THE JOURNAL OF FINANCE • VOL. LX, NO. 3 • JUNE 2005

Finance and the Business Cycle: International, Inter-Industry Evidence

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ABSTRACT

By considering yearly production growth rates for several manufacturing industries in more than 100 countries during (roughly) the last 40 years, we show that industries that are more dependent on external finance are hit harder during recessions. The observed difference in the behavior of industries is larger when financial frictions are thought to be more prevalent, linking the result directly to the financial mechanism hypothesis. In particular, more dependent industries are more strongly affected in recessions when they are located in countries with poor financial contractibility, and when their assets are softer or less protective of financiers.

THERE IS A LARGE LITERATURE THAT STUDIES the effect of a country's financial development on the growth rate of output (see Levine (1997) for a survey). The overall conclusion of this literature is that financial markets and institutions have a positive and significant effect on long-run growth. Effort has been made toward establishing that causality goes effectively from financial to economic development and not the other way around. In particular, some recent papers analyze industry- and firm-level data in order to clarify the mechanisms that are sometimes obscured in cross-country studies (Demirgüç-Kunt and Maksimovic (1998), Rajan and Zingales (1998)). These papers show that financial development helps firms to grow faster by supplying more external funds; the effect is particularly strong among firms or industries that typically need more external funds to finance their investments.

So far, the financial development literature has focused on long-run growth, for example a span of 10 or more years. We focus instead on short-run fluctuations in production and on how financial frictions amplify them. Our focus on short-run fluctuations is motivated by the fact that, besides allocating resources for long-term investment, financial systems pool, and diversify risks and provide liquidity. A long tradition, going back as far as Fisher (1933), points out the importance of finance in the propagation (and perhaps as the starting point) of business cycles. This idea is called the credit channel of the business cycle and

*Braun is from the University of California, Los Angeles and Larrain is from Harvard University. We thank Robert Barro, John Campbell, Eduardo Fernandez-Arias, Oliver Hart, Alejandro Micco, Andrei Shleifer, Jeremy Stein, and participants in seminars at Harvard University, the Latin American Econometric Society, and the Latin American Finance Network for valuable comments and suggestions. This article was improved substantially by incorporating comments from an anonymous referee and from Robert Stambaugh (the editor). All remaining errors are our own.

is the most direct theoretical reference for this paper (see e.g., Bernanke and Gertler (1989, 1990), Kiyotaki and Moore (1997)).

If financial conditions play an important role in aggregate cyclical behavior, one expects the response to negative shocks to depend on the agent's reliance on financial markets. In particular, when investment is primarily financed with internal funds, worsening conditions should not have as large an impact as when external funds account for the bulk of financing. Since this only happens if financial markets are imperfect (i.e., if internal and external funds are not perfect substitutes), the differential impact should be stronger when financing frictions are more prevalent.

We test these ideas with a data set that consists of yearly production observations for 28 manufacturing industries in over 100 countries from 1963 to 1999. Our tests are based on three building blocks. First, in order to determine business cycle shocks, we identify recessions by looking at fluctuations of aggregate output in each country. Second, we rank industries according to the degree to which they naturally finance their activities with external funds (or external finance dependence) using the index developed by Rajan and Zingales (1998). Our first hypothesis is that, since capital markets are imperfect, recessions should have a larger impact on industries with higher external dependence. The third step consists of measuring differences in financial frictions at the country level (e.g., the number of international accounting standards used by firms, a proxy for informational asymmetries), and at the industry level (e.g., the absence of hard or tangible assets able to support the borrower–lender relationship). As frictions increase, the difference between highly dependent industries vis-à-vis less dependent ones should be larger. This is our second hypothesis.

We find that while recessions are associated with a decrease in growth of 4.7 percentage points for the typical industry, industries that are highly dependent on external finance (in the 85^{th} percentile of the index) exhibit a 0.9 points larger drop than those industries with little dependence (in the 15^{th} percentile). This differential impact of recessions over industries sorted by their dependence on external funds is not homogeneous. In the group of countries with poor accounting, highly dependent industries experience drops that are 1.7 percentage points larger than those of less dependent industries, about twice the difference found when averaging across all countries. Also, the difference in the impact of recessions is significantly larger for those industries that rely less on hard assets. In those industries with lower than median asset tangibility, the differential is 1.4 percentage points, compared to just 0.5 points for the high tangibility group.

We expand the macroeconomic literature on financial constraints in terms of country experiences and time period to include virtually every recessive episode in the last 40 years. We show that the financial mechanism is not just a peculiarity of the United States or other developed economies—from which previous evidence is almost exclusively extracted (e.g., Gertler and Gilchrist (1994)), but is a widespread feature of business cycles around the world, and that is not peculiar to some particular kind of shocks. Also, since our data vary along three dimensions (time, country, and industry) and not just along the customary

two (time and productive unit), we can apply better controls and hence obtain cleaner results. Our approach eases some of the difficulties in measuring financial constraints faced by the literature, in particular, the relation between current cash flow and investment opportunities at the firm level, and the fact that firms of different sizes might exhibit different cyclic behavior for reasons unrelated to finance. An industry's external finance dependence might still be correlated to changes in its investment opportunities; however, there is no obvious reason to believe that this association is related to the degree of the country's financial development or the tangibility of the industry's assets.

Our results are in line with those of independent work by Raddatz (2003), who uses a cross-section of the panel we use here to show that financial development reduces the volatility of value-added growth, and more strongly so among industries with high liquidity needs (defined as inventories over sales). Our approach differs from his in that we explicitly take the time dimension of the data into account, therefore applying further controls and speaking more directly about business cycle shocks. We also analyze the asymmetry of booms and recessions, which is obscured when working with unconditional volatilities.

The rest of the paper is organized as follows. Section I briefly reviews the literature and motivates the hypotheses. In Section II, we summarize our empirical approach. Section III presents the main result, a number of robustness checks and more detailed tests. Finally, in Section IV we state the conclusions.

I. Related Literature and Hypotheses

A. Main Hypotheses

Consider two firms for which internal and external funds are not perfect substitutes. The two firms differ only in their dependence on external financiers: One firm has internal funds that cover a relatively higher fraction of its investment needs. Now suppose that a recession occurs and internal funds are reduced. To keep investment unchanged, both firms would want to increase external borrowing. Because of the presence of financial frictions, the firms would not be able to costlessly make up for the decrease in internal cash with increased credit, and would have to accommodate the shock with a mix of borrowing and spending reduction. This mix differs across firms, however. In particular, the less constrained or dependent firm would be able to dampen the reduction in production due to its higher availability of internal funds. This is the basic financial mechanism hypothesis.

Now suppose that we vary the frictions that exist in the external finance relationship. The change may be related to the environment in which these firms seek external finance or to the firm's characteristics (other than its dependence on external funds). Consider, for example, another country where informational asymmetries are stronger and the relationship between firms and investors is more problematic. For incentive reasons, the link between the firms' balance sheet position and the terms of external finance is stronger in

this country. This would make spending more responsive to the initial shock, but to a lesser extent for the firm that primarily finances itself with internally generated funds. Were capital markets to be frictionless, the link would simply not be there, implying that there is no differential response to shocks. The same rationale can be applied to the case in which it is a firm's characteristic, instead of the informational or contracting environment that makes the relationship with external financiers subject to more frictions. The shock can be dampened if firms bring assets to the relationship that are more protective to financiers, therefore easing the frictions of the environment. In the absence of hard assets, the relationship is fully exposed to the environmental frictions, augmenting the differential impact of shocks across firms.

Simply put, the firm that has less internal funds is disproportionately affected by recessions in the presence of financial frictions, with both conditions operating by effectively tightening the borrowing constraint that the firm faces. We can now make our two hypotheses explicit. First, in a given financial environment, firms that depend more on external funds are hit harder during recessions: $\partial^2 g_{it}/\partial R_t \partial D_i < 0$, where g_{it} is the growth rate of production of firm i at time t, R_t is an indicator of recessions, and D_i is a measure of the dependence on external funds. Second, an increase in the severity of the financial frictions makes the previous effect stronger: $\partial^3 g_{it}/\partial R_t \partial D_i \partial F < 0$, where F is a measure of cross-country or cross-industry financial frictions. This second hypothesis is one novelty of our approach with respect to the previous credit channel literature.[1] Compared to the hypothesis of Rajan and Zingales (1998)—that is, that growth is increasing in the product of financial dependence and financial development,—ours is that the effect of recessions on output growth is decreasing (i.e., less severe reduction) in the product of financial dependence and financial development.

Although the two hypotheses are intuitive, there are some caveats. First, as Kaplan and Zingales (1997) note in a related setup, focusing on $\partial^3 g_{it} / \partial R_t \partial D_i \partial F$ is a meaningful exercise in showing the effect of financial frictions only if $\partial^2 g_{it} / \partial R_t \partial D_i$ is monotonically decreasing with respect to F. If there is a nonmonotonic relationship, the negative sign for $\partial^3 g_{it} / \partial R_t \partial D_i \partial F$ is not guaranteed, and we may learn little about the impact of financial frictions by doing this exercise. The source of the problem is the extent to which a firm internalizes the cost of financial frictions in its investment decisions. A firm that is highly dependent on external funds may decide to limit its reliance on outside financing by reducing the scale of its project or by hoarding reserves so as to avoid losses during recessions. The question then becomes how much of the effect is internalized by firms, or how technological is the demand for credit? We return to this issue in the empirical implementation, where we show that the identification strategy hinges on obtaining a measure of technological reliance on external funds being predetermined by the line of business in which the firm operates.

[1] A somewhat similar hypothesis, though in the context of the bank-lending channel, and still in a one-country framework, can be found in Kashyap and Stein (2000).

While acknowledging this theoretical caveat, we note that the existence of nonmonotonicities is ultimately an empirical matter, as Kaplan and Zingales (2000) admit. We find that they are not a prominent feature of the data, at least when comparing broad groups of industries or countries. Our approach can also average out the nonmonotonicities if they are at all present. The issue should be less of a concern when working with industries as opposed to working with firms, which were the focus of the original Kaplan and Zingales' critique. Both when a firm is absolutely unconstrained and when it is so constrained that it has to rely just on internal funds, the response to marginal changes in financial conditions is equally flat, making the relationship between financial frictions and loss during recessions u-shaped. It is arguably hard to say that an entire industry is in either of these two extreme positions. In every industry, there are probably more constrained and less constrained firms at each point in time, making the industry as a whole sensitive to changes in financial frictions.

It is important to stress that the credit channel hypothesis does not presuppose that investment opportunities are constant throughout the cycle. In fact, investment opportunities can worsen during recessions. The assumption is that credit is relatively scarce during economic downturns, which is not inconsistent with the observed cyclical behavior of credit aggregates (see Bernanke and Gertler (1995) on this point). Consequently, during economic downturns, some reduction in activity is forced by borrowing constraints, instead of it being a voluntary response to worse investment prospects. Empirically, it is hard to control for changing investment opportunities, or more generally, for other (nonfinancial) sources of cyclical fluctuations in firm activity. Our empirical strategy and the cross-country/cross-industry nature of the UNIDO data set are specially suited to apply these controls, while still identifying the effects of the credit channel as we explain in the next section.

B. Literature Review

The credit channel (i.e., the link between financial frictions and the business cycle) is generally considered a propagation mechanism of primitive shocks, such as technology, tastes, or monetary shocks. A first branch focuses on the credit-worthiness of firms, and is usually called the balance sheet channel.[2] A negative wealth shock damages the firms' balance sheet and reduces the amount of credit that firms can get, multiplying the effect of the primitive shock on the firm's spending (Bernanke and Gertler (1989, 1990), Kiyotaki and Moore (1997)). The connection between the strength of the balance sheet and the borrowing capacity of a firm can be explained by moral hazard, asymmetric information, or the lack of collateral. A second line of research studies the more specific role of banks (the bank lending channel). In this case, a negative shock (typically associated with monetary tightening) affects the ability of banks to provide funds and therefore reduces real activity (Bernanke and Blinder (1998), Stein (1998)).

[2] This categorization of the literature is taken from Bernanke and Gertler (1995).

The existing evidence shows the impact of financial constraints on firm-level fluctuations in employment (Sharpe (1994)), inventories (Kashyap, Lamont, and Stein (1994)), pricing strategies (Chevalier and Scharfstein (1996)), investment (Oliner and Rudebusch (1996)), sales, and short-term borrowing (Bernanke, Gertler, and Gilchrist (1996); and Gertler and Gilchrist (1994)). The standard methodology consists of comparing the behavior of constrained to unconstrained firms (or groups thereof) around recessions. Kashyap, Stein, and Wilcox (1993) and Kashyap and Stein (2000) provide evidence on the bank lending mechanism. Overall, the evidence is mainly based on U.S. data and a few other industrialized economies. It typically refers to the more recent recessive episodes, and operates with a dichotomous definition of financially constrained firms (such as small versus large). We extend the evidence in these three dimensions. We also link these cross-firm differences to the degree of financial frictions faced by the agents.

With regard to our hypothesis, a similar set of issues is behind both the bank lending and the balance sheet views. Both suggest that firms that rely more on external finance should exhibit a disproportionate response to negative shocks. In the balance sheet channel, the basic mechanism is that a decrease in internal funds triggers a reduction in the access to external funds (or, more generally, a worsening of the conditions), amplifying the effect of the initial shock, particularly for firms that rely more heavily on external finance. This happens only if capital markets are imperfect, that is, when the relationship between borrowers and financiers is subject to frictions so that internal and external funds are no longer perfect substitutes. The differential impact is therefore more likely to show up when financial frictions are pervasive.

In the bank lending view, the reason for the differential impact is the direct reduction in the total amount of external funds available, together with the relative dependence of some firms on bank loans. The reasoning in this case applies more generally to credit crunches, that is, exogenous, widespread reductions in the amount of bank credit available to agents. The differential effect is also likely to be stronger when financial frictions are more important. It is precisely these frictions that prevent borrowers from replacing bank loans with other forms of external finance, and that prevent banks from easily making up for the lost deposits or replenishing their capital in arms-length markets.

In practice, the distinction between the balance sheet and the bank lending view becomes blurred when the correlation between dependence on external funds and dependence on bank loans is high, or when banks are the predominant source of external finance. This is most probably the case in our data since they represent all firms in each industry. Moreover, financial frictions are at the core of both the balance sheet and the bank lending views, and in that sense these financial stories are quite distinct from other business cycle mechanisms that do not naturally entail the cross-sectional pattern mentioned above. This paper aims to get an empirical sense of the general idea of a financial mechanism of business cycles.

II. Data and Empirical Approach

In this section, we provide a framework to test the two hypotheses previously developed. Our empirical approach consists of exploiting the differential behavior of various industries around the cycle. The industry data are taken from the UNIDO Indstat-3 (2001) data set, which provides yearly observations for 28 ISIC-3 manufacturing industrial segments in a large number of countries from 1963 to 1999. The basic sample consists of 57,538 observations that correspond to 2,395 country–industry data points for 111 different countries, and for 28 industries, during 36 years. The panel is unbalanced due to data availability. The sample size varies, as country-level data are not always available for all economies.

Our approach is divided into three basic steps: (1) identifying recessions in each country, (2) measuring the extent to which each industry depends on external funds, and (3) finding proxies for the severity of financial frictions. The benchmark regression is as follows:

$$\begin{aligned} Growth_{i,c,t} = {} & \alpha_1 Size_{i,c,t-1} + \alpha_2 Recession_{c,t} \\ & + \alpha_3 (Recession_{c,t} \times External\,Finance\,Dependence_i) \\ & + \boldsymbol{\alpha_4}\mathbf{Dummy\,Variables} + \varepsilon_{i,c,t}. \end{aligned} \tag{1}$$

Bold Greek letters represent vectors of coefficients in equation (1). The dependent variable $Growth_{i,c,t}$ is the log-change in the production index of industry i in country c between the year $t-1$ and t. The variation in growth rates can be decomposed into the following components: country, industry, year, country–industry, year–industry, country–year, and the remaining country–industry–year term. In the specification above, we control for the first five components by means of fixed effects. The term *Dummy Variables* includes indicator variables that identify each country–industry and each year–industry pair, respectively (including the main industry, country, and year effects).[3] We parameterize the residual variation as a sum of three terms plus an orthogonal error. The variable $\text{Size}_{i,c,t-1}$ is the share of industry i in country c's total value added in year $t-1$. Since the effect of the average size of each industry in a given country is controlled for with the country–industry fixed effects, the coefficient of this variable captures the growth effects of abnormal industry size. The indicator variable $Recession_{c,t}$ takes the value 1 if country c is experiencing a recession in year t, while $External\ Finance\ Dependence_i$ is the external finance dependence for industry i. We allow the error term $\varepsilon_{i,c,t}$ to be heteroskedastic and to be correlated in time for each country–industry series.

We expect the estimates of both α_2 and α_3 to be negative, implying that on average, recessions are associated with lower production growth rates, and that the effect is stronger when the industry is more dependent on external funding. The interpretation of α_3 is akin to a difference in differences. The key element

[3] A Hausman test strongly favors (p-value well below 1%) the fixed-effects versus the alternative random-effects specification.

of the financial mechanism is that this differential effect is related to the existence of financial frictions. By showing how α_3 changes across subsamples constructed on the base of different proxies for financial frictions, we link the results directly to the financial mechanism hypothesis. In particular, we expect a more negative coefficient when frictions are more prevalent.

The data vary along three dimensions: time, industry, and country. The time–country aspect, and the distinction between recession and nonrecession years in particular, identifies the cyclic behavior of each economy. Previous studies exploit differences in the behavior of productive units around the cycle, typically focusing on a single country and on very few recessive or harsh monetary events. Adding the cross-country dimension enables us to identify the financial mechanism, while controlling for the country variation that is specific to each productive unit (i.e., an industry or firm) in a way that was not possible in previous frameworks. Country–industry fixed effects control not only for characteristics that are specific to either an industry or a country, but also for characteristics that are specific to an industry when it is located in a particular country, as long as these are persistent in time, obviously. These include, for instance, the effect of persistent differences in the size, concentration, or government intervention and support, derived from different factor endowments, market size, or institutional characteristics that may generate different growth patterns across industries and countries. They also control for the differential effect that financial frictions have on average growth rates documented by, among others, Rajan and Zingales (1998).

Considering a long list of recessive events of varying characteristics helps avoid confusing the effects of finance with the effects of industry shocks, as long as not all the recessions have the same pattern of industry shocks as their origin. The industry-time fixed effects pick the variation coming from worldwide industry shocks. For instance, substantial increases in the price of oil are usually associated with recessions in most countries. The fact that the transportation equipment industry is hit harder during these events is not confused with the credit channel despite the fact that this industry is in the upper quartile of the external finance-dependence index.

A. Identifying Recessions

Our identifying assumption is that recessions do not systematically affect investment returns of industries as ranked by their dependence on external funds. We think of recessions as periods of tighter credit conditions that do not necessarily reflect the stance of investment opportunities in these industries.[4]

[4] This approach fits well with the developments in the credit channel literature, which has moved away from credit aggregates and interest rates (except for the interest rates that signal the stance of monetary policy) toward the NBER recessions or the Romer dates as instruments for exogenous shocks. The problem with the amount of credit and interest rates is that they are endogenously determined by supply and demand as a response to changes in technology, monetary policy, or other primitive shocks; credit and interest rates are not driving forces. Similar issues are present in the literature on money as the cause of output fluctuations.

As aggregate shocks, recessions are caused by a variety of sources, such as monetary policy, technology, and terms of trade shocks. Arguably, some of these shocks could be correlated with our ranking of industries. However, it is hard to claim that all recessive episodes in every country come from a unique source, which at the same time has a cross-industry impact associated with external finance dependence. We perform some robustness checks later on to control for this possibility.

Since we need a practical procedure for comparing more than 100 countries, we identify recessions from the fluctuations of total real GDP (in annual frequency). We take the cyclical component of GDP as a proxy for the overall state of the economy, where cyclical GDP is the difference between the actual series and a trend computed using the Hodrick–Prescott filter (Hodrick and Prescott (1980)). Our definition of a recession follows a peak-to-trough criterion. A trough occurs when cyclical GDP is more than one standard deviation below zero. We use the standard deviation of the cyclical GDP of each country; hence, our definition of recession is country-specific. Once we identify the trough, we go backward in time until we find a local peak, which is defined as a year in which cyclical GDP is higher than in both the previous and the posterior years. A recession goes from the year after the peak to the year of the trough. The Appendix describes the construction and sources of this and the other key variables in more detail.

The mean (median) share of recession years in a country is 19.5% (18.2%). The mean and median duration of a recession are both close to 2 years. This implies that a country experiences approximately 2 years of recession every 10 years. The (almost) four decades that we cover are very similar in the average number of countries experiencing recessions (around one-fifth each year); the 1990s are slightly less recessive years. Some worldwide recessions are evident in the data, such as the oil crises of the 1970s, the debt crisis of the early 1980s, the Gulf War recession in 1990 and 1991, and the recessions in Asian economies in the late 1990s. Among the most recessive episodes are from 1965 to 1967, 1981 to 1983, and 1990 to 1993, with approximately one-third of the countries experiencing a downturn. This suggests that many recessions are even exogenous to each country, and not just to each industry, since they are driven by worldwide aggregate shocks.

Recessions (as we define them) are not likely to be concentrated in countries grouped by a particular set of characteristics (e.g., political instability, openness to trade in goods or assets, geographic location, or per capita income). This protects our results against some possible biases. For instance, our results are not solely derived from the behavior of poor or volatile countries: Zaire, a very volatile country, has the same percentage of recession years as the United States (14%). In any case, we try several alternative definitions of recessions and the results are the same.

Data availability gives us no choice but to rely on annual GDP. In using annual data, some of the rich dynamics that can be observed in monthly or quarterly data are certainly obscured, so we probably fail to identify some mild or brief fluctuations. In general, this biases the results toward finding no effect

at all, unless the effects are only observed during long and severe recessions. In this case, our results are conditional on that.

B. External Finance Dependence

Perhaps the most important difficulty that the related literature faces is identifying financially constrained agents (see e.g., Fazzari, Hubbard, and Petersen (1988), Kaplan and Zingales (1997)). The issue is approached differently in this paper. Following Rajan and Zingales (1998, hereafter RZ), we use an industry index, which is constant across countries for a given industry. This approach eases some of the difficulties with measuring financial constraints at the firm level, particularly the use of firm size or the sensitivity of firm investment to cash flow as proxies.

RZ's index is defined as capital expenditures minus cash flow from operations divided by capital expenditures. They aggregate U.S.-based, publicly listed firm level data (from COMPUSTAT) into industries for the 1980s and 1970s. We use the average of the two indices as our basic indicator of external dependence. Following RZ, we assume that there are technological reasons why some industries need more external financing than others. For instance, industries that operate on large scales, with long gestation periods, high R&D, or high working capital needs (to keep inventories, for example) tend to be highly dependent. Assuming that these technological differences persist across countries, one can use the external dependence of industries in the United States to rank industries in every country along this dimension. Identification does not require that industries have exactly the same external dependence level in every country, just that their ranking remains stable. In support of this assumption, RZ show that their results are robust to using data from the 1970s and from Canadian industries (since Canada is the only other country for which there is detailed data on the flow of funds in COMPUSTAT). We later relax this assumption somewhat by allowing an industry's dependence to vary over time and across countries. Table A.I shows this index for the 28 industries in our sample. Industries with low external dependence include tobacco, footwear, and clothing in general; industries with high external dependence include plastic products, machinery, and professional equipment.

We think of external dependence as an industry characteristic that is predetermined by the time when the recession affects the ongoing project. In theory, highly dependent industries could protect themselves by hoarding reserves in advance to avoid the effects of the recession, or they could choose to start smaller projects. Moreover, these effects could be particularly strong in poorly developed financial systems, thus invalidating the use of RZ's index for every country. The assumption behind using RZ's index is that such actions cannot completely eliminate the technological need for external finance and reverse the ranking observed among U.S. industries. If financial frictions obscure the technological constraints, it becomes even more important to measure dependence for U.S. firms in order to isolate the technological component of the demand for external funds.

We recognize that there are other explanations for industry cyclicality besides external finance dependence. This point is important if one thinks that industries with other characteristics correlated with external dependence react differently during recessions, and that the degree of this response is correlated with the proxies of financial frictions. We later include other industry characteristics that help explain their cyclicality and show that, in general, their effect is no different across samples based on the degree of financial imperfections.

C. Financial Frictions

At the country level, we focus on the quality of accounting standards. The index of international accounting standards is taken from La Porta et al. (LLSV 1998) and reflects the quality of information available to external financiers and therefore, the costs of monitoring and screening. This variable is strongly correlated with aggregate measures of financial development, such as private credit over GDP. The analysis that follows also checks for the robustness of the results by using other measures of cross-country financial frictions. We also show that nonfinancial differences across countries, such as the overall level of development (i.e., per capita GDP) do not drive the results.

At the industry level, we concentrate on industry tangibility. In a world with incomplete financial contractibility, having assets that can be easily transferred to investors (i.e., hard assets) improves a firm's access to external funding. We use the measure of tangibility developed by Braun (2002). That paper constructs a measure of each industry's assets' hardness, aggregating asset tangibility figures, that is, net property, plant, and equipment over total assets, from publicly listed U.S. firms. It shows that industries with assets that are relatively soft perform disproportionately worse in terms of long-term growth and contribution to GDP in countries with poor financial contractibility (see also Claessens and Laeven (2003)).

The motivation for the cross-country and cross-industry comparisons is to avoid the endogeneity problems that are pervasive in the financial constraints literature. One does not expect the changes in investment opportunities of industries sorted by their external dependence to be related to the financial development of the country. In the same spirit, there is no obvious reason to believe that changes in investment opportunities are related to the tangibility of the assets. The cross-country and cross-industry comparisons are made by splitting the data into different samples and then comparing the results across samples. These comparisons are most meaningful when the variables used for sorting the data are uncorrelated. While financial development and financial dependence are uncorrelated by design, since they are in a different dimension (country and industry), tangibility and dependence just happen to be virtually orthogonal. The correlation between asset tangibility and external finance dependence is very low (0.092) and insignificant in statistical terms. One can also easily reject the hypothesis of dependency in terms of rank (p-value 0%). Ultimately, the

justification for looking at the effects of tangibility is that this variable captures a key concept rooted in the theoretical literature of financial contracting (see Hart (2001) for a survey).

III. Results

A. Basic Results

Table I presents the basic results of the paper. The benchmark regression corresponds to that given in equation (1). We begin with the results for the entire sample in the upper panel, first column. As expected, the estimate for the recession-external finance dependence coefficient is negative and highly significant. Compared to normal times, recession years are associated with a fall of 4.7 percentage points in the rate of growth of industrial production of a typical industry (i.e., one with an external finance dependence value equal to the median of the index). The decline in growth, however, is larger when an industry is more dependent on external finance. While, on average, a recession is associated with a fall of 5.4 percentage points in the production growth rate for sectors that are highly dependent on external funds (85^{th} percentile in the index), the decline amounts to just 4.5 points for the less-dependent industries (15^{th} percentile). The difference of 0.9 percentage points (reported here and throughout the paper at the bottom of each table to simplify the assessment of the estimated effect) is significant in statistical terms (p-value well below 1%). We call this the differential effect. In this benchmark case, the differential effect represents 19% of the decrease in growth during recessions for the typical industry. The negative and significant coefficient for the lagged industry size indicates mean reversion: When an industry appears to be larger than its average size in a given country, its growth rate is likely to fall.

In the following columns in Table I, we show how the differential impact of recessions across industries varies with the degree of financial frictions faced by agents. In columns two and three, we split the sample according to whether the number of international accounting standards used in each country is above or below the median. In countries with high accounting standards, highly dependent industries still fare worse than less dependent ones (though the effect is small and not significant). However, in countries with poor accounting quality, their growth rate falls by 1.7 points more than that of less dependent industries. This last figure, which represents about one-third of the average impact of recessions in the typical industry, is statistically larger (in absolute value) than the differential effect in the high accounting quality sample (p-value 0.1%, reported in the last row of each table).

We do not take the small and insignificant difference we find for high accounting standards countries as evidence for the nonexistence of a financial mechanism in those economies. In our view, the result is due to the fact that we apply strong controls, perhaps reducing the first order effects, and relying only on how the effects vary across samples. Unless we extensively control for other

differences across sectors, we can never be certain that we identify the financial mechanism. This is precisely why we focus on how the basic effect changes across samples, and why the added cross-country dimension of our data allows us to improve the tests carried out in this literature.

Table I

The Effect of Recessions, External Finance Dependence, and Financial Frictions on Industrial Growth

This table presents the results from the following regression:

$$Growth_{i,c,t} = \alpha_1 Size_{i,c,t-1} + \alpha_2 Recession_{c,t} + \alpha_3 (Recession_{c,t} \times External\ Finance\ Dependence_i) + \alpha_4 \mathbf{Dummy\ Variables} + \varepsilon_{i,c,t}$$

The dependent variable is the yearly growth rate in the production index of each ISIC-3 industry in each country computed from UNIDO's Indstat-3 (2001) data set. $Size_{(t-1)}$ is the share of a country's total manufacturing value added that corresponds to the industry in the previous year. *Recession* is a dummy variable that takes a value of 1 when the year and country observation has been identified as recessive as explained in the text, and is 0 otherwise. *External finance dependence* is the average figure for each industry in Rajan and Zingales's (1998) index for the 1970s and 1980s. The set of dummies includes country, year, industry, industry–year, and country–industry fixed effects (coefficients not reported). In all but the first column in the upper panel, the regression is run separately for the samples named in the headings. The entire sample is split according to whether the country or industry to which the observations belong is above or below the median in each index. Heteroskedasticity and time-correlated robust standard errors are presented below the coefficients. Significance (p-value): *10%, **5%, ***1%. The last four rows in the table present the predicted change in the growth rate for an industry in the 85th percentile and an industry in the 15th percentile in the external finance dependence index during recessions, the difference between these two (implied differential effect), and the p-value for the test that the implied differential effect is larger (in absolute terms) than the effect in the preceding column.

	Subsamples				
Variable	Entire Sample	Countries w/High Accounting Quality	Countries w/Low Accounting Quality	High Tangibility Industries	Low Tangibility Industries
Size ($t-1$)	−0.1580***	−0.2536***	−0.2870***	−0.0982**	−0.3266***
	(0.0415)	(0.0689)	(0.1069)	(0.0470)	(0.0668)
Recession	−0.0444***	−0.0345***	−0.0483***	−0.0426***	−0.0471***
	(0.0023)	(0.0030)	(0.0044)	(0.0034)	(0.0032)
Recession × external finance dependence	**−0.0312*****	**−0.0011**	**−0.0612*****	**−0.0174***	**−0.0486*****
	(0.0078)	**(0.0086)**	**(0.0166)**	**(0.0102)**	**(0.0115)**
R^2	0.1458	0.2733	0.1801	0.1408	0.1507
Number of obs	57538	16630	13959	29082	28456
Change in growth rate for high dependence industry	−5.4%	−3.5%	−6.6%	−4.8%	−6.2%
Change in growth rate for low dependence industry	−4.5%	−3.5%	−4.9%	−4.3%	−4.8%
Implied differential effect	−0.9%	0.0%	−1.7%	−0.5%	−1.4%
Differential effect larger than in preceding sample (p-value)			0.1%***		2.1%**

(*continued*)

Table I—*Continued*

	Subsamples			
	Countries w/High Accounting Quality		Countries w/Low Accounting Quality	
Variable	High Tangibility Industries	Low Tangibility Industries	High Tangibility Industries	Low Tangibility Industries
Size ($t-1$)	−0.1983	−0.2873***	−0.1267	−0.6294***
	(0.1291)	(0.0764)	(0.1249)	(0.1809)
Recession	−0.0323***	−0.0360***	−0.0401***	−0.0565***
	(0.0042)	(0.0041)	(0.0066)	(0.0059)
Recession × external finance dependence	**−0.0090**	**0.0063**	**−0.0424***	**−0.0926*****
	(0.0102)	**(0.0141)**	**(0.0251)**	**(0.0205)**
R^2	0.2889	0.26	0.1625	0.2006
Number of obs	8330	8300	6975	6984
Change in growth rate for high dependence industry	−3.5%	−3.4%	−5.3%	−8.4%
Change in growth rate for low dependence industry	−3.2%	−3.6%	−4.1%	−5.8%
Implied differential effect	−0.3%	0.2%	−1.2%	−2.6%
Differential effect larger than in preceding sample (p-value)		19.0%		6.0%*

In columns four and five, we split the industries according to whether their tangibility level is above or below the median. The results show that while among relatively tangible industries, being highly dependent on external finance implies a 0.5 percentage point larger impact during recessions, among the less tangible industries, the impact amounts to 1.4 points. Again, the difference across samples is statistically significant at conventional levels.

This result is intuitive. Highly dependent industries such as nonelectric machinery and wood products, that finance around 30% of their investments with external funds are more affected during downturns than less dependent ones, such as wearing apparel and iron, that finance investment almost entirely with internally generated funds. However, the differential impact is much smaller when comparing the iron and the wood industries, because they both use hard assets, which can serve as protection for financiers.

In the lower panel of Table I we split the sample into four parts and explore the role of asset tangibility in countries with different degrees of financial development. In countries where external finance is not particularly problematic, we find that hard assets are not especially valuable, as can be seen when comparing the differential effect of dependence across the first two columns. Columns three and four, however, show that in countries where financial frictions are more important, hard assets do become valuable. Variation in the degree of external dependence has a significantly larger effect when considering industries that rely on softer assets. This is what one would expect if hard assets help

ameliorate the frictions in the environment. The results also suggest, nonetheless, that structuring external finance relationships on hard assets is not a perfect substitute for a good financial contracting environment, since the differential effect of dependence is still present and large for the hard assets industries.

The lower panel of Table I shows that the differential effect identified in the upper panel comes from where it should, in order to be consistent with the financial mechanism hypothesis: from financially dependent and intangible industries in countries with poor financial contracting. Put simply, sectors more reliant on external financing are hit particularly hard during recessions, unless they are located in countries with adequate financial contracting. If they are not, employing hard assets helps ameliorate the impact.

The economic magnitude of the effect identified is considerable. A country that became financially developed would see the higher impact of recessions on high dependence industries decline by 1.7 percentage points. This alone reduces the growth effect on the aggregate manufacturing sector by around 0.9 percentage points (from 5.8% to 4.9%).[5] This figure corresponds to approximately one-fifth of the lost growth induced by the average recession. Since financial development also reduces the impact of recessions on less dependent industries, the total effect is even larger (from 5.8% to 3.5%, 38% of the average recession loss). Alternatively, if we assume that institutional differences are as given and imagine that all industries had assets hardness equal to the typical high tangibility industry, aggregate production growth lost could be reduced by a total of 0.9 points (from 5.5% to 4.6%) in the typical country, and by more than twice as much in an underdeveloped one. The reduction in the impact of recessions on high dependence industries alone explains half the total effect for the typical country.

B. Country and Industry Characteristics

In this section, we check the robustness of the results by considering alternative measures of financial frictions at the country level, and by considering a number of other country and industry characteristics that may be important for explaining cyclical behavior.

The first two columns of Table II show that more dependent industries are more affected during recessions in countries with less effective creditor rights protection. The same result is obtained when the sample is split according to other popular measures of financial development: the origin of the legal system, bank credit to the private sector over GDP, and total value traded in the stock market over GDP (not reported). This suggests that there is nothing peculiar about accounting standards as a proxy for countrywide financial frictions.

[5] For parsimony, the exercise assumes that industrial composition does not vary in response to financial development (i.e., highly dependent sectors are not smaller in countries with less developed financial systems). There is evidence pointing to the contrary, though (see, for instance, Braun (2002)).

The following two columns in the upper panel of Table II show that the positive correlation between the degree of development of financial markets and income level across countries is not behind our results. When the sample is split according to the median GDP per capita from 1960 to 2000, we find no

Table II

The Effect of Recessions, External Finance Dependence, and Financial Frictions on Industrial Growth: Alternative Measures of Financial Frictions at the Country Level and other Country Characteristics

The basic regression is the same as in Table I. The dependent variable is the yearly growth rate in the production index of each ISIC-3 industry in each country computed from UNIDO's Indstat-3 (2001) data set. $Size_{(t-1)}$ is the share of a country's total manufacturing value added that corresponds to the industry in the previous year. *Recession* is a dummy variable that takes a value of 1 when the year and country observation has been identified as recessive as explained in the text, and is 0 otherwise. *External finance dependence* is the average figure for each industry in Rajan and Zingales's (1998) index for the 1970s and 1980s. The set of dummies includes country, year, industry, industry–year, and country–industry fixed effects (coefficients not reported). The regression is run separately for the samples named in the headings of the columns. The entire sample is split according to whether the country to which the observations belong is above or below the median in each index. In the lower panel, each institutional variable is first instrumented with either settler mortality or legal origin and then used to split the sample. Heteroskedasticity and time-correlated robust standard errors are presented below the coefficients. Significance (p-value): *10%, **5%, ***1%. The last four rows in the table present the predicted change in the growth rate for an industry in the 85th percentile and an industry in the 15th percentile in the external finance dependence index during recessions, the difference between these two (implied differential effect), and the p-value for the test that the implied differential effect is larger (in absolute terms) than the effect in the preceding column.

	Subsamples			
Variable	Countries w/High Effective Creditors Rights	Countries w/Low Effective Creditors Rights	Countries w/Higher than Median GDPpc 1960–2000	Countries w/Lower than Median GDPpc 1960–2000
Size ($t-1$)	−0.1785***	−0.2185***	−0.1874***	−0.1536***
	(0.0659)	(0.0818)	(0.0604)	(0.0564)
Recession	−0.0481***	−0.0376***	−0.0378***	−0.0526***
	(0.0032)	(0.0048)	(0.0024)	(0.0044)
Recession × external finance dependence	**−0.0147**	**−0.0414*****	**−0.0269*****	**−0.0353****
	(0.0100)	**(0.0157)**	**(0.0082)**	**(0.0146)**
R^2	0.1835	0.1593	0.178	0.1511
Number of obs	22407	19895	32088	25170
Change in growth rate for high dependence industry	−5.2%	−5.0%	−4.6%	−6.3%
Change in growth rate for low dependence industry	−4.8%	−3.8%	−3.8%	−5.3%
Implied differential effect	−0.4%	−1.2%	−0.8%	−1.0%
Differential effect larger than in preceding sample (p-value)		7.3%*		25.2%

(*continued*)

Table II—*Continued*

Variable	Subsamples			
	Countries w/Good Property Rights Institutions IV Settler Mortality	Countries w/Poor Property Rights Institutions IV Settler Mortality	Countries w/Good Contracting Institutions IV Legal Origin	Countries w/Poor Contracting Institutions IV Legal Origin
Size ($t-1$)	−0.2554***	−0.2270***	−0.1665**	−0.2085***
	(0.0808)	(0.0580)	(0.0660)	(0.0545)
Recession	−0.0586***	−0.0451***	−0.0394***	−0.0515***
	(0.0077)	(0.0043)	(0.0025)	(0.0045)
Recession × external finance dependence	**−0.0027**	**−0.0505*** **	**−0.0225*** **	**−0.0337** **
	(0.0276)	**(0.0149)**	**(0.0083)**	**(0.0156)**
R^2	0.2111	0.1539	0.1824	0.1528
Number of obs	9017	20040	28691	23005
Change in growth rate for high dependence industry	−5.9%	−6.0%	−4.6%	−6.2%
Change in growth rate for low dependence industry	−5.9%	−4.6%	−4.0%	−5.2%
Implied differential effect	−0.1%	−1.4%	−0.6%	−1.0%
Differential effect larger than in preceding sample (p-value)		2.3%**		15.9%

significant difference across countries in the cyclical behavior of industries sorted by external finance dependence (p-value = 25.2%). The differential impact of recessions on industries is also not related to other nonfinancial country characteristics (in particular, the degree of openness as measured by Sachs and Warner (1995), and the size of the government, once the correlation between this and financial development is taken into account). This result is interesting given the difficulty the literature has faced in isolating the effects of poor financial development from the effects of just low economic development or poor institutions, more generally.

A recent strand of the literature tries to determine which institutions are behind the cross-country variation in financial development. Acemoglu and Johnson (2003) in particular ask whether property rights institutions, which protect citizens against expropriation by the government and powerful elites, are more important than contracting institutions, which make possible private contracts between citizens. Following them, we instrument protection against expropriation risk with settler mortality and the degree of legal formalism (from Djankov et al. (2003)) with the origin of the legal system of each country. In the lower panel of Table II, we split our sample according to the component of protection and formalism that can be explained by these colonial history instruments. In both cases, the differential impact of recessions is stronger in the subsample of countries with poor institutions. The differential effect,

however, is both larger and more significant when the sample is split according to the quality of property rights institutions. Consistent with the findings in Acemoglu and Johnson, our results suggest that property rights institutions might matter more than contracting ones.

Recessions may also affect industries differently for reasons unrelated to finance. Industries may, for instance, produce goods with different durability, goods that target different final users (i.e., investment versus consumption goods), or that have different degrees of international tradability. As both durable and investment goods have previously been shown to be more procyclical, we might be confusing their effect with that of dependence on external finance. In terms of tradability, highly dependent industries might produce less tradable goods and therefore be more affected by local conditions (i.e., country-specific recessions). Another possibility is that more dependent industries actually produce more tradable goods and that recessions in many countries originate in negative shocks to terms of trade. In the first two columns of Table III, we add the interaction between our recession dummy and each of these industry characteristics to the basic specification. The variables are based on classifications from the Bureau of Economic Analysis.

Just like industries that are more dependent on external funds, industries producing durable goods are more affected during recessions. However, the effect of durability is not significantly different across the financial development samples. Tradable goods producers are more affected in countries with good accounting practices, probably because these countries tend to be more open to trade and therefore more exposed to shocks to terms of trade. Producers of investment goods are more affected in countries with poor quality accounting rules; however, in neither of the samples, the drop in growth rates is significant. This is partly because of the correlation between durable and investment goods industries.[6] The basic pattern with respect to external finance dependence remains robust even after controlling for these industry characteristics. The difference in the effect of recessions on industries sorted by external finance dependence is very similar to the benchmark and is again larger in countries in which financial frictions are more prevalent.

In columns three and four we add to the benchmark regression the interaction between the recession and a variable that measures each industry's cyclicality in the United States. The variable is the OLS coefficient for each industry of a regression of cyclical production on cyclical GDP. We use the U.S. data to extract an index that is closer to technological cyclicality and less affected by financial frictions. The correlation of U.S. cyclicality and external finance dependence is relatively high (0.29), but is not significantly different from zero at conventional levels. The durability, tradability, and investment variables account for 57.4% of the total variation in U.S. cyclicality. As expected, the coefficient for this new

[6] The effect of both investment and tradability is sensitive to the inclusion of the durability variable. In particular, when the durability interaction is excluded, the coefficient for the investment interaction is large and significantly negative. The differential effect of the external finance dependence recession interaction remains strong and significant, though.

Table III

The Effect of Recessions, External Finance Dependence, and Financial Frictions on Industrial Growth: Additional Industry Characteristics

The basic regression is the same as in Table I, except for the additional interactions of the recession variable with other industry characteristics. The dependent variable is the yearly growth rate in the production index of each ISIC-3 industry in each country computed from UNIDO's Indstat-3 (2001) data set. $Size_{(t-1)}$ is the share of a country's total manufacturing value added that corresponds to the industry in the previous year. *Recession* is a dummy variable that takes a value of 1 when the year and country observation has been identified as recessive as explained in the text, and is 0 otherwise. *External finance dependence* is the average figure for each industry in Rajan and Zingales's (1998) index for the 1970s and 1980s. The variables for industries producing durables, investment goods, and tradable goods, and U.S. cyclicality are explained in detail in the appendix. The set of dummies includes country, year, industry, industry–year, and country–industry fixed effects (coefficients not reported). The regression is run separately for the samples named in the headings of the columns. The entire sample is split according to whether the country measure of accounting quality is above or below the median accounting quality in the sample. Heteroskedasticity and time-correlated robust standard errors are presented below the coefficients. Significance (p-value): $^{*}10\%$, $^{**}5\%$, $^{***}1\%$. The last four rows in the table present the predicted change in the growth rate for an industry in the 85th percentile and an industry in the 15th percentile in the external finance dependence index during recessions, the difference between these two (implied differential effect), and the p-value for the test that the implied differential effect is larger (in absolute terms) than the effect in the preceding column.

	Subsamples			
Variable	Countries w/High Accounting Quality	Countries w/Low Accounting Quality	Countries w/High Accounting Quality	Countries w/Low Accounting Quality
Size $(t-1)$	-0.2640^{***}	-0.2821^{***}	-0.2561^{***}	-0.2872^{***}
	(0.0693)	(0.1061)	(0.0690)	(0.1052)
Recession	-0.0124^{**}	-0.0368^{***}	-0.0089^{**}	-0.0203^{***}
	(0.0054)	(0.0082)	(0.0045)	(0.0076)
Recession × external finance dependence	**0.0036**	**-0.0443^{**}**	**0.0155***	**-0.0432^{**}**
	(0.0089)	**(0.0183)**	**(0.0090)**	**(0.0170)**
Recession × durable goods producer	-0.0295^{***}	-0.0219^{*}		
	(0.0078)	(0.0115)		
Recession × investment goods producer	0.0114	−0.0346		
	(0.0130)	(0.0232)		
Recession × tradable goods producer	-0.0210^{**}	0.0056		
	(0.0096)	(0.0161)		
Recession × U.S. cyclicality			-0.0161^{***}	-0.0177^{***}
			(0.0027)	(0.0047)
R^2	0.2804	0.1842	0.2758	0.1815
Number of obs	16082	13483	16630	13595
Change in growth rate for high dependence industry	−1.1%	−5.0%	−0.4%	−3.3%
Change in growth rate for low dependence industry	−1.2%	−3.7%	−0.9%	−2.1%
Implied differential effect	0.1%	−1.3%	0.4%	−1.2%
Differential effect larger than in preceding sample (p-value)		1.8%**		0.0%***

interaction turns out to be negative and highly significant in both the samples. However, unlike the coefficient for the recession-external finance dependence interaction, which remains significantly larger in countries with low financial development, the coefficient for the recession-U.S. cyclicality term is virtually unchanged across samples. This reassures us that we are identifying a financial mechanism, despite the many reasons why some industries are more affected by recessions than others.

C. Recession Characteristics

One key element in our identification strategy is the assumption that in the absence of financial frictions, recessions have no differential effect on the various sectors of the economy as ranked by their dependence on external funds. However, persistent characteristics of recessions correlated with country or industry characteristics can potentially explain or bias the results. Since the vast majority of previous investigations are country case studies (sometimes even referring to only a single recession), this matter is not properly addressed. In our case, however, this issue does not represent a major concern. Aside from enabling us to generalize previous country-level evidence, pooling together the information from a number of different countries and recessions provides us with episodes of varied characteristics. Only when the differential behavior of industries is consistently observed across different kinds of recessions one can obtain the results presented so far. In Table IV we replicate the previous analysis using different definitions of recessions.

First, not all recessions are equally severe; some are associated with huge disruptions of production while others cause just mild swings in activity. It is certainly the case, for instance, that the recessions we have identified are worst in countries with poorer accounting standards. In the first panel of Table IV, we use the magnitude of the recession (in terms of absolute percentage points of GDP lost with respect to the trend) instead of just the dummy indicator. The measure normalizes for the size of recessions and therefore pins down not the absolute effect of a recession on the change in growth rates across sectors as before, but rather pins down the marginal effect of an additional point of GDP growth lost during downturns. The results are mostly unaltered. The coefficient estimates imply that in countries with poor accounting standards, for each percentage point of GDP growth lost, highly dependent industries see their growth fall by 1.49 points, while less dependent industries exhibit a fall of just 1.14 points. The differential impact is much larger than the (insignificant) one observed in high accounting quality economies. The same is true when one divides the sample according to tangibility, although the differential effect is now marginally insignificant.

In the second panel, we consider only those recessive episodes that were preceded by a sizable monetary contraction and compare the behavior of industries to times when there was neither a recession nor a monetary tightening. The exercise serves two purposes: First, to investigate whether monetary policy has a differential effect over different kinds of productive units, and

Table IV

The Effect of Recessions, External Finance Dependence, and Financial Frictions on Industrial Growth: Alternative Measures of Recessions

The basic regression is the same as in Table I. The recession variable is measured in four different ways: (1) the percentage points of GDP lost with respect to the Hodrick–Prescott trend during a recession year as identified by our previous method, and is 0 otherwise; (2) a dummy variable that takes a value of 1 when the year has been identified as a recession previously and the year before corresponds to a monetary contraction in the country, and is 0 otherwise; (3) world recessions that are years 1965–67, 1974–75, 1981–83, 1990–93, and (4) a dummy variable that takes a value of 1 when the year has been identified as a recession by our previous method and there is also a credit crunch in the country the same year, and is 0 otherwise. Except for the upper panel, the table presents the predicted change in the growth rate for an industry in the 85th percentile and an industry in the 15th percentile in the external finance dependence index during recessions, the difference between these two (implied differential effect), and the *p*-value for the test that the implied differential effect is larger (in absolute terms) than the effect in the preceding column. In the upper panel, the figures correspond to the predicted recession points elasticities. Heteroskedasticity and time-correlated robust standard errors are presented below the coefficients. Significance (*p*-value): *10%, **5%, ***1%.

Variable	Countries w/High Accounting Quality	Countries w/Low Accounting Quality	High Tangibility Industries	Low Tangibility Industries
		Recession Points		
Recession points elasticity of high dependence industry	−1.03	−1.49	−0.99	−1.18
Recession points elasticity of low dependence industry	−1.06	−1.14	−0.89	−0.95
Implied differential effect	0.04	−0.36	−0.09	−0.23
Differential effect larger than in preceding sample (*p*-value)		1.2%**		10.9%
		Monetary Recessions		
Change in growth rate for high dependence industry	−3.2%	−6.2%	−5.3%	−7.7%
Change in growth rate for low dependence industry	−2.4%	−5.2%	−4.9%	−5.1%
Implied differential effect	−0.8%	−1.0%	−0.4%	−2.6%
Differential effect larger than in preceding sample (*p*-value)		37.3%		2.1%**
		World Recessions		
Change in growth rate for high dependence industry	−2.3%	−5.1%	−5.4%	−6.6%
Change in growth rate for low dependence industry	−2.5%	−3.6%	−5.0%	−5.8%
Implied differential effect	0.3%	−1.4%	−0.5%	−0.8%
Differential effect larger than in preceding sample (*p*-value)		1.1%**		28.0%
		Recessions with Credit Crunch		
Change in growth rate for high dependence industry	−0.2%	−7.1%	−5.1%	−5.9%
Change in growth rate for low dependence industry	−1.3%	−4.0%	−4.7%	−4.3%
Implied differential effect	1.0%	−3.1%	−0.3%	−1.6%
Differential effect larger than in preceding sample (*p*-value)		0.6%***		15.7%

second, to address the problem of the potential endogeneity in our definition of recessions.

Up to now we have assumed that a recession is a countrywide, exogenous shock. One downside of using industry as opposed to firm-level data is that recessions can be thought to be more endogenous to industry-specific shocks than to firm-specific ones. Recessions may be triggered by industry-specific shocks that spread throughout the economy either through their effect on aggregate demand or via production linkages. This can create problems only if the origins of recessions were consistently rooted in shocks to the same group of industries that happened to be more dependent on external finance. Also, either the shocks or their effects would need to be stronger in countries with poorer quality accounting practices and for industries with little tangible assets. Although plausible, this alternative seems less appealing in practice. The typical industry in our sample represents on average less than 1% of a country's total manufacturing value added, so it is reasonable to assume that recessions are exogenous to each industry. Still, taking advantage of the lag with which monetary policy affects real activity, we can circumvent the problem, at least in part, by using policy changes that precede the recessions in time. It seems reasonable to think that when a recession is immediately preceded by a sizable monetary contraction, its origin is more related to an aggregate demand shock than to an industry-specific one. Of course, one may still argue that monetary policy anticipates and responds to changes in activity. However, it is not obvious that a monetary tightening would be the likely response to a coming recession, particularly when the recession is supposedly rooted in a shock to industries that are relatively more dependent on external finance.

We identify periods of tight money in the same way that we identify recessions, only this time we use M2 over GDP instead of real GDP as the underlying variable. We confirm that the same basic pattern is obtained for this subsample of recessions likely to be related to monetary shocks. While the differential effect remains large and significant when comparing across asset tangibility, the effect is smaller and not significantly different across countries when using accounting standards.

Taking advantage of the cross-country correlation of cyclical fluctuations, we can extract an indicator of recessive periods that is more exogenous at the country level. We constructed an indicator variable that takes a value of one if a country recession occurs when the world as a whole is experiencing a downturn and is 0 otherwise. World recessions were defined to include the following periods: 1965–1967, 1974–1975, 1981–1983, and 1990–1993. With the exception of the oil crisis of the 1970s, these are the episodes in which the share of countries in our sample experiencing a recession surpassed 30% in the worst year of the episode. The third panel in Table IV shows that, qualitatively, the results are invariant to this new measure.

We also distinguish those episodes where a change in the external finance possibilities of firms is larger or more evident by identifying recessions that are accompanied by a credit crunch. We take these as exogenous reductions in the supply of external finance. The identification of credit crunches follows

the same procedure used for recessions, this time using Bank Credit to the Private Sector over GDP (from Beck, Demirgüç-Kunt, and Levine (2000)) as the driving variable. We compare the behavior of industries to times when neither a recession nor a credit crunch has been identified. The results are reported in the fourth panel of the table. The difference in the behavior of industries based on their dependence on external funds is still present in this subset of recessions. Furthermore, the effect is stronger. While in our benchmark in Table I, decreasing accounting quality and tangibility, is associated with -1.7 and -0.9 points larger differential impact of recessions, here the differences increase to -4.1 and -1.3 percentage points, respectively.

Of course, this result is subject to criticism based on a combination of reverse causality and credit demand arguments. A recession may entail reduced demand for external finance (maybe because it signals weaker investment opportunities in the future or because firms can rapidly scale down their investments when faced with temporary demand falls). If this is the case, it is not surprising to see that when the heavy users of external finance scale down production to a greater extent, the equilibrium quantity of external funds falls as well. However, we think this alternative explanation does not naturally imply that the differential effect is larger in countries with inferior accounting practices and for less tangible industries.

Since we measure the external finance supply contraction with the availability of *bank* credit, this speaks of a more specific bank-lending channel. We certainly think that a more thorough approach is needed to disentangle specific mechanisms at play, and therefore do not claim this evidence to be conclusive in favor of the bank-lending mechanism.

We also checked that the same results obtain when we use the years of negative GDP growth rates as our recession indicator, or when using the entire variation in GDP growth to characterize the cyclical behavior of the economy (not reported). To sum up, the results do not seem particularly dependent on the definition of recessions.

D. External Finance Dependence

To some extent, one can relax the assumption that external finance dependence is an immutable characteristic of industries. While it seems plausible that the industry ranking on external dependence does not change rapidly, and therefore allows identification of cyclical effects, it is not natural to assume that they do not change at all. Instead of using the same number for four decades, we use Rajan and Zingales's (1998) index for the 1970s for the pre-1980 observations and the index for the 1980s afterwards. The results were not materially affected, since the correlation between the two indices is quite high (0.63), and the rank is not significantly altered. More dependent industries are still hit disproportionately harder during recessions and especially so if they are more exposed to financial frictions.

Critical to our strategy is that the ranking of external finance dependence remains relatively stable across countries. We argue that this is plausible if

we think that technology is an important determinant of financing needs. This implicitly assumes that a given industry uses a similar technology in every country, which is not necessarily the case. We note that the time variation in the ranking of external finance dependence can be linked to country characteristics. For instance, poor countries today can use the technologies that rich countries used in the past, so that the ranking for poor countries today may be better approximated with the ranking rich countries had earlier. We redefined the external finance dependence variable, using the ranking based on U.S. data during the 1970s for those countries with lower than median GDP per capita, and the index constructed with 1980s data for the rich countries. Again, the results do not change much.

E. Asymmetry: Recessions and Booms

There are multiple reasons why some industries do better than others during recessions that could be mapping into our sorting based on external finance dependence. Although we address some of them above, the omitted variable issue can never be completely solved. Still, we can show that the mechanism we identify is asymmetric over the cycle (stronger in recessions than in booms), a characteristic that rules out most alternative explanations that are not obviously asymmetric. It also serves to verify the assumption that credit conditions worsen in downturns.

We think of a boom as a phenomenon associated with looser credit conditions. This will certainly improve the position of more dependent industries vis-à-vis less dependent ones, and especially so if they were initially subject to more important financial frictions. However, the financial mechanism is likely to be more potent in downturns than in booms, since credit constraints bind across a wider cross-section of dependent firms in recessions. This asymmetric behavior is found in a number of models (see, for instance, Bernanke and Gertler (1989)), and this has been documented empirically in other settings (Gertler and Gilchrist (1994)).

We add to our basic specification a variable capturing the occurrence of booms and its interaction with the external finance dependence index. The same basic procedure employed to define recessions is now used to identify booms. A peak occurs when the current GDP is more than one standard deviation above its trend. Once we identify a peak, we go back in time until we find a local trough. The years that fall between trough and peak are labeled as a boom. Table V presents the results.

Our benchmark that divides years into recessions and normal times, as opposed to the new three-way split including booms (or a completely continuous characterization), is reinforced. Booms do exist, but they are much subtler phenomena. Relative to times in which neither recessions nor booms are identified, the typical industry sees its growth rate drop by around 4% during recessions, while the increase during booms is just 1.5%. The difference in the behavior across industries during booms is very small and typically insignificant. It is also not materially related to our financial frictions variables. However, the

Table V

The Effect of Recessions, External Finance Dependence, and Financial Frictions on Industrial Growth: The Asymmetry of Booms and Recessions

The basic regression is the same as in Table I, except for the additional interaction of the boom variable with external finance dependence, and the boom variable itself. The dependent variable is the yearly growth rate in the production index of each ISIC-3 industry in each country computed from UNIDO's Indstat-3 (2001) data set. $Size_{(t-1)}$ is the share of a country's total manufacturing value added that corresponds to the industry in the previous year. *Recession* is a dummy variable that takes a value of 1 when the year and country observation has been identified as recessive as explained in the text, and is 0 otherwise. *Boom* is a dummy variable that takes a value of 1 when the year and country observation has been identified as a boom as explained in the text, and is 0 otherwise. External finance dependence is the average figure for each industry in Rajan and Zingales's (1998) index for the 1970s and 1980s. The set of dummies includes country, year, industry, industry–year, and country–industry fixed effects (coefficients not reported). In all but the first column, the regression is run separately for the samples named in the headings. The entire sample is split according to whether the country or industry to which the observations belong is above or below the median in each index. Heteroskedasticity and time-correlated robust standard errors are presented below the coefficients. Significance (p-value): *10%, **5%, ***1%. Below the row with the number of observations, we present the predicted change in the growth rate for an industry in the 85th percentile and an industry in the 15th percentile in the external finance dependence index during recessions, the difference between these two (implied differential effect), and the p-value for the test that the implied differential effect is larger (in absolute terms) than the effect in the preceding column. The same is done for booms.

	Subsamples			
Variable	Countries w/High Accounting Quality	Countries w/Low Accounting Quality	High Tangibility Industries	Low Tangibility Industries
Size $(t-1)$	-0.2508^{***}	-0.2876^{***}	-0.0981^{**}	-0.3273^{***}
	(0.0654)	(0.1064)	(0.0469)	(0.0654)
Recession	-0.0284^{***}	-0.0440^{***}	-0.0371^{***}	-0.0402^{***}
	(0.0032)	(0.0047)	(0.0035)	(0.0035)
Recession × external finance dependence	**0.0050**	**−0.0575*****	**−0.0169***	**−0.0458*****
	(0.0092)	**(0.0169)**	**(0.0097)**	**(0.0121)**
Boom	0.0164^{***}	0.0118^{***}	0.0165^{***}	0.0207^{***}
	(0.0026)	(0.0036)	(0.0027)	(0.0025)
Boom × external finance dependence	0.0176^{**}	0.0100	0.0017	0.0077
	(0.0089)	(0.0108)	(0.0097)	(0.0093)
R^2 =	0.2786	0.1812	0.1425	0.1531
Number of obs	16630	13959	29082	28456
Recessions				
Change in growth rate for high dependence industry	−2.7%	−6.1%	−4.2%	−5.4%
Change in growth rate for low dependence industry	−2.8%	−4.5%	−3.7%	−4.1%
Implied differential effect in recessions	0.1%	−1.6%	−0.5%	−1.3%
Differential effect larger than in preceding sample (p-value)		0.1%***		4.2%**
Booms				
Change in growth rate for high dependence industry	2.2%	1.5%	1.7%	2.3%
Change in growth rate for low dependence industry	1.7%	1.2%	1.7%	2.1%
Implied differential effect in booms	0.5%	0.3%	0.0%	0.2%
Differential effect larger than in preceding sample (p-value)		4.9%**		15.1%

differential effect in recessions is again much stronger in countries with poor quality accounting practices and for less tangible industries. The magnitudes are not significantly different to those in our benchmark result.

F. Industry Outcome

Aggregate production growth (i.e., GDP) is commonly used to identify and summarize business cycles. Therefore, industry production growth is the natural outcome to look for cross-sectional differences around the cycle. The size of the effect on industrial production has a direct counterpart in terms of aggregate quantities of interest to macroeconomists. We also use it as our benchmark because much more data is available for production, and it is less subject to measurement problems. UNIDO also reports some data on employment, number of establishments, and gross fixed capital formation. The same basic pattern arises with these other variables. Employment growth, the number of establishments, and real fixed capital formation of highly dependent industries are all relatively more affected by recessions in countries that rank low in the accounting index and in industries with low asset tangibility (not reported). The magnitude of the estimated effects is in line with those documented for production.

The statistical significance of the results is generally weaker than when we use production indexes, though. We think that in the case of employment and establishments, higher adjustment costs subtract power from the test as compared to the case of output. Timing issues may also be important (in fact, some estimates for the coefficient of the recession dummy are not even significantly negative). In the case of fixed capital formation and establishments, the sample is also significantly smaller (about 30% to 50% of the output sample). Lastly, the deflation of the fixed capital formation series is likely to introduce significant noise.

IV. Conclusion

The evidence presented in this paper strongly supports the existence of a financial channel of business cycles. The credit channel, or more broadly the implications of financial imperfections for business cycles, is a widespread phenomenon across countries. The (differentially) higher impact of recessions on industries that naturally rely more on external funds is, on average, relevant in magnitude and statistically significant.

The differences vary with the institutional setting, which is crucial for the identification of the effects as consequences of financial frictions. Deterioration in the country-level financial environment implies that there is a larger differential impact of recessions across industries sorted by their external dependence. Also, in line with previous results, industries that rely more heavily on soft assets are hit harder during recessions. The financial mechanism is asymmetric over the cycle (stronger during downturns than in booms), and is especially strong when recessions are accompanied by credit crunches.

Appendix: Description of Variables

Industry Growth Rate. This is the log change in the production index of each ISIC-3 manufacturing industry in a given country between two consecutive years. Production indexes are taken from UNIDO (2001).

Recession. This is a dummy variable indicating whether a country is experiencing a recession in a particular year. For each country, troughs are identified as years when the current logarithm of real local currency GDP (from World Bank (2001)) deviates by more than one standard deviation from its trend level (computed using the Hodrick–Prescott filter with a smoothing parameter of 100). For each trough, a local peak is defined as the closest preceding year for which cyclical GDP (the difference between actual and trend values) is higher than during the previous and posterior years. The recession variable takes a value of 1 all the years between peak and trough (excluding the peak year), and is 0 otherwise. The cyclical component of the GDP is constructed with data from 1960 to 1999, whenever available. In countries where the GDP series starts later than 1963, we do not consider the first 3 years when identifying recessions. This gives 3 years for constructing a reliable trend. The recession dummy is assigned a missing value whenever there are no GDP data or if a trend cannot be reliably constructed.

Recession Points. These are absolute points of GDP lost with respect to the trend during a recession. This is the product of the absolute value of the cyclical component of GDP and the recession dummy variable.

Monetary Recession. These are the recession years preceded by a sizable monetary tightening the year immediately before. The identification of tight money periods is based on the cyclical component of M2 over GDP (from World Bank (2001)). For each country, troughs are identified as years when M2 over GDP deviates by more than one standard deviation from its trend level (computed using the Hodrick–Prescott filter with a smoothing parameter of 100). For each trough, a local peak is defined as the closest preceding year for which cyclical M2 over GDP (the difference between actual and trend values) is higher than during the previous and posterior years. The monetary tightening variable takes a value of 1 for all the years between peak and trough (excluding the peak year), and is 0 otherwise. Monetary recession is a dummy variable that takes the value of 1 when the monetary tightening variable is 1 the previous year and the recession indicator is 1 also, and is 0 otherwise.

World Recession. These are the recession episodes in which the share of countries experiencing a recession is above 30% for at least 1 year (1965 to 1967, 1981 to 1983, and 1990 to 1993) plus the oil crisis of 1974–1975.

Recession with Credit Crunch. These are the recession years accompanied by a credit crunch. The identification of credit crunch periods is based on the cyclical component of bank credit to the private sector over GDP (from Beck

et al. (2000)). For each country, troughs are identified as years when private credit to GDP deviates by more than one standard deviation from its trend level (computed using the Hodrick–Prescott filter with a smoothing parameter of 100). For each trough, a local peak is defined as the closest preceding year for which cyclical private credit over GDP (the difference between actual and trend values) is higher than during the previous and posterior years. The credit crunch variable takes a value of 1 for all the years between peak and trough (excluding the peak year), and 0 otherwise. Recession with credit crunch is a dummy variable that takes a value of 1 when both credit crunch and recession are 1, and is 0 when they both are 0.

External Finance Dependence. This is the industry median of the share of capital expenditures not financed with internal funds (capital expenditures minus cash flow from operations divided by capital expenditures) by U.S.-based publicly listed firms. This is taken from Rajan and Zingales (1998) and from Luigi Zingales' web page. For each of the 28 ISIC-3 manufacturing sectors, our measure averages their index computed from firm-level data for the 1970s and 1980s.

International Accounting Standards. This is the number of international accounting standards used in reporting financials in each country (from La Porta et al. (1998)). Based on annual reports (balance sheet information, income statements, stock data, and others) of companies in different countries, the variable measures the inclusion of each of 90 items (originally from the Center for International Financial Analysis and Research).

Asset Tangibility. This is the industry median of the ratio of net property, plant and equipment to total assets by U.S.-publicly listed firms during the 1986–1995 period. This is taken from Braun (2002).

Creditor Rights. This is the degree of effective protection of creditors in each country. La Porta et al. (LLSV1998) collect information regarding regulations determining creditor rights in the event of reorganization or bankruptcy (automatic stay on assets, secured creditors are paid first, need to consult with creditors before filling for reorganization, and forced removal of current management), assigning each country a score from 0 (worst protection) to 4 (best). Galindo and Micco (2001) extend LLSV's variable to include additional countries. This is multiplied by Kaufmann, Kraay, and Zoido-Lobaton's (1999) rule of law index to take into account variation in the degree of law enforcement across countries (i.e., the effective creditor rights index).

Contracting Institutions. This is the index of formality in legal procedures for collecting on a bounced check. This is taken from Djankov et al. (2003). The measure used in this paper instruments the legal formalism index with the origins of the legal system (a variable that indicates whether the legal system in each country originated in the French civil law or the English common law tradition. This is taken from La Porta et al. (1998)).

Property Rights Institution. This corresponds to the risk of expropriation of private foreign investment by government, from Acemoglu, Johnson, and Robinson (2001) (originally from Political Risk Services). The measure used in this paper instruments expropriation risk with log settler European mortality, from Acemoglu et al. (2001).

Durable Goods Producer. Durable goods are assigned a 1, nondurable goods a 0, and semidurable goods 0.5. We use the classification of durable and nondurable goods presented in BEA's Industry Accounts in the section of Gross Domestic Product by Industry (www.bea.gov/bea/dn2/gpo.htm). The industries described there are almost the same as the 28 industries we use. Since there is disagreement about the durability of some products, we create a semidurable category. The semidurable industries correspond basically to clothing, footwear, and printing. For supporting evidence about the durability of these last items, see table 2 in Bils and Klenow (1998).

Investment Goods Producer. The BEA provides information about the final uses of each commodity, which is very close to industry use, in particular when we aggregate to get 28 industries. This information is contained in the use table of the input–output data section (www.bea.gov/bea/dn2.htm). We use the latest data available, which is from 1998. For each industry, we consider the columns labeled as consumption and gross investment, either private or public, to construct the following measure: Investment/(investment + consumption). This measure captures how tilted an industry is toward investment goods.

Tradable Goods Producer. Using the BEA use tables we construct the following measure of tradability of an industry's product: Trade/(trade + domestic use), where trade is defined as exports plus imports, and domestic use is defined as consumption plus investment, either private or public. If this ratio is close to 1 the industry is producing highly tradable goods.

U.S. Cyclicality. This is the OLS coefficient of a regression of the (HP-cyclically adjusted) production index (from UNIDO) on the (HP-cyclically adjusted) real GDP for the United States and a constant.

Table A.I
Industry Variables

Industry	External Finance Dependence	External Finance Dependence 1970s	External Finance Dependence 1980s	Asset Tangibility	Durable Goods Producer	Investment Goods Producer	Tradability	U.S. Cyclicality
Beverages	0.010	−0.057	0.077	0.279	0.0	0.000	0.158	0.428
Fabricated metal products	0.201	0.166	0.237	0.281	1.0	0.474	0.621	2.670
Food products	0.097	0.058	0.137	0.378	0.0	0.000	0.158	0.474
Footwear, except rubber or plastic	−0.169	−0.261	−0.078	0.117	0.5	0.000	0.495	−0.011
Furniture, except metal	0.198	0.161	0.236	0.263	1.0	0.465	0.223	2.060
Glass and products	0.297	0.066	0.529	0.331	1.0	0.000	0.686	1.280
Industrial chemicals	0.161	0.117	0.205	0.412	0.0	0.062	0.881	2.070
Iron and steel	0.037	−0.013	0.087	0.458	1.0	0.069	0.919	3.320
Leather products	−0.089	−0.038	−0.140	0.091	0.5	0.000	0.495	0.871
Machinery, electric	0.515	0.262	0.768	0.213	1.0	0.473	0.568	2.710
Machinery, except electrical	0.300	0.156	0.445	0.183	1.0	0.908	0.485	2.970
Misc. petroleum and coal products	0.062	−0.211	0.334	0.304	0.0	0.000	0.234	1.280
Non-ferrous metals	0.100	0.194	0.006	0.383	1.0	0.305	0.958	2.800
Other chemicals	0.073	−0.073	0.219	0.197	0.0	0.062	0.881	1.140
Other manufactured products	0.296	0.121	0.470	0.188	–	0.137	0.397	1.410
Other non-metallic mineral products	0.076	0.090	0.062	0.420	0.0	0.000	0.706	2.710
Paper and products	0.085	−0.006	0.176	0.558	0.0	0.000	0.570	1.120
Petroleum refineries	0.049	0.056	0.042	0.671	0.0	0.000	0.234	1.040
Plastic products	1.140		1.140	0.345	0.0	0.008	0.781	2.150
Pottery, china, earthenware	−0.298	−0.450	−0.146	0.075	1.0	0.000	0.706	2.710
Printing and publishing	0.097	−0.010	0.204	0.301	0.5	0.000	0.107	1.300
Professional & scientific equipment	0.681	0.400	0.961	0.151	1.0	0.629	0.401	1.610
Rubber products	0.150	0.073	0.227	0.379	0.0	0.016	0.562	1.970
Textiles	0.180	−0.040	0.401	0.373	0.5	0.095	0.444	0.984
Tobacco	−0.288	−0.126	−0.451	0.221	0.0	0.000	0.157	0.505
Transport equipment	0.267	0.226	0.307	0.255	1.0	0.535	0.456	3.560
Wearing apparel, except footwear	0.030	0.031	0.029	0.132	0.5	0.000	0.405	1.520
Wood products, except furniture	0.282	0.280	0.284	0.380	1.0	0.751	0.560	2.220
Correlation with External Finance Dependence (significance: **5%, ***1%)		0.849***	0.948***	0.092	0.141	0.387**	0.183	0.299

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