time. This is necessary because our dependent variable is at the firm level and not at the transaction level.

Table 5: Interaction Terms, Linear Probability Model

Dep. variable: *Stock of foreign orders*						
	Model: Linear Probability Model with FE					
	(1)	(2)	(3)	(4)	(5)	(6)
Hermes	0.173**	-0.167***	0.061	0.364***	0.193	
	(.084)	(.039)	(.094)	(.137)	(.189)	
× ln *Emp*	-0.022*					
	(.012)					
× *Ibrate*		0.066***				
		(.013)				
× avg. ln *WorkingCap*			-0.003			
			(.006)			
× avg. ln *CashFlow*				-0.023***		
				(.008)		
× ln *Tangibles*					-0.012	
					(.011)	
Δ*Ibrate*						
× ln *Emp*	0.006***					
	(.001)					
× avg. ln *WorkingCap*			0.002***			
			(.0003)			
× avg. ln *CashFlow*				0.001*		
				(.001)		
× ln *Tangibles*					0.001*	
					(.001)	
ln *ContractSize*						0.0001
						(.014)
× ln *ContractSize*						0.0001
						(.001)
N	211,063	211,063	114,607	93,323	65,616	211,063
adj. R^2	.31	.31	.31	.31	.35	.31

LPM with firm fixed effects. Standard errors clustered on firm level in parenthesis. *,**,*** indicate significance on the 10,5, and 1% significance level. Coefficients of covariates and time FE not shown.

4 Conclusion

In this paper, we analyze the effect of German state export credit guarantees ("Hermes guarantees") on firms' exports. This policy instrument is commonly justified by politicians as a means to mitigating negative consequences of financial market frictions for exporting firms and, indeed, previous research finds evidence of a positive relationship. However, due to lack of appropriate data, evidence on the channels through which the policy instrument really works is scarce, even though this is crucial for the welfare implications of the state intervention and for the instrument's efficient design.

We build a model with heterogeneous exporters and financing constraints and derive conditions under which state export credit guarantees can mitigate financial market imperfections. Firms will benefit from such a scheme only if the government can provide guarantees at lower costs than private financial agents. We argue that the government has a cost advantage in financing specific types of projects, specifically projects characterized by large values at risk or projects involving foreign governments. According to the model, the beneficial effect of a public guarantee scheme should also be stronger for firms that are more dependent on external finance, and stronger when financing conditions in private markets are tight.

The theoretical model's predictions are tested with a unique firm-level data set that results from joining data on German state credit guarantees, granted to firms between 2000 and 2010, with the Ifo Business Survey. Our main findings are that Hermes guarantees have a positive effect on firms' export performance and especially so for small firms and firms that are more dependent on external finance. Financing conditions on private financial markets also matter for the strength of the effect. Moreover, for guarantees covering large transactions we find a particularly strong effect, suggesting that risk diversification and/or coordination costs matter in private financial markets. These results lend support to the hypothesis that the positive effect of Hermes guarantees manifests itself through mitigating financial constraints by passing through the government's cost advantages to German firms.

As to the welfare effects of the policy instrument, our analysis shows that a state export credit guarantee scheme can decrease both the variable and the fixed costs of exporting. Provided that the long-run profits of the scheme are indeed non-negative as suggested by observable figures, this is achieved at no cost. In the context of the commonly used general equilibrium model with monopolistic competition and heterogeneous firms, such an adjustment is comparable to a reduction of trade barriers, which yields a strictly positive effect on welfare if the change is homogeneous across firms. The role of heterogeneity in the profitability threshold, here resulting from differences in the firms' equipment with liquid assets that render the effect of changes in the costs of external finance heterogeneous across firms, is less clear cut. This provides an interesting avenue for future research.

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A Proofs

A.1 Proof of Result 1

For a given financing mode $o' \in (B, G)$, $\frac{\partial r[a]}{\partial R^{o'}} < 0$, optimal sales fall if the firm is operating under mode o' and does not switch to $o \neq o'$, or if it switches the mode and had not been indifferent in the initial situation. If the firm is operating under mode o or if it was indifferent in the initial situation, optimal sales remain unchanged.

Let RHS denote the right-hand side of Equation (7). Since $f > k$, $\frac{\partial RHS}{\partial R^{o'}} > 0$ and since $\frac{\partial r[\bar{a}^{o'}]}{\partial(1/\bar{a}^{o'})} > 0$, $1/\bar{a}^{o'}$ increases as $R^{o'}$ increases. The threshold productivity that is relevant for the firm increases unless it is operating under $o \neq o'$ or was indifferent in the initial situation.

Since $\frac{\partial^2 RHS}{\partial R^{o'} \partial k} < 0$, the adjustment in $1/a^{o'}$ is stronger the smaller k. ■

A.2 Proof of Results 2 & 3.

For $o \in [B, G]$,

$$\begin{aligned}
\frac{\partial R^o}{\partial \bar{R}} &= \frac{1}{\rho^o} - \frac{1}{(\rho^o)^2}\frac{\partial \rho^o}{\partial \bar{R}} > 0 \qquad \text{since} \qquad \frac{\partial \rho^o}{\partial \bar{R}} = -c^o(1-\lambda)(1-b^o) < 0 \\
\frac{\partial R^o}{\partial \lambda} &= -\frac{\bar{R}}{(\rho^o)^2}\frac{\partial \rho^o}{\partial \lambda} < 0 \qquad \text{since} \qquad \frac{\partial \rho^o}{\partial \lambda} = (1-b^o)(1+\bar{R}c^o) > 0 \\
\frac{\partial R^o}{\partial c^o} &= \frac{\bar{R}^2}{(\rho^o)^2}(1-\lambda)(1-b^o) > 0 \\
\frac{\partial R^o}{\partial b^o} &= -\frac{\bar{R}^2}{(\rho^o)^2}\left[(1-\lambda)(1+\bar{R}c^o)\right] < 0 \\
\frac{\partial^2 R^o}{\partial c^o \partial \bar{R}} &= \frac{2\bar{R}}{(\rho^o)^2}(1-\lambda)(1-b^o)\left[1 - \frac{\partial \rho^o}{\partial \bar{R}}\frac{\bar{R}}{\rho^o}\right] > 0 \\
\frac{\partial^2 R^o}{\partial c^o \partial \lambda} &= -\frac{\bar{R}^2}{(\rho^o)^2}(1-b^o)\left[\frac{2}{\rho^o}\frac{\partial \rho^o}{\partial \lambda}(1-\lambda) + 1\right] < 0 \\
\frac{\partial^2 R^o}{\partial b^o \partial \bar{R}} &= \frac{\bar{R}}{(\rho^o)^2}(1-\lambda)\left[\frac{2\bar{R}}{\rho^o}(1+\bar{R}c^o)\frac{\partial \rho^o}{\partial \bar{R}} - 2 - 3\bar{R}c^o\right] < 0 \\
\frac{\partial^2 R^o}{\partial b^o \partial \lambda} &= \frac{\bar{R}^2}{(\rho^o)^2}(1+\bar{R}c^o)\left[\frac{2}{\rho^o}\frac{\partial \rho^o}{\partial \lambda}(1-\lambda) + 1\right] > 0. \qquad ■
\end{aligned}$$

B Generalization of the Model

In the following, we prove that a qualitatively similar but weaker form of Result 1 holds if we dispense with the simplifying assumptions made in Section 2, where we considered only the case when external finance is more costly than internal finance, $\lambda R^o > \bar{R}$, and the firm's liquid funds are small, $k < f$. In the general case, the firm chooses the optimal price, the size of the loan $L = \ell + \gamma G$ (including the guarantee costs), and the degree of coverage g. Let g denote the share of the loan that is covered (without the interest payment). Then, the amount of coverage purchased (as defined above in Subsection 2.4) is $G = \bar{R}g$.[40] The maximization problem is then

$$\max_{p,\ell,g} \; \pi = \lambda pq - (aq + f) + \ell - \lambda \bar{R}g - \lambda R^B(\ell + \gamma \bar{R}g - g) + (\bar{R} - 1)(\ell - aq - f) \tag{B.1}$$

$$\text{s.t.} \qquad \ell + k \geq aq + f \tag{B.2}$$

$$pq \geq R^B(\ell + \gamma \bar{R}g - g) + \bar{R}g \tag{B.3}$$

$$g \geq 0 \tag{B.4}$$

$$\ell + \gamma \bar{R}g \geq g \tag{B.5}$$

and subject to demand as in Equation (1). In the first period, the firm pays production costs, receives the loan $\ell + \gamma G$ and pays γG for the guarantee (leaving the firm with net borrowed funds of ℓ). In the second period, with probability λ it receives the value of its sales, and with probability $(1 - \lambda)$ the importer defaults and the guarantee pays off in the amount $\bar{R}g$. Furthermore, the firm pays back the bank; with certainty the covered share plus interest $G = \bar{R}g$ (leaving the firm with a net expected payment of λG) and with probability λ the uncovered part plus interest $R^B(L - g)$ as well. Moreover, the firm receives interest $\bar{R} - 1$ from investing its remaining liquid funds $\ell + k - (aq + f)$. Finally, it substracts the opportunity costs $(\bar{R} - 1)k$ of the investment, which it could have undertaken instead of the export project.[41]

The financing constraint (B.2) requires that the firm's total means suffice to cover total costs. The borrowing constraint (B.3) states that the total payment for the project-specific loan cannot exceed the volume of the project. The third constraint requires that the covered amount is non-negative and finally, the fourth constraint states that coverage cannot exceed the borrowed amount.[42] To narrow down the number of possible cases of financing modes, it is assumed that whenever the costs of two

[40] While the distinction between g and G might not seem intuitive at first sight, it allows to split the total loan into a covered part g for which the bank charges the "risk-free" interest rate $\bar{R}$ and an uncovered part $L - g$ for which the risk-adjusted interest rate R^B is demanded.

[41] Note that the last two components rest on the assumption that the firms' opportunity costs of investment is the same as for banks, that is, they can invest an unlimited amount at an interest rate of $\bar{R}$. Our qualitative results are not sensitive to choosing other rates for the alternative investment, such as a deposit rate that is smaller than the bank-lending rate, or the return to another project that might exceed the risk-free lending rate.

[42] This assumption simplifies the maximization problem. It will become clear below that it is innocuous, since a necessary condition for the risk-neutral firm to buy a guarantee for any reasons other than to lower the cost of the loan, is that the guarantee premium be actuarially favorable. Under those conditions, however, it is always profitable to also take out the maximum loan.

modes are equal, the firm chooses the one that involves less transactions, i.e., the firm uses internal finance if this is as costly as external finance and it purchases a guarantee only if this strictly lowers the costs of external finance.

Kuhn-Tucker conditions:

$$\frac{\partial \pi}{\partial p} = \mu_1 a q' + \mu_2 (pq)' \qquad \Leftrightarrow \qquad \lambda (pq)' - \bar{R} a q' = \mu_1 a q' - \mu_2 (pq)' \tag{B.6}$$

$$\frac{\partial \pi}{\partial \ell} = -\mu_1 + \mu_2 R^B - \mu_4 \qquad \Leftrightarrow \qquad \bar{R} - \lambda R^B = -\mu_1 + \mu_2 R^B - \mu_4 \tag{B.7}$$

$$\frac{\partial \pi}{\partial g} = -\mu_2 \left[R^B (1 - \gamma \bar{R}) - \bar{R} \right] - \mu_3 + (1 - \gamma \bar{R}) \mu_4$$

$$\Leftrightarrow \qquad \lambda R^B (1 - \gamma \bar{R}) - \lambda \bar{R} = -\mu_2 \left[R^B (1 - \gamma \bar{R}) - \bar{R} \right] - \mu_3 + (1 - \gamma \bar{R}) \mu_4 \tag{B.8}$$

$$\mu_1 \left[\ell + k - (aq + f) \right] = 0 \qquad \& \qquad \mu_1 \geq 0 \tag{B.9}$$

$$\mu_2 \left[pq - R^B (\ell - (1 - \gamma \bar{R}) g) - \bar{R} g \right] = 0 \qquad \& \qquad \mu_2 \geq 0 \tag{B.10}$$

$$\mu_3 g = 0 \qquad \& \qquad \mu_3 \geq 0 \tag{B.11}$$

$$\mu_4 \left[\ell - (1 - \gamma \bar{R}) g \right] = 0 \qquad \& \qquad \mu_4 \geq 0 \tag{B.12}$$

Here, μ_i for $i = 1, ..., 4$ are Kuhn-Tucker multipliers and a prime indicates the partial derivative with respect to p.

B.1 Optimal Financing and Pricing Decisions

Consider first the optimal choice of g, g^*, given the optimal amount of the loan ℓ^*. Suppose $0 < \ell^* < \ell^{max}$ where ℓ^{max} is the maximum loan size determined by the borrowing constraint. For $\mu_1 \geq 0$; $\mu_2 \geq 0$, the firm will chose (i) no coverage if $R^G \geq R^B$ and (ii) full coverage if $R^G < R^B$.

Proof: i) By contradiction. Suppose $R^G > R^B$ and $g^* > 0$. $R^G > R^B \Leftrightarrow \frac{\bar{R}}{1 - \bar{R}\gamma} > R^B$. Since $\ell^* > 0$, Equation (B.11) implies $\mu_3 = 0$. Equation (B.8) implies $\mu_4 (1 - \gamma \bar{R}) = (\lambda + \mu_2) \left[R^B (1 - \gamma \bar{R}) - \bar{R} \right] < 0$ and Equation (B.12) implies: $\mu_4 \geq 0$. A contradiction.

ii) By contradiction. Suppose $R^G < R^B$ and $g^* = 0$. $R^G > R^B \Leftrightarrow R^B (1 - \bar{R}\gamma) > \bar{R}$. Since $g^* = 0$, Equation (B.12) implies $\mu_4 = 0$. Equation (B.8) implies $\mu_3 = (\lambda + \mu_2) \left[\bar{R} - R^B (1 - \gamma \bar{R}) \right] < 0$ and Equation (B.11) implies $\mu_3 \geq 0$. A contradiction.

By assumption, the firm covers nothing in the knife-edge case $R^G = R^B$. ■

If $\ell^* = 0$, $g^* = 0$ by definition. Hence, in our earlier notation, $o^* = B$ if $R^G \geq R^B$ and $o^* = G$ if $R^G < R^B$. Importantly, the decision about coverage is independent of the choice of p^*, given ℓ^*. Hence, we can consider the choice of ℓ^* and p^*, taking as given the choice of o^*. To characterize the set of solutions, it is helpful to define a threshold output level $\bar{q}$, denoting the maximum quantity the firm could produce *without* relying on external finance, that is, the quantity that solves the financing constraint (B.2) for $\ell = 0$:

$$k - a\bar{q} - f = 0 \quad \Leftrightarrow \quad \bar{q} = \frac{k - f}{a}$$

We obtain four possible optimal pricing and borrowing strategies, for a given $o^* \in (B, G)$, which we label cases (1)-(4). The firm's choice among these strategies depends on exogenous parameters, most importantly the costs of external finance and the firm's productivity relative to its stock of liquid funds.

If external finance is cheaper than internal finance, then there is only one optimal decision as regards the choice of ℓ^* and p^*, independent of the other parameters. We label this Case 1.

Case 1 ($\mu_1 = 0, \mu_2 \geq 0$): If $\lambda R^{o*} < \bar{R}$, the firm borrows the maximum amount given by the borrowing constraint (B.3).

Proof that $\ell^* = \ell^{max}$ if $\lambda R^{o*} < \bar{R}$. By contradiction. Suppose $\lambda R^B < \bar{R}$ and $\ell^* < \ell^{max}$. Then, Equation (B.10) implies $\mu_2 = 0$ and Equation (B.7) implies $\mu_1 + \mu_4 - \lambda R^B + \bar{R} = 0$. Since $\mu_1 \geq 0$ and $\mu_4 \geq 0$, this implies $\lambda R^B \geq \bar{R}$. A contradiction. Suppose now that $\lambda R^G < \bar{R}$ and $\ell^* < \ell^{max}$. Then, Equation (B.10) implies $\mu_2 = 0$. Equation (B.7) and Equation (B.8) imply $\mu_1 + \frac{\mu_3}{1-\gamma\bar{R}} + \bar{R} - \lambda R^G = 0$, and since $\mu_1 \geq 0$ and $\mu_3 \geq 0$ this implies $\lambda R^G \geq \bar{R}$. A contradiction. ■

This result implies that we can ignore the possibility that the firm buys a guarantee for an amount that exceeds the size of the loan, which might be profitable if the premium is actuarially favorable, that is, $\bar{R}\gamma < 1 - \lambda$. Under this condition, however, external finance is also cheaper than internal finance and hence, the firm will always take out the maximum (project-specific) loan, which is also equal to the maximum amount of coverage. As to the coverage decision, we can use the result derived above. Taking out the full loan with coverage is profitable if $R^B > R^G$, since $\bar{R}\gamma < 1 - \lambda \Leftrightarrow \lambda R^G < \bar{R}$. Then, $\mu_3 = 0$. Conducting the business with pure bank finance is preferred if $R^B \leq R^G$. Then, $\mu_4 = 0$. The optimal price p^* is determined by Equation (B.6) and, for either choice of financing mode $o^* \in (B, G)$, results as

$$p_1^* = \frac{R^{o*} a}{\theta}. \tag{B.13}$$

Maximum (expected) profits are then

$$\pi_1^* = \frac{\bar{R}}{\varepsilon R^{o*}} \left(\frac{R^{o*} a}{\theta} \right)^{1-\varepsilon} A - \bar{R} f. \tag{B.14}$$

If external finance is more expensive than internal finance, the firm either borrows nothing or the minimum amount given by the financing constraint (B.2).

Proof. We first show that for $\lambda R^{o*} > \bar{R}$ and $\ell^* \geq 0$ the borrowing constraint cannot be binding, because either (i) firms would make non-negative profits if it was binding or (ii) find it optimal anyway to decrease the size of the loan. Hence, $\mu_2 = 0$. Then, we show (iii) that if the financing constraint is also not binding ($\mu_1 = 0$), ℓ^* must be zero. It follows that for $\ell^* > 0$ the financing constraint must be binding. (i) Suppose both constraints (B.2) and (B.3) are binding. Then, expected profits (B.1) become $-\bar{R}k$. (ii) By contradiction. Suppose the borrowing constraint (B.3) is binding, but the financing constraint is not. Then, Equation (B.10) implies $\mu_2 \geq 0$. If $\lambda R^G \geq \lambda R^B > \bar{R}$, Equation (B.12) implies $\mu_4 = 0$ and Equation (B.7) implies $\mu_2 = \bar{R} - \lambda R^B < 0$. A contradiction. If $\lambda R^B \geq \lambda R^G > \bar{R}$, Equation (B.11) implies $\mu_3 = 0$ and Equations (B.7) and (B.8) imply $\mu_2 = 1 - \lambda - \gamma\bar{R} < 0$. A contradiction. (iii) If $\mu_1 = 0$ and $\mu_2 = 0$, Equation (B.7) implies that $\mu_4 > 0$. Hence, $\ell^* = 0$. ■

As regards the optimal price (output), we can distinguish three cases. Which one the firm chooses depends on the its size (productivity level) relative to the amount of liquid funds.

Case 2 ($\mu_1 = 0; \mu_2 = 0$): $\ell^* = 0$. In this case, the firm produces the first best quantity that sets $\frac{\partial \pi}{\partial p} = 0$ without using external finance, that is, $q^* \leq \bar{q}$. This is the case where the firm is relatively unproductive so that its first-best quantity is small. The financing constraint is not binding and p^* is determined by Equation (B.6):

$$p_2^* = \frac{\bar{R}a}{\lambda\theta}.$$

Optimal profits are derived from Equation (B.1) and result as

$$\pi_2^* = \frac{\lambda}{\varepsilon}\left(\frac{\bar{R}a}{\lambda\theta}\right)^{1-\varepsilon} A - \bar{R}f.$$

Case 3 ($\mu_1 \geq 0; \mu_2 = 0$): The firm is of intermediate size and chooses its optimal price (quantity) such as to avoid borrowing external funds; hence, $\ell^* = 0$ and $q^* = \bar{q}$ is given by the financing constraint. p^* is derived from Equation (1) as

$$p_3^* = \bar{q}^{-\frac{1}{\varepsilon}} A^{\frac{1}{\varepsilon}},$$

maximum profits according to Equation (B.1) result as

$$\pi_3^* = \lambda \left(\frac{k-f}{a}\right)^{1-\frac{1}{\varepsilon}} A^{\frac{1}{\varepsilon}} - \bar{R}k. \tag{B.15}$$

Case 4 ($\mu_1 \geq 0; \mu_2 = 0$:) The firm is large and takes out a loan $\ell^* > 0$ that is determined by the financing constraint in Equation (B.2).[43] With the financing constraint binding, the optimal loan size

[43] In the simplified model in Section 2, we consider a special case of Case 4. Under the assumption that $k < f$, all firms, independently of their productivity level, must use external finance (which we assume is more costly than internal finance) in order to produce a positive quantity.

ℓ^* is determined given p^*, which in turn follows from Equation (B.7) with $\mu_1 = \lambda R^B - \bar{R}$ if $o^* = B$ or $\mu_1 = \frac{\bar{R}}{1-\gamma\bar{R}} - \bar{R} > 0$ if $o^* = G$ and results as

$$p_4^* = \frac{R^{o*}a}{\theta}. \tag{B.16}$$

Maximum (expected) profits are then

$$\pi_4^* = \frac{\lambda}{\varepsilon}\left(\frac{R^{o*}a}{\theta}\right)^{1-\varepsilon} A - \lambda R^{o*} f + (\lambda R^{o*} - \bar{R})k. \tag{B.17}$$

B.2 Sorting

Given a certain k, firms sort themselves uniquely into Cases $2-4$ depending on their productivity level. The pricing strategy of Case 2 is only feasible, if the firm is small enough to produce the profit maximizing quantity without relying on external finance in the first place, that is, if $q^* \leq q$. The threshold productivity level $(1/a_2)$ below which firms optimally use the strategy of Case 2 is thus given by $q^* = \bar{q}$, that is,

$$\left(\frac{\bar{R}a_2}{\theta\lambda}\right)^{-\varepsilon} A = \frac{k-f}{a_2}.$$

At $1/a_2$, not only quantities but also prices and profits are identical for Cases 2 and 3. Once firms cross the threshold $1/a_2$, the financing constraint binds. The firm now chooses between producing a smaller than optimal quantity to avoid external finance (Case 3), or producing the profit-maximizing quantity and borrowing the least possible amount needed (Case 4). Since $\pi_2^*[1/a_2] = \pi_3^*[1/a_2]$ and $\pi_2^*[1/a_2] > \pi_4^*[1/a_2]$, Case 3 is the preferred financing choice for productivity levels above and sufficiently close to $(1/a_2)$. Profits in Case 3, as well as in Case 4, grow as productivity increases. Whether they eventually intersect depends on the curvature of optimum profits π_4^*. The intersection $\pi_4^*(1/a_3) = \pi_3^*(1/a_3)$ determines $1/a_3$, the productivity level where firms switch from Case 3 to 4. Since π_3^* is concave in productivity, $(1/a_3)$ exists if π_4^* is not too concave in productivity ($\varepsilon \geq 2$ is a sufficient condition). Note that the existence of both cutoffs $(1/a_2)$ and $(1/a_3)$ depends also on the support of the productivity distribution $[a_H, a_L]$ as well as on further parameter constellations: For example, let $k < f$, then pricing strategies of Cases 2 and 3 are infeasible. Also, their relevance depends on the location of the profitability threshold $1/\bar{a}_m^{o*}$ defined by $\pi_m^*[1/\bar{a}_m^{o*}] = 0$ for $m = 1, ..., 4$ and $o \in (B, G)$.[44]

B.3 Generalization of Result 1

Next, we derive the more general version of Result 1, allowing for both higher and lower costs of external relative to internal finance and the case where firms can choose to produce with internal funds only. The results is qualitatively the same, but weaker in the sense that the set of firms that

[44] Note that each possible combination of pricing and financing modes has its own profitability threshold, but once firms have chosen the profit-maximizing mode only the associated profitability threshold is relevant.

is not affected increases. Firms that do not use external finance are also not affected by changes in its costs. Furthermore, when external finance is less costly than internal finance so that firms want to borrow the maximum amount, the impact of financing costs on exports does not depend on the firm's amount of liquid funds.

Result 1b. *An increase in the costs of external finance $R^{o'}$ with $o' \in [R, G]$ weakly increases the productivity threshold and weakly decreases optimal sales. The effect on the profitability threshold is weakly stronger for firms with small liquid funds.*

Proof: Suppose first that external finance is more costly than internal finance so that firms are in one of Cases 2-4. The costs of external finance affect only firms in Case 4. And, as before, it affects only firms which continue using the same optimal financing mode $o' \neq o$, with $o', o \in [R, G]$, or which switch to o but had not been indifferent between the two in the initial situation. For those firms the increase in the costs of external finance of mode o' is relevant. $\frac{\partial r_4^*}{\partial R^{o'}} < 0$ follows from Equations (B.16) and (1). Higher $R^{o'}$ increases the cutoff $(1/a_3)$, hence some firms will switch from Case 4 to 3. This comes with a decrease in the optimal quantity, which is now restricted to what can be produced without external finance. $\frac{\partial(1/a_3)}{\partial R^{o'}} > 0$ follows from $\pi_4^*(1/a_3) = \pi_3^*(1/a_3)$ as given in Equations (B.17) and (B.15), and $\frac{\partial \pi_3^*}{\partial R^{o'}} = 0$, $\frac{\partial \pi_4^*}{\partial R^{o'}} < 0$ and $\frac{\partial \pi_4^*}{\partial(1/a_3)} > \frac{\partial \pi_3^*}{\partial(1/a_3)} > 0$. Firms that switch from Case 4 to 3 produce smaller quantities than before. This follows from the fact that for $1/a \geq 1/a_3$, where $\pi_4^* \geq \pi_3^*$, the firms that use external finance (Case 4) must have higher sales because their marginal costs are higher. The increase in the profitability threshold $\frac{\partial(1/\bar{a}_4^{o'})}{\partial R^{o'}} > 0$ follows from $\pi_4^*(1/\bar{a}_4^{o'}) = 0$ as given by Equation (B.17), $\frac{\pi_4^*}{\partial(1/\bar{a}_4^{o'})} > 0$ and $\frac{\partial \pi_4^*}{\partial R^{o'}} < 0$. Furthermore, $\frac{\partial^2 \pi_4^*}{\partial R^{o'} \partial k} > 0$ implies $\frac{\partial^2(1/\bar{a}_4^{o'})}{\partial R^{o'} \partial k} < 0$, that is, the increase in the profitability threshold is stronger if k is small.

Suppose now that external finance is cheaper than internal finance so that all firms are in Case 1. The increase in R^o leads to lower sales and a higher profitability threshold. However, the change in the profitability threshold does not depend on k, sinces k does not impact the amount of borrowing in this case. If the costs of external finance increase sufficiently strongly, internal finance becomes cheaper at some point so that firms move into one of the Cases 2-4. This will come with a decrease in optimal sales as well. The decrease in sales for firms who stay in Case 1, $\frac{\partial r_1^*}{\partial R^{o'}} < 0$, follows from Equations (B.13) and (1), and the increase in the profitability threshold $\frac{\partial(1/a_1^{o'})}{\partial R^{o'}} > 0$ follows from $\pi_1^*(1/\bar{a}_1^{o'}) = 0$ as given by Equation (B.14), and $\frac{\pi_1^*}{\partial(1/\bar{a}_1^{o'})} > 0$ and $\frac{\partial \pi_1^*}{\partial R^{o'}} < 0$. It is straightforward to show that sales decrease when firms switch from Case 1 into 2 or 4, since optimal sales decrease in the (opportunity) costs of finance. Furthermore, since sales in Case 3 are smaller than first-best because the quantity is constrained by the amount of firms' liquid funds, they must also decrease for a firm that switches from Case 1 (first-best) to 3.

C Empirical Appendix

C.1 Average Partial Effects and Predicted Probabilities

Based on scaled coefficients obtained from the Mundlak-Chamberlain probit estimation, $\tilde{\boldsymbol{\beta}}_{\boldsymbol{a}} = \tilde{\boldsymbol{\beta}} \frac{1}{(\sigma_c^2+\sigma_u^2)^{-1/2}}$, $\boldsymbol{b_a} = \boldsymbol{b} \frac{1}{(\sigma_c^2+\sigma_u^2)^{-1/2}}$ and $\boldsymbol{\psi^s_a} = \boldsymbol{\psi}^s \frac{1}{(\sigma_c^2+\sigma_u^2)^{-1/2}}$, predicted probabilities can be computed as

$$\widehat{\mathrm{P}}[\Delta y_t = 1] = \frac{1}{N} \sum_{i=1}^{N} \Phi(\mathbf{x}'_{it} \hat{\tilde{\boldsymbol{\beta}}} - \hat{c}_i) = \frac{1}{N} \sum_{i=1}^{N} \Phi(\hat{\psi}^s_a + \mathbf{x}'_{it} \hat{\tilde{\boldsymbol{\beta}}}_a + \bar{\mathbf{z}}'_i \hat{\mathbf{b}}_a). \tag{C.1}$$

The average partial effect (APE) of a binary covariate x_h is given by

$$\mathrm{d}\widehat{\mathrm{P}}[\Delta y = 1] = \frac{1}{NT_i} \sum_{i=1}^{N} \sum_{t=1}^{T_i} \left(\widehat{\mathrm{P}}[\Delta y_{it} = 1 | x_{it,h} = 1] - \widehat{\mathrm{P}}[\Delta y_{it} = 1 | x_{it,h} = 0] \right), \tag{C.2}$$

and the average partial effect of a continuous covariate x_h is given by

$$\frac{\partial \widehat{\mathrm{P}}[\Delta y = 1]}{\partial x_h} = \frac{1}{NT_i} \sum_{i=1}^{N} \sum_{t=1}^{T_i} \hat{\tilde{\beta}}_{ah} \phi(\hat{\psi}^s_a + \mathbf{x}'_{it} \hat{\tilde{\boldsymbol{\beta}}}_a + \bar{\mathbf{z}}'_i \hat{\mathbf{b}}_a). \tag{C.3}$$

ϕ and Φ denote the probability density function and cumulative density function of the standard normal distribution, respectively. T_i is the number of observations of firm i over time. Standard errors are obtained with the Delta method. Details can be found e.g. Chapter 2.6.4 in Greene and Henscher (2010).

Table C.1: Summary Statistics of Full Sample

Full sample		Obs	Mean	Std. Dev.	Min	Max
Stock of for. orders	binary	326,201	0.09	0.29	0	1
Demand	ordinal	327,805	1.99	0.65	1	3
Employment		328,052	2,102	14,555	1	200,000
ExpectExp	ordinal	293,505	2.07	0.54	1	3
Unconstrained	binary	325,942	1.60	.30	1	2
Ibrate	in %	328,053	2.98	1.32	0.64	5.11
WorkingCap	in bn. EUR	91,636	38.6	136	-1,290	2,550
CashFlow	in bn. EUR	79,035	29.8	167	-1,130	4670
Tangibles	in bn. EUR	100,756	43.9	247	0	10,600
ContractSize	in EUR	3,183	3.02	15.1	0	445
# Firms		5,741				
with *Hermes*		684				

Table C.2: Translated Survey Questions and Answers

Variable	Variable name in original dataset	*Question*/Answer	Coding	Alternative coding
Stock of for. orders	foreord	*Our current stock of foreign orders is*		
		larger than usual	3	1
		sufficient (as usual (for the season))	2	0
		too small	1	0
		we do not export	-	0
ExpectExp	expexp	*Considering settled deals and deals under negotiation, we expect exports (in the next three months) to*		
		increase	3	
		stay the same	2	
		decrease	1	
		we do not export	-	
Demand	demand_vpq	*(Last month's tendency) The demand situation has*		
	(before 11/2001	improved	3	
	"demand")	not changed	2	
		worsened	1	
Unconstrained	constrain	*Our domestic production activity right now is constrained*		
		no	2	
		yes	1	

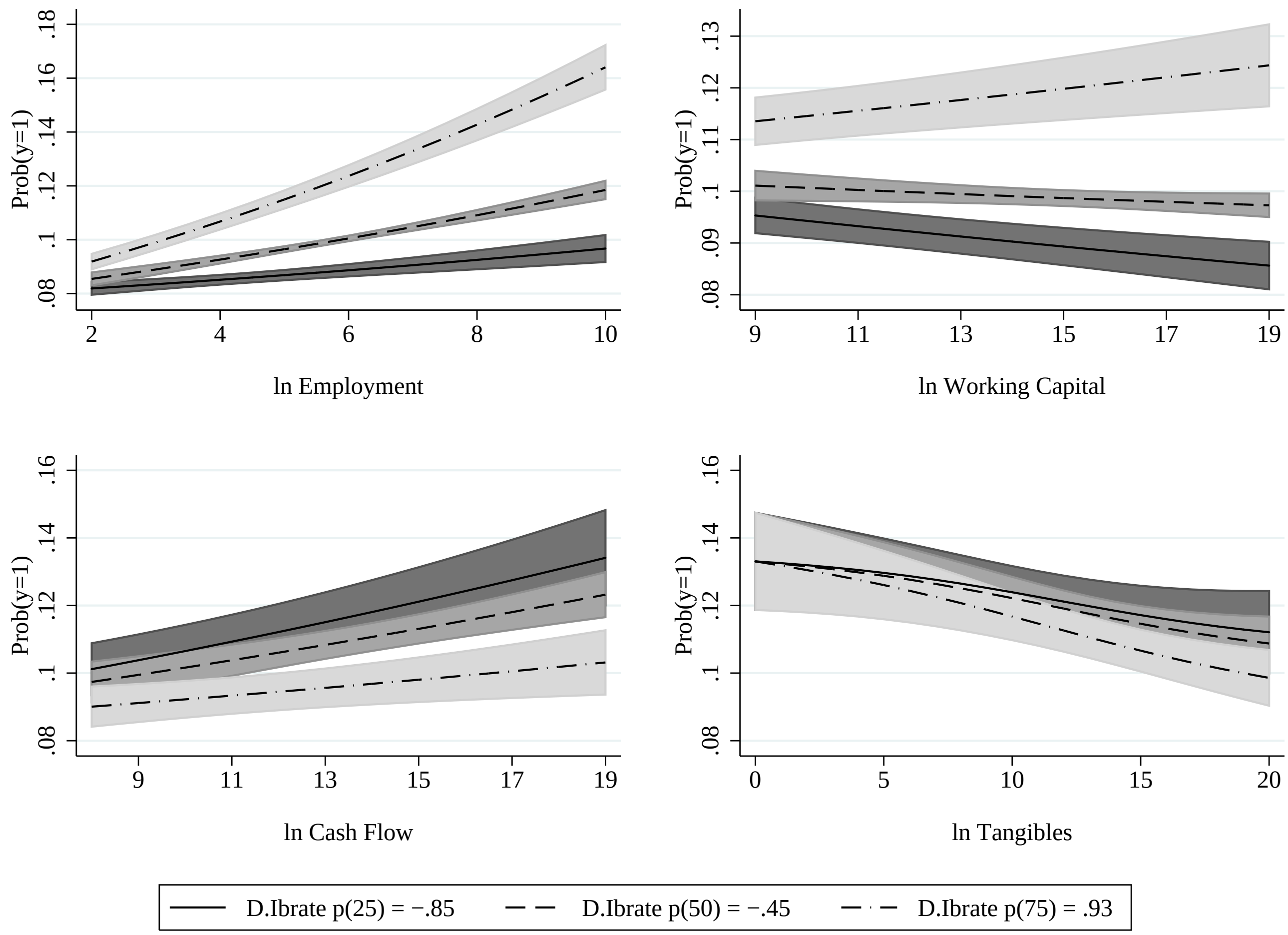
Explanations in brackets were given to firms as supplementary information on how the questions are to be interpreted.

Table C.3: Interaction Terms, Conditional Logit Model

Dep. variable: *Stock of foreign orders*							
	Model: Conditional Logit						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Hermes	0.259***	1.968***	-1.049***	1.271	3.323***	1.956	
	(.081)	(.454)	(.194)	(1.160)	(.961)	(1.330)	
× ln *Emp*		-0.254***					
		(.067)					
× *Ibrate*			0.414***				
			(.055)				
× avg. ln *WorkingCap*				-0.060			
				(.068)			
× avg. ln *CashFlow*					-0.210***		
					(.062)		
× ln *Tangibles*						-0.123	
						(.081)	
Δ*Ibrate*							
× ln *Emp*		0.048***					
		(.005)					
× avg. ln *WorkingCap*				0.022***			
				(.003)			
× avg. ln *CashFlow*					0.001		
					(.005)		
× ln *Tangibles*						0.005	
						(.005)	
ln *ContractSize*							-0.042
							(.048)
× ln *ContractSize*							0.004
							(.004)
N	137,940	137,940	137,940	75,676	63,092	38,410	137,940
Pseudo R^2	.21	.21	.21	.21	.21	.23	.21

Model conditions on firm fixed effects. Standard errors in parenthesis. *,** ,*** indicate significance on the 10,5, and 1% significance level. Coefficients of covariates and time FE not shown.

Figure C.1: Liquid Funds and Changes in the Interbanking Rate



Note: The figure shows means of predicted probabilities and 90% confidence intervals computed at different levels of four measures of external finance demand and the 25th, 50th, and 75th percentile of the distribution of changes in the interbanking rate.