DISCUSSION PAPER SERIES

No. 6885

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INTERNATIONAL MACROECONOMICS

Centre for Economic Policy Research

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ISSN 0265-8003

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Discussion Paper No. 6885
June 2008

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ABSTRACT

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JEL Classification: E44 and O43
Keywords: credit and output, emerging economies and sharp recessions

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* The authors would like to thank Guido Borà for excellent research assistance.

Submitted 16 June 2008

Finance and growth: When does credit really matter?

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June 2008
(Preliminary draft)

Abstract

The paper provides a simple theory and empirical evidence on the asymmetric effect of credit markets on output decline and output growth. When credit markets are underdeveloped and enterprise activity is financed outside the banking sector, 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 reduce the probability of such collapses. Using industry-level data across a large cross-section of countries, the empirical analysis suggests that credit markets play a more important role in softening output declines than in fostering growth or recovery. These results suggest that credit markets are one of the main suspects for explaining why the magnitude of output declines tends to be larger in emerging markets than in advanced market economies.

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)". Neglecting episodes of output collapse gives a misleading picture of the growth process, especially for emerging countries (EMs). 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

*The authors would like to thank Guido Borà for excellent research assistance.

anything like the dynamics at other times". Furthermore, these episodes of output collapse tend to affect long-term growth, as recently found by Cerra and Chaman 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 main determinants of growth analyzed in previous literature, namely the development of the financial sector.

Although several analytical contributions emphasize the asymmetric effect of finance on outptut, with larger effects during downturns rather than upturns[1], the empirical literature, including the seminal work by Rajan and Zingales, has generally assumed symmetric effects, studying the impact of finance on average rates of growth. In this paper, we investigate whether credit markets play a more significant role in softening (or magnifying) the effects of negative shocks during episodes of output decline than in fostering growth during episodes of economic expansion[2]. Extending the seminal framework of Rajan and Zingales (1998) to distinguish episodes of output decline from those of output growth, we find empirical evidence that the impact of credit markets on growth is indeed asymmetric. The presence of asymmetric effects suggests that financial markets may affect output dynamics via different channels during episodes of expansion and decline. During downturns, liquidity effects are likely to dominate. By contrast, the role of financial markets during upturns is to support an efficient allocation of resources and foster innovative activities - a role that has so far been emphasized by the finance-growth nexus literature[3].

In order to interpret the empirical results, 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 trough 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.

The paper is structured as follows. Section 2 contains an empirical analysis covering 28 manufacturing industries in 115 countries between 1963 and 2003. We first update the original work of Rajan and Zingales and find no significant effect of credit market development on average growth rates in a cross-country analysis. We then isolate the episodes of cumulative output decline and find that the development of credit markets significantly affects the magnitude of those declines. Moreover, we differentiate periods of mild recessions from deep recessions and find that credit markets matter most during deep recessions. Section 3 develops a model of production chains, in which

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

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

[3]See Levine (2005) for a survey.

firms are interlinked trough 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 4 concludes.

2 Empirical analysis

Figure 1 shows that countries with a less developed banking system tend to experience sharper output falls. Dividing the sample in quartiles based on the distribution of credit-to-GDP ratios, it turns out that the average percentage deviation of output decline from its 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)[4].

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.

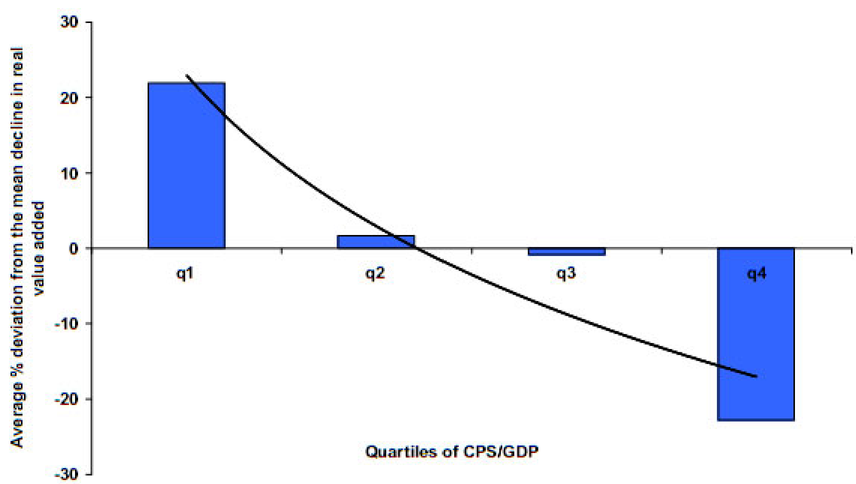


Figure 1: Percentage falls in real value added and financial development

2.1 Sample and empirical model

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

[4]This difference is significant at conventional levels.

addressed the problem of endogeneity and reverse causality, which characterized most of the cross-country literature. Using industry-level data, Rajan and Zingales proposed 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). In our estimations, we interact the RZ measure 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 replicate the analysis of Rajan and Zingales using several samples taken from the UNIDO database, but fail to uncover any robust relationship between financial development and growth. We estimate the Rajan and Zingales specification over the whole available sample from 1963 to 2004, over subperiods and using different country samples, including the original one analyzed in Rajan and Zingales. The coefficients on the financial interaction term vary in sign and significance depending on the estimation method, the period of time covered by the sample and the number of countries included. Overall, there is little evidence of a significant positive effect of financial sector development on industrial growth (Table 1)[5].

We then extend the analysis of Rajan and Zingales by dividing the sample in two different sub-samples, one including the episodes of output decline, the other those of output growth or recovery. We trace the episodes of output decline starting from the first year of negative output change until the end of the contraction. Using the episodes of decline, we estimate the following model

[5]We replicated the analysis for the 41 countries covered in Rajan and Zingales (1998) and an extended sample of 115 countries for the period 1963-2004 (the average annual growth rate was computed as a simple arithmetic average for the various sub-periods for which complete data was available). We repeated the analysis for the periods 1980-1990 and 1990-2000 on a sample of countries for which complete time series were available. We used both OLS and robust regression techniques, namely iteratively re-weighted least squares (IRLS).

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

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

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

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

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

Growth is measured using value added data from the UNIDO database. Data are deflated using CPI from the IMF IFS database. 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. The sample covers a total of 115 countries across 28 manufacturing industries (3-digit ISIC Rev.2 level) between 1963 and 2003.[6]. Since the time span is not the same across all countries, we have an unbalanced panel.

We define two different measures that capture industry decline. The first measure is simply the absolute value of the average percentage change of value added (or output) over the period of decline. 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 of decline 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 loss or the output recovery.
For notational simplicity, define $\triangle = (1 + \triangle_{t-n-1})...(1 + \triangle_{t-1})(1 + \triangle_t)$. Then, the 'area' variable is

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

[6]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'. Note that our value-added sample is dominated by emerging markets and developing countries. By contrast, the sample used by Rajan and Zingales (1998) 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. In addition, our sample is much larger in terms of time span and the number of countries covered. RZ's sample only covers 41 countries between 1980 and 1990. As a robustness check, we also estimate the model using output data instead of value added and find that results do not change. Our output sample covers a total of 120 countries across the same 28 industries between 1963 and 2003, and has a very similar composition in terms of countries' income levels.

for an episode of decline that lasts n years. A statistical description of the sample is provided in Appendix 3.

In addition, we distinguish between mild and sharp output contractions, defining 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[7]. 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. 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 of decline.

2.2 Results and discussion

Table 2 reports the results of the estimations performed on the episodes of decline in real value added [8]. 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[9]. This indicates that industries which are relatively more dependent on external finance decline relatively slower in countries with better banking 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[10]. If we constrain our sample to include sharp contractions only, namely contractions greater than the median 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.

That the development of the banking sector crucially affects the magnitude of sharp output declines but not the average growth rate, suggests the presence of the phe-

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

[8]The coefficients obtained using the output data are broadly similar in magnitude, sign and significance - which points to the robustness of our results. They are not reported here.

[9]The results were obtained by OLS.

[10]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.

nomenon described as 'Phoenix Miracles' in Calvo et al (2006), according to which output recovers from sharp declines with virtually no recovery in credit. These findings suggest that credit market development plays a more important role in softening output declines than in fostering growth, which supports the conjecture that the impact of financial development on growth is asymmetric[11].

In the next section we sketch a theoretical framework that can help explain the empirical results obtained using the episodes of decline, in particular the qualitative difference in the behavior of output decline in countries with underdeveloped financial markets compared to advanced economies.

[11]The results also highlight the importance of distinguishing recovery from true economic growth when studying the conjecture that the impact of financial development on output is asymmetric - an extension of the analysis we are working on.

Table 1: Rajan and Zingales analysis - value added data (t-statistics between brackets)

	115 countries 1963-2004		RZ countries 1963-2004		115 countries 1980-1990		115 countries 1990-2000	
	OLS	**IRLS**	**OLS**	**IRLS**	**OLS**	**IRLS**	**OLS**	**IRLS**
Industry's share of total value added in first year of sample	3.156209	-0.1817921	-0.5487226	-0.2625439	-0.3969356	-0.1095315	-0.3188	-0.2054774
	(1.27)	(-7.65)*	(-4.30)*	(-6.37)*	(-3.34)*	(-4.78)*	(-1.25)	(-4.38)*
Interaction (financial development x RZ-indicator)	0.5732903	-0.0301527	-0.0315436	-0.0161463	0.0428219	0.0106699	-0.0052389	0.0162156
	(0.62)	(-2.12)**	(-0.72)	(-1.41)	(0.94)	(0.66)	(-0.08)	(1.18)
Number of observations	3758	3758	1450	1450	1203	1203	873	873

Note: Significance levels are (*) 1%; (**) 5%; and (***) 10%. For the period 1963-2004, the average annual growth rate was computed as a simple arithmetic average for the various sub-periods for which complete data was available. We repeated the analysis for the periods 1980-1990 and 1990-2000 on a sample of countries for which complete time series were available.

Table 2: 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	-0.0946264 (-2.68)*	0.017695 (0.31)
Interaction (financial development x RZ-indicator)	-0.040813 (-2.61)*	-0.0744669 (-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	-0.0717254 (-1.56)	0.1229552 (1.28)
Interaction (financial development x RZ-indicator)	-0.0516987 (-2.01)**	-0.1592074 (-2.72)*
Number of observations	6554	6563

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

3 A simple model of production chains with trade credit

In this section we present a simple model that provides one possible way of interpreting the empirical results. The model attempts to illustrate in the simplest way the role that formal credit markets play as insurers against adverse shocks. The model highlights the qualitative difference between credit markets in emerging markets as opposed to advanced market economies.

3.1 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[12]. 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 enforcement 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 [13]. 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 $p = 1$[14] or sell it on a 'secondary market' at a discounted price $\mu < 1$. As in Blanchard and Kremer (1997), this alternative use of the input may for example involve the production of a much simpler good, with a lower

[12]See Ethier (1982).

[13]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.

[14]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.

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 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 $\beta \in [0, 1]$[15]. 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

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

acknowledges the importance of institutions for the functioning of financial markets[16]. Figure 2 below shows a clear positive relationship between the development of the financial system, measured as the credit-to-GDP ratio, and recovery rates[17] in our sample.

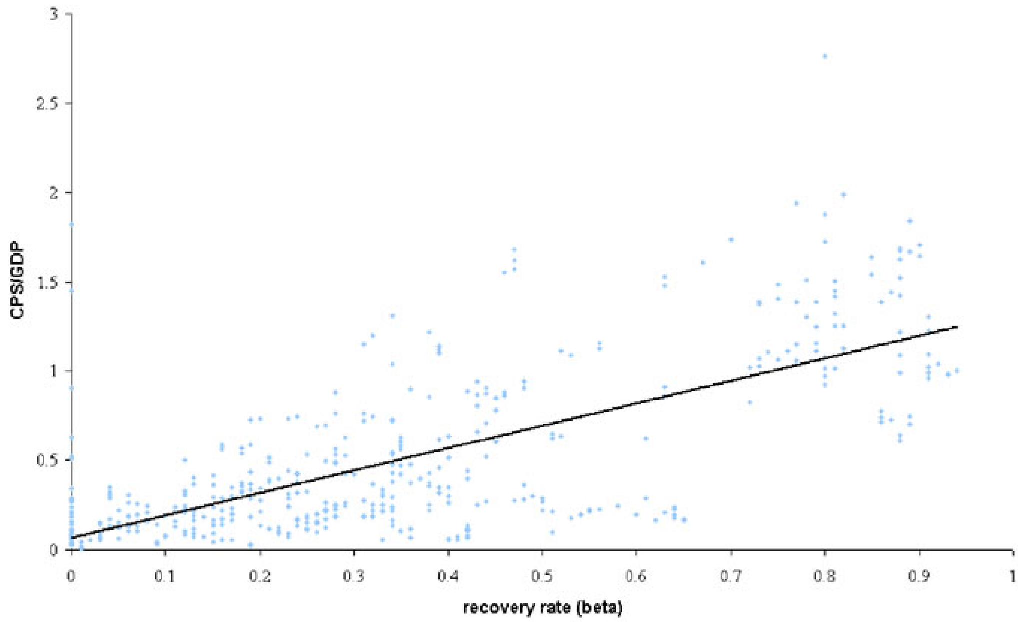


Figure 2: Financial development and recovery rate

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, 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

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

[16] See for example Roland (2000).

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

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.

There are two types of PCE, one with localized default and one with generalized default. However, in both cases the production chain is not broken.
Once a firm has entered a PC and its customer defaults, it can either default on its own supplier or continue paying its debts. The supplier that ordered its own inputs under the assumption of receiving the amount N from its customer may find itself in difficulties if its customer defaults. This may induce the firm to default on its own debt, creating a chain-reaction typical of trade credit chains[18]. Therefore, two separate PCE can arise. The first PCE is characterized by the absence of default (or 'localized default'), the second by 'generalized default'[19]. Assume that d is the unit cost of default, i.e. the cost a firm must incur when it defaults on its supplier. A firm whose customer has defaulted on the payment of the inputs will not default on its own supplier if and only if

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

or

$$d > (1-\beta) = d^*$$

When d is smaller than the critical value d^* defined above, the PCE is characterized by generalized default, in the form of a sharp increase in inter-enterprise arrears. We define this equilibrium as PCE'. The condition above tells us that generalized default will not arise if the cost of default is sufficiently high and that the higher β, i.e. the better contract enforcement, the lower the threshold d^*, i.e. the lower the cost of default necessary to avoid generalized default. Note that such an equilibrium is still a PCE, as the production chain does not collapse[20]. However, the level of output in PCE' is below the non-default equilibrium, by a proportion dnN.

3.1.1 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.

[18] See Kiyotaki and Moore (1997).

[19] The model can be extended to incorporate the analysis of Calvo and Coricelli (1996) on the equilibrium level of payment default. For a model of debt and extreme inefficiencies of credit markets leading to barter, with an application to Russia, see Guriev, Makarov and Maurel (2002).

[20] In fact, the possibility of generalized default in equilibrium helps prevent the collapse of the PC in the short run. This seems to have been the case in countries like Romania and Russia, where a burst in payment arrears seems to have prevented the collapse of production in the short run. See Calvo and Coricelli (1993).

β^* has the following properties:

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

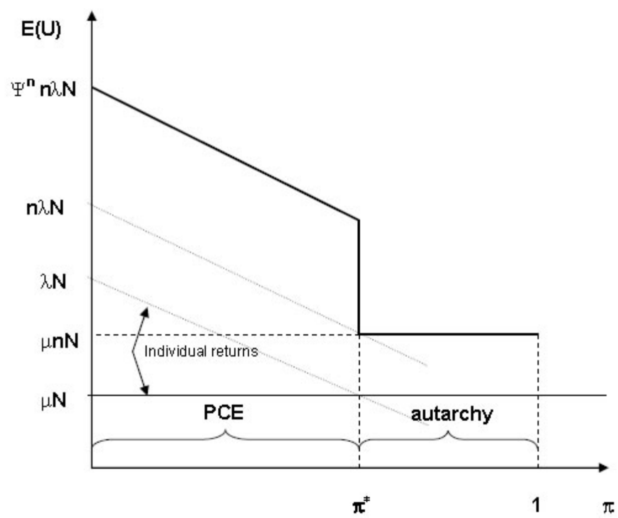
For our analysis, the most interesting effect is the impact of an increase in the probability of default on β^*. Given β, a shock to π can lead to the breakdown of a PCE and a reversal to autarchy, explaining crisis volatility in countries with poor levels of contract enforcement. Indeed, if we interpret 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[21].

The cut-off value of $\beta = \beta^*$ is associated with 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 discrete and large changes in output, rather than regular random variations around a trend[22].

Figure 3 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. For simplicity, assume that $d = d^* = (1-\beta)$. 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

[21]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. The banking sector may arise to mitigate that vulnerability.

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



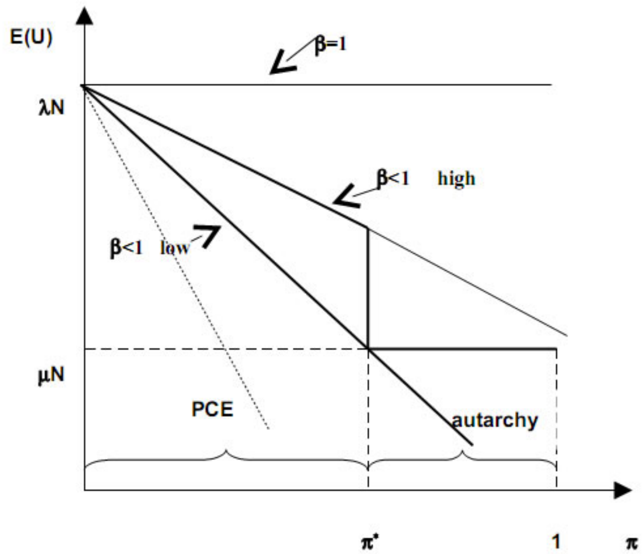
2.jpg

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

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 4 depicts the relationship between expected utility and the probability of default at the firm level.

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 (See Appendix 1 for a simple extension of the above model). This may be one of the reasons why output growth tends to be higher and volatility lower in countries with deeper credit markets. This appears to be the case in our sample.

In addition to banking sector depth as an indicator of financial development, there is another element distinguishing a developed and a less developed financial sector. In terms of our simple model, this can be described as the ability of firms to adjust their level of bank borrowing following a shock to the probability of default. We would define an advanced financial market as one in which following a shock to π, a supplier can substitute the cash usually obtained from its customers with increased bank borrowing. If this is the case, the local shock is not magnified through the production chain. Of course, there is an indirect effect associated with the increased cost of bank loans to the supplier. Nevertheless, the aggregate effect of the local shock is only marginally larger



1.jpg

Figure 4: Production Chain Equilibrium and Autarchy - Individual level of production and utility

than the local shock itself. By contrast, in an economy with a less developed banking sector, the local shock is magnified.

4 Concluding remarks

This paper extended Rajan and Zingales (1998) to study the potential asymmetric effects of financial markets on growth. Replicating the analysis of Rajan and Zingales using several samples taken from the UNIDO database, we fail to uncover any robust evidence of a significant positive effect of financial sector development on industrial growth. However, using industry-level data across a large cross-section of countries during episodes of recession, the empirical analysis shows that financial development plays an important role during episodes of output decline. In particular, industries which are relatively more dependent on external finance decline relatively faster in countries with lower financial sector development, measured as the credit-to-GDP ratio. These findings suggest that credit markets play a more important role in softening (or, depending on the quality of credit market institutions, magnifying) output declines than in fostering growth, which supports the conjecture that the impact of financial development on growth is asymmetric.

The paper 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.

The paper could be usefully extended along several directions. We are investigating whether the asymmetric impact of credit markets on growth depends on the nature of shocks (industry-specific versus aggregate shocks). Furthermore, it could be empirically analyzed whether a higher actual reliance on trade credit with respect to bank credit would magnify negative shocks[23]. Finally, both episodes of decline and expansion could be classified in a finer way. In addition to the distinction between periods of mild decline and deep recessions, upturns can be separated between periods of recovery and growth[24].

[23] See for example Raddatz (2008).

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

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Appendix 1: 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. We assume that there is an equilibrium ratio of trade-to-bank credit, which depends on the relative convenience and availability of the two instruments. We are not interested in the theory of trade credit and the factors determining its size relative to bank credit[25] in this model, but in the relationship between credit market institutions and the characteristics of equilibria in a system in which firms can finance their purchase of inputs through *both* trade and bank credit. Assuming perfect competition in the banking sector, the interest rate on bank credit r is equal to

$$r = \frac{\pi(1-\beta)}{(1-\pi)} \tag{2}$$

with

$$\frac{\partial r}{\partial \beta} = -\frac{\pi}{(1-\pi)} < 0$$

and

$$\frac{\partial r}{\partial \pi} = \frac{(1-\beta)}{(1-\pi)^2} \geq 0$$

Assume further that firms entirely finance their purchase of inputs by a combination of bank credit (BC) and trade credit (TC). In other words,

$$N = BC + TC$$

Denote with γ the equilibrium trade-to-bank credit ratio

$$\gamma = \frac{TC}{BC}$$

[25] See for example Petersen and Rajan (1997) for such an analysis.

Define $\gamma' = \frac{TC}{N}$ as the share of inputs financed by TC. The existence of a PCE in a system with trade and bank credit is determined by the following inequality

$$E(U)^{PCE} > \mu N$$

or

$$(1-\pi)[\lambda N - r(1-\gamma')N] + \pi[\lambda N - r(1-\gamma')N - (1-\beta)\gamma' N] > \mu N$$

Given r determined by equation 2, this inequality is satisfied if and only if

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

Comparing equations 1 and 3, it appears that the threshold value of β is always smaller when bank credit is available in addition to trade credit. In other words, the set of values of β consistent with a PCE is larger than in the trade-credit-only case.

The model shows that the development of a banking sector reduces the vulnerability of an economy to exogenous shocks and the probability of sharp output declines through the breakup of production chains. With a banking sector, a customer's default affects a smaller share of supplier resources, as the fraction financed through bank credit has already been paid in cash to the supplier rather than with claims on future production. In other words, the availability of bank credit reduces the default risk borne by firms and therefore prevents shocks from being magnified through the credit chain. The bank can easily absorb the default of individual customers, by spreading the risk over its overall portfolio of loans. In the trade-credit-only regime, a creditor cannot easily ascertain his risks by knowing the characteristics of his debtor. Indeed, the risks a creditor bears do not only depend on these characteristics, but also on the rest of the production chain. Therefore, the likelihood that a production chain is broken declines with the increasing use of bank credit as a source of financing.

Appendix 2: Descriptive statistics - episodes of decline in real value added

Table 3: 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 4: 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 5: 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 6: 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