Export Market Participation and Interest Rates: the Role of Organizational Capital

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Abstract

How do interest rates influence firms' export decisions? We first develop a dynamic model of heterogeneous firms that highlights two key mechanisms: (i) a time lag between export costs and revenues, and (ii) the accumulation of organizational capital. Higher interest rates reduce both the extensive and intensive margins of exporting, the more so for firms with lower organizational capital. We then test these predictions using panel data on Portuguese firms (2008–2021). Our results show that organizational capital mitigates the adverse effect of higher interest rates, and this result is robust to alternative estimation strategies designed to address potential identification concerns. We also show that the magnitude of this mitigating effect depends on firm characteristics shaping access to external funding, i.e., leverage, asset tangibility, and profitability.

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1 Introduction

In past decades, increasing integration across countries through trade has coincided with a long-term decline in interest rates (Antràs, 2023b). While the era of hyper-globalization that characterized the 1990s and early 2000s has given way to a more fragmented trade landscape, there is no evidence of a broad retreat from globalization. During the same period, monetary policy went through dramatic changes. Central banks first responded to the global financial crisis by sharply reducing policy rates and, more recently, reversed course in response to rising inflation before lowering rates again as inflationary pressures subsided. Against this backdrop, this paper investigates how changes in interest rates affect firms' participation in export markets, with particular focus on how such responsiveness is shaped by firms' strength in organizational design and operational capabilities—that is, their organizational capital.

By easing the financing of fixed costs associated with exporting, lower interest rates positively influence firms' decisions to participate in foreign markets. To characterize the mechanism underlying this effect, recent contributions by Antràs (2023a,b) and Kim and Shin (2023) emphasize the importance of time in production and export, drawing inspiration from the "Austrian" theory of capital, notably von Böhm-Bawerk (1889). Time has a dual effect on firms' production decisions. On the one hand, a longer production duration enhances productivity, as it allows the production process to mature. On the other hand, it increases firms' working capital requirements due to the delay between cost incurrence and revenue realization. In the face of this trade-off, interest rates affect the optimal length of production, as higher rates raise the cost of financing working capital needs.

In this paper, we emphasize the temporal structure of production but propose a different microfoundation for the effects of production length. Within an international trade model *à la* Melitz (2003), we introduce firms' stock of organizational capital, which is accumulated over time and enhances productivity. As elucidated by Prescott and Visscher (1980), organizational capital comprises various forms of information held within the firm: information about employee skills and talents, the match between workers and tasks, and the compatibility among team members (Evenson and Westphal, 1995). More broadly, it encompasses operating capabilities and managerial practices that enable some firms to produce and deliver more output from a given set of resources, at lower unit cost (Lev and Radhakrishnan, 2003).

Hence, the role of organizational capital parallels that of time in Antràs (2023b)'s model. Just as a longer temporal lag between production and delivery allows the production process

to mature, in our framework, for a given production length, firms endowed with greater organizational capital can undertake exporting activities more efficiently, requiring less time and working capital.

Our proposed mechanism linking interest rates, organizational capital, and exporting unfolds as follows. Entering export markets entails not only per-unit costs, such as transport expenses and tariffs, but also substantial fixed costs that must be incurred upfront to gain market access.[1] Moreover, exporting entails a temporal dimension that further lengthens the production period relative to domestic sales. Consequently, the costs of trade finance and higher working-capital requirements imply that the profitability of exporting depends critically on the cost of capital faced by firms. Not all firms, however, face the same costs when entering foreign markets. Better-organized firms typically operate more efficiently and require less time to carry out export-related activities—from market entry and product marketing to the intertemporal organization of production. As such, these firms are more insulated from the effects of increases in interest rate. Considering both organizational capital and production time thus allows us to identify an observable source of firm heterogeneity that drives differential responses in export participation to changes in the cost of capital.

To study these mechanisms, we develop a dynamic model of international trade with heterogeneous firms. The model incorporates two key features. First, it captures a temporal discrepancy between the moment production costs are incurred and the time when revenues from foreign sales are realized, following Manova (2013) and Antràs (2023b). Second, it introduces a dynamic process of organizational capital accumulation (Prescott and Visscher, 1980; Atkeson and Kehoe, 2005), driven by the effort of dedicated workers. Changes in the interest rate affect firms' exporting choices by altering the working capital requirements associated with participation in foreign markets and reshaping firms' incentives to invest in organizational capital. The main prediction of the model is that an increase in interest rates reduces export participation, both at the extensive and intensive margins, but this effect is mitigated for firms that have accumulated higher levels of organizational capital.

Next, we test the empirical predictions of the theoretical model relying on firm-level panel data of unusually high quality from the Central Balance Sheet - Harmonized Panel provided by the Bank of Portugal, which contains information on exports and balance sheet

[1] A rich body of literature has documented that these fixed costs include establishing distribution channels, learning to comply with foreign regulations and bureaucratic procedures, and adapting products and packaging to meet foreign consumer preferences and standards (Melitz, 2003; Anderson and Van Wincoop, 2004). Even after entry, firms continue to face fixed costs to maintain their presence, such as conducting market analysis, advertising, monitoring competitors, and managing distribution networks. These export-specific fixed costs require sufficient financial strength to absorb them.

characteristics for about 7,600 Portuguese firms over the period 2008-2021 (Banco de Portugal, Microdata Research Laboratory, 2023). Following the empirical literature, we construct firm-specific measures of organizational capital using information on operating costs. We adopt the methodology proposed by Félix et al. (2021) and construct a measure of organizational capital based on fixed operating costs accumulated over time using the perpetual inventory method to obtain a stock measure, as in Eisfeldt and Papanikolaou (2013). For robustness, we rely on two alternative measures of costs, one based on employee expenses and the other on total non-financial expenses. Firm-level interest rates are converted into real rates using Portugal's expected inflation rate and are instrumented to address potential endogeneity with respect to firm characteristics.

In the panel estimation, for the extensive-margin specifications, we use a two-stage approach, where the second stage is a linear probability model (LPM). For the intensive margin, we employ a two-stage control-function approach within a Poisson Pseudo–Maximum Likelihood (PPML) framework. All specifications include firm-specific fixed effects and control for firm characteristics, such as productivity, size, age, and profitability.

Our findings show that firm strength in terms of organizational capital generates a statistically significant, and economically relevant, degree of heterogeneity across firms in the sensitivity of export decisions to interest rates. The negative impact of an increase in interest rates on both the extensive and intensive margins of export is smaller (in absolute value) for firms with a larger stock of organizational capital. To address potential identification issues, we implement a range of robustness checks. Moreover, we examine several dimensions of firm heterogeneity and show that the magnitude of this mitigating effect depends on firm characteristics shaping access to external funding, i.e., leverage, profitability, and asset tangibility.

While our analysis is closely related to Antràs (2023b), it differs from his work in three key ways. First, whereas in our framework the time lag between production and delivery is exogenous, we introduce organizational capital as a central mechanism in the relationship under study. Second, our model is genuinely dynamic—not only with respect to the temporal dimension of production (i.e., the existence of a non-zero production length) but also because the stock of organizational capital accumulates over time through optimal firm decisions. Third, we empirically test the model's predictions using microeconomic data.

The remainder of the paper is organized as follows. Section 2 reviews the related literature. Section 3 presents the theoretical framework that underpins our empirical analysis. Section 4 outlines the empirical model and methodology. Section 5 describes the firm-level data and provides descriptive statistics. Section 6 presents the baseline estimation results,

and Section 7 discusses extensions and robustness checks. Section 8 concludes.

2 Prior Literature

With the exception of Findlay (1978), until the recent contributions by Antràs (2023b,a) and Kim and Shin (2023), the literature on the role of time and the implied effects of interest rates on exporting, or trade in general, was rather limited. These papers trace the origins of the discussion back to the Austrian school of capital theory, and in particular, to the pioneering contribution of von Böhm-Bawerk (1889). A central idea of the literature in the "Austrian tradition" is the importance of time in production, with each stage of the production process requiring a specific time length that depends on economic and technological features.[2]

Antràs (2023b) develops a model where the time lag between the beginning of production and the delivery of goods to buyers is endogenous, reflecting an optimal choice at which the marginal benefit of additional production time (higher productivity) equals its marginal cost (higher working capital requirements). Participating in export markets implies a longer time gap between production and delivery to foreign consumers. While there are additional gains from this extended production length—arising from access to foreign markets—the associated working capital requirements are also higher than for non-exporting firms. Consequently, interest rates affect the optimal production length, and the decision to extend production and shipping for international sales depends on the trade-off between productivity gains and the financial costs of exporting.

[2]For an insightful discussion on the temporal dimension of production as emphasized by Classical economists first and by the Austrian school of economics later, see also Antràs and Tubdenov (2025) and the references therein. A parallel strand of literature focused on the effect of monetary policy on export participation, and their prediction is not uniform. Imura and Shukayev (2019) conduct a VAR analysis and find that the extensive margin of exports responds negatively to an expansionary monetary policy shock. To interpret this finding, they develop a two-country DSGE model with forward-looking export decisions, showing that, while the lower interest rates and the depreciation of the domestic currency induced by the expansionary monetary policy shock raise the value of export participation, the rise in expected future inflation negatively affects the value of current export participation, as it weakens the competitiveness of some exporters, causing their exit from foreign markets and discouraging entry. By contrast, the structural models with nominal rigidities, particularly in wages, developed by Naknoi (2008) and Rodriguez-Lopez (2011) yield the opposite prediction: expansionary monetary shocks induce an increase of the extensive margin of exports. Among the few papers that focus on the link between interest rates and export, Chen et al. (2015) provide evidence that export decision is more responsive to interest rates in countries with well-developed credit markets, arguing that firms in these environments have greater access to borrowing and are less dependent on internal funds to cover export-specific fixed costs.

The focus of Antràs (2023a) is on global value chains (GVCs) and how interest rates affect the incidence of GVC trade. GVCs involve the cross-country dispersion of production stages, where the gains from differences in unit production costs across countries are offset by the increased time required to complete a product, which raises firms' working capital needs. Thus, the cost of capital plays a central role in determining the profitability of participating in a GVC, and the level of interest rates affects whether longer production processes and delivery times across multiple countries are sustainable. Antràs (2023a) analyzes these issues through a model in which production occurs in multiple stages, and the duration of each stage is endogenously determined. His model predicts that, in a free-trade equilibrium, countries with lower interest rates specialize in relatively "time-intensive" stages of GVCs, and that reductions in trade costs—including those associated with temporal factors—lead to a higher degree of vertical specialization in world trade.

Kim and Shin (2023) develop an Austrian-type model in which the time dimension of production plays a central role, focusing on the offshoring decisions of a multinational firm. In their framework, the more "roundabout" the production chain—that is, the greater the number of production stages—the higher the resulting productivity gains, but also the higher the financial costs due to increased working capital requirements in the form of inventories and receivables. These additional circulating capital needs arise from the time mismatch between incurring production costs and collecting revenues from final sales. Notably, the model features a non-linearity in working capital requirements: as the production chain lengthens, financing needs increase at an accelerating rate. Kim and Shin (2023) show that higher interest rates reduce the optimal number of stages in the sequential production process.[3]

Broadly speaking, the effect of interest rates on exports is related to the role of financial conditions as a determinant of trade, and thus to the extensive literature on the trade-finance nexus. It is well established that firms rely on banks to finance the working capital associated with their trade activities, and several contributions analyze how shocks to credit supply affect firm exports through this channel. Using Japanese data, Amiti and Weinstein (2011) show that deteriorations in a bank's health, measured by its market-to-book value, negatively affect firms that list it as their main bank, causing a larger drop in exports than in domestic sales. Niepmann and Schmidt-Eisenlohr (2017) document a decline in U.S. firm exports following a negative shock to a country's letters-of-credit supply. Similarly,

[3]Therefore, while in Antràs (2023a) the number of stages is fixed and the time length of each stage is endogenous, in Kim and Shin (2023) each stage has a fixed duration, and the number of stages is the endogenously chosen variable.

Paravisini et al. (2015) estimate the elasticity of exports to credit using matched customs and firm-level bank credit data from Peru, showing that credit shortages reduce firm exports on the intensive margin.

Our paper also talks to the extensive literature on the effect of financial constraints on firms' export decisions and their participation in international supply chains through the unbundling and outsourcing of production tasks. In this context, the international trade literature emphasizes access to finance as a key factor shaping firms' self-selection into foreign activities. A large body of theoretical and empirical work shows that credit constraints limit firms' participation in export markets (e.g., Chaney (2016); Manova (2013); Minetti and Zhu (2011); Muûls (2015); Pietrovito and Pozzolo (2021)) as well as in global supply chains (e.g., Manova (2015); Minetti et al. (2019)).

There is also an extensive empirical literature on trade credit. Antràs and Foley (2015) investigate both theoretically and empirically the financing terms that support international trade. Firms can be financed by their suppliers rather than by banks (Petersen and Rajan, 1997). An exporter may require the importer to pay before shipment (cash in advance) or allow payment after the goods have been delivered. Alternatively, exporters can rely on financial intermediaries, that, for example, issue a letter of credit. While trade credit is typically treated as a form of external finance, a stream of literature emphasizes its role as a commitment device rather than as a financing source (Minetti et al., 2019). For instance, Mateut et al. (2006) show that monetary tightening reduces bank loans, but firms can continue their international activities by relying on trade credit, mitigating the effects of contractionary monetary policy. Consequently, the impact of an increase in interest rates is likely to be smaller for firms with access to trade credit as an alternative to bank finance.

Given the crucial role of firms' organizational capital in our analysis, a naturally related strand of literature is that examining this intangible asset. Using U.S. national income and product accounts, Atkeson and Kehoe (2005) show that organizational capital accounts for more than 40% of the cash flow generated by all intangible assets, and Hasan et al. (2021) report evidence from other studies indicating that organizational capital represents about 30% of all intangible assets in the United States. In the previous section, we illustrated Prescott and Visscher (1980)'s view of organizational capital as a stock of diverse information assets, and Evenson and Westphal (1995)'s perspective, which emphasizes the knowledge used to combine human capabilities, skills, and physical capital into sequential production systems. Lev and Radhakrishnan (2003, 2005) define organizational capital as the systems and processes employed in investment, production, and sales, along with the incentives and compensation schemes governing human resources. Lev et al. (2009) describe organizational

capital as the aggregation of unique business processes, practices, and organizational designs, and show that it enables superior operating performance. Empirical evidence further highlights its importance: Hasan et al. (2018) document that firms investing in organizational capital are less likely to enter unfavourable life-cycle stages, while Brynjolfsson et al. (2002) argue that intangible organizational assets complement IT capital, and investments in organizational processes, worker knowledge, and incentive structures are required to fully realize the benefits of IT.

To the best of our knowledge, the mechanism linking international trade, organizational capital and interest rates has not been studied. We now present the theoretical framework examining how interest rates affect exports through firms' organizational structure.

3 The theoretical framework

We develop a model of international trade *à la* Melitz (2003) that incorporates the firms' stock of organizational capital. The latter is accumulated through the efforts of dedicated workers, which in turn enhances productivity. Firms solve an intertemporal profit-maximization problem to determine the optimal allocation of labor between production and the accumulation of organizational capital. Firms engaged in exporting face an additional cost stemming from the temporal gap between the moment production costs are incurred and the time when revenues from foreign sales are realized.

3.1 Domestic market

Demand. The economy is populated by a measure L of infinitely-lived agents, whose intertemporal utility function is given by

$$U = \int_0^\infty e^{-\rho t} \ln C dt, \tag{1}$$

where C is a CES aggregate over a continuum of differentiated goods:

$$C = \left[\int_\Omega c(\omega)^{\frac{\sigma-1}{\sigma}} d\omega \right]^{\frac{\sigma}{\sigma-1}}, \tag{2}$$

and $\omega \in \Omega$ denotes a good variety, $c(\omega)$ is consumption of good ω, and $\sigma > 1$ is the elasticity of substitution between any two goods.

Each agent's budget constraint can be written as:

$$C + \dot{b} = w + (r - m)b, \tag{3}$$

where b denotes the stock of corporate bonds held, w is the wage rate, r is the real interest rate, and $m \in (0, r)$ is a positive parameter capturing transaction costs, due for example to financial frictions.

The intertemporal utility maximization implies that:

$$\frac{\dot{C}}{C} = r - m - \rho. \tag{4}$$

where the individual demand for each variety ω is given by:

$$c(\omega) = \left[\frac{p(\omega)}{P}\right]^{-\sigma} \frac{w}{P}, \tag{5}$$

and P is the price index dual to (2), given by:

$$P = \left[\int_{\Omega} p(\omega)^{1-\sigma} d\omega\right]^{\frac{1}{1-\sigma}}. \tag{6}$$

Technology. The domestic production of variety ω, y_d, takes place according to the following technology:

$$y_d = \varphi \Lambda_d (l_d - f_d), \tag{7}$$

where φ denotes the firm-specific productivity, whose cumulative distribution is given by $G(\varphi)$, l_d is labour employed in producing y_d, and f_d is a fixed production cost sustained to serve the domestic market. To simplify notation, we henceforth omit the variety index ω and the productivity index φ from all endogenous variables.

Λ_d, a measure of the contribution of organizational capital z_d to labor productivity, is a positive and concave function of the stock of organizational capital:

$$\Lambda_d = a z_d^{\psi}, \tag{8}$$

where $a \in R_+$ and $\psi \in (0, 1)$ are two parameters.

Organizational capital is accumulated through a "learning by doing" mechanism, described as follows:[4]

$$\dot{z_d} = b n_d^{\varepsilon} - \delta z_d, \tag{9}$$

[4]See Nickell et al. (2001) for an analysis of new management practices and the reorganization of production methods adopted by firms during recessions.

where n_d denotes labour devoted to the continuous organizational process of the firm's domestic activities (henceforth, organizational labour), bn_d^{ε} represents the gross investment in organizational capital, $\delta > 0$ is the (exogenous) depreciation rate, and $\varepsilon \in (0,1)$ and $b \in \mathbb{R}_+$ are exogenous parameters.[5] We assume that organizational workers earn the same wage as production workers. The underlying idea is that managerial practices accumulate as practical knowledge within the firm, enhancing its ability to solve organizational problems.

Firm's optimization problem. The intertemporal optimization problem of a single firm is:

$$\max_{l_d, n_d, z_d} \int_0^{\infty} \pi_d e^{-\int_0^t r ds} dt, \tag{10}$$

subject to the accumulation of organizational capital (9), the production technology (7), the initial condition $z(0) = z_0$, and the definition of firm's profit:

$$\pi_d = p_d y_d - w\left(l_d + n_d\right). \tag{11}$$

In equilibrium, the firm's production is equal to the total demand for a single variety, that is, $y_d = c_d L$. Using the individual demand function (5), the current-value Hamiltonian associated with the firm's maximization problem is therefore:

$$H = P^{\frac{\sigma-1}{\sigma}} (wL)^{\frac{1}{\sigma}} \left[\varphi \Lambda_d (l_d - f_d)\right]^{\frac{\sigma-1}{\sigma}} - w(l_d + n_d) + \lambda\left(bn_d^{\varepsilon} - \delta z_d\right), \tag{12}$$

where λ, the Lagrange multiplier associated with (9), represents the shadow value of organizational capital for a single firm.

The first-order conditions of this problem are:

$$p_d = \frac{\sigma}{\sigma - 1} \frac{w}{\varphi \Lambda_d}, \tag{13a}$$

$$\lambda b \varepsilon n_d^{\varepsilon - 1} = w, \tag{13b}$$

$$-\dot{\lambda} + \lambda(r + \delta) = \frac{\psi w}{z_d}(l_d - f_d). \tag{13c}$$

[5] Gross investment in organizational capital could also depend on z_d. If this function were linearly homogeneous in its arguments, the qualitative results would remain unchanged.

Steady state. Since at the steady state $\dot{\lambda} = 0$ and $bn_d^{\varepsilon} = \delta z_d$, after applying (13b), equation (13c) can be rewritten as:[6]

$$n_d = \frac{\varepsilon\delta\psi}{r+\delta}\frac{y_d}{\varphi\Lambda_d}. \tag{14}$$

We normalize w to 1. Using (13a) and (14), and after some algebraic manipulation, we obtain:

$$\pi_d = \Gamma\frac{y_d}{\varphi\Lambda_d} - f_d, \tag{15}$$

where:

$$\Gamma \equiv \frac{r+\delta-(\sigma-1)\psi\varepsilon\delta}{(\sigma-1)(r+\delta)}. \tag{16}$$

Using(13a), the goods market clearing condition implies:

$$y_d = \left(\frac{\sigma-1}{\sigma}\right)^{\sigma} LP^{\sigma-1}(\varphi\Lambda_d)^{\sigma}. \tag{17}$$

Substituting (17) into (15) yields:

$$\pi_d = B(\varphi\Lambda_d)^{\sigma-1} - f_d, \tag{18}$$

where:

$$B \equiv LP^{\sigma-1}\Gamma\left(\frac{\sigma-1}{\sigma}\right)^{\sigma}.$$

Plugging (17) into (14), we get:

$$n_d = \frac{\varepsilon\delta\psi}{r+\delta}\left(\frac{\sigma-1}{\sigma}\right)^{\sigma} LP^{\sigma-1}(\varphi\Lambda_d)^{\sigma-1}. \tag{19}$$

Recalling that, at the steady state, $n_d = \left(\frac{\delta}{b}z_d\right)^{1/\varepsilon}$ and $\Lambda_d = az_d^{\psi}$, equation (19) can be rewritten as:

$$\left(\frac{\delta}{b}z_d\right)^{1/\varepsilon} = \frac{\varepsilon\delta\psi}{r+\delta}\left(\frac{\sigma-1}{\sigma}\right)^{\sigma} LP^{\sigma-1}(\varphi a z_d^{\psi})^{\sigma-1}, \tag{20}$$

which can be solved for z_d yielding:

$$z_d = \left[\frac{\Delta}{a}\varphi^{\frac{(\sigma-1)\varepsilon\psi}{1-(\sigma-1)\varepsilon\psi}}\right]^{1/\psi}, \tag{21}$$

[6] A more general specification of organizational capital accumulation, for example $n^{\varepsilon}z^{\eta}$, would not qualitatively affect our results.

where:

$$\Delta \equiv \left[\left(\frac{b}{\delta} \right)^{\frac{1}{\varepsilon}} \frac{\psi \varepsilon \delta}{r+\delta} \left(\frac{\sigma-1}{\sigma} \right)^{\sigma} L P^{\sigma-1} \right]^{\frac{\varepsilon\psi}{1-(\sigma-1)\varepsilon\psi}} a^{\frac{1}{1-(\sigma-1)\varepsilon\psi}}.$$

Substituting (21) into (18), the expression for domestic profits can finally be written as:

$$\pi_d = B\Delta^{\sigma-1}\varphi^{\frac{\sigma-1}{1-(\sigma-1)\varepsilon\psi}} - f_d. \tag{22}$$

Setting $\pi_d = 0$, the zero-cutoff-profit (ZCP_d) condition, which determines the minimum level of productivity that allows a firm to produce for the domestic market without incurring losses, is given by:

$$\underline{\varphi}_d^{\frac{\sigma-1}{1-(\sigma-1)\varepsilon\psi}} = \frac{f_d}{B\Delta^{\sigma-1}}. \tag{23}$$

3.2 Foreign market.

Since revenues from foreign markets are collected with a delay (Antràs, 2023b; Hummels and Schaur, 2013), whereas production costs are incurred immediately, this temporal discrepancy is reflected in foreign-market profits, π_x, through the interest rate:

$$\pi_x = e^{-r\overline{s}} p_x y_x - (l_x + n_x), \tag{24}$$

where p_x and y_x denote the foreign-market price and quantity, and $\overline{s}$ is the (exogenous) time interval between incurring costs and collecting revenues. Variables with subscript x, rather than d, refer to the corresponding export-market aggregates.

Foreign production is obtained according to the following technology:

$$y_x = \frac{\varphi \Lambda_x}{\tau}(l_x - f_x),$$

where $\tau > 1$ is a parameter capturing iceberg trade costs.[7] We suppose that $f_x > f_d$. As Melitz (2003), we assume, for simplicity, a world economy consisting of identical countries. Under this symmetry assumption, wages are equal across all countries and can thus be normalized to unity. Aggregate expenditures, revenues, and the price index are also identical across countries.

[7] In principle, iceberg trade costs could be affected by the interest rate, as they involve the use of infrastructures and durables for shipping goods abroad. We do not make this assumption to keep the model more tractable.

Solving the firm's intertemporal optimization problem as outlined in Section 3.1, using the pricing rule, $p_x = \frac{\sigma}{\sigma-1}\frac{\tau}{\varphi\Lambda_x}e^{r\bar{s}}$, and focusing on the stationary equilibrium, we can express the profit function in the foreign market as:

$$\pi_x = \Gamma\frac{y_x\tau}{\varphi\Lambda_x} - f_x,$$

where Γ was defined in (16).

Following the same steps as in Section 3.1, we obtain:

$$\pi_x = B\Delta^{\sigma-1}e^{-\frac{\sigma r\bar{s}}{1-(\sigma-1)\varepsilon\psi}}\tau^{-\frac{(\sigma-1)}{1-(\sigma-1)\varepsilon\psi}}\varphi^{\frac{\sigma-1}{1-(\sigma-1)\varepsilon\psi}} - f_x.$$

Setting $\pi_x = 0$, the zero-cutoff-profit (ZCP_x) condition for the export market, which determines the minimum level of productivity that allows a firm to produce for the export market without incurring losses, is given by:

$$\underline{\varphi}_x^{\frac{\sigma-1}{1-(\sigma-1)\varepsilon\psi}} = \frac{f_x e^{\frac{\sigma r\bar{s}}{1-(\sigma-1)\varepsilon\psi}}\tau^{\frac{\sigma-1}{1-(\sigma-1)\varepsilon\psi}}}{B\Delta^{\sigma-1}}. \tag{25}$$

3.3 Equilibrium with international trade

In the steady state, equation (4) implies that the real interest rate is exogenously given by $r = \rho + m$. Using (23) and (25), the cutoff ratio can be expressed as:

$$\left(\frac{\underline{\varphi}_x}{\underline{\varphi}_d}\right)^{\frac{\sigma-1}{1-(\sigma-1)\varepsilon\psi}} = \frac{f_x e^{\frac{\sigma r\bar{s}}{1-(\sigma-1)\varepsilon\psi}}\tau^{\frac{\sigma-1}{1-(\sigma-1)\varepsilon\psi}}}{f_d}. \tag{26}$$

Note that, under plausible parameter values, $\underline{\varphi}_x > \underline{\varphi}_d$, i.e, the minimum productivity level for a firm to produce and sell domestically is lower than that required to produce and sell in foreign markets. The free-entry condition for the domestic and export markets, according to which an entrant's ex-ante expected profits must equal the sunk cost f_e incurred by all entrants (as in Melitz (2003)), is:

$$\begin{aligned}\int_{\underline{\varphi}_d}^{\infty}\left[B\Delta^{\sigma-1}\varphi^{\frac{\sigma-1}{1-(\sigma-1)\varepsilon\psi}} - f_d\right]dG(\varphi)+\\ +\int_{\underline{\varphi}_x}^{\infty}\left[B\Delta^{\sigma-1}e^{-\frac{\sigma r\bar{s}}{1-(\sigma-1)\varepsilon\psi}}\tau^{-\frac{(\sigma-1)}{1-(\sigma-1)\varepsilon\psi}}\varphi^{\frac{\sigma-1}{1-(\sigma-1)\varepsilon\psi}} - f_x\right]dG(\varphi) = f_e.\end{aligned} \tag{27}$$

The system of equations (23), (25) and (27) determines the triple $(\varphi_d, \varphi_x, P)$.

Trade equilibrium under Pareto distribution. Assume that the stochastic productivity follows a Pareto distribution, with cumulative distribution function $G(\varphi) = 1 - \varphi^{-\kappa}$, for $\varphi \geq 1$ and $\kappa > \Xi \equiv \frac{\sigma-1}{1-\varepsilon\psi(\sigma-1)} > 0$. Under this hypothesis, the free-entry condition (27) can be written as:

$$\underline{\varphi}_d^{-\kappa} + \frac{f_x}{f_d}\underline{\varphi}_x^{-\kappa} = \frac{f_e}{f_d}\frac{\kappa - \Xi}{\Xi}, \tag{28a}$$

and the cutoff ratio (26) as:

$$(\underline{\varphi}_x)^{-\kappa} = \left(\frac{f_x}{f_d}\right)^{-\frac{\kappa[1-\varepsilon\psi(\sigma-1)]}{\sigma-1}} e^{-\frac{\kappa\sigma r\bar{s}}{\sigma-1}} \tau^{-\kappa}(\underline{\varphi}_d)^{-\kappa}. \tag{28b}$$

The solution to the system of equations (28a)-(28b) determines the fraction of firms serving the domestic and export markets $(\underline{\varphi}_d^{-\kappa}, \underline{\varphi}_x^{-\kappa})$.

Denoting by M_x the mass of exporting firms and by $\hat{R}_x$ the firm's expected revenues from export sales, the country's total exports, X, can be expressed as:

$$X = \underbrace{M_x}_{ext.margin} \times \underbrace{\hat{R}_x}_{int.margin}. \tag{29}$$

We now examine these two components in turn.

Mass of producing and exporting firms. The mass of producing firms, M, is given by the mass of entering firms, M_e, multiplied by the probability of obtaining from the draw a sufficient level of productivity, $\underline{\varphi}_d$):

$$M = M_e[1 - G(\underline{\varphi}_d)]. \tag{30}$$

The labour market clearing condition can be written as:

$$L = M\int_{\underline{\varphi}_d}^{\infty} \frac{l_d + n_d}{1 - G(\underline{\varphi}_d)} dG(\varphi) + M_x \int_{\underline{\varphi}_x}^{\infty} \frac{l_x + n_x}{1 - G(\underline{\varphi}_x)} dG(\varphi) + M_e f_e, \tag{31}$$

where M_x, the mass of exporting firms, is given by:

$$M_x = \int_{\underline{\varphi}_x}^{\infty} \frac{M}{1 - G(\underline{\varphi}_d)} dG(\varphi) = M\frac{1 - G(\underline{\varphi}_x)}{1 - G(\underline{\varphi}_d)} < M. \tag{32}$$

Condition (31) can be rewritten as:

$$L = M(l_d + n_d) + M_x(l_x + n_x) + M_e f_e. \tag{33}$$

Using the first-order conditions (13), the production function and the corresponding expression for profits, we obtain:[8]

$$l_d + n_d = \frac{(r+\delta+\psi\varepsilon\delta)(\sigma-1)}{r+\delta-(\sigma-1)\psi\varepsilon\delta}\left[\frac{f_e}{1-G(\underline{\varphi}_d)}+f_d\right]+f_d. \tag{34a}$$

Similarly, the total labour employed in foreign markets can be expressed as:

$$l_x + n_x = \frac{(r+\delta+\psi\varepsilon\delta)(\sigma-1)}{r+\delta-(\sigma-1)\psi\varepsilon\delta}\left[\frac{f_e}{1-G(\underline{\varphi}_x)}+f_x\right]+f_x. \tag{34b}$$

Substituting (34a) and (34b) into (33), and solving for the mass of active firms, M, we finally obtain:

$$M = \frac{[r+\delta-(\sigma-1)\psi\varepsilon\delta]L}{\sigma(r+\delta)F^T}, \tag{35}$$

where F^T, denoting the average fixed costs of active firms, can be expressed as:

$$F^T = \frac{f_e}{1-G(\underline{\varphi}_d)} + f_d + \frac{1-G(\underline{\varphi}_x)}{1-G(\underline{\varphi}_d)}f_x. \tag{36}$$

Note that, under the Pareto distribution:

$$\frac{M_x}{M} = \frac{1-G(\underline{\varphi}_x)}{1-G(\underline{\varphi}_d)} = \left(\frac{\underline{\varphi}_x}{\underline{\varphi}_d}\right)^{-\kappa} = \left(\frac{f_x}{f_d}\right)^{-\frac{\kappa[1-\varepsilon\psi(\sigma-1)]}{\sigma-1}} e^{-\frac{\kappa\sigma r\bar{s}}{\sigma-1}}\tau^{-\kappa}, \tag{37}$$

where M_x/M is the fraction of firms that produce for the export market (extensive margin). We are now ready to state the following proposition:

Proposition 1
The probability that a firm exports is decreasing in the interest rate, $\left(\frac{\partial(M_x/M)}{\partial r}<0\right)$ *and this effect is stronger (in absolute value) the lower the firm's level of organizational capital,* $\left(\frac{\partial^2(M_x/M)}{\partial r\partial z_x}>0\right)$.

Proof. See Appendix A. ■

[8] Analytical details are provided in appendix A.

Firms' revenues (intensive margin). Recall that the expected profits from the foreign market can be expressed as

$$\hat{\pi}_x = f_x \int_{\underline{\varphi}_x}^{\infty} \left[\left(\frac{\varphi}{\underline{\varphi}_x} \right)^{\frac{\sigma-1}{1-(\sigma-1)\varepsilon\psi}} - 1 \right] dG(\varphi). \tag{38}$$

Since $\hat{\pi}_x = \hat{R}_x/\sigma - f_x$, where $\hat{R}_x$ denotes the firm's expected revenues from foreign markets, it follows that

$$\hat{R}_x = \sigma f_x \int_{\underline{\varphi}_x}^{\infty} \left(\frac{\varphi}{\underline{\varphi}_x} \right)^{\frac{\sigma-1}{1-(\sigma-1)\varepsilon\psi}} dG(\varphi). \tag{39}$$

We can now formalize the following proposition:

Proposition 2
Exports per firm are decreasing in the interest rate, $\left(\frac{\partial \hat{R}_x}{\partial r} < 0\right)$ *and this effect is stronger (in absolute value) the lower the firm's level of organizational capital* $\left(\frac{\partial^2 \hat{R}_x}{\partial r \partial z_x} > 0\right)$.

Proof. See Appendix A. ■

Propositions 1 and 2 lend themselves to empirical scrutiny. In the following, we test them using data for a large panel of Portuguese manufacturing firms from 2008 to 2021.

4 The Empirical Analysis

4.1 The Empirical Strategy

To test the predictions of the theoretical model, we estimate two firm fixed-effects reduced-form specifications that aim to characterize the impact of interest rate variations on both the extensive and intensive margins of exports.

Exploiting the panel dimension of the dataset, our empirical model is specified as follows:

$$\begin{aligned} Export_{it} = {} & \beta_0 + \beta_1 IntRate_{it} + \beta_2 \ln(OrgK_{it}) + \beta_3 \big(IntRate_{it} \times \ln(OrgK_{it}) \big) \\ & + \boldsymbol{\beta}_4' \mathbf{X}_{it} + \boldsymbol{\beta}_5' \mathbf{M}_t + \gamma_i + \varepsilon_{it} \end{aligned} \tag{40}$$

where, in the specification for the extensive margin, the dependent variable, $Export_{it}$, is a dichotomous variable equal to one if firm i exports in period t (and zero otherwise), and in

the specification for the intensive margin, the dependent variable is the share of revenues derived from exports. $OrgK_{it}$ denotes the stock of organizational capital of firm i at time t; $IntRate_{it}$ is the firm-level real interest rate in period t, constructed by combining firm-level nominal rates with data on expected inflation in Portugal; $\mathbf{X}_{it}$ is a vector of firm-level, time-varying control variables, including firm size (measured by total assets, total sales, and the number of employees), age, return on assets (ROA), labour productivity and sectoral export value, as described in Section 4.2; $\mathbf{M}_t$ is a vector of macroeconomic variables (GDP, unemployment rate, and real effective exchange rate); γ_i denotes firm fixed effects and ε_{it} is a zero-mean, i.i.d. error term. The inclusion of firm fixed effects, γ_i, controls for unobserved, time-invariant firm-specific characteristics that may influence export decisions.

To test the theoretical prediction that firms with a larger stock of organizational capital are better insulated from fluctuations in interest rates, the key explanatory variable is the interaction term, $IntRate_{it} \times ln(OrgK_{it})$. A positive estimate of the coefficient β_3 associated with this interaction indicates that a negative effect of higher interest rates on export participation—captured by the coefficient β_1—is attenuated for firms with greater organizational capital.

We estimate the extensive-margin specification using a linear probability model (LPM), and the intensive margin employing a Poisson Pseudo–Maximum Likelihood (PPML) framework, following Silva and Tenreyro (2006). To address potential endogeneity in export decisions with respect to firm-level interest rates, we estimate the extensive-margin specification using a two-stage instrumental-variable approach, and the intensive margin employing a two-stage control-function approach. In nonlinear models such as PPML, the control-function (CF) approach is specifically designed to address endogeneity, and Wooldridge (2015) demonstrates how including first-stage residuals achieves this. This control-function correction ensures consistent estimates under standard assumptions regarding the orthogonality of instruments and structural errors, while the PPML estimator accommodates the multiplicative functional form, heteroskedasticity, and the presence of zero outcomes (Wooldridge (2015)). Accordingly, the estimated first-stage residuals from two separate regressions—one for the interest rate and one for its interaction with organizational capital—are included in the second-stage PPML equation for the intensive margin, together with the original endogenous variables and the controls. Standard errors are then bootstrapped to account for the two-stage nature of the estimation and ensure valid inference in the presence of generated regressors. In both LPM and PPML specifications, the instrumental variable strategy is primarily based on the ECB monetary policy rate, and includes the ECB main refinancing operations rate, its interaction with organizational capital and with firm-level (lagged) fi-

nancial liabilities. To account for potential correlation of the error terms within the same industry and year, we cluster standard errors at the sector-year level in both the extensive- and intensive-margin specifications. This approach allows for arbitrary intra-group correlation and relaxes the assumption of independence of observations within industry–time cells.

To address identification concerns, we also pursue several robustness strategies. One potential issue is that, despite using instrumental variables for firm-level interest rates (and their interaction with organizational capital), endogeneity may persist. In particular, the instrumented interest rate could capture, to some extent, variation in firms' financial strength or risk profile, rather than purely exogenous shifts in the cost of credit.

To begin with, we employ non-instrumental variable regressions, replacing the firm-level real interest rates with the ECB real policy interest rate. We follow two approaches. First, we include only the interaction between the ECB rate and organizational capital, but add time (year) fixed effects. Second, we include the ECB rate in the specification both on its own and interacted with organizational capital, while retaining macroeconomic controls. We apply both approaches to the extensive- and intensive-margin specifications and to both alternative measures of organizational capital.

Subsequently, we address the concern that the attenuating role of organizational capital on the effect of interest rates on exports may be driven by other firm characteristics, particularly total assets. To this end, we conduct a horse-race and augment the baseline specifications for both the extensive and intensive margins by including the interaction between firm-level interest rates and the log of total assets. The key test is whether the positive and statistically significant coefficient on the interest rate–organizational capital interaction remains robust. In this verification, we employ both alternative measures of organizational capital.

Another robustness check consists of estimating, for both the extensive and intensive margins, an exactly identified equation rather than one with over-identifying restrictions. To do so, we exclude the ECB monetary policy interest rate interacted with (lagged) financial liabilities from the set of instrumental variables. This check is carried out using the two alternative measures of organizational capital.

Subsequently, we address the possibility that the attenuating effect of organizational capital on the impact of interest rates on exports may depend on firm characteristics that shape access to external funding. To investigate this, the empirical analysis focuses on three dimensions of firm heterogeneity capturing this aspect. First, we consider financial structure (leverage); second, profitability, proxied by ROA; and third, asset tangibility.

In the following, we describe the dataset employed in the empirical analysis.

4.2 Data and Descriptive Statistics

Our empirical analysis draws on very high quality firm-level data on the universe of Portuguese firms made available to external researchers by the Bank of Portugal as the Central Balance Sheet - Harmonized Panel (CBHP) dataset.[9]

The CBHP dataset is designed to provide longitudinal information on Portuguese non-financial firms, integrating multiple dimensions such as general firm information, detailed economic and financial data extracted from balance sheets and profit-and-loss statements, employment details, trade information by destination markets (EU and non-EU), and records of corporate actions (Banco de Portugal, Microdata Research Laboratory, 2023). The dataset is updated annually and, in compiling and maintaining it, the Bank of Portugal ensures comparability over time by adapting the information to reflect changes in national accounting standards.

The selection criteria used to construct the dataset for our empirical analysis ensure a comprehensive and representative sample of active Portuguese firms, excluding those that do not meet specific legal, economic, and financial requirements. Firms were selected based on their legal form, including only public limited companies, limited partnerships, and private limited companies. Economic activity was used to exclude firms operating in financial and insurance activities, public administration and defense, compulsory social security, household activities, and extraterritorial organizations. Only firms that were actively operating were retained, and a minimum threshold of five employees was applied. Firms with negative total expenses were also excluded. The final dataset comprises more than 7,600 Portuguese firms and approximately 41,000 observations, for which we have information on whether a firm engages in exporting activities or operates exclusively in the domestic market, as well as on the value of sales generated from exports.

For the measurement of organizational capital, most of the empirical literature relies on U.S. data and typically adopts a proxy based on fixed operating costs, measured by selling, general, and administrative expenses (SG&A), following (Eisfeldt and Papanikolaou, 2013). Unfortunately, the balance sheet data in CBHP do not provide information on SG&A expenditures. For this reason, we follow Félix et al. (2021) and measure the value of fixed

[9]We wish to thank the BPLIM staff for their professionalism and kindness; for more details on the database, see https://msites-dee-bplim-prd.azurewebsites.net/content/central-balance-sheet-harmonized-panel-cbhp.

operating costs using a risk-management approach. Specifically, we classify costs as fixed only if firms cannot adjust them easily within a short period and at a reasonable cost.[10] The key identification hypothesis is the dependence of firms' costs to changes in sales. If a firm's costs do not vary significantly with fluctuations in sales, this indicates a higher proportion of fixed costs. We apply the methodology in Félix et al. (2021) to two sets of costs. The first includes employee expenses, i.e., salaries, social security, and other employee expenses. The second is more encompassing and includes all non-financial expenses, defined as total expenses net of interest expenses, income taxes, impairment losses, changes in fair value, and other expenses and losses related to financial investments and financial instruments.

After predicting the value of the fixed component of employee and labour non financial expenses, we apply the perpetual inventory method to the estimated flows (Eisfeldt and Papanikolaou, 2013; Hasan et al., 2018), accumulating the deflated values using a depreciation rate of 20%.[11]

Interest rates at the firm level are measured as the ratio of interest expenses to total interest-bearing liabilities, including both current and non-current debt. Real firm-level interest rates are obtained by subtracting the expected inflation rate in Portugal from the nominal rate. Expected inflation is sourced from the IMF World Economic Outlook: Country and Regional Perspectives (https://www.imf.org/en/Publications/WEO). The ECB policy interest rate is measured as the annual average of the interest rate on the main refinancing operations, which are conducted by the ECB on a weekly basis.

Control variables at the firm level include standard determinants of export performance: (i) firm size, measured by both the number of employees and total current and non-current assets; (ii) return on assets (ROA), calculated as operating net income divided by total assets; (iii) total turnover; (iv) labour productivity, measured as value added per employee; (v) leverage, defined as the ratio of current and non-current liabilities to total equity and liabilities; and (vi) firm age, measured as the number of years since the firm's founding.

Macroeconomic variables are obtained from the ECB and IMF data portals, as well as the Eurostat database. Macroeconomic controls include: (i) Portugal's annual real effective

[10] Félix et al. (2021) estimate an empirical specification that separates the effects of current and past sales on operating costs, thereby allowing an assessment of how sales shocks translate into firms' cost structures.

[11] We estimate the following equation $OC_{it} = (1 - \delta_{OC})OC_{it-1} + \frac{O_{it}}{\pi_t}$, where OC_{it} is the estimated stock of organizational capital of firm i at timer t, δ_{OC} is the annual rate of depreciation of organizational capital, that we assume to be 20%, O_{it} is its value of operating costs at time t, π_t is the deflator of operating costs and the initial stock of organizational capital is estimated as $OC_0 = \frac{O_1}{g+\delta_{OC}}$, where g is the average rate of growth of firm-level operating costs in our sample.

exchange rate, computed against 37 trading partners using consumer price indices to capture changes in international competitiveness; (*ii*) real GDP at constant prices; and (*iii*) the unemployment rate.[12]

Finally, industry-level controls account for total exports, computed using CBHP data at the two-digit level of the Classificação Portuguesa das Atividades Económicas (CAE), which is based on the European Union's NACE classification.

In order to analyse firm heterogeneity, we split the sample according to several firm-level characteristics, including leverage, return on assets (ROA), and asset tangibility, measured as the share of tangible fixed assets in total assets, following the approach of Manova (2013).

The first part of Table 1 reports descriptive statistics on the characteristics of firms in our sample. The share of exporters is 72%, which is relatively high but consistent with evidence for many European countries trading within the Single Market. By contrast, the share of exports in total sales is lower, at 21%. According to the broad measure of operating costs—defined as the time-invariant component of non-financial expenses—the estimated stock of organizational capital has a mean value of €3.9 million and a median slightly above €2 million, with a standard deviation of €4.4 million indicating substantial heterogeneity across firms. Using the narrower measure of operating costs based on employee expenses, which includes total wages and other labour-related costs, the stock of organizational capital has a mean of €1.6 million and a median slightly above €1 million, with a standard deviation of €1.7 million. The average firm-level interest rate is 2.8%, with a standard deviation of 3.3 percentage points. Firms are on average relatively small, with a mean of 29 employees and a median of 19. Total assets exhibit a similar degree of variability, with a mean of €2.7 million and a median of €1.3 million. Return on assets (ROA) averages 12%, with a standard deviation of 7.7 percentage points. Firms are on average 22 years old, with a median of 20 years and a standard deviation of 13 years. Labour productivity, measured as value added per employee, is highly dispersed, with a mean slightly above €6.9 thousand and a standard deviation of €8.2 thousand.

The second part of Table 1 reports descriptive statistics for the macroeconomic variables used in our analysis, including interest rates. Over the sample period, the average real interest rate—calculated as the ECB's main refinancing operations rate minus the expected inflation rate in Portugal—was -0.75%, reflecting the constantly expansionary monetary policy of the past decade. The real interest rate exhibited substantial variability, with a standard deviation of 0.91 percentage points. The unemployment rate averaged 11.0%, with

[12]For further details, see https://ec.europa.eu/eurostat/databrowser/view/ei_mfef_m/default/table?lang=en

Table 1: Descriptive statistics

			Panel A - Firm characteristics
	Mean	Median	Std. dev.
Dependent variables			
Export dummy (extensive margin)	0.719	1.000	0.449
Export share (intensive margin)	0.214	0.039	0.306
Firm-level interest rates			
Interest rates (real)	2.788	1.948	3.313
Organizational capital measures			
Employee expenses (€, millions)	1.645	1.003	1.687
Non-financial expenses (€, millions)	3.905	2.128	4.446
Firm-level controls			
Financial liabilities	0.285	0.269	0.179
Number of employees	28.772	19.000	26.386
ROA	0.121	0.106	0.077
Age	22.268	20.000	13.064
Productivity	6.895	4.252	8.189
Total assets (€, millions)	2.736	1.298	3.888
Total sales (€, millions)	2.656	1.308	3.343
Asset tangibility	0.317	0.295	0.198
	Panel B - Macroeconomic characteristics		
	Mean	Median	Std. dev.
ECB rate (real)	-0.754	-1.090	0.910
Real exchange rate	101.783	102.273	1.559
Real GDP	188.885	187.410	7.389
Unemployment rate	0.110	0.113	0.035
Sector total exports (€, thousands)	15.978	13.296	9.560
Observations			41,363

Notes: Financial liabilities refers to leverage (financial liabilities over total assets). Asset tangibility is defined as fixed assets over total assets. Authors' elaboration on Bank of Portugal, ECB, Eurostat and IMF data.

a median of 11.3% and a standard deviation of 3.5 percentage points.

4.3 Baseline Results

We begin our empirical analysis by focusing on whether a firm is an exporter, i.e., the extensive margin of trade. A large body of empirical literature has confirmed that, consistent with our theoretical framework, firms must sustain significant fixed and variable costs ex ante in order to access foreign markets. These include legal and administrative costs, as well as the costs of identifying appropriate marketing and sales channels. Focusing on the discrete export decision, independently of the share of total sales generated in foreign markets, is therefore an important level of analysis.

Consistent with our theoretical framework, the decision to export depends crucially: (i) on the real interest rate faced by each firm, which captures the cost of financing expenses that must be anticipated ex ante to access foreign markets; (ii) the firm's level of organizational capital, which captures its ability to perform the legal, administrative, and marketing tasks described above; and (iii) the interaction between the two. As described in Section 4.1, we estimate Equation (40) using a two-stage approach. Specifically, we use three instruments for the level of the real interest rate and for its interaction with the firm's organizational capital: the real interest rate set by the ECB on its main refinancing operations, and its interaction with the firm's level of organizational capital and (lagged) leverage.[13]

Table 2 reports the estimation results for the extensive margin of trade using our two measures of organizational capital. Column (1) presents results based on the narrower measure, which computes organizational capital from labour expenditures following the methodology described in Section 4.2. Column (2) uses the more encompassing measure based on the aggregate value of non-financial expenditures. The results provide reassuring support for the predictions of the empirical model. In both cases, the coefficient on the real interest rate is negative and statistically significant at the 1% level (with standard errors allowing for clustering at the sector–year level), and the coefficient on organizational capital is positive and statistically significant—at the 10% level for the labour-based measure and at the 1% level for the broader measure. More importantly, the coefficient on the interaction term between organizational capital and the real interest rate is positive and statistically significant,

[13]Estimates have been conducted using the *ivreghdfe* command in Stata. The first-level regressions, available from the authors upon request, confirm that we can reject the hypothesis of weak instruments based on the Kleibergen-Paap F statistic relative to the Stock-Yogo critical values, and we can also reject the hypothesis of endogeneity of the instruments based on Hansen's over-identification test.

confirming the theoretical prediction that firms with a higher stock of organizational capital are better able to absorb the negative impact of higher real interest rates on their export policies. Since the overall impact of changes in the real interest rate and in organizational capital reflects both their direct effects and the indirect effect arising through the interaction term, we also compute the corresponding marginal effects, which are reported in Table 2. Reassuringly, evaluated at the sample values of the other covariates, the marginal effect of an increase in the interest rate is negative and statistically significant at the 1% level for both measures of organizational capital, while the marginal effect of organizational capital is positive and statistically significant at the 1% level. These results are particularly compelling given that our specification includes firm fixed effects; therefore, identification relies entirely on within-firm variation over time (i.e., our unit of analysis is the same firm observed across years).[14]

Overall, the extensive-margin results provide strong support for our theoretical predictions, confirming the crucial role of organizational capital in shaping firms' decisions to access foreign markets and in insulating them from adverse shocks in financial markets.

To further validate the model, we next study the intensive margin of exports. By focusing on the share of exports in total sales, the intensive margin captures not only whether a firm is present in foreign markets, but also the economic incidence of such presence. As discussed in Section 4.1, two issues arise. First, the decision to start exporting entails costs that plausibly differ from those associated with deciding how much to export once access to foreign markets has already been established. At the same time, treating these choices as unrelated would introduce a sample-selection concern in estimates of the determinants of export intensity. For this reason, as anticipated in Section 4.1, we follow the literature and estimate the PPML model proposed by Silva and Tenreyro (2006), including firm-level fixed effects. Second, as in the extensive-margin analysis, the real interest rate faced by each firm is likely to depend on its degree of internationalization, raising endogeneity concerns. To address this issue, we follow the methodology also described in Section 4.1 and estimate Equation (40) by augmenting the PPML specification with the residuals from two first-stage regressions: one for the real interest rate and one for its interaction with organizational capital. These regressions rely on the same set of instruments used for the extensive-margin IV estimation—the real interest rate set by the ECB, and its interaction with the firm's level of organizational capital and (lagged) leverage. Because these residuals are generated

[14]The full set of coefficient estimates, including firm-specific time-varying controls such as total assets, employment, sales, labour productivity, age, profitability, and leverage, as well as macroeconomic variables capturing the role of the business cycle for exports, such as real GDP, unemployment, and the real effective exchange rate, are available upon request.

Table 2: Extensive margin of exports - Baseline results

	(1) Employee expenses	(2) Non-financial expenses
Interest rate × ln (Org. capital)	0.010***	0.010***
	(0.002)	(0.002)
ln (Org. capital)	0.025*	0.025
	(0.015)	(0.015)
Interest rate	-0.142***	-0.162***
	(0.031)	(0.032)
Marginal effects		
Org. capital	*0.052***	*0.055***
	(0.013)	*(0.014)*
Interest rate	*-0.008***	*-0.009***
	(0.002)	*(0.002)*
Firm-level FE	Y	Y
Year FE	N	N
Firm-level controls	Y	Y
Macro controls	Y	Y
Observations	41,363	41,363
Kleibergen-Paap F-stat	201.91	174.92
Hansen J-stat (p-value)	2.10 (0.147)	1.95 (0.163)

Notes: This table reports instrumental variable estimates of the extensive margin of exports. The dependent variable is a binary indicator for export participation. Firm real interest rate and its interaction with organizational capital are instrumented using the EU main refinancing rate and its interaction with organizational capital and lagged financial liabilities. Column (1) uses the measure of organizational capital based on employee expenses, while column (2) uses that based on non-financial expenses. Firm-level controls (not reported) include lagged financial liabilities, number of employees, ROA, firm age, productivity, total assets, and total sales. Macroeconomic controls (not reported) include sector total exports, real exchange rate, real GDP, and unemployment rate. All specifications include firm fixed effects. Standard errors (in parentheses) are clustered at the sector-year level. The Kleibergen-Paap F-statistic tests for weak identification, and the Hansen J-statistic tests for overidentifying restrictions. Marginal effects are computed using the Delta method and represent the average partial effects evaluated at sample means. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

regressors, inference must account for first-stage prediction error. We therefore bootstrap standard errors using 1,000 replications, clustering at the sector–year level.[15]

Table 3 adopts the same structure as Table 2 and reports the estimation results for the intensive margin of trade using our two measures of organizational capital: the narrower labour-expenditure-based measure (Column (1)) and the broader non-financial-expenditure-based measure (Column (2)).

Reassuringly, these findings confirm the picture emerging from the extensive margin. The coefficient on the real interest rate is negative and statistically significant, the coefficient on organizational capital is positive and statistically significant, and, most importantly, the coefficient on the interaction between organizational capital and the real interest rate is positive and statistically significant, respectively, at the 5% and 1% levels for the labour-based and non-financial-expenditure-based measures. As in the extensive-margin analysis, we also verify that the overall marginal effect of an increase in the real interest rate on the share of exports in total sales is negative, while the marginal effect of organizational capital is positive for both measures.[16]

Overall, the empirical results provide strong support for the predictions of the theoretical model. On the one hand, increases in real interest rates reduce firms' propensity to export at both the extensive and the intensive margins. On the other hand, firms that have accumulated a larger stock of organizational capital are better able to shield themselves from the effects of interest-rate fluctuations.

4.4 Robustness

While the empirical evidence presented in Section 4.3 provides strong support for the predictions of our theoretical model, its robustness may be questioned insofar as it relies on specific identification assumptions underlying the empirical strategy. To address these potential concerns, we conduct a battery of robustness checks, focusing both on the instrumental-variable strategy used to address endogeneity and on the possibility that channels other than organizational capital may be driving our results.

Our first set of robustness checks concerns the choice of instruments used to address the potential endogeneity of the real interest rate faced by the firm. Although the Hansen

[15] Estimates have been conducted using the *ppmlhdfe* command in Stata. The first-level regressions are available from the authors upon request.

[16] The full set of coefficient estimates, including the same firm-specific time-varying controls and macroeconomic variables used in the extensive-margin specification, are available upon request.

Table 3: Intensive margin of exports - Baseline results

	(1) Employee expenses	(2) Non-financial expenses
Interest rate × ln (Org. capital)	0.010***	0.018***
	(0.004)	(0.004)
ln (Org. capital)	0.065**	0.082***
	(0.028)	(0.025)
Interest rate	-0.160***	-0.297***
	(0.055)	(0.060)
Marginal effects		
Org. capital	*0.023***	*0.033***
	(0.006)	*(0.006)*
Interest rate	*-0.005***	*-0.005***
	(0.002)	*(0.002)*
Firm-level FE	Y	Y
Year FE	N	N
Firm-level controls	Y	Y
Macro controls	Y	Y
Observations	35,461	35,461

Notes: This table reports Poisson Pseudo-Maximum Likelihood (PPML) estimates of the intensive margin of exports. The dependent variable is the export share (export sales over total sales). Endogeneity is addressed through a two-stage control-function (residual inclusion) approach. In the first stage, each potentially endogenous regressor is regressed on its corresponding external instruments—the EU main refinancing rate and its interaction with organizational capital and lagged financial liabilities—together with all exogenous firm-level controls and fixed effects. The resulting residuals, which capture the endogenous components unexplained by the instruments, are included as additional covariates in the PPML estimation to purge endogeneity bias. Column (1) uses the measure of organizational capital based on employee expenses, while column (2) uses that based on non-financial expenses. Firm-level controls (not reported) include lagged financial liabilities, number of employees, ROA, firm age, productivity, total assets, and total sales. Macroeconomic controls (not reported) include sector total exports, real exchange rate, real GDP, and unemployment rate. The specification includes firm fixed effects. Standard errors (in parentheses) are clustered at the sector-year level. Marginal effects are computed using the Delta method and represent the average partial effects evaluated at sample means. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

tests for all IV specifications allow us to accept the null hypothesis of instrument exogeneity at conventional significance levels, the low power of over-identification tests against the alternative hypothesis of endogeneity is a well-known limitation. To provide additional support for our baseline findings, we therefore adopt a more demanding specification in which we focus exclusively on the interaction between changes in the monetary policy interest rate and firms' organizational capital, while controlling for all other determinants of firms' internationalization through firm fixed effects and time-varying firm characteristics.

Specifically, Table 4 reports the results from a specification in which organizational capital is interacted directly with the real monetary policy rate, defined as the ECB nominal interest rate on main refinancing operations net of expected inflation, while all time-varying macroeconomic conditions are absorbed by year fixed effects. This specification has two main weaknesses. First, it does not account for heterogeneity in the real interest rates faced by individual firms. Second, it does not allow us to estimate the direct effect of aggregate interest rates on firm internationalization, since this effect is absorbed by the year dummies. At the same time, it has two important strengths: it allows for a full control of aggregate shocks affecting internationalization decisions through time fixed effects, and it does not rely on the validity of firm-level instruments, thereby directly testing the impact of aggregate monetary policy on firms' export behaviour.

Column (1), which refers to the labour-based measure of organizational capital, shows that its interaction with the real monetary policy rate has a positive and statistically significant effect on the probability that a firm exports. Thus, a tightening of monetary policy in real terms has a smaller impact on export participation for firms with a higher endowment of organizational capital. To verify that the overall effect of monetary policy on export participation is negative—consistent with the results obtained using firm-level real interest rates—we also estimate an alternative specification that replaces year fixed effects with macroeconomic controls, thereby allowing the real monetary policy rate to enter directly as a regressor. Column (2) again yields a positive and statistically significant coefficient on the interaction between organizational capital and the ECB real interest rate, with a magnitude very close to that obtained in the specification with year fixed effects. Reassuringly, Table 4 also shows that the marginal effect of an increase in the real interest rate derived from ECB monetary policy is negative, reducing firms' access to foreign markets, while the marginal effect of organizational capital is positive, fostering internationalization. Columns (3) and (4) provide further confirmation of these findings when using the alternative measure of organizational capital based on aggregate non-financial expenses. The results obtained for the extensive margin of international trade are also confirmed when focusing on the intensive

Table 4: Extensive margin of exports - Robustness checks - ECB interest rates

	Employee expenses		Non-financial expenses	
	(1)	(2)	(3)	(4)
ECB rate × ln (Org. capital)	0.013***	0.011***	0.012***	0.011***
	(0.002)	(0.002)	(0.002)	(0.002)
ln (Org. capital)	0.049***	0.049***	0.052***	0.052***
	(0.013)	(0.013)	(0.014)	(0.014)
ECB rate		-0.163***		-0.168***
		(0.029)		(0.029)
Marginal effects				
Org. capital		*0.041***		*0.045***
		(0.013)		*(0.014)*
ECB rate		*-0.008***		*-0.008***
		(0.002)		*(0.002)*
Firm-level FE	Y	Y	Y	Y
Year FE	Y	N	Y	N
Firm-level controls	Y	Y	Y	Y
Macro controls	N	Y	N	Y
Observations	58,069	58,069	58,069	58,069

Notes: This table reports fixed effects estimates of the extensive margin of exports using the ECB main refinancing rate. The dependent variable is a binary indicator for export participation. Columns (1) and (3) include the interaction between the ECB rate and organizational capital along with year fixed effects. Columns (2) and (4) additionally include the ECB rate as a separate regressor and replace year fixed effects with macroeconomic controls. Columns (1) and (2) use the measure of organizational capital based on employee expenses, while columns (3) and (4) use that based on non-financial expenses. Firm-level controls (not reported) include lagged financial liabilities, number of employees, ROA, firm age, productivity, total assets, and total sales. Macroeconomic controls (not reported) include sector total exports, real exchange rate, real GDP, and unemployment rate. All specifications include firm fixed effects. Standard errors are robust. Marginal effects are computed using the Delta method and represent the average partial effects evaluated at sample means, and are reported only for columns (2) and (4). * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

margin, measured by the share of exports over total sales (Table 5).

As discussed in Section 4.1, an alternative interpretation of our baseline results is that organizational capital may simply proxy for firm size. Since, for larger firms, the incidence of size-independent internationalization costs is mechanically smaller, a skeptical reader might argue that our findings merely reflect scale effects. To address this concern, we augment the baseline specifications for both the extensive and intensive margins by including the interaction between firm-level real interest rates and the logarithm of total assets. Table 6 provides strong support for our interpretation of the baseline results.

Columns (1) and (2) of Table 6 report the estimates for the extensive margin using, respectively, the labour-based and the aggregate non-financial-expenses-based measures of organizational capital, while Columns (3) and (4) report the corresponding results for the intensive margin. In three out of four specifications, the coefficient on the interaction between the firm-level real interest rate and organizational capital remains positive and statistically significant. The only exception is the intensive-margin specification using the labour-based measure of organizational capital, where the estimated coefficient is statistically insignificant, although still positive and similar in magnitude to the baseline estimate. In all four cases, the marginal effects of the real interest rate and organizational capital are, respectively, negative and positive. Notably, the coefficient on the interaction between the real interest rate and firm size (total assets) is statistically insignificant in three out of four specifications, and negative and statistically significant only for the intensive margin when organizational capital is measured using aggregate non-financial expenses.

Finally, we estimate an alternative version of the baseline model in which the real interest rate faced by each firm and its interaction with organizational capital are instrumented exclusively using the ECB main refinancing rate and its interaction with organizational capital. Although this specification is exactly identified and therefore does not allow us to perform a Hansen test of over-identifying restrictions, it excludes firm-level variables—such as leverage—that may themselves respond to changes in financial conditions. Reassuringly, Table B.1 in Appendix B shows that the results for both the extensive and the intensive margins are broadly unchanged relative to the baseline specifications.

Overall, the robustness checks provide consistent evidence supporting the key prediction of the theoretical model: organizational capital mitigates the negative impact of tighter financial conditions on firms' export activity.

Table 5: Intensive margin of exports - Robustness checks - ECB interest rates

	Employee expenses		Non-financial expenses	
	(1)	(2)	(3)	(4)
ECB rate × ln (Org. capital)	0.028***	0.018***	0.029***	0.025***
	(0.003)	(0.004)	(0.003)	(0.003)
ln (Org. capital)	0.092***	0.097***	0.109***	0.116***
	(0.019)	(0.019)	(0.019)	(0.019)
ECB rate		-0.279***		-0.397***
		(0.052)		(0.053)
Marginal effects				
Org. capital		*0.021***		*0.024***
		(0.005)		*(0.005)*
ECB rate		*-0.006***		*-0.006***
		(0.001)		*(0.001)*
Firm-level FE	Y	Y	Y	Y
Year FE	Y	N	Y	N
Firm-level controls	Y	Y	Y	Y
Macro controls	N	Y	N	Y
Observations	46,807	46,807	46,807	46,807

Notes: This table reports Poisson Pseudo-Maximum Likelihood (PPML) estimates of the intensive margin of exports using the ECB main refinancing rate. The dependent variable is the export share (export sales over total sales). Columns (1) and (3) include the interaction between the ECB rate and organizational capital along with firm and year fixed effects. Columns (2) and (4) additionally include the ECB rate as a separate regressor and replace year fixed effects with macroeconomic controls while maintaining firm fixed effects. Columns (1) and (2) use the measure of organizational capital based on employee expenses, while columns (3) and (4) use that based on non-financial expenses. Firm-level controls (not reported) include lagged financial liabilities, number of employees, ROA, firm age, productivity, total assets, and total sales. Macroeconomic controls (not reported) include sector total exports, real exchange rate, real GDP, and unemployment rate. All specifications include firm fixed effects. Standard errors (in parentheses) are robust. Marginal effects are computed using the Delta method and represent the average partial effects evaluated at sample means, and are reported only for columns (2) and (4). * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 6: Robustness checks – Allowing for a mitigating role of size (Total Assets)

	Extensive margin		Intensive margin	
	Employee expenses	Non-financial expenses	Employee expenses	Non-financial expenses
	(1)	(2)	(3)	(4)
Interest rate × ln (Org. capital)	0.009**	0.016***	0.010	0.048***
	(0.003)	(0.004)	(0.008)	(0.012)
Interest rate × ln (Total assets)	0.001	-0.005	-0.000	-0.029***
	(0.003)	(0.003)	(0.007)	(0.010)
ln (Org. capital)	0.029	0.006	0.066	-0.025
	(0.018)	(0.020)	(0.042)	(0.051)
ln(Total Assets)	-0.019	-0.007	0.000	0.007
	(0.013)	(0.014)	(0.005)	(0.006)
Interest rate	-0.142***	-0.171***	-0.156**	-0.322***
	(0.032)	(0.032)	(0.066)	(0.075)
Marginal effects				
Org. capital	*0.053***	*0.050***	*0.023***	*0.027***
	(0.013)	*(0.014)*	*(0.005)*	*(0.006)*
Interest rate	*-0.008***	*-0.008***	*-0.005***	*-0.005***
	(0.002)	*(0.002)*	*(0.001)*	*(0.001)*
Firm-level FE	Y	Y	Y	Y
Year FE	N	N	N	N
Firm-level controls	Y	Y	Y	Y
Macro controls	Y	Y	Y	Y
Observations	41,363	41,363	35,461	35,461
Kleibergen–Paap F-stat	154.99	176.08	—	—
Hansen J-stat (p-value)	2.23 (0.136)	1.74 (0.187)	—	—

Notes: For the extensive margin (columns 1–2), the dependent variable is a binary indicator for export participation. For the intensive margin (columns 3–4), the dependent variable is the export share (export sales over total sales). For the extensive margin, firm real interest rate and its interactions are instrumented using the ECB main refinancing rate and its interactions with organizational capital, total assets, and lagged financial liabilities. For the intensive margin, endogeneity is addressed through a control-function approach where residuals from first-stage regressions are included in the PPML estimation. Columns (1) and (3) use the measure of organizational capital based on employee expenses, while columns (2) and (4) use that based on non-financial expenses. All specifications include firm fixed effects. For the extensive margin, standard errors (in parentheses) are clustered at the sector-year level. For the intensive margin, standard errors are bootstrapped with 1,000 replications clustered at the sector-year level. The Kleibergen–Paap F-statistic tests for weak identification and the Hansen J-statistic tests for overidentifying restrictions (reported only for extensive margin). Marginal effects are computed using the Delta method and represent the average partial effects evaluated at sample means. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

4.5 Heterogeneity

Changes in the interest rate faced by a firm may have heterogeneous effects depending on how easily the firm can access external finance. Within our framework, this implies that the attenuating effect of organizational capital on the relationship between interest rates and exports may itself depend on firm characteristics that shape access to external funding. Our hypothesis is therefore that firms facing tighter financing constraints benefit more from the shielding role of organizational capital. Operationally, this implies that the coefficient on the interaction between the real interest rate and organizational capital should be larger for firms that find it more difficult to obtain external finance.

To test this channel of heterogeneity, we split the sample according to three firm characteristics that are known to affect access to external funding: leverage, profitability, and asset tangibility. The rationale for each measure is straightforward. More leveraged firms are more likely to be credit constrained because, in the event of default, new lenders must compete with existing claimants. More profitable firms are perceived as less risky by external investors and can rely more on internal funds. Finally, firms with a higher share of tangible assets typically have easier access to external finance because these assets can be pledged as collateral.

Table B.2 in Appendix B reports the results obtained by splitting the sample according to whether firms' leverage is above or below the industry-level median, for both measures of organizational capital and for both margins of international trade.[17] Columns (1)–(4) focus on the extensive margin and show that, for both measures of organizational capital, the interaction between organizational capital and the real interest rate is larger for firms with leverage above the median. Columns (5)–(8) confirm this pattern for the intensive margin of international trade.

Table B.3 in Appendix B mirrors the structure of Table B.2, but splits the sample according to firms' profitability, proxied by return on assets (ROA). The results strongly confirm those obtained using leverage: the coefficient on the interaction between the real interest rate and organizational capital is systematically larger for firms with below-median profitability, indicating that less profitable firms benefit more from the shielding effect of organizational capital.

Finally, Table B.4 presents the results obtained by splitting the sample according to whether the share of tangible assets in total assets is above or below the industry-level

[17] We split the sample at the industry median, rather than the overall median, to account for systematic heterogeneity in financial structures across industries.

median. In this case, the predictions are weaker. While firms with a lower share of tangible assets are expected to be more exposed to interest rate fluctuations and therefore to benefit more from organizational capital, the evidence is mixed: only in two specifications is the interaction coefficient larger for firms with lower asset tangibility.

Taken together, these findings reveal a consistent pattern. Firms that are more likely to face binding external financing constraints—because they are more leveraged, less profitable, and have fewer assets that can be pledged as collateral—benefit more from the shielding effect of organizational capital when interest rate fluctuations affect their export decisions.

5 Conclusions

Our analysis, both theoretical and empirical, shows that higher interest rates reduce firms' exports at the extensive and the intensive margins, with the effect being weaker for firms with larger stocks of organizational capital.

From a theoretical perspective, these results stem from a dynamic heterogeneous-firm trade model featuring two key elements: a time lag between export costs and revenues, which raises firms' working capital requirements relative to domestic activities; and a stock of organizational capital that accumulates over time, enhances productivity, and mitigates the financing pressures associated with exporting. While higher interest rates generally discourage export activity by tightening the financing of the fixed costs associated with it, firms with greater organizational capital are better able to withstand these effects.

Organizational capital refers to the firm's stock of information about employee skills and thus reflects the firm's operating capabilities and managerial practices. Given the significant time lag between export costs and revenue generation, firms endowed with greater organizational capital can undertake exporting activities more efficiently, requiring less time and working capital.

Empirically, our analysis draws on comprehensive panel data covering Portuguese firms from 2008 to 2021. We construct firm-level measures of organizational capital and estimate how the impact of interest rates on exporting varies with a firm's organizational capital. The evidence provides strong support for the model's predictions

Our findings underscore a new channel of heterogeneity in the effects of interest rate fluctuations, highlighting the role of organizational capital as a key intangible asset that insulates firms from increases in the cost of capital. This highlights the policy relevance of

fostering firms' organizational capital to enhance resilience to adverse shocks.

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A Appendix A: Technical notes and proofs

We here derive an expression for $l_d + n_d$ given in (34a). As $l_d = \frac{y_d}{\varphi \Lambda_d} + f_d$ and $n_d = \frac{\psi\varepsilon\delta}{r+\delta}\frac{y_d}{\varphi\Lambda_d}$ then

$$l_d + n_d = \frac{y_d}{\varphi\Lambda_d}\frac{r+\delta+\psi\varepsilon\delta}{r+\delta} + f_d. \tag{41}$$

After using the pricing rule, the profit function can be expressed as

$$\pi_d = \frac{y_d}{\varphi\Lambda_d}\Gamma - f_d. \tag{42}$$

Combining the two previous equations, we obtain

$$l_d + n_d = \frac{(r+\delta+\psi\varepsilon\delta)(\sigma-1)}{r+\delta-(\sigma-1)\psi\varepsilon\delta}(\pi_d + f_d) + f_d. \tag{43}$$

Considering that the ex-ante expected profits of active firms (those whose productivity is above the cutoff) are given by

$$\pi_d = \frac{f_e}{1-G(\underline{\varphi}_d)}, \tag{44}$$

we obtain (34a). Using the same procedure with exporting variables, we obtain (34b).

Proof of Proposition 1 Using the expression $l_x - f_x = \frac{r+\delta}{\psi\varepsilon\delta}n_x$ into (34b) and rearranging, we obtain

$$n_x = \frac{(\sigma-1)\psi\varepsilon\delta}{r+\delta-(\sigma-1)\psi\varepsilon\delta}\left[\frac{f_e}{1-G(\underline{\varphi}_x)} + f_x\right]. \tag{45}$$

After substituting (45) into (37) for $1-G(\underline{\varphi}_x)$, using the above Pareto distribution and rearranging, we obtain

$$\frac{M_x}{M} = \frac{f_e}{\underline{\varphi}_d^{-\kappa}}\frac{(\sigma-1)\psi\varepsilon\delta}{\{n_x[r+\delta-(\sigma-1)\psi\varepsilon\delta] - f_x(\sigma-1)\psi\varepsilon\delta\}}. \tag{46}$$

The impact of the interest rate on the fraction of exporting firms is given

$$\frac{\partial\left(M_x/M\right)}{\partial r}=-\frac{M_x}{M}\left[\frac{1}{\underline{\varphi}_d^{-\kappa}}\underbrace{\frac{\partial\left(\underline{\varphi}_d^{-\kappa}\right)}{\partial r}}_{(+)}+\frac{n_x}{\{n_x[r+\delta-(\sigma-1)\psi\varepsilon\delta]-f_x(\sigma-1)\psi\varepsilon\delta\}}\right]<0. \tag{47a}$$

The effect of organizational capital (i.e., n_x) on the multiplier (47a) is

$$\frac{\partial^2\left(M_x/M\right)}{\partial r\partial n_x}=\frac{M_x}{M}\left\{\frac{f_x(\sigma-1)\psi\varepsilon\delta}{\{n_x[r+\delta-(\sigma-1)\psi\varepsilon\delta]-f_x(\sigma-1)\psi\varepsilon\delta\}^2}\right\}+$$
$$-\left[\frac{1}{\underline{\varphi}_d^{-\kappa}}\underbrace{\frac{\partial\left(\underline{\varphi}_d^{-\kappa}\right)}{\partial r}}_{(+)}+\frac{n_x}{\{n_x[r+\delta-(\sigma-1)\psi\varepsilon\delta]-f_x(\sigma-1)\psi\varepsilon\delta\}}\right]\frac{\partial\left(M_x/M\right)}{\partial r}>0. \tag{47b}$$

Since n_x is a monotonic transformation of z_x (i.e., $n_x=(\delta z_x/b)^{\varepsilon}$), then $\frac{\partial^2(M_x/M)}{\partial r\partial z_x}>0$.

The extensive margin is then negatively affected by the interest rate. However, this effect, when measured in absolute terms, diminishes as the level of organizational capital increases.

Proof of Proposition 2 As r increases, $\underline{\varphi}_x$ also increases, and thus the integral contained in (39), which is proportional to the intensive margin, goes down.

The role played by organizational capital for the effect of the interest rate on the intensive margin can be analyzed as follows.

Considering the Pareto distribution for firm productivity φ as specified above, expected revenues of exporting firms can be expressed as

$$\hat{R}_x=\frac{\kappa}{\kappa-\Xi}\underline{\varphi}_x^{-\kappa}. \tag{48}$$

After using $G(\underline{\varphi}_x)=1-\underline{\varphi}_x^{-\kappa}$ in (45), the fraction of exporting firms becomes

$$\underline{\varphi}_x^{-\kappa}=\frac{f_e(\sigma-1)\psi\varepsilon\delta}{n_x[r+\delta-(\sigma-1)\psi\varepsilon\delta]-f_x(\sigma-1)\psi\varepsilon\delta}. \tag{49}$$

Substituting (49) into (48) we get

$$\hat{R}_x=\frac{\kappa f_e(\sigma-1)\psi\varepsilon\delta}{\kappa-\Xi}\frac{1}{[r+\delta-(\sigma-1)\psi\varepsilon\delta]n_x-f_x(\sigma-1)\psi\varepsilon\delta}. \tag{50}$$

The effect of an increase in the interest rate on expected revenues from exports, for a given value of organizational capital, is

$$\frac{\partial\hat{R}_x}{\partial r}=-\frac{\kappa f_e(\sigma-1)\psi\varepsilon\delta}{\kappa-\Xi}\frac{n_x}{\{[r+\delta-(\sigma-1)\psi\varepsilon\delta]n_x-f_x(\sigma-1)\psi\varepsilon\delta\}^2}<0. \tag{51a}$$

By taking the partial derivative of the multiplier (51a) with respect to n_x, we get

$$\frac{\partial^2 \hat{R}_x}{\partial r \partial n_x} = \frac{\kappa f_e(\sigma-1)\psi\varepsilon\delta}{\kappa - \Xi} \frac{\{[r+\delta-(\sigma-1)\psi\varepsilon\delta]n_x + f_x(\sigma-1)\psi\varepsilon\delta\}}{\{[r+\delta-(\sigma-1)\psi\varepsilon\delta]n_x - f_x(\sigma-1)\psi\varepsilon\delta\}^3} > 0. \tag{51b}$$

Since n_x is a monotonic transformation of z_x (i.e., $n_x = (\delta z_x/b)^{\varepsilon}$), then $\frac{\partial^2 \hat{R}_x}{\partial r \partial z_x} > 0$.

An increase in the interest rate reduces the intensive margin. The effect of an interest rate change on the intensive margin, when measured in absolute value, is smaller the greater the organizational capital. Therefore, exporting firms with more organizational capital are less exposed to the costs of an interest rate hike.

B Appendix B: Additional empirical results

Table B.1: Robustness checks - Exactly identified specification

	Extensive margin		Intensive margin	
	Employee expenses	Non-financial expenses	Employee expenses	Non-financial expenses
	(1)	(2)	(3)	(4)
Interest rate×ln (Org. capital)	0.010***	0.011***	0.011**	0.018***
	(0.002)	(0.002)	(0.004)	(0.005)
ln (Org. capital)	0.025*	0.025	0.062*	0.082***
	(0.015)	(0.016)	(0.032)	(0.029)
ln(Total Assets)	-0.017*	-0.022**	-0.002	-0.005
	(0.010)	(0.010)	(0.004)	(0.005)
Interest rate	-0.146***	-0.167***	-0.179***	-0.297***
	(0.033)	(0.033)	(0.068)	(0.074)
Marginal effects				
Org. capital	*0.053***	*0.055***	*0.023***	*0.033***
	(0.013)	*(0.014)*	*(0.006)*	*(0.006)*
Interest rate	*-0.008***	*-0.009***	*-0.005***	*-0.005***
	(0.002)	*(0.003)*	*(0.002)*	*(0.002)*
Firm-level FE	Y	Y	Y	Y
Year FE	N	N	N	N
Firm-level controls	Y	Y	Y	Y
Macro controls	Y	Y	Y	Y
Observations	41,363	41,363	35,461	35,461
Kleibergen-Paap F-stat	287.11	246.34	—	—
Hansen J-stat (p-value)	—	—	—	—

Notes: This table reports exactly identified specification results. For the extensive margin (columns 1-2), the dependent variable is a binary indicator for export participation, estimated using instrumental variables. For the intensive margin (columns 3-4), the dependent variable is the export share (export sales over total sales), estimated using Poisson Pseudo-Maximum Likelihood (PPML) with a two-stage control-function approach. In these specifications, the interaction with lagged financial liabilities is excluded from the instrumental variables set, making the specifications just identified (two endogenous variables instrumented with two excluded instruments). For the extensive margin, firm real interest rate and its interaction with organizational capital are instrumented using the EU main refinancing rate and its interaction with organizational capital. For the intensive margin, endogeneity is addressed through a control-function approach where residuals from first-stage regressions are included in the PPML estimation. All specifications include firm fixed effects. For the extensive margin, standard errors (in parentheses) are clustered at the sector-year level. For the intensive margin, standard errors are bootstrapped with 1,000 replications clustered at the sector-year level. The Kleibergen-Paap F-statistic tests for weak identification (reported only for extensive margin). The Hansen J-statistic is not reported as these specifications are exactly identified. Marginal effects are computed using the Delta method and represent the average partial effects evaluated at sample means. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table B.2: Heterogeneity - Sample split by financial liabilities

	Extensive margin				Intensive margin			
	Employee exp.		Non-financial exp.		Employee exp.		Non-financial exp.	
	(1) Below	(2) Above	(3) Below	(4) Above	(5) Below	(6) Above	(7) Below	(8) Above
Interest rate×ln (Org. capital)	0.007*	0.012***	0.007*	0.012***	0.004	0.012**	0.010*	0.022***
	(0.004)	(0.003)	(0.004)	(0.002)	(0.005)	(0.005)	(0.005)	(0.005)
ln (Org. capital)	0.017	0.037*	0.010	0.039**	0.074	0.050*	0.073*	0.073**
	(0.028)	(0.019)	(0.028)	(0.019)	(0.047)	(0.030)	(0.042)	(0.029)
Interest rate	-0.108*	-0.169***	-0.122**	-0.188***	-0.079	-0.183**	-0.172**	-0.344***
	(0.059)	(0.039)	(0.060)	(0.037)	(0.075)	(0.079)	(0.084)	(0.083)
Marginal effects								
Org. capital	*0.038*	*0.067***	*0.032*	*0.071***	*0.021***	*0.021****	*0.024***	*0.034****
	(0.027)	*(0.019)*	*(0.027)*	*(0.020)*	*(0.010)*	*(0.007)*	*(0.010)*	*(0.007)*
Interest rate	*-0.011***	*-0.007***	*-0.011***	*-0.008***	*-0.006****	*-0.004***	*-0.006****	*-0.004***
	(0.005)	*(0.003)*	*(0.005)*	*(0.003)*	*(0.001)*	*(0.002)*	*(0.001)*	*(0.002)*
Firm-level FE	Y	Y	Y	Y	Y	Y	Y	Y
Year FE	N	N	N	N	N	N	N	N
Firm-level controls	Y	Y	Y	Y	Y	Y	Y	Y
Macro controls	Y	Y	Y	Y	Y	Y	Y	Y
Observations	12,989	26,580	12,989	26,580	10,949	22,552	10,949	22,552
Kleibergen-Paap F-stat	92.12	276.22	87.67	218.66	—	—	—	—
Hansen J-stat (p-value)	1.23 (0.268)	0.60 (0.440)	1.31 (0.253)	0.40 (0.526)	—	—	—	—

Notes: This table reports sample split results by financial liabilities across both margins of exports and both measures of organizational capital. The sample is split by the sector-level median of financial liabilities. "Below" indicates firms below the median and "Above" indicates firms above the median. For the extensive margin (columns 1-4), the dependent variable is a binary indicator for export participation, estimated using instrumental variables. Firm real interest rate and its interaction with organizational capital are instrumented using the EU main refinancing rate and its interaction with organizational capital and lagged financial liabilities. Standard errors (in parentheses) are clustered at the sector-year level. The Kleibergen-Paap F-statistic tests for weak identification and the Hansen J-statistic tests for overidentifying restrictions. For the intensive margin (columns 5-8), the dependent variable is the export share (export sales over total sales), estimated using Poisson Pseudo-Maximum Likelihood (PPML). Endogeneity is addressed through a two-stage control-function (residual inclusion) approach where residuals from first-stage regressions are included in the PPML estimation to purge endogeneity bias. Standard errors are robust. All specifications include firm fixed effects. Marginal effects are computed using the Delta method and represent the average partial effects evaluated at sample means. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table B.3: Heterogeneity - Sample split by ROA

	Extensive margin				Intensive margin			
	Employee exp.		Non-financial exp.		Employee exp.		Non-financial exp.	
	(1) Below	(2) Above	(3) Below	(4) Above	(5) Below	(6) Above	(7) Below	(8) Above
Interest rate×ln (Org. capital)	0.012***	0.009***	0.012***	0.011***	0.015*	0.010**	0.024***	0.016***
	(0.004)	(0.003)	(0.004)	(0.003)	(0.008)	(0.004)	(0.007)	(0.004)
ln (Org. capital)	0.019	0.005	0.024	-0.001	0.115**	0.041	0.180***	-0.001
	(0.023)	(0.017)	(0.026)	(0.021)	(0.047)	(0.032)	(0.042)	(0.031)
Interest rate	-0.175***	-0.138***	-0.183***	-0.170***	-0.230**	-0.155**	-0.391***	-0.265***
	(0.052)	(0.040)	(0.059)	(0.042)	(0.111)	(0.064)	(0.112)	(0.071)
Marginal effects								
Org. capital	*0.054***	*0.030**	*0.059***	*0.028*	*0.038****	*0.017***	*0.061****	*0.011*
	(0.021)	*(0.016)*	*(0.024)*	*(0.020)*	*(0.010)*	*(0.008)*	*(0.010)*	*(0.008)*
Interest rate	*-0.009***	*-0.005**	*-0.010***	*-0.006**	*-0.005***	*-0.004****	*-0.005****	*-0.004****
	(0.004)	*(0.003)*	*(0.004)*	*(0.003)*	*(0.002)*	*(0.002)*	*(0.002)*	*(0.002)*
Firm-level FE	Y	Y	Y	Y	Y	Y	Y	Y
Year FE	N	N	N	N	N	N	N	N
Firm-level controls	Y	Y	Y	Y	Y	Y	Y	Y
Macro controls	Y	Y	Y	Y	Y	Y	Y	Y
Observations	18,680	20,221	18,680	20,221	15,786	17,099	15,786	17,099
Kleibergen-Paap F-stat	133.05	135.91	114.13	128.93	—	—	—	—
Hansen J-stat (p-value)	1.40 (0.237)	1.99 (0.159)	1.54 (0.215)	1.72 (0.190)	—	—	—	—

Notes: This table reports sample split results by return on assets (ROA) across both margins of exports and both measures of organizational capital. The sample is split by the sector-level median of ROA. "Below" indicates firms below the median and "Above" indicates firms above the median. For the extensive margin (columns 1-4), the dependent variable is a binary indicator for export participation, estimated using instrumental variables. Firm real interest rate and its interaction with organizational capital are instrumented using the EU main refinancing rate and its interaction with organizational capital and lagged financial liabilities. Standard errors (in parentheses) are clustered at the sector-year level. The Kleibergen-Paap F-statistic tests for weak identification and the Hansen J-statistic tests for overidentifying restrictions. For the intensive margin (columns 5-8), the dependent variable is the export share (export sales over total sales), estimated using Poisson Pseudo-Maximum Likelihood (PPML). Endogeneity is addressed through a two-stage control-function (residual inclusion) approach where residuals from first-stage regressions are included in the PPML estimation to purge endogeneity bias. Standard errors are robust. All specifications include firm fixed effects. Marginal effects are computed using the Delta method and represent the average partial effects evaluated at sample means. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table B.4: Heterogeneity - Sample split by asset tangibility

	Extensive margin				Intensive margin			
	Employee exp.		Non-financial exp.		Employee exp.		Non-financial exp.	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Below	Above	Below	Above	Below	Above	Below	Above
Interest rate×ln (Org. capital)	0.012***	0.009***	0.011***	0.011***	0.008	0.008*	0.021***	0.016***
	(0.003)	(0.003)	(0.004)	(0.003)	(0.005)	(0.005)	(0.006)	(0.005)
ln (Org. capital)	0.008	0.029	0.020	0.013	0.115**	0.027	0.119***	0.035
	(0.024)	(0.019)	(0.027)	(0.018)	(0.047)	(0.032)	(0.042)	(0.030)
Interest rate	-0.170***	-0.126***	-0.175***	-0.171***	-0.153*	-0.128*	-0.357***	-0.245***
	(0.046)	(0.043)	(0.058)	(0.049)	(0.081)	(0.071)	(0.095)	(0.078)
Marginal effects								
Org. capital	*0.044**	*0.051****	*0.055***	*0.042***	*0.035****	*0.012*	*0.045****	*0.019***
	(0.023)	*(0.018)*	*(0.027)*	*(0.017)*	*(0.011)*	*(0.007)*	*(0.010)*	*(0.008)*
Interest rate	*-0.007*	*-0.006**	*-0.007*	*-0.006***	*-0.009****	*-0.002*	*-0.009****	*-0.002*
	(0.005)	*(0.003)*	*(0.005)*	*(0.003)*	*(0.002)*	*(0.001)*	*(0.002)*	*(0.001)*
Firm-level FE	Y	Y	Y	Y	Y	Y	Y	Y
Year FE	N	N	N	N	N	N	N	N
Firm-level controls	Y	Y	Y	Y	Y	Y	Y	Y
Macro controls	Y	Y	Y	Y	Y	Y	Y	Y
Observations	16,721	23,272	16,721	23,272	13,964	20,012	13,964	20,012
Kleibergen-Paap F-stat	100.07	147.95	78.65	128.77	—	—	—	—
Hansen J-stat (p-value)	0.48 (0.489)	2.31 (0.129)	0.57 (0.451)	2.04 (0.154)	—	—	—	—

Notes: This table reports sample split results by asset tangibility across both margins of exports and both measures of organizational capital. The sample is split by the sector-level median of asset tangibility (fixed assets over total assets). "Below" indicates firms below the median and "Above" indicates firms above the median. Firm real interest rate and its interaction with organizational capital are instrumented using the EU main refinancing rate and its interaction with organizational capital and lagged financial liabilities. Standard errors (in parentheses) are clustered at the sector-year level. The Kleibergen-Paap F-statistic tests for weak identification and the Hansen J-statistic tests for overidentifying restrictions. For the intensive margin (columns 5-8), the dependent variable is the export share (export sales over total sales), estimated using Poisson Pseudo-Maximum Likelihood (PPML). Endogeneity is addressed through a two-stage control-function (residual inclusion) approach where residuals from first-stage regressions are included in the PPML estimation to purge endogeneity bias. Standard errors are robust. All specifications include firm fixed effects. Marginal effects are computed using the Delta method and represent the average partial effects evaluated at sample means. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.