LUISS

CASMEF Centro Arcelli
per gli Studi Monetari e Finanziari

CASMEF Working Paper Series

OUT OF SIGHT, OUT OF MIND?
GLOBAL VALUE CHAINS AND CREDIT ALLOCATION IN BAD TIMES

Raoul Minetti
Pierluigi Murro
Valentina Peruzzi

Working Paper No. 2
March 2025

Arcelli Centre for Monetary and Financial Studies
Department of Economics and Finance
LUISS Guido Carli
Viale Romania 32, 00197, Rome - Italy
http://casmef.luiss.edu

Out of sight, out of mind?
Global value chains and credit allocation in bad times

Raoul Minetti*
Michigan State University

Pierluigi Murro
LUISS University

Valentina Peruzzi
Sapienza University of Rome

Abstract

We investigate the influence of firms' global status on the allocation of credit during a financial crisis. Using data on 15,000 businesses from seven European countries, we find that firms participating in global value chains were 25% less likely to be rationed by banks during the 2009 financial crisis. Matching the firm-level information with data on banks' branch and subsidiary networks in the countries, we obtain that banks insulated global chain participants from credit rationing, not only accounting for the beneficial effects of global chain participation, but also to reduce spillovers on their own foreign activities related with global chains.

Keywords: Banks; global value chains; financial crises; spillovers.
JEL codes: F10; G20; D22.

1 Introduction

The link between finance and firms' internationalization has attracted growing interest in recent years. To internationalize their activities (e.g., participate in global value chains), firms must invest resources to identify foreign commercial partners and tailor products to match the regulations of foreign countries (Baldwin and Krugman 1989; Paravisini et al. 2015; Leibovici 2021). Most of these expenses have to be sustained up front so that firms often need external financing (Manova 2013). Due to this reliance on external finance, one would be tempted to conclude that international activities are disproportionately exposed to credit market crises. Yet, the effect of aggregate credit contractions on internationally active firms is far from clear-cut. Levchenko et al. (2010) demonstrate that during the Great Financial Crisis of 2008-2009 the decline in U.S. international trade was larger than in previous downturns not caused by financial disruptions. In contrast, Alessandria et al. (2010) highlight that, while sizeable, the trade decline was not unusual relative to the output drop.

*Corresponding author. Email: minetti@msu.edu. Address: Department of Economics, 486 W. Circle Drive, 110 Marshall-Adams Hall, Michigan State University, East Lansing, MI 48824-1038, USA. We wish to thank several seminar and conference participants for helpful comments and conversations. All remaining errors are ours. Funding: This work was supported by the Italian Ministry for Universities and Research (MUR, PRIN 2022 n. 2022EPTMLJ).

Figure 1 displays the patterns of credit aggregates, trade flows (total export and import content of export) and GDP during the Great Financial Crisis for seven major European countries (Austria, France, Germany, Hungary, Italy, Spain, and the United Kingdom). The figure confirms that a significant drop in credit occurred in all those countries.[1] It also shows substantial cross-country differences in the decline of trade flows relative to that of the GDP. In France and Germany, trade shrank significantly more than the GDP, while the opposite occurred in the United Kingdom and Hungary. Finally, there are also cross-country differences between the pattern of export and that of the import content of export: in the United Kingdom, for instance, the import content of export decreased less than total export while the opposite occurred in Spain.

This paper revisits the nexus between finance and internationalization, possibly shedding new light on the debate about the effect of credit crises. While the reliance of firms' international activities on external funding is well established, a critical aspect that the literature often neglects is that the main providers of credit, banks, are concentrated financial institutions which routinely make sophisticated lending decisions. For example, there is evidence that in bad times banks do not contract credit uniformly across firms but strategically choose how to allocate their scarce liquidity across sectors, regions and segments of firms, possibly insulating some of their clients from the credit contraction at the expense of other customers (Giannetti and Laeven 2012; De Haas and Van Horen 2013; De Jonghe et al. 2020; Saidi and Streitz 2021).

These observations lead to fundamental questions. How does firms' global status affect banks' credit allocation? Do banks treat internationally active clients differently from domestic-oriented ones during a credit crisis? Answering these questions can yield new insights into the dynamics of credit crises and help policy makers design interventions, possibly tailored to firms' international status. Our analysis will reveal that accounting for the corporate global network can be important for the management of credit crises and for the international coordination between policy makers and financial regulators.

In this paper, we study whether firms' exposure to bank credit rationing is influenced by their participation in global value chains (GVCs). We also investigate the possible channels of influence of firms' international status on their credit access. To this end, we match information from

1. This drop in credit is also reflected in our data, as further discussed below. The percentage of credit rationed firms in our 2009 sample is approximately three times the percentages found in similar surveys in normal periods.

five databases: the EU-EFIGE Bruegel-UniCredit survey, the Bureau van Dijk (BvD) Amadeus database, the BIS Cross Border Banking Statistics, the Bureau van Dijk (BvD) Orbis dataset, and the Moody's Analytics BankFocus. Our main source of data consists of the EFIGE survey which targeted almost 15,000 manufacturing firms in 103 regions of seven European countries (Austria, France, Germany, Hungary, Italy, Spain, and the United Kingdom) at the peak of the Great Financial Crisis (2009). The EFIGE survey provides information on firms' access to credit, as measured by a precise supply-side indicator of bank credit rationing, as well as information on firms' usage of bank credit. It also gives details on firms' modes of internationalization, including firms' participation in global value chains, as captured by firms' purchases and/or sales of intermediate products to firms abroad. We match the EFIGE firm data with balance-sheet information from BvD-Amadeus, a comprehensive source of financial information on European firms. We further hand-match the EFIGE data with BankFocus data on the banks with which firms do business, particularly banks' international presence through branches and subsidiaries abroad. To identify the lending banks of the sample firms, we exploit the BvD-Orbis database.

Firms' participation in global value chains could influence banks' credit allocation and hence rationing, but, at the same time, credit rationing could affect firms' global chain participation decisions (reverse causality). Moreover, unobservable firm characteristics could jointly determine credit rationing and firms' global chain participation. Building on an established body of studies on the determinants of firms' supply chain participation, we address these endogeneity issues by using detailed information on firms' access to information technology (IT). As shown, e.g., by Brynjolfsson and Hitt (2000), firms with easier access to IT infrastructures are facilitated in their ability to connect with other businesses, and hence to participate in supply chains. Moreover, Freund and Weinhold (2002) show that firms' ability to establish international trade linkages is strongly affected by their access to information technology. Our data give details on whether firms have access to broadband connections and the purposes for which they view such connections as essential. We interact detailed firm-level information on firms' reliance on broadband connections for the specific purpose of managing purchases/sales firm networks with a regional measure of the quality of local IT infrastructures (broadband access, from Eurostat data). There is ample evidence that the quality of IT infrastructures differs greatly across European regions and this significantly affects firms' ability to establish supply chain links and international trade connections.

After instrumenting for firms' participation in global value chains, and controlling for granular sets of industry, region, product destination, and bank fixed effects, as well as for possible determinants of credit access, we estimate striking effects of firms' global chain participation status on the probability that firms were rationed by banks during the 2009 credit crunch. We find that firms that were involved in global supply chains in 2008 (prior to the start of the crisis) were less likely to suffer from bank credit rationing than those that were not. The magnitude of the effects is sizable. The participation of a firm in a global supply chain reduced the probability that the firm suffered from credit rationing in 2009 by 2.2 percentage points, which amounts to about 25% of the average probability (8.7%) of credit rationing in the sample. We confirm these findings in an alternative test in which we use panel information from balance sheet data on firms' credit usage. Using panel data from 2005 to 2009, we obtain that for global supply chain participants the access to bank credit dropped significantly less during the crisis (by about 14% in IV estimates). Overall, these findings indicate that during the crisis banks partially insulated global chain participants from the effects of the credit crunch.

To dissect the scenarios in which the effects are more pronounced, we exploit heterogeneity along a variety of characteristics of the firms and of the global chain. The negative effect of global chain participation on bank credit rationing is more significant, statistically and economically, for firms that participate in supply chains with a European span than for those with commercial partners in far-away countries.[2] This result suggests that the effects manifest themselves when global chain participation is perceived to be less uncertain by banks. The effects are also stronger for businesses that are traditionally perceived to be vulnerable to bank credit constraints, such as younger firms, and businesses that inherently rely more on external financing.

We argue that our findings could reflect two complementary mechanisms. Banks could protect global supply chain participants because they attribute value to this participation ("client-protection"). Participation in a global chain could entail better diversification of destination markets, more stable future prospects and hence higher future expected returns (e.g., lower borrower default probability) for a lending bank. In the words of an Italian banker, from banks' point of view "the weaknesses of small enterprises are attenuated in supply chains, thanks to the strength-

2. The findings do not appear to be driven by firms' position in supply chains, although we find some evidence that downstream firms are better protected from credit rationing.

ening of their knowledge and of their professional, managerial and organizational competencies" (Rotondi 2013, p.VI). Anecdotal evidence suggests that banks attribute importance to supply chain participation in their lending decisions. In a survey conducted by a major European banking group (UniCredit 2012), one-third of the surveyed firms argued that their banks view supply chain participation as a pivotal dimension when making lending decisions.

A second interpretation of our findings instead relates to the nature of banks as institutions with a broad scope of operations. Banks could protect supply chain participants because they internalize the negative consequences that the denial of credit to these clients could have on other foreign entities with which the banks do business ("spillover-avoidance"). For instance, consider a large German corporation operating in a global supply chain with Polish commercial partners and suppose that its German lending bank has a network which also involves operations in Poland (including the provision of credit and consultancy services to supply chain participants in Poland). If the bank anticipates that, if denied credit, its German customer could terminate its business with the Polish counterparts, the bank could fear negative consequences for its own lending and consulting activities in Poland. It could then be reluctant to deny credit to the client and instead choose to penalize other borrowers with no international ramifications. In the words of an Italian banker, the expansion of global value chains "pushes to modify the bank lending activity towards a model that we could define as a value-chain bank (...), that is, a bank with interest and concerns in the firms connected along the supply chain" (Rotondi 2013, p. VII).

We find that both mechanisms play a role in our results. Regarding the "client-protection"channel, the effect of global supply chain participation on bank credit rationing is more pronounced when firms engage in profit-enhancing activities within the chain, such as projects aimed at expanding firms' distribution network and brand recognition abroad. Banks could view these activities as signals that the global chain participation will enhance the future profits of their client and thus be reluctant to penalize it. Regarding the "spillover-avoidance" channel, we uncover that the effect of global chain participation is stronger for banks with an international scope, as captured by a broad international branch network. To probe this point, we additionally merge our data with information from the BvD-Orbis database and the Moody's Analytics BankFocus and construct proxies for banks' engagement in the geographical areas where client firms entertain supply chain linkages. Specifically, we hand-match data on the number of subsidiaries per country of each lending

bank with information on the location of firms' supply chain partners. The effect of supply chain participation on bank credit rationing is stronger when a bank conducts relatively more business (that is, it has more subsidiaries relative to its world subsidiaries) in the countries in which client firms have chain links. That is, when the countries where the firms have supply chain links are relatively more important in the global portfolio of the bank ("bank country specialization"). The effect of supply chain participation is also stronger when a bank is relatively more important for the foreign firms operating in the country and, hence, the bank's credit denial could have larger repercussions in the country ("bank country relevance"). On the other hand, additional tests show that our findings are not driven by the knowledge of globally active banks about products traded among the chains. That is, our results do not reflect a bank knowledge mechanism.

The paper speaks to two strands of the literature. The first investigates the implications of credit for international activities. We relate to the studies that use firm-level data to investigate these implications (Manova 2013; Minetti and Zhu 2011; Paravisini et al. 2015; Paravisini et al. 2023), but we reverse the research question. In fact, we are interested in the influence of firms' internationalization on bank credit decisions. In this sense, our paper is close in spirit to Do and Levchenko (2007), who analyze the effect of international trade on a country's level of financial development in an aggregate perspective and show that financial development is affected by the external finance needs of exported goods. The paper is also broadly related to a growing literature on the higher or lower resilience of internationally active firms (e.g., multinationals) to financial crises (Manova et al. 2015). The second related literature investigates the allocation of credit, especially during crises. There is growing evidence that banks make sophisticated decisions about credit provision (Giannetti and Saidi 2019; De Jonghe et al. 2020). However, we still have limited evidence on how firms' internationalization influences credit allocation. Our results suggest that banks engage in a strategic credit allocation choice, protecting firms that internationalize their activities through global chain participation. We will discuss the links to the prior literature in greater detail when framing our hypotheses.

The remainder of the paper is organized as follows. Section 2 presents a simple background theoretical model and lays out testable hypotheses. Section 3 describes the data and the econometric approach. Section 4 discusses the main empirical results. In Section 5, we study the mechanisms underlying our main findings. In Section 6, we draw some quantitative implications of our results

for the behavior of firms' foreign and domestic sales during crises. Section 7 concludes. Details on the data and additional results are in the online Appendix.

2 An illustrative model

We derive the testable hypotheses of the analysis with the help of a stylized banking model. The model will also be used to examine the quantitative implications of our results for the effects of bank lending contractions on foreign and domestic sales during the Great Financial Crisis.

2.1 Theoretical framework

Consider a representative bank that can grant loans to two categories of firms: globally active (G) and domestically oriented (D). There are three key ingredients of the framework. First, the bank is capital constrained and chooses how to allocate its scarce lending capacity between the two segments of firms. Second, the bank derives different returns from extending loans to globally active firms (L_G) and to domestically oriented ones (L_D). We will elaborate below on the sources of such higher returns. Third, globally active firms rely more than domestically oriented ones on external (bank) financing to cover the expenses for their production input (Manova 2013).

The lending capacity of the bank is determined by its net worth (NW) through a standard capital constraint, which states that its total lending cannot exceed a multiple $1/\psi$ of the bank's net worth (where ψ denotes the regulatory or market-based capital adequacy ratio). We take the initial bank net worth (NW) as given. The bank's objective is to maximize its future net worth NW', given by the gross returns on the loans to the two firm categories, $\mathcal{R}(L_D)$ and $\mathcal{R}(L_G)$, net of the cost of deposits, $(1+r)D$ (where r denotes the net deposit rate and D is the deposit stock). The bank's constraints are given by a standard budget constraint and by the net worth constraint:

$$\max_{L_D, L_G, D} NW' = \mathcal{R}(L_D) + \mathcal{R}(L_G) - (1+r)D \tag{1}$$

$$s.t. \qquad L_D + L_G = D + NW \tag{2}$$

$$NW \geq \psi \left(L_D + L_G\right). \tag{3}$$

We posit that the bank derives different returns from lending to globally active firms, e.g., $\mathcal{R}(L_G) =$

$\omega\mathcal{R}(L_D)$, with $\omega > 1$ if the return edge is positive and $\omega < 1$ if it is negative.

Firms produce using a unique input (labor, Lab). In order to hire labor, they need to partly rely on bank loans. We model this dependence in reduced form, by letting $Lab_D = f(L_D)$ and $Lab_G = g(L_G)$, with $f(L_D) > 0$ and $g(L_G) > 0$. To capture the higher relevance of external finance for globally active firms, we posit that the impact of bank loans on their labor usage exceeds the impact of bank loans on the labor used by domestically oriented firms: $g(L_G) = \theta f(L_D)$, where $\theta > 1$. Formally, the domestic sales of domestically oriented firms and the foreign sales of globally active firms are given by

$$Y_D = ALab_D = Af(L_D) \tag{4}$$

$$Y_G = ALab_G = Ag(L_G) = A\theta f(L_D) \tag{5}$$

where A denotes the TFP common to all firms. After some algebra, the bank's problem becomes:

$$\max_{L_D, L_G, D} N' = \mathcal{R}(L_D) + \mathcal{R}(L_G) - (1+r)\left(L_D + L_G - NW\right) \tag{6}$$

$$s.t. \qquad \frac{NW}{\psi} = L_D + L_G \tag{7}$$

$$\mathcal{R}'_D(\frac{NW}{\psi} - L_G) = \mathcal{R}'_G(L_G). \tag{8}$$

We consider a negative shock to the bank's net worth, in the spirit of what occurred during the Great Financial Crisis. From the above,

$$\frac{\partial L_D}{\partial NW} = \frac{\mathcal{R}''_G(.)}{\psi\left[\mathcal{R}''_G(L_G) + \mathcal{R}''_D(.)\right]} = \frac{\omega}{\psi(1+\omega)}, \tag{9}$$

$$\frac{\partial L_G}{\partial NW} = \frac{\mathcal{R}''_D(.)}{\psi\left[\mathcal{R}''_G(L_G) + \mathcal{R}''_D(.)\right]} = \frac{1}{\psi(1+\omega)}, \tag{10}$$

where $\mathcal{R}_D(.)$ and $\mathcal{R}_G(.)$ are banks' expected returns per unit of loan extended to domestically oriented and globally active firms. Comparing (9) and (10), we have $\frac{\partial L_G}{\partial NW} < \frac{\partial L_D}{\partial NW}$, that is, the contraction of credit faced by globally active firms following the negative bank net worth shock is lower than that faced by domestically oriented firms. Denoting by Y_D and Y_G the total volumes of

operations of domestically oriented and globally active firms, we also have

$$\frac{\partial Y_D}{\partial NW} = \frac{A}{\psi} f'(L_D) \frac{\omega}{1+\omega} \tag{11}$$

$$\frac{\partial Y_G}{\partial NW} = \frac{A}{\psi} \theta f'(L_D) \frac{1}{1+\omega} \tag{12}$$

where $f'(L_D)$ and $\theta f'(L_D)$ denote the responses of the input demand of domestically oriented and globally active firms to changes in external bank financing, respectively.

2.2 Why firms' global status matters

In what follows, we discuss the possible sources of banks' return edge from lending to globally active firms (ω in our illustrative framework). Foreign activities are typically perceived by financiers as uncertain and risky (Manova 2013). Information on foreign markets is hard to obtain for creditors: purchases and sales are made in foreign countries with different laws and regulations. Hence, the enforceability of loan contracts in international transactions is limited. Moreover, exporters and importers need substantial working capital due to the time lags associated with international transactions, thus increasing refinancing risk (Amiti and Weinstein 2011). Due to these information asymmetries and risk, firms involved in global value chains could exhibit lower expected returns for banks than their domestically oriented counterparts, especially during periods of credit crunch ($\omega < 1$).

Yet, banks could also view firms' participation in global value chains as beneficial ($\omega > 1$). Firms participating in a global value chain are found to have better opportunities to enhance productivity and efficiency than domestic-only firms (Wagner 2007; Blaum et al. 2018; Bernard et al. 2018b; Bernard et al. 2019; Antràs and Chor 2022). Interviewing a large sample of Italian banks, Degasperi et al. (2007) obtain that for about three quarters of the banks credit extension is conditioned on obtaining information about the global supply chain participation of the borrower and its commercial partners, especially in periods of crisis. And in a survey of loan officers in the Italian province of Vicenza, Bosi and Degasperi (2007) report that for roughly 63% of the loan officers the participation of customer firms in supply chain networks is relevant for the loan extension decision. In a 2010 survey conducted by the UniCredit banking group, one-third of the

firms declared that their bank attributes importance to their collaborations with other firms within networks. Based on this, UniCredit introduced a "supply chain rating" to measure the growth potential of borrowers involved in global value chains (UniCredit 2012).

The above evidence suggests that the participation in a global value chain can represent a positive signal for banks, as firms involved in this kind of network have higher future chances to survive and grow (Biais and Gollier 1997; McMillan and Woodruff 1999). Thus, banks could choose to protect global value chain participants in periods of tight credit.

Hypothesis 1 (client-protection). Although firms' global chain participation is characterized by larger information asymmetries and risk ($\omega < 1$), which get exacerbated during credit crunches, banks may positively value firms' participation in global chains and contract credit less to global chain participants ($\omega > 1$).

A second reason for which banks could insulate global chain participants from credit rationing could be that banks internalize the negative spillovers associated with the denial of credit to such firms. Banks with large exposures in foreign countries may be less likely to cut credit to firms operating in foreign markets (Favara and Giannetti 2017). This may be even more true when banks have customers positioned at different stages of the same global value chain and these customers account for a non-trivial amount of activity within the chain.[3] Moreover, banks may offer profitable foreign consulting activities to global chain participants in foreign countries. In these cases, banks could anticipate that, by maintaining liquidity provision for their customers, they will contain the effects of costly defaults on outstanding loans and on consulting activities, preserving their own foreign business (Giannetti and Saidi 2019).

Hypothesis 2 (spillover-avoidance). Banks with high exposure in a foreign country may extend more credit to borrowers involved in GVCs operating in that country to preserve their own credit or foreign consulting business ($\omega > 1$).

3. In 2010, major European banking groups held a significant share of their total assets abroad (Duijm and Schoenmaker 2021): 87% for Standard Chartered, which is particularly exposed to the Asia-Pacific region (18% in Hong Kong, 7% in India, 11% in Korea, and 14% in Singapore); 86% for Raiffeisen Zentralbank Osterreich, whose main foreign assets are concentrated in developing European countries; 74% for BNP Paribas and 59% for UniCredit, which are mainly exposed to Central Europe; 69% for Banco Santander, that has a significant exposure in Latin America (15% in Brazil and 5% in Mexico); 60% for Deutsche Bank, whose foreign assets are mainly concentrated in Central Europe and the United States (22%).

After presenting the main findings, we will test these mechanisms (Section 5).

3 Data and empirical strategy

3.1 Data sources

We match information from five main sources: the EU-EFIGE Bruegel-UniCredit survey, the BvD-Amadeus database, the BIS Cross Border Banking Statistics, the BvD-Orbis data set, and Moody's Analytics BankFocus.[4] The EFIGE survey, coordinated by the Bruegel Institute and supported by the Directorate General Research of the European Commission, collects information on a representative sample of manufacturing firms with more than 10 employees in seven European countries (Austria, France, Germany, Hungary, Italy, Spain, and the United Kingdom). The survey was conducted in early 2010 and spans the period 2007-2009. To ensure statistical representativeness, the data set was designed to meet two main criteria. First, the availability of an adequately large target sample of firms: 3,000 firms for each large country (France, Germany, Italy, Spain, and the United Kingdom) and 500 firms for each small country (Austria and Hungary), for a total of almost 15,000 firms. Second, the sample was stratified to ensure representativeness of the data for every country, especially focusing on the composition by sectors, regions, and size classes. The questionnaire surveys the following broad areas: firm ownership and governance; workforce; innovation; internationalization; financial conditions and bank-firm relationships; market structure and competition. Importantly, it also includes specific questions on firms' behavior during the crisis. To all the firms, we attach balance-sheet information for the years 2005-2009 from the BvD-Amadeus database.

We match the two firm-level databases with detailed information from BankFocus on the lending banks of the firms in our sample. To hand-match the EFIGE data with the BankFocus data, we recover the names of the firms' lending banks through the BvD-Orbis database.

Appendix Table C1 describes the variables used in the analysis. Table 1 displays summary statistics. At the mean, the sample firms have been in business for 34 years. More than 60% of them have fewer than 50 employees, while about 4% have more than 500 employees. The average (median) firm size, 72 (26) employees, suggests that the firms are small and medium-sized. 70% of the businesses are family owned and 22% are part of a group. Only about 7% of our firms

4. Additional details on the sources of data are provided in the online Appendix.

are subsidiaries of multinational corporations. The majority of firms (almost 80%) are located in Germany, France, Italy and Spain, while 14% are located in the United Kingdom, 3.3% in Hungary and 3% in Austria.

3.2 Empirical model and measurement

We study whether firms' global chain participation status affects bank credit rationing. The probability that firm i is credit rationed can be written as:

$$P(CreditRationing_i = 1) = \Phi(\alpha_1 + GVC_i\beta_1 + Z_i\gamma_1) \tag{13}$$

where $CreditRationing_i$ is a binary bank credit rationing indicator; GVC_i denotes our measure of firms' global chain participation; and Z_i is a rich vector of covariates, as well as detailed fixed effects. Below we describe in detail our variables and fixed effects.

The reader will be concerned that firms' decisions to participate in global value chains are endogenous to their exposure to credit rationing. Although our specification controls for a rich set of factors that may affect rationing, including firm-level characteristics as well as detailed fixed effects, there could be concerns of reverse causality. Firms subject to more severe financing constraints may decide to participate in supply chains to obtain trade credit from suppliers (Minetti et al. 2019). And firms' internationalization can depend on their access to credit (Manova 2013). The information in the EFIGE survey partially helps us to deal with the reverse causality issue since we observe credit rationing in 2009, and global chain participation in 2008. Nonetheless, global chain participation decisions may be persistent and forward looking. Moreover, there can also be an issue of omitted variables that are correlated with firms' global chain participation and also affect credit rationing.

To address endogeneity problems, we rely on an instrumental variable approach. We estimate a bivariate probit model that comprises equation (13) and the following probit equation for firms' global chain participation:

$$P(GVC_i = 1) = \Phi(IV_i\delta_1 + Z_i\lambda_1) \tag{14}$$

where IV_i denotes our instrument (described below) and Z_i is a vector comprising all the exogenous covariates and fixed effects included in (13).[5]

5. Equations (13) and (14) constitute a recursive bivariate probit model. The effect of firms' global chain partici-

We complement the empirical model in (13)-(14) with a panel analysis that relates firms' use of bank credit to global chain participation. To this end, we exploit indicators of credit access constructed from firms' balance sheet data. While lacking precision in the measurement of liquidity constraints permitted by the credit rationing indicator, such balance sheet indicators of credit usage will allow to capture time variation in credit access. We will describe the panel model in Section 3.3.

Bank credit rationing The large majority of the firms in our sample rely heavily on bank credit for external financing: for more than 50%, financial debt consists only of bank debt, and on average only 18% of financial debt consists of corporate bonds and other forms of non-bank debt. The EFIGE survey allows us to construct a precise measure of supply-driven bank credit constraints through the direct measurement of the bank credit rationing status of the firms. In particular, the survey asks: *During the last year (2009), did the firm apply for more credit? (i) yes, applied for it and it was successful; (ii) yes, applied for it and was not successful; (iii) no, did not apply for it.* Following a broad body of studies (e.g., Angelini and Generale 2008; Minetti and Zhu 2011; Jappelli 1990; Ferri et al. 2019), our measure of bank credit rationing (*Credit Rationing*) is a dummy variable taking the value of one if the firm responded (ii) to this question, that is, if it applied for more credit without success.[6]

As shown in Table 1, 8.7% of the surveyed firms were credit rationed during the crisis. Rationed firms are on average younger, more indebted, and have lower liquidity, profitability, and productivity. Figure 2(a) plots the distribution of credit rationed firms across the 103 regions, at the NUTS-2 level, of the seven European countries in our sample and reveals that rationed firms are not clustered in few areas.[7] The incidence of rationing ranges from 12.3% in Italy and 12.5% in Spain, to 3.8% in France and 6.3% in Germany. Although Spanish and Italian firms are overall more likely to be rationed, some French and German regions have a relatively high share of rationed businesses

pation on the probability of being credit restricted can be identified under the assumption that the set of instruments IV_i are excluded from (13).

6. Similar definitions of financially constrained firms have been also adopted by Angelini and Generale (2008), who employed the Survey on Italian Manufacturing Firms (SIMF), by Minetti et al. (2019), who relied on the UniCredit Survey on small and medium-sized enterprises, and by Jappelli (1990) and Duca and Rosenthal (1993), who used the Survey on Consumer Finances.

7. The NUTS classification (Nomenclature of territorial units for statistics) is a hierarchical system for dividing up the economic territory of the European Union and the United Kingdom for the purpose of: the collection, development and harmonization of European regional statistics; socio-economic analyses of the regions; framing of EU regional policies. In our sample, we have 103 regions.

(e.g., Picardie in France and Schleswig-Holstein in Germany). A comparison of these figures with analogous figures for non-crisis periods reveals an increase of credit rationing during the crisis. For example, the average of credit rationing in Italy is higher than the average of the "strong credit rationing" measure (4.4%) observed by Minetti and Zhu (2011) for the Italian manufacturers covered by the Capitalia survey in 2000. For France, the average of credit rationing is higher than that (1.3%) measured by Kremp and Sevestre (2013) for French manufacturers for the period 2004-2006. In Figure 1, using World Bank data, we display the dynamics of credit growth in each country from 2008 to 2012. The figure shows the significant drop in credit in 2009: the average growth rate across countries was -2.7%. While the intensity of the credit crunch differed across countries, credit growth was depressed across the board (equaling -4% in the United Kingdom, -3.9% in Germany, and -0.8% in Italy).

Global value chain participation In 2008, before the onset of the global financial crisis, the participation of European firms in global chains was relatively high compared to the world average and to that in other major economies, such as the United States and China (ECB 2019). For the countries in our sample, the import content of exports amounted to 25.49% on average at the end of 2007, with the smallest countries, such as Hungary and Austria, sourcing a greater share of inputs from abroad (45.86% and 26.64%, respectively).

Based on the information in the EFIGE survey, we define firms involved in a global value chain as those that in 2008 both imported intermediate goods or services and exported intermediate or final goods (Bernard et al. 2018a; Antràs and Chor 2022). Our definition of global value chain participation is in line with the taxonomy used by World Bank (2016) and plausibly captures the most globalized businesses, that simultaneously trade with foreign firms on the buy and sell sides.[8] Our measures may thus capture a "deep" form of globalization. In our sample, 32.7% of the firms participate in global value chains. These figures are in line with those of Blaum et al. (2018) for French enterprises and Brancati et al. (2020) for Italian small and medium-sized enterprises.[9] Figure 2(b) shows that the percentage of firms participating in global supply chains is particularly high in Austria (41.3%) and the United Kingdom (39.38%). The distribution of global chain participants by

8. Observe that on the sell side (export) we cannot separate sales to firms and to final consumers. However, we will perform tests on this aspect later in the analysis.

9. For example, Brancati et al. (2020) report an incidence of global value chain participation of 29%. In our sample, the percentage of Italian firms in global value chains is 32%.

sector is shown in Figure 3: pharmaceutical, chemical, and textile industries are the most involved in global value chains. Table 1 further suggests that global value chain participants are on average larger and more productive, and more frequently belong to a business group. Pairwise correlations, reported in Appendix Table C2, do not highlight differences in the incidence of credit rationing between global supply chain participants and non-participants.

Control variables To mitigate the risk that omitted variables drive both firms' global chain participation and credit rationing, we control for a large set of possible confounding effects. As our dependent variables refer to 2009, all the balance-sheet indicators are computed as average values over the years 2007-2009.[10] First, to account for the fact that young and small firms lack transparent information about their businesses and therefore are more likely to be credit restricted (Petersen and Rajan 1994; Guiso and Minetti 2010), we include firm size (*Size*, expressed as the logarithm of the number of employees) and age (*Age*, measured as the number of years from the firm inception). Second, since the firm's financial and economic position may significantly affect bank credit availability, we insert the firm's leverage (*Leverage*, computed as total debt over total assets), profitability (*ROA*, return on assets), and productivity (*Labour Productivity*, computed as value added per employee). While a firm's leverage might increase its credit risk and the extent of financing constraints (Jensen and Meckling 1976), a firm's profitability and productivity could be positively associated with the availability of bank credit. We also account for the tangibility of the firm's assets (*Asset Tangibility*, defined as tangible fixed assets over total assets). This is plausibly a good proxy for the pledgeability of collateral by the borrowing firm, which may reduce the probability of experiencing credit constraints (Almeida and Campello 2007). In robustness tests, we further include an overall measure of the perceived quality of a firm, as given by its ISO9000 certification status (*Quality certification (ISO9000)*), and a proxy for the technological sophistication of the firm, the share of annual turnover invested in technologically advanced equipment (*Investments in ICT*).

We also account for the organizational and ownership structure of the firm. To account for the possibility that participation in business groups affects the probability of being rationed, we insert a dummy variable for the participation in a business group (*Business Group*). Moreover, in line with the studies showing that family firms tend to be less credit rationed during a crisis (D'Aurizio

10. Estimation results are robust to the inclusion of balance-sheet information taken in 2007.

et al. 2015), we include a measure of the firm's ownership structure (*Family Firm*, a dummy variable equal to one if the firm is family owned, and zero otherwise).

We saturate the empirical model with a comprehensive array of fixed effects: sector fixed effects according to the two-digit NACE classification and regional fixed effects (at the NUTS-2 level), based on the region where the firm is located. We also control for a measure of economic activity at the sector-region level, as given by the number of productive establishments in the sector-region in 2008 (*Number of establishments region/sector*). In addition, we show the results remain unchanged when controlling for a number of bank-related variables: a dummy taking a value of one if the bank is medium/large (non local) (*Medium/large bank*); an indicator taking the value of one if the bank is reported to be relatively efficient in its operations by the firm (*Relatively efficient bank*); and the number of banking relationship in which the firm engages (*Number of banks*).

We also show that all the results are robust to the inclusion of sector $\times$ region fixed effects, main destination country fixed effects and bank fixed effects, which we can construct thanks to the matching of the EFIGE data with BvD-Orbis data.[11]

Instrument To construct the instrument, we need an exogenous factor that could affect firms' decisions to participate in a global value chain. A growing literature has documented that firms' access to information technology is associated with a decrease in vertical integration and an increase in international trade. By using detailed data on 31 countries and 14 industries from 1995 to 1999, Freund and Weinhold (2002) find that internet development abroad facilitates service export to the United States. In a subsequent study, Freund and Weinhold (2004) confirm that internet stimulates international trade, by showing that a 10 percentage points increase in the growth of web hosts in a country leads to a 0.2 percentage points increase in export growth. As internet reduces market-specific entry costs, suppliers can more easily gather information about new markets and advertise to numerous buyers at once. Regarding firms' participation in global value chains, Brynjolfsson and Hitt (2000) document that access to IT is associated with a decrease in vertical integration because it lowers the costs of coordinating externally with buyers and suppliers. This result is supported

11. For a subset of the sample firms we cannot recover the lending banks from BvD-Orbis and the information about the main destination countries. While our database is cross-sectional and hence does not allow for the inclusion of firm fixed effects, it is worth recalling that firms' participation in global value chains is inherently a very persistent variable. For example, Brancati et al. (2020) show for Italy that approximately 5% of firms switch from participating to not participating in supply chains across years.

by Fort (2017), who uses data on firms' decisions to source manufacturing services from domestic or foreign suppliers and documents that a firm's adoption of communication technology between 2002 and 2007 is associated with an increase in its probability of production fragmentation. In line with these studies, the critical role of access to IT in promoting firms' participation in global value chains is also confirmed by anecdotal evidence (see, e.g., AIP-Il Sole 24 Ore 2008, for a number of case studies referring to Italian firms).

Based on these studies, we construct our instrument for firms' global supply chain participation by considering firms' reliance on IT systems specifically for managing the purchasing and sales network, interacted with a regional indicator of broadband connection diffusion. The firm-level reliance on IT is drawn from the EFIGE survey, while the regional indicator (at the NUTS-2 level) of broadband access for the year 2008 is provided by the Eurostat database on broadband infrastructures. Campante et al. (2018) demonstrate for Italy that regional access to broadband crucially depends on the position of the region in the preexisting voice telecommunications infrastructure. The relevant survey questions ask whether the firm strongly benefits from a broadband connection and, if so, whether it relies on it for: (i) internal information management; (ii) e-commerce (online purchasing/online sales); (iii) management of the sales/purchase network (suppliers' orders, customer service). Hence, our instrument for the firm's participation in a global value chain is computed as the interaction between the firm's reliance on a broadband connection specifically for the management of the sales/purchase network of suppliers and customers and the regional indicator of broadband access. Observe also that the EFIGE survey question is formulated in such a way that it captures the reliance on, rather than the current usage of, a broadband connection.[12] The instrument exhibits significant variation. The overall standard deviation equals 26.25, and the coefficient of variation (standard deviation/mean) equals 1.18.

For our instrument to be valid, it needs to be correlated with our measure of firms' participation in global value chains, whereas it must not correlate with unobservable variables that could also explain firms' credit availability. We have no reason to be concerned about the fulfillment of the exclusion restrictions. However, we will come back to this point later in Sections 4.1-4.2.

12. In further tests, we will explore the correlation between this indicator and the investment in technologically advanced equipment, finding an insignificant relationship.

3.3 Panel analysis

We carry out an alternative test using balance sheet information on firms' use of bank debt from 2005 to 2009. An advantage of this approach is that we can exploit intertemporal variation in firms' access to credit and include firm and time fixed effects. However, we lose the precision of our supply-driven measure of bank credit rationing.[13] We collected balance sheet data from BvD-Amadeus on the ratio between firms' non-current liabilities and total assets for the five years from 2005 to 2009. Non-current liabilities exclude trade credit and, given the size of the firms in our sample, are likely to capture predominantly debt exposure to banks. We treat 2009 as the crisis year and 2005-2008 as the pre-crisis period. We then estimate the following empirical model:

$$BankDebt_{it} = \beta_1 GVC_i \times CreditCrisis_t + Z_{it}\gamma_1 + \zeta_i + \theta_t + \epsilon_{it} \tag{15}$$

where $BankDebt_{it}$ is the ratio of non-current liabilities over total assets of firm i in year t; $GVC_i \times CreditCrisis_t$ is the key variable of interest, the interaction between the crisis (2009) dummy and the indicator for global chain participation; θ_t denotes the time fixed effects (dummies for each year from 2005 to 2009); ζ_i captures firm fixed effects; Z_{it} represents the vector of firm variables already included in the baseline model (13)-(14), now measured at the firm and year level; and ϵ_{it} is the error term. We use the 2008 global chain participation indicator as in the baseline model but also experiment with an indicator equal to one if the firm was a GVC participant in 2008 and it also declares that it was a regular global chain participant in previous years. We estimate the model in equation (15) both by OLS and two-stage least squares. In the IV approach, we instrument the interaction term between the crisis dummy and the global chain participation indicator with the interaction between the crisis dummy and the IT reliance variable, constructed as the interaction between firm-level reliance on IT systems for managing the purchasing and sales network and the regional indicator of broadband connection diffusion.

13. Our measure of credit rationing is taken directly from firms' responses to the survey rather than indirectly inferred from firms' financial statements.

4 Main results

In Section 4.1 we present the baseline findings for the empirical model in equations (13)-(14) and discuss preliminary insights on the underlying mechanisms, while in Section 4.2 we elaborate on the identification strategy. Section 4.3 addresses measurement issues and the relevance of the effects. In Section 4.4, we present results from the panel model in equation (15).

4.1 Baseline findings

Tables 2-4 report the baseline estimates of the bivariate probit model (13)-(14) for the impact of participation in a global value chain on bank credit rationing. As noted, we treat firms' global chain participation status as endogenous and use as an instrument the indicator of IT access detailed above. In all the regressions, standard errors are heteroskedasticity robust, clustered at the region level.[14]

We detect a negative and statistically significant effect of GVC participation on credit rationing (Table 2, column 1). The estimate of the marginal effect (reported in Table 3) for the variable *Global chain participant* is -0.023, implying that a firm involved in a GVC is 2.3 percentage points less likely to be credit rationed than a firm that does not participate in a global supply chain. This impact is sizeable, amounting to about 25% of the average probability of rationing (8.7%) in the sample in 2009. As discussed in Section 2, we interpret this result as suggesting that banks tend to protect firms in global value chains from tight credit conditions. We will later perform tests on the mechanisms that can motivate such a behavior of banks.[15]

The instrument appears to be reassuringly strong. The bottom of column 1 (Panel A) reports the estimated coefficient on the instrument from the probit equation of GVC participation.[16] We find that the higher the IT access of a firm, the higher the probability that the firm participates in a global value chain. The Kleibergen-Paap Wald F-statistic from a linear first stage suggests that we do not face a weak instrument issue (the value of the F-statistic is 10.85, above the conventional threshold for weak instruments indicated by Stock and Yogo 2005).[17]

14. The results are robust to clustering at the industry level.

15. The estimated coefficients for the firm level controls are in line with expectations. More indebted firms are more likely to be rationed by banks. In contrast, more profitable businesses feature a lower probability of experiencing credit constraints. Somewhat more surprisingly, firm size appears to be positively associated with credit rationing.

16. To save space, the first-stage coefficients on firm controls and on region and industry dummies are not reported.

17. The literature on weak instruments is less developed with regard to diagnostics for nonlinear IV models (see,

The estimated effects carry through when, in column 2 of Table 2, we exclude from our definition of global chain participation the small subset of firms that import exclusively raw materials from abroad. In column 3, we further redefine our global chain participant indicator so as to exclude importers of raw materials and include firms that do not import intermediates but that declare to sell intermediate goods abroad through subcontracting. The results remain virtually unchanged.[18][19]

In column 4, we insert additional proxies for the quality of the firms (the availability of an ISO9000 certification) and for their technological sophistication (the investment in technologically advanced equipment). This can help reduce the concern that our instrument is capturing the firm's sophistication.[20] In column 5, we also control for bank-related characteristics: the number of banking relationships, a dummy taking a value of one if the bank is medium/large (non local), and an indicator taking the value of one if the bank is reported to be relatively efficient in its operations by the firm. In column 6, we show that the results hold when further including a proxy for the level of local economic development, the number of productive establishments in the region and sector in 2008. The inclusion of this control can also assuage possible concerns that our instrument is picking up the level of economic development in the region-sector.

In Panel B of Table 2, column 1, to further control for region-sector explanatory factors, we include sector-by-region fixed effects, reaching conclusions very similar to the baseline. Another concern could be that the banking related variables discussed above do not exhaustively control for the characteristics of the banks. In particular, firms that participate in global value chains might match with banks that have intrinsically lower propensity to ration credit. We then re-estimate our baseline regression by also including bank fixed effects (column 2, Panel B of Table 2). Therefore, the estimates now capture within-bank variation of the credit rationing of firms with different global chain participation status. The results remain virtually unchanged.

e.g., Mikusheva 2013, for a survey). Thus, the often used cutoff values for the first-stage F-statistics are derived using a linear model. Moreover, the cut-off values for the Kleibergen-Paap Wald F-statistic are computed under the assumption that the error terms are homoskedastic (Stock and Yogo 2005).

18. As noted, given the nature of our data, we cannot precisely disentangle firms that export intermediate goods without being at the same time importers of intermediates. Since such businesses are part of global chains but end up being a portion (perhaps relatively small) of our control group, we suspect that, if anything, this could lead us to underestimate the effect of global chain participation. Nonetheless, in column 3 we perform robustness tests by capturing this subset of global chain participants using EFIGE survey information on subcontracting.

19. To exclude the possibility that our results are driven by the largest firms, in Appendix Table C3 column 1, we exclude large firms (according to the EU definition) from the sample. The baseline results carry through. We also experimented excluding subsidiaries of foreign owned firms, with results virtually unchanged.

20. We detect a slightly negative effect of the economic activity in the sector-region on the probability of firm rationing, while the effect of the ISO9000 proxy for firm sophistication is estimated with low degree of precision.

One could also wonder whether the conditions in the foreign destination country of a firm could impact on the rationing decisions of the firm's banks and also correlate with the firm's participation in a global chain. For instance, if an Italian firm engages in chain linkages with French counterparts, and France experiences better prospects than Italy, Italian lending banks could protect this firm. In turn, conditions in France could also correlate with the Italian firm's decision to participate in global chains. In column 3 of Panel B of Table 2, we re-estimate our model by adding main destination country fixed effects (at the cost of a loss of observations). The results carry through.

4.2 More on the identification strategy

Exclusion restrictions We have no reason to expect that our instrument influences the probability of credit rationing through channels alternative to firms' global chain participation. Further, the instrument is constructed based on a detailed question to the surveyed firms about their reasons for relying on IT, beyond standard e-mail management. By construction, this excludes IT for financial purposes. Nonetheless, in Table 4 we verify that firms' access to broadband connections is unlikely to drive bank credit availability.

In our sample, firms are asked whether one of the reasons why they rely on their main bank is that the bank is an efficient user of internet. Only little more than 15% of the survey respondents declare that this is one of the reasons. Another element that validates this point is that the large majority of firms in our sample are small and medium-sized and tend to rely on personal lending relationships with loan officers rather than impersonal contacts with financial institutions. Based on this argument, we next study whether the estimated effects differ depending on the characteristics of the lending technology used by the main bank, that is, the length of the credit relationship with the firm and the type of information typically used by the bank in its lending relationships (Panel A of Table 4). In column 1, we consider the number of years that a firm has been operating with its current main bank. Our baseline results are confirmed when focusing on global chain participants with a lending relationship longer than 5 years. It thus appears that banks' propensity to protect global chain participants from credit rationing is confirmed for firms more likely to engage in personal relationships with their loan officers. Importantly, these are the businesses for which the type of lending technology of the bank (personal repeated interactions with the borrowing firm over the course of several years) plausibly makes firms' access to internet irrelevant for the availability

of bank credit.[21]

In column 2 of Panel A of Table 4 we restrict attention to the firms that declare that typically most of the information acquisition of loan officers occurs through personal interviews and meetings with the firm's management. Again, the estimates show that personally interviewed firms that participate in a global value chain are characterized by a lower probability of experiencing credit rationing. In addition, in column 3, we also restrict attention to the firms that declare that their lending banks do not focus their information acquisition on collateral guarantees.

To conclude this robustness analysis, we refer to information provided by the aforementioned Capitalia survey of Italian manufacturing firms, which roughly covers the Italian subsample of the EFIGE survey. In the Capitalia survey, firms declare that they visit their loan officer every 15 days and more than 50% of the firms visit loan officers every 5 days. In addition, the average firm is located only 4 kilometers from the bank branch. This points to the significant relevance of personal interactions, and a negligible relevance of internet access, for banks' decisions regarding credit extension.

Matched sample In Panel B of Table 4, we run our baseline regression of column 1, Table 2, on a matched sample of businesses, considering the participation in global value chains as a treatment. To this end, we partitioned the sample into two groups: firms engaged in a global value chain and firms with no involvement in a global chain. We then performed a matching procedure to ensure the comparability of the two subsamples, aiming to maximize similarity regarding variables that might be correlated with the likelihood of credit rationing. Specifically, we used a probit model, wherein the dependent variable is our measure of global value chain participation. This probit regression incorporates all the firm-specific controls included in our baseline estimation. In addition, it requires a tolerance level for the maximum propensity score distance (caliper) between the treatment and control groups to be equal to 0.0001 (Fang et al. 2014). The results, presented in column 4, confirm the lower likelihood of credit rationing for firms that participate in a global value chain.

21. As shown in Appendix Table C4, the results of column 1 are fully robust to interacting the global chain indicator with the dummy for relationship lending (instead of partitioning the sample) and instrumenting both the global chain indicator and the relationship lending dummy. In particular, to instrument the relationship lending dummy, we restrict attention to the subsample of Italian businesses and employ as instruments the indicators of the 1936 Italian banking regulation (see, e.g., Guiso et al. 2004, and the Appendix B for more details on these instruments).

4.3 Heterogeneity by firm and supply chain characteristics

Firm characteristics Investigating for what segments of firms our results are stronger can help understand whether the effects bite especially for the businesses more vulnerable to bank credit rationing and, hence, are indeed relevant. We investigate this point in Appendix Table C5. Age is generally considered a proxy for vulnerability to credit constraints, as young firms typically have fewer sources of financing and are informationally opaque in financial markets. The estimates in columns 1-2 suggest that the participation in global value chains especially mitigates the probability of experiencing credit rationing for younger firms (below the median age).

The EFIGE survey also provides direct, self-reported measures of firms' reliance on external finance. In columns 3-4, we re-estimate our baseline regressions subdividing the sample according to whether a firm declares to rely highly on external financing or not. The estimates suggest that the effects are more significant for firms more dependent on external funding (column 3). In columns 5-6, we also find that the effects are stronger for firms that declare that typically their external debt consists entirely of bank debt. Overall, the findings in Appendix Table C5 point to a relevance of the effects for businesses more likely to be vulnerable to bank credit denial (e.g., more reliant on external finance and, among source of external financing, more reliant on bank funding).[22]

Characteristics of supply chain participation Next, we exploit heterogeneity in terms of supply chain characteristics to gain insights into the impact of GVC participation on credit rationing. In Panel A of Table 5, we find that both the global chain participants that import services and those that import intermediate goods have a lower probability of experiencing credit rationing (column 1 carries over the coefficients of the baseline regression of Table 2). In Panel B of Table 5, we separate upstream from downstream firms.[23] The results suggest that firms participating in global chains are less likely to experience credit restrictions, regardless of their position in the chain.

In Panel C of Table 5, we test whether the effects depend on the intensity of inter-firm linkages along the chain. We first rely on information on the volume of foreign trade declared by the sample firms.[24] The estimates suggest that the effect of global chain participation is larger for global chain

22. By construction, the binary measure of credit rationing does not capture the intensity of constraints. By splitting the sample according to financial dependence, we can also capture the possible intensity of the effects of rationing.

23. Observe that in our setting we define relatively upstream firms as those that both import and export intermediate goods, where the export of intermediate goods is captured by the aforementioned subcontracting variables.

24. Observe, however, that we cannot separate the volume of trade in final goods from that of trade in intermediates.

participants engaging in a larger volume of foreign trades (Panel C, columns 6-7). We supplement this test by considering sector-country information from Eurostat on the relevance of purchases of intermediates by two-digit sectors and countries (a frequently used proxy for the density of supply chain networks in sectoral studies on value chains). We normalize this measure by the total output of the firm's industry.[25] The estimates suggest that the effect of global chain participation is larger in sectors characterized by stronger production fragmentation, that is, with a relative value of intermediates above the median (Panel C, columns 8-9).

4.4 Panel results

We complement the baseline analysis using the panel model in (15). Panel A of Table 6 reports summary statistics for the growth rates of the ratio between non-current liabilities and total assets before the crisis and during the crisis. We observe a reduction in the credit extended to firms during the crisis. On average, firms' assets also shrank, implying that the ratio actually grew during the crisis, although less than before the crisis.

Panel B of Table 6 displays the panel regression results.[26] We find a significantly positive effect of the interaction term $GVC_i \times Crisis_t$, which suggests that during the crisis firms in global chains had better access to credit than their counterparts not in global chains. Consistent with what found in Table 2 for the baseline model, the results hold across the various measures of global chain participation, and also carry through when we focus on regular global chain participants. It is also reassuring that the IV estimations confirm the OLS estimates.[27]

In Appendix Table C3, we conduct robustness tests. Using survey information, we further refine the measurement of the non-current liabilities ratio, by taking its product with the self-reported share of long-term bank debt over total non-current liabilities. Moreover, we drop the firms with positive or non-negligible medium-long term bonds, obtaining results similar to those of Table 6.

25. As a robustness, we also experimented with scaling by the total import content of export of the country.
26. Figure 4 shows the point estimates and confidence intervals of the regression for the years before and during the crisis. The estimates show parallel trends in debt dynamics before the crisis.
27. The values of the F-statistics confirm the validity of our instruments.

5 Mechanisms

We envisage two main mechanisms that could drive the effect of firms' global engagement on bank credit rationing. First, banks could view participation in a global chain as a signal of promising prospects of their clients, and therefore be especially willing to protect global chain participants ("client-protection"). Second, banks could internalize the negative consequences of their credit denial on their own activities abroad ("spillover-avoidance"). In Tables 7-9, we investigate these two mechanisms. We highlight that we do not view these mechanisms as alternative to each other, but as possible complementary forces driving our findings.

In Table 7, we study the "client-protection" mechanism by exploiting information on the profitability of firms' activities in global chains. Firms' participation in global value chains increasingly affects banks' assessment of borrowers' prospects (Cabigiosu and Proto 2015). Banks have started to expand their focus from the individual borrower to its entire supply chain (Rotondi 2013). Supply-chain ratings are built on information on the amount and frequency of transactions, payment terms, and financial instruments employed along the value chain. For a sample of software start-ups, Raz and Gloor (2007) find that firms with larger informal business networks have higher chances to survive external shocks. Similarly, by using a data set of new ventures in the open source software industry, Stam and Elfring (2008) demonstrate that firms' networks positively affect firms' performance. These studies highlight the positive effects of firms' business networks on firms' future performance, which in turn could influence bank lending decisions.

To the extent that global chain participation is a positive signal of borrowers' prospects, we would then expect our results to be stronger when global chain participation leads to profit-enhancing activities. In Panel A of Table 7, we disentangle the participants in global chains that declare to carry out investments aimed at expanding the firm's global network. Our results are confirmed for the subsample of businesses engaging in such activities while they tend to lose significance for less sophisticated global chain participation. This could suggest that banks especially insulate from credit rationing those firms that have a proactive global chain participation.

The results in Panel A are confirmed when we capture profit-enhancing global chain participation by looking at global chain investments in brand recognition and quality. In Panel B, we find that our baseline results are stronger for firms participating in global chains that engage in such profit-

enhancing investments.

5.1 Spillover effects

Banks may anticipate that, by providing liquidity to domestic borrowers operating in a foreign country, they can limit costly defaults on outstanding loans, preserving their own business in that country.[28] The literature has shown that banks account for spillover effects in their lending decisions. Studying US local housing markets during the 2007-2010 housing crisis, Favara and Giannetti (2017) find that lenders with a high share of collateralized debt in their portfolios internalize the negative effects of liquidation decisions on collateral values and renegotiate their debt to avoid price-default spirals. Giannetti and Saidi (2019) indicate that lenders with a high market share in an industry grant disproportionately more credit than other banks to firms in that industry during periods of distress in comparison to normal times.

Using data from the BIS Cross Border Banking Statistics, Figure 5 illustrates the international diffusion (allocation of foreign asset portfolios) of the banks of six of our sample countries. Spanish and Italian banks have the largest involvement in EU 15 countries,[29] while Austrian banks are especially exposed to non-EU 15 European countries. UK banks are particularly active across the Atlantic, for example, in the United States. Besides their lending activities abroad, internationally active banks could also internalize the consequences of credit decisions for their foreign consulting activities to global chains. Firms' involvement in global value chains has fostered the consultancy services offered by banks to internationally active firms. The French banking group BNP Paribas has opened new branches in China and India to assist companies that want to expand their activities in those regions. Deutsche Bank and Credit Agricole have developed innovative technologies to improve the performance of their borrowers' supply chains (Rotondi 2013). Using BankFocus data, Figure 6a plots for each world country the average share of the subsidiaries of the banks in our sample normalized by the banks' subsidiaries worldwide. A darker color signals that the country has on average a higher importance (in terms of bank affiliates' presence) for the multinational banks in our sample. For example, EU countries, North America, major Latin America countries

28. Banks operating in foreign markets may also have an information advantage and be better positioned to overcome information asymmetries. In the analysis, we will try to disentangle the role of banks' knowledge.

29. Since the approval of the Second Banking Directive and the Single Banking License in 1989, cross-border financial flows have grown considerably in Europe, and the banking sector has consolidated through a wave of cross-border mergers and acquisitions (Allen 2011).

and fast-growing Asian countries (e.g., China and India) have the largest importance for the banks.

In Tables 8 and 9, we test the "spillover-avoidance" mechanism, that is, the hypothesis that banks protect global chain participants because they internalize the consequences that a denial of credit could have on their own foreign business.

Preliminary evidence To gain preliminary insights on the spillover mechanism, in Panel A of Table 8 we distinguish between firms borrowing from banks with a local scope (domestic local banks or domestic national banks without an international network) and firms borrowing from banks with a global scope (domestic national banks with an international network or foreign banks).[30] The estimates suggest that the participation in global value chains mitigates the probability of experiencing credit constraints for both subgroups. However, the effects are significantly more pronounced in the case of banks with an international scope, plausibly the banks that are more concerned about international spillovers of their credit decision to global chain participants.

A second piece of preliminary evidence comes from investigating the geographic location of the firm's commercial partners. In Panel B of Table 8, we classify firms based on whether they import or export their products and services in three main geographical areas: Europe, Asia and the Americas. The estimates in column 4 indicate that global chain participants with partners located in Europe are less likely to experience credit rationing, while global chain participants doing business with customers and suppliers located in Asia (mainly India and China) are more exposed to bank credit rationing (column 5).[31] As explained below, this can point to a tendency of banks to especially protect firms whose global chains span European markets, in which banks themselves have a larger presence (see again Figure 5).

The "spillover" channel In Table 9, we test the spillover mechanism using matched bank-firm data. We have information from EFIGE on the countries in which firms' supply chain partners are located.[32] We identify the lending banks of a firm by exploiting information from the BvD-Orbis database regarding the names of the banks with which our sample firms do business.[33] We then

30. To classify our sample firms, we rely on two questions of the EFIGE survey: *What type of bank/credit institution does the firm use? (i) domestic local banks; (ii) domestic national banks; (iii) foreign banks.*; *Which factors are key in the choice of a main bank? ...; (v) the bank has an extensive international network; ...* .

31. In the first stage we insert the instrument interacted with the destination market.

32. EFIGE reports the three main foreign countries where the firm does business.

33. In conducting this test, we suffer a loss of observations due to data availability.

use Moody's Analytics BankFocus to obtain details on banks' international presence (subsidiaries per country). To measure the relative importance of a firm i's foreign trade countries for its main bank, we construct a measure of the bank's country specialization:

$$BankCountrySpecialization_i = \sum_{c=1}^{3} \frac{BankCountrySubsidiaries_{c,i}}{BankTotalSubsidiaries_i} \tag{16}$$

where $BankCountrySubsidiaries_{c,i}$ is the number of subsidiaries of firm i's main bank in each of the three main origin/destination countries (c) of the firm's foreign trade; and $BankTotalSubsidiaries_i$ is the total number of subsidiaries of firm i's main bank. For example, for a French firm in our sample with supply chain partners in China, United States, and Brazil, and BNP Paribas as its main bank, the value of the *BankCountrySpecialization* indicator is 8.47%. This is calculated as the sum of BNP Paribas' subsidiaries in the three countries (22, 130, and 12, respectively) divided by the total number of Paribas's subsidiaries worldwide (1934). An analogous computation for a second client of BNP Paribas with supply chain partners in Saudi Arabia, United Arab Emirates and Togo yields a value of the indicator of 0.2%. This measure of bank specialization in firms' foreign trade countries is similar to the measure of bank sectoral specialization in Ongena et al. (2018).

In Panel A of Table 9, we re-estimate the baseline regression of Table 2 after accounting for banks' specialization in the countries where firms have global chain linkages. Specifically, we distinguish between global chain participants with *BankCountrySpecialization* equal to 0, participants with *BankCountrySpecialization* between 0 and 4% (the median value of the indicator, conditional on this being positive), and participants with *BankCountrySpecialization* greater than 4%. We then re-estimate the model in (13)-(14) separately for each subgroup. The results provide evidence that the attenuating effect of global chain participation on bank credit rationing manifests itself especially when the firm's main bank is specialized in the countries where the firm has chain links.

The test in Panel A captures the spillover mechanism by looking at the specialization of the firms' main banks in the countries where the firms trade. However, one could argue that a bank will be more inclined to protect its clients operating in a foreign country not only when the country is more important for the bank, but also when the bank itself is more important for the country. Put differently, the concern about the spillover effects of credit rationing could be stronger when the bank has a large share in the financing of global chains in the country. For each country in the

world, Figure 6b plots the average share of the subsidiaries of the banks in our sample (normalized by the banks' subsidiaries worldwide) weighted by the share of clients of the banks that engage in supply chains in that country (relative to the number of sample firms that engage in supply chains in the country). A darker colour signals that the banks in our sample are important for that country and, in turn, that country is important for the banks. Comparing Figure 6b with Figure 6a, we observe that major Asian countries, such as Russia and India, lose relevance when we account for firms' trade links. In contrast, a number of Latin American countries (for example, Peru and Colombia) acquire more relevance.

To capture the relative importance of a firm i's main bank for the global chains in a foreign country where the firm has chain links, we construct the following proxy:

$$BankCountryRelevance_i = \sum_{c=1}^{3} \frac{GlobalChainParticipants_{c,i}}{GlobalChainParticipants_c} \tag{17}$$

where $GlobalChainParticipants_{c,i}$ captures the number of global chain participants in our sample that are clients of the main bank of firm i and export/import in the three main countries c of the firm's trade; and $GlobalChainParticipants_c$ is the number of global chain participants in our sample that export/import in that country. For example, for the first of the two firms mentioned in the example above, the value of $BankCountryRelevance$ is 9.09%. This is calculated as the sum of the number of clients of BNP Paribas in our sample involved in supply chains in China, the United States and Brazil (10, 28, and 6, respectively), divided by the total number of global supply chain participants in our sample that export or import from those countries (495, 1155, and 129, respectively). This proxy for bank country relevance is similar to the measure of bank sectoral concentration proposed by Giannetti and Saidi (2019). The correlation of the proxy of bank relevance in (16) with the proxy of bank specialization in (17) is positive but low (0.077), indicating that these two measures capture related but distinct aspects.

In Panel B of Table 9, we re-estimate the baseline regression of Table 2 after accounting for banks' country relevance, as measured by (17). Specifically, we distinguish between global chain participants with $BankCountryRelevance$ between 0 and 16.5% (the median value of the indicator, conditional on this being positive), and participants with $BankCountryRelevance$ greater than 16.5%. We then re-estimate the model in (13)-(14) separately for each subgroup. The attenuating

effect of global chain participation on bank credit rationing is stronger when the firms' main banks have a relatively strong importance for the supply chains operating in the firms' foreign trade countries. In Appendix Table C6, we also account for the bank physical presence in a country by interacting the measure in (17) with a dummy taking the value of one when the bank has affiliates in the country, zero otherwise. The results carry through.

Finally, to capture the possible spillovers associated with bank lending decisions, we also rerun the regression in column 5 (*BankCountryRelevance* greater than 16.5%) by considering the size of firms' foreign trade. The larger the foreign trade of a client, the greater the repercussions credit denial could have in a foreign market. The results, reported in columns 6 and 7, show that the attenuating effect of global chain participation on bank credit rationing manifests itself for firms with larger foreign trade volumes.

5.2 Is it bank knowledge?

The reader could wonder whether the findings in Tables 8 and 9 mostly reflect banks' superior knowledge about internationally traded products rather than banks' interest in preserving their own activities abroad. Our results show that internationally active firms are significantly less exposed to bank rationing than domestically oriented ones. For this finding to be driven by banks' knowledge, one should conjecture that such knowledge is stronger for international activities than for domestically oriented activities. We view this as unlikely, at least for a substantial portion of the banks in our sample.[34]

In Table 10 Panel A, we consider the nature of internationally traded products. Bank knowledge could be more relevant for goods that are not well known either because they are not sold in the domestic market or because they are inherently informationally opaque. In columns 1-2, we use the indicators of product information complexity constructed by Nunn (2007) (the conservative and non-conservative sectoral fraction of inputs not sold on exchange). When we restrict our attention to products that are informationally transparent, the results continue to hold. This suggests that banks' knowledge is not the primary driver of our findings. In column 3, we restrict attention to export products that are also sold domestically.[35] Again, we continue to estimate an attenuating

34. If we rerun the regressions of Table 9 Panel A by dropping firms whose main bank is foreign (e.g., French firms whose main bank is Italian), the results are virtually unchanged.

35. The EFIGE survey specifically asks: *The main product line you sell to foreign markets... (i) is also the main*

effect of GVC participation on bank rationing.

Panel B exploits an alternative proxy for banks' knowledge of products. We compute the number of sectoral peers of a firm with which the lending bank does business and normalize it by the total number of clients of the bank (De Jonghe et al. 2020; Paravisini et al. 2023). We then rerun the baseline regression by distinguishing between banks with high and low specialization in the sector of the firm (columns 4-5). In contrast with the bank knowledge hypothesis, the result remains significant only for the subsample of banks with low specialization in the firm's sector. This result is even more striking when compared with that shown in columns 6-7 of Panel B. In those columns, we see that the negative effect of global chain participation is stronger when banks have high specialization in the sector contiguous to that of the firm (that is, the sector with the highest volume of gross trade, according to the Eurostat input-output tables). The latter finding may suggest that banks are especially concerned about the business of the commercial partners (customers or suppliers) of its client firms (spillover mechanism).

In conclusion, the results in Table 10 indicate that banks' protection of global chain participants can mostly reflect the interest of banks to preserve their business abroad rather than banks' knowledge of internationally traded products.

6 Some implications for lending contractions

We examine the implications of our results for the effects of bank lending contractions such as that occurred during the Great Financial Crisis. Recall that in the model of Section 2 the effect of a negative bank's net-worth shock on foreign and domestic sales is given by:

$$\frac{\partial Y_D}{\partial NW} = \frac{A}{\psi} f'(L_D) \frac{\omega}{1+\omega}; \frac{\partial Y_G}{\partial NW} = \frac{A}{\psi} \theta f'(L_D) \frac{1}{1+\omega} \tag{18}$$

where Y_D and Y_G are the total volumes of operations of domestically oriented and globally active firms, respectively; A denotes firms' TFP; ψ is banks' capital requirement; $f'(L_D)$ and $\theta f'(L_D)$ denote the responses of the input demand of domestically oriented and globally active firms to

product line in your domestic market; (ii) is also sold in your domestic market but is not the main product line; (iii) is not sold in your domestic market.

changes in external bank financing, respectively. Therefore,

$$\underbrace{\frac{\partial Y_G}{\partial NW} / \frac{\partial Y_D}{\partial NW}}_{\approx 1.6} = \underbrace{\theta}_{\approx 2 \text{ (see, Table 11)}} \times \underbrace{\frac{1}{\omega}}_{\approx 0.8 \text{ (this paper)}} . \tag{19}$$

In the back-of-the-envelop calculation in (19), to gauge θ, we use the firm-level estimates in Minetti and Zhu (2011). According to their results (see Table 11), the reduction in foreign activities due to credit constraints is around twice as large as the reduction in domestic activities. This estimate is also broadly in line with the aggregate evidence of Alessandria et al. (2010) and Levchenko et al. (2010) (see again Table 11). Using a value of $\theta \approx 2$, in conjunction with a value of $\omega \simeq 1.25$ inferred from the estimates in Tables 2-3 and the summary statistics in Table 1, suggests that a bank lending contraction could reduce the foreign sales of global chain participants by approximately 60% more than the sales of domestically oriented firms. Put differently, the mitigating effect of supply chain participation uncovered in our analysis could imply a (relatively) smaller drop of import-export up to 40%.

7 Conclusions

This paper has studied the influence of firms' globalization on credit allocation. We have found that during the credit crunch induced by the Great Financial Crisis banks especially protected firms with a participation in global supply chains. The results also reveal that two mechanisms contribute to these findings. First, banks view global chain participation as a signal of future positive prospects of their clients. Second, banks protect global supply chain participants with the goal of minimizing negative spillovers on their own lending and consulting activities abroad. This second hypothesis confirms recent results that banks are sophisticated credit providers, that account for the broader consequences of their lending decisions (Giannetti and Saidi 2019).

The results raise relevant policy questions. In recent years, an intense debate has developed on the extent to which internationalized economies could be more or less resilient to financial crises. Our findings unveil an alternative mechanism through which a globally interconnected business sector may be more resilient to a credit crisis, based on banks' credit allocation decisions. From the viewpoint of policy makers, promoting firms' participation in global chains could then turn out to

be desirable not only in a long-run perspective of firms' growth, but also in a cyclical perspective, in order to better insulate the economy from the consequences of a credit crisis.

References

AIP-Il Sole 24 Ore. 2008. "Reti di imprese oltre i distretti: nuove forme di organizzazione produttiva, di coordinamento e di assetto giuridico."

Alessandria, G., J. Kaboski, and V. Midrigan. 2010. "The Collapse of International Trade: An Inventory Adjustment?" *IMF Economic Review* 58:254–294.

Allen, F. 2011. *Cross-border banking in Europe: implications for financial stability and macroeconomic policies.* CEPR.

Almeida, H., and M. Campello. 2007. "Financial constraints, asset tangibility, and corporate investment." *The Review of Financial Studies* 20 (5): 1429–1460.

Altomonte, C., and T. Aquilante. 2012. *The EU-EFIGE/Bruegel-unicredit dataset.* Technical report. Bruegel working paper.

Amiti, M., and D. E. Weinstein. 2011. "Exports and financial shocks." *The Quarterly Journal of Economics* 126 (4): 1841–1877.

Angelini, P., and A. Generale. 2008. "On the evolution of firm size distributions." *American Economic Review* 98 (1): 426–438.

Antràs, P., and D. Chor. 2022. "Global value chains." *Handbook of International Economics* 5:297–376.

Baldwin, R., and P. Krugman. 1989. "Persistent trade effects of large exchange rate shocks." *The Quarterly Journal of Economics* 104 (4): 635–654.

Bernard, A. B., J. B. Jensen, S. J. Redding, and P. K. Schott. 2018a. "Global firms." *Journal of Economic Literature* 56 (2): 565–619.

Bernard, A. B., A. Moxnes, and Y. U. Saito. 2019. "Production networks, geography, and firm performance." *Journal of Political Economy* 127 (2): 639–688.

Bernard, A. B., A. Moxnes, and K. H. Ulltveit-Moe. 2018b. "Two-sided heterogeneity and trade." *Review of Economics and Statistics* 100 (3): 424–439.

Biais, B., and C. Gollier. 1997. "Trade credit and credit rationing." *The Review of Financial Studies* 10 (4): 903–937.

Blaum, J., C. Lelarge, and M. Peters. 2018. "The gains from input trade with heterogeneous importers." *American Economic Journal: Macroeconomics* 10 (4): 77–127.

Boot, A. W. A., and A. V. Thakor. 2000. "Can relationship banking survive competition?" *The Journal of Finance* 55 (2): 679–713.

Bosi, G., and M. Degasperi. 2007. "Le reti di imprese nel distretto orafo di Vicenza." In *Reti di imprese tra crescita e innovazione organizzativa,* 181–231. Il Mulino.

Brancati, E., R. Minetti, and S. C. Zhu. 2020. "Finance and Innovation in the Production Network." *Michigan State University, Department of Economics.*

Brynjolfsson, E., and L. M. Hitt. 2000. "Beyond computation: Information technology, organizational transformation and business performance." *Journal of Economic Perspectives* 14 (4): 23–48.

Cabigiosu, A., and A. Proto. 2015. "Le reti di imprese: accesso al credito e misurazione delle performance." *Bancaria* 2:70–83.

Campante, F., R. Durante, and F. Sobbrio. 2018. "Politics 2.0: The multifaceted effect of broadband internet on political participation." *Journal of the European Economic Association* 16 (4): 1094–1136.

D'Aurizio, L., T. Oliviero, and L. Romano. 2015. "Family firms, soft information and bank lending in a financial crisis." *Journal of Corporate Finance* 33:279–292.

De Haas, R., and N. Van Horen. 2013. "Running for the exit? International bank lending during a financial crisis." *The Review of Financial Studies* 26 (1): 244–285.

De Jonghe, O., H. Dewachter, K. Mulier, S. Ongena, and G. Schepens. 2020. "Some borrowers are more equal than others: Bank funding shocks and credit reallocation." *Review of Finance* 24 (1): 1–43.

Degasperi, M., D. De Luca, and A. Zorzi. 2007. "Le reti di imprese nel settore vitivinicolo veronese." In *Reti di imprese tra crescita e innovazione organizzativa: riflessioni da una ricerca sul campo,* 133–180. Il Mulino.

Do, Q. T., and A. A. Levchenko. 2007. "Comparative advantage, demand for external finance, and financial development." *Journal of Financial Economics* 86 (3): 796–834.

Duca, J. V., and S. S. Rosenthal. 1993. "Borrowing constraints, household debt, and racial discrimination in loan markets." *Journal of Financial Intermediation* 3 (1): 77–103.

Duijm, P., and D. Schoenmaker. 2021. "European banks straddling borders: Risky or rewarding?" *Finance Research Letters* 38:101525.

ECB. 2019. *The impact of global value chains on the euro area economy.* Technical report. European Central Bank.

Fang, V. W., X. Tian, and S. Tice. 2014. "Does stock liquidity enhance or impede firm innovation?" *The Journal of Finance* 69 (5): 2085–2125.

Favara, G., and M. Giannetti. 2017. "Forced asset sales and the concentration of outstanding debt: Evidence from the mortgage market." *The Journal of Finance* 72 (3): 1081–1118.

Ferri, G., R. Minetti, and P. Murro. 2019. "Credit Relationships in the great trade collapse. Micro evidence from Europe." *Journal of Financial Intermediation* 40:100809.

Fort, T. C. 2017. "Technology and production fragmentation: Domestic versus foreign sourcing." *The Review of Economic Studies* 84 (2): 650–687.

Freund, C., and D. Weinhold. 2002. "The Internet and international trade in services." *American Economic Review* 92 (2): 236–240.

Freund, C. L., and D. Weinhold. 2004. "The effect of the Internet on international trade." *Journal of International Economics* 62 (1): 171–189.

Giannetti, M., and L. Laeven. 2012. "The flight home effect: Evidence from the syndicated loan market during financial crises." *Journal of Financial Economics* 104 (1): 23–43.

Giannetti, M., and F. Saidi. 2019. "Shock propagation and banking structure." *The Review of Financial Studies* 32 (7): 2499–2540.

Guiso, L., and R. Minetti. 2010. "The structure of multiple credit relationships: Evidence from US firms." *Journal of Money, Credit and Banking* 42 (6): 1037–1071.

Guiso, L., P. Sapienza, and L. Zingales. 2004. "Does local financial development matter?" *The Quarterly Journal of Economics* 119 (3): 929–969.

Hauswald, R., and R. Marquez. 2006. "Competition and strategic information acquisition in credit markets." *The Review of Financial Studies* 19 (3): 967–1000.

Herrera, A. M., and R. Minetti. 2007. "Informed finance and technological change: Evidence from credit relationships." *Journal of Financial Economics* 83 (1): 223–269.

Jappelli, T. 1990. "Who is credit constrained in the US economy?" *The Quarterly Journal of Economics* 105 (1): 219–234.

Jensen, M. C., and W. H. Meckling. 1976. "Theory of the firm: Managerial behavior, agency costs and ownership structure." *Journal of Financial Economics* 3 (4): 305–360.

Kremp, E., and P. Sevestre. 2013. "Did the crisis induce credit rationing for French SMEs?" *Journal of Banking & Finance* 37 (10): 3757–3772.

Leibovici, F. 2021. "Financial development and international trade." *Journal of Political Economy* 129 (12): 3405–3446.

Levchenko, A. A., L. T. Lewis, and L. L Tesar. 2010. "The Collapse of International Trade during the 2008–09 Crisis: In Search of the Smoking Gun." *IMF Economic Review* 58 (2): 214–253.

Manova, K. 2013. "Credit constraints, heterogeneous firms, and international trade." *The Review of Economic Studies* 80 (2): 711–744.

Manova, K., S. Wei, and Z. Zhang. 2015. "Firm exports and multinational activity under credit constraints." *Review of Economics and Statistics* 97 (3): 574–588.

McMillan, J., and C. Woodruff. 1999. "Interfirm relationships and informal credit in Vietnam." *The Quarterly Journal of Economics* 114 (4): 1285–1320.

Mikusheva, A. 2013. "Survey on statistical inferences in weakly-identified instrumental variable models." *Applied Econometrics* 29 (1): 117–131.

Minetti, R., P. Murro, Z. Rotondi, and S. C. Zhu. 2019. "Financial constraints, firms' supply chains, and internationalization." *Journal of the European Economic Association* 17 (2): 327–375.

Minetti, R., and S. Zhu. 2011. "Credit constraints and firm export: Microeconomic evidence from Italy." *Journal of International Economics* 83 (2): 109–125.

Nunn, N. 2007. "Relationship-specificity, incomplete contracts, and the pattern of trade." *The Quarterly Journal of Economics* 122 (2): 569–600.

Ongena, S., G. Tümer–Alkan, and N. Von Westernhagen. 2018. "Do exposures to sagging real estate, subprime, or conduits abroad lead to contraction and flight to quality in bank lending at home?" *Review of Finance* 22 (4): 1335–1373.

Paravisini, D., V. Rappoport, and P. Schnabl. 2023. "Specialization in bank lending: Evidence from exporting firms." *The Journal of Finance* 78 (4): 2049–2085.

Paravisini, D., V. Rappoport, P. Schnabl, and D. Wolfenzon. 2015. "Dissecting the effect of credit supply on trade: Evidence from matched credit-export data." *The Review of Economic Studies* 82 (1): 333–359.

Petersen, M. A., and R. G. Rajan. 1994. "The benefits of lending relationships: Evidence from small business data." *The Journal of Finance* 49 (1): 3–37.

Raz, O., and P. A. Gloor. 2007. "Size really matters—new insights for start-ups' survival." *Management Science* 53 (2): 169–177.

Rotondi, Z. 2013. "Filiere produttive e nuova globalizzazione." *Laterza Editore.*

Saidi, F., and D. Streitz. 2021. "Bank concentration and product market competition." *The Review of Financial Studies* 34 (10): 4999–5035.

Stam, W., and T. Elfring. 2008. "Entrepreneurial orientation and new venture performance: The moderating role of intra-and extraindustry social capital." *Academy of Management Journal* 51 (1): 97–111.

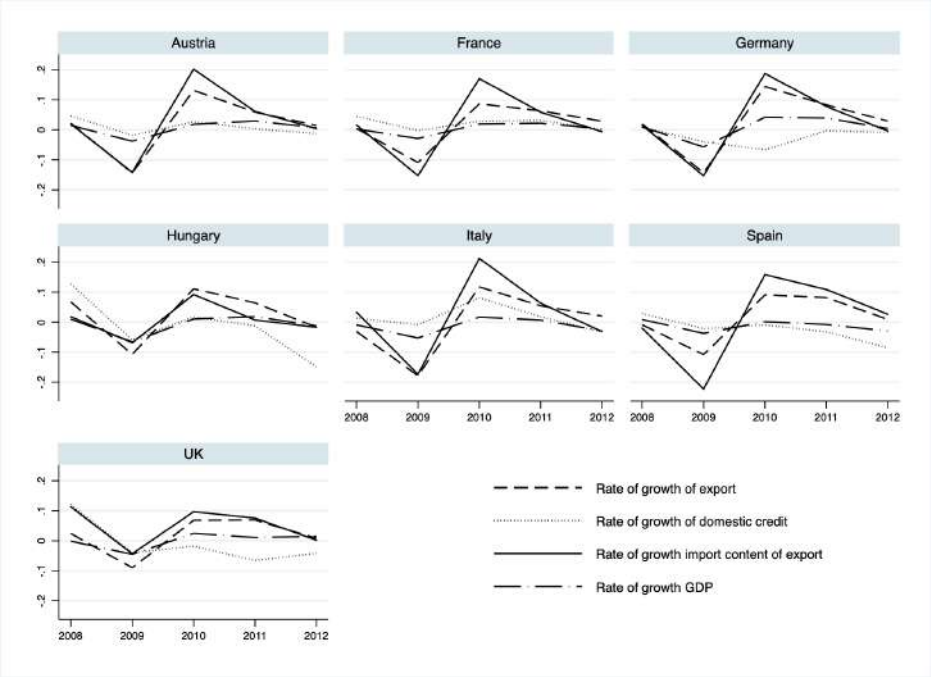
Stock, J., and M. Yogo. 2005. "Asymptotic distributions of instrumental variables statistics with many instruments." *Identification and inference for econometric models: Essays in honor of Thomas Rothenberg* 6:109–120.

UniCredit. 2012. "Le aggregazioni di rete: modello vincente per la sostenibilità e lo sviluppo. Rapporto UniCredit sulle piccole imprese e analisi comparata tra piccole e medie imprese manifatturiere." VIII Edizione.

Wagner, J. 2007. "Exports and productivity: A survey of the evidence from firm-level data." *World Economy* 30 (1): 60–82.

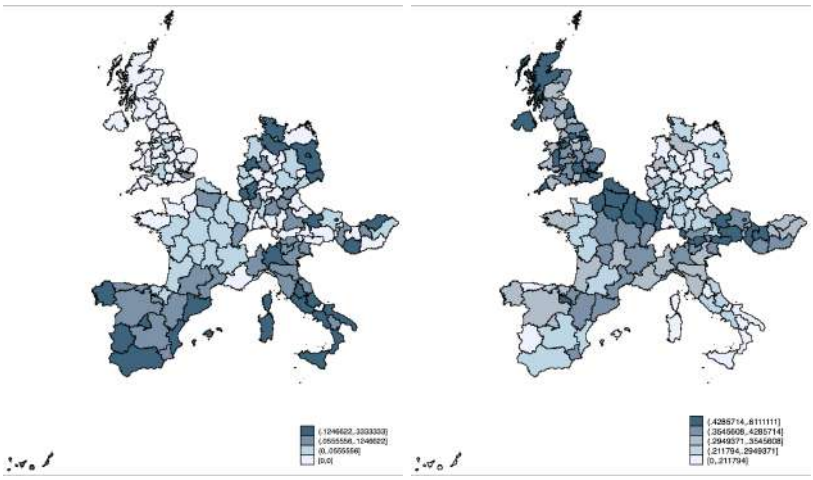
Tables and Figures

Figure 1: Credit, trade flows and GDP during the Great Financial Crisis



Notes: The figure displays the growth rate of domestic credit, export, import content of export, and GDP in seven European countries in 2008-2012. All growth rates are in real terms. Our calculations from World Bank data.

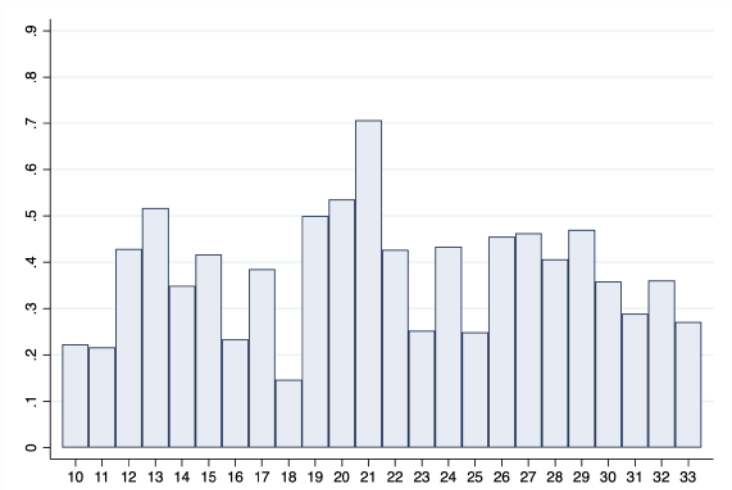
Figure 2: Credit rationing and global chain participation in European regions



(a) Rationing (b) Global chain participation

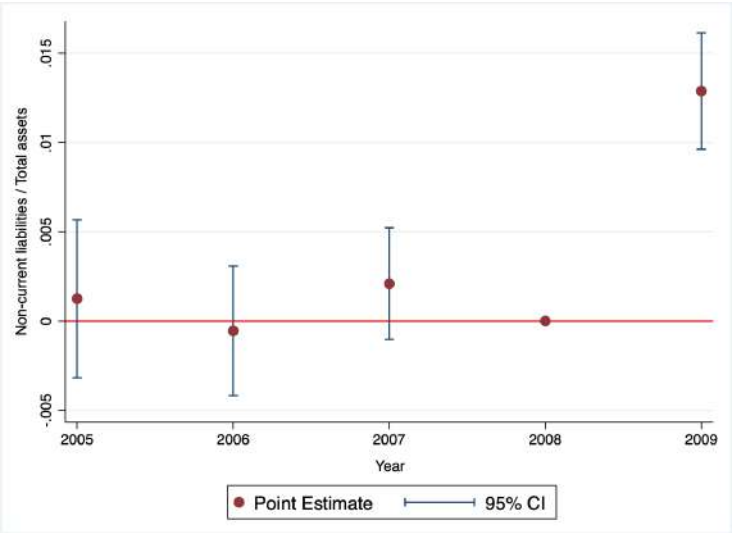
Notes: The figure shows the percentage of firms in European regions (NUTS-2) that are credit rationed (a) and the percentage of firms that participate in global chains (b) computed from our sample data.

Figure 3: Distribution of global chain participants by sector



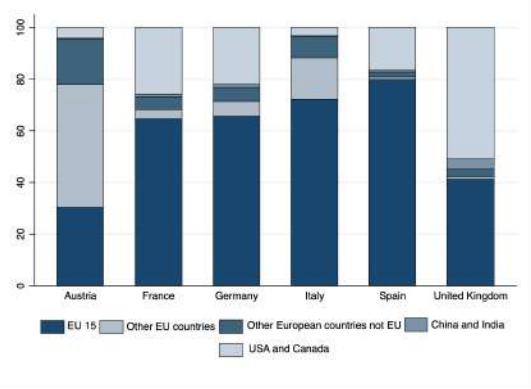
Notes: The figure shows the share of firms participating in global value chains in each two-digit NACE sector (EFIGE data). The x-axis reports the two-digit NACE codes for the manufacturing sectors: 10 Food products, 11 Beverages, 12 Tobacco products, 13 Textiles, 14 Wearing apparel, 15 Leather and related products, 16 Wood, except furniture, 17 Paper and paper products, 18 Printing and reproduction of recorded media, 19 Coke and refined petroleum products, 20 Chemicals and chemical products, 21 Pharmaceutical products, 22 Rubber and plastic products, 23 Other non-metallic mineral products, 24 Manufacture of basic metals, 25 Fabricated metal products, 26 Computer, electronic and optical products, 27 Electrical equipment, 28 Machinery and equipment, 29 Motor vehicles, 30 Other transport equipment, 31 Furniture, 32 Other manufacturing, 33 Repair and installation of machinery and equipment.

Figure 4: Internationalization and debt dynamics pre and post crisis



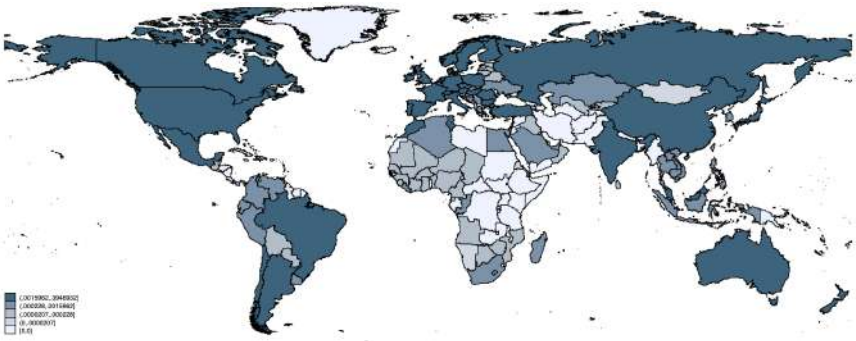
Notes: The figure shows the point estimates and confidence intervals of the regression in equation (15) for the years before and during the crisis.

Figure 5: Banks' presence in world regions

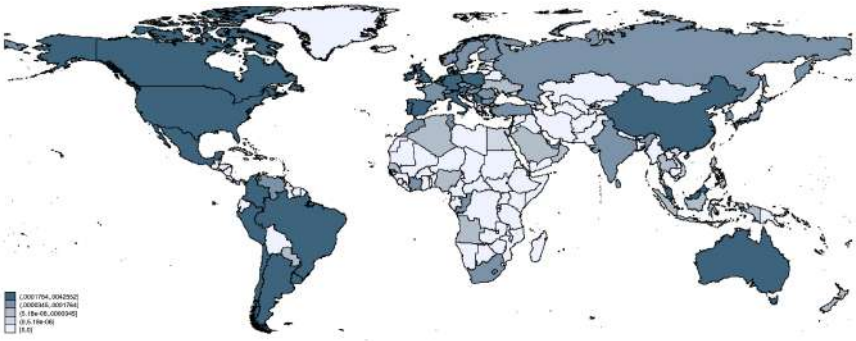


Notes: The figure shows the share of banks' foreign loan portfolios in world regions by banks' country of origin. Our calculations from Bank for International Settlement data.

Figure 6: Relevance of world countries in international banks' activities



(a) Relevance of countries in international banks' branch network



(b) Relevance of countries from (a), weighted by client firms' supply chain activity in the country

Notes: Panel (a) of this figure displays the share of foreign banks' subsidiaries in a country relative to the total number of subsidiaries of the banks. Panel (b) shows the same share weighted by the share of global chain participants in that country that are clients of the banks. Our computations from BankFocus, EFIGE and Orbis data.

Table 1
Summary statistics and univariate tests

	All firms			GVC participation				
				Global chain participant =1		Global chain participant =0		*t-test*
	Mean	Std. Dev.	Obs	Mean	Obs	Mean	Obs	
Bank Credit rationing:								
Credit Rationing	0.087	0.282	6,749	0.088	2,304	0.086	4,445	*-0.268*
Non-current liabilities / Total assets	0.204	1.048	63,425	0.189	21,154	0.212	42,266	*3.537*
Foreign activity:								
Global chain participant (GVC)	0.327	0.469	14,758					
Global chain participant (i. excluding importers of raw materials)	0.233	0.423	14,758	0.713	4,828			
Global chain participant (i + including non-importing subcontractors of intermediates)	0.245	0.430	14,758	0.713	4,828			
Global chain participant: services	0.079	0.269	14,758	0.241	4,828			
Global chain participant: intermediate goods	0.306	0.461	14,758	0.935	4,828			
Relatively downstream	0.112	0.316	14,758	0.344	4,828			
Relatively upstream	0.215	0.411	14,762	0.656	4,828			
Global chain participant: Europe	0.307	0.461	14,758	0.939	4,828			
Global chain participant: Asia	0.127	0.333	14,758	0.388	4,828			
Global chain participant: America	0.103	0.304	14,758	0.314	4,828			
Global chain participant: good also sold domestically	0.279	0.449	14,758	0.853	4,828			
Mechanisms:								
Bank country specialization	0.069	0.183	5,324	0.124	1,957			
Bank country relevance	0.170	0.159	4,262	0.166	2,560			
Bank concentration (same sector)	0.075	0.061	1,665	0.072	646			
Bank concentration (contiguous sector)	0.104	0.081	1,684	0.105	655			
Control variables:								
Age	34.53	30.63	14,725	37.58	4,811	33.06	9,913	*-8.182*
Leverage	0.652	0.274	13,873	0.632	4,622	0.662	9,250	*6.105*
Profitability (ROA)	0.046	0.140	10,849	0.042	3,841	0.048	7,007	*1.980*
Asset tangibility	0.255	0.195	13,788	0.238	4,589	0.263	9,198	*7.317*
Number of employees	71.64	142.96	11,442	114.57	3,944	49.05	7,497	*-19.865*
Labour productivity	52.25	43.61	9,645	56.24	3,469	50.01	6,175	*-6.585*
Family firm	0.704	0.457	14,727	0.650	4,815	0.730	9,911	*9.744*
Business Group	0.221	0.415	14,759	0.350	4,828	0.158	9,930	*-24.639*
Quality certification (ISO9000)	0.597	0.490	14,720	0.698	4,818	0.548	9,902	*-18.088*
Investment in ICT	10.357	13.465	14,748	9.031	4,825	11.002	9,923	*8.689*
Number of banks	3.089	2.531	14,654	3.569	4,781	2.857	9,873	*-14.010*
Medium/large (non local) bank	0.384	0.486	14,759	0.438	4,828	0.358	9,930	*-9.274*
Relatively efficient bank	0.464	0.499	8,923	0.539	2,790	0.430	6,133	*-9.592*
Number establishments region/sector (thousands)	1.191	1.617	14,524	1.057	4,549	1.246	9,457	*6.990*
Instrumental variable:								
Firm IT reliance for sales/purchase network × region (NUTS-2) broadband quality	22.236	26.254	14,695	25.877	4,804	20.470	9,890	*-11.557*
Countries:								
Austria	0.030	0.171	14,759	0.038	4,828	0.026	9,930	*-3.684*
France	0.201	0.401	14,759	0.236	4,828	0.185	9,930	*-6.986*
Germany	0.199	0.399	14,759	0.136	4,828	0.230	9,930	*14.425*
Italy	0.205	0.403	14,759	0.201	4,828	0.206	9,930	*0.741*
Hungary	0.033	0.179	14,759	0.039	4,828	0.030	9,930	*-2.848*
Spain	0.192	0.394	14,759	0.182	4,828	0.197	9,930	*2.228*
UK	0.140	0.347	14,759	0.169	4,828	0.126	9,930	*-6.695*

Notes: The table reports summary statistics and univariate tests for the main variables used in the regressions. All of the variables are defined in Table C1.

Table 2
Baseline results: Firms' global chain participation and bank rationing

Panel A: Baseline estimations						
Dep. Variable: Credit Rationing	(1)	(2)	(3)	(4)	(5)	(6)
Global chain participant (GVC)	-0.592**			-0.609**	-0.683**	-0.709***
	(0.285)			(0.312)	(0.270)	(0.276)
Global chain participant		-1.129***				
(i. excluding importers of raw materials)		(0.350)				
Global chain participant (i + including			-1.183***			
non-importing subcontractors of intermediates)			(0.274)			
Control variables (firm-related characteristics)						
Age (ln)	0.036	0.043	0.048	0.033	0.029	0.031
	(0.043)	(0.040)	(0.038)	(0.042)	(0.043)	(0.044)
Leverage	1.347***	1.154***	1.106***	1.341***	1.219***	1.231***
	(0.159)	(0.217)	(0.206)	(0.162)	(0.158)	(0.162)
Profitability (ROA)	-0.890*	-0.771*	-0.792**	-0.891*	-0.892*	-0.896*
	(0.514)	(0.408)	(0.397)	(0.514)	(0.476)	(0.482)
Asset tangibility	-0.001	-0.068	-0.063	-0.005	0.016	0.010
	(0.101)	(0.119)	(0.115)	(0.107)	(0.104)	(0.105)
Number of employees (ln)	0.099*	0.145**	0.152***	0.092	0.071	0.074
	(0.057)	(0.059)	(0.051)	(0.060)	(0.056)	(0.058)
Labour productivity (ln)	-0.115	-0.087	-0.078	-0.121	-0.139	-0.153*
	(0.091)	(0.087)	(0.080)	(0.094)	(0.087)	(0.090)
Family firm	-0.032	-0.032	-0.028	-0.032	-0.042	-0.040
	(0.061)	(0.055)	(0.055)	(0.060)	(0.057)	(0.057)
Business Group	0.164**	0.202***	0.199***	0.160**	0.144*	0.156**
	(0.079)	(0.073)	(0.068)	(0.079)	(0.076)	(0.077)
Quality certification (ISO9000)				0.073	0.057	0.064
				(0.068)	(0.065)	(0.064)
Investments in ICT				-0.000	-0.000	-0.000
				(0.002)	(0.002)	(0.002)
Control variables (bank-related and sector/region char.)						
Number of banks					0.036***	0.036***
					(0.008)	(0.008)
Medium/large (non local) bank					-0.040	-0.044
					(0.049)	(0.050)
Relatively efficient bank					-0.297***	-0.294***
					(0.064)	(0.065)
Number establishments region/sector						-0.053*
						(0.030)
Instrumental variable:						
Firm IT reliance for sales/purchase network	0.002***	0.003***	0.003***	0.002***	0.002***	0.002***
× region (NUTS-2) broadband quality	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Sector (NACE two-digit) fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Region (NUTS-2) fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5,061	5,061	5,061	5,051	4,999	4,820
F-instruments	10.85	19.91	20.18	10.42	9.76	7.08

Panel B: Additional fixed effects			
	Sector × Region	+ Bank	+ Main destination countries
Global chain participant (GVC)	-1.010***	-1.488***	-1.590***
	(0.272)	(0.109)	(0.207)
Control variables	Yes	Yes	Yes
Sector (NACE two-digit) × region (NUTS-2) fixed effects	Yes	Yes	Yes
Bank fixed effects	No	Yes	Yes
Destination country fixed effects	No	No	Yes
Observations	5,061	2,229	2,115

Notes: This table reports the effects of firms' global chain participation on credit rationing, estimated using bivariate probit. All the columns report the estimated coefficients and all the regressions include industry and regional fixed effects. The measures for firms' global chain participation are instrumented using a proxy of firms' reliance on IT systems for managing the sales/purchase network interacted with a regional indicator of broadband access. Panel B reports the results of our baseline regression (column 1 of Panel A) with the inclusion of additional fixed effects. See Table C1 and Section 3.2 for details on the control variables. The table also reports the Kleibergen-Paap Wald F-statistic from the first stage. In parentheses are standard errors that are robust to heteroskedasticity and clustered at the regional level. *Significant at 10%; **significant at 5%; ***significant at 1%.

Table 3
Baseline results: Firms' global chain participation and bank rationing (cont.)

Dep. Variable: Credit Rationing	(1)	(2)	(3)	(4)	(5)	(6)
Global chain participant (GVC)	-0.023			-0.024	-0.030	-0.036
Global chain participant (i. excluding importers of raw materials)		-0.054				
Global chain participant (i + including non-importing subcontractors of intermediates)			-0.063			
Sector (NACE two-digit) fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Region (NUTS-2) fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5,061	5,061	5,061	5,051	4,999	4,820

Notes: This table reports the marginal effects, estimated using bivariate probit, of the baseline estimations reported in Panel A of Table 2. All the regressions include control variables, industry and regional fixed effects. The measures for firms' global chain participation are instrumented using a proxy of firms' reliance on IT systems for managing the sales/purchase network interacted with a regional indicator of broadband access. See Table C1 and Section 3.2 for details on the control variables.

Table 4
More on identification strategy

	Panel A: Relationship lending measures			Panel B: Matched sample
	Lending rel. longer than 5 years	Info. acquisition through personal interviews	No use of collateral for lending decisions	
Dep. Variabe: Credit Rationing	(1)	(2)	(3)	(4)
Global chain participant (GVC)	-1.039***	-0.664*	-0.984**	-1.646***
	(0.275)	(0.340)	(0.401)	(0.056)
Control variables	Yes	Yes	Yes	Yes
Sector (NACE two-digit) fixed effects	Yes	Yes	Yes	Yes
Region (NUTS-2) fixed effects	Yes	Yes	Yes	Yes
Observations	3,882	2,613	2,443	1,902

Notes: This table reports variations of the baseline test, estimated using bivariate probit. In Panel A, we report the effects of firms' global chain participation on credit rationing for the subsample of firms with a lending relationship longer than 5 years, for the subsample of firms that declare that most of the information acquisition of loan officers occurs through personal interviews and for the subsample of firms that declare that the main bank does not use collateral for the lending decisions. In Panel B, we report the effects of firms' internationalization on credit rationing using a matched sample. All the columns report the estimated coefficients. The measure for firms' global chain participation is instrumented using a proxy of firms' reliance on IT systems for managing the sales/purchase network interacted with a regional indicator of broadband access. See Table C1 and Section 3.2 for details on the control variables. In parentheses are standard errors that are robust to heteroskedasticity and clustered at the regional level. *Significant at 10%; **significant at 5%; ***significant at 1%.

Table 5
Heterogeneity by supply chain characteristics

	Panel A: Robustness on measurement			Panel B: Position in the GVC		Panel C: Intensity firm linkages			
						Trade Volume < median	Trade Volume ≥ median	Intermediates /Output < median	Intermediates /Output ≥ median
Dep. Variable: Credit Rationing	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Global chain participant (GVC)	-0.592**					-0.098	-1.040**	-0.305	-1.028***
	(0.285)					(0.997)	(0.418)	(0.262)	(0.296)
Global chain participant: services		-1.631***							
		(0.068)							
Global chain participant: intermediate goods			-0.787**						
			(0.311)						
Relatively downstream				-1.520***					
				(0.050)					
Relatively upstream					-1.203***				
					(0.293)				
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector (NACE two-digit) fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region (NUTS-2) fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5,061	5,061	5,061	5,061	5,061	4,220	4,212	2,208	2,853

Notes: This table reports tests that exploit heterogeneity by characteristics of the supply chain, estimated using bivariate probit. All the columns report the estimated coefficients and all the regressions include industry and regional fixed effects. The measures for firms' global chain participation are instrumented using a proxy of firms' reliance on IT systems for managing the sales/purchase network interacted with a regional indicator of broadband access. In Panel A we consider the nature of intermediates traded along the global chain. In Panel B we study the effect of the position in the global chain. In Panel C we study the effect on credit rationing of the intensity of inter-firm linkages along supply chains, as measured by the volume of trade and the ratio of intermediates purchases over output. See Table C1 and Section 3.2 for details on the control variables. In parentheses are standard errors that are robust to heteroskedasticity and clustered at the regional level. *Significant at 10%; **significant at 5%; ***significant at 1%.

Table 6
Firms' global chain participation and debt dynamics

Panel A: Summary statistics								
Δ Non curr. liab. pre-crisis = 4.7%	Δ Total asset pre-crisis = 2.9%				Δ Non curr. liab./Tot. ass. pre-crisis = 6.2%			
Δ Non curr. liab. crisis = -3.3%	Δ Total asset crisis = -7.4%				Δ Non curr. liab./Tot. ass. crisis = 2.6%			
Panel B: Panel fixed effects regressions								
	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS
Dep. variable: Non current liab. / Tot. ass.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Global chain participant (GVC) × Crisis	0.015**	0.147**						
	(0.006)	(0.056)						
Regular global chain participant × Crisis			0.015**	0.144***				
			(0.006)	(0.054)				
Global chain participant × Crisis					0.016**	0.151**		
(i. including non-importing subcontractors of intermediates)					(0.006)	(0.058)		
Global chain participant × Crisis							0.015*	0.138***
(i + excluding importers of raw materials)							(0.008)	(0.051)
Number of employees (ln)	-0.054**	-0.054**	-0.054**	-0.053**	-0.054**	-0.054**	-0.054**	-0.054**
	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)
Profitability (ROA)	0.012	0.005	0.012	0.005	0.012	0.004	0.012	0.009
	(0.061)	(0.060)	(0.061)	(0.060)	(0.061)	(0.059)	(0.061)	(0.060)
Asset tangibility	0.183***	0.185***	0.183***	0.186***	0.183***	0.185***	0.184***	0.188***
	(0.029)	(0.029)	(0.029)	(0.030)	(0.029)	(0.030)	(0.029)	(0.029)
Labour productivity (ln)	-0.082**	-0.080**	-0.082**	-0.080**	-0.082**	-0.080**	-0.082**	-0.081**
	(0.035)	(0.035)	(0.035)	(0.035)	(0.035)	(0.035)	(0.035)	(0.035)
Instrumental variables:								
(Firm IT reliance for sales/purchase network × region		0.002***		0.002***		0.002***		0.002***
broadband quality) × Crisis		(0.000)		(0.000)		(0.000)		(0.000)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	34,178	34,117	34,178	34,117	34,178	34,117	34,178	34,117
F-instruments		42.39		41.59		38.18		37.23

Notes: This table reports the effects of firms' global chain participation on non current liabilities over total assets over the period 2005-2009. All the columns report the estimated coefficients and all the regressions include firm and year fixed effects. The measures for firms' global chain participation are instrumented using a proxy of firms' reliance on IT systems for managing the sales/purchase network interacted with a regional indicator of broadband access. See Table C1 and Section 3.2 for details on the control variables. The table also reports the Kleibergen-Paap Wald F-statistic from the first stage. In parentheses are standard errors that are robust to heteroskedasticity and clustered at the regional level. *Significant at 10%; **significant at 5%; ***significant at 1%.

Table 7
Mechanisms: Global chain participation as a signal

	Panel A: Expanding global network		Panel B: Improving brand recogn.	
	Expanding the distribution network	Not expanding the distribution network	Improving brand recognition and quality	Not improving brand recognition and quality
Dep. Variable: Credit Rationing	(1)	(2)	(3)	(4)
Global chain participant (GVC)	-0.938**	-0.873	-1.284***	-0.645*
	(0.422)	(0.627)	(0.352)	(0.388)
Control variables	Yes	Yes	Yes	Yes
Sector (NACE two-digit) fixed effects	Yes	Yes	Yes	Yes
Region (NUTS-2) fixed effects	Yes	Yes	Yes	Yes
Observations	2,066	2,995	1,128	3,933
Marginal effects				
Global chain participant (GVC)	-0.051	-0.018	-0.018	-0.023

Notes: This table studies the first mechanism that could drive the effect of firms' global engagement on bank credit rationing: banks could view global supply chain participation as a signal of the future prospects of their client firms. All the regressions are estimated using bivariate probit. All the columns, report the estimated coefficients and all the regressions include industry and regional fixed effects. At the bottom of the table we report the marginal effects for our measure of global chain participation. The measure for firms' global chain participation is instrumented using a proxy of firms' reliance on IT systems for managing the sales/purchase network interacted with a regional indicator of broadband access. In Panel A we study the effect of the implementation of activities aimed at expanding the firms' global network; in Panel B we study the role of the implementation of activities aimed at improving brand recognition and product quality. See Table C1 and Section 3.2 for details on the control variables. In parentheses are standard errors that are robust to heteroskedasticity and clustered at the regional level. *Significant at 10%; **significant at 5%; ***significant at 1%.

Table 8
Mechanisms: Spillover effects of credit rationing (preliminary evidence)

	Panel A: Nature of the bank		Panel B: Origin and destination markets			
	Local banks & domestic without int. network	National with int. network & foreign banks	Full sample	Europe	Asia	America
Dep. Variable: Credit Rationing	(1)	(2)	(3)	(4)	(5)	(6)
Global chain participant (GVC)	-0.646**	-1.181***	-0.592**			
	(0.303)	(0.383)	(0.285)			
Global chain participant: Europe				-0.202**		
				(0.101)		
Global chain participant: Asia					0.211*	
					(0.117)	
Global chain participant: America						0.175
						(0.164)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Sector (NACE two-digit) fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Region (NUTS-2) fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4,658	1,193	5,061	5,061	5,061	5,061
Marginal effects						
Global chain participant (GVC)	-0.025	-0.051	-0.023			
Global chain participant: Europe				-0.022		
Global chain participant: Asia					0.003	
Global chain participant: America						0.002

Notes: This table studies the second mechanism that could drive the effect of firms' global engagement on bank credit rationing: banks could protect supply chain participants because they internalize the negative consequences that a denial of credit can have on their own foreign business. All the regressions are estimated using bivariate probit. All the columns report the estimated coefficients and all the regressions include industry and regional fixed effects. At the bottom of the table we report the marginal effects for our measures of global chain participation. The measures for firms' global chain participation are instrumented using a proxy of firms' reliance on IT systems for managing the sales/purchase network interacted with a regional indicator of broadband access. In Panel A we study the effect of the nature of the bank; in Panel B we study the effect of origin and destination markets. See Table C1 and Section 3.2 for details on the control variables. In parentheses are standard errors that are robust to heteroskedasticity and clustered at the regional level. *Significant at 10%; **significant at 5%; ***significant at 1%.

Table 9
Mechanisms: Spillover effects of credit rationing (bank specialization and relevance)

	Panel A: Bank specialization			Panel B: Bank relevance			
	Share (x) bank subsidiaries in firms' foreign trade countries			Ratio (x) bank clients / Total GVC participants			
						Client trade > median	Client trade < median
	x=0%	0%<x<4%	x>4%	0%<x<16.5%	x>16.5%	x>16.5%	x>16.5%
Dep. Variable: Credit Rationing	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Global chain participant (GVC)	2.282***	-1.379***	-1.645***	-0.652**	-0.902***	-0.946***	0.386
	(0.253)	(0.131)	(0.131)	(0.324)	(0.301)	(0.235)	(0.670)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector (NACE two-digit) fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region (NUTS-2) fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	880	1,305	1,460	4,675	4,641	3,413	1,228
Marginal effects							
Global chain participant (GVC)	0.000	-0.008	-0.010	-0.022	-0.045	-0.029	0.002

Notes: This table reports the effects of firms' global chain participation and areas of operation of internationally active banks on credit rationing, estimated using bivariate probit. Panel A considers the role of bank specialization in firms' foreign trade countries, as measured in equation (16) in Section 5.1. Panel B considers the role of bank relevance in firms' foreign trade countries, as measured in equation (17) in Section 5.1. All the columns report the estimated coefficients and all the regressions include industry and regional fixed effects. At the bottom of the table we report the marginal effects for our measure of global chain participation. The measure for firms' global chain participation is instrumented using a proxy of firms' reliance on IT systems for managing the sales/purchase network interacted with a regional indicator of broadband access. See Table C1 and Section 3.2 for details on the control variables. In parentheses are standard errors that are robust to heteroskedasticity and clustered at the regional level. *Significant at 10%; **significant at 5%; ***significant at 1%.

Table 10
Mechanisms: the role of banks' knowledge

	Panel A: Nature of exported products			Panel B: Bank sectoral specialization			
	Excluding opaque products		Excluding	Bank specialization in the sector of the company		Bank specialization in the contiguous sector	
	Sectoral fraction of inputs not sold on exchange	Sectoral fraction of inputs not sold on exchange (conservative)	products not sold domestically	Concentration < median	Concentration > median	Concentration < median	Concentration > median
Dep. Variable: Credit Rationing	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Global chain participant (GVC)	-0.904**	-1.205**		-1.584***	-0.374	2.027***	-0.609*
	(0.378)	(0.545)		(0.123)	(0.442)	(0.095)	(0.352)
Global chain participant: good also sold domestically			-0.724**				
			(0.289)				
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector (NACE two-digit) fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region (NUTS-2) fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,095	1,094	4,811	825	843	838	853

Notes: This table studies how the banks' knowledge could drive the effect of firms' global chain participation on bank credit rationing, estimated using bivariate probit. All the columns report the estimated coefficients and all the regressions include industry and regional fixed effects. The measures for firms' global chain participation are instrumented using a proxy of firms' reliance on IT systems for managing the sales/purchase network interacted with a regional indicator of broadband access. In Panel A we study the effect of the nature of exported products; in Panel B we consider the bank specialization in the sector of the company and in the contiguous sector (according to the input-output table). See Table C1 and Section 3.2 for details on the control variables. In parentheses are standard errors that are robust to heteroskedasticity and clustered at the regional level. *Significant at 10%; **significant at 5%; ***significant at 1%.

Table 11
Effects of credit frictions on foreign activities versus domestic production

Source	Reduction in Foreign activities / Domestic production
Minetti and Zhu (2011)	$38\%/19\% \approx 2$
Alessandria et al. (2010)	$19\%/13\% \approx 1.46$
Levchenko et al. (2010)	$35\%/13.5\% \approx 2.59$

Notes: This table reports the estimates of the ratio between the reduction in foreign activities due to financial frictions respect to the reduction in domestic production, according to different papers in the literature.

Online Appendix

"Out of sight, out of mind? Global value chains and credit allocation in bad times"

This Appendix provides more details on the main data sources and additional robustness analyses.

A. More details on data sources

To perform our empirical investigation, we draw information from five main sources: (i) the EU-EFIGE Bruegel-UniCredit survey, (ii) the Bureau van Dijk (BvD) Amadeus database, (iii) the BIS Cross Border Banking Statistics, (iv) the Bureau van Dijk (BvD) Orbis dataset, (v) Moody's Analytics BankFocus.

The EU-EFIGE Bruegel-UniCredit Survey was conducted within the project EFIGE - European Firms in a Global Economy: internal policies for external competitiveness - supported by the Directorate General Research of the European Commission through its 7th Framework Programme (Altomonte and Aquilante 2012). The survey has been coordinated by the Bruegel Institute and carried out from September 2008 to August 2012 by leading academic institutions in Europe. The project also involved partnerships with some National Central Banks (Bundesbank, Bank of France, Bank of Italy, Bank of Spain, Bank of Belgium) and international institutions (OECD). The survey was carried out on a representative sample of manufacturing firms with more than 10 employees in seven European countries: Austria, France, Germany, Hungary, Italy, Spain, and the United Kingdom. Data collection was performed by a professional Contractor, GFK, the fourth largest market research company in the world, aimed at gathering both qualitative and quantitative information at the firm level. The questionnaire submitted to the firms covers six broad areas, for a total of 150 variables: structure of the firms, including company ownership, domestic and foreign control, and management; workforce, including skills, type of contracts, domestic vs. migrant workers, and training; investment, technological innovation, and R&D; export and internationalization processes; market structure and competition; financial structure and bank-firm relationships. As the survey was run in 2010, it mainly collected cross-sectional information for the most recent completed fiscal year, 2008. However, some questions extended over the period 2007-2009, also addressing the behavior of firms during the Great Financial Crisis. To ensure statistical representativeness, the dataset was designed to meet two main criteria. First, it included an adequately large target sample of firms, initially set at around 3,000 firms for large countries (France, Germany, Italy, Spain, and the United Kingdom) and approximately 500 firms for smaller countries (Austria and Hungary). Second, the sample was stratified to maintain representativeness of the data collected from each country, using three dimensions for stratification: industries (11 NACE industry codes), regions (at the NUTS-1 level), and size class (10-19; 20-49; 50-250; more than 250 employees). Furthermore, specific response rate requirements were established: at least an 85-90% response rate for 5 to 10 key questions previously agreed, no less than a 70% response rate for 10-15 important questions, and an overall average response rate of no less than 60% for the rest of the questionnaire.

For all the firms included in the EFIGE survey, balance-sheet information for the years 2005-2009, drawn from the Bureau van Dijk Amadeus database, was attached. This database is recognized as the most comprehensive source of financial data for both public and private firms in Europe, providing detailed and reliable information that enhances the depth of our analysis.

We then complement the two firm-level databases with country-level data from the BIS Cross Border Banking Statistics, taking into account the countries of origin of the surveyed firms and the locations of their global value chain partners. From this database, we draw information on the locational activities of internationally active banks. Specifically, it includes data on the amount of foreign claims held by banks in the EFIGE countries (Austria, France, Germany, Hungary, Italy, Spain, and the United Kingdom) against countries where global value chain partners are based.

To deepen our analysis of internationally active banks and test the "spillover-avoidance" channel, we identify the lending banks of the firms included in the EFIGE survey. For this purpose, we exploit information from the Bureau van Dijk Orbis database regarding the names of the banks with which the sample firms do business. It should be noted

that in conducting this test, we suffer a loss of observations due to limitations in data availability. Given the names of the firms' banks, we use the Moody's Analytics BankFocus database to extract details on the banks' international presence. Specifically, we take the number of affiliates that banks have in the countries where their client firms' global value chain partners are located, as well as the total number of foreign affiliates.

B. IV strategy for relationship length

In Table C4, in the spirit of Guiso et al. (2004) and Herrera and Minetti (2007), we propose an IV approach for the subsample of Italian firms by instrumenting the relationship lending dummy with variation in the tightness of the 1936 Italian banking regulation across local banking markets (at the provincial level).

The instrumental variables rely on identifying exogenous restrictions on the local banking system that affect firms' opportunity and availability of borrowing from a main bank on a relational basis but do not directly affect banks' decisions about credit rationing. To this end we exploit the 1936 Banking Law which subjected the Italian banking system to strict regulation of entry and branch opening in provinces, freezing the size and bank-composition of the local credit markets until the beginning of the 1990s. The rationale for using this regulatory event to instrument relationship length is the theoretical and empirical evidence showing that the likelihood of close bank-firm relationships depends on the concentration, size and organizational structure of local credit markets (see, e.g., Boot and Thakor 2000; Hauswald and Marquez 2006).

The 1936 Banking Law imposed strict limits on the ability of different types of banking institutions to open new branches. Specifically, each bank type was attributed a geographical area of competence based on its presence in 1936, and its ability to grow and lend was restricted to that area. In particular, national banks could open branches only in the main cities; cooperative and local commercial banks could open branches within the boundaries of the province; savings banks could expand within the boundaries of the region. Guiso et al. (2004) demonstrate that the geographical distribution of bank branches in 1936 was broadly uncorrelated with the geography of economic development, and that it deeply impacted local credit markets in the decades that followed. Entry into the local markets was liberalized only during the 1990s.

In Table C4, we use as instruments three indicators that Guiso et al. (2004) employ to characterize the local structure of the banking system in 1936: (i) the share of bank branches owned by local banks over total banks in the province in 1936, (ii) the number of popular bank branches in the province per 100,000 inhabitants in 1936, and (iii) the number of bank branches in the province per 100,000 inhabitants in 1936.

C. Additional tables

Table C1
Variable definitions

Variable	Description and source
Bank credit rationing:	
Credit Rationing	Dummy variable equal to one if the firm unsuccessfully applied for credit, and zero otherwise. (EFIGE)
Non-current liabilities / Total assets	The ratio of firm's non-current liabilities over total assets. (BvD-Amadeus)
Global value chain participation:	
Global chain participant (GVC)	Dummy variable equal to one if the firm participates in a global value chain, and zero otherwise. We define firms involved in a global value chain as firms that import intermediate goods and/or services and export their own products/services in 2008. (EFIGE)
Global chain participant (i)	Dummy variable equal to one for global chain participants and for non-importing firms that are subcontractors of intermediate goods, and zero otherwise. (EFIGE)
Global chain participant (i + including non-importing subcontractors of intermediates)	Dummy variable equal to one for global chain participants with the exclusion of importers of raw materials and/or intermediate goods, and for non-importing firms that are subcontractors of intermediate goods, and zero otherwise. (EFIGE)
Global chain participant: services	Dummy variable equal to one if the firm participates in a global value chain (by importing services), and zero otherwise. (EFIGE)
Global chain participant: intermediate goods	Dummy variable equal to one if the firm participates in a global value chain (by importing intermediate goods), and zero otherwise. (EFIGE)
Relatively downstream	We define firms involved in a global value chain (relatively downstream) as firms that import intermediate goods and/or services and export their own final products/services in 2008. (EFIGE)
Relatively upstream	We define firms involved in a global value chain (relatively upstream) as firms that import intermediate goods and/or services and export their own intermediate products/services in 2008. (EFIGE)
Global chain participant: Europe	Dummy variable equal to one if the firm participates in a global value chain with partners located in Europe, and zero otherwise. (EFIGE)
Global chain participant: Asia	Dummy variable equal to one if the firm participates in a global value chain with partners located in Asia, and zero otherwise. (EFIGE)
Global chain participant: America	Dummy variable equal to one if the firm participates in a global value chain with partners located in America, and zero otherwise. (EFIGE)
Global chain participant: good sold in domestic market	Dummy variable equal to one if the firm participates in a global value chain (by exporting goods sold also in the domestic market), and zero otherwise. (EFIGE)
Control variables:	
Age (ln)	Logarithm of the number of years since inception. (EFIGE)
Debt ratio	Total debt over total assets. (BvD-Amadeus)
Profitability (ROA)	EBIT over total assets. (BvD-Amadeus)
Asset tangibility	Tangible fixed assets over total assets. (BvD-Amadeus)
Number of employees (ln)	Logarithm of the number of workers employed in the firm. (EFIGE)
Labour productivity	Value added (EBITDA plus labour costs) over the number of employees. (BvD-Amadeus)
Family firm	Dummy variable equal to 1 if the firm's main shareholder is a family or an individual, and zero otherwise. (EFIGE)
Business Group	Dummy variable equal to 1 if the firm belongs to a business group, and zero otherwise. (EFIGE)
Region dummies	Region where the firm is located (at the NUTS-2 level). (BvD-Amadeus)
Sector dummies	Two-digit activity sector of the firm (NACE rev2 code). (BvD-Amadeus)
Quality certification (ISO9000)	Dummy variable equal to one if the firm have a ISO9000 certification. (EFIGE)
Investments in ICT	The percentage of the annual turnover do the overall investments in machines, equipment and ICT represent on average in 2007-2009 period. (EFIGE)
Number of banks	The number of banking relationship in which the firm engages (EFIGE)
Medium/large (non local) bank	Dummy variable equal to 1 if the firm's main bank is medium/large (non local) (EFIGE)
Relatively efficient bank	Dummy variable equal to 1 if the bank is reported to be relatively efficient in its operations by the firm (EFIGE)
Number establishments region/sector	The number (in thousands) of productive establishments in the sector-region in 2008. (Eurostat)
Instrumental variable:	
Firm IT reliance for sales/purchase network × region (NUTS-2) broadband quality	Triple interaction among a dummy variable equal to one if the firm declares to have access to a broadband connection (zero otherwise), a dummy variable equal to one if the firm declares the reliance on IT systems for managing the sales/purchase network (zero otherwise), and a regional indicator of broadband connection diffusion (households' broadband access). (EFIGE and Eurostat)

Table C2
Correlation matrix

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1) Credit Rationing	1.000									
(2) Global chain participant (GVC)	0.003	1.000								
	0.788									
(3) Age (ln)	-0.048	0.076	1.000							
	0.000	*0.000*								
(4) Leverage	0.140	-0.052	-0.149	1.000						
	0.000	*0.000*	*0.000*							
(5) Profitability (ROA)	-0.093	-0.021	0.007	-0.300	1.000					
	0.000	*0.031*	*0.467*	*0.000*						
(6) Asset tangibility	0.001	-0.060	-0.049	0.011	-0.052	1.000				
	0.926	*0.000*	*0.000*	*0.182*	*0.000*					
(7) Number of employees (ln)	-0.015	0.288	0.198	-0.028	0.008	0.037	1.000			
	0.272	*0.000*	*0.000*	*0.004*	*0.400*	*0.000*				
(8) Labour productivity (ln)	-0.100	0.079	0.120	-0.202	0.390	-0.103	0.031	1.000		
	0.000	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.003*			
(9) Family firm	0.007	-0.082	0.091	0.034	0.018	0.073	-0.160	-0.055	1.000	
	0.583	*0.000*	*0.000*	*0.000*	*0.067*	*0.000*	*0.000*	*0.000*		
(10) Business Group	-0.003	0.217	0.016	-0.025	-0.040	-0.071	0.399	0.129	-0.259	1.000
	0.815	*0.000*	*0.052*	*0.004*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	

Notes: This table reports the pairwise correlation coefficients of the main variables used in the analysis and the significance level of each coefficient.

Table C3
Further robustness checks

	Robust. baseline	Robustness tests on panel analysis					
	Excluding large firms	Refine the measure using self reported data		Excluding firms with long term bonds		Excluding firms with long term bonds > 5%	
	Biv. Probit	OLS	2SLS	OLS	2SLS	OLS	2SLS
Dep. Variables	Credit Rationing	% l.t.debt × Non curr. liab. / Tot. ass.	% l.t.debt × Non curr. liab. / Tot. ass.	Non curr. liab. / Tot. ass.	Non curr. liab. / Tot. ass.	Non curr. liab. / Tot. ass.	Non curr. liab. / Tot. ass.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Global chain participant (GVC)	-0.667**						
	(0.272)						
Global chain participant (GVC) × Crisis		0.015**	0.143**	0.015**	0.142**	0.015**	0.145**
		(0.006)	(0.056)	(0.007)	(0.057)	(0.007)	(0.057)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector (NACE two-digit) & region (NUTS-2) f.e.	Yes	No	No	No	No	No	No
Firm fixed effects	No	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	No	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4,789	34,178	34,117	33,181	33,120	333,280	33,219

Notes: This table reports some robustness checks on our estimates. In column 1 we re-estimate the baseline regression (column 1 of Table 2) by excluding large firms. Columns 2-7 report some robustness tests on the effects of firms' global chain participation on non current liabilities over total assets. All the columns report the estimated coefficients and all the regressions include firm and year effects. The measures for firms' global chain participation are instrumented using a proxy of firms' reliance on IT systems for managing the sales/purchase network interacted with a regional indicator of broadband access. See Table C1 and Section 3.2 for details on the control variables. The table also reports the Kleibergen-Paap Wald F-statistic from the first stage. In parentheses are standard errors that are robust to heteroskedasticity and clustered at the regional level. *Significant at 10%; **significant at 5%; ***significant at 1%.

Table C4
Instrumenting relationship lending

	Subsample of Italian firms			
	Second stage	First stage		
Dep. Variables	Rationing	Global chain participant	Rel. Length > 5 years	Global chain participant × Rel. Length > 5 years
	(1)	(2)	(3)	(4)
Global chain participant (predicted)	-1.442			
	(1.257)			
Relationship length >5 years (pred.)	-0.013			
	(0.991)			
Global chain participant * Rel. Length >5 years (pred.)	-0.821*			
	(0.423)			
Instrumental variables:				
IT access (sales/purchase network)		0.004*		-0.226***
		(0.002)		(0.014)
IT access (sales/purchase network) * Rel. length >5 years				0.236***
				(0.015)
Popular banks in 1936			-0.163**	
			(0.075)	
Local banks in 1936			-0.862***	
			(0.329)	
Branches over population in 1936			0.020***	
			(0.006)	
Control variables	Yes	Yes	Yes	Yes
Sector (NACE two-digit) fixed effects	Yes	Yes	Yes	Yes
Region (NUTS-2) fixed effects	Yes	Yes	Yes	Yes
Observations	1,517	2,428	1,517	1,517

Notes: This table reports the effects of firms' global chain participation and relationship length on credit rationing, estimated using probit model. All the columns report the estimated coefficients and all the regressions include industry and regional fixed effects. The measure for firms' global chain participation is instrumented using a proxy of firms' reliance on IT systems for managing the sales/purchase network interacted with a regional indicator of broadband access. The measure for firms' lending relationship is instrumented using the indicators of the 1936 Italian banking regulation (see, e.g., Guiso et al., 2004, and the Appendix B for more details on these instruments). See Table C1 and Section 3.2 for details on the control variables. In parentheses are standard errors that are robust to heteroskedasticity and clustered at the regional level. *Significant at 10%; **significant at 5%; ***significant at 1%.

Table C5
Heterogeneity by firm characteristics

	Firm age		External financial dependence		Reliance on bank financing	
	Age < 25 years	Age ≥ 25 years	High dependence on external finance	Low dependence on external finance	Only bank debt as source of financial debt	Other forms of financial debt besides bank debt
Dep. Variable: Credit Rationing	(1)	(2)	(3)	(4)	(5)	(6)
Global chain participant (GVC)	-0.951**	-0.198	-1.078***	1.254	-1.011**	-0.468
	(0.374)	(0.809)	(0.265)	(2.643)	(0.445)	(0.551)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Sector (NACE two-digit) fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Region (NUTS-2) fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,506	2,555	3,707	1,354	3,588	1,471

Notes: This table reports the effects of key firm characteristics on the relationship between firms' global chain participation and credit rationing, estimated using bivariate probit. In columns (1) and (2) we study the effect of firms' age, by classifying firms based on the median value of the sample (25 years); in columns (3) and (4) we study the effect of firms' external financial dependence; in columns (5) and (6) we study the effect of firms' reliance on bank financing. All the columns report the estimated coefficients and all the regressions include industry and regional fixed effects. The measures for firms' global chain participation are instrumented using a proxy of firms' reliance on IT systems for managing the sales/purchase network interacted with a regional indicator of broadband access. See Table C1 and Section 3.2 for details on the control variables. In parentheses are standard errors that are robust to heteroskedasticity and clustered at the regional level. *Significant at 10%; **significant at 5%; ***significant at 1%.

Table C6
Robustness on bank relevance

	(Bank clients/Total GVC participants × Dummy bank presence) x		
	x=0%	0%<x<16.5%	x>16.5%
Dep. Variable: Credit Rationing	(1)	(2)	(3)
Global chain participant (GVC)	2.500***	-0.637**	-0.833*
	(0.632)	(0.276)	(0.462)
Control variables	Yes	Yes	Yes
Sector (NACE two-digit) fixed effects	Yes	Yes	Yes
Region (NUTS-2) fixed effects	Yes	Yes	Yes
Observations	335	4,897	4,419

Notes: This table reports the effects of firms' global chain participation and areas of operation of internationally active banks on credit rationing, estimated using bivariate probit. All the columns report the estimated coefficients and all the regressions include industry and regional fixed effects. The measures for firms' global chain participation are instrumented using a proxy of firms' reliance on IT systems for managing the sales/purchase network interacted with a regional indicator of broadband access. See Table C1 and Section 3.2 for details on the control variables. In parentheses are standard errors that are robust to heteroskedasticity and clustered at the regional level. *Significant at 10%; **significant at 5%; ***significant at 1%.