



Financing constraints and exports: Evidence from manufacturing firms in India

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Abstract

This paper examines the relationship between external financing constraints and the intensive margin of exports for manufacturing firms in India. We use a sample of nearly 3200 firms over the period: 2000–2015 and construct a multivariate index proposed by Musso and Schiavo (J Evol Econ 18(2):135–149, 2008) to estimate the degree of external financing constraints. We find that an increase in the degree of external financing constraints faced is associated with lower firm-level exports and this result holds even after accounting for endogeneity issues. We next examine whether business group-affiliated firms are less dependent on external finance to support their overseas sales. We find that financing constraints are a significant binding factor even for firms with access to internal capital markets. Moreover, we find that firm size matters, as a decline in the financial health of small- and medium-sized firms is associated with a significantly larger decline in their export levels. Finally, we find some evidence of industry-level heterogeneity, as financing constraints lead to a more pronounced decline in the exports of firms in industries with greater dependence on external finance.

Keywords Financial constraints · Intensive margin of exports · Firm size · Firm heterogeneity · Endogeneity · External financial dependence

JEL Classification D22 · F14 · G32 · L25

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1 Introduction

A firm's ability to expand its business activities beyond domestic borders and export goods and services assumes an important role in its growth trajectory. Indeed, domestic firms that sell in foreign markets can benefit from greater diversification as well as from positive feedback effects in the form of productivity gains which result from increased international competitiveness. Policies related to export promotion have consequently assumed a significant position in a country's development agenda. Despite the associated benefits, a firm's decision to export is contingent on several factors. Exporting to foreign markets involves substantial entry costs as firms need to acquire knowledge about foreign markets, customize their products to cater to local preferences and set up distribution networks (Minetti and Zhu 2011). As these costs are incurred prior to exporting and paid in advance, a firm's decision to become an exporter rests crucially on its ability to finance such expenditure. In the presence of financial market imperfections, constrained access to finance is likely to influence a firm's decision to export as well as its volume of exports.

Manova (2013) and Chaney (2016) provide the theoretical framework to analyze this relationship. While both agree that credit constraints can affect export participation, Manova (2013) additionally predicts that it can hurt export volumes, to the extent that firms rely on external finance to cover the variable production costs of exports. In recent years, following Greenaway et al. (2007), a large body of empirical literature has empirically tested these predictions, using various proxies of financing constraints.

One of the major challenges in empirically examining this relationship is with measuring financing constraints. As the difficulties that a firm faces in accessing external finance are not directly observable, much of the literature has relied on various financial variables to represent this complex phenomenon. While a number of studies have employed measures such as investment cash flow sensitivity, size and dividend policy to assess the existence of financing constraints, their accuracy in measuring constraints has often been questioned because they represent only specific dimensions of performance. Attempts to address these limitations have led to two important developments in the relevant literature: First, given the exogenous assessment of financial risk that is embodied in a credit rating score, a few studies have employed credit rating scores to represent financing constraints. The second development has been the use of new measures of financing constraints, which are based on various dimensions of a firm's performance. In this regard, the indices proposed by Whited and Wu (2006), Musso and Schiavo (2008), and Hadlock and Pierce (2010) combine information from multiple firm-level features to provide a composite assessment of the firms' degree of financing constraints.

This paper examines whether an increase in financing constraints influences the export earnings (foreign sales) of manufacturing firms in India. In other words, we examine the relationship between firm-level financing constraints and the intensive margin of exports. We examine this relationship using a detailed sample of nearly 3200 firms observed over the period: 2000–2015. To address concerns on measurement issues, we employ a multivariate index proposed by Musso and Schiavo (2008) (MS index, henceforth) which is likely to be a more composite measure of financing constraints. The MS index is then used along with two conventionally used measures

in a fixed-effects framework to examine the effect of the firms' financial health on exports. To account for the possible endogeneity of regressors, we additionally estimate our model using the generalized method of moments (GMM) estimator proposed by Arellano and Bond (1991).

Our results are summarized as follows: We find that an increase in the degree of financing constraints faced is significantly associated with lower exports and this result holds even after accounting for endogeneity issues. Our findings are therefore consistent with Manova's predictions that several firms may depend on external finance to meet the variable production costs of exports. We next examine whether firms affiliated to business groups experience a differential effect of constraints. Our results suggest that financing constraints are a significant binding factor, even for firms that have access to internal capital markets. Going further, we examine whether the observed association is contingent on the size of the firm. We find that financing constraints are likely to be a more severe concern for the small- and medium-sized firms (SMEs) in India, as deterioration in the financial health of such firms is associated with a significantly larger decline in their export levels. Finally, we also find evidence of industry-level heterogeneity, as a decline in financial health is associated with a more pronounced decline in the exports of firms in industries with greater dependence on external finance.

An assessment of the impact of financing conditions on the export performance of Indian firms is an important issue for various reasons. Despite the extensive economic reforms implemented following the Balance of Payment Crisis in 1991 and high GDP growth rates since 2000, manufacturing sector development has lagged behind, and as a result, India's manufactured exports remain underrepresented in world trade flows.¹ While the prevailing labour laws, inadequate infrastructural development and complex regulatory norms for starting businesses have contributed to the stagnation, inadequate access to external finance can be an additional impediment. Credit constraints due to the weaknesses in the financial sector may have prevented the small- and medium-sized firms from growing (Eichengreen et al. (2010)). Moreover, the high cost of credit and limited access to long-term finance are recognized as factors affecting the growth of manufacturing sectors (Department of Commerce Report 2011). These observations suggest that several manufacturing firms potentially face difficulties in obtaining external finance. As this can significantly affect the firms' ability to invest in various undertakings, it can be one of the leading factors contributing to the slow overall pace of growth of manufactured exports. An empirical assessment of this issue will be a first step toward assessing the relevance of this impediment facing firms in India.

By examining the relationship between external finance and exports for manufacturing firms in India, this paper contributes to the trade and financing constraints' literature in three important ways: One, this is the first study that systematically examines the role of external financing constraints in influencing the intensive margin of exports for Indian firms. An investigation into this relationship is important for a large developing country like India, and the findings reported here are pertinent in the current economic setting, especially since the recent slowdown in India's economic

¹ India's manufactured exports contributed 2% to world manufacturing exports in 2014 (UNCTAD statistics).

growth is characterized by a notable decline in its manufacturing sector performance and the emergence of financial sector stress as a potentially decisive factor. Recent developments have revealed that the domestic banking system's increasing burden of non-performing assets, distressed loans and exposure to stressed non-banking financial institutions (NBFCs) have severely impacted credit supply and uncovered the fragility of the domestic financial system. It is therefore increasingly important to understand not just how firm-level financial health has evolved under these conditions, but also examine whether the difficulty in obtaining external finance has a sizeable bearing on the average firm's growth, by limiting its ability to sell overseas. Despite being of critical importance, the role of external finance in shaping outcomes for existing Indian exporters has not been systematically examined and this paper fills this gap in the literature.

Two, to our knowledge, this is the first study that constructs a multivariate index of financing constraints for a large developing country such as India. As noted earlier, the advantage of a multidimensional index is that it provides a well-rounded assessment of a firm's financial health and thereby represents a more reliable measure of the constraints faced. The use of this index is an important aspect of our empirical analysis and distinguishes our approach from most of the existing empirical research on this topic, which relies on only a limited set of financial ratios. Going further, to demonstrate the consistency of this index and allow comparability, we show that the observed relationship is not contingent on our preferred measure, but holds across alternative measures of financing constraints and after accounting for potential issues of endogeneity. Three, this is the first study to show that for business group-affiliated firms, access to internal capital markets does not meaningfully reduce the dependency of such firms on external finance to support exporting activity, and that sources of firm and industry-level heterogeneity can also assume a significant role in moderating the relationship between financing constraints and export growth among Indian firms. Overall, this paper provides a set of new and previously undocumented empirical insights into an important relationship for manufacturing firms in India.

The remainder of the paper is organized as follows: Sect. 2 outlines the institutional setting in which manufacturing firms in India operate, Sect. 3 provides an overview of the relevant literature on financing constraints, and Sect. 4 describes the empirical model. Section 5 presents the summary statistics; Sect. 6 presents the main results; and Sect. 7 concludes.

2 Institutional setting

The macroeconomic policy environment in India underwent a paradigm shift since the Balance of Payments crisis in 1991. Financial sector reforms were an important part of the economic reform program initiated in 1991 and were introduced to improve the allocative efficiency of resources and address other sources of imperfections in domestic financial markets.

Following the recommendation of the Narasimham Committee in 1991, a number of significant reforms were introduced in the banking system between 1992 and 1997. Some of the most important reforms introduced over this period included liberalizing

the domestic interest rate regime and deregulating interest rates on time deposits; lowering the mandated levels of statutory liquidity measures (such as the cash reserve ratio and statutory liquidity ratio); increasing competition in the banking sector by encouraging domestic private bank and foreign bank participation; and diversifying the ownership of state-owned banks.² In addition to these, stronger rules mandating the disclosure of balance sheets and prudential norms (on capital adequacy requirements and adequate provisioning norms for loans) were introduced in an effort to improve the transparency, strength and stability of the domestic banking system (Ahluwalia 2002). Capital market reforms were also an important part of this change and abolished the requirement for companies to seek prior government approvals for accessing capital markets and issues pricing, conditional on meeting the strict disclosure requirements laid down by the Securities and Exchange Board of India (SEBI).³

In addition to the above, some policy measures have been adopted to mobilize credit to disadvantaged segments such as the small- and medium-sized enterprises (SMEs) and the export-oriented units (EOUs), among others. In this context, an important policy binding the Indian banking sector is the Priority Sector Lending (PSL) program that is designed to facilitate institutional credit to certain segments of the economy. In place since the 1970s, the PSL regulation requires all banks to lend at least 40% of their net credit to priority segments which include the agricultural sector, SMEs, export credit, housing and social infrastructure. There are segment-wise targets which must be met and the interest rate on these loans is determined by the Reserve Bank of India.⁴ In addition to the above, the Export–Import Bank of India (EXIM) extends credit to EOUs under various development categories such as innovation, R&D and purchase of production equipment.

While Ghosh (2006), among others, has shown that financial liberalization has eased financing conditions in the domestic credit market in the post-reform period (i.e., post-1991), the effectiveness of existing policies in meeting the demand for formal credit in the post-reform period is not known. Since lending typically takes place at the prevailing commercial rates and is based on the firms' ability to pledge sufficient collateral, firms facing constraints in borrowing from banks are likely to face similar challenges in qualifying under the special schemes. As such, despite the existence of such provisions, external financing constraints are likely to be a pertinent factor for the larger population of manufacturing firms, making it important to investigate the role of financing constraints in shaping the export behavior of such firms.

3 Literature review

A large body of theoretical literature examines the implications of credit market frictions on firm-level investment and growth. In recent years, several studies have documented that these frictions can assume a significant role in influencing the export-

² Prior to 1991, the cash reserve ratio was 25% and the statutory liquidity ratio was 40%, and these ratios currently stand at 4% and 19.5%, respectively (as of December, 2019).

³ The SEBI is the apex regulatory authority governing capital markets in India and was formed in 1992.

⁴ The priority sector guidelines do not lay down preferential rates of interest for loans under this category. <https://www.rbi.org.in/scripts/FAQView.aspx?Id=87>.

ing activities of firms. The models proposed by Manova (2013) and Chaney (2016) provide the theoretical framework to examine the relationship between credit constraints and firm-level exports.

Both Manova (2013) and Chaney (2016) adopt the Melitz (2003) model of trade with heterogeneous firms and introduce credit constraints as an additional source of firm heterogeneity to examine its implications on firm export behavior. In particular, given the existence of fixed entry costs, both recognize the need for adequate liquidity and predict that better financial access increases the firm's probability of exporting. However, they differ on the intensive margin effect of access to finance. In Chaney's model, once a firm starts exporting, it is only the productivity of the firm which influences the quantity of exports. Having incurred the costs associated with entering foreign markets, firms should be able to cover the variable costs of increased production using internal funds. In Manova's model, however, credit constraints can be expected to affect the quantity exported. The distinguishing feature is that Manova assumes that some firms depend on external finance to cover the variable production costs. In particular, she predicts that some firms with intermediate productivity are likely to choose sub-optimal levels of export quantities which will reduce the amount of external finance needed and consequently the repayment required to satisfy the participation constraint of the lenders. As such, while Chaney predicts that credit constraints do not matter for exports, Manova predicts that they can play a role in reducing the level of exports.

In recent years, a large body of empirical literature has tested the validity of these predictions. One of the major challenges in examining this relationship is with the measurement of credit constraints. As the difficulties faced by firms in obtaining formal credit are inherently unobservable to the econometrician, studies have relied on various proxies to represent the degree of constraints faced. In what follows, we summarize the main findings from relevant studies which use various measures of credit constraints.

Some of the most commonly used firm-level proxies of financing constraints are investment cash flow sensitivity (ICFS, henceforth) and financial ratios such as liquidity or leverage. In this regard, Greenaway et al. (2007) examine the association between exports and financial health for a sample of manufacturing firms in the UK over the period: 1993-2003. Using liquidity and leverage ratios as measures of financial health, they find no evidence that firms with better financial health are more likely to become exporters, but report that participating in export markets improves the firms' financial health. In contrast, using firm-level data on nine developing countries and the same indicators of financial health, Berman and Héricourt (2010) report that an increase in constraints significantly reduces the probability of becoming an exporter but has no effect on the level of exports.

While most studies rely on indirect information to estimate the degree of financing constraints, a selected few use survey information to obtain direct measures of credit constraints. Minetti and Zhu (2011) use the firms' response to a survey question on whether "access to credit was denied" to identify whether a firm is credit constrained. Using a cross-sectional sample of 4680 firms in Italy and instrumenting for potential endogeneity, they find that credit constraints significantly reduce the probability of becoming an exporter and export sales.

While measures such as ICFS, liquidity or credit scores represent some aspects of the firms' financial health, there are some limitations associated with these indicators. For instance, the use of ICFS hinges on the assumption that only firms that face higher costs of external funds are more likely to exhibit greater investment sensitivity to cash flow. However, Kaplan and Zingales (1997) demonstrate that even the larger firms (which are usually less financially constrained) can exhibit higher ICFS and thus raise questions on the efficacy of this approach in identifying "constrained" firms. The use of financial ratios can also be problematic. Arguably, the main concern with the use of firm liquidity or leverage is that they represent only certain aspects of a firm's financial situation. Moreover, there is no predicted (theoretical) relationship that is expected to exist between the firms' liquidity, leverage and degree of financing constraints (Bellone et al. 2010). While a high debt-ratio (or leverage) is seen to be indicative of greater financing constraints, it can also reflect that the firm in question has access to more external financial resources. Similarly, while high levels of liquidity are interpreted as a sign of good financial health, it can be as a consequence of the firm being unable to obtain adequate external finance.

Recent advances in the measurement of financing constraints mitigate these concerns by combining information from various dimensions of firm performance to estimate an index of financing constraints. In this regard, Musso and Schiavo (2008) construct a time-varying index of the firms' financing constraints based on each firm's position with respect to seven variables which are found to affect the firm's financial health. Bellone et al. (2010) employ this index to examine the implications on firm export behavior for a sample of French firms. Using the MS index, they find that better access to external finance increases the probability of becoming an exporter and also reduces the time taken to serve foreign markets, but does not affect the export intensity of firms. Whited and Wu (2006) propose an alternative index of external financing constraints which is used to examine its implications on firm returns. In more recent work, Hadlock and Pierce (2010) estimate an index of financing constraints for a sample of US firms solely based on firm size and age, which they argue provides an exogenous assessment of constraints.

In light of the previous findings on the role of external financing constraints, the empirical evidence on Indian manufacturing firms' exports is scant. While Nagaraj (2014) examines this association for a sample of firms, her analysis focuses on the impact on export participation (or the extensive margin effect). While she only provides cursory estimates on the intensive margin effect and finds no evidence of the same, her observation is based on a shortened sample of exporters. More importantly, the estimation strategy adopted does not account for either the role of firm-specific determinants (such as size and use of capital) or within-firm variability or endogeneity issues, factors which can influence the observed effect of financing constraints on firm-level exports. The available evidence on the effect of financing constraints on the intensive margin of exports for firms in India is therefore virtually nonexistent.

Our paper fills this gap in the literature and examines the effect of external financing constraints on the level of exports, additionally accounting for endogeneity as well as sources of firm heterogeneity. Moreover, this is one of the first studies after Bellone et al. (2010) that uses a multivariate index of financing constraints in relation to export behavior, an index which is expected to perform better than existing indicators (Bellone

et al. 2010). In doing so, this paper contributes to the empirical literature on the role of financing constraints in developing countries and to a very recent body of empirical research which uses multivariate indices to examine the implications of financing constraints on firm outcomes.

4 Empirical methodology

4.1 Data and sample selection

Our sample comprises of annual firm-level information on manufacturing industries in India over the period: 2000–2015. We obtain our data from the Centre for Monitoring the Indian Economy (CMIE) Prowess Database, which provides comprehensive balance sheet information on all listed and unlisted companies (in the organized sector) across several industries of the Indian economy. We exclude firm-year observations which report missing or invalid information on sales, wages, raw material expenses, fixed assets and total assets. We retain only those observations which report valid information on the variables used to construct the MS Index. All firm-specific variables are deflated using the relevant price indices obtained from the RBI Handbook of Statistics, and the data on India's aggregate and industry-level manufactured exports are obtained from the Comtrade database.⁵ Our final estimation sample comprises of an unbalanced panel of 21,580 observations (from 3179 firms) observed between 2000 and 2015, with an average of seven observations per firm.

4.2 Measuring financing constraints

We use the index proposed by Musso and Schiavo (2008) to obtain firm-specific, time-varying estimates of financing constraints. We also use the liquidity ratio and the leverage ratio as two additional measures of financing constraints. While the use of these financial ratios may aggravate endogeneity concerns, they can be correlated with the degree of the firm's credit risk and are therefore likely to reflect some aspects of financing constraints (Minetti and Zhu 2011).

4.3 The Musso and Schiavo (2008) Index

Following Musso and Schiavo (2008), the multivariate index is constructed by com- clearly indicate that financial healthbining information from seven variables which convey vital information on the existence of financing constraints. The variables are: firm size, profitability, liquidity, cash flow generating ability, solvency, trade credit and repaying ability.⁶

⁵ Refer to the table in "Appendix 1" for variable definitions.

⁶ See "Appendix 1" for variable definitions. The variables that constitute this index are chosen based on their performance in prior studies and their expected role in influencing the firm's ability to raise external finance (Musso and Schiavo (2008)).

Table 1 Correlation matrix

	Score A	Score B	Liquidity ratio	Leverage ratio
Score A	1			
Score B	0.7091*	1		
Liquidity ratio	0.1994*	0.1319*	1	
Leverage ratio	-0.4133*	-0.2103*	-0.4825*	1

Pearson's pair-wise correlations reported
*Indicates statistical significance at the 5% level

For each of the seven variables, we first compute the value of the firm relative to the industry average (at the 2-digit industry (NIC) level), following which, the firm is placed in one of the quintiles of the distribution of the scaled variable.⁷ For each variable, the firm is then assigned a number corresponding to the quintile it falls under. Hence, for each firm/year observation, we obtain seven scores ranging between one and five. This information is then collapsed into an index in two alternative ways: The first index (Score A) is a simple sum of the seven scores, and the second index (Score B) is a count of the number of dimensions for which the firm/year observation lies above the second quintile.⁸ The two indices are then rescaled to lie within a common range of 1–10. An increase in either of the two indices thus represents of an improvement in the financial health of the firm (on at least some aspects), which is expected to ease the firm's access to external finance.

Table 1 presents the correlation among the four measures of financing constraints and highlights some key attributes of these measures. First, the two indices of financing constraints (Score A and Score B) are strongly correlated, which indicates that the ranking of firm/year observations is fairly robust to alternative ways of combining information from the seven variables.⁹ Second, the correlation of the index with the financial ratios suggests that an increase in the firm's liquidity ratio or a decrease in its leverage is associated on average with an improvement in its financial health. This co-movement is consistent with prior studies and is suggestive of the fact that the variation in the MS index and the other measures over time is likely to capture common aspects of the underlying change in the degree of financing constraints faced by the firms.

4.4 Control variables

Firm-level export behavior can be influenced by various firm, industry and structural characteristics which must be accounted for. In line with previous studies, we control

⁷ Each variable is defined such that an increase in the value represents an improvement in that financial metric of the firm. Sectoral averages are used to account for industry-specific differences in the variables.

⁸ Our results are also robust to other ways of combining the scores from the seven variables.

⁹ This pattern is consistent with Musso and Schiavo (2008) and Bellone et al. (2010), who report a correlation (between Score A and Score B) of 0.78 and 0.91, respectively.

for the effect of firm size, total factor productivity, use of capital and firm age.¹⁰ In addition to this, we include an industry-level demand variable to account for external demand conditions which can have a significant bearing on how much firms export each year. We define industry-specific demand as the total value of all goods exported by the respective industry to all its partners in the preceding year. In addition to demand conditions, while macroeconomic and structural factors like exchange rate fluctuations, export-related incentives or regulatory changes can influence firm-level exports, their effects are expected to be captured by industry and year dummies included in all regressions.

4.5 Empirical model

We estimate the following equation to examine the effects of financing constraints on the level of firm exports:

$$\text{Exp}_{it} = \beta_1 + \beta_2 \text{FC}_{i,t-1} + \beta_3 X_{i,t-1} + \beta_4 Z_{k,t} + u_i + n_t + \varepsilon_{it} \quad (1)$$

where Exp_{it} represents the value of exports of firm i in year t (expressed in natural logarithm); FC represents one of the four measures of financing constraints (Score A, Score B, liquidity or leverage); X_{it} is a vector of firm and industry-level characteristics which include firm size, productivity, capital intensity and firm age; Z_{kt} denotes the k th industry's external demand conditions; u_i , n_t and ε_{it} represent firm fixed effects, year fixed effects and the idiosyncratic error term, respectively.¹¹ Our basic model comprises of estimating Eq. (1) using a fixed-effects regression. All firm-specific variables are lagged by one year to avoid simultaneity issues.

A potential concern with the financing constraints' index (Score A and Score B), as defined by Musso and Schiavo (2008) and specified in the regression model [Eq. (1)], is that firm size is one of the seven variables used to assess the firm's financial health. Since firm size is also an independent regressor in our empirical specification, this can potentially lead to biased estimates. To account for this, we construct the index using all variables excluding firm size and profitability and report the results from this alternative definition. It is worth noting that the modified version of the index has a correlation of 0.95 (or 0.96, in case of Score B) with the original definition/score (based on seven variables) and the results based on either of the two definitions are quantitatively similar.

As discussed, our specified regression model [Eq. (1)] controls for firm, industry and structural factors that are found to influence export behavior. However, in addition to these factors, some firms are also likely to have long-term contracts with existing importers, especially given the increasingly prominent role of global value chains in shaping international trade. For such firms, the existence of binding contracts can potentially cause firm-level export trends to persist over time, or past exports to

¹⁰ Refer to "Appendix 1" for all variable definitions. We follow Levinsohn and Petrin (2003) to estimate firm-specific productivity for each two-digit industry uniquely.

¹¹ We refrain from defining export sales (the dependent variable) in terms of annual (percentage) growth as this can introduce autocorrelation in the error terms.

correlate with current period exports. We account for this possibility by additionally estimating an alternative version of our main regression model [Eq. (1)], based on a generalized method of moments (GMM) estimator, which includes lagged dependent variables as additional regressors. Our motivation for adopting this approach is described in the following section.

4.5.1 Potential endogeneity

While lagging all explanatory variables in Eq. (1) by one time period alleviates concerns of reverse causality, the model as specified in Eq. (1) may still suffer from endogeneity issues. This can arise due to an omitted variable bias or the joint determination of exports and financing constraints. It is possible that a firm's financial health is correlated with unobservable firm-level characteristics. For instance, as lenders have more knowledge about the "true" productivity of the borrowing firm (than evident in the data), they may use this knowledge to limit the supply of credit to the less productive firms (Minetti and Zhu (2011)). As the proxies for firm productivity are unlikely to represent all aspects of firm efficiency, controlling for the same may not be sufficient to ensure that the firm's financial health remains exogenous. Similarly, unobserved characteristics such as the extent of agency problems can simultaneously influence the firm's use to external credit and its exporting activity. Moreover, to the extent that firms may seek external finance to expand its exports in the future or that exporting improves the credibility of the borrowing firm, a firm's exports and financial health are likely to be jointly determined. Finally, as noted earlier, some firms are likely to have binding contracts with existing importers and for such firms, previous period exports are likely to exhibit persistence over time.

To account for these factors, we additionally estimate an alternative version of our main regression model [Eq. (1)] using the generalized method of moments (GMM) estimator proposed by Arellano and Bond (1991). Not only does the GMM estimator eliminate the unobserved effects which correlate with the lagged dependent variable, the inclusion of the lagged dependent variable as an additional regressor accounts for the persistence of past export behavior. Importantly, this method allows the regressors to be instrumented by their lagged levels to address their endogeneity.

The following regression equation is estimated using the GMM estimator to examine the effects of financing constraints on firm export sales:

$$\text{Exp}_{it} = \gamma_1 \text{Exp}_{i,t-1} + \gamma_2 \text{Exp}_{i,t-2} + \gamma_3 \text{FC}_{i,t} + \gamma_4 X_{i,t} + \gamma_5 Z_{k,t} + u_i + n_t + \varepsilon_{it} \quad (2)$$

Drawing from the preceding discussion, to the extent that long-term binding contracts for exporters influence current period export quantity, the lagged dependent variables are expected to exhibit significant persistence ($\gamma_1, \gamma_2 \geq 0$). On the main variable of interest, to the extent that firms depend on external finance to cover variable production costs, external financing constraints can potentially influence the level of exports ($\gamma_3 \geq 0$). Most of the other firm-level characteristics are expected to have a positive effect on exports ($\gamma_4, \gamma_5 > 0$).

5 Summary statistics

We summarize some of the main features of our sample. Our original sample comprises of an unbalanced panel of nearly 40,000 observations from 4803 manufacturing firms (which includes non-exporters). The relevant sample (of exporting firms) comprises of 21,580 observations from 3179 firms. A favorable feature of our sample is that the firm-level exports cumulatively account for nearly 60% of the aggregate manufactured exports reported in the RBI (Handbook of Statistics). As such, our sample is closely representative of the export dynamics of manufacturing industries in India.

To set the context, we begin with a comparison between exporting firms (which include occasional exporters) and non-exporting firms, which reveals important differences.¹² As seen in Table 2, exporting firms are on average, larger, older and significantly more productive than non-exporting firms. Importantly, exporting firms are seen to have significantly better financial health, as indicated by our indices of financing constraints. This difference is also reflected by the other indicators, which highlight that exporting firms tend to hold more liquid assets and are significantly less leveraged. Finally, for the average exporting firm in our sample, foreign sales account for 22% of total revenues.

Table 3 summarizes the variables that constitute our index of financing constraints. As seen, exporters appear to perform significantly better than non-exporters along most dimensions. Exporting firms are on average significantly more solvent, have greater cash flow generating ability and are more profitable. The use of trade credit, however, is similar across both groups. The fact that the firm's ability to repay debt does not differ between the two groups suggests that servicing the existing debt burden is a challenge for both types of firms. Overall however, exporters appear to perform better than non-exporters along most dimensions of the index, which explains the higher scores observed in Table 2.

Going further, we test our main hypotheses by conducting a series of univariate tests on the key variables of interest, which highlights several important features of our sample. To this end, we segment our sample into two non-overlapping groups, based on the degree of financing constraints faced by firms (on average) over the sample period, following which, we test the significance of difference between the two groups.¹³ As seen in Table 4, the financially *more* constrained firms in our sample are on average, significantly smaller in size (in terms of total assets) and less productive than the financially *less* constrained firms. Such firms also have lower liquidity and are significantly more leveraged than the *less* constrained firms. Importantly, it is seen that financially constrained firms have significantly lower export sales and are also less export-intensive than the *less* constrained firms. It is also seen that in industries that are more reliant on external finance, firms that are relatively *more* financially constrained export significantly lesser than the *less* constrained firms in the sample, a feature that also holds for firms in industries that are relatively less dependent on external finance.

¹² A firm is recognized as a continuous exporter if it has exported in all periods (observed in the sample). Firms which exported only in some of the (reported) years are classified as occasional exporters, and firms which did not export in any year (over the sample period) are classified as non-exporters.

¹³ This segmentation is based on the industry-specific median of the multivariate FC index (Score A) at the 3-digit industry-level classification.

Table 2 Descriptive statistics

Variable	All exporters	Continuous exporters	Occasional exporters	Never exporters	F-statistic
Sales	13,433.66	17,293.78	5772.15	1335.66	75.20*
Total assets	12,850.23	16,528.78	5549.10	1277.41	131.13*
Wages	537.617	708.559	198.334	62.009	226.17*
Capital intensity	0.622	0.619	0.627	0.718	208.74*
K/L ratio	9.426	8.428	11.406	18.607	166.88*
Productivity	11.098	9.311	14.646	8.452	12.71*
Age	30.473	31.931	27.581	26.379	235.36*
Business group affiliation	1198	769	429	400	
Listed firms	1824	1065	759	628	
Liquidity ratio	0.297	0.298	0.297	0.274	43.54*
Leverage	0.352	0.343	0.371	0.383	109.71*
<i>Financial Constraints Index</i>					
Score A	6.457	6.610	6.152	5.490	1977.69*
Score B	8.375	8.513	8.100	7.098	1482.22*
Export sales	2359.1	3054.8	978.7		
Export growth	2.485	1.012	6.019		
Export intensity	0.223	0.269	0.130		
Obv.	21,577	14,348	7229	8418	
No. of firms	3179	1853	1326	1624	

Statistics on firm sales, assets, wages and export sales are reported in Rs. Million. K/L ratio is defined as the ratio of fixed capital to wages, and productivity represents the firm-specific estimates obtained from the Levinsohn–Petrin (LP) method. Export growth represents annual change in exports (in %), and export intensity is defined as the ratio of exports over sales. Business group affiliation refers to the number of firms under each category

*Indicates statistical significance at the 1% level

Table 3 Components of the Financing Constraints Index (Musso and Schiavo 2008)

Variable	All exporters	Continuous exporters	Export starters	Never exporters	F-statistic
Size	9842.936	12,675.82	4220.268	1005.509	153.56*
Profitability	0.031	0.036	0.022	0.015	39.10*
Liquidity	3.337	3.366	3.478	4.098	11.41**
Cash flow	696.743	933.811	266.216	51.625	102.1*
Solvency	25.279	35.381	5.229	2.776	8.38*
Trade credit	0.147	0.145	0.151	0.160	38.22*
Repaying ability	3.289	3.410	3.050	1.317	0.35

*Indicates statistical significance at the 1% level

Table 4 Univariate tests of hypotheses

Variable	Financially constrained exporters	Less financially constrained exporters	T statistic
Sales	12,020.94	14,833.99	– 1.74*
Total assets	8427.564	17,234.11	– 7.53***
Productivity	7.680	14.486	– 5.95***
Export sales	1196.805	3511.287	– 4.79***
Export intensity	0.226	0.219	2.05**
Age	28.570	32.359	– 14.04***
Liquidity	0.280	0.314	– 13.46***
Leverage	0.401	0.304	38.26***
Business group affiliation	583	615	
<i>High external dependence industries</i>			
Export sales	2000.17	6111.11	– 3.9***
Export intensity	0.234	0.229	1.03
<i>Low external dependence industries</i>			
Export sales	442.038	1534.814	– 15.99***
Export intensity	0.218	0.212	1.52

Financially constrained exporters comprise of all firms that are relatively more financially constrained (on average) than other firms within each industry (at the 3-digit level) over the entire sample period. This classification is based on the constructed multidimensional financing index (Score A). The reported t-statistic corresponds to the *t* test of the difference in sample means

***, ** and *Indicate statistical significance at the 1%, 5% and 10% level, respectively

Taken together, the univariate tests support our hypotheses and suggest that the degree of external financing constraints faced by Indian manufacturing firms is likely to be a significant factor shaping firm-level exports, and this association is likely to be stronger among the smaller firms and in industries with greater dependence on external finance.

6 Results

6.1 Baseline results

Table 5 presents the results from the fixed-effects estimation of our baseline model [Eq. (1)] on the level of exports. On the role of firm-specific determinants, most of the results are consistent with our expectations. Specifically, our results indicate that firms tend to export more as they grow bigger and older. Somewhat surprisingly, we find that that neither improvements in firm productivity nor the capital-intensity of production has a sizeable effect on export quantities.¹⁴ External demand conditions, however, are important and associated with higher firm exports across all specifications.

¹⁴ One possible explanation for this could be that firms may reduce investments in productivity-enhancing activities after becoming exporters, which can happen even if they face borrowing constraints.

Table 5 Baseline model (fixed effects)

	I	II	III	IV	V
ln productivity (TFP)	- 0.028 (0.058)	- 0.067 (0.059)	- 0.059 (0.058)	- 0.060 (0.059)	- 0.037 (0.059)
Size	0.762*** (0.041)	0.775*** (0.041)	0.764*** (0.041)	0.810*** (0.043)	0.775*** (0.041)
Capital intensity	- 0.070 (0.110)	- 0.063 (0.109)	- 0.069 (0.109)	0.047 (0.113)	- 0.052 (0.110)
Firm age	0.183* (0.103)	0.157 (0.103)	0.159 (0.102)	0.153 (0.103)	0.177* (0.103)
Ext. demand	0.225*** (0.050)	0.216*** (0.050)	0.217*** (0.050)	0.218*** (0.050)	0.222*** (0.050)
Score A		0.072*** (0.011)			
Score B			0.048*** (0.007)		
Liquidity				0.625*** (0.125)	
Leverage					- 0.130** (0.052)
Firm and year fixed effects	Y	Y	Y	Y	Y
No. of obs.	21,577	21,577	21,577	21,577	21,577
Firms	3179	3179	3179	3179	3179
Adj- R^2	0.177	0.180	0.180	0.180	0.177

Robust standard errors (clustered at the firm level) reported in parentheses. All explanatory variables are lagged by 1 time period. All regressions include a constant term (not reported)

***, ** and *Represent significance at the 1%, 5% and 10% level, respectively

On the role of financial factors, our results indicate that financing constraints assume an important role in influencing firm-level exports. Controlling for other factors, a decline in the firm’s financial health (represented by a decline in Score A or Score B) is significantly associated with lower export revenue. Similarly, our results using financial ratios suggest that when firms hold fewer liquid assets or become more leveraged (or indebted), they tend to export less. Hence, our results from four different measures of constraints unanimously demonstrate that deterioration in the firms’ financial conditions is associated with lower exports and this effect is statistically significant.

As the fixed-effects estimation of our baseline model can potentially still suffer from the endogeneity, as a next step, we estimate the model using the GMM estimator and the results are presented in Table 6. As seen, our main result remains qualitatively unchanged. An increase in the degree of financing constraints is associated with significantly lower firm-level exports. Importantly, this result holds across multiple measures of financing constraints. The effects of other determinants also remain qualitatively similar.

Table 6 Baseline model (GMM estimator)

	I	II	III	IV	V
1.lnExports	0.466*** (0.028)	0.451*** (0.028)	0.456*** (0.028)	0.466*** (0.027)	0.461*** (0.028)
2.lnExports	0.059*** (0.015)	0.046*** (0.014)	0.043*** (0.014)	0.056*** (0.014)	0.059*** (0.014)
ln TFP	0.264 (0.164)	0.242 (0.152)	0.262* (0.153)	0.235 (0.144)	0.268* (0.142)
Size	0.186** (0.087)	0.299*** (0.076)	0.269*** (0.080)	0.310*** (0.084)	0.231*** (0.081)
Capital intensity	- 0.111 (0.240)	- 0.210 (0.220)	- 0.220 (0.217)	0.244 (0.204)	- 0.088 (0.202)
Firm age	- 0.365 (0.231)	- 0.379* (0.225)	- 0.284 (0.226)	- 0.373* (0.219)	- 0.415* (0.219)
ln Demand	0.184* (0.094)	0.156* (0.089)	0.200** (0.090)	0.139* (0.081)	0.130 (0.086)
Score A		0.038*** (0.013)			
Score B			0.014* (0.007)		
Liquidity				0.977*** (0.184)	
Leverage					- 0.218*** (0.080)
Year dummies	Y	Y	Y	Y	Y
No. of obs.	13,957	13,957	13,957	13,957	13,957
Firms	2155	2155	2155	2155	2155
Instruments	370	466	466	466	466
m1 (<i>p</i> value)	0.000	0.000	0.000	0.000	0.000
m2(<i>p</i> value)	0.847	0.849	0.761	0.920	0.814
Hansen's J-test (<i>p</i> value)	0.221	0.124	0.090	0.482	0.230

Robust standard errors reported. Our specification for the GMM estimation is as follows: Firm age, industry demand and year dummies are treated as strictly exogenous; exports and firm productivity enter the regression as potentially endogenous; and firm size, capital intensity and our measure of financing constraints are all treated as weakly exogenous

***, ** and *Represent significance at the 1%, 5% and 10% level, respectively

Our result on the intensive margin effect of financing constraints compares in interesting ways to the existing evidence. First, our finding is consistent with Manova's predictions that credit constraints can potentially depress the volume of exports. It is also in line with empirical studies such as Minetti and Zhu (2011) and Muûls (2015) who find that credit constraints tend to depress firm-level exports. Note that while constrained access to finance can directly affect the volume of exports by influencing

the level of production undertaken, it can also exert an indirect effect by influencing the level of innovation or productivity-related investments that firms can afford to undertake.¹⁵ In this respect, our result is also in line with previous evidence on India, such as Bas and Berthou (2012), who find that financing constraints have a deterring effect on a the firm's decision to import capital goods. Finally, our result contradicts Nagaraj (2014). The discrepancy between our observations highlights the need to account for within-firm variation and for key firm and industry-specific determinants which evidently have a significant role in influencing the firms' export behavior.

6.2 Are external financing constraints relevant for all manufacturing firms?

Taking this forward, we next examine whether external financing constraints matter equally for all exporting firms. In other words, do all exporting firms necessarily rely on external funds to manage their overseas sales?

While most firms in our sample appear to rely heavily on external finance, some firms are likely to have access to alternative sources of credit. The firms that belong to a business group may indeed have an advantage over the stand-alone firms. Firms that are affiliated to a business group or corporation can get access to the group's distribution networks and may therefore face lower fixed costs of entering export markets (Minetti and Zhu (2011)). Importantly, such firms can also obtain access to additional funds at more favourable terms by resorting to intra-group borrowing, that is, by resorting to a form of internal capital market.

There exists a large body of literature on the role of internal capital markets that has documented evidence of significant financial and operational linkages between group-affiliated firms as a means of risk-sharing and helping group firms overcome difficulties in obtaining external finance (Gopalan et al. 2007). According to Gopalan et al. (2007), the motives for the transfer of resources can vary across group-affiliated firms. On the one side, while loans secured through intra-group borrowing can minimize the cost of raising external capital (Stein 2003) and be used to finance new profitable investment opportunities, it can also be used to meet short-term liquidity constraints or, in extreme situations, avoid the possibility of a default or bankruptcy.

Empirical research on the role of internal capital markets among Indian firms suggests that business-group ownership structures create internal capital markets (Manos et al. 2007); affiliated firms may have better access to funds than stand-alone firms (Lensink et al. 2003); and that intra-group loans are used to support the weaker firms within the group (Gopalan et al. 2007). In view of the existing empirical evidence, we examine whether external financing constraints exert a differential effect on the exports of group-affiliated firms. Indeed, if a majority of group-affiliated firms in our sample resort to internal capital markets to meet liquidity shortfalls or (and) fund new investment opportunities, they may be less reliant on external finance in supporting their business processes. In this case, a deterioration in the firm's perceived financial risk (or an increase in external financing constraints) may not be as important in

¹⁵ These can include a range of activities such as investment in better technology, import of capital goods or research and development-related expenses, all of which have implications for product quality and subsequently for the future demand for the products exported.

determining its overseas sales. In other words, if group-affiliated firms mostly rely to intra-group borrowing to support and expand their overseas activities, an increase in external financing constraints should not materially affect their export sales.

To examine the role of business group affiliation, we augment our baseline model [Eq. (1)] with an interaction term which is the product of our constraints' measures and a binary variable that assumes the value of 1 for all business group-affiliated firms in our sample and 0 for all non-affiliated firms.¹⁶ Table 7 presents the results of this exercise. As seen, while an increase in external financing constraints is significantly associated with lower export sales for the stand-alone firms, the marginal impact of external financing constraints for the average group-affiliated firm is not statistically different from that of a stand-alone firm, a result that is consistently observed across measures of financing constraints.

This finding has important implications. First, it reveals that for the average Indian manufacturing firm, external financing constraints are an important factor that influences export sales and the dependency on external finance is not contingent on the firm's larger ownership structure. Second, while our results may appear to counter the role of internal capital markets for group-affiliated Indian firms at first glance, a closer look sets this in perspective.

While our finding reveals that firms rely on external financing to support their export activities regardless of their larger ownership structure, it does not counter the possibility that group-affiliated firms access internal capital markets.¹⁷ In contrast, our results only indicate that funds that may be raised through internal capital markets are unlikely to be utilized for financing export-related activities, which can happen if these funds are used instead to meet liquidity shortfalls or address other financial needs. Such an outcome is indeed possible for the group-affiliated firms in India, as Gopalan et al. (2007) find that group loans are typically extended to financially weaker firms; the loans extended to such firms increase significantly following poor earnings growth and that most recipients of group loans underperform after receiving these loans.¹⁸ As such, our finding on the role of business-group affiliation does not contradict the existence of internal capital markets, but rather, distinguishes between the motives for accessing these markets. Our results lend support to the possibility that these funds are used by group-affiliated firms to primarily meet liquidity or other financial requirements rather than to reduce the dependency on external finance to support export-related activities.

¹⁶ We use the CMIE Prowess database's group classification for identifying the group affiliation for all firms in our sample. This approach follows existing studies on Indian business groups, including Khanna and Palepu (2000), Bertrand et al. (2002) and Gopalan et al. (2007), among others. The Prowess classification is appropriate for our empirical analysis as it is based on a continuous monitoring all corporate announcements as well as a qualitative interpretation of group-specific behavior of all affiliated firms. In our sample, 38% of all exporting firms are affiliated to an Indian or foreign-owned business group [Table 2 (Summary Statistics)].

¹⁷ Our empirical approach is not designed (or intended) to test for the existence of internal capital markets. However, prior studies by Gopalan et al. (2007) and Manos et al. (2007) provide strong evidence in support of the existence of internal capital markets among Indian business groups and our findings build on these well-established results.

¹⁸ Gopalan et al. (2007) find limited evidence of tunneling among Indian affiliated firms, in which intra-group flows are used to divert resources away from group firms with low insider holding and toward firms with high insider holding. This leads the authors to conclude that there is no evidence of intra-group loans being used by Indian firms to finance investment activities or to divert cash.

Table 7 Business group-affiliated firms

	I	II	III	IV
ln TFP	- 0.067 (0.059)	- 0.058 (0.059)	- 0.060 (0.058)	- 0.037 (0.059)
Size	0.775*** (0.041)	0.775*** (0.041)	0.808*** (0.043)	0.777*** (0.041)
Capital intensity	- 0.062 (0.109)	- 0.070 (0.109)	0.043 (0.113)	- 0.046 (0.110)
Firm age	0.158 (0.103)	0.157 (0.103)	0.154 (0.103)	0.174* (0.103)
ln demand	0.216*** (0.050)	0.216*** (0.050)	0.218*** (0.050)	0.218*** (0.051)
Score A	0.079*** (0.013)			
Score B		0.039*** (0.007)		
Liquidity			0.523*** (0.151)	
Leverage				- 0.282* (0.157)
FC measure _{t-1} × bus. group indicator	- 0.017 (0.021)	- 0.001 (0.011)	0.247 (0.239)	0.089 (0.238)
Firm and year fixed effects	Y	Y	Y	Y
No. of obs.	21,577	21,577	21,577	21,577
Firms	3179	3179	3179	3179
Adj-R ²	0.180	0.180	0.180	0.177

Robust standard errors reported in parentheses
 ***, ** and *Represent significance at the 1%, 5% and 10% level, respectively

6.3 Are small- and medium-sized firms (SMEs) more adversely affected by financing constraints?

We next examine whether the effect of external financing constraints on exports is more severe for the small- and medium-sized firms (SMEs). The motivation to examine this as a potential source of heterogeneous effect is due to various reasons. First, it is widely documented that the SMEs in developing countries play a significant role in employment generation and manufacturing output (Beck et al. (2005)). Despite their contribution, most SMEs remain constrained in their performance and face shortages in terms of working capital requirements and technology upgradation. One of the factors causing the slowdown is inadequate and lack of timely access to banking finance (World Bank report 2014).¹⁹ The high cost of credit coupled with the need to

¹⁹ The World Bank report (2014) on financial inclusion documents that SMEs usually face greater shortages of formal credit, especially in low- and middle-income countries. Based on the World Bank Enterprise

provide collateral makes it increasingly difficult for SMEs to obtain the required level of external funds.

These concerns are equally pertinent in the context of the SMEs in India. The relevant group, referred to as the micro-, small- and medium-sized enterprises (MSMEs), employ close to 80 million workers, contribute nearly 45% to manufacturing output and comprise over 40% of the sector's exports.²⁰ Despite their sizeable contribution, the MSMEs face severe challenges in accessing formal sources of credit. While the Government of India has undertaken initiatives such as the Priority Sector Lending (PSL) program to meet the requirements of the concerned segments (which include MSMEs), the efficacy of this program in improving the small firms' access to formal credit is unknown. If SMEs continue to face severe constraints in obtaining external finance, they are likely to reduce their exports by a larger volume as they become more constrained. Such a response would be in line with prior findings (such as Beck et al. 2005), which suggest that financing constraints affect the growth opportunities for small firms significantly more than for the larger firms.

As a next step therefore, we examine whether the effect of financing constraints is systematically different for the smaller firms in our sample. We hypothesize that a decline in financing constraints will have a stronger deterring effect of the exports of smaller firms, relative to the larger firms. To test our hypothesis, we first segment our sample into two (non-overlapping) groups and estimate our baseline model [Eq. (1)] for each of the two groups.

The appropriate identification of the smaller firms in our sample is important. We follow two alternative ways of classifying firms. We first use the definition of MSMEs (as per the MSME Act (2006)) and identify firms with an investment (in plant and machinery) of less than Rs. 100 million as MSMEs. In addition to this, we identify the set of small firms as those who have assets less than the industry-specific median (at the 3-digit NIC level). Table 8 presents the results based on the MSMEs in our sample, and Table 9 presents the results from the second classification.²¹

As seen in Table 8, while a decline in financial health is associated with lower exports across all firms, the negative impact is significantly larger for the MSMEs. This confirms our hypothesis that financing constraints have a significantly stronger deterring effect on the exports of SMEs, relative to large firms.

A potential concern with the first classification is that our sample includes only 662 firms which qualify as MSMEs. To ensure that our results are not influenced by the underrepresentation of small firms, we repeat this exercise following the second classification. The results, presented in Table 9, clearly indicate that financial health has a distinctly larger effect on the export levels of the smaller firms and this effect is robustly observed for most measures. Overall, our results are consistent with the findings of Beck et al. (2005) and Oliveira and Fortunato (2006) and demonstrate that the growth-deterring effects of financing constraints are more adversely felt by the SMEs in India.

Footnote 19 continued

Survey, they find that nearly 44% of SMEs are involuntarily denied loans in low-income countries, whereas a comparatively smaller share of the large firms (25%) experience this issue.

²⁰ Numbers are based on the Fourth Census of MSMEs conducted between 2006 and 2009.

²¹ The corresponding GMM estimates are reported in Table 2.1 (Appendix 2 in Electronic Supplementary Material).

Table 8 Firm size (based on MSME classification)

Firm size (group)	I Large	II Small	III Large	IV Small	V Large	VI Small	VII Large	VIII Small
In TFP	- 0.013 (0.068)	- 0.201* (0.115)	- 0.004 (0.067)	- 0.191* (0.116)	- 0.009 (0.067)	- 0.180 (0.116)	0.017 (0.067)	- 0.174 (0.117)
Size	0.787*** (0.044)	0.692*** (0.125)	0.788*** (0.044)	0.680*** (0.125)	0.825*** (0.046)	0.740*** (0.136)	0.789*** (0.044)	0.684*** (0.131)
Capital intensity	- 0.076 (0.110)	- 0.002 (0.411)	- 0.080 (0.110)	- 0.041 (0.415)	0.033 (0.114)	0.073 (0.416)	- 0.062 (0.111)	- 0.023 (0.423)
Firm age	0.214* (0.110)	- 0.293 (0.307)	0.214* (0.110)	- 0.314 (0.309)	0.206* (0.110)	- 0.322 (0.313)	0.232** (0.111)	- 0.297 (0.315)
In demand	0.214*** (0.053)	0.271* (0.163)	0.214*** (0.053)	0.274* (0.163)	0.217*** (0.053)	0.262 (0.164)	0.221*** (0.053)	0.273* (0.163)
Score A	0.065*** (0.011)	0.103*** (0.028)						
Score B			0.037*** (0.006)	0.046*** (0.014)				
Liquidity					0.661*** (0.138)	0.736** (0.296)		
Leverage							- 0.128** (0.054)	- 0.086 (0.159)
Coefficient difference (p-value)	0.054		0.086		0.233		0.700	
Firm and year fixed effects	Y	Y	Y	Y	Y	Y	Y	Y
No. of obs.	18,273	3304	18,273	3304	18,273	3304	18,273	3304
Firms	2517	662	2517	662	2517	662	2517	662
Adj-R ²	0.192	0.119	0.192	0.117	0.192	0.117	0.189	0.112

Robust standard errors reported. The statistical significance of difference in the coefficients of the constraints' measures between the small and large firms is denoted by the *p* value of the associated χ^2 test statistic
 ***, ** and *Represent significance at the 1%, 5% and 10% level, respectively

6.4 Differences due to higher industry-level dependence of external finance?

In the final step, we examine the role of industry-level heterogeneity in influencing the financing constraints–exports relationship. While easier access to external finance can influence export-related activities in various ways, the average dependence on external funds differs across industries. For instance, capital-intensive industries like transport equipment which require investments in high-cost production processes have a larger dependence on external finance relative to other industries. For such industries, an increase in financing constraints can have a disproportionately larger effect on production-related processes and consequently result in a larger decline in the export levels.

We therefore examine whether the association between the firm's financial health and its exports is significantly different for the group of industries which have a greater dependence on external finance. We follow Rajan and Zingales (1998) and estimate each industry's dependence on external finance as the extent to which the median

Table 9 Firm size (classification based on asset size)

Firm size (group)	I Large	II Small	III Large	IV Small	V Large	VI Small	VII Large	VIII Small
In TFP	-0.052 (0.077)	-0.103 (0.089)	-0.043 (0.076)	-0.097 (0.089)	-0.050 (0.076)	-0.084 (0.091)	-0.027 (0.076)	-0.065 (0.090)
Size	0.831*** (0.050)	0.658*** (0.076)	0.822*** (0.050)	0.643*** (0.076)	0.862*** (0.052)	0.706*** (0.080)	0.828*** (0.051)	0.676*** (0.077)
Capital intensity	0.185 (0.133)	-0.424** (0.176)	0.186 (0.132)	-0.444** (0.176)	0.286** (0.136)	-0.308* (0.185)	0.196 (0.134)	-0.400** (0.180)
Firm age	0.051 (0.128)	0.327* (0.181)	0.056 (0.128)	0.325* (0.180)	0.051 (0.128)	0.317* (0.182)	0.071 (0.128)	0.345* (0.182)
In demand	0.228*** (0.064)	0.192** (0.082)	0.230*** (0.064)	0.195** (0.081)	0.227*** (0.064)	0.201** (0.082)	0.230*** (0.065)	0.205** (0.082)
Score A	0.061*** (0.013)	0.090*** (0.017)						
Score B			0.044*** (0.009)	0.054*** (0.010)				
Liquidity					0.622*** (0.162)	0.583*** (0.196)		
Leverage							-0.099* (0.060)	-0.190* (0.099)
Coefficient difference (<i>p</i> value)	0.004		0.002		0.812		0.034	
Firm/year fixed effects	Y	Y	Y	Y	Y	Y	Y	Y
No. of obs.	13,296	8281	13,296	8281	13,296	8281	13,296	8281
Firms	1720	1459	1720	1459	1720	1459	1720	1459
Adj- <i>R</i> ²	0.212	0.131	0.212	0.130	0.212	0.128	0.209	0.126

Robust standard errors reported

***, ** and *Represent significance at the 1%, 5% and 10% level, respectively

firm's capital expenditure exceeds its cash flow. Industries with higher values are those which have a higher deficit that needs to be covered using external finance. Following this, industries are classified into two groups, representing high dependence and low dependence, based on their score relative to the sample median value. Table 10 presents this classification. As expected, industries like transport and electrical equipment have greater dependence on outside finance, whereas the traditional industries such as textiles have relatively lesser dependence on external finance.²² As before, we augment our model with an interaction term between the constraints' measures and an indicator variable (which equals 1 for industries with high dependence) and re-estimate the equation.

The results are presented in Table 11 and highlight two important features of our sample.²³ First, for the average firm in an industry with greater dependence on external

²² The classification of industries based on our sample is similar (but not identical) to the classification listed in Rajan and Zingales (1998). We obtain qualitatively similar results following the original classification, which are not reported for brevity.

²³ GMM estimates are reported in Table 2.2 (Appendix 2 in Electronic Supplementary Material).

Table 10 Classification of industries (dependence on external finance)

External financial dependence	Industry
High dependence	Transport equipment, electrical equipment, base metals, fabricated metal, computer and electronics, coke and petroleum products, pharmaceuticals, beverages, wearing apparel, leather products, wood products, other manufacturing, furniture
Low dependence	Textiles, food products, tobacco products, paper products, chemical products, rubber and plastics, nonmetallic minerals, machinery and equipment, motor vehicles, printing

Classification of industries based on the Rajan and Zingales (1998) index

finance, an increase in financing constraints is associated with a significantly larger decline in the firm's exports. This confirms our hypothesis that a firm's financial health has a stronger influence on the export revenue in industries more reliant on outside finance. This is also consistent with the findings of Minetti and Zhu (2011). Second, while the magnitude is lower in industries with lesser dependence, financial health continues to be a significant factor which influences the level of exports. Hence, regardless of the industry's dependence on outside finance, easier access to external finance is an important determinant of export levels for a majority of manufacturing firms in India.²⁴

6.5 Robustness checks

We check the robustness of our results using alternative specifications. First, given that continuous exporters can potentially respond very differently to changes in financial factors, we re-estimate our baseline model (eq. (1)) for a subset of our original sample which exclusively comprises of firms who are continuous exporters. The results from this exercise [presented in Table 2.3 (Appendix 2 in Electronic Supplementary Material)] clearly highlight that financial factors are a significant determinant of export levels for occasional as well as continuous exporters. We also estimate our baseline model using export intensity as an alternative measure of export performance [Table 2.4 (Appendix 2 in Electronic Supplementary Material)]. Finally, given that our sample covers the period between 2000 and 2015, it is possible that significant institutional or structural changes that may have taken place over this time have potentially influenced the observed financing constraints and exports' relationship.

To verify this, we consider the global financial crisis (GFC) of 2008 as a major economic event that triggered institutional changes and one that could have potentially altered the observed relationship. To test if the observed association between financing constraints and exports has changed since the GFC, we define a post-crisis dummy, which is a binary variable that assumes that value of 1 for all years after 2009 and 0 otherwise. Following this, we interact our measures of financing constraints with the dummy variable and re-estimate our baseline model [Eq. (1)]. As seen in Table 2.8

²⁴ We obtain similar results using industry-specific capital intensity (as an alternative measure of external financial dependence). These results are not reported for brevity.

Table 11 External financial dependence

	I	II	III	IV
ln TFP	- 0.052 (0.066)	- 0.044 (0.066)	- 0.061 (0.059)	- 0.041 (0.059)
Size	0.747*** (0.046)	0.749*** (0.046)	0.809*** (0.043)	0.780*** (0.041)
Capital intensity	- 0.050 (0.121)	- 0.055 (0.121)	0.046 (0.113)	- 0.043 (0.110)
Firm age	0.288** (0.137)	0.283** (0.137)	0.153 (0.103)	0.167 (0.103)
ln demand	0.211*** (0.055)	0.210*** (0.055)	0.216*** (0.050)	0.213*** (0.051)
Score A	0.064*** (0.011)			
Score B		0.034*** (0.006)		
Liquidity			0.532*** (0.171)	
Leverage				- 0.108 (0.128)
<i>FC measure*High ext. fin. dependence</i>	0.046*** (0.018)	0.034*** (0.009)	0.184 (0.230)	- 0.450** (0.178)
Firm and year fixed effects	Y	Y	Y	Y
Obs.	18,198	18,198	21,577	21,577
Firms	2735	2735	3139	3139
Adj-R ²	0.164	0.164	0.180	0.178

Robust standard errors reported. The classification of firms into two groups is based on the industry classification in Table 9 ***, ** and *Represent significance at the 1%, 5% and 10% level, respectively

(Appendix 2 in Electronic Supplementary Material), while an increase in external financing constraints is significantly associated with lower firm exports, there is no conclusive evidence that this relationship has changed over time, since the occurrence of the global financial crisis in 2008.²⁵

Overall, our main results from all alternative specifications (presented in Tables 2.5–2.10, Appendix 2 in Electronic Supplementary Material) remain unchanged: that an increase in the degree of financing constraints is significantly associated with lower firm-level exports; the deterring effect being more pronounced for the small- and medium-sized firms and for firms in industries with greater dependence on external finance.

²⁵ We obtain qualitatively similar results using the GMM estimator, which are not reported for brevity.

7 Conclusion

This paper examines the effect of financing constraints on the intensive margin of exports for a large sample of manufacturing firms in India. Using a multivariate index of financing constraints proposed by Musso and Schiavo (2008) along with conventional measures, we examine whether changes in the firms' financial health influence the level of exports. We find that an increase in the degree of financing constraints is significantly associated with lower firm-level exports, a result which is consistently observed using multiple measures of constraints as well as accounting for the potential endogeneity of regressors.

We also examine the role of firm and industry-level heterogeneity in influencing the observed association. Specifically, we first examine whether the effect of financial factors is contingent on the firm's affiliation to a business group or on firm size. We find that for business group-affiliated firms, access to internal capital markets does not meaningfully reduce the dependency of such firms (on external finance) in supporting their export sales. On the role of firm size, we find that SMEs' exports are significantly more vulnerable to deterioration in their financial conditions. Finally, we examine whether the observed effect is conditional on the industry's dependence on external finance. We find that while financing constraints have a more pronounced effect on the export levels in industries with higher dependence, it is a significant factor influencing export levels across all industries.

This paper offers new insight into the role of firm-level determinants of export levels in India and highlights the challenges facing domestic manufacturing firms. First, this study demonstrates that, in addition to the widely recognized structural complexities, inadequate access to external finance is a major concern for exporters in India. This finding is in line with ministry reports and more importantly corroborates policy recommendations which call for the need to address issues relating to the cost of credit and availability of long-term loans to exporters. Our finding also empirically substantiates one of the key observations put forward by the World Bank Report (2014), which states that better access to credit for the small and medium enterprises can lead to significant improvements in their growth prospects.

Our findings recognize various sources of weakness and categorically underscore the need for greater intervention and policy reform for Indian manufacturing industries. First, since weak credentials are possibly one of the principal causes for constrained access to credit, policy measures to address this issue should focus on developing alternative means for credit provision on relatively more flexible terms. In this regard, an important step will be to develop performance-based schemes which can mobilize term loans to support investments in development-oriented initiatives of exporters. Two, the requirements of the SMEs need to be given priority consideration in the allocation process and in the design of new schemes, since credit constraints appear to have a more severe impact on their growth opportunities. Three, the fact that most group-affiliated firms may not utilize their access to intra-group borrowing to support productive investment opportunities further suggests that there is a larger group of firms facing severe liquidity constraints and thus a larger than anticipated shortfall in the availability of formal credit in the domestic financial system, which raises the need for (and the urgency of) well-designed schemes that can address the demand

and supply mismatch. In the long run, the effective implementation of such schemes which address the needs of this sector will prove beneficial and can complement current initiatives such as the directed lending (PSL) program in alleviating credit shortages.

In this regard, some initiatives such as the import, production equipment and R&D finance programs [for export-oriented units (EOUs)] undertaken by the EXIM Bank of India represent a positive step in this direction. However, for many of these schemes, preconditions such as the need for sufficient collateral and the imposition of commercial lending rates reduce the possibility for several firms to qualify for loans under these categories. As such, some modifications in the current provisions (discussed above) can have a favorable impact on increasing the accessibility of credit for manufacturing firms in India.

Future research on the export performance of Indian firms can develop along some dimensions. First, subsequent work should empirically examine various channels through which credit constraints influence foreign sales. This will be important in precisely identifying the processes which are frequently compromised due to insufficient credit. Second, subsequent research should focus on assessing the long-term effectiveness of existing schemes such as the PSL program in improving the SMEs' access to bank credit. The findings from such an assessment can guide the development of future credit-related schemes.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval This article does not contain any studies with human participants or animals performed by any of the authors.

Appendix 1

a. Definitions

Control variables

Firm size	Log (assets)
Productivity	LOG (TFP) (based on the Levinsohn–Petrin method described below)
Capital intensity	Fixed capital/total assets
Business group affiliation	A binary variable equal to 1 if firm belongs to an Indian or foreign-owned business group and 0 otherwise
Demand	LOG (total industry exports) (proxy for external demand conditions, defined at the 2-digit NIC level)

Control variables

Measures of financing constraints

Musso and Schiavo (2008) Index

Firm size	Log (assets)
Profitability	Return of assets (net income/total assets)
Liquidity	Current assets/current liabilities
Cash flow	Cash flow from operations
Solvency	(Profit after tax + depreciation)/(short-term liabilities + long-term liabilities)
Trade credit	Trade credit/total assets
Repaying ability (represents the coverage ratio)	Cash flow from operations/debt
Other measures of financing constraints	
Liquidity	(Current assets-short-term debt)/total assets
Leverage	Short-term debt/current assets

b. Measuring firm-level productivity (Levinsohn–Petrin method)

Following Levinsohn and Petrin (2003), the firm-specific, time-varying estimates of TFP are obtained by estimating the following production function:

$$y_{it} = \beta_0 + \beta_1 k_{it} + \beta_2 w_{it} + \beta_3 n_{it} + \mu_{it} + \varepsilon_{it} \tag{3}$$

where y_{it} denotes firm revenue, k_{it} denotes capital or fixed assets, w_{it} represents the number of employees and n_{it} denotes expenditure on intermediate inputs. The unexplained variation in output (y_{it}) comprises of the *unobserved* efficiency term (μ_{it}) and the error component (ε_{it}). Estimating Eq. (3) above by Ordinary Least Squares (OLS) can be problematic as firms are likely to *choose* their factor inputs each period contingent on their contemporaneous productivity levels (which are *unobservable* to the econometrician). This may give rise to biased coefficient estimates of the production function and consequently biased estimates of firm productivity. Levinsohn and Petrin (2003) account for this possibility and propose the use of intermediate inputs to correct the simultaneity problem.²⁶ Their method (referred to as the LP method, henceforth) comprises of a semi-parametric approach to obtain consistent estimates of β , following which, TFP is obtained using the following equation:

$$\mu_{it} = y_{it} - \beta_1 k_{it} - \beta_2 w_{it} - \beta_3 n_{it} \tag{4}$$

We follow the LP method to obtain consistent estimates of firm-specific productivity by estimating Eq. (4) for each industry at the two-digit NIC level.²⁷ We use annual sales as our measure of firm revenue, fixed assets as a measure of capital [k_{it}], total wage bill as a proxy for labor (w_{it}) and raw material expenses as a measure of intermediate

²⁶ See Levinsohn and Petrin (2003) for more information on the methodology.

²⁷ We use the “levpet” command in Stata to obtain these estimates.

inputs (n_{it})]. All variables used are in real terms and enter the regression equation in natural logarithm.²⁸

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²⁸ We use the total wage bill to represent labor as most firms over the sample period do not report information on the number of employees.

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