Credit and recessions

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Abstract

The paper develops a simple model on the asymmetric role of credit markets in output fluctuations. When credit markets are underdeveloped and enterprise activity is financed by trade credit, shocks may induce a break-up of credit and production chains, leading to sudden and sharp contractions. The development of a banking sector can reduce the probability of such collapses and hence plays a crucial role in softening output declines. However, the banking sector becomes a shock amplifier when shocks originate in the financial sector. Using industry-level data across a large cross-section of countries, we provide evidence in support of the model's predictions.

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1   Introduction

"If developing-country output paths look more like mountains, cliffs, and plains than the steady 'hills' observed in the industrial world, then looking for an explanation of average cross-country growth differences can lead to misleading results (Pritchett, 2000)". In other words, neglecting crisis episodes gives a misleading picture of the growth process, especially for emerging markets (EMs)[1]. Looking at the period 1960-2000, Durlauf et al. (2005) report that "Of the 102 countries in our sample, 50 showed at least one three-year output collapse of 15% or more. 65 countries experienced a three-year output collapse of 10% or more. In contrast, between 1960 and 2000, the largest three-year output collapse in the USA was 5.4%, and in the UK 3.6%, both recorded in 1979-82. It is not clear that the dynamics of output in the wake of a major collapse would look anything like the dynamics at other times". Furthermore, these episodes of sharp output collapse tend to affect long-term growth, as recently found by Cerra and Saxena (2008). This evidence suggests that variables usually identified as drivers of economic growth may have sharply different effects on output decline and output growth. In this paper, we investigate this issue in connection with one of the

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[1]For an analysis of output behavior during different types of recessions see Claessens, S., Kose, A. and M.E. Terrones (2008), 'What Happens During Recessions, Crunches and Busts?,' CEPR Discussion Papers 7085.

main determinants of growth analyzed in the literature, namely the development of the financial sector.

Although several analytical contributions emphasize the asymmetric effect of finance on output, with larger effects during downturns[2], the empirical literature, including the seminal work by Rajan and Zingales (1998), has generally assumed symmetric effects, studying the impact of finance on average rates of growth. It is worth noting that the seminal paper by Rajan and Zingales (1998) covers the period between 1980 and 1990 and therefore excludes the experiences of sharp output collapse associated with crises in developing and emerging markets which occurred after 1990.

Our analysis is close to the work by Braun and Larrain (2005), who found a much stronger effect of financial market frictions during periods of downturn, defined as periods of negative output gap. In contrast to their analysis that focuses on short-term cyclical fluctuations, we focus on episodes of sharp output contraction and, furthermore, we distinguish between financial crises and recessions associated with different types of shocks. The correlation between financial underdevelopment and extreme drops in output has also been found in previous analyses (Raddatz (2006)). In addition, empirical analyses carried out using the UNIDO data set (which we also use in this paper) indicate that a larger financial sector (for instance in terms of credit to GDP) is associated

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[2]See for example Kiyotaki and Moore (1997).

with stronger adverse effects of banking crises[3].

In this paper, we investigate whether credit markets play a significant role in softening (or magnifying) the effects of negative shocks during episodes of output decline[4]. We develop a simple theoretical framework that illustrates how underdeveloped credit market institutions may initiate episodes of sharp output decline. In particular, a model of production chains, in which firms are interlinked through trade credit contracts, shows how exogenous shocks may lead to a sub-optimal equilibrium in which production chains are broken and output declines sharply when credit market institutions are weak. The model also illustrates how the development of a banking sector reduces the risk of such a sub-optimal equilibrium, except for the case of shocks originating in the financial sector or aggregate shocks. The relevance of credit chains has been explored in previous work[5]. Following Calvo and Coricelli (1996) and Kim and Shin (2007), we emphasize the circularity of the system, with symmetry between assets and liabilities (payables and receivables). Traditionally, trade credit has been seen as a mechanism to channel liquidity from liquidity-rich firms to liquidity-poor firms. In contrast, we emphasize the linkages among firms, through production and credit chains, associated with zero net trade credit. The chain is the main amplifying mechanism.

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[3]See for example Dell'Ariccia, Detragiache and Rajan (2008), and Klingebield, Kroszner and Laeven (2007).

[4]See also Calvo et al. (2006) for an examination of the role of financial factors in explaining sharp output collapses.

[5]See for example Kyiotaki and Moore (1997), Calvo and Coricelli (1996), and Kim and Shin (2007).

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Raddatz (2008) found that trade credit chains increase the correlation between output fluctuations in industries linked through input-output chains. Fisman and Love (2003) extended Rajan and Zingales (1998) to take into account the reliance of sectors on trade credit. They found evidence of substitutability between trade credit and other sources of finance and concluded that in less developed financial markets firms relying more on trade credit perform better than other firms. Therefore, trade credit could soften the negative effects of financial underdevelopment. Our analysis reaches different conclusions, both at the theoretical and empirical levels. In our model, trade credit chains act as a channel for the amplification of adverse shocks, especially in less developed financial markets.

The novelty of the model is that trade credit per se does not increase the vulnerability of a system to shocks. Vulnerability is a function of the degree of development of the overall financial sector. Such overall development is related to the degree of trust in the system and the strength of contract enforcement institutions. After all, with perfect markets, a system of trade credit based on IOU's supports a Pareto optimal equilibrium in which the system does not require outside finance (from outside the enterprise sector). It is worth noting that trade credit plays an important role both in advanced and underdeveloped financial sectors. However, depending on the overall degree of financial development, trade credit has sharply different implications in terms of the amplification of shocks. The idea is that when the financial sector is developed, for instance through deep official credit markets, difficulties arising from insolvencies

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within the trade credit chain can be buffered by relying on bank credit. In contrast, in countries with less developed financial sectors, insolvencies in the trade credit chain cannot be buffered because of the lack of alternative sources of financing.

The empirical part of the paper tests the predictions of the theoretical model regarding the role of financial markets in softening output declines and making them less likely, as well as the predictions regarding trade credit and its interaction with bank credit and financial development. Following Rajan and Zingales (1998), we analyze the role of credit markets on output performance by focusing on the differential performance of industries. We analyze whether industries that are more dependent on external finance experience larger drops in output in countries with less developed financial markets. We find robust evidence of such effects. Furthermore, we find that the development of financial markets does not shield industries with high reliance on external finance when the shock originates in the financial sector. Indeed, during episodes of financial crises, industries that rely more on external finance are hit harder than less dependent industries. The empirical analysis also provides insights into the impact of trade credit on output dynamics. First, we find that a higher reliance on trade credit relative to bank credit at the firm and country levels increases the probability and magnitude of sharp contractions. Second, we find that sectors that rely more on trade credit relative to bank credit experience milder contractions in countries with a better developed financial sector.

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The paper is structured as follows. Section 2 develops a model of production chains, in which firms are interlinked through trade credit contracts, and describes the various possible equilibria conditional on the level of contract enforcement in credit markets. The model demonstrates how exogenous shocks may lead to a sub-optimal equilibrium in which production chains break down when credit market institutions are weak. Finally, the model shows how the development of a banking sector reduces the risk of the emergence of a sub-optimal equilibrium. Section 3 contains the empirical analysis that lends support to the various predictions of the theoretical model. Section 4 concludes.

2 A simple model of production chains with trade credit

2.1 Production chain equilibria

Starting with Adam Smith, one of the main tenets of economics has been that deeper division of labor leads to greater productivity. Both at the national and international levels, the largest share of trade involves the exchange of intermediate goods between independent firms[6]. In a market economy, such division of labor requires the use of credit as the exchange of inputs occurs in a sequential rather than simultaneous manner. A natural way of representing this process of division of labor is through a production chain in which firms are each other's suppliers and customers. When contract enforce-

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[6]See Ethier (1982).

ment is perfect, the production chain can be supported by a system of inter-enterprise trade credit, without the need for a banking system. However, in reality contract enforcement is far from perfect and every entrepreneur-creditor is exposed to the probability of its customers defaulting on their debts, in particular following a negative shock to the economy. We develop a rudimentary model of production chains, in which firms are interlinked through trade credit contracts, and show how weak credit market institutions, proxied by a measure of contract enforcement, increase the vulnerability of an economy to exogenous shocks. In particular, the model demonstrates how exogenous shocks may lead to the collapse of production chains when credit market institutions are weak.

Assume that n symmetric firms are organized along a production chain, in which each firm is linked to two partners only, one supplier and one customer[7]. Every firm is endowed with a unit of an intermediary good N. It can either sell it as an input to another firm, the customer, at a price $p = 1$[8] or sell it on a 'secondary market' at a discounted price $\mu < 1$. As in Blanchard and Kremer (1997), this alternative use of the

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[7]This high degree of specificity in the relationships between firms is only introduced for expositional simplicity. The model is similar to the one analyzed by Blanchard and Kremer (1997), with two main differences: First, we assume that firms are endowed with a unit of an intermediary good that they cannot directly consume. Second, we allow for the presence of trade credit, or claims on future output, and later a banking system.

[8]Assuming symmetry across firms, it is clear that inputs N will exchange at the same price in every market. Thus, a price $p = 1$ is an equilibrium price.

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input may for example involve the production of a much simpler good, with a lower value, because it avoids the division of labor that is present in the production chain. Every firm has to purchase its own input from another firm, the supplier, at a price of $p = 1$. All firms use an identical production technology. The production function of firm i is represented by the following linear function

$$y_i = \lambda N_j$$

with $\lambda > 1$ and N_j the input that firm i purchased from firm j. Final output can be consumed by the entrepreneur. Suppliers can decide to stay out of the production chain and, instead of producing, obtain the liquidation value of N, which is equal to μN, with $\mu < 1$. Since $\lambda > 1 > \mu$, firms have an incentive to supply inputs to each other, i.e. to enter the production chain.

Following Smith's idea of external economies of scale, we assume that the more specialized the production process, the larger is aggregate output. In other words, the 'aggregate production function' is increasing in the number of inputs used - reflecting the length of the production chain or the degree of specialization of the economy. Define Y as aggregate output

$$Y = f(ny_i)$$

with n the number of firms in the economy and $f'_n > 0$. Assuming that there is a continuum of firms, we can simply represent aggregate output as the following linear

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function.

$$Y = f(ny_i) = \Psi^n ny_i$$

with $\Psi > 1$.

Given that there is a time interval between the sale-purchase of inputs and the completion of production, suppliers of inputs obtain a claim on the output of their customers in the amount of N. In other words, the equilibrium is supported by a system of trade credit (in the form of accounts payable and accounts receivable). Assume firms grant each other trade credit at zero interest. Each firm is both creditor and debtor in the inter-enterprise trade credit market. In other words, an entrepreneur simultaneously lends to his customers and borrows from his suppliers. The entrepreneur's balance sheet has accounts receivable and accounts payable. Hence the entrepreneur is exposed to the risk of default by his customers. Assume $\pi \in [0,1]$ is the probability of default in the economy.

Finally, the strength of credit market institutions, or the degree of contract enforcement, is measured by the share of a loan that the lender recovers if the borrower defaults, i.e. the recovery rate $\beta \in [0,1]$[9]. This parameter reflects a large number of institutional variables, such as the quality of bankruptcy law and the judicial system for commercial disputes. Partly stimulated by research on transition economies, the literature widely

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[9]Enforcement is perfect when $\beta = 1$.

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acknowledges the importance of institutions for the functioning of financial markets[10].

Figure 1 below shows a clear positive relationship between the development of the financial system, measured as the credit-to-GDP ratio, and recovery rates[11] in our sample.
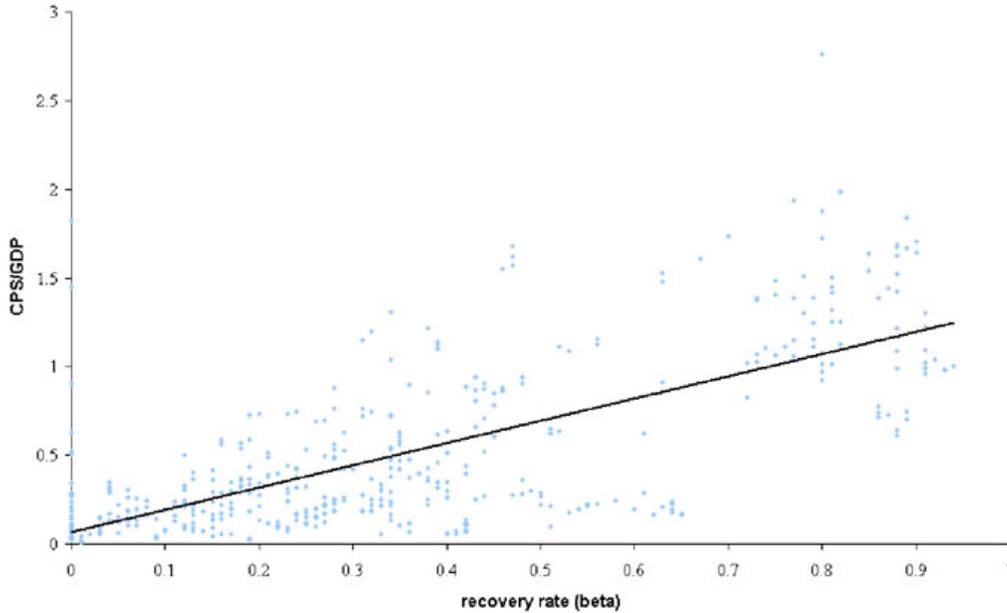
Figure 1: Financial development and recovery rate

If the customer defaults, the supplier will receive only a fraction of its claim, namely βN. Given the possibility of default and non-perfect contract enforcement, firms have to decide whether they want to enter the production chain (henceforth PC) described above or sell their endowments on the 'secondary market'. Such choice depends on the value of expected utility associated with entering the PC compared to the certain utility obtained through liquidation of the initial endowment. Assuming firms are risk-neutral,

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[10]See for example Roland (2000).

[11]Recovery rates are taken from the World Bank Doing Business surveys 2004-2007.

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the expected utility of a firm entering a PC is

$$E(U)^{pce} = (1 - \pi)\lambda N + \pi(\lambda - 1 + \beta)N$$

which has to be compared with the liquidation value μN obtained in 'autarchy'. Hence, the firm will enter the PC if and only if

$$(1 - \pi)\lambda N + \pi(\lambda - 1 + \beta)N > \mu N$$

or

$$\beta > \frac{\mu + \pi - \lambda}{\pi} = \beta^* \tag{1}$$

In other words, the production chain equilibrium (PCE) can only arise if contract enforcement in credit markets is sufficiently high. The PCE is clearly Pareto optimal. Not only is individual output higher than under 'autarchy', aggregate output also increases with the length of the chain.

2.1.1 Collapse of production chains following a shock

For a given β, factors inducing an increase in β^* may produce a switch from a PCE to an 'autarchic' equilibrium. Such a factor is the probability of default, π, that can be affected by negative shocks to the economy.

β^* has the following properties:

$$\frac{\partial \beta^*}{\partial \pi} > 0 \; ; \; \frac{\partial \beta^*}{\partial \mu} > 0 \; ; \; \frac{\partial \beta^*}{\partial \lambda} < 0$$

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For our analysis, the most interesting effect is the impact of an increase in the probability of default on β^*. Given β, a shock to π can lead to the breakdown of a PCE and a reversal to autarchy, explaining crisis volatility in countries with poor levels of contract enforcement. Indeed, if we interpret an increase in the probability of default as resulting from shocks to the economy, the positive impact of an increase in π on β^* implies that a shock can lead to a discrete collapse in output in countries with underdeveloped credit markets (β close to β^*). If β^* increases, following an increased probability of default, then β might fall short of the new threshold β^*, in which case the PCE breaks down[12].

Associated to the cut-off value of $\beta = \beta^*$ there is a cut-off value of the probability of default, π^* . Because the value of π^* depends on the level of development of credit markets, the likely condition of EMs, with less efficient financial markets, is one in which π^* is small - or equivalently β is low and close to β^*. In other words, EMs are more likely to find themselves in the autarchic equilibrium or to revert to it after a shock to the probability of default. Hence, the model shows how poor contract enforcement in credit markets may help explain not only the fact that EMs display higher output volatility but also the observation that volatility in EMs tends to be associated with

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[12]Note that it is not the level of trade credit per se that increases the vulnerability to shocks in this model. Rather, it is the combination of weak credit market institutions and the extensive usage of trade credit that sharply magnifies exogenous shocks through the break-up of production chains. A banking sector may arise to mitigate that vulnerability.

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discrete and large changes in output, rather than regular random variations around a trend[13].

Figure 2 depicts the relationship between total expected utility (output) and the probability of default π and represents the various possible equilibria a given economy can end up in for different levels of contract enforcement β. Identify a cut-off value of the probability of default, π^*, that is the one associated with $\beta = \beta^*$. With perfect enforcement ($\beta = 1$), output is $\Psi^n n\lambda N$, that is the level of output associated with the Pareto optimal solution. Note that, with perfect enforcement, the PCE will always arise given that $\beta^* < 1$. Moreover, for any d however small, the PCE will be the one without generalized default. When $\pi < \pi^*$ but $\beta < 1$, the economy is in a PCE and output is a continuous decreasing function of π, namely $\Psi^n n(\lambda - \pi d)N$. The slope of the relationship is $-(1 - \beta)\Psi^n nN$. In other words, an increase in π induces a reduction in output along the chain linking the various firms in a PCE. However, the new equilibrium is qualitatively identical to the previous one. By contrast, passed π^* the system switches to the 'autarchic equilibrium', with output equal to $n\mu N$. The magnification effect induced by the break-up of the PCE is proportional to $(\Psi^n\lambda - \mu)$. Note that the loss $\Psi^n\lambda - \mu$ is not internalized by the individual firm, that perceives that passed π^*, its utility is higher in autarchy. Figure 3 depicts the relationship between expected utility and the probability of default at the firm level.

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[13]See Hnatkovska and Loyaza (2004) for empirical evidence.

The notion of 'crisis volatility' is captured in our model by the switch from an equilibrium with a production chain to one without it. The presence of a banking sector providing financing to enterprises and thus avoiding a credit chain would significantly decrease the probability of a switch from a production chain equilibrium to autarchy.
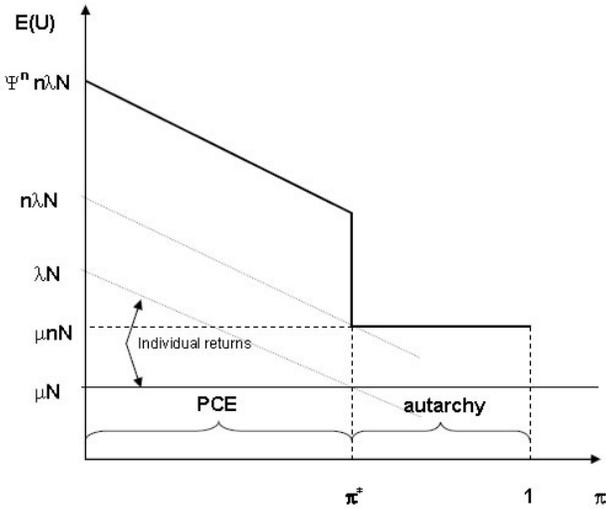
2.jpg

Figure 2: Production Chain Equilibrium and Autarchy - Aggregate level of production and utility

2.2 A model of production chains with trade credit and bank credit

In this section, we enrich the model with a banking system that can provide funds to firms to finance the purchase of inputs. Assume firms can finance their inputs with trade credit (TC) and bank credit (BC). Assume further that there is an equilibrium

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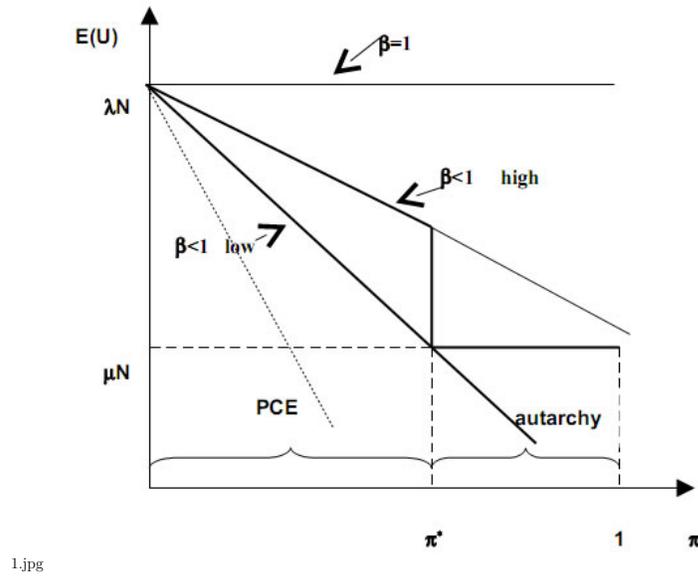
Figure 3: Production Chain Equilibrium and Autarchy - Individual level of production and utility

ratio of trade-to-bank credit, which depends on the relative convenience and availability of the two instruments. In the limiting case of a fully circular chain with trade credit only, the default of one firm is transmitted through the chain and may result in a generalized default because of symmetry across firms. A shock that hits a given proportion of firms will result in generalized default ex post when TC is the only available form of external finance. In other words, when an adverse shock hits a given number of firms, there will be default in payments at every link in the chain, even if the original shock affected firms far away from a given link. By contrast, default of an individual firm does not affect payments throughout the chain when bank credit is available. Each firm finances its purchases with cash and has a debt position with the bank. Banks take into account the probability of default of their customers and the loss given default

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when pricing their loans. The probability of default is equal to the average proportion of firms defaulting.

Let's assume as before that π is the probability of occurrence of an adverse shock (the probability of default). Denote with α' the share of firms in a TC-only system that are hit by the shock, directly and indirectly (ex post) through the chain. Denote with α the share of firms hit by the shock in a system with bank credit. It follows from the above reasoning that $\alpha' > \alpha$. Without loss of generality, we can assume that $\alpha' = 1$. Assuming that banks lend to all the firms in the chain, the probability of default in an equilibrium with only bank financing is $\alpha\pi = \pi' < \pi$[14].

Banks raise funds necessary for lending at a given constant cost r^*. The break-even condition for banks implies that the lending rate r is such that expected income for the bank equals its funding costs, a condition that is satisfied in a competitive banking sector.

$$(1+r)(1-\pi') + \pi'\beta = 1 + r^*$$

or

$$r = \frac{\pi'}{(1-\pi')}(1-\beta) + \frac{r^*}{(1-\pi')} \qquad (2)$$

[14]Given symmetry across firms, default in trade credit payments does not affect default on bank loans. One way to rationalize this characterization is that banks are senior creditor with respect to suppliers, a feature common to most legal systems.

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We assume that the ratio between the two forms of financing, trade credit and bank credit, is exogenous. This assumption is consistent with the view in Fisman and Love (2003) and Giannetti et al. (2007) according to which the two forms of financing are related to technological factors. Define $\gamma = \frac{TC}{(TC+BC)}$, the share of trade credit in total credit. Initially, we also assume that $r^* = 0$. The condition for entry in the production chain becomes

$$\pi(\lambda + \beta - 1)TC + (1 - \pi)(\lambda + 1 - 1)TC + (\lambda + 1 - 1 - r)BC > \mu N$$

$$\beta > 1 - \frac{\lambda - \mu}{\pi\gamma + \frac{\pi'}{(1-\pi')}(1 - \gamma)} = \beta^{**} \tag{3}$$

Under mild assumptions about the characteristics of the shocks affecting the system, a larger banking sector (a lower γ) increases the probability of obtaining a production-chain equilibrium (PCE). A sufficient condition is that the probability of an aggregate shock is low, or in other words, that the probability of a very large shock is low. This is a mild condition as it has been observed that large declines in aggregate economic activity are rare events[15]. Therefore, countries with developed financial sectors tend to be far away from the critical value of β that triggers the switch to autarchy. The condition under which bank credit increases the probability of a PCE is

$$\pi < \frac{1 - \alpha}{\alpha} \tag{4}$$

In the case of an aggregate shock ($\alpha = 1$), $\beta < \beta^{**}$ and thus the presence of a banking sector makes it harder to maintain the PCE.

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[15]See Levchenko et al. (2008).

Similarly, if the shock arises from the financial sector, for instance through higher interest rates, a larger banking sector may magnify the shock and induce a break-up of production chains. Indeed, the presence of the banking sector exposes the country to potential financial shocks. These shocks can be analyzed by considering an increase in funding costs r^*, which we now assume to be greater than zero. With $r^* > 0$ the new critical value, β^{***}, becomes

$$\beta > 1 - \frac{\lambda - \mu}{\pi\gamma + \frac{\pi'}{(1-\pi')}(1-\gamma)} + \frac{r^*}{(1-\pi')}(1-\gamma)\left[\frac{1}{\pi\gamma + \frac{\pi'}{(1-\pi')}(1-\gamma)}\right] = \beta^{***} \quad (5)$$

Higher funding costs for banks increase β^{***}, and thus reduce the range of parameter values consistent with a PCE. The strength of the financial shock depends on the size of the banking sector, through the share $(1 - \gamma)$. Therefore, the benefits of a more developed domestic financial sector have to be weighed against the greater exposure to financial shocks. Countries with weak institutions, summarized by low β, are vulnerable to financial shocks, which may induce a switch from a PCE to autarchy. This result suggests that the role of financial development in softening shocks depends on the nature of the shocks and, in addition, on the institutional strength of the financial sector (the parameter β). This result has the following empirical implications: An increase in the credit-to-GDP ratio (CPS) is equivalent to an increase in β and as a result a lower risk of collapse of the production chain. Furthermore, an increase in $(1-\gamma)$ corresponds to an increase in the relative weight of bank credit with respect to trade credit. This implies lower β^{**} and β^{***} and thus a higher probability of a PCE, except in the case of financial and aggregate shocks (higher r^* or higher α).

In the model, there are two channels through which trade credit affects the response of the economy to shocks. First, at the firm level, higher reliance on trade credit *relative* to bank credit increases the probability of a shift to autarchy following an adverse shock. In the model, an increase in $\gamma = \frac{TC}{(TC+BC)}$ increases β^{**}, thus making it harder to sustain a PCE. The individual effect is amplified if all firms in the chain have a larger reliance on trade credit, and thus the country-level ratio of trade credit to bank credit is larger. In the model, as we assume that all firms are alike, the individual γ is equal to the aggregate γ. The second channel relates to the interaction between trade credit chains and the overall level of development of the financial sector. In our model this is summarized by the value of β. A higher β makes the PCE more likely. This implies that sectors that rely more on trade credit (relative to bank credit) have a better performance (less risk of autarchy) in countries with a higher development of financial sector (higher β).

3   Empirical analysis

Figure 4 shows that countries with a less developed banking system tend to experience sharper output falls. Dividing our sample in quartiles based on the distribution of credit-to-GDP ratios (CPS/GDP), it turns out that the average percentage deviation of output decline from its full sample mean is 44.65 percentage points higher in the first quartile (lowest credit-to-GDP ratios) than in the fourth quartile (highest credit-

to-GDP ratios)[16].

In the next section we investigate whether the negative relationship between the magnitude of output drops and the depth of credit markets survives in an econometric analysis, which allows to control for other factors affecting output falls.
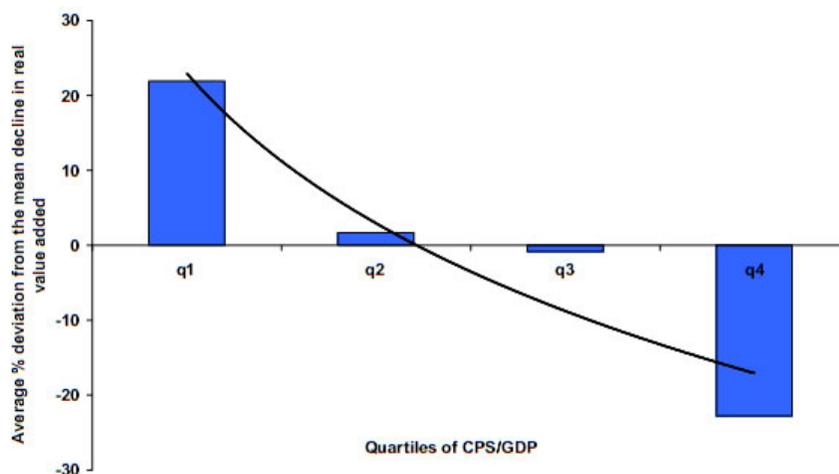
Figure 4: Percentage falls in real value added and financial development

3.1 Sample and data issues

Our starting point is the analysis of Rajan and Zingales (1998), which has become a main reference in the literature on finance and growth, mainly because the authors addressed the problem of endogeneity and reverse causality, which characterized most of the cross-country literature. Using industry-level data, Rajan and Zingales proposed

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[16]This difference is significant at conventional levels.

a solution to this problem. In particular, they used the dependence on external finance of manufacturing sectors in the US as a measure of the 'technological' dependence on external finance of these industries worldwide. The idea is based on the assumption that US financial markets are close to perfect and thus the financial structure of firms in the US is determined by an optimal choice, based solely on technological factors. In addition, Rajan and Zingales argue that differences across firms in the same sector are minor, and thus sectoral indicators are a good proxy for firm-level dependence on external finance. Since the US indicators of financial dependence can be considered as exogenous indicators of financing needs, a cross-country analysis of industrial output growth, excluding the US, can be used to determine the impact of financial development on growth. The sectoral US financial dependence indicator is multiplied by the level of financial sector development in different countries to construct what is by now a familiar indicator in the literature, the Rajan-Zingales indicator (henceforth RZ indicator). In our estimations, we interact the RZ indicator of external dependence with the private sector credit-to-GDP ratio. A positive coefficient on the RZ indicator implies that sectors that need more external finance grow faster in countries with a more developed financial sector. We make use of this methodology in order to test the implications of our theoretical model.

We use value added data from the UNIDO database. Our main sample covers a total of 115 countries across 28 manufacturing industries (3-digit ISIC Rev.2 level) between

1963 and 2004[17]. Data are deflated using CPI from the IMF IFS database[18]. Our sample is dominated by emerging markets and developing countries. Using the World Bank income categorization, 29 countries are 'low income', 27 are 'lower middle income', 27 are 'upper middle income', and 32 are 'high income'. By contrast, the sample used by Rajan and Zingales (1998) covers only 41 countries between 1980 and 1990 and is dominated by high-income countries. Using the World Bank classification, their sample consists of 5 low-income countries, 7 lower-middle income countries, 8 upper-middle income countries and 21 high income countries. This difference is important since we are interested in studying episodes of sharp output contraction, many of which happened in emerging markets after 1990 (e.g. ouput collapse in the fomer Communist block, the Mexican crisis, the Asian crisis and the Russian crisis). A statistical description of the sample is provided in the Appendix.

In addition, we introduce a methodological extension. Instead of working with annual data, we conduct our analysis on 'episodes' of growth or decline in value added. We trace the episodes of output decline (growth) starting from the first year of negative (positive) output change until the end of the contraction (expansion). We believe this is a better approach for dealing with a data set that has a lot of missing data, especially for emerging markets. We define two different measures that capture industry decline

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[17]Since the time span is not the same across all countries, we have an unbalanced panel.

[18]The choice of CPI as deflator allowed us to retain the largest possible number of countries, as for many developing countries the CPI is the only price index available for a long time series.

(growth). The first measure is simply the absolute value of the average percentage change of value added over the period of decline (growth) - from the first year to the trough (peak) of the recession (expansion). In other words, it is the absolute value of

$$\triangle\% = [(1 + \triangle_{t-n-1})...(1 + \triangle_{t-1})(1 + \triangle_t)] - 1$$

for an episode that lasts n years, where $\triangle_t$ represents the percentage change between year $t-1$ and t. The second measure is related to the 'area' of the output decline (growth), also from the first year to the trough (peak) of the recession (expansion). For notational simplicity, define $\triangle = (1 + \triangle_{t-n-1})...(1 + \triangle_{t-1})(1 + \triangle_t)$. Then, the 'area' variable is

$$\text{AREA} = \frac{1 + (1 + \triangle_{t-n-1}) - 2\triangle}{2} + ... + \frac{(1 + \triangle_{t-2}) + (1 + \triangle_{t-2})(1 + \triangle_{t-1}) - 2\triangle}{2}$$
$$+ \frac{(1 + \triangle_{t-2})(1 + \triangle_{t-1}) - \triangle}{2}$$

for an episode of decline that lasts n years.

Since our aim is to study crisis episodes, we distinguish between mild and sharp output contractions, and focus on the latter. We define sharp contractions as cumulative falls in real value added greater than the median value for the whole sample, which is 0.1658 for the percentage variable and 0.1076 for the area variable[19].

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[19]Calvo et al. (2006) use a similar measure to identify episodes of sharp recessions at the country level.

3.2 OLS estimations - truncated sample

We first replicate the analysis of Rajan and Zingales using a sample that consists of the episodes of sharp contractions in valued added and estimate the following model

$$\text{Growth}_{j,k} = \text{Constant} + \beta_{1...m}.\text{Country Indicators}$$

$$+ \beta_{m+1...n}.\text{Industry Indicators}$$

$$+ \beta_{n+1}.(\text{Industry } j\text{'s share of manufacturing in country } k \text{ in first available year})$$

$$+ \beta_{n+2}.(\text{External Dependence of industry } j \text{ . Financial Development of country } k)$$

$$+ \epsilon_{j,k}$$

As in Rajan and Zingales (1998), we include sector and country dummies to account for omitted variables. The regression includes an industry's share of total manufacturing in a country in the first available year of observation for that country-industry combination in order to control for convergence effects, namely the fact that certain industries will grow faster just because they start from a very low level. As mentioned above, an industry's dependence on external finance is measured by the RZ indicator.

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To avoid endogeneity problems, related to the potential reverse causality between industry growth and the level of financial development, we use the credit-to-GDP ratio in the first year of each episode.

Table 1 reports the results of these OLS estimations[20]. During episodes of decline, we find a significantly negative effect of credit market development on the magnitude of output falls for both measures, average percentage change or area. This indicates that industries which are relatively more dependent on external finance suffer relatively smaller declines in countries with better financial sector development. In other words, even after controlling for sector and country effects, a higher level of financial development significantly reduces the magnitude of output declines[21]. If we constrain our sample to include sharp contractions only, namely contractions greater than the median

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[20]As a robustness check, we also estimate the model using output data instead of value added and find that results do not change substantially. They are not reported here. Our output sample covers a total of 120 countries across the same 28 industries between 1963 and 2004, and has a very similar composition in terms of countries' income levels.

[21]We also checked whether the effects could be nonlinear, with the coefficient on the interaction term varying depending on the depth of credit markets. We multiplied the interaction term between financial development and the RZ-measure of external dependence with a dummy for each quartile of the credit-to-GDP ratio in our sample. The coefficients on the interaction terms are all negative and significant at conventional levels. The effect decreases as countries become more financially developed. These results are not reported here.

Table 1: Episodes of decline - value added data; OLS robust std errors (t-statistics between brackets)

Periods of economic downturn	Percentage change	Area
Industry's share of total output in first year of sample	-0.095 (-2.68)*	0.018 (0.31)
Interaction (financial development x RZ-indicator)	-0.041 (-2.61)*	-0.074 (-2.59)*
Number of observations	13339	13339
Periods of sharp contraction	**Percentage change**	**Area**
Industry's share of total output in first year of sample	-0.072 (-1.56)	0.123 (1.28)
Interaction (financial development x RZ-indicator)	-0.052 (-2.01)**	-0.159 (-2.72)*
Number of observations	6554	6563

Note: Significance levels are (*) 1%; (**) 5%; and (***) 10%.

in absolute value, we obtain similar results. The fact that the coefficients on the interaction term are larger in absolute value than when all episodes of decline are included, suggests that credit markets matter most during deep recessions.

3.3 Probit and logit estimations - full sample[22]

The above analysis is subject to the criticism that the OLS coefficients may be biased because, by isolating episodes of decline, we truncate the sample and ignore the information effectively contained in the positive growth data. In order to address this point and verify the robustness of our results, we perform a Probit estimation on the full sample of episodes, i.e. the sample that includes both episodes of downturn and growth. The dependent variable is a dummy that takes the value 1 if the episode is a downturn and the value 0 if positive growth is observed. The probit model is defined as

$$Pr(y = 1|x) = \Phi(xb)$$

where Φ is the standard cumulative normal probability distribution and xb the probit index specified as in the OLS model.

In addition, we estimate a logit model using the method of penalized maximum likelihood in order to solve a 'separation problem' present in our data set[23]. The logit model

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[22]Since the results are similar whether we use the percentage or area variable, we only use the percentage variable in the remainder of the paper.

[23]'Separation' occurs when a single type of episode (downturn or growth) is observed for a country-industry combination and consequently that specific country-industry combination perfectly predicts the binary outcome. Since our statistical software package (Stata) addresses the separation issue by simply dropping the problematic observations in the probit estimations, we estimate a logit model with

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is defined as

$$Pr(y = 1|x) = F(xb) = \frac{1}{1 + e^{-xb}}$$

where xb is the logit index specified as in the OLS model in the previous section.

Table 2 presents the regression coefficients from the probit and logit estimations using two samples. The first sample contains 49 countries used in the analysis by Rajan and Zingales (1998), the second includes 103 countries. Both samples only include sharp downturns as defined above. The coefficient on the interaction term between financial

Table 2: Episodes of sharp decline - value added data; logit and probit estimations

Logit (penalized maximum likelihood)				
	coeff. on cpsrz	std. error	p-value	no. of obs
Rajan Zingales sample	-0.238	0.201	0.236	10343
All countries	-0.336**	0.156	0.031	18491
Probit (maximum likelihood)				
	coeff. on cpsrz	std. error	p-value	no. of obs
Rajan Zingales sample	-0.126	0.118	0.284	10343
All countries	-0.192**	0.092	0.037	18491

Note: Significance levels are (*) 1%; (**) 5%; and (***) 10%. Coefficients on other variables are omitted for brevity.

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a method based on a penalized likelihood correction to the standard binomial GLM score function as proposed by Zorn (2005).

dependence and financial development is negative in both samples. A negative coefficient means that industries that are relatively more dependent on external finance are less likely to experience a sharp decline in value added in countries with developed financial markets. However, the coefficient is only significant (at the 5% level) in the larger sample. It is not surprising that the coefficient is larger in absolute value and more significant in the larger sample as the latter is dominated by emerging markets and developing countries. By contrast, the sample used by Rajan and Zingales (1998) is dominated by high-income countries.

Table 3 reports the average interaction effects between financial development and financial dependence obtained from the above logit and probit estimations. In non-linear models like logit and probit, the marginal effect of a change in both interacted variables is not equal to the marginal effect of changing just the interaction term, meaning that one cannot simply use the coefficient on the interaction term reported in Table 3 to study the interaction effect between financial development and dependence on external finance. The interaction effect is defined as the change in the predicted probability of a downturn for a 1-unit change in both the credit-to-GDP ratio and the RZ indicator of financial dependence. In other words, it is the double derivative with respect to financial development (cps) and financial dependence (rz). For the probit model, it is

computed as follows[24]

$$\frac{\partial^2 \Phi(xb)}{\partial cps \partial rz} = [\beta_{n+2} - (\beta_{n+2} * cps)(\beta_{n+2} * rz)xb]\phi(xb) \tag{6}$$

For the logit model, it is computed as

$$\frac{\partial^2 F(xb)}{\partial cps \partial rz} = \beta_{n+2}[F(xb)(1-F(xb))]+(\beta_{n+2}*rz)(\beta_{n+2}*cps)[F(xb)(1-F(xb))(1-2F(xb))]$$

$$\tag{7}$$

The average interaction effects are similar in both the logit and probit estimations, suggesting that the separation problem is not severe. In the RZ sample, on average, the probability of a downturn decreases by between 4.1% and 4.6% when both financial development and financial dependence increase by 1 unit. In the overall sample, on average, the probability of a downturn decreases by between 6.5% and 6.9% when both financial development and financial dependence increase by 1 unit. Again, given that our sample contains relatively more emerging markets, it is not surprising to find a larger interaction effect on the whole sample.

It is very difficult to obtain a z-statistic for the interaction effects in the logit and probit models with so many indicator variables[25]. However, the significance of the

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[24]We compute the interaction effects as in Ai and Norton (2004).

[25]To remind, we have 28 industry indicators and 103 country indicators.

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Table 3: Episodes of sharp decline - value added data; average interaction effects from logit and probit estimations

Logit (penalized maximum likelihood)					
	mean	stdev.	min	max	no. of obs
Rajan Zingales sample	-0.046	0.010	-0.060	-0.015	10343
All countries	-0.069	0.013	-0.085	-0.012	18491
Probit (maximum likelihood)					
	mean	stdev.	min	max	no. of obs
Rajan Zingales sample	-0.041	0.007	-0.050	-0.014	10343
All countries	-0.065	0.010	-0.077	-0.009	18491

interaction effects can easily be investigated in the probit model when the country-industry indicators are omitted and we control for country and industry fixed effects by including financial dependence and financial development separately as additional explanatory variables. The results are presented in Tables 4 and 5. The coefficients on the interaction term reported in Table 4 are similar in magnitude to the coefficients obtained from the logit estimations with country-industry indicators. They are significantly negative in both samples. The average interaction effects reported in Table 5 are larger than the ones obtained from the models with the country-industry indicators. In the RZ sample, on average, the probability of a downturn decreases by 9% when both financial development and financial dependence increase by 1 unit. In the overall sam-

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ple, on average, the probability of a downturn decreases by 10.1% when both financial development and financial dependence increase by 1 unit.

Table 4: Episodes of sharp decline - value added data; logit and probit estimations

Probit (maximum likelihood)				
	coeff. on cpsrz	std. error	p-value	no. of obs
Rajan Zingales sample	-0.282**	0.125	0.024	10343
All countries	-0.293*	0.097	0.003	18491

Note: Significance levels are (*) 1%; (**) 5%; and (***) 10%. Coefficients on other variables are omitted for brevity.

Table 5: Episodes of sharp decline - value added data; average interaction effects from logit and probit estimations

Probit (maximum likelihood)					
	mean	stdev.	min	max	no. of obs
Rajan Zingales sample	-0.090	0.011	-0.105	0.005	10343
All countries	-0.101	0.012	-0.117	0.015	18491

Figures 5 and 6 plot the z-statistics of the interaction effects against predicted probabilities of a downturn for the probit model above. The figures show that most interaction effects are significant at the 5% level, especially when the whole sample is used.

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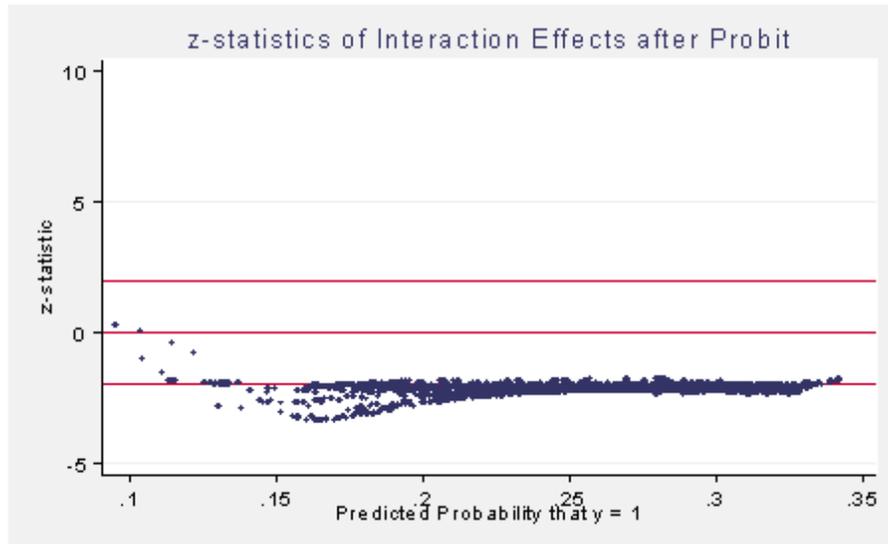
Figure 5: z-statistics of interaction effects - probit model, Rajan Zingales sample, sharp downturns.
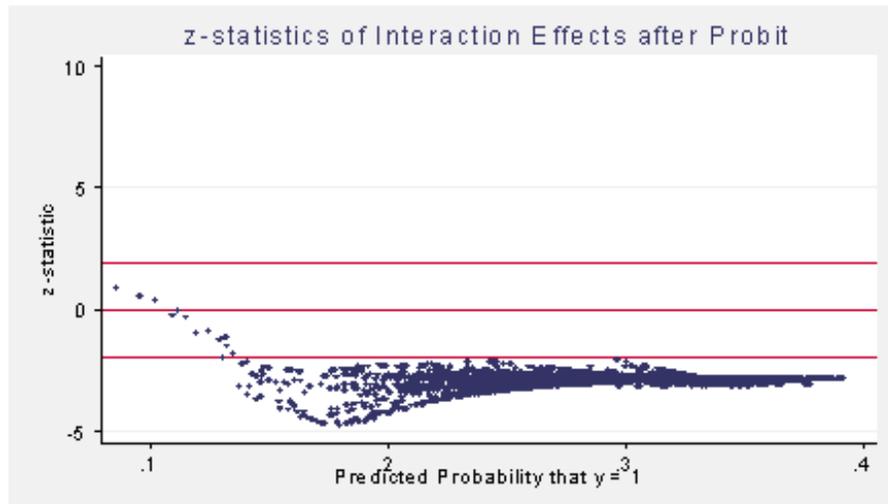
Figure 6: z-statistics of interaction effects - probit model, full sample, sharp downturns.

Visual analysis of logit results

We now perform a visual analysis of the results obtained from the logit regressions. We look at the impact of the credit-to-GDP ratio on the odds of a downturn[26] as

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[26]The odds of a downturn are defined as the ratio of the probability of a downturn to the probability of an upturn.

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a function of the RZ indicator of financial dependence. Using the logit regression results, we compute the predicted log odds of a downturn as a function of the credit-to-GDP ratio for the minimum and maximum values of the RZ indicator (-0.45 and 1.14 respectively). Figures 7 and 8 plot the predicted log odds of a downturn against the credit-to-GDP ratio for the minimum and maximum values of the RZ indicator when the RZ sample is used. Figures 9 and 10 present the analogous results for the entire sample. The predicted log odds of a downturn seem independent of financial development when financial dependence is low, i.e. when the RZ indicator is at its minimum. By contrast, the predicted log odds of a downturn clearly decrease with financial development when financial dependence is high.
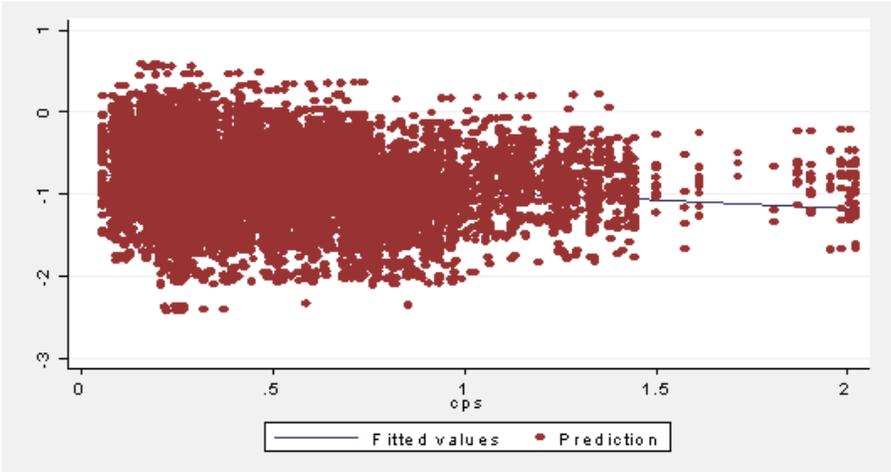
Figure 7: Predicted log odds of a downturn as a function of financial development when RZ indicator is at its minimum, RZ sample

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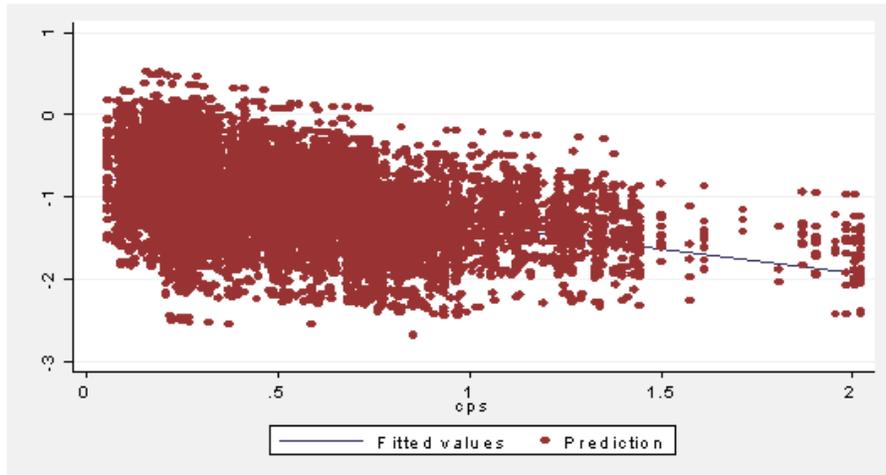
Figure 8: Predicted log odds of a downturn as a function of financial development when RZ indicator is at its maximum, RZ sample
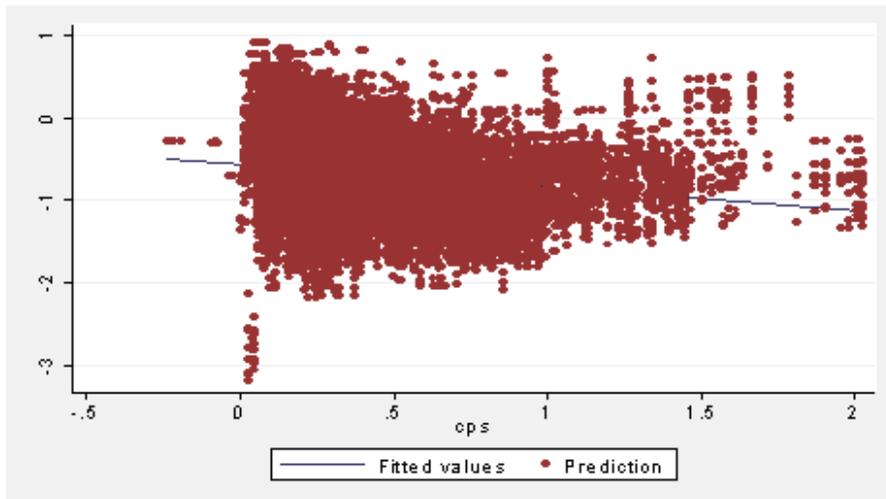
Figure 9: Predicted log odds of a downturn as a function of financial development when RZ indicator is at its minimum, full sample

3.4 Probit and logit estimations - controlling for financial crises

In order to control for the impact of financial crises, we also interact the interaction term between the RZ-indicator and financial development with a dummy for financial

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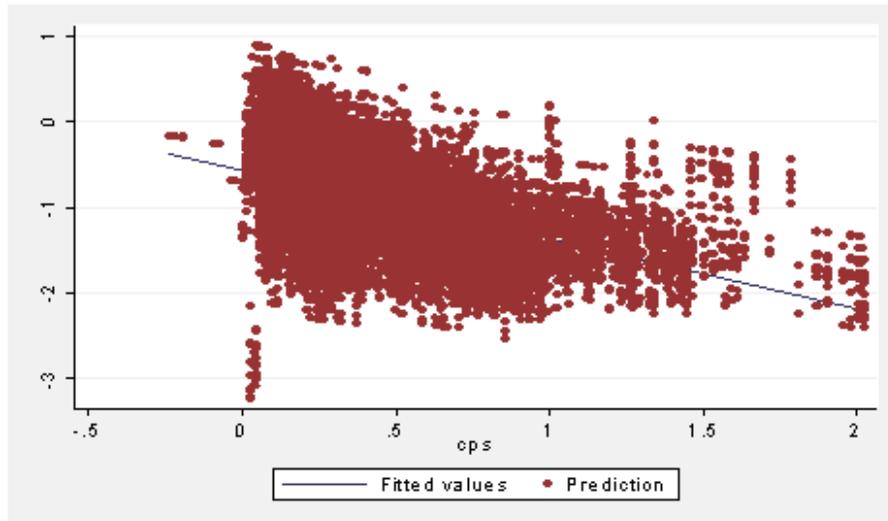
Figure 10: Predicted log odds of a downturn as a function of financial development when RZ indicator is at its maximum, full sample

and currency crises. The dummy is obtained by combining the financial crisis and currency crisis dummies from Cerra and Saxena (2008). In this case the probit and logit indices become

$$\text{Growth}_{j,k} = \text{Constant} + \beta_{1\ldots m}.\text{Country Indicators}$$

$$+ \beta_{m+1\ldots n}.\text{Industry Indicators}$$

$$+ \beta_{n+1}.(\text{Industry } j\text{'s share of manufacturing in country } k \text{ in first available year})$$

$$+ \beta_{n+2}.(\text{External Dependence of industry } j . \text{Financial Development of country } k)$$

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$+ \beta_{n+3}.$(External Dependence of industry j . Financial Development of country k).

(crisis dummy)

$+ \epsilon_{j,k}$

The results are reported in Table 6. The coefficients on the interaction between financial dependence and financial development (crpsrz) are negative in both samples and significant at the 1% level, an improvement on the estimations without the crisis dummy. The coefficients on the additional interaction term (crisiscpsrz) are significantly positive at the 1% level. A positive coefficient indicates that during a financial or currency crisis, industries which are relatively more dependent on external finance are more likely to experience sharp decreases in value added in countries with more developed financial markets. In other words, well-developed financial markets cannot cushion shocks to the economy that originate in the financial sector. The coefficient on crisiscpsrz is systematically larger in absolute value than the coefficient on cpsrz, indicating that well-developed financial markets will overall increase the likelihood of sharp declines in value added when the recession originates from shocks to the financial sector. In other words, financial markets become a shock-transmittor rather than a shock-absorber when the shock originates in the financial sector.

Table 6: Episodes of sharp decline - value added data; logit and probit estimations with financial crisis dummy

Logit (penalized maximum likelihood)			
	coeff. on cpsrz	coeff. on crisiscpsrz	no. of obs
Rajan Zingales sample	-0.799*	1.016*	10343
All countries	-0.780*	0.948*	18491
Probit (maximum likelihood)			
	coeff. on cpsrz	coeff. on crisiscpsrz	no. of obs
Rajan Zingales sample	-0.457*	0.594*	10343
All countries	-0.455*	0.560*	18491

Note: Significance levels are (*) 1%; (**) 5%; and (***) 10%. Coefficients on other variables are omitted for brevity.

3.5   Relative dependence on bank credit versus trade credit

In the model, there are two channels through which trade credit affects the response of the economy to shocks. In this scetion, we investigate the first one. In the model, higher reliance on trade credit relative to bank credit at the firm level increases the probability of a shift to autarchy following an adverse shock. In the model, an increase in $\gamma = \frac{TC}{(TC+BC)}$ increases β^{**}; thus making it harder to sustain a PCE. The individual effect is amplified if all firms in the chain have a larger reliance on trade credit, and thus the overall ratio of trade credit over bank credit is larger at the country level. To test the theoretical predictions, we use data from Raddatz (2008) on the ratio of short-

term debt to payables at the country and industry-level as an indicator of the country and industry-level relative dependence on bank credit vis-à-vis trade credit. This limits our sample to 40 countries and 28 industries[27]. We estimate the following model by OLS

$$\text{Growth}_{j,k} = \text{Constant} + \beta_{1\ldots m}.\text{Country Indicators}$$

$$+ \beta_{m+1\ldots n}.\text{Industry Indicators}$$

$$+ \beta_{n+1}.(\text{Industry } j\text{'s share of manufacturing in country } k \text{ in first available year})$$

$$+ \beta_{n+2}.(\text{External Dependence of industry } j \text{ . Financial Development of country } k)$$

$$+ \beta_{n+3}.(\text{External Dependence of industry } j \text{ . Financial Development of country } k).$$

(crisis dummy)

$$+ \beta_{n+4}.(\text{Relative Dependence of industry } j \text{ on bank credit}).$$

(Relative Dependence of country k on bank credit)

$$+ \beta_{n+5}.(\text{Relative Dependence of industry } j \text{ on bank credit}).$$

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[27]This reduces the number of observations to 10,474.

(Relative Dependence of country k on bank credit).(crisis dummy)

$+ \epsilon_{j,k}$[28]

As shown in Table 7, the interaction term between the RZ indicator and a country's financial development loses its significance. So does the interaction term with the crisis dummy. However, the coefficient on the interaction term between industry-level relative dependence on bank credit and country-level relative dependence on bank credit is significantly positive. This is in line with the theoretical model which predicts a positive coefficient on bctc_ic given that a higher ratio of bank credit to trade credit implies a higher probability of a PCE. As expected, the coefficient on the interaction between bctc_ic and the crisis dummy is significantly negative. This indicates that the role of the banking sector in softening shocks depends on the nature of the shocks. In particular, when shocks originate in the financial sector, a higher dependence on bank credit relative to trade credit no longer softens the ourput declines. In summary, higher bank credit ratios produce better performance (lower risk of autarchy), except for periods of financial crises.

In order to estimate the impact of the relative dependence on bank credit versus trade

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[28]We do not include the variable crisis separately because it is a country effect already captured by the country indicators.

Table 7: OLS regression; sample of episodes; dependent variable: cumulative percentage growth

	coefficient	p-value
Constant	-0.147*	0.000
Industry's share in first year	0.105	0.315
cpsrz	-0.043	0.175
Interaction btw cpsrz and crisis dummy	-0.006	0.825
bctc_ic	0.020***	0.051
Interaction btw bctc_ic and crisis dummy	-0.011**	0.016

Note: *cpsrz* is the interaction term between the RZ indicator of external dependence and the credit-to-GDP ratio; *bctc_ic* is the interaction term between the industry-level and country level ratios of bank credit to trade credit as measured in Raddatz (2008). Significance levels are (*) 1%; (**) 5%; and (***) 10%. Coefficients on other variables are omitted for brevity.

credit on the probability of a sharp contraction, we estimate the following Probit model

$$\text{Growth}_{j,k} = \text{Constant} + \beta_{1\ldots m}.\text{Country Indicators}$$

$$+ \beta_{m+1\ldots n}.\text{Industry Indicators}$$

$$+ \beta_{n+1}.(\text{Industry } j\text{'s share of manufacturing in country } k \text{ in first available year})$$

$+ \beta_{n+2}.$(Relative Dependence of industry j on bank credit).

(Relative Dependence of country k on bank credit)

$+ \beta_{n+3}.$(Relative Dependence of industry j on bank credit).

(Relative Dependence of country k on bank credit).(crisis dummy)

$+ \epsilon_{j,k}$

Table 8: Probit regression; sample of episodes; dependent variable: downturn dummy

	coefficient	p-value
Constant	-0.274	0.272
Industry's share in first year	-0.690***	0.095
bctc_ic	-0.096**	0.015
Interaction btw bctc_ic and crisis dummy	0.113***	0.000

Note: *bctc_ic* is the interaction term between the industry-level and country level ratios of bank credit

to trade credit as measured in Raddatz (2008). Significance levels are (*) 1%; (**) 5%; and (***) 10%.

Coefficients on other variables are omitted for brevity.

As can be seen from Table 8, the interaction term between industry and country-level relative dependence on bank credit is significantly negative, meaning that a higher dependence on bank credit at the country and industry level significantly reduces the probability of sharp contractions. This is no longer the case when shocks originate in the financial sector. These results are in line with Table 7.

3.6 Trade credit, bank credit and financial development

Finally, we investigate the second channel through which trade credit influences growth in the theoretical model. The second channel relates to the interaction between trade credit chains and the overall level of development of the financial sector, β. A higher β makes the PCE more likely. This implies that sectors that rely more on trade credit relative to bank credit have a better performance (lower risk of autarchy) in countries with a higher development of the financial sector. We test these theoretical predictions using the following OLS estimation

$\text{Growth}_{j,k} = \text{Constant} + \beta_{1...m}.\text{Country Indicators}$

$+ \beta_{m+1...n}.\text{Industry Indicators}$

$+ \beta_{n+1}.(\text{Industry } j\text{'s share of manufacturing in country } k \text{ in first available year})$

$+ \beta_{n+2}.(\text{External Dependence of industry } j \text{ . Financial Development of country } k)$

$+ \beta_{n+3}.$(External Dependence of industry j . Financial Development of country k).

(crisis dummy)

$+ \beta_{n+4}.$(Relative Dependence of industry j on bank credit).

(Financial Development of country k)

$+ \beta_{n+5}.$(Relative Dependence of industry j on bank credit).

(Financial Development of country k).(crisis dummy)

$+ \epsilon_{j,k}$[29]

As can be seen in Table 9, the coefficients on the variables involving the RZ indicator have again become insignificant. The coefficient on the interaction between the industry-level relative dependence on bank credit and the credit-to-GDP ratio is significantly negative, which is in line with the theoretical predictions (remember that bctc is the inverse of $\gamma = \frac{TC}{(TC+BC)}$). It is interesting to note that our results are different from those of Fisman and Love (2003), who found that sectors relying on trade credit

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[29]We do not include the variable crisis separately because it is a country effect already captured by the country indicators.

Table 9: OLS regression; sample of episodes; dependent variable: cumulative percentage growth

	coefficient	p-value
Constant	-0.037	0.415
Industry's share in first year	0.100	0.339
cpsrz	-0.014	0.671
Interaction btw cpsrz and crisis dummy	0.010	0.754
bctc_cps	-0.060*	0.000
Interaction btw bctc_cps and crisis dummy	-0.028**	0.019

Note: *cpsrz* is the interaction term between the RZ indicator of external dependence and the credit-to-GDP ratio; *bctc_cps* is the interaction term between the industry-level ratio of bank credit to trade credit as measured in Raddatz (2008) and credit-to-GDP. Significance levels are (*) 1%; (**) 5%; and (***) 10%. Coefficients on other variables are omitted for brevity.

performed better in coutries with lower levels of financial development as measured by the credit-to-GDP ratio. The reasoning behind this result is that firms in less-developed countries are able to grow by substituting scarce bank credit with trade credit. However, this need not be in contradiction with our results. The mechanism through which bank credit contributes to growth in our model is different. Our model highlights the mechanisms that are relevant during sharp output contractions: A well-developed financial sector is important to ensure growth when firms depend on trade credit because it buffers shocks that can lead to the collapse of the PCE. Again note that higher financial

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development no longer softens output declines when shocks originate in the financial sector.

4   Concluding remarks

This paper studies the potential asymmetric effects of financial markets on growth. The paper first develops a simple theoretical framework of production chains with credit chains in order to investigate the channels through which credit markets contribute to the magnification of negative exogenous shocks. The model shows that, when credit market institutions are weak (i.e. contract enforcement is low), exogenous shocks may induce a break-up of both credit and production chains, leading to sudden and sharp collapses in output. The development of a banking sector can mitigate downside output volatility, conditional on a given level of contract enforcement. By contrast, reliance on trade credit increases the vulnerability to a sudden output collapse. Hence, the model shows how weak credit market institutions may help explain the asymmetry found in the empirical analysis. However, when the shocks are aggregate and/or originate from the financial sector, a more developed banking sector cannot shield the economy from the adverse shocks. In fact, in such cases, the banking sector becomes a shock-transmittor rather than a shock-absorber.

The predictions of the model are tested using industry-level data across a large cross-section of countries. The empirical analysis shows with various model specifications

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that financial development plays an important role in reducing the probability and the magnitude of sharp contractions in value-added. In particular, industries which are relatively more dependent on external finance decline relatively faster (and/or are more likely to experience a decline) in countries with lower financial sector development, measured as the credit-to-GDP ratio. For countries at a low level of financial development, such a role may be more important than the positive effect of financial markets during periods of growth, which supports the conjecture that the impact of financial development on growth is asymmetric. The empirical analysis also provides support for the theoretical predictions regarding trade credit and its interaction with bank credit. First, we find that higher reliance on trade credit relative to bank credit at the firm and country levels increases the probability and magnitude of sharp contractions. Second, we find that sectors that rely more on trade credit relative to bank credit experience milder contractions in countries with a better developed financial sector. Finally, we find that when the shocks originate from the financial sector, a more developed banking sector cannot shield the economy from the adverse shocks.

The paper could be usefully extended along several directions. In addition to the identification of period of financial crises, it would be useful to identify different shocks to the various countries, distinguishing shocks arising from terms of trade changes - real shocks - and those arising from tightening of credit markets - financial shocks. Finally, episodes of downturn and growth could be classified in a finer way. In addition to the distinction between periods of mild decline and deep recessions, upturns can

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be separated between periods of recovery and growth[30]. Finally, the role of different sources of financing during the recovery period following sharp output decline could be investigated in order to verify at the industry level the phenomenon of credit-less recoveries observed in macroeconomic data.

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[30]See also Hausmann et al. (2005) on growth accelerations.

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Appendix: Descriptive statistics - episodes of decline

Table 10: Descriptive statistics - overall averages and standard deviations

	mean	**std. dev.**
percentage	0.2471831	0.244562
area	0.2608466	0.4270972
CPS/GDP	0.4091753	0.3189869
Real GDP per capita	9211.248	7460.719

Note: Real GDP per capita at 2000 USD PPP from Penn World Tables

Table 11: Descriptive statistics - by World Bank income categories

	percentage	**area**	**CPS/GDP**	**Real GDP per capita**
Low income	0.3083234	0.299191	0.1714772	1479.227
Lower middle income	0.2967555	0.2882302	0.2581137	3613.993
Upper middle income	0.2671119	0.287795	0.3289129	8186.305
High income: OECD	0.1554151	0.1943514	0.630864	16272.59
High income: non OECD	0.2750322	0.2879059	0.6593155	17474.61

Table 12: Descriptive statistics - by quartiles of the sample distribution of credit-to-GDP

	percentage	area	CPS/GDP	Real GDP per capita
Q1	0.2968287	0.2914494	0.1250744	3577.683
Q2	0.245981	0.253351	0.2397689	7192.928
Q3	0.2392876	0.2531248	0.420091	10014.06
Q4	0.1855446	0.2217815	0.8810022	16390.43

Table 13: Descriptive statistics - by quartiles of the sample distribution of real GDP per capita

	percentage	area	CPS/GDP	Real GDP per capita
Q1	0.2925583	0.2662823	0.1782823	1705.991
Q2	0.2850261	0.3033266	0.3020533	4704.908
Q3	0.2143717	0.2401186	0.4547584	10566.14
Q4	0.1964281	0.2365459	0.7051304	19912.6

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