The Collateral Channel under Imperfect Debt Enforcement*

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Abstract

Does a country's ability to enforce debt contracts affect the sensitivity of economic activity to fluctuations in collateral values? To answer this question, we introduce a novel industry-specific measure of real asset redeployability - the ease with which real assets are transferred to alternative uses - as a proxy for collateral liquidation values. Our measure exploits the heterogeneity of expenditures in new and used capital and the heterogeneity in the composition of real asset holdings across U.S. industries. Using a cross-industry cross-country approach, we find that industry growth is more sensitive to changes in collateral values in countries with weaker debt enforcement.

JEL classification : E44, O16, G33

Keywords: Collateral Channel, Redeployability, Debt Enforcement, Economic Activity, Volatility

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1. Introduction

Imperfect enforceability of debt contracts implies that a firm's borrowing capacity depends on the collateral value of its pledgeable real assets. This dependence is at the core of a collateral channel that amplifies the business cycle when economic activity affects the collateral value of real assets (Fisher, 1933; Bernanke and Gertler, 1989; Kiyotaki and Moore, 1997). Prior research has found a positive relationship between the price of real estate and investment of U.S. firms (Chaney et al., 2010) or between the price of land and debt capacity of Japanese firms (Gan, 2007). However, the impact of a country's ability to enforce debt contracts on the magnitude of the collateral channel has not been investigated in the empirical literature. This paper attempts to fill this gap by using a cross-industry cross-country approach based on the methodology developed by Rajan and Zingales (1998). We find a collateral channel under imperfect debt enforcement, namely that inefficient debt enforcement institutions amplify the sensitivity of industry growth to changes in collateral values.

The identification of a collateral channel under imperfect debt enforcement requires to observe firms' collateral values. Unfortunately no comprehensive data on collateral values for different real assets are available. Moreover observed collateral values would not necessarily correspond to the expected resale values upon default. To address these shortcomings, we construct a novel industry-specific measure of real assets' redeployability - the ease with which real assets used by firms in an industry are transferred to alternative uses - as a proxy for the industry's collateral liquidation value (Williamson, 1988; Shleifer and Vishny, 1992). In a first step, we compute the redeployability of different asset types by exploiting the heterogeneity of expenditures in new and used capital across U.S. industries. We consider a real asset to be more redeployable if industries purchase on average a high share of used capital of that type. In a second step, we define the redeployability of an industry's real assets portfolio as the weighted average of the redeployability index of each real asset type, where the weights are the shares of capital of each type in the total capital stock employed by the industry. Our measure is designed to capture technological factors such as the degree of specificity of real assets to industries and therefore the long-term collateral value of an industry's real assets.

Controlling for industry and country fixed effects, we then regress the growth rate of real value added at the sectoral level on the interaction between the industry's collateral value and the country's quality of debt enforcement measured by Djankov et al. (2008).

Using data on 28 manufacturing industries located in 35 countries over the period 1980-2000, we find that the difference in growth between industries with low and high collateral values is significantly larger in countries with inefficient debt enforcement institutions. This result indicates that weaker debt enforcement amplifies the sensitivity of industry growth to changes in collateral values. Our estimates also suggest that the collateral channel under imperfect debt enforcement is economically sizeable. The annual growth rate of value added of a representative industry located in a country that ranks at the 25th percentile of the debt enforcement quality index (like Jordan) would decrease by around 1.2 percentage points more than the growth rate of the same industry in a country ranked at the 75th percentile (like Hong-Kong) if its collateral value would decline from the 75th to the 25th percentile of the redeployability index. This differential effect represents more than half of the average annual industry growth rate in the sample, and is of the same order of magnitude as the differential effect of financial development in Rajan and Zingales (1998). These findings are robust to a battery of robustness checks including to using instrumental variables and controlling for alternative channels. Importantly, we perform several robustness checks concerning issues related to our measure of real assets' redeploability.

We further show that the quality of debt enforcement is the basic source of variation in the magnitude of the collateral channel across countries in the sense that financial development does not affect it when the effect of debt enforcement institutions is taken into account. We also disentangle the effect of legal rules devised to protect creditors from the effect of their enforcement in alleviating financial constraints. We find that only debt enforcement has a significant impact on the magnitude of the collateral channel.

We finally analyze the aggregate implications of our main empirical result for growth and volatility. Using our micro-estimates of the collateral channel under imperfect debt enforcement, we perform the following counterfactual exercise for the sample of countries present in our growth regressions: we estimate how an increase in debt enforcement efficiency over the period 1980-2000 would have changed the annual growth of their manufacturing sector. We find that on average, the manufacturing sector of a country at the 25th percentile of the debt enforcement quality index would have grown annually by 4.6 percentage points more if a bankruptcy reform would have allowed to reach the 75th percentile. Based on cross-country regressions, Levine et al. (2000) and Acemoglu et al. (2003) find a growth effect of institutions of the same order of magnitude. Using a simple theoretical framework, we then show that our result provides indirect evidence that better debt enforcement reduces macroeconomic volatility by mitigating the sensitivity of industry growth to fluctuation in their collateral values along the business cycle. With this interpretation we also provide a specific mechanism that rationalizes the negative relationship between volatility and development found in the empirical literature (see e.g. Koren and Tenreyro, 2007). Altogether, our results suggest that a government's aim of reducing macroeconomic volatility and fostering economic growth can be achieved by improving the quality of legal institutions devised to enforce debt contracts rather than increasing financial development more broadly.

This paper contributes to the large literature analyzing the effect of judicial efficiency on financial and economic development initiated by the seminal papers of La Porta et al. (1997, 1998) and Demirgüç-Kunt and Maksimovic (1998). A strand of this literature analyses bank loans across countries or across regions within countries characterized by heterogeneous contract enforcement efficiency or creditor protection. A general finding of these papers is that financing conditions are worse under weaker institutions (see e.g. Laeven and Majnoni, 2005; Jappelli et al., 2005; Qian and Strahan, 2007; Bae and Goyal, 2009; Ellingsen and Kristiansen, 2011). Closest to our paper are Liberti and Mian (2010) who show that a worsening in financial development driven by weaker institutions is associated with an increase in the difference in collateralization rates between high- and low-risk borrowers.

The collateral channel is also related to recent findings in the empirical literature in corporate finance on the effect of collateral values on financial contracts. Empirical evidence shows that U.S. firms using real assets with low collateral values sign financial contracts characterized by higher costs, smaller size and shorter maturity than firms with high collateral values (see e.g. Benmelech et al., 2005; Benmelech and Bergman, 2008; Benmelech, 2009; Benmelech and Bergman, 2009; Gavazza, 2010). Finally, our paper is related to the evidence on fire sales of collateral. Pulvino (1998) documents that financially constrained airlines receive lower prices for their used aircrafts than their unconstrained competitors. Acharya et al. (2007) uses data of defaulted firms to show that industry distress affects collateral liquidation values, in particular for industry-specific assets. Benmelech and Bergman (2011) provide evidence that bankrupt firms impose a negative externality on other firms operating in the same industry through their effect on collateral values. In contrast to these papers on collateral values in fire sales, we focus on the long term value of collateral and use a measure of redeployability that captures technological factors.

The paper is organized as follows. In the next section we propose theoretical underpinnings of the channel whereby a country's ability to enforce debt contracts affects the sensitivity of industry growth to changes in collateral values. In Section 3 we explain the empirical methodology used to identify the collateral channel under imperfect debt enforcement. In particular we introduce our novel industry-specific measure of real assets' redeployability as a proxy for collateral liquidation values. Data to measure real assets' redeployability, debt enforcement and economic activity are described in Section 4. Section 5 presents the results of the empirical analysis and the robustness tests. Section 6 analyses the aggregate implications of the collateral channel under imperfect debt enforcement for growth and volatility. We conclude in Section 7.

2. Theoretical underpinnings

Many theoretical models have shown that limited contract enforcement implies that a firm's debt capacity depends on the collateral value of its pledgeable real assets (see e.g. Holmstrom and Tirole, 1997; Kiyotaki and Moore, 1997; Aghion et al., 1999). To the best of our knowledge, however, there is no paper that outlines the theoretical underpinnings of a collateral channel under imperfect debt enforcement. In this section, we propose a channel whereby a country's ability to enforce debt contracts affects the sensitivity of economic activity to fluctuations in collateral values.[1] Our theoretical framework emphasizes the role of a key outcome of debt enforcement procedures as a determinant of a country's debt enforcement efficiency, due to its empirical relevance (see Djankov et al., 2008). As the firm's value is lower in case of piecemeal sale, the efficiency of debt enforcement is captured by the probability $p \in [0, 1]$ that courts decide to keep a defaulting firm as going concern.

Consider a firm that pledges real assets with collateral values $\tau \in \{\underline{\tau}, \overline{\tau}\}$ ($\underline{\tau} < \overline{\tau}$) to borrow funds from a lender in order to finance a project. Before the completion of the project the firm decides either to meet its debt obligations or to renegotiate the debt contract with the lender. Courts enforce the debt contract if they do not find an agreement during the bargaining process. The framework generates a standard borrowing constraint with the firm's maximum leverage given by $\nu(\tau, p)$. The mechanism we highlight operates as follows. As the firm may find optimal to renegotiate, the lender provides funds up to the net present value of the agreed payment to deter such opportunistic behavior. Firm's collateral values determine the lender's threat to enforce the debt contract through courts. As a result, firms with high collateral values $\overline{\tau}$ have to pay more to lenders in order to avoid debt enforcement procedures, and can borrow more (i.e. $\nu(\overline{\tau}, p) - \nu(\underline{\tau}, p) > 0$). Our model features a collateral channel in the sense that firms $\overline{\tau}$ benefit from a larger investment capacity and grow more than firms $\underline{\tau}$. However, the lender's threat τ is more effective in countries characterized by a lower quality of debt enforcement, as liquidation is more likely. Debt enforcement mitigates the difference in debt capacity between firms with high and low collateral values (i.e. $\frac{\partial[\nu(\overline{\tau},p)-\nu(\underline{\tau},p)]}{\partial p} < 0$), and thus acts as a substitute for the lack of collateral. Therefore industry growth is expected to be more sensitive to fluctuations in collateral values in countries with weak debt enforcement.

3. Empirical methodology

In this section we present our empirical methodology to identify the effect of a change in the quality of debt enforcement on the sensitivity of industry growth to fluctuations in collateral values. We adopt a cross-industry cross-country approach and build an industry-level measure

[1] This section is based on Section 1 of the Web Appendix that presents a simple model that formalizes the collateral channel under imperfect debt enforcement.

of redeployability of real assets using U.S. data as a proxy for the collateral value. Before presenting and motivating our measure, we discuss our empirical model which is as follows :

$$g_{ic} = \beta \left(R_i \times E_c \right) + \gamma X_{ic} + \eta_i + \eta_c + \varepsilon_{ic} \tag{1}$$

where i and c indexes industries and countries, respectively. The dependent variable g_{ic} measures the growth of an industry's real value added. The variable of interest is the interaction term $R_i \times E_c$, where R_i measures the redeployability of the industry's real assets and E_c measures the quality of debt enforcement in the country. X_{ic} is a set of additional determinants of economic growth, η_i an industry fixed effect, η_c a country fixed effect and ε_{ic} a random error. The coefficient β quantifies the effect of the quality of debt enforcement on the magnitude of the collateral channel. A negative and significant point estimate of β indicates that the sensitivity of economic growth to changes in collateral values is stronger in countries with weaker debt enforcement.

3.1. Endogeneity and measurement errors

The cross-industry cross-country approach allows to include industry and country fixed effects to control for any determinants of economic growth that vary at the industry or country level and thus reduces the concern of omitted variable bias. However, we still need to include potential determinants of economic growth that vary over both dimensions and might be correlated with the interaction term $R_i \times E_c$. Our results would be misleading if we omit to control for these alternative channels, since the channel we identify would absorb all their effect. We take care of this problem in Section 5.3.4.

The second potential problem for the identification of the collateral channel under imperfect debt enforcement relates to the endogeneity and measurement errors of E_c. If industries with lower real assets' redeployability increase their growth rate, policymakers might be tempted to improve insolvency institutions. This process might result in making debt enforcement endogenous to the evolution of economic growth. To address these two problems, we estimate the empirical model (1) using the method of instrumental variables (IV). Following La Porta et al. (1998), the legal origin of commercial laws is the instrument usually used for financial development in the finance and growth literature. We slightly depart from the literature in that respect. Djankov et al. (2008) provide country-level data on the legal origin of bankruptcy laws and the quality of debt enforcement.[2] They find that the legal origin of bankruptcy laws is one of the most important cross-country determinants of debt enforcement quality. Based on that evidence, instrumenting debt enforcement by the legal origin of bankruptcy laws seems more appropriate. We also have to take care of the potential endogeneity and measurement errors of real assets' repdeployability. Our strategy is to exclude United States from our regressions, as the redeployability index is calculated from U.S. industry data. This strategy is standard in the literature employing an industry characteristic measured in a benchmark country in a cross-industry cross-country framework (see e.g. Rajan and Zingales, 1998; Claessens and Laeven, 2003; Fisman and Love, 2007). We address the potential measurement error problem of R_i by instrumenting it with the redeployability calculated with data on industries' capital expenditures in the 70's in a robustness test. Further testing of the collateral channel with additional instruments is an important task left for future research.

3.2. A sectoral measure of real assets' redeployability

An empirical test of the collateral channel under imperfect debt enforcement requires that we observe the collateral liquidation values of different types of real assets in order to compute the collateral value of a portfolio of real assets owned by an industry. Such a direct approach poses two problems. First, no comprehensive data on collateral liquidation values are available for a wide range of real assets.[3] Second, at the time the debt contract is signed observed collateral liquidation values do not necessarily meet the expected resale values upon default (Benmelech et al., 2005).

We therefore have to find an indirect way to capture the expected value of collateral to

[2] Up to some exceptions, the legal origin of bankruptcy laws is identical to the legal origin of commercial laws reported in La Porta et al. (1998).

[3] There are data available on firm-level transaction prices for one particular type of real asset, namely commercial aircrafts. See Pulvino (1998) and Gavazza (2011).

lenders upon default. We follow Williamson (1988) and Shleifer and Vishny (1992) who argue that the liquidation value of a real asset is closely related to the ability to redeploy it to other firms. The identification of the redeployability of a real asset in liquidation first requires to determine the potential buyers. We assume that the potential buyers of a used real asset are the firms already operating it. Second, we need to find the determinants of the redeployability of a real asset in liquidation to the potential buyers. We suppose that a real asset is more easily redeployed to firms in an industry whose expenditures in used assets of that type represent a large fraction of their total expenditures in capital. The first assumption is standard in the literature on financial contracts and liquidation values (see Benmelech and Bergman, 2008; Benmelech, 2009; Benmelech and Bergman, 2009; Gavazza, 2010). Regarding the second one, we rather consider the investment flows of used capital instead of the stock of capital since investment in used real assets is a more accurate proxy for liquidity and better captures trading frictions in secondary markets. This assumption is based on Gavazza (2011) who investigates the role of trading frictions in real asset markets. He argues that traders must incur trading costs to find a trading partner because secondary markets of real assets are decentralized. The value of the search process to match buyers and sellers increases with the market size of used capital as the probability to find a good match is larger. Therefore if the market of used capital of a given type is thin, market participants do not search exhaustively for the best matches which reduces on average the number of transactions and the transaction prices. Using datasets concerning the market of commercial aircrafts, Gavazza (2011) provides evidence consistent with these predictions. He finds that an aircraft model with a thinner market (i.e. with a lower stock or fewer operators) is less frequently traded and fetches lower average transaction prices.

To compute a proxy for the collateral liquidation value of a real asset based on its redeployability, we exploit the heterogeneity in the expenditures in used and new capital of that type across industries. Based on the two aforementioned assumptions, we measure the redeployability of real assets of type a as

$$R_a = \frac{1}{N} \sum_i \left(\frac{E_{a,i}^{used}}{E_i^{used} + E_i^{new}} \right) \tag{2}$$

where total expenditures in used and new capital by industry $i = 1, ..., N$ are given by $E_i^{used} = \sum_a E_{a,i}^{used}$ and $E_i^{new} = \sum_a E_{a,i}^{new}$, respectively. Then to construct a proxy for the sector-level collateral value, we aggregate the asset-type redeployability measures across all real assets owned by firms in industry i. Specifically, we build an industry measure of redeployability as a weighted average of the rededeployability corresponding to each real asset a

$$R_i = \sum_a \omega_{a,i} \times R_a \tag{3}$$

where the weight $\omega_{a,i}$ is the share of real assets of type a in total real assets owned by industry i. In contrast to observed collateral liquidation values, the asset-type based measure (2) serves to capture the long-term collateral value of a real asset. This strategy puts less emphasis on current market condition and prices, and fits better to the need to measure the expected collateral value of a portfolio of real assets owned by an industry.

3.3. Methodological issues

An important aspect of our empirical specification (1) is that the redeployability of real assets is considered as specific to the industry (no cross-country variation). The industry measure of real assets' redeployability (3) is indeed computed solely from U.S. data and extrapolated to industries located in other countries.[4] However it is likely that the collateral value of real assets not only depends on factors varying at the industry level but also depends on country-specific and idiosyncratic factors. For the aforementioned reasons, we do not attempt to measure the actual collateral value of real assets, but we measure the industry-specific component of it, which is the redeployability of real assets arising from technological factors. Under the assumption that idiosyncratic terms are uncorrelated with industry-specific variables, an

[4] This approach is based on Rajan and Zingales (1998) and frequently used in the finance and growth literature (see Claessens and Laeven, 2003; Braun, 2005; Ilyina and Samaniego, 2011). In contrast to these studies, we use industry-level data to compute the redeployability measure instead of firm-level data, because firm-level data from Compustat does not offer a high enough level of disaggregation for asset types. However we are not the first to use industry-level data in order to compute an industry-specific characteristic and apply the same empirical methodology (see Nunn, 2007).

empirical model using our sectoral measure of redeployability without measurement error still allows to identify the collateral channel under imperfect debt enforcement. If the true redeployability is measured with error, a classical attenuation bias arises with the estimate of β being biased towards zero.[5]

The validity of the approach based on a sectoral measure of real assets' redeployability relies on two basic assumptions. First, there is a technological reason why some industries purchase a lower share of used capital of a given type (due for instance to the specificity of the asset required in the production process) and own a different portfolio of real assets. If the U.S. economy can be considered as relatively frictionless and thus represents a good benchmark, the computation of the redeployability from U.S. data should reflect exogenous characteristics of the industry production technology. Second, we assume that the technological differences underlying the ranking of redeployability across industries persist across countries. We will discuss the adequacy of our measure of real assets' redeployability with these assumptions in Section 4.1.1.

One concern about our measure of redeployability of real assets is that it does not depend on the industrial structure at the country level. Intuitively a real asset is more redeployable to an industry that represents a large share of the economy. One way to account for this would be to modify the measure of redeployability at the asset level (2) by weighting the ratio $\frac{E_{a,i}^{used}}{E_i^{used}+E_i^{new}}$ by the relative size of industry i in each country. We do not follow this strategy for two reasons. As potential buyers of an asset are firms operating in either sector of the economy, we need to have data on the relative size of each sector for a wide range of countries. However such data are available only for manufacturing industries. Most importantly such a measure of redeployability would create an endogeneity problem due to reverse causality and bias our empirical results.[6]

[5]Formally, the problem is the following. Suppose that the true model of the economy is $g_{ic} = \beta\,(Collateral\ Value_{ic} \times E_c) + \gamma X_{ic} + \eta_i + \eta_c + \varepsilon_{ic}$, with $Collateral\ Value_{ic} = \alpha_c + \alpha_i + \alpha_{ic}$. Instead, suppose that we estimate $g_{ic} = \beta\,(R_i \times E_c) + \gamma X_{ic} + \eta_i + \tilde{\eta}_c + \nu_{ic}$, where $\nu_{ic} = \beta(\alpha_{ic} - u_i) \times E_c + \varepsilon_{ic}$ and $\tilde{\eta}_c = \eta_c + \beta\,(\alpha_c \times E_c)$ with $R_i = \alpha_i + u_i$. Under the assumptions $E[\alpha_i \alpha_{ic}] = E[\alpha_i \varepsilon_{ic}] = E[\alpha_i u_i] = E[\alpha_{ic} u_i] = E[\varepsilon_{ic} u_i] = 0$, the OLS estimate of β is plagued by a classical measurement error bias (attenuation bias).

[6]The argument is the following. Suppose that expression (2) is replaced by $R_{a,c} = \sum_i \alpha_{i,c} \left(\frac{E_{a,i}^{used}}{E_i^{used}+E_i^{new}} \right)$

A central hypothesis underlying our sectoral measure of redeployability (3) is that the data on expenditures in used and new capital covers all the sectors of the U.S. economy so that all potential buyers are considered. It could be that some industries present in the U.S. have no active firms in some countries, especially in developing countries where the production structure differs widely from the U.S. In that case the variance of measurement error associated to our measure would increase in developing countries which would raise the attenuation bias. We provide evidence in Section 4.1.1 that the ranking of sectors according to their redeployability is not sensitive to the omission of certain types of industries as potential buyers and in Section 5.4.1 that it does not affect our main empirical results.

4. Data

4.1. The redeployability of real assets in the data

The measure of redeployability of each type of real asset given in expression (2) is calculated combining two distinct sources that provide data on capital expenditures for a wide range of U.S. manufacturing and non-manufacturing sectors.[7] The Detailed Fixed Assets Tables from the Bureau of Economic Analysis (BEA) detail the expenditures in private nonresidential real assets for 73 types, belonging to the broad categories *Equipment* and *Structures*. This database is available on a yearly frequency over the period 1901-2009, but only provides data on total capital expenditures without disaggregating expenditures in used and new real assets of each type. On the contrary, the Annual Capital Expenditure Survey (ACES) dataset from U.S. Census Bureau provides data on used and new capital expenditures on an annual basis over the period 1994-2006 but only for the two broad categories *Equipment* and *Structures*. To extract the available information from the two datasets, we decompose expression (2) into two main determinants of the redeployability of real asset a, namely the market *liquidity* and

with α_{ic} defined as the relative size of industry i in country c. Instead of an industry-specific measure of redeployability (3), we would have an industry-country measure $R_{ic} = \sum_a \omega_{a,i} \times R_{a,c}$. However, R_{ic} would be endogenous to the dependent variable g_{ic} as α_{ic} depends on long-run sectoral growth.

[7] The industrial classification of the two datasets is not similar. For details on the conversion see Appendix A.1.

the degree of *nonspecificity* of the used asset

$$R_a = \frac{1}{N}\sum_i \underbrace{\left(\frac{E_{a,i}^{used}+E_{a,i}^{new}}{E_i^{used}+E_i^{new}}\right)}_{\equiv Liquidity_{a,i}} \times \underbrace{\left(\frac{E_{a,i}^{used}}{E_{a,i}^{used}+E_{a,i}^{new}}\right)}_{\equiv Nonspecificity_{a,i}} \tag{4}$$

The first determinant, *liquidity*, accounts for the *relative* thickness of the asset market and is averaged over the period 1980-2000 for each real asset in each industry using the Detailed Fixed Assets Tables.[8] The second determinant, *nonspecificity*, captures the degree of substitutability between used and new capital. We average it over the available time period for each real asset in each industry using the ACES dataset. Since used and new capital expenditures are only split into two broad categories *Equipment* and *Structures*, the nonspecificity measure is equal for all real assets that fall into the same category.[9] Ramey and Shapiro (2001) argue that these two ingredients can be considered as a plausible characterization of secondary capital markets. They argue that capital specialization at the firm level entails search costs to find potential buyers with the best match to the real asset's characteristics and thus ready to pay a price close to its fundamental value. In line with Gavazza (2011), a thin market and a high degree of specificity for a real asset increase the search costs and hence decreases its liquidation value.

A list of the five most and five least redeployable real assets is provided in Table 1. At the top of the ranking are offices which can be easily transfered from a firm to another firm and hence feature a high redeployability. Other highly redeployable assets are manufacturing structures, transportation, communication and general industrial equipments. At the bottom of the ranking are local transit, wind and solar structures as well as other transportation structures. Overall, the ranking of real assets redeployability looks sensible.

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[8] Since our measure of redeployability represents a proxy for all the countries in our sample, we do not calculate the absolute liquidity provided by industries as in the aforementioned studies, but the liquidity provided for an asset a relative to total assets.

[9] Almeida et al. (2009) and Campello and Giambona (2012) argue that equipment capital is less specific than other types of capital, like buildings (falling into category *Structure*). This assumption is confirmed by our measure. On average, the ratio of used to total capital expenditures is equal to 7.8 percents for *Equipment* and to 5.6 percents for *Structures*

Insert TABLE 1 here

The industry measure of redeployability (3) based on the asset-type redeployability (4) is calculated for manufacturing and non-manufacturing industries identified by the North American Industry Classification System (NAICS). Since data on economic activity are detailed at the 3-digits ISIC Revision 2 classification and only available for industries in the manufacturing sector, we match industries corresponding to both classifications and report the measure only for manufacturing industries. The details of the concordance can be found in Appendix A.1. We tabulate the measure of redeployability of real assets by ISIC industry in ascending order in Table 2.

Insert TABLE 2 here

According to our measure, the industries that have the most redeployable assets are *Leather products*, *Wearing apparel* and *Textiles*. These industries are intensive in redeployable assets such as buildings, offices or general industrial equipment and correspond to what is sometimes termed "soft" industries. In contrast, "heavy" industries like *Iron and steel*, *Fabricated metal products* and *Transport equipment* are among the industries with the least redeployable assets. In the paper we focus on the redeployability of an a asset as a determinant of its collateral liquidation value, but there are other sources of heterogeneity in the liquidation value of an asset. We consider three characteristics of a firm's assets: the first is the relative quantity of tangible assets used by firms, the second is the *depreciation* rate of capital in each industry and the third is a measure of *obsolescence* or embodied technical change in capital. A firm with a lower share of tangible assets is expected to have a lower collateral value. Similarly a real asset with a higher physical or technological depreciation rate is expected to have a lower collateral value. We report in Table 2 the industry-specific measures of *Tangibility* of assets from Braun (2005) and of *Depreciation* and *Obsolescence* from Ilyina and Samaniego (2011) next to our measure of redeployability. We calculate Pearson's correlation coefficients between our redeployability index and the three other characteristics. Our redeployability index is independent of the three other characteristics as we cannot reject the null hypothesis of no correlation.

4.1.1. Assessing the methodological issues on the redeployability measure

An important issue raised in Section 3.2 is whether our measure is a good proxy for the industry-specific component of the collateral value of real assets. To assess this issue we calculate our measure of redeployability using data from different decades and calculate the correlation of the measure across decades. As shown in Table A.2 of the appendix, measures of redeployability are highly correlated across different decades (1960's, 1970's, 1980's and 1990's). The Spearman's rank correlation coefficients are above 0.9 with the null hypothesis of independence strongly rejected (below the 1 percent level of significance).[10] These findings support the assumption that the determinants of redeployability in expression (3) are mainly technological and can be considered as industry-specific at least for the US economy. Second, we assume that the technological differences underlying the ranking of redeployability across industries persist across countries. Unfortunately, we cannot test whether the industry measures of redeployability are highly correlated across countries since no data on real assets with high enough disaggregation at the asset level are available for other countries.

We have argued above that some industries present in the U.S. might not have any firms operating in some countries. As a consequence, these industries should not be considered as potential buyers for liquidated assets in those countries, which might affect the redeployability of real assets. To assess whether this is an issue we compute our measure of redeployability using data from different sets of industries. In particular, we compute a first alternative measure after excluding industries of the service sector from our dataset, based on the intuition that this sector is more developed in the U.S. than in other countries, especially developing ones. Then, we compute a second measure keeping only industries of the manufacturing sector. The (Spearman and Pearson) correlations between the benchmark measure and the two alternative measures shown in Table A.3 are all above 0.5 with the null hypothesis of independence rejected at a significance level slightly above 1 percent. This indicates that our benchmark industry-specific measure of redeployability can be considered as a good proxy even for countries that only have firms operating in the manufacturing sector.

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[10] Note that Pearson correlations are of the same order of magnitude and highly statistically significant.

4.2. Measures of debt enforcement and industry growth

To test the collateral channel under imperfect debt enforcement, we use the measure of efficiency of debt enforcement procedures constructed by Djankov et al. (2008) as a proxy for the quality of debt enforcement. Djankov et al. (2008) presented a case study of an identical firm about to default on its debt to insolvency practitioners in 88 countries. They then collected their responses on various aspects corresponding to domestic procedures required to enforce the debt contract. The measure of debt enforcement efficiency defines the present value of the terminal value of the firm minus bankruptcy costs and combines data on three aspects of debt enforcement. The first aspect considers whether the firm is kept as going concern or sold piecemeal, assuming its value is lower in the latter case. The second aspect is the legal costs associated with the enforcement procedure. The third aspect measures the opportunity costs arising from the time to resolve the enforcement procedure and the level of interest rates. A formal description of the measure is provided in Appendix A.1.

A major drawback of the measure constructed by Djankov et al. (2008) is that it is based on responses collected after our sample period. Ideally, we would like to use a measure of debt enforcement quality that covers the period 1980 to 2000 considered in the empirical analysis. Indeed, insolvency procedures may have evolved over time in response to economic performance and using ex-post values is known as raising deeper issues concerning endogeneity. We believe the concern to be small for two reasons. First, as mentioned in the section devoted to the empirical strategy, we address the issue of reverse causality using IV. Second, measures of institutions are shown to be persistent over long periods of time (Acemoglu et al., 2001, 2002). However in a robustness check, we proxy the quality of debt enforcement by the average size of debt market over the period 1980-2000 since Djankov et al. (2008) provides evidence that their measure of debt enforcement quality is a strong predictor of debt market size across countries. Table 3 reports the measure of debt enforcement quality with the associated debt market size for the three most and three least efficient countries across two groups, the high-income and middle- to low-income countries.

Insert TABLE 3 here

We observe that high-income countries have more efficient debt enforcement procedures than those in middle- and low- income countries. The difference is highly statistically significant showing some heterogeneity in debt enforcement across countries. Moreover debt enforcement is positively correlated with debt market size associated to each group of countries.[11]

Economic activity is measured using sectoral data on value added collected annually by the United Nations Industrial Development Organization (UNIDO). Specifically, we use the database compiled by Nicita and Olarreaga (2007) which covers 100 countries over the period 1976-2004. The data are disaggregated into 28 industries of the manufacturing sector according to the ISIC Revision 2 classification. The dependent variable g_{ic} is the average annual real growth rate of value added of industry i in country c over the period 1980-2000, and is measured as the log of real value added in 2000 less the log of real value added in 1980, divided by 20. The sample period 1980-2000 is chosen to maximize the country coverage.

However, due to differences in country coverage between datasets of debt enforcement and economic activity, our dataset includes 67 countries (instead of the 88 potential countries). For some of these countries data on sectoral value added for the years 1980 and 2000 are missing. Moreover, we drop the benchmark country, the United States, as the redeployability index is calculated from U.S. industry data. The sample reduces to 35 countries associated to 829 observations (instead of 980=35×28 possible observations). The countries included in the regressions with the number of industries available for each country are listed in Table A.5 in the Appendix.

5. Empirical analysis

5.1. The collateral channel under imperfect debt enforcement

In this section we test the collateral channel under imperfect debt enforcement based on the estimation of the empirical equation (1). The OLS estimates are shown in the first four

[11]The correlation for the sample holding the two groups is equal to 0.697 and significant at the 1% percent level.

columns of Table 4 and the Instrumental Variables (IV) estimates in the last four columns. We report standard errors clustered two-way by industry and country computed using the procedure of Cameron et al. (2011).[12]

Insert TABLE 4 here

The estimation of our baseline specification using OLS is presented in the first column. It includes our variable of interest, namely the interaction between the industry's real assets' redeployability and the country's quality of debt enforcement (*Redeployability* × *Debt enforcement*) as well as country and industry dummy variables. The coefficient estimate on our variable of interest has a negative sign and is significant at the 5% level. In line with the theoretical underpinnings of the collateral channel under imperfect debt enforcement, this result indicates that the difference in growth between industries with low and high collateral values is significantly larger in countries characterized by weak debt enforcement.

In this paper, we test the effect of the quality of debt enforcement on the sensitivity of industry growth to changes in collateral values. Our focus is thus on the *intensive margin* of collateral use following the terminology of Benmelech and Bergman (2009). However, the collateral value of a defaulted firm also depends on its share of tangible and thus pledgeable assets, which can be termed as the *extensive margin* of collateral use. This aspect has been shown empirically relevant for the relative performance of industries in different contexts (Braun, 2005; Manova, 2008). To precisely identify the collateral channel under imperfect debt enforcement that works through the intensive margin of collateral use (i.e. through real assets' redeployability), we thus add an interaction between the share of tangible assets and the quality of debt enforcement (*Tangibility* × *Debt enforcement*) to our baseline specification in column 2. Our coefficient of interest is not significantly affected by the inclusion of this interaction term. This finding indicates that an industry whose tangible assets are difficult to redeploy will perform relatively worse than an industry whose tangible assets are easy to redeploy in a country with weak debt enforcement *even if* both industries own the same share of tangible assets. It should be not noted however that according to our estimates, industries

[12] In some IV estimations the covariance matrix of moment conditions has not full rank when standard errors are clustered two-way by industry and country and we compute standard errors clustered by country instead.

with a smaller share of tangible assets do not grow significantly slower in countries with weak debt enforcement.

We have argued that the redeployability of a real asset determines the expected value of collateral to lenders upon default. There are, however, other characteristics of a real asset that could influence it. If our measure of redeployability is correlated to those characteristics, omitting them would bias the estimate of our coefficient of interest. We therefore control for the interactions of two such characteristics with the quality of debt enforcement in column 3. The first is the *depreciation* rate of capital in each industry and the second is a measure of *obsolescence* or embodied technical change in capital. A real asset with a higher physical or technological depreciation rate is expected to have a lower collateral value. Although both characteristics affect economic growth with the expected sign, as it can be seen from column 3, their inclusion does not alter the collateral channel under imperfect debt enforcement that works through the real assets' redeployability.

In column 4, we include the share of the industry in GDP at the beginning of the sample period to account for the potential 'catch-up' effect for industries representing a small size of the economy. As expected, this coefficient is negative and significant, but again our coefficient of interest is not affected qualitatively and quantitatively.

As mentioned in the empirical methodology, we are concerned with the potential endogeneity of debt enforcement. We therefore perform an instrumental variables (IV) estimation of equation (1). To determine the most suitable method, we performed the Pagan-Hall test of heteroskedasticity of the error term (not shown). The null hypothesis of no heteroskedasticity is strongly rejected (at a significance level below 1 percent). As a result, we use the Generalized Method of Moments (GMM) to identify our coefficient of interest β since this estimator is more efficient than the Two-Stage Least Squares estimator in case of heteroskedasticity. We perform the Hansen J test to test the null hypothesis that instrumental variables are uncorrelated with the disturbance term.

Our estimates of equation (1) using GMM are reported in columns 5 to 8 of Table 4. We see that the results are qualitatively unaffected by the instrumentation procedure. Across the different specifications, our coefficient of interest is higher in absolute value. As discussed in

Section III, this result can be attributed to an attenuation bias due to measurement errors in debt enforcement quality. The p-values of the Hansen J test are above 0.1. Therefore the overidentification test validates our identification strategy requiring that the interaction between the legal origin of a country's bankruptcy law and industry's repedeployability is truly exogenous. In the rest of the paper, we will thus only report GMM estimates.

Besides statistical estimates and their significance, we are interested in the economic importance of the collateral channel under imperfect debt enforcement. To gain insight, we calculate the differential growth effect for an industry with a low collateral value (25th percentile) with respect to an industry with a high collateral value (75th percentile) when debt enforcement worsens from the 75th to the 25th percentile of debt enforcement quality.[13] The industry at the 75th percentile, with high collateral value, is *Pottery, china and earthenware.* The industry at the 25th percentile, with low collateral value, is *Glass and products.* The calculated differential effect is reported for each regression in Table 4 directly below the coefficient estimates. Our first observation is that the growth effect through which the collateral channel under imperfect debt enforcement operates is economically sizable. The coefficient estimates in IV regressions predicts that the industry with a low collateral value would grow annually between 1 and 1.6 percentage points less than the high collateral value industry in Jordan compared to Hong Kong. This is a substantial decrease compared to the average annual industry growth of 2.18% in the sample. Moreover, the size of the differential effect is larger than in Rajan and Zingales (1998). Using the same percentiles, they find that industries with a larger dependence on external finance roughly grow 1 percentage point less in economies with less developed financial markets.

5.2. The source of the collateral channel under imperfect debt enforcement

The results presented in the previous section raise the question whether the quality of debt enforcement is the basic source of the sensitivity of economic growth to changes in collateral

[13] The differential effect of debt enforcement on the collateral channel is calculated as:

$$\Delta\widehat{g} = \widehat{\beta} \times \left(Redeployability_{\text{low}} - Redeployability_{\text{high}}\right) \times \left(Debt\ Enforcement_{\text{low}} - Debt\ Enforcement_{\text{high}}\right)$$

values or whether the collateral channel under imperfect debt enforcement is driven by the effect of financial development. Djankov et al. (2008) show that the quality of debt enforcement procedures is strongly correlated with the development of debt markets. Therefore, our interaction term would capture the effect of financial development if industries with different levels of real assets' redeployability are affected differently by a change in financial development. For example, Liberti and Mian (2010) show that the development of credit markets shifts the composition of collateralizable assets from non-specific towards firm-specific, namely non-redeployable, assets. Williamson (1988) argues that firms with specific assets are optimally financed by equity. Following these arguments, improvements in the development of the credit and stock markets would benefit firms with a lower redeployability relatively more.

We rule out these two alternative explanations and show that the effect of financial development on the sensitivity of industry growth to changes in collateral values works through its correlation with the efficiency of debt enforcement. To obtain this result, we proceed as follows. First we estimate equation (1) including the interaction term *Redeployability* $\times$ *Financial development* instead of the interaction involving debt enforcement. In columns 1 and 2 of Table 5 we present the estimates obtained when *Financial development* is proxied with the size of the debt market, respectively the size of the stock market.

Insert TABLE 5 here

As expected, the coefficient on both interaction terms is negative and significant, giving some credit to the two mechanisms explained above. The point estimates differ slightly from those in Table 4 as the magnitudes of the variables measuring debt enforcement and debt market development differ. However, when we include in addition our interaction term of interest *Redeployability* $\times$ *Debt enforcement* (columns 3 and 4), we first observe that our coefficient of interest is significant and has the expected sign. Second, the interactions involving *Financial development* become insignificant. We interpret this result as evidence that a variation in financial development that is uncorrelated to a variation of debt enforcement quality has no significant impact on the sensitivity of industry growth to changes in collateral values.

The role of creditor protection in alleviating financial constraints has been emphasized in the literature analyzing the effect of legal institutions on economic outcomes. The first studies in this category have focused on the quality of legal rules devised to protect creditors (see La Porta et al., 1997, 1998). A second and more recent strand of the literature has analyzed the enforcement of legal rules rather than the law itself (see Djankov et al., 2003, 2008). Accordingly, we disentangle the effects of creditor rights and of the enforcement of debt contracts on the collateral channel. In column 5 we present the estimates of equation (1) when we include an interaction between *Redeployability* × *Creditor rights* in addition to our variable of interest. We use Djankov et al. (2007)'s creditor rights index computed for 129 countries over the period 1978 - 2003. This index measures whether different powers are provided by a country's legal code to a secured creditor in bankruptcy.[14] The results show that the quality of enforcement of secured debt contracts has a significant and negative effect on the sensitivity of economic growth to changes in collateral values. On the contrary, creditor rights in bankruptcy do not affect significantly the collateral channel. Interestingly, this result complements Bae and Goyal (2009)'s findings that the enforceability of contracts matters for bank loan size and maturity whereas creditor rights does not. Accordingly, policymakers should focus on improving the quality of legal institutions devised to enforce debt contract to mitigate the sensitivity of economic activity to fluctuations in collateral values in their country.

5.3. Robustness analysis

In this section, we analyze the robustness of our main result. Firstly, we investigate several issues related to our measure of redeployability. Secondly, we examine whether our results spuriously capture other channels that might affect industry growth. Finally, we perform additional robustness tests by estimating several alternative specifications of our empirical model.

5.3.1. Robustness tests related to the redeployability measure

The robustness tests presented in this section address in different ways the potential measurement errors on our measure of redeployability. The regressions reported in Table 6 show that

[14] We refer the reader to Djankov et al. (2007) for a detailed description of the index.

whether or not our measure of redeployability entails measurement errors the results are not significantly affected.[15]

Insert TABLE 6 here

In column 1, we report the IV estimates when both *Redeployability* and *Debt enforcement* are instrumented. We use the index of redeployability calculated with data on industries' capital expenditures in the 70's as an instrument for current redeployability. A potential source of measurement error that we have emphasized previously is that some industries present in the U.S. have no active firms in some countries which might alter the set of potential buyers for real assets. We account for this in columns 2 and 3 by using the measures of redeployability calculated from data on expenditures in assets of different subsets of industries, as explained in Section 4.1.1. In column 4, we use an alternative concordance between ISIC and BEA industry classifications to calculate *Redeployability* at the ISIC industry level to account for the uncertainty on a few ISIC-BEA industry matches.[16] Finally, in column 5, we aggregate sectoral data to match the BEA industry Code, on which our redeployability index is based. Doing so allows to have a single redeployability value for each industry.

5.3.2. Testing alternative explanations

Industry growth may in principle be affected by many channels. Our results could be misleading if we omit to control for significant channels that are correlated with our interaction term, since the latter would absorb all the effect of these omitted variables. We therefore include a series of alternative explanations to test whether our results are spuriously driven by the correlation of our interaction term with these alternative determinants of economic growth at the sectoral level.

We explore three alternative explanations for our results. First, we argue that the production of complex goods involves the use of specific assets. For example, in the O-ring

[15] The absolute values of the estimates vary across regressions mainly due to changes in the range of the redeployability measure.

[16] Appendix A.1 describes the differences between the benchmark and alternative ISIC-BEA concordances in detail.

production function of Kremer (1993) the elaboration of more complex products is associated with a larger number of differentiated tasks to be performed which likely require more specific assets. Moreover, the degree of complexity of a product determines the need for good institutions to enforce contracts, as it is harder to write a complete sale contract for a complex product than for a simple one (Berkowitz et al., 2006; Levchenko, 2007). We account for this channel in several ways. We use the Herfindhal index of intermediate goods from Cowan and Neut (2007) as a direct proxy for product complexity. We also argue that firms producing more complex goods are more intensive in R&D. These firms are more dependent on the availability of skilled workers which in a cross-country perspective is positively correlated with the quality of institutions. A production process that involves more tasks is also likely to last longer and thus shift cash-flow earnings later in time, increasing the need to use external finance. In columns 1 to 3 of Table 7, we see on the one hand that only the latter industry characteristics significantly affects industry growth, on the other hand that it leaves the relevance of our channel unchanged.

Insert TABLE 7 here

In column 4, we use a different approach which consists in adding to our baseline specification the interaction between the average PPP-adjusted GDP per worker and industry dummies. As worker productivity is positively correlated with product complexity, country's GDP per worker should be a good proxy for the ability of a country to produce complex goods. Adding these 28 extra regressors therefore allows to control for the product complexity channel in an unrestricted way. We see that our coefficient of interest remains mostly unaffected.

Second, it is possible that firms using specific real assets also need relationship-specific inputs. In that case, our measure of real asset redeployability would capture the need for contract enforcement. As shown by Nunn (2007), industries which rely on relationship-specific investments benefit more from better contract enforcement institutions. To account for this channel, we add an interaction term of *Contract intensity* $\times$ *Rule of law* in column 5. Moreover, as the quality of different institutions is highly correlated within a country, our variable measuring the quality of debt enforcement could capture the effect of the quality of institutions in general. To take care of that, we add an interaction between our industry-specific variable and the initial level of a country's GDP, which is highly correlated with the quality of institutions. We see that our results are not affected qualitatively and quantitatively by including these alternative channels.

Eventually, our interaction term could be capturing a general (proportional) effect of good institutions on economic growth if the economic outlook of the different industries is correlated with the redeployability of real assets. We would then expect industries with better economic opportunities to perform relatively better in countries with good institutions, independently of our channel. To account for this possibility, we add to our regression an interaction term between economic growth in a benchmark country, and financial development in column 9 and initial GDP per capita in column 10. As in Fisman and Love (2007), we consider industry growth in the U.S. economy as the benchmark by representing the global growth outlook. Overall, we see that our coefficient of interest remains negative and significant at the 1% level in 6 out of 8 regressions (5% in the remaining cases) when the alternative channels are accounted for. Moreover, the coefficients are not significantly different from the coefficient estimated in the baseline regression.

5.3.3. Additional robustness tests

We analyze the robustness of our main result using a series of tests. The estimation results of several alternative specifications of equation (1) are reported in Table 8.

Insert TABLE 8 here

First, we use different measures of debt enforcement quality. In the first two columns, we use the recovery rate of secured creditors from Djankov et al. (2008) (column 1) and World Bank (2008) (column 2). An advantage of the second measure is that it is available for a larger sample of countries, but it corresponds less to our sample period as it has been computed more recently. Then, we take three measures of the efficiency of the judicial system in the collection of an overdue debt from World Bank (2008): the time required for dispute resolution (column 3), the number of procedures involved in (column 4) and the official costs of going through court procedures (column 5). We scale each variable so that all values lie in the unit interval, with a higher value representing a better judicial quality, in order to facilitate the comparison of the estimated coefficients. The results indicate that the estimated coefficients remain negative and significant for all alternative measures.

We have argued that the dependence of an industry's investment capacity on the collateral value of its pledgeable real assets is underlying the sensitivity of industry growth to changes in collateral values. We provide evidence for our argument by running the baseline regression with industry investment instead of value added as a dependent variable. The results in column 6 show that weaker debt enforcement exacerbates the sensitivity of industry growth in investment to changes in collateral values. In columns 7 and 8, we additionally use domestic output and exports respectively as alternative measures of economic activity. The results show that growth in domestic output and in exports are more sensitive to changes in collateral values in countries with a lower quality of debt enforcement. This result complements Nunn (2007) who finds that contract enforcement quality is a source of comparative advantage in trade. Next, in column 9, we use the settler mortality in former European colonies from Acemoglu et al. (2001) instead of the legal origin of bankruptcy law to instrument our institutional variable. This results in a large drop in the number of countries included in the regression, but does not affect our basic result. Finally, we analyze the robustness of our results over different time periods. In columns 10 and 11, we report our estimates of equation (1) for two sub-periods, 1981-1990 and 1991-2000. Our results are qualitatively and quantitatively similar for the two different time periods.

6. Aggregate implications

In this section, we analyze the aggregate implications of the collateral channel under imperfect debt enforcement for growth and volatility.

6.1. Estimating the effect of debt enforcement on aggregate growth

The empirical methodology used in previous section does not allow to identify the overall effect of debt enforcement on economic growth since this effect is subsumed in the country fixed effects. We propose as an alternative to use the micro-estimates of the collateral channel under imperfect debt enforcement to uncover the aggregate growth effect of better debt enforcement. Such an approach entails two advantages with respect to cross-country regressions used to analyse the impact of institutions on economic growth (see e.g. Levine et al., 2000; Acemoglu et al., 2003). First, fixed effects can be included to control for any determinants of economic growth that vary at the industry or country level. Hence, it largely improves over cross-country analysis on the issue of omitted variable bias. Second, it allows to pin down a specific channel whereby institutions affect aggregate growth, and hence to establish the direction of causality.

Let aggregate growth of manufacturing sector in country c be denoted by $g_c = \sum_i s_{ic} \times g_{ic}$, where s_{ic} is the size of industry i. A change in aggregate growth triggered by better debt enforcement may go through changes in sectoral growth, or through a change in industrial composition (or both). Namely:

$$dg_c = \sum_i \left(s_{ic} \frac{dg_{ic}}{dE_c} + \frac{ds_{ic}}{dE_c} g_{ic} \right) dE_c \tag{5}$$

To estimate the aggregate growth effect of debt enforcement that works through the collateral channel, we use the coefficient β in regression (1) as an estimate of the cross-derivative $\frac{d^2 g_{ic}}{dR_i dE_c}$. We then specify the same regression model as (1) but with industry size as dependent variable to obtain β_s as an estimate of $\frac{d^2 s_{ic}}{dR_i dE_c}$. Debt enforcement is expected to change industrial composition through the collateral channel. The estimate of β_s is negative and significant at the 1% level (results not reported), and thus confirms this prediction.[17] The only identification assumption that we make is that economic activity in the sector with the highest real assets' redeployability denoted by $i = 1$ is not affected by a change in debt enforcement. Under this assumption, the effects of debt enforcement on sectoral growth and allocation can be expressed as $\frac{dg_{ic}}{dE_c} = \beta(R_i - R_1)$ and $\frac{ds_{ic}}{dE_c} = \beta_s(R_i - R_1)$, respectively.[18] By plugging these micro-estimates of the collateral channel under imperfect debt enforcement in expression (5), we can obtain the aggregate growth effect of debt enforcement.

Using IV estimates of coefficients β and β_s, we perform the following counterfactual exercise

[17] These results are available in Panel B of Table W.1 in the Web appendix.

[18] Formally, $\frac{dx_{ic}}{dE_c} - \frac{dx_{1c}}{dE_c} = \beta(R_i - R_1)$ with $\frac{dx_{1c}}{dE_c} = 0$ for $x \in \{g, s\}$.

for the sample of countries present in our basic growth regressions. We estimate how an increase of 0.1 in debt enforcement efficiency would have changed annual growth of their manufacturing sector over the period 1980-2000. The results are reported in Table 9.

Insert TABLE 9 here

We find that the estimated aggregate growth effect of debt enforcement working through the collateral channel is economically significant. An increase of 0.1 in debt enforcement efficiency over the period 1980-2000 would have lead on average to a rise in annual growth of more than 1 percentage point (column 5 in Table 9). The magnitude of this effect is about 40% of the manufacturing sector average growth (column 2), and is comparable to estimates obtained from cross-country regressions (see e.g. Levine et al., 2000; Acemoglu et al., 2003).[19] We also observe a large cross-country heterogeneity. Developing countries would have benefited more from more efficient debt enforcement institutions than developed countries. The source of this heterogeneity mainly operates through the growth effect resulting from a change in industrial composition (column 4) rather than from changes in sectoral growth (column 3). However the two components contribute on average equally to the aggregate growth effect of debt enforcement.

6.2. Debt enforcement and macroeconomic volatility: some indirect evidence

Developing countries are known to be more volatile than rich ones. Koren and Tenreyro (2007) provides evidence that more severe macroeconomic shocks in poor countries explain 50 percent of the difference in volatility. Acemoglu et al. (2003) find that the development

[19] Levine et al. (2000) (Acemoglu et al., 2003) use the log of "private credit to GDP" as institutional regressor that ranges from ln(141.3) and ln(4.1) (the index of "constraint of the executive" that ranges from 1 to 7). We take the IV coefficient estimate of 2.51 (1.57) of growth regression in Regression Set #1 of Table 3 (column 10 of Table 1). We then consider an increase in the institutional regressor of the same magnitude, namely an increase that would correspond of one-tenth of the difference between its maximum and minimum. We find that a country experiencing such an exogenous increase in the institutional regressor is growing faster by $0.89 = 2.51 \times 0.35$ ($0.94 = 1.57 \times 0.6$) percentage points per year.

of better institutions is the main driver for the reduction in volatility. In this section we show how our empirical result provides indirect support that the reduction in macroeconomic volatility can be achieved by implementing bankruptcy reforms that improve the quality of debt enforcement.

To simplify exposition, we slightly modify our theoretical framework of Section 2 as follows. Firms are now homogenous and characterized by a collateral value τ that fluctuates along the business cycle. We assume that τ is equal to $\overline{\tau}$ during economic booms occurring with probability θ and to $\underline{\tau}$ during recessions.[20] This exogenous shock may be generated by the type of externality imposed by insolvent firms on the collateral value of nonbankrupt firms (see Shleifer and Vishny, 1992, 2011; Benmelech and Bergman, 2011). Let the growth rate of a country characterized by debt enforcement p be $g(\tau, p)$. The expression for aggregate volatility can be thus written as $V(p) = \theta(1-\theta)[g(\overline{\tau}, p) - g(\underline{\tau}, p)]^2$. The effect of debt enforcement on volatility that operates through the collateral channel is given by:

$$\frac{\partial V(p)}{\partial p} = 2\theta(1-\theta)[g(\overline{\tau}, p) - g(\underline{\tau}, p)]\frac{\partial[g(\overline{\tau}, p) - g(\underline{\tau}, p)]}{\partial p}$$

The collateral channel implies that $g(\overline{\tau}, p) > g(\underline{\tau}, p)$ as firms can be more leveraged during booms. The first term is hence positive. In this set-up, exogenous fluctuations in collateral values across time for homogenous firms can be alternatively interpreted as changes in collateral values across sectors as in Section 2. The negative estimate of coefficient β in regression (1) uncovered in the empirical analysis provides indirect evidence that $\frac{\partial[g(\overline{\tau},p)-g(\underline{\tau},p)]}{\partial p} < 0$. Therefore, our main result implies that better debt enforcement will reduce volatility by mitigating the sensitivity of economic activity to fluctuation in collateral values. However a more direct empirical approach would consist in identifying exogenous shocks to firms' collateral values and analyze how debt enforcement affects the sensitivity of firms' performance to these fluctuations. This is left for future research.

The mechanism stressed in this section is close to the one proposed by Mendoza (2010) who introduces a borrowing constraint into a DSGE model where firms' debt capacity depends on

[20]The long-term collateral value equal to $\theta\overline{\tau} + (1-\theta)\underline{\tau}$ would correspond to our redeployability measure developed in Section 3 of the paper.

collateral values. He shows that the Fisherian debt-deflation process triggering a drop in firms' collateral values explains the emergence of a financial crisis in emerging countries that is followed by recessions and sudden stops. However due to better debt enforcement this transmission mechanism should be less prevalent among developed countries. Cooley et al. (2004) provide an alternative explanation to the negative relationship between macroeconomic volatility and contract enforcement. Their theory predicts that limited contract enforcement amplifies the business cycle by not excluding defaulting firms from credit markets.

7. Conclusion

This paper has provided evidence that a country's ability to enforce debt contract affects the sensitivity of industry growth to changes in collateral values. Using a novel industry-specific measure of real assets' redeployability as proxy for collateral liquidation values, we find that the difference in growth between sectors with low and high collateral values is larger in countries with weaker debt enforcement institutions. Our estimates suggest that the differential effect is sizeable. This finding is robust using instrumental variables, controls for alternative channels and a battery of robustness checks. We have also shown that the basic source of variation of the collateral channel across countries is debt enforcement in the sense that financial development has no strong impact on the collateral channel beyond the correlation with debt enforcement.

We have analyzed the aggregate implications of our main empirical result for growth and volatility. We find that the effect of debt enforcement on aggregate growth working through the collateral channel is on average economically significant. Using a simple theoretical framework, we then show that our main result provides indirect evidence that improving the quality of debt enforcement will reduce macroeconomic volatility by mitigating the sensitivity of economic activity to fluctuation in collateral values. This result is in line with empirical evidence showing a negative relationship between the quality of institutions and macroeconomic volatility (see Acemoglu et al., 2003; Koren and Tenreyro, 2007). We suggest a specific channel but leave its formal testing for future research.

Overall, our findings suggests that a policymaker aiming at fostering aggregate growth and reducing macroeconomic volatility arising from fluctuations in collateral values should focus on improving the quality of legal institutions rather than the level of financial development alone. The empirical investigation has highlighted some general aspects of the bankruptcy procedure that could be improved: reaching the efficient outcome, reducing the time to resolve the dispute and the number of procedure and decreasing the costs occurred in the procedure. How these improvements can be achieved in practice is however beyond the scope of our paper.

Appendix

A.1. Sources and description of data

Redeployability of real assets. The Detailed Fixed Assets Tables are available on the website of the Bureau of Economic Analysis (BEA) (`http://www.bea.gov/national/FA2004/index.asp`). BEA provides data in current value on investment expenditures over the period 1901-2009 and on capital stock over the period 1947-2009 for 74 private nonresidential real assets for each of the 63 U.S. industries (3-digit level of disaggregation; 2002 NAICS classification). 42 assets fall into the category "Equipment" while the category "Structures" contains 32 types of capital. We use the tables providing for each industry i investment expenditures in used and new real assets of type a ($E_{a,i,t}$) and stock of asset a ($K_{a,i,t}$), both expressed in time t current million dollars value. To obtain $Liquidity_{a,i}$, we sum the current-value investment expenditures in capital a of industry i over the period 1981-2000 ($\sum_{t=1981}^{2000} E_{a,i,t}$) and then divide it by the sum of industry i's total current-value investment expenditures over the same period ($\sum_{a=1}^{74} \sum_{t=1981}^{2000} E_{a,i,t}$). To get the asset share $\omega_{a,i}$, we sum the current-value capital stock for real asset a of industry i over the period 1981-2000 ($\sum_{t=1981}^{2000} K_{a,i,t}$) and then divide it by the sum of industry i's total current-value capital stock over the same period ($\sum_{a=1}^{74} \sum_{t=1981}^{2000} K_{a,i,t}$). We repeat the procedure for each asset and industry considered in the tables.

The Annual Capital Expenditure Survey from the U.S. Census Bureau provide data over the period 1996-2006 on investment expenditures on used capital ($E_{a,i,t}^{used}$) and on new capital ($E^{new}_{a,i,t}$) expressed in time t current million dollars value (available on the webpage `http://www.census.gov/econ/aces`). The database covers the same U.S. sectors as in the Detailed Fixed Assets Tables (1987 SIC classification for the period 1994-1997; 1997 NAICS classification for the period 1998-2006), but only for two broad categories of real assets, namely "Equipment" and "Structures". We convert the 1994-1997 data from the 1987 SIC classification into the 1997 NAICS classification using the detailed concordance available on the CENSUS website (`http://www.census.gov/eos/www/naics/concordances/concordances.html`). To obtain $Nonspecificity_{a,i}$, we sum the expenditures on used capital of industry i for category a of real assets over 1996-2006 ($\sum_{t=1996}^{2006} E^{used}_{a,i,t}$) and then divide it by the sum of total capital expenditures for the same category over the same period $[\sum_{t=1996}^{2006}(E^{used}_{a,i,t} + E^{new}_{a,i,t})]$.

The redeployability of assets used by industry i is reported according to BEA industry codes based on the NAICS classification. In order to match our measure of redeployability to the ISIC rev. 2 classification, we first use a concordance from NAICS02 (6-digits) to ISIC rev. 3 (4-digits) and then another one from ISIC rev. 3 to ISIC rev. 2 (3-digit), both available on the United Nations Statistics Division's website (`http://unstats.un.org/unsd/class/`). We attribute to each ISIC rev. 2 industry the value of redeployability of the BEA industry with which it shares the most NAICS02 categories. The advantage of this strategy is that all ISIC categories are mapped. However, for some ISIC categories the same BEA category is attributed, which reduces the variability of our measure across industries. The benchmark concordance constructed with this procedure is shown in Table A.1. The concordance we obtain appears sensible as most industries share the same industry name across ISIC and BEA classifications. We also construct an alternative concordance that addresses the following issues: i) a few ISIC categories (e.g. 324 Footwear, except rubber or plastic) share an approximately equal number of NAICS02 categories with two BEA codes. To account for this we attribute to the ISIC category the average redeployability of the two BEA industries. ii) for ISIC and BEA industry names that patently do not correspond (e.g. ISIC 362 Glass Products) we arbitrarily attribute the BEA industry that is closest to the ISIC industry.

Insert TABLE A.1 here

We also compute $Liquidity_{a,i}$ and $\omega_{a,i}$ for different periods of time using the same procedure as the one described above to get a correlation matrix of redeployability for the whole sample of industries (manufacturing and non-manufacturing) across time. The correlation matrix is displayed in Table A.2. Note that the Spearman's and Pearson's correlation coefficients are of the same order of magnitude when only manufacturing industries are considered.

Insert TABLE A.2 here

Note that in robustness tests related to the redeployability measure (column 1 in Table 7), *Redeployability* (i.e. $R_{80s-90s}$) is instrumented with R_{70s}. In additional robustness tests (Table 9), we use the redeployability index R_{80s} (R_{90s}) when we consider the time period 1980s in column 10 (1990s in column 11).

Insert TABLE A.3 here

Industry growth. Industry growth is measured using production data provided by Nicita and Olarreaga (2007) for 28 manufacturing sectors over the period 1976-2004. The data is originally from United Nations Industrial Development Organization (UNIDO) and is reported according to the 3-digit ISIC Rev. 2 classification. Value added is reported by UNIDO in thousand current US dollars. We divide value added by $[(CGDP_{ct}/RGDP_{ct})] \times (P_{ct}/100)$ to express value added in constant international dollars of industry i in country c at year t (va_{ict}). This deflation procedures is from Levchenko et al. (2009). Data on per capita nominal GDP ($CGDP_{ct}$) and real GDP ($RGDP_{ct}$) in international dollars, on the price level of GDP (P_{ct}) and population (POP_{ct}, in thousands) are taken from the Penn World Table (Heston et al. (2006)). Real growth in value added is the annual compounded growth rate in real value added of industry i in country c over the period 1980-2000 $[Y_{ic} = (\log va_{ic,2000} - \log va_{ic,1980})/20]$.

In additional robustness tests (Table 9), we use gross fixed capital formation and output, which represents the value of goods produced in a year, whether sold or stocked, both from the UNIDO database. We apply the same transformations than for value added to obtain investment and output in constant international dollars. In column 8, we use export data from Feenstra et al. (2005) (4-digit level of disaggregation; SITC rev. 2 classification). We convert the export data in the SITC rev. 2 classification into the ISIC rev. 2 classification using the concordance produced by Muendler (available at `http://www.econ.ucsd.edu/muendler/html/resource.html`). Growth in investment, output or exports is the annual compounded growth rate in the particular variable associated to industry i in country c over the period 1980-2000.

Debt enforcement, financial development, property and creditor rights. The efficiency of debt enforcement is taken from Djankov et al. (2008). In this study, the authors have questioned insolvency practitioners from 88 countries to describe in detail how debt enforcement in their country will proceed with respect to an identical firm that is about to default on its debt. The firm is a hotel with a given number of employees, capital and ownership structure, value as a going concern and value if sold piecemeal. The value of the hotel is 100 (equal to the value of debt) if it kept as going concern but decreases to 70 if it sold piecemeal. Debt enforcement efficiency is defined as the present value of the terminal value of the firm minus bankruptcy costs. From collected responses of practitioners, *Debt enforcement* efficiency is computed as $[100 \times GC + 70 \times (1 - GC) - 100 \times c]/(1 + r)^t$ where GC equals one if the hotel continues as a going concern and zero otherwise, c is the cost of debt enforcement procedures, t the time to resolve insolvency, and r the nominal lending rate prevailing in the country.

In Table 5 we split the sample according to whether the measure of *Property rights* is below or above the median (columns 3 and 4). *Property rights* from Gwartney et al. (2010) is averaged over the period 1995-2000 and measures how well real or financial assets are protected by law and how clearly they are defined.

In additional robustness tests (Table 9), we use alternative measures of debt enforcement. First, we consider the recovery rate for secured creditors constructed as the efficiency of debt enforcement and defined as $[100 \times GC + 70 \times (1 - GC) - 12 \times (P - 1) - 100 \times c]/(1 + r)^t$ where P stands for the order of priority in which claims are paid. The measure of recovery rate is from Djankov et al. (2008) in column 1 and from World Bank (2008) in column 2. Then we use data from World Bank (2008) on the efficiency of the judicial system in the collection of an overdue debt: the time required for dispute resolution, the number of procedures involved in and the official costs of going through court procedures. As in Nunn (2007), we change and normalize each variable in order to get an alternative measure of debt enforcement increasing in it and ranging from zero to one [$(1500 - Time)/1500$ in Column 3, $(60 - Procedures)/60)$ in Column 4 and $(6 - \ln(Costs))/6$] in Column 5.

We consider two types of variable as a proxy for the level of financial development. *Debt market size* in period t is defined as $0.5 \times \{[F_t/P_t^e + F_{t-1}/P_{t-1}^e]/[GDP_t/P_t^a]\}$ where F is credit by deposit money bank and other financial institutions to the private sectors (lines 22d + 42d), GDP is line 99b, P^e is end- of period CPI (line 64) and P^a is the average CPI for the give year. Data come from International Financial Statistics (IFS). *Stock market size* in period t taken from Beck et al. (2009) is calculated as debt market size with F defined as the value of listed shares. We average each variable over the period 1981-2000. The legal origin of a country's bankruptcy laws from Djankov et al. (2008) and the log of European settler mortality in former colonies from Acemoglu et al. (2001) are used as an instrument for debt enforcement, while the instrument for the level of financial development is the legal origin of commercial laws from La Porta et al. (1998).

Creditor rights is the mean value over the period 1981-2000 of the creditor rights index from Djankov et al. (2007).

Controls. The *Initial industry share* is computed using the UNIDO dataset from Nicita and Olarreaga (2007), and defined as the share of the industry i's real value added to the country c's total manufacturing real value added in 1980 ($va_{ic,1980}/\sum_{i=1}^{28} va_{ic,1980}$).

Industry-specific variables. The sectoral financial characteristics are taken from Table II in Braun (2005). *Tangibility* of assets is the median ratio of net property, plant and equipment to total assets over U.S. firms in industry i, while *External finance dependence* is the median ratio of capital expenditures minus cash-flows from operations to total capital expenditures over U.S. firms in industry i. Considering other industry-specific variables, *R&D intensity* is the ratio of R&D expenditures over total capital expenditures, *Depreciation* the industry rate of capital depreciation and *Obsolescence* the embodied technical change in industry capital based on Cummins and Violante (2002). These variables are from Ilyina and Samaniego (2011). *Product complexity* is the Herfindhal index of intermediate input use from Cowan and Neut (2007). *Contract intensity* comes from Levchenko (2010) and reports the industry share of intermediate inputs that cannot be bought on organized exchanges and is not reference-priced. *Benchmark economic activity* is computed using the UNIDO dataset from Nicita and Olarreaga (2007). In the allocation regression, it measures the value added to GDP of industry i in United States, while in the growth regression, it measures the annual compounded growth rate in industry real value added in United States. Both variables are averaged of the period 1980-2000.

Country-specific variables. *Human capital* is computed from the average years of schooling over the population in a given country using data from Barro and Lee (2001) with concave Mincerian returns to education. The computational method is from Caselli (2005). *Rule of law* ranging from -2.5 to 2.5 is computed from survey data by Kaufmann et al. (2009) and measures the extent to which agents have confidence in and abide by the rules of society in 1996. *Initial GDP per capita* is the log of real GDP per capita in 1980, while *GDP per worker* is the log of the mean of real GDP per worker over period 1981-2000. Data are from the Penn World Tables (Heston et al., 2006).

A.2. Summary statistics

Insert TABLE A.4 here

A.3. Sample

Insert TABLE A.5 here

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Tables

TABLE 1

THE FIVE MOST AND FIVE LEAST REDEPLOYABLE REAL ASSETS

R_a is the redeployability of real asset a used by U.S. firms between 1981-2000 defined by expression (4) in the text. The redeployability of each asset type is scaled by the value of the most redeployable assets (i.e. by the redeployability of offices equal to 0.0068).

The Most Redeployable Real Assets		The Least Redeployable Real Assets	
R_a	Real Asset Description	R_a	Real Asset Description
1	Offices	.000	Local transit structures
.560	Manufacturing structures	.000	Wind and solar structures
.526	Trucks, buses and other trailers	.003	Tape drives
.510	General industrial equipment	.004	Other transportation structures
.478	Communication equipment	.004	Nuclear fuel

Table 2

Redeployability, Tangibility, Depreciation and Obsolescence of Real Assets

Redeployability is the redeployability of real assets used by U.S. firms between 1981-2000 in industry i is defined by expression (3) in the text. For interpretation purposes, the redeployability of each sector is scaled by the highest value of the redeployability index (i.e by the redeployability of the industry *Management of companies and Enterprises* equal to 0.0043). *Tangibility* of assets is the median ratio of net property, plant and equipment to total assets over U.S. firms in industry i (see Braun, 2005). *Depreciation* is the industry rate of capital depreciation and *Obsolescence* the embodied technical change in industry capital based on Cummins and Violante (2002). Those two variables are from Ilyina and Samaniego (2011). ^{a} indicates that the null hypothesis of no correlation is not rejected at 10% level.

ISIC	Industrial sector	Redeployability	Tangibility	Depreciation	Obsolescence
384	Transport equipment	0.6093	0.2548	0.1079	0.0424
324	Footwear, except rubber or plastic	0.6396	0.1167	0.0825	0.0376
371	Iron and steel	0.6396	0.4581	0.0662	0.0311
381	Fabricated metal products	0.6396	0.2812	0.0700	0.0328
341	Paper and products	0.6510	0.5579	0.0856	0.0304
372	Non-ferrous metals	0.6540	0.3832	0.0549	0.0310
382	Machinery, except electrical	0.6631	0.1825	0.0883	0.0497
362	Glass and products	0.6631	0.3313	0.0785	0.0433
385	Professional and scientific equipment	0.6848	0.1511	0.0911	0.0414
383	Machinery, electric	0.6848	0.2133	0.0912	0.0447
351	Industrial chemicals	0.6881	0.4116	0.0923	0.0372
352	Other chemicals	0.6881	0.1973	0.0663	0.0379
356	Plastic products	0.6995	0.3448	0.0983	0.0310
355	Rubber products	0.6995	0.3790	0.0983	0.0304
390	Other manufactured products	0.7034	0.1882	0.0997	0.0278
313	Beverages	0.7338	0.2794	0.0711	0.0351
311	Food products	0.7338	0.3777	0.0711	0.0349
314	Tobacco	0.7338	0.2208	0.0529	0.0351
342	Printing and publishing	0.7413	0.3007	0.0964	0.0408
353	Petroleum refineries	0.7492	0.6708	0.0665	0.0362
354	Miscellaneous petroleum and coal products	0.7492	0.3038	0.0665	0.0369
369	Other non-metallic mineral products	0.7537	0.4200	0.0851	0.0470
361	Pottery, china, earthenware	0.7537	0.0745	0.0851	0.0455
332	Furniture, except metal	0.7708	0.2630	0.0813	0.0394
331	Wood products, except furniture	0.7718	0.3796	0.0959	0.0380
321	Textiles	0.8056	0.3730	0.0757	0.0362
323	Leather products	0.8896	0.0906	0.0924	0.0372
322	Wearing apparel, except footwear	0.8896	0.1317	0.0629	0.0405
Mean		0.7172	0.2977	0.0812	0.0375
Correlation with Redeployability			-0.1978^{a}	-0.1192^{a}	0.1242^{a}

Table 3
Debt Enforcement and Debt Market Size across Countries

This table reports the efficiency of debt enforcement from Djankov et al. (2008) for the 3 most and 3 least efficient countries across high-income and non high-income countries present in our regression samples. For these countries, it reports debt market size measured as the average ratio of private credit by deposit money bank and other financial institutions to GDP between 1981-2000. To classify countries, we use the World Bank classification of countries. We also present the means and correlations of the two measures for each group, and t-statistics for the difference in means across the two groups. **: significant at 1% level. *: significant at 5% level. $^{+}$: signficant at 10% level.

High-Income Countries			Middle- and Low-Income Countries		
Country	Debt Enforcement	Debt Market Size	Country	Debt Enforcement	Debt Market Size
Singapore	0.961	0.981	Mexico	0.726	0.177
Japan	0.955	1.627	Colombia	0.648	0.295
Netherlands	0.949	1.106	Tunisia	0.566	0.592
...			...		
France	0.541	0.807	Indonesia	0.251	0.315
Hungary	0.467	0.286	Costa Rica	0.25	0.154
Italy	0.453	0.539	Turkey	0.066	0.146
Number of countries	21	21		14	14
Mean	0.797	0.808		0.409	0.392
t-test of difference in means	6.64**	4.11**			
Correlation	1	0.599**		1	0.266

Table 4
The Effect of Imperfect Debt Enforcement on the Collateral Channel

The dependent variable is the annual compounded growth rate in real value added over the period 1980-2000 for each 3-digit ISIC industry in each country. The main variable of interest *Redeployability* × *Debt enforcement* denotes the product of these two variables. *Redeployability* defined by expression (3) in the text is the redeployability of real assets owned by each 3-digit ISIC U.S. industry between 1981-2000. *Debt enforcement* is a time-invarying variable constructed by Djankov et al. (2008) and denotes the efficiency of debt enforcement procedures in each country. *Tangibility* from Braun (2005) is the median ratio of net property, plant and equipment to total assets over U.S. firms in each 3-digit ISIC industry. *Depreciation* and *Obsolescence* from Ilyina and Samaniego (2011) are the industry rate of capital depreciation and the embodied technical change in capital measure based on Cummins and Violante (2002). Columns 1 to 4 report the OLS estimates. Columns 5 to 8 report IV results obtained by GMM with *Debt enforcement* instrumented by the legal origin of a country's bankruptcy laws. The differential effect measures in percentage points how much slower an industry at the 25th percentile of the redeployability of real assets would grow with respect to an industry at the 75th percentile when the industries are located in a country at the 25th percentile of debt enforcement rather than in one at the 75th percentile. All regressions include both country and industry fixed effects and a constant (coefficient estimates not reported). Standard errors clustered two-way by industry and country (columns 1-5) and standard errors clustered by country (columns 6-8) are reported in parentheses. **: significant at 1% level. *: signficant at 5% level. $^{+}$: signficant at 10% level.

	OLS				IV			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Redeployability × Debt enforcement	**−0.262***	**−0.250***	**−0.268***	**−0.277****	**−0.350****	**−0.401****	**−0.255****	**−0.299****
	(0.125)	**(0.115)**	**(0.123)**	**(0.104)**	**(0.125)**	**(0.113)**	**(0.083)**	**(0.085)**
Tangibility × Debt enforcement		0.029		0.033		0.042		0.010
		(0.044)		(0.049)		(0.056)		(0.051)
Depreciation × Debt enforcement			0.001	0.002			0.009^{+}	0.011*
			(0.003)	(0.003)			(0.005)	(0.004)
Obsolescence × Debt enforcement			0.009	0.014^{+}			0.017*	0.022**
			(0.007)	(0.008)			(0.007)	(0.007)
Initial industry share				−0.106*				−0.132**
				(0.045)				(0.038)
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Differential effect (percentage points)	**−1.04**	**−0.99**	**−1.06**	**−1.10**	**−1.39**	**−1.59**	**−1.01**	**−1.16**
Hansen J test (p-value)	–	–	–	–	0.684	0.326	0.368	0.412
Observations	829	829	829	829	829	829	829	829
Countries	35	35	35	35	35	35	35	35

Table 5

The Source of the Collateral Channel under Imperfect Debt Enforcement

The dependent variable is the annual compounded growth rate in real value added over the period 1980-2000 for each 3-digit ISIC industry in each country. The main variable of interest *Redeployability* × *Debt enforcement* denotes the product of these two variables defined as in Table IV. The level of financial development is the following: (i) *Debt market size* defined as the average ratio of private credit by deposit money bank and other financial institutions to GDP in each country between 1981-2000; (ii) *Stock market size* defined as the ratio of stock market capitalization to GDP in each country, averaged over the period 1981-2000. The index *Creditor rights* from Djankov et al. (2007) measures the legal rights of creditors against a defaulting debtor in each country, averaged over the period 1981-2000. All regressions include both country and industry fixed effects and a constant (coefficient estimates not reported) and are estimated by GMM with *Debt enforcement* and *Creditor rights* instrumented by the legal origin of a country's bankruptcy laws and the level of financial development (*Debt market size* and *Stock market size*) instrumented by the legal origin of a country's commercial laws. Additional controls include the initial industry share. Standard errors clustered two-way by industry and country (columns 1,2,4 and 5) and standard errors clustered by country (column 3) are reported in parentheses. **: significant at 1% level. *: signficant at 5% level. $^{+}$: signficant at 10% level.

	(1)	(2)	(3)	(4)	(5)
Redeployability × Debt market size	−0.253**		0.055		
	(0.095)		(0.142)		
Redeployability × Stock market size		−0.135*		0.111	
		(0.069)		(0.095)	
Redeployability × Debt enforcement			**−0.513***	**−0.603****	**−0.566****
			(0.220)	**(0.155)**	**(0.214)**
Redeployability × Creditor rights					0.058
					(0.058)
Initial industry share	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes	Yes
Hansen J test (p-value)	0.621	0.368	0.427	0.581	0.722
Observations	998	968	829	829	829
Countries	43	41	35	35	35

Table 6

Robustness Tests related to the Redeployability Measure

The dependent variable is the annual compounded growth rate in real value added over the period 1980-2000 for each 3-digit ISIC industry in each country. The main variable of interest *Redeployability* × *Debt enforcement* denotes the product of these two variables. In column 1, *Redeployability* is instrumented with the index of *Redeployability* calculated using data from 1971-1980. In column 2, data on capital expenditures of service industries are excluded for the computation of $Redeployability_a$, whereas in column 3 only data on capital expenditures of manufacturing industries are used to compute $Redeployability_a$. An alternative concordance between ISIC and BEA classifications is used in column 4 (see Appendix). In column 5, industries are defined according to the BEA classification. Additional controls include the initial industry share corresponding to the dependent variable. All regressions include both country and industry fixed effects and a constant (coefficient estimates not reported) and are estimated by GMM with *Debt enforcement* instrumented by the legal origin of a country's bankruptcy laws. Standard errors clustered two-way by industry and country (columns 2 to 5, Panel B) or by country (Panel A and column 1, Panel B) are reported in parentheses. **: significant at 1% level. *: signficant at 5% level. $^{+}$: signficant at 10% level.

	IV	Without Services	Only Manufacturing	Alternative Concordance	BEA Code
	(1)	(2)	(3)	(4)	(5)
Redeployability × Debt enforcement	**−0.468****	**−1.662****	**−1.391****	**−0.513****	**−0.323***
	(0.133)	**(0.487)**	**(0.377)**	**(0.161)**	**(0.152)**
Initial industry share	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes	Yes
Hansen J test (p-value)	0.579	0.439	0.444	0.614	0.611
Observations	829	829	829	829	531
Countries	35	35	35	35	35

Table 7

Testing Alternative Explanations

All regressions include both country and industry fixed effects and a constant (coefficient estimates not reported) and are estimated by GMM with *Debt enforcement* instrumented by the legal origin of a country's bankruptcy laws. The dependent variable is the annual compounded growth rate in real value added over the period 1980-2000 for each 3-digit ISIC industry in each country. The main variable of interest *Redeployability* × *Debt enforcement* is defined as in Table IV. Each interaction term is the product of the corresponding two variables. The industry-specific variables, which are built using U.S. data, are the following: (i) *Product complexity* is the Herfindhal index of intermediate input use from Cowan and Neut (2007); (ii) *R&D intensity* is the ratio of R&D expenditures over capital expenditures; (iii) *External finance dependence* is the median ratio of capital expenditures minus cash-flows from operations to capital expenditures; (iv) *Industry dummy* is a dummy variable for each 3-digit ISIC industry; (v) *Contract intensity* reports the industry share of intermediate inputs that cannot be bought on organized exchanges and are not reference-priced; (vi) *Benchmark economic activity* averaged over the period 1980-2000 measures the annual compounded growth rate in industry real value added in United States. The country-specific variables are the following: (a) *Rule of law* measures the extent to which agents have confidence in and abide by the rules of society in 1996; (b) *Human capital* is log of the mean average years of schooling over the period 1981-2000; (c) *Financial development* is the average ratio of private credit by deposit money bank and other financial institutions to GDP in each country between 1981-2000; (d) *GDP per worker* is the log of the mean of real GDP per worker over the period 1981-2000; (e) *Initial GDP per capita* is the log of real GDP per capita in 1980. Additional controls include the initial industry share. Standard errors clustered by country (and industry in columns 2, 6 and 8) are reported in parentheses. **: significant at 1% level. *: signficant at 5% level. +: signficant at 10% level.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Redeployability × Debt enforcement	**−0.459****	**−0.292***	**−0.376****	**−0.426***	**−0.425****	**−0.456****	**−0.402****	**−0.363****
	(0.119)	**(0.123)**	**(0.118)**	**(0.201)**	**(0.117)**	**(0.143)**	**(0.116)**	**(0.114)**
Product complexity × Rule of Law	0.028							
	(0.020)							
R&D intensity × Human capital		0.009						
		(0.008)						
External finance dependence × Financial development			0.052**					
			(0.017)					
Industry dummy × GDP per worker				–				
				–				
Contract intensity × Rule of law					0.013			
					(0.015)			
Redeployability × Initial GDP per capita						0.080		
						(0.050)		
Benchmark growth × Financial development							0.148	
							(0.244)	
Benchmark growth × Initial GDP per capita								0.254**
								(0.075)
Initial industry share	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hansen J test (p-value)	0.110	0.478	0.476	0.514	0.304	0.345	0.167	0.586
Observations	829	754	829	829	829	829	788	788
Countries	35	32	35	35	35	35	35	35

Table 8

Additional Robustness Tests

All regressions include both country and industry fixed effects and a constant (coefficient estimates not reported) and are estimated by GMM with *Debt enforcement* instrumented by the legal origin of a country's bankruptcy laws (except in Column 8 where the log of European settler mortality from Acemoglu et al. (2001) is used as an instrument). The dependent variable is the following: (i) Columns 1 to 5, and 9 to 11: the annual compounded growth rate in real value added for each 3-digit ISIC industry in each country; (ii) Columns 6 to 8: the annual compounded growth rate in real investment, output and exports resp. for each 3-digit ISIC industry in each country. Each dependent variable is averaged over the following period: (a) 1981-2000 (Columns 1 to 9); (b) 1981-1990 (Column 10); (c) 1991-2000 (Column 11). *Redeployability* defined by expression (3) in the text is the redeployability of real assets owned by each 3-digit ISIC U.S. industry over the specified time period. *Debt enforcement* is a time-invarying country-specific variable and denotes the following: (i) the recovery rate for secured creditors (constructed by Djankov et al. (2008), Column 1, and by World Bank (2008), Column 2); (ii) the efficiency of the judicial system in the collection of an overdue debt measured by $(1500 - Time)/1500$ in Column 3, $(60 - Procedures)/60)$ in Column 4 and $(6 - \ln(Costs))/6$ in Column 5 (data from World Bank (2004) on time, the number of procedures and the official costs to recover debt through courts); (iii) the efficiency of debt enforcement procedures (constructed by Djankov et al. (2008), Columns 6 to 11). Additional controls include the initial industry share corresponding to the dependent variable. Standard errors clustered two-way by industry and country or only by country (columns 1, 10 and 11) are reported in parentheses. **: significant at 1% level. *: signficant at 5% level. $^+$: signficant at 10% level.

	Measure of debt enforcement					Dependent variable			Instrument	Time period	
	Recovery Djankov	Recovery WB	Time	Procedures	Costs	Investment	Output	Exports	Settler mortality	1980s	1990s
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Redeployability × Debt enforcement	**−0.333****	**−0.403****	**−0.733***	**−0.682$^+$**	**−0.809***	**−0.346**	**−0.349****	**−0.463***	**−0.395***	**−0.311****	**−0.504***
	(0.105)	**(0.123)**	**(0.363)**	**(0.380)**	**(0.343)**	**(0.266)**	**(0.119)**	**(0.190)**	**(0.189)**	**(0.109)**	**(0.200)**
Initial industry share	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hansen J test (p-value)	0.674	0.762	0.509	0.513	0.256	0.162	0.841	0.818	-	0.092	0.442
Observations	829	961	812	812	812	540	844	1495	417	1148	850
Countries	35	41	34	34	34	26	35	60	18	44	37

Table 9. The Estimated Growth Effect of Debt Enforcement

Country	Debt enforcement	Annual growth (%)	Growth effect: Sectoral growth (pp)	Growth effect: Industrial composition (pp)	Growth effect: Overall (pp)
	(1)	(2)	(3)	(4)	(5)
Uruguay	0.29	−2.51	0.44	−0.49	−0.05
Hungary	0.47	−3.59	0.55	−0.56	−0.01
France	0.54	−1.10	0.51	−0.17	0.34
Sweden	0.86	−0.30	0.61	−0.14	0.47
Kuwait	0.56	1.04	0.45	0.20	0.65
Italy	0.45	0.23	0.57	0.10	0.67
Spain	0.82	0.79	0.55	0.19	0.74
Austria	0.78	1.19	0.50	0.27	0.77
Colombia	0.65	1.58	0.48	0.29	0.77
Costa Rica	0.25	2.18	0.38	0.44	0.82
Portugal	0.82	1.77	0.50	0.50	1.00
Jordan	0.44	3.82	0.45	0.72	1.17
Chile	0.41	3.81	0.55	0.78	1.33
Sri Lanka	0.46	5.20	0.46	0.96	1.42
Morocco	0.42	5.70	0.50	0.97	1.47
Turkey	0.07	4.06	0.47	1.03	1.51
Iran	0.29	4.48	0.48	1.21	1.70
South Korea	0.88	6.50	0.51	1.26	1.76
Malaysia	0.48	7.97	0.50	1.74	2.24
Indonesia	0.25	9.34	0.48	1.88	2.35
Mean	0.51	2.60	0.50	0.56	1.06

Column 2 of this table reports the efficiency of debt enforcement from Djankov et al. (2008) for the sample of countries used in basic growth regressions (listed in Table A.5) that cover at least 75% of sectors (i.e. more than 20 sectors) and that are below the 75th percentile of the debt enforcement quality index (equal to 0.88). In column 3, we report the annual growth of the manufacturing sector averaged over the period 1980-2000. We then show the growth effect in percentage points (pp) of an increase of 0.1 in debt enforcement over this period that works through: (1) changes in sectoral growth given by $\hat{\beta}\sum_i(R_i - R_1)s_{ic} \times 0.1 \times 100$ (column 4), where s_{ic} is the share of the industry's real value added to total value added in the manufacturing sector in 1980; (2) through a change in industrial composition given by $\hat{\beta}_s \sum_i(R_i - R_1)g_{ic} \times 0.1 \times 100$ (column 5), where g_{ic} is the annual compounded growth rate in industry's real value added over the period 1980-2000. The overall growth effect of debt enforcement in the manufacturing sector reported in column 5 is the sum of these components. Coefficient estimates $\hat{\beta}$ and $\hat{\beta}_s$ are taken from Columns (8) in Table 4 and Table W.1, respectively.

TABLE A.1

ISIC-BEA Classifications Concordance

This Table reports the concordance between ISIC rev.2 classification and BEA code. The methodology used to construct the concordance is described in Appendix A.1.

		Benchmark Concordance		Alternative Concordance	
ISIC		BEA		BEA	
Code	Industry Name	Code	Industry Name	Code	Industry Name
311	Food products	311A	Food, beverage, and tobacco products	311A	Food, beverage, and tobacco products
313	Beverages	311A	Food, beverage, and tobacco products	311A	Food, beverage, and tobacco products
314	Tobacco	311A	Food, beverage, and tobacco products	311A	Food, beverage, and tobacco products
321	Textiles	313T	Textile mills and textile product mills	313T	Textile mills and textile product mills
322	Wearing apparel, except footwear	315A	Apparel and leather allied products	315A	Apparel and leather allied products
323	Leather products	315A	Apparel and leather allied products	315A	Apparel and leather allied products
324	Footwear, except rubber or plastic	3320	Fabricated metal products	315A	Apparel and leather allied products (50%)
				3320	Fabricated metal products (50%)
331	Wood products, except furniture	3210	Wood products	3210	Wood products
332	Furniture, except metal	3370	Furniture and related products	3370	Furniture and related products
341	Paper and products	3220	Paper products	3220	Paper products
342	Printing and publishing	3230	Printing and related support activities	3230	Printing and related support activities
351	Industrial chemicals	3250	Chemical products	3250	Chemical products
352	Other chemicals	3250	Chemical products	3250	Chemical products
353	Petroleum refineries	3240	Petroleum and coal products	3240	Petroleum and coal products
354	Miscellaneous petroleum and coal products	3240	Petroleum and coal products	3240	Petroleum and coal products
355	Rubber products	3260	Plastics and rubber products	3260	Plastics and rubber products
356	Plastic products	3260	Plastics and rubber products	3260	Plastics and rubber products
361	Pottery, china, earthenware	3270	Nonmetallic mineral products	3270	Nonmetallic mineral products
362	Glass and products	3330	Machinery	3270	Nonmetallic mineral products
369	Other non-metallic mineral products	3270	Nonmetallic mineral products	3270	Nonmetallic mineral products
371	Iron and steel	3320	Fabricated metal products	3320	Fabricated metal products
372	Non-ferrous metals	3310	Primary metals	3310	Primary metals
381	Fabricated metal products	3320	Fabricated metal products	3320	Fabricated metal products
382	Machinery, except electrical	3330	Machinery	3330	Machinery
383	Machinery, electric	3340	Computer and electronic products	3340	Computer and electronic products
384	Transport equipment	336M	Motor vehicles, bodies and trailers, and parts	336M	Motor vehicles, bodies and trailers, and parts (50%)
				336O	Other transport equipment (50%)
385	Professional and scientific equipment	3340	Computer and electronic products	3330	Machinery
390	Other manufactured products	338A	Miscellaneous manufacturing	338A	Miscellaneous manufacturing

TABLE A.2

Correlations between Redeployability of Different Decades

Spearman's rank correlation coefficients are reported on first lines while second lines refer to Pearson's correlation coefficients. The null hypothesis of independence is rejected below the 1% level of significance for Spearman's correlations. The Pearson's correlations are significantly different from zero below the 1% level. The redeployability of real assets $R_{i,t}$ defined in (3) has been calculated over different decades t for each industry i (manufacturing and non-manufacturing) present in the Detailed Fixed Assets Table from BEA. We use $Specificity_{a,i}$ computed for the period 1994-2006 since it is the most recent coverage that ACES database provides.

Correlation	$R_{80s-90s}$	$R_{60s-70s}$	R_{90s}	R_{80s}	R_{70s}	R_{60s}
$R_{80s-90s}$	1					
	1					
$R_{60s-70s}$	0.92	1				
	0.94	1				
R_{90s}	0.99	0.91	1			
	0.99	0.91	1			
R_{80s}	0.98	0.93	0.95	1		
	0.98	0.95	0.96	1		
R_{70s}	0.92	0.99	0.90	0.93	1	
	0.93	0.99	0.92	0.95	1	
R_{60s}	0.92	0.97	0.90	0.92	0.95	1
	0.91	0.97	0.89	0.94	0.96	1

TABLE A.3

Correlations between Redeployability Calculated from Different Industry Sets

Spearman's rank correlation coefficients are reported on first lines while second lines refer to Pearson's correlation coefficients. The null hypothesis of independence is rejected below the 1% level of significance for Spearman's correlations. The Pearson's correlations are significantly different from zero below the 2% level. The redeployability of real assets defined in (3) has been calculated using data on different sets of industries. *Redeployability* is the benchmark measure of redeployability, $R_{w\backslash service}$ is computed after excluding industries of the services sectors and R_{manuf} uses only data from manufacturing industries.

Correlation	*Redeployability*	$R_{w\backslash service}$	R_{manuf}
Redeployability	1		
	1		
$R_{w\backslash service}$	0.60	1	
	0.53	1	
R_{manuf}	0.63	0.98	1
	0.53	0.99	1

TABLE A.4

Summary Statistics

	Mean	**Std. dev.**	**Min.**	**Max.**	**Obs.**
Industry-country-specific variables					
Real growth rate of value added (1980-2000)	0.0218	0.0546	-0.2215	0.2221	829
Redeployability × Debt enforcement	0.4624	0.1904	0.0402	0.8549	829
Redeployability × Debt market size	0.4411	0.2560	0.0895	1.4477	998
Redeployability × Stock market size	0.3145	0.3086	0.0061	1.8655	968
Redeployability × Creditor rights	1.4638	0.7974	0	3.5583	829
Initial share of value added to GDP (1980)	0.0394	0.0455	0.0002	0.5238	829
Country-specific variables					
Efficiency of debt enforcement	0.6422	0.255	0.066	0.9610	35
Mean private credit to GDP (1981-2000)	0.6417	0.3554	0.1469	1.6274	35
Stock market capitalization to GDP (1981-2000)	0.4732	0.4631	0.0102	2.0971	35
Creditor rights (1981-2000)	2.0357	1.157	0	4	35
British legal origin (bankruptcy law)	0.3143	0.471	0	1	35
French legal origin (bankruptcy law)	0.5143	0.5071	0	1	35
German legal origin (bankruptcy law)	0.0857	0.284	0	1	35
Nordic legal origin (bankruptcy law)	0.0857	0.284	0	1	35
British legal origin (common law)	0.2571	0.4434	0	1	35
French legal origin (civil law)	0.5143	0.5071	0	1	35
German legal origin (civil law)	0.0857	0.284	0	1	35
Scandinavian legal origin (civil law)	0.0857	0.284	0	1	35
Socialist legal origin	0.0571	0.2355	0	1	35
Industry-specific variables					
Redeployability	0.7173	0.0688	0.6093	0.8896	28
Tangibility	0.2977	0.1392	0.0745	0.6708	28
Depreciation	8.1199	1.4535	5.293	10.79	28
Obsolescence	3.7547	0.5494	2.782	4.9700	28

TABLE A.5

Sample of Countries

This sample includes countries present in growth regressions of Table 4.

Country	**Number of industries**	**Country**	**Number of industries**
Australia	20	Japan	27
Austria	22	South Korea	28
Canada	27	Kuwait	22
Chile	28	Sri Lanka	27
Colombia	25	Morocco	26
Costa Rica	23	Mexico	18
Spain	27	Malaysia	26
Finland	26	Netherlands	26
France	23	Norway	26
United Kingdom	26	Panama	18
Hong Kong	21	Poland	10
Hungary	26	Portugal	27
Indonesia	22	Singapore	21
Ireland	26	Sweden	28
Iran	28	Tunisia	17
Israel	17	Turkey	26
Italy	26	Uruguay	21
Jordan	22		