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Financial leverage and export quality: Evidence from France

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ABSTRACT

Does corporate financial structure matter for a firm's ability to compete in international markets through output quality? This study answers this question by using firm-level export and balance sheet data covering a large sample of French manufacturing exporters over the period 1997–2007. The main result is that there is a negative causal relation between a firm's leverage and export quality, where quality is inferred from the estimation of a discrete choice model of foreign consumers' demand. This result is robust across different specifications and estimation techniques. In addition, by estimating investment models we find that the negative impact of leverage on quality is consistent with theories predicting that the agency cost of debt determines suboptimal investment.

1. Introduction

Departing from the Modigliani and Miller (1958) theorem, a number of empirical studies questions the irrelevance of corporate financial structure for real activities by showing that leverage, as a measure of debt financing, affects investment patterns and productivity growth (e.g., Lang et al., 1996; Ahn et al., 2006; Coricelli et al., 2012). Contributions to the international trade literature show that a firm's export activity depends on financial factors, and several papers suggest that exporters are less leveraged and more liquid than non-exporters (e.g., Bellone et al., 2010; Minetti and Zhu, 2011).

The present study provides new elements to understand the relation between a company's financial structure and export performance by investigating whether leverage affects a firm's ability to compete in foreign markets through output quality. This research question is relevant from a policy perspective. On the one hand, the promotion of quality as a dimension of international competitiveness is an objective of high-income economies facing price competition from low-wage countries. On the other hand, because corporate financial structure is sensitive to policy parameters, the debt-quality nexus should be considered when evaluating the implications of policies that may affect a firm's financial structure. For example, the relation between debt financing and output quality can be a channel through which corporate tax reforms affect exporters' performance, if their level of debt respond to changes in profit taxation.

A possible link between financial leverage and output quality emerges by observing that debt financing redirects investment toward short-term projects (Maksimovic and Titman, 1991; Peyer and Shivdasani, 2001), while quality upgrading requires upfront investment delivering higher returns in the long-term (Shapiro, 1983). In addition, upgrading output quality requires firm-specific activities such as market research and R&D that generate few collateralizable assets. Hence, these activities are more difficult to monitor by bondholders, who may therefore require a higher premium on the cost of debt to bear the risk of default and moral hazard (Long and Malitz, 1985). Hence, *ceteris paribus* firms with high levels of debt should find it more costly and have less incentive to invest in quality upgrading. By signaling higher risk of bankruptcy, high leverage may also discourage a firm's

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suppliers from making relationship-specific investment, or it may compromise the expectations of its customers on the provision of post-sale services (Titman, 1984; Kale and Shahrur, 2007). It is then possible that these channels further reduce the perceived or real quality of a highly leveraged firm's products.

However, the intense use of debt financing may also result from a profit optimizing choice of the company or from the strategic use of financial leverage to acquire advantages over the competitors (Jensen and Meckling, 1976; Myers and Majluf, 1984; Brander and Lewis, 1986). In these cases, we expect high leverage to be chosen also by firms with sufficient internal liquidity because the negative effect of leverage on quality is offset by its positive effects on efficiency and market position. On the basis of these theoretical premises, we formulate three hypotheses on the impact of debt on export quality. First, more leveraged firms export lower quality varieties within narrowly defined product categories. Second, the effect of leverage on quality is stronger for illiquid exporters that have less ability to substitute internal funds for debt. Third, the negative impact of leverage is stronger in less concentrated industries with less scope for strategic interactions among competitors.

These hypotheses are investigated by using a rich dataset combining flow-level export data with firm-level balance sheet data on French companies. This dataset covers a large sample of exporters over the period 1997–2007, and it allows to conduct panel analyses both at the level of the individual export flow (i.e., firm-product-destination) and at the level of individual exporters. Because leverage is expected to impact output quality through investment, this premise is tested by estimating an investment equation augmented with an indicator of financial leverage. The relation between leverage and export quality is then investigated by estimating a model where the dependent variable is either a firm-level or a flow-level proxy for export quality. This proxy is obtained from the estimation of a discrete choice model of foreign consumer demand that exploits information on market shares and prices to infer the relative quality of each exported variety *vis-a-vis* the varieties exported by other firms targeting the same export destination within the same product category (Berry, 1994; Khandelwal, 2010). A negative correlation between quality and leverage is first obtained from an OLS model exploiting quality variations across varieties of the same product exported to a single market by companies with different levels of debt. A causal claim on this relation is supported by the use of a Two Stage Least Squares (2SLS) and Instrumental Variable Fixed Effect models introducing external instruments to address the endogeneity of leverage in regressions on quality, while controlling for firm-level unobserved heterogeneity and industry-level factors.

Our paper relates closely to the financial literature that investigates the nexus between a firm's capital structure and the product market. In the model of Brander and Lewis (1986) financial leverage is used by Cournot oligopolists to commit to higher levels of output at the expense of the competitors. While there is some evidence that industry concentration leads to higher levels of leverage and to the strategic use of debt among competitors (MacKay and Phillips, 2005), there is no clear empirical support for a positive relationship between leverage, investment and market performance (e.g., Campello, 2003, 2006). A recent extension of the original model of Brander and Lewis rationalizes this conflicting evidence, by showing that the limited liability of debt may also decrease a firm's incentive to invest when a firm's investment decision is introduced explicitly in the theoretical setup (Clayton, 2009).

By investigating the impact of a firm's level of debt on its export quality our contribution to the financial literature is twofold. First, we empirically identify a specific channel through which capital structure affects a firm's competitive position in foreign markets. To our knowledge, this is the first study that investigates the impact of leverage on quality for a large sample of companies from different manufacturing industries. Second, our empirical setting is favorable to address the ambiguous direction of causality between a firm's capital structure and the nature of the competitive environment. If a firm's financial leverage responds strategically to changes in the structure of the product market, it is expected to respond more sensitively to changes in the domestic market because this constitutes the single most important market for the majority of firms. Because our measure of quality is based on foreign sales, we can convincingly control for cross-industry heterogeneity in market structure (i.e., with industry-level or firm-level fixed effects), changes in the concentration of the domestic market (i.e., with time varying indices of market structure) while still retaining sufficient variation in the dependent variable to identify the impact of a firm's financial structure on quality.

The remainder of the paper is structured as follows. Section 2 introduces the conceptual framework underpinning the relation between leverage and quality. Section 3 describes the dataset and details the construction of the main variables. Section 4 illustrates the econometric specifications of the investment and the quality equation and motivates the choice of estimation methods. Section 5 describes the results and introduces robustness checks. Section 6 concludes.

2. Leverage, investment and quality

The milestone result of Modigliani and Miller (1958, 1963) that a firm's financial structure is irrelevant for investment depends crucially on the Arrow–Debreu setting of complete markets without information asymmetries, taxes, transaction or bankruptcy costs. In contrast, Myers (1977) shows that debt financing may induce suboptimal investment in the presence of uncertain returns and conflicting interests between creditors and stockholders. Despite the distortive effect of debt on investment, the 'pecking order theory' of capital structure suggests that this source of financing is used by companies with insufficient internal funds when information asymmetries between current and perspective stockholders increase the cost of equity financing above the cost of debt (Myers and Majluf, 1984). Jointly taken these results suggest that firms with greater dependence on debt are more subject to underinvestment. To the extent that investment is required to upgrade product quality, highly leveraged companies may be less capable to adjust output quality to seize demand opportunities arising from cross-sectional and longitudinal variations in consumers' preferences.

In addition, quality upgrading requires more intangible assets than alternative projects. The model of Long and Malitz (1985) shows that the agency cost of debt financing is relatively higher for investments in intangibles such as R&D and advertisement because these assets cannot be pledged as collateral and it is more difficult for bondholders to monitor the use of resources. Consistently with the predictions of their model, they observe that US firms undertaking more advertising and R&D choose a less leveraged financial structure. This result is largely supported by the empirical literature on R&D financing that provides strong evidence that this kind of investment is particularly sensitive to the availability of internal resources (e.g., Hall, 2002).

An alternative story on the negative relation between leverage and quality emphasizes the short-term bias determined by debt financing on a firm's investment choice. In the presence of bankruptcy costs, a highly leveraged company may prefer low-risk investment opportunities that in the short-term generate sufficient cash-flow for debt service. Along this line of argument, Maksimovic and Titman (1991) present a model in which investment in product quality develops 'reputation capital' that allows a firm to charge higher prices in the future. High leverage increases the probability of future bankruptcy, it shortens a firm's optimization horizon and reduces present investment in quality. In addition, highly leveraged firms that face an immediate threat of bankruptcy may reduce quality to cut costs and to sustain cash-flows for debt servicing. In the words of the authors, this strategy is equivalent to "obtaining an involuntary loan from consumers because the reduction in future revenue resulting from the loss of reputation corresponds to the repayment" (Maksimovic and Titman, 1991, p. 117). Supporting empirical evidence emerges from the US supermarket industry where more leveraged companies incur frequent shortfalls in inventories (i.e., an industry specific proxy for 'bad quality') to preserve cash-flow for debt servicing (Matsa, 2011). Peyer and Shivdasani (2001) exploit leveraged recapitalizations to identify the impact of debt on a company's allocation of investment across different business segments. After finding that leveraged recapitalizations redirect a firm's investment toward activities with higher current cash-flow, they similarly conclude that there is evidence of a short-term investment bias induced by higher debt. Lastly, high leverage may worsen the quality of a firm's output when suppliers and customers base their expectations on a firm's risk of bankruptcy on its level of debt (Titman, 1984; Kale and Shahrur, 2007). Indeed, customers requiring post-sale service may evaluate of lower quality the product provided by a firm with greater risk of bankruptcy, and suppliers may be less willing to make sunk investment to customize the intermediate inputs sold to a highly leveraged firm, with negative consequences for the quality of the final good.

Differences in preferences, product standards and regulations are important barriers to trade imposing upfront costs on firms entering foreign markets. Because foreign sales are more uncertain and difficult to monitor by lenders, the agency cost of debt may be higher when it comes to financing foreign operations (Feenstra et al., 2011). Empirically, financial constraints have been found preventing some firms from selecting into exporting and expanding their foreign operations (Bellone et al., 2010; Minetti and Zhu, 2011; Manova and Zhang, 2012; Amiti and Weinstein, 2011). Hence it might be expected that export activity exacerbates the agency cost of debt when it comes to finance quality upgrading. Drawing on these theoretical results and empirical evidence, we formulate our first working hypothesis:

Hyp 1: Exporters with high level of debt have a cost-disadvantage or fewer incentives to invest in quality upgrading projects. As a result, they export low quality varieties.

However, the 'trade-off theory' of corporate financial structure suggests that, despite the agency cost of debt, a leveraged financial structure can also result from a value optimizing choice. For example, Jensen and Meckling (1976) show that if ownership and management are separated, and if perfect monitoring is impossible (or costly), debt acts as a 'disciplinary device' on managers by limiting free cash-flow and unprofitable discretionary spending. Margaritis and Psillaki (2010) provide some evidence consistent with this hypothesis by finding that more efficient firms choose higher levels of leverage. In addition, because interest rate payments can be deducted from taxable profits, debt 'shields' profits from taxation (Kraus and Litzenberger, 1973). Unfortunately, in our dataset it is not possible to identify firms for which high leverage characterizes the optimal financial structure.[5] However, when a firm has greater internal resources, it is more likely that high leverage stems from a value optimizing choice rather than from a lack of alternative sources of financing. This observation leads to our second hypothesis:

Hyp 2: For firms with greater internal liquidity, a leveraged financial structure is more likely to arise as a value optimizing choice, and it should be less detrimental to product quality.

On the basis of this hypothesis we should expect a firm's liquidity to moderate the impact of leverage on quality.

Finally, models of oligopolistic competition predict that higher levels of debt financing may serve as a commitment device to induce competitors to produce lower levels of output (Brander and Lewis, 1986), or to acquire bargaining power over workers (Bronars and Deere, 1991) and suppliers (Perotti and Spier, 1993). On the basis of these theoretical results we should expect leverage to have a more negative impact on output quality, when this effect is not offset by the strategic advantage of setting high levels of debt. The degree of market concentration is then likely to interact with the level of leverage which results from the firm's value optimizing choice. We then formulate our last hypothesis:

Hyp 3: The negative effect of leverage on firm export quality is stronger in more competitive industries, where the strategic use of the capital structure is not a viable option to gain market shares or to reduce the costs of production.

3. Features of the data and of the main variables

The dataset used for this study is assembled from two main administrative sources. The *Fichier complet de Système Unifié de Statistique d'Entreprises* (FICUS) provided by the French National Statistical Office (INSEE) reports balance sheet information for almost the entire population of French firms observed over the period 1997–2007.[6] In this dataset we retain only manufacturing companies whose export activity is documented in the *French Customs Dataset* during the same period of time. Indeed, a unique fiscal identifier (SIREN code) allows us to associate each exporter in FICUS with its own export flows in the Customs dataset. This second database reports quantities (kilograms), free-on-board values (euros) and countries of destination for each firm-level export flow disaggregated at the 8-digit product category of the Combined Nomenclature (CN8).[7] In order to reduce the number of flow-level export series discontinued over time, 8-digit product categories are collapsed at the 6-digit level by aggregating quantities and values exported by the same firm within a destination in a given year.[8]

[5] The maturity structure of a firm's debt is not observable in our dataset and we cannot use it to identify the strategic use of debt.

[6] In FICUS, firms with revenues below €81,500 (manufacturing) or €35,600 (services) are excluded. We also dropped firms with less than 10 employees. All values reported in this dataset are in '000 euros and they are deflated using 2-digit industry specific indices provided by INSEE for consumer, value added and capital prices.

[7] Export data are collected monthly by the French Customs Office, but we can only access these information at the yearly frequency. Firms that over the same fiscal year export less than €1,000 outside the EU, or less than €100,000 within the EU (raised to €150,000 in 2006), are not required to report their transactions and they are underrepresented in the Customs dataset. Some CN8 product categories are reclassified over the years and we use Eurostat tables to concord all product categories to the 2007 classification.

[8] For example, in the CN8 classification men's shirts of man-made fibre are subdivided in shirts of synthetic fibre (CN8: 61052010) and shirts of artificial fibre (CN8: 61052090). We sum quantities and values exported by the same company to the same destination within these two product categories to obtain a unique export flow for men's shirts of man-made fibre (CN6: 610520). The resulting 6-digit code is consistent with the harmonized standard nomenclature (HS6) that is the classification used by most studies on trade.

FICUS reports the book value of a firm's debt (*debt*) as the sum of bonds, loans and other form of debt to credit institutions, plus deposits and funds of employee participation. Notice that payables to tax authorities and social security administration are excluded from the computation. A limitation of the dataset is that it does not include information on the maturity of debt. An indicator of a firm's f leverage at time t is constructed as $lev_{ft} = debt_{ft}/(debt_{ft} + equity_{ft} + trade_{ft})$ where $equity_{ft}$ is the nominal value of a company's shares, and $trade_{ft}$ is the total amount owed by the firm to its suppliers.[9] An alternative indicator is obtained as the ratio of a firm's debt over total assets $lev2_{ft} = debt_{ft}/asset_{ft}$. This will be used in robustness tests. We use the perpetual inventory method to obtain a measure of the replacement value of the capital stock (K). In the first year that a company is observed, the historic cost and the replacement cost of capital are assumed to be equal, and capital is measured as the book value of a firm's tangible assets. In later periods the replacement value of capital is computed as: $K_{f(t+1)} = K_{ft} \times (1-\delta) \times (p_{t+1}/p_t) + I_{ft}$ where δ is the economic depreciation rate of capital set at 5.5%, p_{t+1}/p_t is the ratio of the industry specific price deflators for capital goods in two consecutive periods, and I is the investment of the firm.[10]

Cash-flow CF, computed as the sum of after-tax profits and depreciation, approximates a firm's ability to generate internal resources from sales. Following Guariglia (2008), CF is used to construct three dummy variables: $NGCF_{ft} = 1$ when the ratio of CF_{ft} over total sales is negative, $MDCF_{ft} = 1$ when the same ratio is positive but below the 75th percentile computed at the 2-digit industry-year level, and $HICF_{ft} = 1$ when it is above the 75th percentile. These three indicators identify firm-years observations characterized by insufficient, normal or abundant internal resources for self-financing investment. Variations in demand are captured by Δs_{ft}; that is the log difference between a firm's sales at time t and at time $t-1$.

Because the literature suggests that there is a positive relation between export quality and productivity (Verhoogen, 2012), regressions on quality include a control for a firm's total factor productivity tfp_{ft}. This is obtained as the residual of the production function on log value-added according to the method of Levinsohn and Petrin (2003).[11] Further controls introduced in regressions on quality are: a firm's capital intensity $kapint_{ft}$ measured as the log of the value of tangible assets per employee, labor input lab measured as the number of permanent employees multiplied by the yearly average number of hours worked per employee in the industry, export intensity $expint_{ft}$ obtained as the ratio of foreign sales over total sales, the log and the log squared of a firm's age age_{ft} and $age2_{ft}$, and the dummy variables $group_{ft}$ and $foreign_{ft}$ respectively taking value one when a firm belongs to a domestic or a foreign business group and zero otherwise.

In addition to firm-level factors, industry-level and country-level factors are relevant determinants of a firm's capital structure (e.g., Jong et al., 2008). Because the empirical analysis is conducted on French firms only, it is possible to ignore the role of institutional factors determining most of the variation in capital structure across countries (Demirguc-Kunt and Maksimovic, 1999). On the contrary, it is still necessary to control for industry-level factors that may correlate both with the regressor of interest, leverage, and with the dependent variable measuring quality.[12] Hence, industry-level heterogeneity is controlled for by introducing industry-specific fixed effects in all the specifications that do not already control for firm-specific fixed effects. We also control for a set of time-varying industry-specific factors such as market concentration in a firm's own industry HI_{st}, and the average concentration across the industries of its suppliers $SupplierHI_{st}$ and clients $ClientHI_{st}$. While HI_{st} is computed as the Herfindahl index on the total assets of French companies operating in the same 2-digit ISIC industry of the firm, $SupplierHI_{st}$ and $ClientHI_{st}$ are weighted averages of HI_{st} computed across all industries supplying inputs and using the output from s as an input.[13] These controls are necessary in the light of theoretical results and empirical evidence suggesting that a firm's optimal capital structure depends not only on the competitive environment in which it operates but also on the market structure of its suppliers and customers (Hennessy and Livdan, 2009; Chu, 2012).

Lastly, we control for differences in research and development (R&D) intensity across industries, and across the industries of a firm's suppliers and customers by introducing in regressions the industry-level time-varying controls $RD_{st}, SupplierRD_{st}$ and $ClientRD_{st}$. RD_{st} measures sectoral R&D intensity as R&D expenditure on total output, $SupplierRD_{st}$ and $ClientRD_{st}$ are weighted averages of R&D intensity across the industries of a firm's suppliers and clients.[14] These variables control for differences in innovative intensity across industries that may affect both product quality and debt levels. Indeed, Kale and Shahrur (2007) find that by discouraging suppliers' and consumers' relationship-specific investment high debt levels hamper more seriously the performance of firms operating in R&D intensive industries.

3.1. Estimation of export quality

The working definition of 'quality' adopted in this study refers to the set of a product characteristics that increase a consumer's utility. According to this definition, a firm's ability to compete through quality entails its capacity to identify consumers' preferences and to translate them into desirable product characteristics. Because consumers' preferences vary over time and across foreign markets, a country-specific and time-varying measure of export quality is obtained by estimating a discrete choice model of consumer demand. This model, popular in the Industrial Organization literature, has been recently applied to trade data by Khandelwal (2010) to estimate the quality of different import flows to the US. Our empirical approach follows closely Khandelwal (2010) even thus we use data on firm-level export flows instead of data on bilateral trade flows between countries.

The simple intuition behind this approach is to infer quality as the share of an exported variety over a country's total import in a given product category that is not explained by the price. Under the assumption that individual consumers make a discrete choice among different varieties of the same product, the share of one variety over the total quantity consumed within a product class can be seen as the empirical counterpart of a consumer's probability of choosing one variety over the others. A logit model expresses this probability as a function of a variety's price, observable and unobservable characteristics and consumers' random taste parameters. This model can be conveniently expressed in a linear form:[15]

$$ln(s_i) - ln(s_o) = X_i'\beta + \alpha p_i + \sigma ln(s_{i/g}) + Q_i \quad (1)$$

[9] The measure of leverage adopted in our study is identical to the one computed by Bertrand et al. (2007), who use similar administrative French data.

[10] The economic depreciation rate of capital is set at 5.5% as in Guariglia (2008). In an unreported robustness check, all results hold when we change this parameter to 8% as in Bond et al. (2010).

[11] The production function is estimated separately for each 2-digit ISIC industry.

[12] We wish to thank an anonymous referee for suggesting to control for industry-specific factors.

[13] The weights are based on the OECD STAN input–output table for France. When computing $SupplierHI_{st}$ weights are calculated as the shares of total input of industry s obtained from each other industry. When computing $ClientHI_{st}$ weights are calculated as the shares of output sold by industry s to each other industry.

[14] The measure of R&D intensity is obtained from OECD STAN INDICATORS. Weights from input–output tables are used to compute suppliers' and customers' R&D intensity.

[15] The derivation of Eq. (1) is detailed in the Appendix A.

where the dependent variable $ln(s_i)$ is the log quantity share of a variety i in a particular product class normalized subtracting the log share of an 'outside variety' $ln(s_o)$.[16] This normalized share depends on a variety's price p_i, 'horizontal' characteristics X' and quality Q_i. The vector of parameters β captures consumers' preferences for different product attributes and α is the disutility of price. The term $ln(s_{i/g})$ is the 'nest share' of variety i, namely the quantity share of variety i over a more disaggregated product category than the one used to construct shares on the left-hand side of the model.[17] This term allows a product market to be segmented in subclasses g including varieties that are closer substitutes.

From an empirical perspective, the export price p_i of a variety (defined at the HS6 product-firm-destination level) can be represented by its unit-value, obtained dividing the value of the flow by its quantity.[18] The share of a variety within an export destination d_i is computed as the quantity of the variety over the total quantity imported by a destination in that year within a 4-digit HS product category. The share of the outside variety s_o is measured as the share of a country's imports within each 4-digit product class that is not originated from France. After normalization, the demand for the variety exported by a French company to a destination country is expressed in relation to a benchmark 'generic variety' obtained by pooling the imports from all other countries to the same destination. Because the objective is to identify the heterogeneity in the quality of the varieties exported by French firms, the choice of the outside variety does not affect our analysis. The nest-share $s_{i/g}$ is computed as the quantity share of the same variety over the total import of the country within the more disaggregated 6-digit product category.[19]

Eq. (1) is estimated separately for each of the 1217 4-digit product classes observed in the dataset to accommodate variations in the parameters α and σ across products. Demand equations are both estimated by Fixed-Effect models (FE) with the panel unit set at the HS6 product-destination level, and by Two Stage Least Squares Fixed-Effect models (IVFE) where in addition to controlling for product-destination fixed effects, external instruments are used to address the endogeneity of prices and nest-shares that correlate with the unobservable quality term subsumed in the error. Endogeneity is suspected to bias upward the parameter α: if price increases in unobserved quality, and quality affects positively market shares, omitted-variable bias leads to underestimate the negative impact of prices on demand. We use the average price of French exporters computed at the year-HS6 product-destination level to instrument for the price of individual varieties. This instrument is correlated with the price of the individual varieties because it varies over time due to common demand shocks affecting all French exporters, but it is expected to be orthogonal with respect to the quality of individual varieties that is the main cause of endogeneity. The instrument for $s_{i/g}$ is instead the number of French exporters in a given HS6 product class targeting the same export market in a given year. Again, the number of competitors is expected to correlate with the 'nest-share' of each exporter but to be independent with respect to individual exporters' quality. Customs data do not provide information on a variety's characteristics, making it impossible to disentangle the component of demand explained by 'horizontal' product attributes in X' that fit more closely the taste of some consumers (e.g., color), from the component explained by 'vertical' attributes that all consumers perceive as desirable (e.g., quality of the fabric). Instead, we measure a broader concept of quality Q_i^*, that is the closeness of a variety to consumers' tastes, that an exporter achieves by combining 'horizontal' and 'vertical' attributes:

$$Q_i^* = [ln(s_i) - ln(s_o)] - [\hat{\alpha}p_i + \hat{\sigma}ln(s_{i/g})] \qquad (2)$$
$$Q_i^* \equiv X_i'\beta + Q_i.$$

where Q_i^* is the residual market share of a variety obtained as the distance from the fitted market share computed using the estimated parameters $\hat{\alpha}$ and $\hat{\sigma}$. In some econometric specifications we aggregate flow-levels estimates of quality Q_i^* to obtain a firm-level indicator Q_f^* that expresses the average *relative* quality of a firm's exports across all its varieties:

$$Q_f^* = \sum_i w_i \times (Q_i^* - \bar{Q}^*_{pd})$$

where w_i is the value share of flow i over the total exports of firm f in a given year, and $\bar{Q}^*_{pd}$ is the average quality level within the same HS6 product-destination cell of variety i.[20]

3.2. Descriptive statistics

Table 1 describes the panel structure of the final dataset. This includes only the HS4 product categories exported by manufacturing firms for which we obtain significant and credible estimates of the demand parameters (i.e., $\hat{\alpha} > 0$ and $0 < \hat{\sigma} < 1$).[21] The reason for eliminating HS4 product categories that do not conform with these criteria is to retain in the sample only those observations for which we obtain reliable estimates of quality. Only 490 of the initial 1217 HS4 categories are retained. Nevertheless these products account for more than 75% of all firm-product-year observations. This cleaning eliminates HS4 products that are exported mainly by non-manufacturing companies, and those for which it is not possible to identify precisely the parameters of the demand equation because of insufficient observations.

In Table 1, Panel A reports the number of unique export varieties and unique firms observed each year. The number of exporters ranges from a minimum of 18,591 in 2000 to a maximum of 24,320 in 1999. The number of unique export varieties (firm-product-destination) ranges from a minimum of 324,759 in 2000 to a maximum of 546,399 in 1999. Large variations in these figures arise because in some years a number of export flows misses the information on export quantities. Hence, it is not possible to estimate quality for these varieties, and they are dropped from the sample. Panel B reports the number of unique varieties

[16] The 'outside variety' indexed by o is a variety excluded from the estimation sample for which we observe the market share. The 'outside variety' is a variety whose price and quality are uncorrelated with the price and quality of the varieties included in the estimation sample (Nevo, 2000). By subtracting the log share of the 'outside variety' s_o to the log share of each variety included in the estimation sample s_i we obtain normalized quantity shares mirroring the relative probability that a consumer in a given market chooses one unit of variety i over one unit of variety o. Without loss of generality, the utility derived from consuming one unit of o is normalized at 0. This normalization greatly simplifies the dimensionality problem in the estimation of the demand function.

[17] For example, s_i on the left-hand side of the model is the share of men's shirts of man-made fibre exported by the French firm f to Italy in 2000 (HS6:610520) over the total quantity of men's shirts of all materials imported by Italy in the same year (HS6:6105), while $s_{i/g}$ on the right-hand side is the share of men's shirts of man-made fibre exported by the French firm f to Italy in 2000 (HS6:610520) over Italy's total imports of men's shirts of man-made fibre in that same year (HS6:610520).

[18] The unit-value is the best proxy for a variety's price that can be computed from Customs data (Bastos and Silva, 2010; Manova and Zhang, 2012). However this proxy is noisy due to measurement errors in export quantities and to product heterogeneity within export classes. HS6 product classes are defined at a fine-grained level of disaggregation, and we are mostly worried about measurement errors. For this reason, we eliminate extreme observations by dropping unit-values that are below the 1st and above the 99th percentile of the distribution within each product class.

[19] Details on the use of trade data to construct the market shares are left in the Appendix A.

[20] The time subscript is omitted to avoid cluttering the notation even if flow- and firm-level measures of quality vary over time.

[21] Table 10 in the Appendix A reports summary statistics from the estimation of Eq. (1) and shows the percentage of observations retained in the sample.

Table 1
Panel structure of the dataset.

Panel A			Panel B		
Year	# Varieties i	# Firms f	# Periods	# Varieties i	# Firms f
1997	471,966	22,158	1	1,302,188	13,784
1998	500,374	23,352	2	373,353	7,333
1999	546,339	24,320	3	201,033	5,425
2000	324,759	18,591	4	116,108	4,173
2001	549,224	23,403	5	85,498	3,597
2002	547,947	23,964	6	59,101	2,917
2003	379,358	18,861	7	40,080	2,946
2004	398,106	18,560	8	41,270	4,151
2005	398,725	20,741	9	18,287	1,988
2006	394,784	20,052	10	13,729	2,282
2007	447,042	20,696	11	13,410	3,932

and firms present in the dataset for each number of periods. A large number of varieties and firms appear in the dataset for one year only. Because firms that exit the sample (i.e., stop exporting) are generally smaller and more financially constrained, over time the panel overrepresents financially sound companies with strong export performance. This attrition bias works against finding evidence of a negative impact of debt financing on export quality, because more financially sound companies are conceivably less affected by the issues discussed in Section 2.

Table 2 reports the mean and the standard deviation of the variables of interest computed within the whole sample (column 1), and within sub-samples of firm-year observations with different liquidity (columns 2–4) and leverage (columns 5–7). A negative relation between leverage and investment is not apparent looking at these statistics, as we find that the investment ratio $I_{ft}/K_{f(t-1)}$ is higher in the subs-ample of firm-year observations with high leverage than in the sub-samples with medium and low leverage. This relation can be explained by the fact that debt is used for investment and that these simple statistics are insufficient to capture the causal effect of the level of debt on current investment.

On average, firms with high levels of leverage are also characterized by slower sale growth Δs, lower productivity *tfp*, fewer HS6 product exported, and fewer export destinations served than exporters with low or medium leverage. More importantly, descriptive statistics already provide some evidence that high leverage may be a determinant of low-quality exports. On average, low-leverage exporters sell varieties that are more expensive and with higher quality than high-leverage exporters competing on the same product. In contrast, capital intensity *kapint* and export intensity *expint* increase in the level of leverage.[22]

4. Empirical strategy

4.1. Investment model

This paper focuses on exporters, and a rich empirical literature emphasizes how these companies self-select into international activities due to their superior characteristics. For instance, previous studies found that exporters are less financially constrained than non-exporters (e.g., Bellone et al., 2010; Minetti and Zhu, 2011). Hence, it is necessary to test whether the negative relation between leverage and investment, suggested by some of the studies discussed in Section 2, applies to exporters. To do so, we estimate a static and a dynamic specification of the following investment model:

$$
\begin{aligned}
I_{ft}/K_{f(t-1)} = {} & \alpha_0 + \alpha_1 I_{f(t-1)}/K_{f(t-2)} + \alpha_2 \Delta s_{ft} + \alpha_3 \Delta s_{f(t-1)} \\
& + \alpha_4 CF_{ft}/s_{ft} + \alpha_5 lev_{f(t-1)} + v_f + v_s + v_t + e_{ft}
\end{aligned} \qquad (3)
$$

where v_f, v_s and v_t are respectively firm-, industry- and year-specific fixed effects, and e_{ft} is the idiosyncratic component of the error term. In this model, firm-level investment opportunities are proxied by contemporaneous and lagged variations in a firm's sales Δs_{ft} and $\Delta s_{f(t-1)}$, while the availability of internal resources is captured by the cash-flow over current sales CF_{ft}/s_{ft}.

To mitigate endogeneity arising from reverse causation, on the right-hand side we introduce leverage in its first lag, instead of its contemporaneous value. When we estimate a static specification of the model, we impose the restriction $\alpha_1 = 0$ and exclude the lagged dependent variable $I_{f(t-1)}/K_{f(t-2)}$ from the right-hand side. Static specifications are estimated by Random-Effect (RE) and Fixed-Effect (FE) Panel model. RE models allow for serial correlation in the errors within individual firms' time series, but they generate consistent estimates only if the component v_f of the error term is not systematically correlated with the regressors. FE models instead relax this assumption and eliminate the firm fixed effects from the error by applying within-group transformation. In these models, we identify the coefficient on $lev_{f(t-1)}$ by exploiting only variations in debt levels and investment within the time series of individual firms. Even if the FE estimator addresses the omitted variable bias caused by the correlation between the regressors and the firm-specific fixed effects, endogeneity may still arise because of time-varying unobserved factors (e.g., contingent policies of the firm) affecting both $lev_{f(t-1)}$ and $I_{ft}/K_{f(t-1)}$.

To address this issue we estimate a dynamic specification of Model (3) by relaxing the assumption that $\alpha_1 = 0$, and by introducing the lagged dependent variable $I_{f(t-1)}/K_{f(t-2)}$ as an additional regressor. Following a popular approach in the investment literature, we estimate this model by First-Difference GMM (Arellano and Bond, 1991). The lagged dependent variable on the right-hand side captures the effect of an unobservable and predetermined policy on current investment if the same policy determines investment both at time t and at time $t-1$. In addition, in AB models we address reverse causation by using the lagged levels of an endogenous regressor to instrument its contemporaneous first-differences. For example, if funds for investment at time t are obtained in the previous period, unobserved credit demand may affect $\Delta lev_{f(t-1)}$ determining reverse causation. However, the risk that the demand for investment at time t determines the level of debt at time $t-2$ is lower, and we can use $lev_{f(t-2)}$ as an internal instrument for $\Delta lev_{f(t-1)}$.

In a different model, we follow the same approach of Guariglia (2008) to allow for non-linearities in the relation between cash-flow and investment, and to investigate the existence of a differential impact of leverage on investment conditional on internal resources. The model that we estimate is the following:

$$
\begin{aligned}
I_{ft}/K_{f(t-1)} = {} & \alpha_0 + \alpha_1 I_{f(t-1)}/K_{f(t-2)} + \alpha_2 \Delta s_{ft} + \alpha_3 \Delta s_{f(t-1)} \\
& + \alpha_{4a}[CF_{ft}/s_{ft} \times NGCF_{ft}] + \alpha_{4b}[CF_{ft}/s_{ft} \times MDCF_{ft}] \\
& + \alpha_{4c}[CF_{ft}/s_{ft} \times HICF_{ft}] + \alpha_{5a}[lev_{f(t-1)} \times NGCF_{ft}] \\
& + \alpha_{5b}[lev_{f(t-1)} \times MDCF_{ft}] + \alpha_{5c}[lev_{f(t-1)} \times HICF_{ft}] \\
& + v_f + v_s + v_t + e_{ft}
\end{aligned} \qquad (4)
$$

If the negative effect of leverage on investment is stronger for liquidity constrained companies, the three coefficients α_{5a}, α_{5b} and α_{5c} are expected to be negative with $\alpha_{5a} < \alpha_{5b} < \alpha_{5c}$. If instead the effect of leverage on investment holds only for firms with insufficient liquidity the only coefficient that is expect to be negative and significant is α_{5a}.

[22] For all variables mentioned in this section, t-tests indicate that differences in means across sub-samples are significant at confidence levels lower than 1%.

Table 2
Descriptive statistics.

	All exporters (1)	$NGCF_{it}$ (2)	$MDCF_{it}$ (3)	$HICF_{it}$ (4)	$LLEV_{it}$ (5)	$MLEV_{it}$ (6)	$HLEV_{it}$ (7)
Panel A: financial attributes							
Real assets	7,336	7,562	6,920	8,570	9,116	6,534	7,732
	(75,396)	(67,157)	(71,017)	(91,519)	(67,823)	(71,908)	(90,759)
$I_{ft}/K_{f(t-1)}$	0.154	0.109	0.151	0.189	0.131	0.156	0.175
	(0.253)	(0.225)	(0.245)	(0.286)	(0.231)	(0.246)	(0.284)
Δs_{ft}	0.031	−0.098	0.025	0.128	0.029	0.038	0.022
	(0.215)	(0.242)	(0.195)	(0.212)	(0.221)	(0.212)	(0.215)
CF_{ft}/s_{ft}	0.062	−0.064	0.050	0.172	0.064	0.056	0.064
	(0.081)	(0.060)	(0.028)	(0.064)	(0.080)	(0.074)	(0.088)
lev_{ft}	0.272	0.290	0.263	0.289	0.026	0.244	0.571
	(0.220)	(0.227)	(0.210)	(0.242)	(0.036)	(0.112)	(0.126)
$lev2_{ft}$	0.168	0.231	0.160	0.155	0.014	0.144	0.364
	(0.168)	(0.216)	(0.155)	(0.167)	(0.024)	(0.099)	(0.165)
Panel B: exports & performance							
# Destinations	16.321	15.704	15.682	15.147	16.359	17.019	15.413
	(19.876)	(19.380)	(19.226)	(18.106)	(19.644)	(20.199)	(19.643)
# HS6 Products	21.576	21.244	20.891	20.928	21.933	22.277	20.462
	(34.207)	(33.638)	(32.512)	(33.440)	(33.055)	(34.235)	(35.716)
Mean export value	187,256	176,359	214,296	123,438	201,971	171,287	205,230
	(3,890,437)	(2,705,921)	(4,818,172)	(2,096,056)	(4,192,683)	(3,662,757)	(4,030,908)
$\bar{u}v_{it}$	0.000	0.000	−0.026	0.034	0.025	−0.012	0.001
	(0.934)	(0.934)	(0.908)	(0.965)	(0.973)	(0.924)	(0.914)
$\overline{Q}_{it}$	0.000	−0.011	0.000	−0.043	0.013	−0.002	−0.006
	(1.298)	(1.319)	(1.290)	(1.296)	(1.305)	(1.294)	(1.297)
$kapint_{ft}$	−4.032	−4.244	−3.834	−4.821	−4.177	−4.040	−3.854
	(1.146)	(1.178)	(1.005)	(1.115)	(1.233)	(1.078)	(1.151)
$expint_{ft}$	0.216	0.230	0.206	0.226	0.219	0.208	0.229
	(0.253)	(0.261)	(0.246)	(0.269)	(0.260)	(0.243)	(0.262)
tfp_{ft}	1.346	1.140	1.280	1.578	1.504	1.391	1.131
	(1.179)	(1.179)	(1.149)	(1.141)	(1.195)	(1.145)	(1.193)
# Obs. (Firm-year)	234,698	22,602	111,611	26,755	61,205	112,288	58,977
# Firms	52,528	5,143	21,986	6,102	13,712	24,005	13,811
# Flows(HS6-dest.-year)	4,958,624	461,813	2,130,867	525,417	1,207,790	2,467,470	1,274,903

Notes: The table reports the mean and standard deviation (in parenthesis) of each of the variables, computed on samples of firm-year observations including all exporters (column 1), exporters with negative cash-flow (column2), exporters with positive cash-flow but below the 75th percentile of the distribution at the industry-year level (column 3), exporters with cash-flow aboth the 75th percentile (column 4), exporters with leverage below the 25th percentile at the industry-year level (column 5), exporters with leverage above the 25th and below the 75th percentile (column 6), and exporters with leverage above the 75th percentile (column 7). $\bar{u}v_{fpdt}$ and $\bar{Q}_{fpdt}$ are normalized by subtracting the mean level of these variables at HS6-destination level and dividing by the standard deviation computed at the same level.

4.2. Quality model

Flow-level export data provide sufficient cross-sectional variations in the main variables of interest to test the validity of *Hyp 1*: when comparing varieties of the same product exported to the same market, is it the case that the exports of more leveraged companies is characterized by lower quality? The 'quality model' that answers this questions takes the following specification:

$$Q^*_{it} = c_{pd} + \beta_1 lev_{ft} + Z'_{ft}\gamma + Z'_{st}\theta + \eta_f + \eta_s + \eta_t + \epsilon_{it} \quad (5)$$

where the subscript i refers to a single variety (i.e., a unique firm-product-destination triplet), the term c_{pd} is a product-destination fixed-effect, while the terms η_f, η_s and η_t are respectively firm-, sector- and year-specific fixed effect. The error term ϵ_{it} is variety- and time-specific. The vectors Z'_{ft} and Z'_{st} respectively include observable firm-level and industry-level controls as described in Section 3. To maximize the number of flow-level observations retained in the estimation sample, we introduce in the model the contemporaneous value of *lev* instead of its first lag.[23]

Endogeneity issues that may compromise the identification of the causal effect of leverage are more difficult to address in the quality model. This is because a variety's 'quality' at time t depends on a firm's current and past effort to identify consumers' preferences, to develop a consistent product, and to promote and advertise it in a particular market. Hence, it is less clear whether lagged values of *lev* are valid instruments for the present value of this variable in the quality model. These concerns prevent us from using internal instruments to deal with the endogeneity of *lev*. We instead construct two external instruments for an exporter's level of leverage that are exogenous with respect to its quality choice and unobserved idiosyncratic shocks. These instruments are introduced in first-stage regressions on *lev* and excluded from second-stage regressions on Q^*_{it} when Model (5) is estimated by 2SLS.

The first instrument $l\bar{e}v_{slt}$ is the mean level of *lev* computed across the *non-exporting* firms that belong to the same 2-digit ISIC industry s, and that are based in the same administrative department l of each exporter.[24] Because common shocks in the credit supply affect both this instrument and an exporter's level of leverage, we expect this instrument to correlate with the endogenous regressor, but to affect an exporter's quality choice only indirectly through *lev*. The power of this instrument in explaining individual firms' capital structure is supported by previous evidence in the empirical literature suggesting that the level of leverage in the

[23] In an unreported robustness check we estimate all quality models with the first lag of *lev* instead of the contemporaneous value. Results are not qualitatively different (same sign and significance). However, the number of flow-level observations is greatly diminished because many firms do not export the same product to the same destination continuously over the period of the analysis.

[24] France is geographically divided in 101 administrative departments, and this is the unit that we use to characterize the location of the firm. Non-exporting firms are observed in FICUS but they are excluded from the estimation sample.

industry correlates positively with the debt choice of individual firms (e.g., Frank and Goyal, 2009).

The second instrument $\bar{r}_{slt}$ is the average interest rate across *non-exporting* firms in the same industry and location of the exporter. This instrument is computed as the average ratio of interest rate payments over debt. The validity of $\bar{r}_{sl}$ as an instrument for *lev* depends on the following two assumptions: exogeneity with respect to individual exporters' choices, and the absence of a direct effect on Q^*_{it}. Because these instruments are not affected by the unobserved decisions made by exporters, we argue that they successfully address the most serious source of bias arising when we estimate the impact of lev_{ft} on Q^*_{it}. Arguably, these instruments may still be correlated with industry-specific characteristics affecting both the output quality of individual exporters and their levels of debt. To mitigate these concerns, both the first- and second-stage equations of Instrumental Variable models include firm-level or industry-level fixed effects capturing the influence of time-invariant industry level factors on a firm's capital structure and export quality, and time-varying indicators of industry concentration and R&D intensity in a firm's own industry and in the industries of its suppliers and customers. These controls further reinforce the tenability of the conditional exclusion restriction applied to our instruments.

Model (5) regresses firm-level explanatory variables on a flow-level dependent variable. Because multiple export flows can be generated by the same exporter, standard errors are clustered at the firm-level. For robustness, we also estimate the model on firm-level observations by using as a dependent variable the firm-specific measure of quality (Q^*_{ft}) instead of the variety-specific one (Q^*_{it}). Firm-level regressions are also used to test *Hyp 2*. More specifically, we test whether the effect of debt on quality is conditional on liquidity by estimating the following equation:

$$Q^*_{ft} = \beta_0 + \beta_{1a}[lev_{f(t-1)} \times NGCF_{f(t-1)}] + \beta_{1b}[lev_{f(t-1)} \times MDCF_{f(t-1)}] + \beta_{1c}[lev_{f(t-1)} \times HICF_{f(t-1)}] + Z'_{ft}\gamma + Z'_{st}\theta + \eta_f + \eta_s + \eta_t + \epsilon_{ft} \quad (6)$$

Because firm-level panel data are less affected by discontinuity than flow-level data, this model includes lagged values of the regressors of interest without causing a great reduction of the estimation sample. Model (6) is estimated by RE, FE and by Fixed-Effect 2SLS (IVFE). The latter applies 2SLS to the data after that the firm-level fixed effect η_f is removed from the error by within-group transformation. Notice, that this estimator will deliver the most conservative estimates as it both controls for firm-level unobserved time-varying factors (by IV) and for firm-level fixed effects (by FE). The set of excluded instruments used to estimate 2SLS and IVFE models includes the three interactions $[\bar{lev}_{sl(t-1)} \times NGCF_{f(t-1)}]$, $[\bar{lev}_{sl(t-1)} \times MDCF_{f(t-1)}]$, and $[\bar{lev}_{sl(t-1)} \times HICF_{f(t-1)}]$.

Arguably, industry-level fixed effects may not be sufficient to eliminate the endogeneity of leverage that arises because an exporter's level of debt depends on the product-market structure in the destinations it serves. Indeed, the nature of competition may be different across export destinations, even within very disaggregated product categories. We adopt different strategies in flow-level and firm-level regressions to address this issue. In flow-level regressions product-destination specific fixed effects control for different market structures across export destinations. In these regressions the identification of the parameters relies on variations in leverage and quality across French exporters competing in the same market. In firm-level regressions, the dependent variable is obtained by averaging the quality of a firms' varieties demeaned at the product-destination level. Hence, the firm-level dependent variable does not depend on the set of destinations served by the firm.[25]

5. Results

5.1. Leverage and investment

Table 3 reports the results obtained when the investment models specified by Eq. (3) (col. 1, 3, 5) and Eq. (4) (col. 2, 4, 6) are respectively estimated by RE, FE and AB. A negative coefficient $\hat{\alpha}_5$ of $lev_{f(t-1)}$ is obtained across all methods used to estimate Model (3). This coefficient ranges from -0.195 (FE) to -0.065 (AB). This coefficient is economically significant and it implies that everything else equal a firm increasing the level of debt from 0.244 (mean level of *lev* in the *MLEV* sample) to 0.571 (mean level of *lev* in the *HLEV* sample) invests on average 41% less (according to FE estimates) or 13% less (according to AB estimates) than the average firm in the whole sample of exporters.[26] The fact that the estimated impact of leverage on investment is less negative in the dynamic specification of the model suggests that the negative effect of leverage is partly absorbed by the coefficient on the lagged dependent variable. This happens if the level of debt at time $t-1$ affects both investment at time $t-1$ and at time t. Despite quantitative differences in the estimated parameters, both results from the dynamic and the static specifications suggest that leverage affects negatively future investment.[27]

When the static specification of Model (4) is estimated by RE and FE we find clear evidence that the negative impact of leverage on investment is stronger when firms generate insufficient internal resources to cover operating costs (i.e., when $NGCF_{ft} = 1$). The estimated coefficient $\hat{\alpha}_{5a}$ of the term $[lev_{f(t-1)} \times NGCF_{f(t-1)}]$ is consistently more negative than $\hat{\alpha}_{5b}$ and $\hat{\alpha}_{5c}$, that are respectively the estimated coefficients of the terms $[lev_{f(t-1)} \times MDCF_{f(t-1)}]$ and $[lev_{f(t-1)} \times HICF_{f(t-1)}]$. However, while χ^2 tests clearly reject that $\hat{\alpha}_{5a}$ is statistically equal to $\hat{\alpha}_{5b}$ and $\hat{\alpha}_{5c}$, they fail to reject the statistical equivalence between $\hat{\alpha}_{5b}$ and $\hat{\alpha}_{5c}$. Results are less clear for the dynamic specification. The AB point estimate $\hat{\alpha}_{5a}$ is more negative than the AB estimates $\hat{\alpha}_{5b}$ and $\hat{\alpha}_{5c}$. Equality tests on these parameters suggest that the effect of leverage is more negative for firm with negative cash-flow than it is for firms with medium cash-flow. However, the effect of leverage on investment in this specification appears statistically equal between firms with high and negative cash-flow. Overall, we can conclude that leverage has a negative impact on French exporters' investment, and that this effect is stronger for companies with low cash-flow.

5.2. Leverage and export quality

We move now to the results of the quality model. Table 4 reports the results obtained by estimating two specifications of the quality model on flow-level (col. 1–6), and on firm-level (col. 7–10) observations. We refer to specification (a) as the *short* specification, as it includes only the main regressors of interest in addition to fixed effects. In the *long* specification (b) we introduce additional firm-level and industry-level controls. The different coefficient of *lev* across the two specifications suggests the presence of upward bias when the model is estimated by OLS on

[25] Firm-level fixed effects in flow-level regressions contribute to minimize this risk.

[26] These figures are computed as: $(0.571 - 0.244) \times \hat{\alpha}_5 \times \frac{1}{0.154}$, where 0.571 is the average level of leverage in the group of high-leverage exporters, 0.244 is the average level of leverage in the group of medium-leverage exporters, and 0.154 is the average investment rate in the whole sample (see Table 2).

[27] Because the majority of firms in the sample are not quoted, it is not possible to test whether the impact of leverage on investment changes depending on a firm's Tobin's q-ratio as in Lang et al. (1996).

Table 3
The effect of leverage on investment.

	RE		FE		AB	
	(1)	(2)	(3)	(4)	(5)	(6)
$I_{f(t-1)}/K_{f(t-2)}$					0.063***	0.064***
					(0.007)	(0.006)
$lev_{f(t-1)}$	−0.072***		−0.195***		−0.065***	
	(0.003)		(0.006)		(0.015)	
CF_{ft}	0.090***		0.040***		1.286***	
	(0.009)		(0.014)		(0.170)	
$CF_{ft} \times NGCF_{ft}$		−0.058***		−0.067***		0.027
		(0.021)		(0.026)		(0.442)
$CF_{ft} \times MDCF_{ft}$		0.118***		0.014		2.251***
		(0.024)		(0.030)		(0.386)
$CF_{ft} \times HICF_{ft}$		0.117***		0.094***		1.225***
		(0.014)		(0.019)		(0.165)
$lev_{f,(t-1)} \times NGCF_{f,(t-1)}$		−0.118***		−0.218***		−0.083***
		(0.005)		(0.007)		(0.018)
$lev_{f,(t-1)} \times MDCF_{f,(t-1)}$		−0.066***		−0.186***		−0.058***
		(0.004)		(0.006)		(0.015)
$lev_{f,(t-1)} \times HICF_{f,(t-1)}$		−0.058***		−0.183***		−0.062***
		(0.005)		(0.007)		(0.017)
Δs_{ft}	0.163***	0.163***	0.109***	0.106***	0.263*	0.198*
	(0.004)	(0.004)	(0.004)	(0.004)	(0.157)	(0.113)
$\Delta s_{f(t-1)}$	0.145***	0.142***	0.077***	0.076***	0.070***	0.065***
	(0.003)	(0.003)	(0.004)	(0.004)	(0.014)	(0.011)
χ^2 (*p*-value)						
$\hat{\alpha}_{5a} = \hat{\alpha}_{5b}$		0.000		0.000		0.026
$\hat{\alpha}_{5a} = \hat{\alpha}_{5c}$		0.000		0.000		0.194
$\hat{\alpha}_{5b} = \hat{\alpha}_{5c}$		0.113		0.592		0.698
t-FE	Yes	Yes	Yes	Yes	Yes	Yes
s-FE	Yes	Yes	No	No	No	No
f-FE	No	No	Yes	Yes	Yes	Yes
J (*p*-value)					0.496	0.162
Sargan (*p*-value)					0.170	0.099
ar1(*p*-value)					0.000	0.000
ar2(*p*-value)					0.828	0.732
Firms	30,740	30,740	30,740	30,740	23,069	23,069
Obs.	143,806	143,806	143,806	143,806	111,435	111,435

Notes: The panel unit is set at the firm-level. Models in columns 5–6 are estimated using a GMM first-difference specification (AB). Time dummies are included in all specifications. Internal instruments (2nd and 3rd lags) are used for the endogenous variables $I_{f(t-1)}/K_{f(t-2)}$, $lev_{f(t-1)}$, CF_{ft}, Δs_{ft}, $lev_{f,(t-1)} \times NGCF_{f,(t-1)}$, $lev_{f,(t-1)} \times MDCF_{f,(t-1)}$, $lev_{f,(t-1)} \times HICF_{f,(t-1)}$. $\Delta s_{f(t-1)}$ is treated as predetermined and included in the instrument set. $J(p-value)$ is the *p*-value of the Hansen overidentification test, while $Sargan(p-value)$ is the *p*-value of the Sargan overidentification test. *ar*1 and *ar*2 are respectively the *p*-values from the tests for first- and second-order autocorrelation in the error terms. The table presents *p*-values from χ^2 tests of equality between the coefficients obtained interacting $lev_{f(t-1)}$ with different cash-flow categories. Standard errors are reported in parenthesis and are robust to heteroscedasticity. Significance levels: *.1, **.05, ***.01.

flow-level data. Indeed, the *long* specification is expected to reduce, if not eliminate, the omitted variable bias arising from unobserved factors that are positively correlated with quality and credit demand. Flow-level 2SLS estimates of the *short* and the *long* specifications are respectively reported in columns 3–4 and 5–6.

For 2SLS and IVFE models, we present both the estimates from first-stage regressions on the endogenous variable lev_{ft} and from second-stage regressions on Q^*_{it} and Q^*_{ft}. As expected, the average level of debt $\bar{lev}_{sl}$ across non-exporters, is strongly and positively correlated with the individual leverage of exporters that operate in the same industry and the same location, while the coefficient on the average interest rate $\bar{r}_{sl}$ is negative but significant only in firm-level regressions (col. 8 and 10).[28] Overidentification tests strongly support the validity of our instrument set. The negative coefficient of tfp_{fp} in the *long* specification of the first-stage model on *lev* indicates that firms with higher levels of debt are also the least productive ones. Although we refrain from inferring causality, the negative relation between quality and leverage suggests that the average level of debt is higher for the least productive companies.

The estimated impact of leverage on Q^*_{it} is stronger in second-stage 2SLS estimates, and its significance is more robust to the inclusion of firm-level controls than in OLS models. However, the cluster-robust standard errors associated with these estimates are large and they do not decrease much when controls are introduced passing from the *short* (col. 3–4) to the *long* specification (col. 5–6). The reason why we obtain imprecise estimates is that firm-level regressors on the right-hand side of the model vary less than the flow-level dependent variable. Firm-level regressions (col. 7–10), where the dependent variable is the weighted average of a firm's relative quality across export destinations and products, improve the precision of the estimates. On the basis of the estimated coefficient of *lev* reported in column 9, when leverage increases from 0.244 (mean level in the *MLEV* sample) to 0.571 (mean level in the *HLEV* sample) export quality decreases by 0.8 standard deviations of this indicator.[29]

[28] In an unreported robustness test we repeat the estimation of the 2SLS models (both at the flow- and at the firm-level) including in first-stage regressions only the statistically significant instrument $\bar{lev}_{sl}$. Results are robust to this alternative specification. We choose to report the 2SLS model with both instruments as we find that the inclusion of $\bar{r}_{sl}$ increases the precision of the estimates (smaller standard errors), and it allows us to conduct overidentification tests.

[29] This figure is computed as $(0.571 - 0.244) \times \hat{\beta}_1 \times \frac{1}{0.934}$, where 0.934 is the standard deviation of Q^*_{it} in the whole sample.

Table 4
The effect of leverage on output quality.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel unit:	Flow *i*						Firm *f*			
Estimator:	OLS		2SLS				IVFE			
Specification:	(a)	(b)	(a)		(b)		(a)		(b)	
Dependent:	Q^*_{it}	Q^*_{it}	Q^*_{it}	lev_{ft}	Q^*_{it}	lev_{ft}	Q^*_{ft}	lev_{ft}	Q^*_{ft}	lev_{ft}
lev_{ft}	−0.040	−0.070**	−2.037***		−1.684***		−1.342*		−2.303***	
	(0.027)	(0.028)	(0.548)		(0.538)		(0.767)		(0.833)	
age_{ft}		−0.029			−0.039	−0.005			−0.042	−0.026***
		(0.027)			(0.032)	(0.012)			(0.028)	(0.003)
age^2_{ft}		0.000			0.004	0.002			0.007	0.004***
		(0.006)			(0.007)	(0.002)			(0.005)	(0.001)
$group_{ft}$		0.015			0.035**	0.012**			0.040***	0.008***
		(0.014)			(0.016)	(0.006)			(0.010)	(0.001)
$foreign_{ft}$		0.053***			0.024	−0.016*			0.054***	0.007***
		(0.020)			(0.022)	(0.009)			(0.014)	(0.002)
tfp_{ft}		0.049***			0.006	−0.020***			0.128***	−0.038***
		(0.010)			(0.013)	(0.004)			(0.032)	(0.001)
lab_{ft}		0.040***			0.058***	0.009***			0.305***	0.047***
		(0.007)			(0.008)	(0.003)			(0.040)	(0.001)
$kapint_{ft}$		0.070***			0.086***	0.010***			0.186***	0.062***
		(0.006)			(0.011)	(0.003)			(0.052)	(0.001)
$expint_{ft}$		0.360***			0.374***	0.016			0.680***	0.007**
		(0.021)			(0.026)	(0.010)			(0.020)	(0.003)
HI_{st}		−0.414			−0.517	0.089			−0.366	0.087**
		(0.287)			(0.400)	(0.122)			(0.280)	(0.044)
$ClientHI_{st}$		−1.602**			−2.257**	0.412			−0.760	0.140
		(0.787)			(0.896)	(0.318)			(0.658)	(0.104)
$SupplierHI_{st}$		0.285			0.553	−0.809***			0.897	−0.132
		(1.048)			(0.952)	(0.260)			(0.635)	(0.101)
RD_{st}		−0.824***			−1.363***	−0.083			0.309	−0.021
		(0.270)			(0.249)	(0.076)			(0.217)	(0.033)
$ClientRD_{st}$		1.669***			2.040***	0.015			−0.444	−0.054
		(0.548)			(0.515)	(0.127)			(0.445)	(0.071)
$SupplierRD_{st}$		0.063			0.680*	−0.043			0.003	−0.009
		(0.375)			(0.403)	(0.145)			(0.315)	(0.050)
$\bar{lev}_{sr}$				0.172***		0.166***		0.050***		0.048***
				(0.030)		(0.030)		(0.007)		(0.007)
$\bar{r}_{sr}$				−0.066		−0.060		−0.045**		−0.037**
				(0.084)		(0.083)		(0.018)		(0.018)
t-FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
pd-FE	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No
s-FE	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No
f-FE	No	No	No	No	No	No	Yes	Yes	Yes	Yes
J (*p*-value)			0.389		0.605		0.234		0.297	
F-stat			17.031		15.007		27.324		25.493	
Obs.	4,836,717	4,836,297	4,784,578	4,784,578	4,784,158	4,784,158	216,192	216,192	216,154	216,154

Notes: In flow-level regressions the panel unit is set at the variety level (firm-HS6 product-destination). The panel unit in firm-level regressions is set at the level of the individual exporter. The firm-level quality estimator Q^*_{ft} is obtained collapsing flow-level estimators according to the methodology detailed in the text. All regressors vary at the firm-level with the exception of the excluded instruments $\bar{lev}_{sl}$ and $\bar{r}_{sl}$ that are computed at the location-industry level. The J (*p*-value) is the *p*-value of the Hansen J test of the validity of the excluded instruments while F-stat is the F statistics for the explanatory power of the excluded instruments in first stage regressions. t-FE are individual year fixed effects while pd-FE are HS6 product-destination fixed effects. Cluster-robust standard errors are reported in parentheses and the cluster unit is set at the firm level. Specification (a) includes only the regressor of interest lev_{ft} and fixed effects, while specification (b) includes a set of firm-level controls. Significance levels: *.1, **.05, ***.01.

We conclude that strong statistical evidence supports *Hyp 1*: a highly leveraged corporate financial structure hampers a firm's ability to compete in foreign markets through product quality. The coefficients of the firm-level controls are in line with previous studies on the determinant of export quality; larger and more productive firms with greater capital intensity export products with higher average quality (Verhoogen, 2012). Because the variables we use to control for these characteristics are endogenous, we avoid giving a causal interpretation to the coefficients. Firms' age is negatively associated with export quality and this result can be explained by self-selection of the best young firms into the export market. Because young firms face greater barriers to start exporting, such as the costs of establishing for the first time distribution networks, those that find profitable to export are conceivably the most productive ones, and the ones selling high quality products.

First stage regressions on lev_{ft} control for heterogeneity in financial structure across industries by including industry-level fixed effects (col. 6) or firm-level fixed effects (col. 10). Despite the inclusion of these fixed effects, the point estimate of the coefficient on HI_{st} is positive and statistically significant in the firm-level specification. This parameter should be interpreted as the reaction of a firm's debt level to greater concentration in the product market. A positive relationship between industry concentration and debt levels is consistent with previous findings in the capital structure literature (MacKay and Phillips, 2005). Positive changes in the concentration of clients' and suppliers' industries are respectively positively and negatively correlated with a firms' debt level, but these effects are not significant when we control for firm fixed effects (col. 10). After controlling for industry-fixed effects, time-variations in R&D intensity in a firm's own industry and in the industries of its suppliers and clients do not appear to have a significant correlation with a firm's level of debt. Instead, positive variations in the concentration of clients' and own industry R&D intensity appear affecting negatively a firm's quality. This finding is consistent with previous empirical evidence suggesting that the R&D investment of French firms is generally countercyclical (Aghion et al., 2012). Hence, because our indicator of quality is based on sales, and R&D intensity increases in periods of lower demand, it is not surprising to find a negative correlation between quality and industry-level measures of R&D intensity.

Table 5 reports the estimated parameters of the 'short' and the 'long' specifications of Model (6), that is used to test *Hyp 2*.[30] The point estimates of the coefficients β_{1a}, β_{1b} and β_{1c} are consistently negative across specifications and estimation techniques. However, we find a statistically significant effect of leverage on quality only for firms with negative cash flow. The χ^2 tests used to compare the coefficients on the interactions terms confirm that β_{1a} is significantly different from β_{1b} and from β_{1c}.[31] These results support *Hyp 2* whereby debt affects quality depending on a firm's liquidity. A caveat applies to this conclusion. Even thus coefficients on $lev_{f(t-1)} \times MDCF_{f(t-1)}$ and $lev_{f(t-1)} \times HICF_{f(t-1)}$ are insignificant, they are nevertheless negative, suggesting a more heterogeneous effect of debt across firms with positive cash-flow.

This section concludes by testing *Hyp 3* concerning the differential impact of leverage across firms operating in industries with a different level of concentration. In previous regressions, differences in product-market structure were captured by industry-specific, market-specific or firm-specific fixed effects and by a series of industry-level covariates. Despite these controls the estimated coefficients on lev_{ft} express the average effect of this variable across firms pooled together from heterogeneous industries. We now investigate this heterogeneity by estimating specification (b) of the quality model (5) on samples of firms from industries with different market concentration. Table 6 reports the model estimated on low-concentration (LH), medium-concentration (MH), high-concentration (HH) industries.[32] Consistently with *Hyp 3*, regression results suggest that leverage has a more negative impact on firms that operate in less concentrated industries. The estimated coefficient on lev_{ft} is negative and significant in the low-concentration and medium-concentration samples, while it is insignificant at standard confidence levels for the high-concentration sample.

Table 6 reports the results from regressions estimated on sub-samples of firms belonging to industries with different R&D intensity (col. 4–6). According to the theoretical results in Long and Malitz (1985) more leveraged firms have a cost disadvantage in undertaking investment in intangibles, and we should expect high levels of debt to affect disproportionally more firms in R&D intensive industries. Consistently, we find that the impact of leverage on quality is twice as negative for medium-R&D intensity industries than it is for low-R&D industries. However, the coefficient on leverage is not significant for firms operating in high-R&D intensity. This result may be determined by the self-selection of firms with different attributes into more research intensive industries, in the case these attributes offset the negative effect of debt on quality.

5.3. Robustness tests

This section reports a battery of robustness exercises conducted to test the sensitivity of our main results to the use of alternative measures of quality, leverage and liquidity, and to the use of a different instrument for leverage. We also investigate the presence of non-linearity in the effect of leverage on quality.

In the trade literature, the unit-values of the exported varieties are commonly used as an indirect proxy for output quality (e.g., Bastos and Silva, 2010; Kugler and Verhoogen, 2012; Manova and Zhang, 2012).[33] This proxy relies on the assumption that both the price and the unit-value of a variety increase monotonically in output quality. Upon accepting this assumption, it is possible to investigate the firm-level determinants of product quality by comparing, within narrowly defined product categories, the unit-values of the varieties exported by different companies. Given our specific interest on leverage as a determinant of output quality, the measure of quality that we use in the previous section should be preferred to unit-values, because higher levels of debt may affect a firm's pricing strategy in addition to its output quality (Secchi et al., 2014). Nevertheless, regressions on unit-values can be used to test whether our results depend crucially on our preferred measure of quality. Hence, we re-estimate the flow-level regressions reported in Table 4 by using the log unit-value of a variety $log(uv_{it})$ as the dependent variable. By including product-destination fixed effects in all regressions, we force identification to rely on unit-value variations across varieties of the same HS6 product exported to the same destination by firms with different leverage. The results from this exercise are reported in Table 7. A negative coefficient on lev_{ft} is found across all specifications and estimation techniques, suggesting that firms with higher levels of debt export relatively cheaper varieties. We conclude that our main result is robust to the use of an alternative measure of quality.

Columns 1 of Table 8 reports estimates obtained when leverage is measured by $lev2$ instead of lev. This variable is computed as the ratio of the book value of a firm's debt over the book value of its total assets. Estimates are qualitatively and quantitatively similar to those obtained in Table 5.[34] In the specification reported in column 2, we interact this new measure of leverage with the three cash flow categories. Previous results are largely confirmed as we find a negative effect of leverage on quality only for firms with negative and medium cash-flow.

In column 3 we adopt an alternative classification of the categories of liquidity based on the same underlying continuous variable $CF_{f(t-1)}$. As in previous estimates *NEGF* is still a dummy for firms with negative cash-flow, $CF25^{th}$ is a dummy for firms with positive cash-flow but below the 25th percentile, $CF75^{th}$ between the 25th and the 75th percentiles, and $CF100^{th}$ over the 75th percentile of the cash-flow distribution within an industry-year cell.[35] In column 4 we base this new classification on a different underlying measure of liquidity. This measure is obtained as the difference between a firm's availability and a firm's need for working capital, divided by operating expenses that include wages and the cost of materials. The availability of working capital is measured as a firm's

[30] For this regression the 'short' specification includes the term $CF_{f,(t-1)}$. The inclusion of this additional term is necessary to avoid omitted variable bias because the three dummies interacted with *lev* are based on this variable. Results do not change if instead of $CF_{f,(t-1)}$ we introduce the three un-interacted dummies *NGCF*, *MDCF* and *HICF*.

[31] On the contrary the same tests fail to reject the equality of β_{1b} and β_{1c} across all specifications. Unreported 2SLS estimates on pooled data are in line with those obtained from the RE model.

[32] Low-concentration industries are those with Herfindahl Index lower or equal the 25th percentile of the distribution across industries, medium-concentration industries have the Index included between the 25th and the 75th percentile, high-concentration are industries with Herfindahl above the 75th percentile. The same approach is used to distinguish industries by R&D intensity. Results are insensitive to alternative categorization of concentration and R&D intensity classes.

[33] See Note 17 on the construction of unit-values with trade data.

[34] We compare this robustness with estimates in Table 5 because we include here the same set of controls as in the long specification reported in that table. In particular the inclusion of the cash-flow variable reduces the sample size compared to the specifications reported in Table 4 making a comparison with the estimates in that table inappropriate.

[35] We wish to thank an anonymous referee for suggesting this robustness check.

Table 5
The effect of leverage on quality conditional on liquidity.

	(1)	(2)	(3)	(4)	(5)	(6)
Estimator:	RE		FE		IVFE	
Specification:	(a)	(b)	(a)	(b)	(a)	(b)
Dependent:	Q^*_{ft}	Q^*_{ft}	Q^*_{ft}	Q^*_{ft}	Q^*_{ft}	Q^*_{ft}
$lev_{f(t-1)} \times NGCF_{f(t-1)}$	−0.132***	−0.090***	−0.149***	−0.121***	−0.550***	−0.437***
	(0.027)	(0.026)	(0.032)	(0.032)	(0.141)	(0.163)
$lev_{f(t-1)} \times MDCF_{f(t-1)}$	−0.014	−0.027	−0.014	−0.035	−0.322**	−0.261
	(0.020)	(0.020)	(0.025)	(0.025)	(0.154)	(0.174)
$lev_{f(t-1)} \times HICF_{f(t-1)}$	−0.056*	−0.004	0.032	−0.012	−0.205	−0.210
	(0.031)	(0.029)	(0.036)	(0.035)	(0.172)	(0.184)
$CF_{f(t-1)}$	0.000	0.000	−0.000	−0.000	−0.000	−0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
age_{ft}		−0.097***		−0.052*		−0.125***
		(0.022)		(0.028)		(0.027)
age^2_{ft}		0.012***		0.008		0.021***
		(0.004)		(0.005)		(0.005)
$foreign_{ft}$		0.086***		0.030		−0.013
		(0.015)		(0.019)		(0.017)
$tfp_{f(t-1)}$		0.137***		0.111***		0.072***
		(0.008)		(0.013)		(0.014)
lab_{ft}		0.180***		0.176***		0.166***
		(0.004)		(0.015)		(0.015)
$kapint_{f(t-1)}$		0.088***		0.058***		0.023
		(0.005)		(0.011)		(0.014)
$expint_{f(t-1)}$		0.667***		0.304***		0.298***
		(0.019)		(0.028)		(0.024)
$HI_{s(t-1)}$		0.440		0.718		−0.973**
		(0.432)		(0.475)		(0.408)
$ClientHI_{s(t-1)}$		−1.923**		−2.042*		1.879**
		(0.940)		(1.047)		(0.769)
$SupplierHI_{s(t-1)}$		0.510		0.068		0.561
		(0.828)		(0.887)		(0.814)
$RD_{s(t-1)}$		−0.345		−0.181		1.033***
		(0.289)		(0.333)		(0.276)
$ClientRD_{s(t-1)}$		−1.040*		−1.500**		−3.340***
		(0.563)		(0.626)		(0.551)
$SupplierRD_{s(t-1)}$		1.444***		1.867***		0.125
		(0.440)		(0.474)		(0.384)
t-FE	Yes	Yes	Yes	Yes	Yes	Yes
s-FE	Yes	Yes	No	No	No	No
f-FE	No	No	Yes	Yes	Yes	Yes
χ^2 (*p*-value)						
$\hat{\beta}_{1a} = \hat{\beta}_{1b}$	0.000	0.009	0.000	0.003	0.000	0.000
$\hat{\beta}_{1a} = \hat{\beta}_{1c}$	0.024	0.048	0.000	0.032	0.000	0.004
$\hat{\beta}_{1b} = \hat{\beta}_{1c}$	0.138	0.865	0.140	0.911	0.011	0.508
F-stat					331.108	275.764
Obs.	108,678	108,645	108,678	108,645	97,347	97,329

Notes: In all models panel unit is set at the firm-level. The firm-level measure of export quality $\hat{Q}_{ft}$ is obtained as detailed in the text. Models are estimated by Random-Effect (RE), Fixed-Effect (FE) and 2SLS fixed effects (IVFE). In the unreported first-stage regressions of the IVFE models the endogenous terms $lev_{f,(t-1)} \times NGCF_{f,(t-1)}$, $lev_{f,(t-1)} \times MDCF_{f,(t-1)}$, $lev_{f,(t-1)} \times HICF_{f,(t-1)}$ are instrumented by three terms obtained by interacting $\overline{lev}_{sl}$ with $NGCF_{f,(t-1)}$, $MDCF_{f,(t-1)}$ and $HICF_{f,(t-1)}$. Because the number of exogenous instruments equals the number of endogenous instrumented variables, IVFE models are exactly identified. F-stat is the F statistics for the explanatory power of the excluded instruments in first stage regressions. t-FE are individual year fixed effects while pd-FE are HS6 product-destination fixed effects. Cluster-robust standard errors are reported in parentheses and the cluster unit is set at the firm level. Specification (a) includes only the regressor of interest lev_{ft} and fixed effects, while specification (b) includes a set of firm-level controls. Significance levels: *.1, **.05, ***.01.

capital that is not invested and it includes reserves. The need of working capital is instead obtained as a firm's stocks plus its client's debt minus the debt of the firm to the suppliers. While in column 3 results are insensitive to the alternative definition of cash-flow categories, in column 4 we find negative and significant estimates for each interaction between $lev_{f(t-1)}$ and the different categories of liquidity. This finding contrasts our previous results supporting *Hyp 2*.

A possible explanation for this discrepancy is that the conditionality of the effect of leverage on *CF* is related to a firm's ability to generate pledgeable income rather than to its availability of internal resources. While cash-flow captures a firms' ability to generate pledgeable income, the alternative measure used in this robustness check is more closely related to the availability of internal resources relative to a firm's financing needs. A recent paper by Valta (2012) has shown that the cost of debt is higher for firms operating in more competitive industries, and the author interpret this finding with the negative effect of competition on a firm's profit margin and pledgeable income. This intuition is also consistent with our previous finding that leverage has a more negative effect on quality in industries with low-concentration, where the ability of firms to generate cash-flow is hampered by lower profit margins.

Table 9 reports robustness tests based on Campello (2006). That paper identifies the impact of debt on firms' product market performance by adopting an empirical strategy different from our own. In this section, by adopting Campello's approach to address the endogeneity of leverage, we test the sensitivity of our baseline results to methodological choices. First, as in the Campello's paper,

Table 6
Heterogeneous effect of leverage on quality across industries.

	(1) Split by market concentration	(2)	(3)	(4) Split by R&D intensity	(5)	(6)
	LH	MH	HH	LR	MR	HR
Firm-level regressions						
$lev_{f,t-1}$	−2.570***	−1.179***	−0.791	−0.981*	−2.260***	−1.019
	(0.280)	(0.378)	(0.739)	(0.539)	(0.216)	(0.912)
Obs. (Firm-year)	54,367	80,053	19,140	14,858	138,702	27,732
Flow-level regressions						
$lev_{f,t-1}$	−2.759***	−0.920*	−2.428	−0.920	−1.672***	−2.064
	(0.823)	(0.518)	(1.758)	(1.212)	(0.539)	(1.538)
Obs. (Flow-year)	1,040,220	2,900,740	843,198	162,656	4,621,502	1,258,000

Notes: The table reports 2SLS estimates of the coefficient on $lev_{f,t-1}$ obtained in firm-level (upper panel) and flow-level (lower panel) regressions on Q^*_{ft} and Q^*_{it}. These regressions are estimated adopting the long specification (b). Controls and fixed effects included but not reported. Columns 1–3 report estimates on sub-samples of firms belonging to industries with different level of market concentration (ISIC Rev.3: LH = [15,17,20,22,28], MH = [18,19,21,24,25,26,27,29,32,36,37], HH = [23,30,31,33,35]). Columns 4–5 report regressions on three samples of firms belonging to industries with different R&D intensity (ISIC Rev.3: LR = [20,21,22,28], MR = [15,17,18,19,23,24,25,26,27,29,30,31,32,33,34,35,36,37], HR = [24,30,32,33,34,35]). Cluster-robust standard errors are reported in parentheses and the cluster unit is set at the firm level. Significance levels: *.1, **.05, ***.01.

Table 7
The unit-values of exported varieties and firm leverage.

	OLS (a)	OLS (b)	2SLS (a)		2SLS (b)	
	$\log(uv_{it})$	$\log(uv_{it})$	$\log(uv_{it})$	lev_{ft}	$\log(uv_{it})$	lev_{ft}
lev_{ft}	−0.044	−0.081**	−3.124***		−2.699***	
	(0.034)	(0.035)	(0.724)		(0.713)	
$\bar{lev}_{sr}$				0.173***		0.167***
				(0.030)		(0.030)
$\bar{r}_{sr}$				−0.068		−0.062
				(0.085)		(0.083)
Controls	No	Yes	No	No	Yes	Yes
t-FE	Yes	Yes	Yes	Yes	Yes	Yes
pd-FE	Yes	Yes	Yes	Yes	Yes	Yes
s-FE	Yes	Yes	Yes	Yes	Yes	Yes
J (*p*-value)			0.681		0.899	
F-stat			17.272		15.251	
Obs.	4,947,368	4,946,937	4,894,128	4,894,128	4,893,697	4,893,697

Notes: All regressors vary at the firm-level with the exception of the excluded instruments $\bar{l}ev_{sl}$ and $\bar{r}_{sl}$ that are computed at the location-industry level. The J (*p*-value) is the *p*-value of the Hansen J test of the validity of the excluded instruments while F-stat is the F statistics for the explanatory power of the excluded instruments in first stage regressions. t-FE are individual year fixed effects while pd-FE are HS6 product-destination fixed effects. Cluster-robust standard errors are reported in parentheses and the cluster unit is set at the firm level. Specification (a) includes only the regressor of interest lev_{ft} and fixed effects, while specification (b) includes a set of firm-level controls. Firms-level controls in specification (b) are not reported but they are the same as those reported in Table 4. Significance levels: *.1, **.05, ***.01.

we use asset tangibility as an instrument for the level of debt. Tangibility is constructed as the ratio of the book value of tangible assets over the book value of a firm's total assets $zTang_{f(t-1)}$. Second, we normalize both the regressors and the dependent variable by subtracting to each variable the industry-level mean and dividing by the industry-level standard deviation. By doing so we obtain measures of a firm's relative export quality $zQ^*_{f(t-1)}$ and leverage $zlev_{f(t-1)}$ with respect to the industry average.

First and second-stage 2SLS estimates obtained by using these variables in regressions are reported in columns 1 and 2 of the table. In columns 3 and 4 we report the same exercise but we substitute the continuous variable for leverage with the dummy $levTop3_{f(t-1)}$ that takes value one if the firm is in the three top deciles of the leverage distributions. Although these exercises are based on a different methodological approach, they deliver the same qualitative results as our baseline specification. Hence this robustness test provides a very convincing indication that there is indeed a negative relationship between debt levels and output quality.

Lastly, we investigate the presence of non-linearity in the impact of leverage on quality. In column 5 we allow the coefficient on $zlev_{f(t-1)}$ to vary depending on the level of relative leverage. We do so by interacting $zlev_{f(t-1)}$ with three dummy variables respectively assuming value one if $zlev_{f(t-1)}$ is less than -1.5 standard deviations below the industry mean, if it falls between -1.5 and 1.5 standard deviations, and if it is above 1.5 standard deviations.[36] In column 6 we simultaneously allow for non-linearity and for conditional effect on cash-flow. In general, we do not find evidence of non-linearity in the relationship between leverage and quality. The only exception is for firms with high cash-flow. For these firms we find that leverage affects quality only when leverage is above 1.5 standard deviations from the industry mean.

6. Conclusions

This paper advances the understanding of the relationship between financial factors and firm export behavior by producing novel results on a 'quality channel'. It is shown that corporate financial structure determines a firm's ability to compete through quality on foreign markets, which is consistent with models

[36] We adopt the same breaking points as in Campello (2006).

Table 8
Different measures of leverage and liquidity.

Estimator:	(1) IVFE	(2)	(3)	(4)
Dependent:	Q^*_{ft}	Q^*_{ft}	Q^*_{ft}	Q^*_{ft}
Different measure of leverage				
$lev2_{f(t-1)}$	-0.448^{**} (0.220)			
$lev2_{f(t-1)} \times NGCF_{f(t-1)}$		-0.623^{***} (0.186)		
$lev2_{f(t-1)} \times MDCF_{f(t-1)}$		-0.450^{**} (0.227)		
$lev2_{f(t-1)} \times HICF_{f(t-1)}$		-0.344 (0.260)		
Different liquidity groups				
$lev_{f(t-1)} \times NGCF_{f(t-1)}$			-0.520^{***} (0.149)	
$lev_{f(t-1)} \times CF25^{th}_{f(t-1)}$			-0.358^{**} (0.156)	
$lev_{f(t-1)} \times CF75^{th}_{f(t-1)}$			-0.315^{*} (0.162)	
$lev_{f(t-1)} \times CF100^{th}_{f(t-1)}$			-0.252 (0.170)	
Different measure of liquidity and liquidity groups				
$lev_{f(t-1)} \times NGLIQ_{f(t-1)}$				-2.316^{***} (0.355)
$lev_{f(t-1)} \times LIQ25^{th}_{f(t-1)}$				-2.413^{***} (0.363)
$lev_{f(t-1)} \times LIQ75^{th}_{f(t-1)}$				-2.374^{***} (0.364)
$lev_{f(t-1)} \times LIQ100^{th}_{f(t-1)}$				-2.317^{***} (0.352)
t-FE	Yes	Yes	Yes	Yes
f-FE	Yes	Yes	Yes	Yes
J (*p*-value)	0.861			
F-stat	400.615	269.293	239.255	62.086
Obs.	96,525	97,520	97,335	97,335

The table reports IVFE estimates of the long specification. Controls are included but not reported. Cluster-robust standard errors in parentheses. Significance levels: *.1, **.05, ***.01.

predicting that debt financing and financial distress reduce a firm's incentives to invest in quality-enhancing activities such as advertising and R&D (Long and Malitz, 1985; Maksimovic and Titman, 1991).

Panel regressions and instrumental variable methods are used to analyze a rich dataset of French exporters covering the period 1997–2007. Our analysis generates robust evidence that debt financing has a negative impact on export quality measured as the residual from a discrete choice model of foreign consumers' demand. The distortive impact of debt on investment is a plausible channel to explain the negative relation between leverage and quality. Consistently, static and dynamic specifications of a standard investment model reveal that leverage hampers investment, and that this effect is stronger for firms with negative cash-flow. Our analysis produces less clear evidence on the role of internal liquidity in mediating the impact of leverage on quality. A possible interpretation of our results is that a firm's ability to generate pledgeable income reduces the agency cost of debt and the negative effects of financial leverage on quality. Consistently with this interpretation we find that the negative effect of leverage on quality is stronger in less-concentrated industries, where competitive pressure reduces profit margins and leverage cannot be used to acquire strategic advantage over the competitors.

Our firm-level results leads to new research questions that call for further investigation. First, because policies that affect companies' corporate financial structure may eventually impact on a country's export performance, it is worth investigating how corporate taxation affects a country's position in the 'quality ladder' of trade. Second, our findings leads to investigating whether market based financial systems, where firms have greater access to equity financing and rely less intensively on debt, are more effective in promoting countries' non-price competitiveness in international markets.

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Appendix A

A.1. Derivation of Eq. (1)

The central idea of the discrete choice model of demand consists in inverting the demand function to exploit aggregate market information to infer the mean utility that each variety of a differentiated product delivers to consumers. The model imposes structure on demand by assuming that each individual j consumes only one unit of the variety i that delivers the greatest utility:

$$u_{ij} > u_{kj} \quad \forall\, k \in K \tag{7}$$

where K is a product class encompassing all varieties sharing a certain degree of substitutability. The set K comprises one or more 'nests', which are groups of varieties (indexed by g) characterized by greater substitutability among one another. To allow for the nested structure of K, consumers' utility is modeled according to the following specification:

$$u_{ij} = \delta_i + \zeta_{ig} + (1-\sigma)\epsilon_{ij}, \quad 0 \leqslant \sigma < 1 \tag{8}$$
$$\delta_i = X_{ij}\beta + \alpha p_i + \zeta_i, \quad \alpha \leq 0$$

where δ_i is the expected utility from the consumption of i across all consumers. This depends on a vector of the varietie's attributes X_i and parameters β, on price p_i and product quality ζ_i. The terms ζ_{jg} and ϵ_{ij} are consumers' deviations from the mean utility δ_i that are determined by heterogeneous preferences across consumers for different nests of varieties and across varieties belonging to the same nest. The within-group substitutability parameter σ determines the extent to which different consumers agree on the utility they derive from selecting i. Ultimately, the negative parameter α captures the disutility of price that is common across consumers.

By assuming that idiosyncratic deviations in preferences ϵ_{ij} follow a Type I extreme-value distribution, the utility function (8) is the basis for the following nested logit model[37]:

$$s_i = \frac{e^{\delta_i/(1-\sigma)}}{\left[\sum_{k\in g} e^{\delta_k/(1-\sigma)}\right]^{\sigma} \times \sum_{g\in K}\left[\sum_{k\in g} e^{\delta_k/(1-\sigma)}\right]^{(1-\sigma)}} \tag{9}$$

where s_i is both the share of variety i in a particular market and the expected probability P_i that each consumer chooses good i over the others. If we assume that consumers first choose their favorite 'nest' g and then a variety i within g, the probability P_i can be also written as:

[37] The assumption that the idiosyncratic error in individual preferences follows a Type I extreme-value distribution is a common assumption of multinomial logit models.

Table 9
Alternative instrument for leverage and non-linearities.

	(1)	(2)	(3)	(4)	(5)	(6)
Estimator:	2SLS		2SLS			
Dependent:	zQ^*_{ft}	$zlev_{f(t-1)}$	zQ^*_{ft}	$levTop3_{f(t-1)}$	zQ^*_{ft}	zQ^*_{ft}
$zlev_{f(t-1)}$	−0.203*** (0.076)					
$levTop3_{f(t-1)}$			−0.426*** (0.162)			
$zTang_{f(t-1)}$		0.064*** (0.006)		0.030*** (0.003)		
$-\infty < zlev_{f(t-1)} \leqslant -1.5\sigma$					−0.699*** (0.266)	
$-1.5\sigma < zlev_{f(t-1)} \leqslant +1.5\sigma$					−0.753*** (0.264)	
$+1.5\sigma < zlev_{f(t-1)} \leqslant +\infty$					−0.757*** (0.272)	
For NGCF = 1						
$(-\infty < zlev_{f(t-1)} \leqslant -1.5\sigma)$						−0.681** (0.313)
$(-1.5\sigma < zlev_{f(t-1)} \leqslant +1.5\sigma)$						−0.791*** (0.298)
$(+1.5\sigma < zlev_{f(t-1)} \leqslant +\infty)$						−0.672** (0.319)
For MDCF = 1						
$(-\infty < zlev_{f(t-1)} \leqslant -1.5\sigma)$						−0.787*** (0.268)
$(-1.5\sigma < zlev_{f(t-1)} \leqslant +1.5\sigma)$						−0.823*** (0.266)
$(+1.5\sigma < zlev_{f(t-1)} \leqslant +\infty)$						−0.805*** (0.275)
For HICF = 1						
$(-\infty < zlev_{f(t-1)} \leqslant -1.5\sigma)$						−0.486* (0.289)
$(-1.5\sigma < zlev_{f(t-1)} \leqslant +1.5\sigma)$						−0.442 (0.306)
$(+1.5\sigma < zlev_{f(t-1)} \leqslant +\infty)$						−0.769** (0.370)
t-FE	Yes	Yes	Yes	Yes	Yes	Yes
s-FE	Yes	Yes	Yes	Yes	Yes	Yes
F-stat	121.275		112.574			
Obs.	108,666	108,666	109,352	109,352	109,352	109,352

Notes: The table reports 2SLS estimates from the long specification of the quality model regressed on firm-level observations. Controls are included but not reported. $z-$ variables are obtained by subtracting to each firm-level variable by its industry-level mean and subtracting by its industry-level standard deviation. Columns 5 and 6 report only 2nd stage estimates on quality. Cluster-robust standard errors reported in parentheses. The variables $x\sigma < zlev_{f(t-1)} \leq y\sigma$ are obtained by interacting $zlev_{f(t-1)}$ with a dummy that assumes value one only if $zlev_{f(t-1)}$ is greater than x industry-level standard deviations and smaller than y standard deviations.
Significance levels: *.1, **.05, ***.01.

$$P_i = P_{i/g} \times P_g \tag{10}$$

where P_g is the probability that the choice of the consumer falls on one of the products in group g, and g is an index for each of the varieties' 'nests' that compose the wider set K. By expressing the probability P_g according to a multinomial logit model we can write:

$$P_g = \frac{\left[\sum_{k\in g} e^{\delta_k/(1-\sigma)}\right]^{(1-\sigma)}}{\sum_g \left[\sum_{k\in g} e^{\delta_k/(1-\sigma)}\right]^{(1-\sigma)}} \tag{11}$$

$P_{i/g}$ is instead the probability of choosing i conditional on the choice of group g:

$$P_{i/g} = \frac{e^{\delta_i/(1-\sigma)}}{\sum_{k\in g} e^{\delta_k/(1-\sigma)}} \tag{12}$$

by multiplying the right-hand sides of (11) and (12) we obtain:

$$P_i = \frac{e^{\delta_i/(1-\sigma)}}{\left[\sum_{k\in g} e^{\delta_k/(1-\sigma)}\right]^{\sigma} \times \sum_g \left[\sum_{k\in g} e^{\delta_k/(1-\sigma)}\right]^{(1-\sigma)}} \tag{13}$$

the expression for P_i can be simplified if we normalize the probability of choosing each i by the probability of choosing an outside variety delivering expected utility $\delta_o = 0$.[38] The probability of choosing the outside variety (hence not choosing any of the inside varieties) is:

$$P_o = \frac{1}{\sum_g \left[\sum_{k\in g} e^{\delta_k/(1-\sigma)}\right]^{(1-\sigma)}} \tag{14}$$

taking the log difference of P_i and P_o we obtain:

$$ln(P_i) - ln(P_o) = \frac{\delta_i}{1-\sigma} - \sigma ln\left(\sum_{k\in g} e^{\delta_k/(1-\sigma)}\right) \tag{15}$$

by using (11), (14) and (10) we find that $ln\left(\sum_{k\in g} e^{\delta_k/(1-\sigma)}\right) = [ln(P_g) - ln(P_o)]/(1-\sigma)$. After substituting the right-hand side of this expression in (15), and after some simplification we obtain:

[38] The outside variety is a variety for which we do not identify the mean utility. Instead we normalize it to 0 and express the mean utility of all other varieties in relation to the outside variety (Nevo, 2000). In practice, the market share of the outside variety is computes as $s_o = 1 - \sum_{i\in K} s_i$, where $\sum_{i\in K} s_i$ is the aggregate share of the inside varieties.

$$ln(P_i) - ln(P_o) = X_j'\beta - \alpha p_i + \sigma(P_{i/g}) + \zeta_i \quad (16)$$

because the observed market shares s_i, s_o and $s_{i/g}$ can be thought as empirical counterparts of P_i, P_o and $P_{i/g}$ then Eq. (1) that we estimate is the empirical counterpart of Eq. (16).

A.2. Computation of the market shares used to estimate Eq. (1)

Market shares s_i and $s_{i/g}$ are defined as:

$$s_i = \frac{qty_i}{MKT_{hs4,d}}$$

$$s_{i/g} = \frac{qty_i}{MKT_{hs6,d}}$$

where qty_i is the quantity (in kg) of variety i exported to market d. $MKT_{hs4,d}$ ($MKT_{hs6,d}$) is destination d's total demand (in kg) for goods belonging to the same HS4(HS6) product class of variety i. Because we do not observe countries' demand at this fine level of product disaggregation, we proxy for it with the total imports of a country in a particular product class.[39] $MKT_{hs4,d}$ and $MKT_{hs6,d}$ are obtained as:

$$MKT_{hs4,d} = \frac{\sum_j^{hs4,d} qty_j}{1 - s_o}$$

$$MKT_{hs6,d} = \frac{\sum_j^{hs6,d} qty_j}{1 - s_o}$$

where the numerator $\sum_j^{hs4,d} qty_j$ is the total quantity exported by French firms in a particular HS4 product class to destination d, and $\sum_j^{hs6,d} qty_j$ is the total quantity exported within more disaggregated HS6 product classes. These terms are computed by aggregating individual French firms' exported quantities observed in Customs at the product-destination level. Because the numerators express the import demand of country d from France, in order to obtain the *total* import demand of a country, we divide by $1 - s_o$ that is the import share from France in that product class (while s_o is the import share from all other destinations in that product class).[40] Market shares are computed for each individual year.

A.3. Summary statistics from the estimation of Eq. (1)

Table 10 summarizes the estimation results from the 1,217 regressions of Eq. (1) run on individual HS4 product categories. We report the mean, the median, the 1st and the 3rd quartiles of the coefficients obtained in these regressions both by FE and IVFE. FEIV corrects the expected upward bias affecting FE coefficients.

At the bottom of the table we report the percentage of observations with significant IVFE price and elasticity coefficients. These parameters are not statistically different from zero when the equation is not precisely estimated (i.e., insufficient observations). We drop the product categories for which the parameters are insignificant or outside a credible range (i.e., $\hat{\alpha}_{IVFE} < 0$ and $0 < \hat{\sigma}_{IVFE} < 1$). Although this cleaning shrinks the size of the sample (25% observations are dropped), it enhances the validity of the empirical strategy by retaining only product categories for which we obtain a valid measure of quality. $Elast_{IVFE}$ is computed using the formula in Berry (1994).

[39] This proxy is based on the assumption that the imports of a country in a given product class is proportional to its total demand for that product. Because in regressions on quality we control for country-specific fixed effects, this approximation does not affect our final results.

[40] We compute s_o using the quantities of each country's import from France and from other origins, within each HS6 and HS4 product class, reported in the BACI dataset (Gaulier and Zignago, 2010).

Table 10
Summary statistics on the estimation of Eq. (1).

	Mean	Median	1st Quart.	3rd Quart.
$\hat{\alpha}_{FE}$	−0.005	−0.000	−0.002	−0.000
$\hat{\alpha}_{IVFE}$	−0.100	−0.004	−0.018	−0.001
$\hat{\sigma}_{FE}$	0.942	0.946	0.918	0.966
$\hat{\sigma}_{IVFE}$	0.564	0.612	0.387	0.791
$Elast_{IVFE}$	−2.560	−0.302	−1.084	−0.056
Observations HS4	14,647	4,735	1,479	14,800
5% Sign. $\hat{\alpha}_{IVFE}$	77%			
5% Sign. $\hat{\sigma}_{IVFE}$	92%			

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