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Financial dependence and growth: The role of input-Output linkages☆

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ABSTRACT

We widen the understanding of the finance-growth nexus by accounting for the indirect effect of financial development through input-output (IO) linkages in determining the growth of industries across countries. If financial development is expected to promote disproportionately more the growth of industrial sectors that are more in need of external finance, it also favours more the industries that are linked by IO relations to more financially dependent industries. We explore this new channel in a sample of countries at different development stages over the period 1995–2007. Our results highlight that financial development, besides easing the growth of industries highly dependent on external finance, also fosters the growth of industries strongly linked to highly financially dependent upstream industries. Moreover, the indirect effect - propagated through IO linkages - of finance has a higher and non-negligible role compared to the direct effect and its omission leads to a biased and underestimated perception of the role of finance for industries' growth.

1. Introduction

A general consensus in the growth literature exists on the positive repercussions that a well developed financial sector has on aggregate output (Levine, 2005).[1] In particular, banking industry is pivotal to channel financial resources towards more innovative firms and sectors which are plagued by asymmetric information problems, and whose investment expenditures are strongly constrained by the availability of external finance. In this view, there would be a link between financial development and the growth of a non-financial industry *S* going through the support that banks provide directly to firms in that sector for seizing growth opportunities and responding to global shocks (Beck et al., 2000; Fisman and Love, 2007; Rajan and Zingales, 1998).

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[1] As long as banks and financial markets reach a hypertrophic size compared to the rest of the economy (Arcand et al., 2015; Manganelli and Popov, 2013; Rousseau and Watchel, 2011; Tobin, 1984) or the financial sector grows at a very high pace (Cecchetti and Kharroubi, 2015; Ductor and Grechyna, 2015).

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However, quantitative macroeconomic models and empirical studies have clearly documented that credit supply shocks propagate in the economy through the network of IO linkages across firms and industries (Alfaro and Garcia-Santana, 2017; Bigio and La'O, 2016; Dewachter et al., 2017). This means that financial development can be expected to foster the growth of a non-financial sector *S* also indirectly, through the support to investments of financially dependent firms in downstream and upstream sectors, which buy outputs from and supply inputs to sector *S*. In this paper we analyze the role of input-output (IO) linkages in transmitting and amplifying the effects of financial development on the growth of industrial sectors. More specifically, we explore this conjecture by extending the cross-country industry approach initially proposed by Rajan and Zingales (1998) to include IO linkages among sectors.[2]

The idea that IO linkages are at the heart of the process of economic development has a long tradition in the economic literature, dating back to Scitovsky (1954), Fleming (1955) and Hirschman (1958). In a nutshell, the development of an industry activates sizable positive effects on firms in other industries, which provide inputs to the former one (*backward linkage effects*) and use its outputs as inputs in the production process (*forward linkage effects*).

Recently, literature has refocused the attention on the importance of IO linkages for productivity improvements and economic growth. Ciccone (2002) develops a model of industrialisation in which, consistently with empirical regularities, increasing-return technologies are highly intensive in the use of intermediate inputs and are adopted throughout the chain of intermediate inputs. In this context, the introduction of new industrial technologies generate a large increase in aggregate productivity and income, even if the productivity improvements at the firm level are small. By the same token, however, minor frictions in IO linkages (due, for example, to imperfections in financial markets) can also be expected to cause great differences in productivity and income levels across countries. This view is corroborated by Acemoglu et al. (2007) and Jones (2011). The former show that greater contractual incompleteness leads to the adoption of less advanced technologies, and that this effect is more pronounced when there is strong complementarity among intermediate inputs. Jones (2011) explores the role of input linkages and complementarity and shows that frictions along the production chain can sharply reduce aggregate output.

On the empirical side, Bartelme and Gorodnichenko (2015) at the country level document the "Hirschman conjecture", that the strength of IO linkages is positively associated to output per worker and total factor productivity.[3] In the same vein, Fadinger et al. (2016) find that a multi-sector model with IO linkages explains cross-country income differences much better than a model abstracting from IO linkages.[4] In addition, a number of studies have shown the role of IO linkages among industrial sectors in generating aggregate fluctuations, finding that the chain of input-output relations contributes to spread out and amplify the effects of idiosyncratic individual or sectoral shocks over the entire economy (Acemoglu et al., 2012; Carvalho, 2014; Di Giovanni et al., 2014). In particular, Acemoglu et al. (2016) find that in the United States industries' value added, employment and labor productivity respond more to indirect supply and demand shocks affecting the IO chain than to direct shocks hitting the same industry. Moreover, when they distinguish between upstream and downstream IO linkages, they show that demand shocks propagate upwards to input-supplying industries, while supply shocks propagate downwards to customer industries.[5]

Relatively unexplored are the factors that contribute to explain the aggregate impact of IO linkages, and in particular the role of financial markets in the propagation of shocks in the presence of inter-sectoral IO linkages. As partial exceptions, Acemoglu et al. (2009) document that countries characterised by high contracting costs and low financial development are concentrated in industries where firms tend to be more vertically integrated, relying less on IO linkages. Furthermore, within each industry, they show that financial development helps firms to circumvent contracting costs by providing them with financial resources necessary to grow in size and vertically integrate activities. Bigio and La'O (2016) introduce financial frictions in a multi-sector network framework *à la* Acemoglu et al. (2012). They calibrate the theoretical model to the IO structure of the U.S. economy during the 2007–2008 Great Recession, and show that IO linkages amplify the effect of financial shocks on aggregate output by a factor between two and six, relative to the case of an hypothetical industrial structure with no interactions across sectors. Finally, Alfaro and Garcia-Santana (2017) and Dewachter et al. (2017), using very detailed firm level data on Spanish and Belgian firms respectively, find that individual credit supply shocks strongly propagate to other firms in the value chain by affecting their capital investments, export sales and output.

In this paper, we depart from this business cycle perspective and for the first time, to the best of our knowledge, we investigate whether and to what extent, in a long run perspective, the impact of financial development on the growth rate of an industry *S* is amplified by IO linkages connecting that industry to other industries which are in need of external finance.

Our intuition is simple and extends the same argument advanced by Rajan and Zingales (1998) for financial dependent sectors to the whole IO chain. If financial intermediaries mitigate asymmetric information problems that hamper firms'

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[2] The cross-country industry approach and indicators in Rajan and Zingales (1998) have been widely used in the finance-growth literature. Among others, see: Cetorelli and Gambera (2001), Beck and Levine (2002), Fisman and Love (2003, 2007), Kroszner et al. (2007), Pagano and Pica (2012).

[3] "If we had homogeneous input-output statistics for all countries, it would certainly be instructive to rank countries according to the proportion of intersectoral transactions to total output; it is likely that this ranking would exhibit a close correlation with both income per capita and with the percentage of the population occupied in manufacturing." (Hirschman, 1958, p.109).

[4] At the firm level, the importance of IO linkages has been explored quite extensively in the literature on productivity spillovers from multinational enterprises to domestic firms (Javorcik, 2004).

[5] A similar pattern is documented at the firm level by Barrot and Sauvagnat (2016) who show that sales growth and market value of US firms suffer from idiosyncratic shocks, related to natural disasters, hitting their suppliers.

access to credit, sectors buying from and selling to highly financially dependent sectors should grow at a disproportionately faster pace in countries with a well developed and functioning financial sector. To illustrate this point, consider a number of sectors connected by IO linkages. Each sector produces an output which is used in downstream industries as an input, and buy inputs from upstream sectors. If financial development allows firms in a sector S_1 along this IO chain to have a larger access to credit, capital accumulation in this sector increases, as well as productivity. This possibly causes an increase in the demand of inputs by S_1 produced by firms in an upstream sector S_2, and a decrease in the price of output in S_1 used as an input by firms in a downstream sector S_3. As a result, the output of S_2 and S_3 increase, as well as their investment opportunities. If firms in these sectors are financially dependent, the growth opportunities produced by the higher investments in sector S_1 can be better exploited where they can rely on a well developed financial sector. Beyond these first order interconnections, the increase in investments and productivity in sectors S_2 and S_3 may create, in turn, opportunities of growth in their upstream and downstream sectors that a developed financial sector allows to actually take, and so on.[6] In this way, the impact of financial development on the growth of an industry S reflects the financial support that banks provide along the whole IO chain linking this industry to other industries, and it is the greater the more financial dependent are these industries.

Our empirical analysis considers a sample of countries at different development stages over the period 1995–2007. Following Rajan and Zingales (1998) and Kroszner et al. (2007), the measure of financial dependence varies by sector and is calculated on the basis of U.S. firms' cumulated capital expenditures and cash flows over the period 1990–2007. IO linkages, instead, refer to the first year - 1995 - of our sample and are retrieved from the OECD IO database. For every industry, we distinguish between upstream linkages with industries supplying intermediate goods and downstream linkages with customer industries. Then, we compute two indicators reflecting the overall financial dependence of upstream and downstream industries where the financial dependence of each upstream/downstream sector is weighted by its share in the industry's total purchases/sales. In the baseline model, financial development is proxied by the standard ratio of domestic credit over GDP (WDI, 2015).

We model the growth of real value added of an industry as dependent on the interactions between a country's financial development and the financial dependence of the same industry and of its upstream and downstream industries. Our results confirm the finding by Rajan and Zingales (1998) of a positive contribution of financial development to the growth of financially dependent sectors. However, we also find that, quantitatively, the direct effect of financial development on the industry's growth rate is smaller than the indirect effect that financial development exerts by relaxing financial constraints of the sectors linked to the industry by IO relations. More specifically, we find that the latter effects operate through the financial support that a developed financial sector warrants to upstream industries selling intermediate inputs. The sustain of well developed financial intermediaries to downstream sectors, instead, is not significantly associated with the growth of supplying sectors. This is consistent with the hypothesis that, if we focus the analysis on intermediate goods, the positive role of financial development for the investments of financially dependent firms in upstream sectors fosters productivity improvements (Beck et al., 2000), thus reducing the prices of their goods and opening new opportunities of investment for downstream customer sectors (Acemoglu et al., 2016; Hirschman, 1958). The search for the channels behind the baseline evidence corroborates this interpretation. By contrast, the benefits of financial development are not significantly transmitted across sectors by its potential effects on the demand for intermediate inputs.

Our results are robust to several checks. In order to account for the potential endogeneity of financial development, we implement an instrumental variable (IV) approach based on the close relation between the quality of a country's legal system and its financial development (Beck et al., 2003; La Porta et al., 1998). Furthermore, we use alternative measures of financial development, industry's growth, financial dependence and IO linkages. Also, we explore competing and potentially confounding factors which could affect the growth of industries within a country. More precisely, we consider the impact of countries' development stage, as a proxy of the extent of maturity of a country's industries, human capital endowment, as a further alternative growth determinant of more skill intensive industries, and foreign direct investment (FDI) as an additional source of finance in recipient economies, especially for capital intensive industries. We also confirm our baseline evidence on the original sample used by Rajan and Zingales (1998).

In our country-industry framework, we further inspect the existence of some potential heterogeneity in the finance-growth nexus. We, first, test whether the documented non-linearity of the nexus is also valid for financial development working through IO linkages (Arcand et al., 2015; Cecchetti and Kharroubi, 2012; Demirguc-Kunt et al., 2013; Easterly et al., 2000). Finally, we separately test the role of finance in the 90s, when a relevant number of banking crises occurred, and in the 2000s, during the productivity slowdown decade.

The rest of the paper is organised as follows. The next Section presents the empirical model, while Section 3 presents the data and describes the computation of financial dependence for a sector, for its upstream and downstream sectors. Section 4 shows the results from the estimation of the empirical model, all the array of robustness checks and the test for non-linearity in the finance-growth nexus through IO linkages. Finally, Section 6 concludes the work.

[6] While in the empirical analysis we focus on the first-order linkages, as a robustness we will also test the importance of higher order interconnections by means of the Leontief inverse matrix.

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2. Empirical model

Our main testing hypothesis is that industrial sectors that are linked in the IO chain to industries that are more dependent on external finance grow at relatively higher rates in countries whose financial sector is more developed. To test this hypothesis we need a model of industry growth where the effect of financial development is heterogeneous across sectors according to the financial dependence of their upstream suppliers and downstream buyers. Therefore, we estimate the following empirical model:

$$growth_{ic\ t/\tau} = \alpha + \beta share_{ic\ \tau} + \gamma_0 ED_i \times FD_{c\tau} + \gamma_1 ED_i^{Downstream} \times FD_{c\tau} + \gamma_2 ED_i^{Upstream} \times FD_{c\tau} + \lambda_i + \mu_c + \epsilon_{ic} \quad (1)$$

where $growth_{ic\,t/\tau}$ is the average annual growth of real value added of sector i in country c recorded in the time span between t and τ, where $t = 2007$ and $\tau = 1995$. In the right hand side of the equation, our coefficients of interest are γ_0, γ_1 and γ_2 which are meant to identify the impact of financial development according to sector i's own, downstream and upstream financial dependence, respectively. To this purpose, we interact each financial dependence indicator - namely ED_i, $ED_i^{Downstream}$ and $ED_i^{Upstream}$ - by the degree of financial development in country c in the initial period τ , $FD_{c\tau}$. Eq. (1) includes the full set of industry, λ_i, and country, μ_c fixed effects to control for any observable and unobservable characteristic varying at the country or industry level, and the share of sector i in country c's total manufacturing value added at the initial period τ ($share_{ic\,\tau}$) to control for the initial condition and the presence of a convergence effect.

Therefore, our empirical specification closely parallels that of Rajan and Zingales (1998), the main difference being the inclusion of the two interaction terms $ED_{ic}^{Downstream} \times FD_{c\tau}$ and $ED_{ic}^{Upstream} \times FD_{c\tau}$, which aim at capturing the role of finance in enhancing the growth of industries by removing frictions from inter-sectoral IO linkages.

Table A1 and Table A2 in Appendix A describe the sample composition by sector and country, respectively, while Tables A3 and A4 show descriptive statistics of the variables included in our empirical model and pairwise correlations between them, respectively. In the remainder of the paper, OLS will be our baseline estimator. Nevertheless we will prove that our results are robust to the adoption of an IV estimator.

3. Data and measurement issues

3.1. Industry level data

Data on countries' value added by industry are retrieved from the UNIDO Industrial Statistics Database for the period 1995–2007 at the 2-digit level of the ISIC revision 3.[7] Data by industry have been slightly re-aggregated in order to match the classification system of the IO tables shown in Table A1. From the UNIDO database we calculate discrete annual growth rates of value added, deflated by means of the consumer price index retrieved from the Penn World Tables 8.1. In our baseline specification, we winsorise annual growth rates at the 1*st* and 99*th* percentiles of the distribution and then calculate average growth rates across the 1996–2007 period for all the country-sector pairs in our sample.[8]

3.2. External financial dependence

3.2.1. Measuring industry external dependence

Following Rajan and Zingales (1998), we measure industry financial dependence as the median amount of external finance used by the U.S. companies in each industry. The underlying hypothesis is that, as the U.S. financial markets are almost perfect and frictionless, firms in the U.S. industries do not suffer from financial constraints. As a result, the amount of external funds that large firms in the U.S. demand reflects the "technological" dependence of their capital expenditures on external sources of financing, due, for example, to the scale of investment projects, their gestation period and information opaqueness. Furthermore, it is assumed that the "technological" needs of external finance are common across countries, such that the financial dependence of the sector i is the same one that we observe in the United States in every country.

We use the COMPUSTAT database and define firms' external dependence as capital expenditures minus cash flow from operations divided by capital expenditures.[9] As in Rajan and Zingales (1998), in order to smooth temporal fluctuations and reduce the effect of outliers, we aggregate the firm's use of external finance over the 1990–2007 time span - which covers our sample period - and divide it by the sum of capital expenditure over the same period. Then, we take the industry median of these firm level aggregate ratios as our measure of sectoral financial dependence, ED_i. COMPUSTAT records a firm's industry in US SIC at the 4-digit which, at the 2-digit, has broad direct correspondence with the 3-digit ISIC revision

[7] The availability of cross-country IO tables for 1995 has driven the choice of the initial sample year. We have, therefore, neglected years before 1995 in order to limit endogeneity issues related to the use of IO linkages from a later period to explain growth of preceding years. Also, we decided to exclude year 2008 from the analysis due to the outburst of the economic downturn in that year.

[8] However, it is worth noting that our results are robust to alternative cleaning procedures and persist when growth rates are not cleaned at all and/or are calculated as average annual logarithmic differences.

[9] We measure capital expenditures as the corresponding COMPUSTAT variable (COMPUSTAT # 128), while we define cash flow as the sum of cash flow from operations (COMPUSTAT # 110) plus decreases in inventories, decreases in receivables, and increases in payables. For cash flow statements with format code 7, cash flow is constructed as the sum of items # 123, 125, 126, 106, 213, 217.

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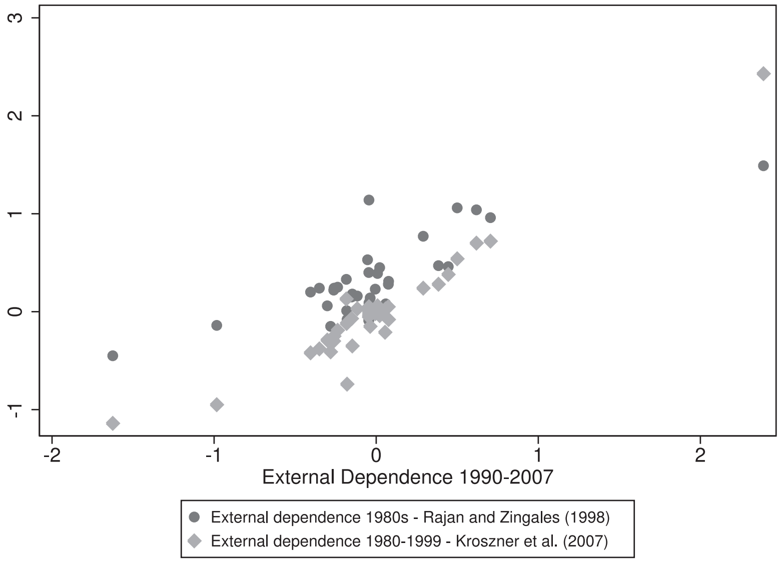

Fig. 1. External dependence - 1990–2007. Comparison with ED's measures from the literature. *Notes:* The y axis refers to the measures of external dependence for the 1980s and for 1980–1990 from Rajan and Zingales (1998) and Kroszner et al. (2007) respectively. The x axis measures our external dependence indicator concerning the 1990–2007 period and is based on own calculations on COMPUSTAT data. Each dot in the Figure corresponds to an industry according to the definition of Rajan and Zingales (1998) and Kroszner et al. (2007).

2 classification. Thus, we first match SIC COMPUSTAT data with ISIC Rev. 3 through the official ISIC Rev. 2- ISIC Rev. 3 available from RAMON website and we, then, calculate the median of the ratios across firms by sector.

While the original measure by Rajan and Zingales (1998) refers to the 80s and is available for the manufacturing sectors only, we extend it to all sectors in the economy in order to compute the financial dependence of upstream and downstream sectors and, as our empirical analysis concerns manufacturing sectors' growth over the 1990s to the 2000s, we update the financial dependence measure by focusing on the same period. To check the validity of our measure, we compute the financial dependence indicator for the specific manufacturing sectors considered by Rajan and Zingales (1998) and Kroszner et al. (2007), and obtain a rank correlation index with their original indicators equal to 0.56 and 0.81 (and a simple correlation of 0.8 and 0.96), respectively. Also, in Fig. 1 we report a scatter plot contrasting our measure (x-axis) against the other two measures from the literature, where each dot corresponds to an industry, clearly confirming that the three measures all bear a similar piece of information and sector ordering.[10]

In order to test our basic premise that external dependence in the U.S. is a good proxy for an industry's technological need for external finance outside the United States, we calculate the weighted average financial dependence for each country by multiplying an industry's financial dependence by the industry's contribution to countries' value added in 1995 (Rajan and Zingales, 1998). We then regress domestic credit to GDP - our baseline financial development indicator - against this weighted average financial dependence for the 39 countries in the sample and we find a strong and positive correlation between the two variables in 1995 ($\beta = 2.27$, t = 3.43). This supports the assumption that the external finance dependence of industrial sectors in the United States captures the industry "technological" need of external finance and is a good proxy for external financing used by the same industry in other countries.

3.2.2. Measuring external dependence of downstream buyers and upstream suppliers

In order to compute external dependence for downstream and upstream sectors with respect to each industry i, we retrieve input-output linkages from OECD IO Tables. The latter are available for a large number of countries for the year 1995 and, for each industry within a country, they provide information on its purchases from and sales to any other sector in the economy. Table A6 in Appendix A reports the list of countries for which the IO tables are available and that we use in our work for the computation of average downstream and upstream sectors' financial dependence.

More in detail, for each country in the OECD IO database, we compute the financial dependence of industry i's downstream sectors as the weighted average of financial dependence of downstream sectors, where the weights are represented by downstream sectors' shares in total sector i's sales. Namely:

$$ED_{ic}^{Downstream} = \frac{\sum_{j \neq i \in J} ED_j \times sales_{ijc}}{sales_{ic}} \quad (2)$$

[10] Table A5 in Appendix A shows the values of financial dependence by sector according to the three measures.

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Similarly, we compute financial dependence of industry *i*'s upstream sectors as the weighted average of financial dependence of upstream sectors, where the weights are represented by upstream sectors' shares in total sector *i*'s purchases. Namely:

$$ED_{ic}^{Upstream} = \frac{\sum_{j \neq i \in J} ED_j \times purchases_{ijc}}{purchases_{ic}} \quad (3)$$

In order to get a unique measure of financial dependence of upstream and downstream sectors by industry, in the baseline empirical model we use the average value of $ED_{ic}^{Upstream}$ and $ED_{ic}^{Downstream}$ across N countries[11]:

$$ED_{i}^{Upstream} = \frac{\sum_{c=1}^{N} ED_{ic}^{Upstream}}{N} \quad (4)$$

$$ED_{i}^{Downstream} = \frac{\sum_{c=1}^{N} ED_{ic}^{Downstream}}{N} \quad (5)$$

The use of the average value of financial dependence of upstream and downstream sectors across countries instead of country level measures rests on two considerations. First, we want to model the impact of other industries' financial dependence in a consistent way with respect to the impact of a sector's own financial dependence, as this eases the readability and interpretation of our results, as well as the assessment of the magnitude of the finance effect that follows the strategy adopted in Rajan and Zingales (1998). Second, as financial dependence recorded in each country may suffer from financial constraints, in a similar way, the country level IO shares are expected to be affected by country specific - technological, institutional, etc. - constraints. Ideally, we would like to exploit upstream and downstream financial dependence built on the basis of IO shares that reflect the optimal use of each input in the output production in the absence of any constraint. Due to the almost perfect and frictionless U.S. financial markets, we expect that the financial dependence recorded for industries in the U.S reflects the optimal use of finance by the same industries in other countries. Nonetheless, it is not straightforward to identify a single country where IO shares are not affected by any existing constraint and that, then, could be considered as benchmark. We, thus, opted for the use of the average value of upstream and downstream financial dependence across countries as our benchmark. In the robustness checks, however, we also use the country-varying $ED_{ic}^{Upstream}$ and $ED_{ic}^{Downstream}$ indicators, we calculate IO shares from an aggregate world IO table and, finally, we use the measures based on the U.S. IO Tables as an external benchmark for all countries.

In order to avoid redundancy in the measurement of upstream and downstream industries' financial dependence, in the baseline model we consider the IO linkages of a manufacturing sector with the whole set of industries but the financial sector. In the robustness checks we will show that our insights are not affected by the inclusion of the financial sector among the IO linkages in indicators (2) and (3).

3.3. Financial development

We measure financial development by the ratio of domestic private credit over GDP (WDI, 2015), the most widely adopted indicator in the empirical literature on finance and growth (Levine, 2005). In the robustness checks, we will document that our baseline results are robust to the adoption of several other proxies of financial depth gathered from the World Bank Global Financial Indicators Database or to alternative ways of measuring countries' financial development related to capitalisation and accounting standards available in the Rajan and Zingales's database.

4. Finance, IO linkages and growth

4.1. Baseline results

Table 1 shows baseline estimation results from model (1) on the 1996–2007 cross-section of country-sector growth rates. Financial development not only favours directly the growth of a financially dependent sector *i*, but it also matters indirectly through the support to financially dependent upstream industries supplying inputs to sector *i*. More specifically, in columns [2]-[4] financial development seems to promote economic growth of sectors through both output and input linkages. However, when industry and country dummies are included in the model (columns [5]-[8]) finance does not play any significant role on the value added growth through output linkages with financial dependent downstream sectors, while the importance of input linkages in propagating the beneficial effects of financial development persists.[12]

[11] It is worth mentioning that from the initial list of 61 economies we exclude two oil countries - Brunei and Saudi Arabia. We further exclude Luxembourg as its IO shares were rather different from the rest of the other economies, and Japan which presents outlier observations for the ratio of domestic credit over GDP. Nevertheless, results are robust to the inclusion of these countries both in the calculation of the upstream and downstream financial dependence measures and in the estimation sample.

[12] In Table A9 in Appendix A we show that our results are broadly confirmed when we aggregate U.S. firm financial dependence by industry, rather than taking the industry median across firms, and use this aggregate industry level indicator to compute financial dependence of upstream and downstream

Table 1
Baseline Evidence.

	OLS								IV
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
$share_{ic\tau}$	−0.239***	−0.261***	−0.266***	−0.259***	−0.183***	−0.176***	−0.166***	−0.178***	−0.193***
	[0.035]	[0.036]	[0.037]	[0.037]	[0.034]	[0.033]	[0.033]	[0.034]	[0.034]
$ED_i{}^*FD_{c\tau}$	0.111***			0.080***	0.051			0.104**	0.190***
	[0.020]			[0.023]	[0.045]			[0.047]	[0.068]
$ED_i^{Downstream} \times FD_{c\tau}$		0.538***		0.105		−0.035		−0.168	−0.422
		[0.114]		[0.142]		[0.236]		[0.234]	[0.315]
$ED_i^{Upstream} \times FD_{c\tau}$			0.241***	0.147***			0.227**	0.321***	0.324**
			[0.047]	[0.048]			[0.107]	[0.111]	[0.151]
Constant	0.130***	0.126***	0.129***	0.140***	0.195***	0.186***	0.178***	0.194***	
	[0.007]	[0.007]	[0.007]	[0.008]	[0.073]	[0.072]	[0.067]	[0.068]	
Observations	503	503	503	503	503	503	503	503	503
R-squared	0.115	0.097	0.097	0.129	0.61	0.609	0.613	0.617	0.617
Fixed Effects									
Country	N	N	N	N	Y	Y	Y	Y	Y
Industry	N	N	N	N	Y	Y	Y	Y	Y
Hansen J									16.18
P-Value									0.18
1*st* Stage F tests									
$ED_i \times FD_{c\tau}$									18.6
$ED_i^{Downstream} \times FD_{c\tau}$									33.47
$ED_i^{Upstream} \times FD_{c\tau}$									27.64

* Significant at 10% level; ** significant at 5% level; *** significant at 1% level. Robust standard errors in brackets. The dependent variable is the average annual growth of real value added of sector i in country c recorded in the time span between $t = 2007$ and $\tau = 1995$.

In column [9] of Table 1, in order to account for reverse causality issues and, more generally, for the potential endogeneity of financial development, we adopt an IV approach by following extant literature which highlights a significant impact of a country's legal system on the development of domestic capital markets and financial industry (Beck et al., 2003; 2000; La Porta et al., 1998). Therefore, we use legal origins from La Porta et al. (2008) and the rule of law index from the World Bank Worldwide Government Index (WGI) as instruments for financial development. The Hansen test fails to reject the validity of the over-identifying exclusion restrictions, while the lower part of the Table shows satisfactory values for the first stage F test statistics.[13] The IV estimator confirms our results, and the magnitude of the effects of financial development, either mediated by the sector's own financial dependence or by the financial dependence of upstream industries, does not sensibly change.

In order to assess the economic magnitude of the estimated effects, we consider coefficients from the specification in column [8]. Similarly to Rajan and Zingales (1998), we take the countries at the 25th and 75th percentiles of the distribution of the ratio of domestic credit over GDP - Mexico and Italy, respectively - and the sectors at the 25th and 75th percentiles of the distribution of the ED_i indicator - metal products and chemicals, respectively - and calculate the differential growth rate of chemicals compared to metal products in Italy compared to Mexico explained by the two significant factors under analysis. The estimate on the coefficient of $ED_i \times FD_{c\tau}$ predicts that the chemical industry should grow 1.45 percentage points faster than Metal products in Italy than in Mexico. Beyond the direct effect of financial development, the effect working through upstream linkages would deliver a growth advantage to the Italian chemical industry over the sector of metal products in Italy that is 2.16 percentage points higher than the growth differential between chemicals and metal products in Mexico. Considering that in our sample the average growth rate of manufacturing sectors is around 9.5%, the beneficial effect of financial development triggered by input linkages turns to be particularly relevant. Moreover, the financial dependence of industries' suppliers has a higher importance in driving the positive role of financial development on growth.

As a further exercise, we take two sectors which have an opposite position in the ranking of ED_i and $ED_i^{Upstream}$.[14] Machinery, which is at the bottom of the $ED_i^{Upstream}$ ranking and records a top position for ED_i, and Food and Beverages, which records a top position in the ranking of $ED_i^{Upstream}$ and a bottom position for ED_i. According to our computation, Food and

sectors. It is also worth mentioning that the above evidence of a positive effect of financial development stemming from upstream sectors is confirmed when we calculate upstream and downstream effects by means of the inverse Leontief purchases and sales matrices elements and, therefore, consider indirect IO effects, that is upstream and downstream higher order effects, spilling from suppliers of a sector's supplier and from buyers of a sector's buyer and so on. Results are shown in Table A7 in Appendix A for the baseline model including all upstream and downstream sectors. In the paper we have decided to analyse the first tier effect because, when the elements of the Leontief matrices are considered, the own sector effect is not easily identifiable out of the upstream and downstream effects, which, moreover, turn to be highly correlated with the own sector effect. More details on the calculation of inverse Leontief purchases and sales matrices and on the identification of direct and indirect IO effects are available in Acemoglu et al. (2016).

[13] Table A10 in Appendix A shows complete first stage results and, at the bottom, reports satisfactory values also for partial R-squares.

[14] Indeed, the rank correlation between the two measures is equal to −0.34 - the simple correlation is equal to −0.36 - and this corroborates the view that neglecting the indirect effect through a sector's interconnections with suppliers delivers an underestimated and biased picture of the role of finance for industry growth.

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Beverages should grow 2.72 percentage points faster than Machinery in Italy - the country at the 75th percentile of the financial development distribution - than in Mexico - the country at the 25th percentile of the financial development distribution - thanks to the impact of financial development on its upstream sectors, but it should grow 2.16 percentage points slower due to the direct effect of financial development. In this case, the indirect effect more than counterbalances the direct one, thus revealing the importance of the potential bias due to neglecting the IO linkages.

In sum, our results suggest the importance of network effects among industries in the analysis of the growth-enhancing role of finance. The understanding of the industrial growth process and the contribution of finance cannot disregard the consideration of the IO linkages. The latter, indeed, are not only statistically, but even economically significant for the explanation of the finance-growth nexus. In this respect, our findings support the recent strand of literature which highlights how network effects are essential to understand the propagation and amplification of a wide variety of shocks, from natural disasters (Barrot and Sauvagnat, 2016) to increased competition (Acemoglu et al., 2016) to financial crisis and credit supply shock (Acemoglu et al., 2012; Alfaro and Garcia-Santana, 2017; Bigio and La'O, 2016; Dewachter et al., 2017). More specifically, we corroborate the view that IO linkages amplify the role of finance in economies. The interplay between the financial dependence of interrelated sectors and financial development may generate supply side productivity shocks which, as modeled by Acemoglu et al. (2016), propagate from upstream input providers to downstream buyers.

4.2. Robustness

We test the sensitivity of our baseline OLS results from column [5] of Table 1 to a number of checks. In Table 2 we show that results are robust when in column [1] we use raw growth rates without applying any cleaning procedure and when we adopt continuous growth rates, whether we winsorise them - column [2] - or not - column [3]. Results hold when in column [4] we cluster standard errors by country to account for potential correlation within countries and across sectors that could be induced by our IO based financial dependence measures, when we re-include the financial sector among the IO linkages in column [5], when we replace the values of *ED* by industry with the industry ranking in terms of financial dependence in column [6], and when in columns [7] and [8] we recalculate financial dependence on different sub-periods. Furthermore, results are unchanged when, rather than taking averages of downstream and upstream financial dependence, we average IO shares across countries in column [9], use IO linkages from the U.S. IO Table only in column [10] and when we use country-varying upstream and downstream financial dependence measures in column [11]. In the latter case, we include the non interacted measures of the country-sector specific upstream and downstream financial dependence in the model specification. In order to overcome the very high correlation between IO based financial dependence measures and their respective interactions with financial development in the baseline cross-section sample, we run the specification of column [11] on annual data with the inclusion of sector-year and country-year fixed effects and, for comparison, in column [12] we report the estimation of our baseline model with annual data. The number of observations is higher in this case, as we do not have information on IO linkages for all of the countries in the UNIDO data base.[15] The importance of upstream linkages is confirmed in all cases.

Furthermore, in Table 3 we use alternative measures of financial development and focus on all domestic credit delivered by financial institutions in column [1] and domestic credit delivered by banks to the private sector in column [2].[16] Whether we adopt a broader definition of financial development - as the one in column [1] - or a narrower - as the one from column [2] - baseline results are confirmed. Also, the same occurs when in column [3] we modify our sample composition in order to exclude BIC countries - that is Brazil, India and China - that in the period of our analysis have experienced unprecedented growth rates in and out the manufacturing sector.

As additional robustness checks, we inspect the possibility that our baseline evidence is a spurious one possibly driven by the omission of relevant factors in the empirical model specification. The higher growth of value added in financially dependent sectors could be fostered by other sources of comparative advantage other than the availability of a well developed financial sector. Hence, in column [4] and [5] we follow Rajan and Zingales (1998) and include the interaction of financial dependence with the level of countries' per capita GDP (WDI 2015) and the average years of schooling of working age population available from the Barro and Lee's Educational Attainment Dataset (Barro and Lee, 2013), respectively. First, industries' financial dependence in the United States could depend on the different industrial maturity stage of sectors and this, in turn, is strictly related to countries' development stages. Hence, by introducing the interaction between financial dependence and per capita GDP we aim at capturing any industry growth source which may simply be driven by a country's development stage. Second, a higher financial dependence of an industry could be highly correlated with its human capital intensity and, by the same token, higher financial development could be highly correlated with human capital endowment. Hence, as highly skill intensive sectors are expected to grow more where a higher endowment of human capital is available, we test whether the estimated effect of financial development is not spurious and actually driven by the omission of a control for human capital. For this reason, we include the interaction of a human capital proxy with the

[15] Botswana, Ecuador, Ethiopia, Iran, Jordan, Kenya Macao, Morocco and Mauritius are dropped from the sample of column [11]. It is worth mentioning that baseline results hold when upstream and downstream financial dependence measures are calculated as averages among the countries available in the UNIDO database only. Results are not shown for the sake of brevity, but they are available upon request.

[16] In Table A8 in the Appendix we show that our results are unchanged when we adopt further indicators of financial depth available from the World Bank Global Financial Indicators Database.

Table 2
Robustness I.

		Continuous Growth Rates		S.E. Cluster	Re-including Finance	ED_i	Time Span Fin.Dep		Average	USA	Country-Varying	
	No Cleaning	Winsorised	No Cleaning	Country	in IO Linkages	Rank	1995–2007	1990–1999	IO Shares	IO shares	$ED_i^{Downstream/Upstream}$	
											Annual Growth Rates	
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
$share_{ic\tau}$	−0.450***	−0.067***	−0.097***	−0.178***	−0.175***	−0.171***	−0.176***	−0.169***	−0.173***	−0.180***	−0.279***	−0.243***
	[0.158]	[0.025]	[0.029]	[0.045]	[0.034]	[0.034]	[0.033]	[0.034]	[0.033]	[0.034]	[0.087]	[0.048]
$ED_i \times FD_{c\tau}$	0.453	0.056*	0.088**	0.104**	0.101**	0.003**	0.076*	0.103*	0.102**	0.087	0.101**	0.101**
	[0.292]	[0.032]	[0.043]	[0.050]	[0.047]	[0.002]	[0.039]	[0.053]	[0.048]	[0.055]	[0.046]	[0.045]
$ED_i^{Downstream} \times FD_{c\tau}$	0.375	0.062	0.106	−0.168	−0.098	0.002	−0.101	−0.025	−0.045	−0.012		−0.098
	[0.837]	[0.161]	[0.186]	[0.276]	[0.194]	[0.002]	[0.210]	[0.299]	[0.181]	[0.166]		[0.198]
$ED_i^{Upstream} \times FD_{c\tau}$	0.813*	0.195**	0.182**	0.321**	0.264***	0.009**	0.314***	0.367***	0.301***	0.248**		0.264**
	[0.427]	[0.076]	[0.084]	[0.126]	[0.090]	[0.004]	[0.108]	[0.119]	[0.103]	[0.106]		[0.103]
$ED_{ic}^{Downstream} \times FD_{c\tau}$											−0.112	
											[0.122]	
$ED_{ic}^{Upstream} \times FD_{c\tau}$											0.143**	
											[0.067]	
$ED_{ic}^{Downstream}$											−0.093	
											[0.087]	
$ED_{ic}^{Upstream}$											0.275**	
											[0.101]	
Observations	503	503	503	503	503	503	503	503	503	503	4868	6008
R-squared	0.279	0.532	0.457	0.617	0.617	0.615	0.617	0.618	0.617	0.616	0.422	0.368
Fixed Effects												
Country	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N
Industry	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N
Country*Year	N	N	N	N	N	N	N	N	N	N	Y	Y
Industry*Year	N	N	N	N	N	N	N	N	N	N	Y	Y

* Significant at 10% level; ** significant at 5% level; *** significant at 1% level. Robust standard errors in brackets.
The dependent variable of columns [1]-[10] is the average annual growth of real value added of sector i in country c recorded in the time span between $t = 2007$ and $\tau = 1995$. In columns [11] and [12] the dependent variable is the yearly growth of real value added of sector i in country c between t and $\tau = t - 1$ observed over the period 1995–2007.
In column [2], we winsorise continuous annual growth rates at the 1% tails of their distribution. In column [6] we compute sectors' own, downstream and upstream financial dependence on the basis of the ranking of ED_i. In column [9] we compute downstream and upstream financial dependence on the basis of the average of IO shares across all the countries included in the OECD IO Tables and listed in Table A6, while in column [10] we compute them on the basis of the US IO shares from the same OECD IO Tables. In column [11] we exploit country-varying upstream and downstream financial dependence, and, as consequence, we include both these indicators non interacted and their interaction with $FD_{c\tau}$. In columns [11] and [12] we estimate a pooled model on annual growth rates, where the sectoral share of value added and FD refer to the period $t - 1$.

Table 3
Robustness II.

	Alternative FD_c Definition		Restricted Sample	Concurring Explanations							
	By Financial Sec.	Banks to Priv.	Exclusion of BIC	Per Capita GDP			Human Capital and FDI			Midpoint Growth Rate	
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]
$share_{ic\tau}$	−0.172***	−0.175***	−0.153***	−0.194***	−0.180***	−0.176***	−0.187***	−0.195***	−0.196***		
	[0.033]	[0.033]	[0.035]	[0.037]	[0.036]	[0.044]	[0.036]	[0.045]	[0.046]		
$ED_i \times FD_{c\tau}$	0.130***	0.102**	0.096*	0.084*	0.098*	0.134**	0.092*	0.130**	0.119**	0539	0923
	[0.048]	[0.051]	[0.050]	[0.051]	[0.054]	[0.054]	[0.049]	[0.057]	[0.057]	[0.585]	[0.567]
$ED_i^{Downstream} \times FD_{c\tau}$	0.009	−0.138	−0.079	0.044	0.066	−0.17	−0,01	−0,195	−0,026	2714	3984
	[0.202]	[0.210]	[0.203]	[0.211]	[0.212]	[0.220]	[0.236]	[0.263]	[0.256]	[2.553]	[2.587]
$ED_i^{Upstream} \times FD_{c\tau}$	0.291***	0.289***	0.282***	0.227**	0.272***	0.281***	0.286**	0.387***	0.346***	2.608*	4.671***
	[0.103]	[0.099]	[0.095]	[0.100]	[0.101]	[0.094]	[0.114]	[0.117]	[0.118]	[1.549]	[1.618]
$ED_i \times Control_{c\tau}$				0.006	0.024	0					
				[0.011]	[0.052]	[0.008]					
$ED_i^{Downstream} \times Control_{c\tau}$				−0.063	−0.306	0.018					
				[0.055]	[0.218]	[0.028]					
$ED_i^{Upstream} \times Control_{c\tau}$				0.009	−0.155	0.014					
				[0.024]	[0.096]	[0.014]					
$Sk_i \times HumanCapital_{c\tau}$							0.187**		0.153**	2.494***	
							[0.079]		[0.075]	[0.946]	
$Cap_i \times FDI_{c\tau}$								0006	0006	0018	
								[0.004]	[0.004]	[0.033]	
Observations	503	503	463	490	491	492	491	492	480	534	574
R-squared	0.62	0.617	0.588	0.623	0.63	0.613	0624	0609	0622	0,33	0375
Fixed Effects											
Country	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Industry	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

* Significant at 10% level; ** significant at 5% level; *** significant at 1% level. Robust standard errors in brackets.
The dependent variable of columns [1]–[9] is the average annual growth of real value added of sector i in country c recorded in the time span between $t = 2007$ and $\tau = 1995$. In columns [10] and [11] the dependent variable is the midpoint growth of real value added of sector i in country c recorded between $t = 2007$ and $\tau = 1995$.
In columns [1] and [2], the baseline *FD* indicator is replaced with the ratio of the domestic credit delivered by the financial sector over GDP and the credit to private sector from the banking sector over GDP, respectively (WBDI 2015). In columns [3] we exclude Brazil India and China from the estimation sample. In columns [5]–[6], the variable Control is represented by the log of GDP per capita (WBDI 2015), the log of average years of schooling as a proxy for countries' human capital endowment (Barro and Lee, 2013) and the FDI net inflows over GDP (WBDI 2015), respectively. Sk_i in column [7] represents the sectoral skill intensity (UNCTAD). Cap_i in column [8] represents the sectoral capital intensity (UNCTAD).

Table 4
Original Rajan&Zingales Database.

	Domestic Credit/GDP				Capitalization	Accounting Standards
	[1]	[2]	[3]	[4]	[5]	[6]
$share_{ic\tau}$	−0.852***	−0.835***	−0.873***	−0.889***	−0.899***	−0.634***
	[0.244]	[0.247]	[0.248]	[0.245]	[0.249]	[0.205]
$ED_i \times FD_{c\tau}$	0.054*			0.050*	0.027*	0.106***
	[0.028]			[0.028]	[0.016]	[0.027]
$ED_i^{Downstream} \times FD_{c\tau}$		0.072		−0.09	−0.005	−0.185
		[0.095]		[0.102]	[0.070]	[0.115]
$ED_i^{Upstream} \times FD_{c\tau}$			0.249***	0.257***	0.128***	0.206*
			[0.069]	[0.071]	[0.045]	[0.108]
Observations	1217	1217	1217	1217	1217	1067
R-squared	0.283	0.28	0.286	0.288	0.288	0.346
Fixed Effects						
Country	Y	Y	Y	Y	Y	Y
Industry	Y	Y	Y	Y	Y	Y

* Significant at 10% level; ** significant at 5% level; *** significant at 1% level. Robust standard errors in brackets.

financial dependence indicators in column [5]. Finally, we ascertain that financial development favours industrial growth through a well functioning domestic credit market rather than through the increased availability of external financial resources, made available to domestic producers possibly through Foreign Direct Investments (FDI). Indeed, the period of our analysis is characterised by an unprecedented upsurge in world FDI flowing from high to low income economies, especially, and which have contributed to the development of global supply chains and manufacturing growth in low and middle income economies (World Bank, 2017). Hence, in column [6] we introduce the interaction between our financial dependence measures and the ratio of FDI net inflows over GDP (WDI, 2015). In all cases, our baseline evidence is confirmed. To further exclude any potential growth effect from human capital and FDI which could differ across sectors, in column [7] we include the interaction of human capital with a measure of skill intensity by sector, in column [8] we add the interaction of FDI with a measure of capital intensity by sector and in column [9] we include both interactions.[17] Once again, our results are robust and financial development proves to be a robust determinant of industrial development across countries compared to other competing factors, among which human capital appears quite important as well. Finally, we inspect whether this finding is robust to the inclusion of emerging and disappearing sectors in our sample. To this purpose, in column [10] we substitute our left hand side variable with the midpoint growth rate and we find that, differently from the own sector effect, financial development mediated by upstream financial dependence favours entry into new sectors and/or hampers exit from the old ones regardless the competing role of human capital, which turns significant, and FDI which, instead, does not seem to matter.[18] In column [11], we report the midpoint growth model estimates for our baseline sample of countries and the evidence is corroborated.

As a final check on the validity and economic relevance of IO linkages in the propagation of the beneficial effects of financial development for industrial growth, we replicate the estimation of our model on the original database available from Rajan and Zingales (1998). We compute financial dependence from the COMPUSTAT sample for the 1980s to calculate financial dependence by industry and we further build upstream and downstream financial dependence measures for all sectors in the U.S. economy, on the basis of U.S. IO tables for the year 1987.[19] Then, we calculate and test their interaction with countries' financial development on Rajan and Zingales's sample. For the sake of comparability with our baseline findings, in columns [1]-[4] of Table 4 we first consider the specification with domestic credit over GDP as financial development indicator, while in column [5] and [6] we consider countries' capitalisation and accounting standards indicators available in the original database. In all cases we confirm that upstream financial dependence matters, as in our baseline model for the 1995–2007 period.

5. Channels and heterogeneity of the finance-growth nexus

After proving the robustness of our findings, in this section we investigate the channels through which financial development foster industries' growth. In addition, we analyze whether the positive direct and indirect average effects of financial development on the industry growth hide heterogeneity in the finance-growth nexus in two dimensions: the size of the financial sector and the time period under analysis.

[17] Sector level indicators are available from UNCTAD at *http://unctad.org/Sections/ditc$_t$ab/docs/RFII$_2$010$_E$xcel.zip*.

[18] The midpoint growth rate is calculated as follows: $midgrowth_{ict/\tau} = \frac{y_t - y_\tau}{0.5*(y_t + y_\tau)}$. As a consequence it varies between -2 and 2, taking value -2 for those country-sector pairs existing in τ and disappearing in t and 2 for those country-sector pairs absent in τ and existing in t.

[19] Note that COMPUSTAT samples and data are updated through the years, so that the 1980s sample at our disposal may differ from the one originally available to Rajan and Zingales (1998). Also, the lack of cross-country IO Tables for this period led us to use the Unites States as the benchmark economy for IO linkages too.

Table 5
Inspecting the Channels.

	[1]	[2]	[3]	[4]
$share_{ic\tau}$	-0.168^{***}	-0.183^{***}	-0.126^{***}	-0.137^{***}
	[0.036]	[0.035]	[0.035]	[0.031]
CapitalStockGrowth		0.018^{***}		0.026^{***}
		[0.005]		[0.006]
TFPGrowth			0.025^{***}	0.032^{***}
			[0.004]	[0.005]
$ED_i{}^{*}FD_{c\tau}$	0.130^{**}	0.123^{**}	0.074	0.049
	[0.057]	[0.055]	[0.054]	[0.050]
$ED_i^{Downstream} \times FD_{c\tau}$	−0.076	−0.209	−0.090	−0.289
	[0.280]	[0.269]	[0.274]	[0.257]
$ED_i^{Upstream} \times FD_{c\tau}$	0.313^{**}	0.322^{***}	0.260^{**}	0.259^{**}
	[0.128]	[0.124]	[0.131]	[0.124]
Observations	436	436	436	436
R-squared	0.637	0.661	0.687	0.734
Fixed Effects				
Country	Y	Y	Y	Y
Industry	Y	Y	Y	Y

* Significant at 10% level; ** significant at 5% level; *** significant at 1% level.
Robust standard errors in brackets. The dependent variable is the average annual growth of real value added of sector i in country c recorded in the time span between $t = 2007$ and $\tau = 1995$.

5.1. Inspecting the channels

In the early cross-country empirical literature on the finance-growth nexus, Beck et al. (2000) proved the existence of a fundamental role of financial development in sustaining growth by fostering total factor productivity (TFP) rather than capital accumulation. To inspect the channels through which financial development enhances growth of industries with different levels of financial dependence and with heterogeneous financial dependence of upstream industries, we include capital and TFP growth in our baseline model and inspect if and how the coefficients on our main right hand side regressors' magnitude and significance change. We expect that, if their effect works through any of these two channels their coefficients' size and significance should shrink or even disappear. Hence, we, first, calculate the capital stock of an industry by means of the perpetual inventory method (Berlemann and Wesselhoft, 2014)[20] and, then, following Beck et al. (2000), we calculate the industry level TFP.[21]

Table 5 shows how the coefficients associated to our variables of interest change when we include the growth of capital stock and TFP in our baseline model. It is worth mentioning that, when running this exercise, the number of observations drops from 503 to 436, due the lack of data on the capital stock and, consequently, on TFP for some country-industry pairs in our sample. For this reason we re-run the baseline model on this smaller sample and report the corresponding results in column [1]. In columns [2] and [3], we alternatively include the capital stock and the TFP growth. We find that while adding the former hardly affects our coefficients of interest, the inclusion of the TFP growth in the model totally absorbs the significance of the interaction between countries' financial development and an industry's own financial dependence. Also, we observe a mild contraction of the magnitude of coefficient on the interaction between financial development and the financial dependence of upstream industries which, nonetheless, remains significant. This evidence, then, corroborates our interpretation of financial development acting as a positive TFP shock and of linkages acting as an effective propagation mechanism of industry specific shocks.

Indeed, if financial development favours TFP growth disproportionately more in more financially dependent industries, these industries' goods will become cheaper and this sector specific effect will benefit downstream sectors that buy inputs from those industries. Hence, beyond the direct effect of financial development, mainly working through TFP growth, downstream industries can grow and expand their scale thanks to the effect of financial development on financially dependent input providers. The persistence of the significance on the upstream effect is, therefore, consistent with its working as a positive propagation effect affecting an industry's growth, beyond its specific TFP growth and/or capital accumulation (Acemoglu et al., 2016).

[20] We apply the perpetual inventory method on the basis of investment flows dating back to 1963.

[21] Assuming a Cobb-Douglas industry level production function with capital, K, labour, L and Hicks neutral technical progress, A:

$$Y = AK^{\alpha}L^{1-\alpha}$$
$$\frac{Y}{L} = A\frac{K}{L}^{\alpha}$$

Taking logs, we get TFP as: $\ln A = \ln y - \alpha \ln k$, with $y = \frac{Y}{L}$, $k = \frac{K}{L}$ and $\alpha = 1/3$.

Table 6
Non Linearities.

	Dummy High	Squared	High	Low
		Financial Development		
	[1]	[2]	[3]	[4]
$share_{ic\tau}$	−0.182***	−0.180***	−0.268**	−0.155***
	[0.034]	[0.035]	[0.106]	[0.037]
$ED_i \times FD_{c\tau}$	0.176**	0.346**	−0.088	0.185**
	[0.087]	[0.154]	[0.120]	[0.092]
$ED_i^{Downstream} \times FD_{c\tau}$	−0.485	−0.403	0.266	−0.478
	[0.440]	[0.884]	[0.787]	[0.454]
$ED_i^{Upstream} \times FD_{c\tau}$	0.656***	1.117***	0.078	0.690***
	[0.202]	[0.408]	[0.417]	[0.208]
$ED_i{}^*FD_{c\tau} \times D^{High\,FD}$	−0.063			
	[0.055]			
$ED_i^{Downstream} \times FD_{c\tau} \times D^{High\ FD}$	0.273			
	[0.268]			
$ED_i^{Upstream} \times FD_{c\tau} \times D^{High\ FD}$	−0.295**			
	[0.123]			
$ED_i \times FD_{c\tau}^2$		−0.189*		
		[0.097]		
$ED_i^{Downstream} \times FD_{c\tau}^2$		0.179		
		[0.606]		
$ED_i^{Upstream} \times FD_{c\tau}^2$		−0.642**		
		[0.283]		
Observations	503	503	130	373
R-squared	0.621	0.621	0.752	0.571
Fixed Effects				
Country	Y	Y	Y	Y
Industry	Y	Y	Y	Y
Test $\beta^{High} = \beta^{Low}$				6.58
P-Value				0.01

* Significant at 10% level; ** significant at 5% level; *** significant at 1% level. Robust standard errors in brackets. $D^{High\,FD}$ is a dummy taking value one when $FD_{c\tau}$ is higher than 85% - the upper quartile value - and taking value zero otherwise. Columns [3] and [4] report the estimation of the baseline model for countries with a financial development value above and below the 75th percentile, respectively.

5.2. Non-linearities

An increasing number of studies have provided evidence of the Tobin's conjecture that financial development is not always beneficial for economic growth. Rioja and Valev (2004) find that an increase of financial development has a positive and strong impact on the rate of growth of countries that are at an intermediate level of financial development, while it has small or no effects in countries at low and high levels of financial development. Easterly et al. (2000), Deidda and Fattouh (2002), Cecchetti and Kharroubi (2012), Law and Singh (2014) and Arcand et al. (2015), have documented that the effect of additional lending on GDP growth rate and volatility become negative when the ratio between private-sector credit and GDP exceeds a certain threshold (typically between 80–120%). In particular in the context of the Rajan and Zingales' (1998)) model, Manganelli and Popov (2013) show that where the ratio of private credit to GDP exceeds a 60% threshold financially dependent industries grow less than industries less dependent on external finance.[22]

In the same vein, in Table 6 we inspect whether the growth rate of industries dependent on external finance and linked to financially dependent upstream industries always benefits of the financial development or whether the latter loses importance after a certain threshold and possibly harms relatively more the industries in need (or linked to sectors in need) of external finance. In order to do this, we build a dummy taking value one for the upper quartile of the distribution of the ratio of domestic credit over GDP - domestic credit over GDP higher than 85% - and taking value zero otherwise and interact it with our financial dependence indicators. Results from column [1] in the Table show that the coefficients on the interactions with both own and upstream financial dependence are negative and the latter is also significant.

This evidence is confirmed in column [2] when we include the square of the financial development indicator. Both coefficients on $ED_i \times FD_c^2$ and $ED_i^{Upstream} \times FD_c^2$ are statistically significant and negative, thus corroborating the existence of a

[22] In a related vein, Ductor and Grechyna (2015) find that in countries where the financial sector grows much more rapidly than industrial sectors the contribution of financial development to real GDP growth is negative, while Cecchetti and Kharroubi (2015) find that higher financial growth unambiguously decreases economic growth and, in particular, those industrial sectors that make greater use of intangible assets and R&D.

Table 7
Before and after 2000.

	Continuous Presence between					
	1995–2007			1995–1999 or 2000–2007		
	1995–1999	2000–2007	2000–2007	1995–1999	2000–2007	2000–2007
			IO 2000			IO 2000
	[1]	[2]	[3]	[4]	[5]	[6]
$share_{ic\tau}$	−0.168*	−0.146***	−0.146***	−0.172**	−0.135***	−0.135***
	[0.096]	[0.042]	[0.042]	[0.075]	[0.042]	[0.042]
$ED_i{}^*FD_{c\tau}$	0.085	0.103***	0.102**	0.125	0.063*	0.063*
	[0.107]	[0.040]	[0.040]	[0.077]	[0.034]	[0.034]
$ED_i^{Downstream} \times FD_{c\tau}$	0.16	−0.219	−0.203	0.216	−0.129	−0.121
	[0.488]	[0.191]	[0.195]	[0.376]	[0.156]	[0.159]
$ED_i^{Upstream} \times FD_{c\tau}$	0.181	0.314***	0.317***	0.173	0.284***	0.290***
	[0.237]	[0.093]	[0.095]	[0.185]	[0.079]	[0.082]
Observations	503	503	503	704	632	632
R-squared	0.384	0.666	0.666	0.361	0.616	0.616

* Significant at 10% level; ** significant at 5% level; *** significant at 1% level. Robust standard errors in brackets. The dependent variable is the average annual growth of real value added of sector i in country c recorded in the time span between $t = 1999$ and $\tau = 1995$ in columns [1] and [4] and between $t = 2007$ and $\tau = 2000$ in the remaining columns.

non monotonic direct and indirect effects of financial development on industry growth. The threshold of the ratio between private credit and GDP above which the contribution of a further expansion of credit to industry growth is negative depends on the degree of industries' own and upstream financial dependence values and slightly varies across sectors, ranging from 89% to 87%, with higher thresholds observed for sectors with lower own financial dependence but higher upstream financial dependence. These ratios fall in the 80–120% range documented by previous studies.

Finally, we run separate estimates for countries above and below the 75th percentile threshold (columns [3] and [4]), and we find that the evidence is driven by countries below the threshold. Once again, we confirm that after a certain threshold level, finance may lose its beneficial effects.

5.3. Banking crises and productivity slowdown

In this Section we examine whether the positive average effects of financial development on the growth rates of industries that are dependent on external finance and buy inputs from financially dependent industries hold for the whole period or whether the relationship between finance and industry growth varies according to the period under analysis. More specifically, we consider two sub-periods, 1995–1999 and 2000–2007. On the one hand, the former sub-period is characterised by a high incidence of credit-boom episodes and banking crises,[23] that have been considered the reason behind the disappearance of the positive cross-country effects of financial deepening on GDP growth rates in the 1990s (Rousseau and Watchel, 2011) and the strong contraction of financially dependent industries in financially developed countries (Kroszner et al., 2007; Pagano and Pica, 2012). On the other hand, the 2000–2007 sub-period has been characterised by a productivity growth slowdown (or even decline) in many advanced economies (Jones, 2017). Among the determinants of this generalised slowdown in the TFP, capital misallocation produced by fast growing financial sectors disproportionally lending to firms with high collateral, but not necessarily high productivity, seems to have had a great influence (Borio et al., 2015; Cecchetti and Kharroubi, 2015; Dias et al., 2015; Gopinath et al., 2017; Gorton and Ordoñez, 2016).

Table 7 reports regression results by sub-periods. In columns (1)-(3) we consider the sample of industry-country pairs which are present for the whole 1995–2007 period, while in columns (4)-(6) we enlarge the sample and consider those industry-country pairs which have a continuous presence either in the 1995–1999 sub-period or in the 2000–2007 one. In columns (1)-(2) and (4)-(5), $ED^{Downstream}$ and $ED^{Upstream}$ are measured considering IO linkages at 1995, while in columns (3) and (6) the IO linkages are the ones prevailing in 2000. Consistent with the banking-crisis hypothesis, we find that financial development has no significant effect on the industry growth during the period 1995–1999.[24] By contrast, in the period 2000–2007 the impact of financial development on sectoral growth has been positive and significant, and this effect is associated both to the external-finance dependence of the sector and to the external-finance dependence of input suppliers.

[23] According to the Laeven and Velencia (2012) dating, during the period 1995–1999 there were 34 systemic banking crises in 33 different countries (plus 7 crises in 1993 and 11 in 1994), while between 2000 and 2007 the crisis episodes were only 4.

[24] The same result holds if we consider the period 1990–1999. Results are available upon request.

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6. Conclusion

For the first time, in this paper we have studied the role of IO linkages in amplifying the positive effect of countries' financial development on the growth of manufacturing sectors. We have extended the Rajan and Zingales's (1998) empirical country-sector growth model by including the interaction of upstream and downstream sectors' financial dependence with countries' financial development. In a cross-section of countries at different development stages, observed in the time span 1995–2007, we replicate Rajan and Zingales's (1998) original result and, more importantly, we further show that the development of domestic financial markets favours disproportionately more the growth of sectors whose upstream providers are more dependent on external finance. On the contrary, we do not find any evidence of significant effects through the downstream linkages. The beneficial indirect effect of financial development propagating from upstream input providers is higher in magnitude than the direct effect mediated by sectors' own financial dependence. This evidence is in line with the existing findings on the magnification of different kinds of shocks by the working of network linkages, which, in the end, engender a higher magnitude effect than direct effects (Acemoglu et al., 2016; Barrot and Sauvagnat, 2016; Bigio and La'O, 2016). Also, the evidence on the relevance of upstream linkages only, is consistent with the productivity enhancing role of financial development, firstly documented by Beck et al. (2000) and confirmed in our framework, which propagates, from upstream suppliers to downstream buyers, through the decline in the price of inputs (Acemoglu et al., 2016). For the first time, in this paper we have studied the role of IO linkages in amplifying the positive effect of countries' financial development on the growth of manufacturing sectors. We have extended the Rajan and Zingales's (1998) empirical country-sector growth model by including the interaction of upstream and downstream sectors' financial dependence with countries' financial development. In a cross-section of countries at different development stages, observed in the time span 1995–2007, we replicate Rajan and Zingales's (1998) original result and, more importantly, we further show that the development of domestic financial markets favours disproportionately more the growth of sectors whose upstream providers are more dependent on external finance. On the contrary, we do not find any evidence of significant effects through the downstream linkages. The beneficial indirect effect of financial development propagating from upstream input providers is higher in magnitude than the direct effect mediated by sectors' own financial dependence. This evidence is in line with the existing findings on the magnification of different kinds of shocks by the working of network linkages, which, in the end, engender a higher magnitude effect than direct one (Acemoglu et al., 2016; Barrot and Sauvagnat, 2016; Bigio and La'O, 2016). Also, the evidence on the relevance of upstream linkages only, is consistent with the productivity enhancing role of financial development, firstly documented by Beck et al. (2000) and confirmed in our framework, which propagates, from upstream suppliers to downstream buyers, through the decline in the price of inputs (Acemoglu et al., 2016).

Our results have proved to be robust to the control for potential endogeneity issues, alternative measures of sectoral growth, financial development and sectoral external dependence as well as to the control for competing explanatory and, possibly, confounding factors which may affect sectoral growth across countries, such as the development stage, the initial human capital endowment and the inflow of foreign capital.

We have further extended the well established non linearity in the relationship between growth and finance to the effects stemming from IO linkages and we have corroborated the disappearance of the nexus in the 90s, where several banking crisis occurred.

Our work highlights that neglecting the role of the propagation effects of finance, so as triggered by IO linkages, delivers a biased view on the role of finance for growth.

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Appendix A

Table A1
Number of Countries by Sector.

Sector	Freq.	Percent	Cum.
Food and beverages	37	7.36	7.36
Textiles, Clothing and Footwear	38	7.55	14.91
Wood and Wood products	34	6.76	21.67
Paper, Paper Products, Publishing and Printing	36	7.16	28.83
Chemicals and Chemical Products	34	6.76	35.59
Rubber and Plastic Products	36	7.16	42.74
Non Metallic Mineral Products	35	6.96	49.7
Metals	33	6.56	56.26
Metal Products	32	6.36	62.62
Machinery	35	6.96	69.58
Office, Radio TV, Precision and Medical Eq.	33	6.56	76.14
Electrical Machineries	33	6.56	82.7
Motor Vehicles	34	6.76	89.46
Other Transport Equipments	18	3.58	93.04
Furniture and Manufacturing nec	35	6.96	100
Total	503	100	

Table A2
Countries in Sample.

Country	Freq.	Percent	Cum.
Austria	14	2.78	2.78
Brazil	12	2.39	5.17
Botswana	3	0.6	5.77
Canada	13	2.58	8.35
Chile	10	1.99	10.34
China	14	2.78	13.12
Colombia	14	2.78	15.9
Costa Rica	10	1.99	17.89
Cyprus	12	2.39	20.28
Czech Republic	14	2.78	23.06
Denmark	14	2.78	25.84
Ecuador	14	2.78	28.63
Spain	15	2.98	31.61
Ethiopia	12	2.39	34
Finland	15	2.98	36.98
Great Britain	15	2.98	39.96
Honk Kong	7	1.39	41.35
Hungary	14	2.78	44.14
India	14	2.78	46.92
Ireland	13	2.58	49.5
Iran	15	2.98	52.49
Israel	14	2.78	55.27
Italy	15	2.98	58.25
Jordan	14	2.78	61.03
Kenya	7	1.39	62.43
Korea	15	2.98	65.41
Latvia	15	2.98	68.39
Macao	4	0.8	69.18
Morocco	14	2.78	71.97
Mexico	15	2.98	74.95
Malta	12	2.39	77.34
Mauritius	12	2.39	79.72
Netherlands	14	2.78	82.5
Norway	15	2.98	85.49
Singapore	15	2.98	88.47
Slovak Republic	14	2.78	91.25
Slovenia	15	2.98	94.23
Sweden	14	2.78	97.02
Turkey	15	2.98	100
Total	503	100	

Table A3
Descriptive Statistics.

Variable	Obs	Mean	Std. Dev.	Min	Max
$growth_{ict/\tau}$	503	0.091	0.076	−0.083	0.431
$share_{ic\tau}$	503	0.071	0.078	0.000	0.758
$ED_i{}^*FD_{c\tau}$	503	−0.199	0.160	−1.093	−0.012
$ED_i^{Downstream} \times FD_{c\tau}$	503	−0.029	0.027	−0.151	0.000
$ED_i^{Upstream} \times FD_{c\tau}$	503	−0.078	0.061	−0.345	−0.004

Table A4
Correlations among the main variables.

	$growth_{ic\,2007/1995}$	$share_{ic\,1995}$	$ED_i{}^*FD_{c\,1995}$	$ED_i^{Downstream} * FD_{c\ 1995}$	$ED_i^{Upstream} * FD_{c\ 1995}$
$growth_{ic\,2007/1995}$	1				
$share_{ic\,1995}$	−0.247	1			
$ED_i{}^*FD_{c\,1995}$	0.233	−0.0032	1		
$ED_i^{Downstream} * FD_{c\ 1995}$	0.1585	0.1169	0.6194	1	
$ED_i^{Upstream} * FD_{c\ 1995}$	0.1544	0.1396	0.3487	0.4131	1

503 observations.

Table A5
External Dependence Indicators.

ISIC	Rajan and Zingales (1998)	Kroszner et al. (2007)	$ED_{1990-2007}$
311	0.14	−0.15	−0.04
313	0.08	0.03	0.06
314	−0.45	−1.14	−1.63
321	0.4	0.01	−0.05
322	0.03	−0.21	0.05
323	−0.14	−0.95	−0.98
324	−0.08	−0.74	−0.18
331	0.28	0.05	0.07
332	0.24	−0.38	−0.35
341	0.18	−0.35	−0.15
342	0.2	−0.42	−0.41
352	0.22	−0.3	−0.26
353	0.04	−0.02	−0.04
354	0.33	0.13	−0.18
355	0.23	−0.02	−0.01
356	1.14	−0.02	−0.04
361	−0.15	−0.41	−0.28
362	0.53	0.03	−0.05
369	0.06	−0.29	−0.30
371	0.09	0.05	−0.04
372	0.01	−0.12	−0.18
381	0.24	−0.25	−0.26
382	0.45	−0.04	0.02
383	0.77	0.24	0.29
384	0.31	−0.08	0.08
385	0.96	0.72	0.70
390	0.47	0.28	0.38
3211	−0.09	−0.05	−0.05
3411	0.15	−0.07	−0.15
3511	0.25	−0.19	−0.24
3513	0.16	0.03	−0.12
3522	1.49	2.43	2.39
3825	1.06	0.54	0.50
3832	1.04	0.7	0.62
3841	0.46	0.38	0.44
3843	0.39	0.06	0.01

Data for computing external dependence for the 1990–2005 period are from COMPUSTAT. Authors' calculations.

Table A6
Countries in the OECD IO Sample.

Argentina	France	Netherlands
Australia	UK	Norway
Austria	Greece	New Zealand
Belgium	Honk Kong	Philippines
Bulgaria	Croatia	Poland
Brazil	Hungary	Portugal
Canada	Indonesia	Pomania
Switzerland	India	Russian Fed.
Chile	Ireland	Singapore
China	Iceland	Slovak Rep.
Colombia	Israel	Slovenia
Costa Rica	Italy	Sweden
Cyprus	Cambodia	Thailand
Czech Republic	Korea	Tunisia
Germany	Lithuania	Turkey
Denmark	Latvia	Taiwan
Spain	Mexico	USA
Estonia	Malta	Vietnam
Finland	Malaysia	South Africa

Table A7
Considering the Inverse Leontief Matrix Elements.

	[1]	[2]	[3]
$share_{ic\tau}$	−0.185***	−0.175***	−0.177***
	[0.034]	[0.033]	[0.034]
$ED_i \times FD_{c\tau}$	0.025	−0.018	−0.034
	[0.051]	[0.049]	[0.056]
$ED_i^{Downstream} \times FD_{c\tau}$	0.026		0.018
	[0.031]		[0.031]
$ED_i^{Upstream} \times FD_{c\tau}$		0.562**	0.540**
		[0.252]	[0.250]
Observations	503	503	503
R-squared	0.61	0.614	0.614
Fixed Effects			
Country	Y	Y	Y
Industry	Y	Y	Y

* Significant at 10% level; ** significant at 5% level; *** significant at 1% level. Robust standard errors in brackets.

Table A8
Further Financial Development Indicators .

	Private credit by deposit money banks to GDP	Deposit money banks' assets to GDP	Deposit money bank assets to deposit money and central bank assets	Liquid liabilities to GDP	Financial system deposits to GDP	Nr of Listed Companies in 1 million inhab.	Bank Deposits over GDP
	[1]	[2]	[3]	[4]	[5]	[6]	[7]
$share_{ic\tau}$	−0.178***	−0.179***	−0.172***	−0.182***	−0.181***	−0.177***	−0.183***
	[0.033]	[0.033]	[0.035]	[0.033]	[0.033]	[0.043]	[0.034]
$ED_i{*}FD_{c\tau}$	0.107**	0.105**	0.018	0.133**	0.113**	0.030**	0.128**
	[0.051]	[0.046]	[0.124]	[0.055]	[0.057]	[0.013]	[0.061]
$ED_i^{Downstream} \times FD_{c\tau}$	−0.238	−0.194	−1.506**	−0.225	−0.262	−0.076	−0.302
	[0.257]	[0.226]	[0.583]	[0.264]	[0.275]	[0.060]	[0.302]
$ED_i^{Upstream} \times FD_{c\tau}$	0.356***	0.300***	0.622**	0.319**	0.280**	0.053*	0.314**
	[0.124]	[0.109]	[0.278]	[0.133]	[0.137]	[0.029]	[0.149]
Observations	503	503	463	489	488	487	474
R-squared	0.617	0.617	0.624	0.609	0.612	0.625	0.609
Fixed Effects							
Country	Y	Y	Y	Y	Y	Y	Y
Industry	Y	Y	Y	Y	Y	Y	Y

* Significant at 10% level; ** significant at 5% level; *** significant at 1% level. Robust standard errors in brackets. The dependent variable is the average annual growth of real value added of sector i in country c recorded in the time span between $t = 2007$ and $\tau = 1995$.

Table A9
Robustness - Industry *ED* aggregated across US firms.

	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
$share_{ic\tau}$	−0.239***	−0.249***	−0.263***	−0.258***	−0.183***	−0.178***	−0.172***	−0.184***
	[0.035]	[0.034]	[0.036]	[0.035]	[0.034]	[0.033]	[0.032]	[0.034]
$ED_i^{Aggregate} * FD_{c\tau}$	0.111***			0.044**	0.051			0.076*
	[0.020]			[0.022]	[0.045]			[0.046]
$ED_i^{Downstream\ Aggregate} \times FD_{c\tau}$		0.315***		0.084		−0.087		−0.106
		[0.054]		[0.065]		[0.099]		[0.101]
$ED_i^{Upstream\ Aggregate} \times FD_{c\tau}$			0.192***	0.133***			0.202**	0.251***
			[0.027]	[0.034]			[0.085]	[0.085]
Observations	503	503	503	503	503	503	503	503
R-squared	0.115	0.108	0.142	0.151	0.61	0.61	0.613	0.617
Fixed Effects								
Country	N	N	N	N	Y	Y	Y	Y
Industry	N	N	N	N	Y	Y	Y	Y

* Significant at 10% level; ** significant at 5% level; *** significant at 1% level. Robust standard errors in brackets. The dependent variable is the average annual growth of real value added of sector i in country c recorded in the time span between $t = 2007$ and $\tau = 1995$.

Table A10
IV Estimates - First Stage Results.

	$ED_i \times FD_{c\tau}$	$ED_i^{Downstream} \times FD_{c\tau}$	$ED_i^{Upstream} \times FD_{c\tau}$
	[1]	[2]	[3]
$share_{ic\tau}$	0.04	−0.006	−0.017
	[0.033]	[0.007]	[0.013]
$ED_i \times rule_{c\tau}^{law}$	0.191***	−0.001	0.002
	[0.023]	[0.003]	[0.006]
$ED_i^{Downstream} \times rule_{c\tau}^{law}$	−0.005	0.201***	−0.014
	[0.071]	[0.018]	[0.028]
$ED_i^{Upstream} \times rule_{c\tau}^{law}$	−0.01	−0.004	0.205***
	[0.038]	[0.008]	[0.020]
$ED_i \times legal_{c\tau}^{uk}$	0.385***	−0.001	−0.003
	[0.073]	[0.010]	[0.018]
$ED_i \times legal_{c\tau}^{fr}$	0.145**	−0.003	−0.0002
	[0.069]	[0.009]	[0.018]
$ED_i \times legal_{c\tau}^{so}$	0.08	−0.001	−0.002
	[0.075]	[0.010]	[0.020]
$ED_i \times legal_{c\tau}^{ge}$	0.232***	0.0003	−0.001
	[0.060]	[0.008]	[0.016]
$ED_i^{Downstream} \times legal_{c\tau}^{uk}$	−0.065	0.359***	0.004
	[0.232]	[0.057]	[0.094]
$ED_i^{Downstream} \times legal_{c\tau}^{fr}$	−0.062	0.150***	−0.003
	[0.206]	[0.056]	[0.091]
$ED_i^{Downstream} \times legal_{c\tau}^{so}$	−0.083	0.049	0.008
	[0.233]	[0.062]	[0.103]
$ED_i^{Downstream} \times legal_{c\tau}^{ge}$	−0.044	0.212***	0.021
	[0.187]	[0.050]	[0.083]
$ED_i^{Upstream} \times legal_{c\tau}^{uk}$	0.02	−0.002	0.340***
	[0.118]	[0.024]	[0.061]
$ED_i^{Upstream} \times legal_{c\tau}^{fe}$	−0.022	−0.005	0.155***
	[0.113]	[0.024]	[0.059]
$ED_i^{Upstream} \times legal_{c\tau}^{so}$	−0.005	−0.002	0.070
	[0.126]	[0.027]	[0.065]
$ED_i^{Upstream} \times legal_{c\tau}^{ge}$	0.025	0.004	0.218***
	[0.101]	[0.022]	[0.052]
Observations	503	503	503
R-squared	0.929	0.919	0.935
F-Test	18.63	33.47	27.64
Partial R^2	0.43	0.47	0.43

* Significant at 10% level; ** significant at 5% level; *** significant at 1% level. Country and industry fixed effects included in each specification.

References

Acemoglu, D., Akcigit, U., Kerr, W., 2016. Networks and the macroeconomy: an empirical exploration. NBER Macroecon Annu 30 (1), 273–335.
Acemoglu, D., Antràs, P., Helpman, E., 2007. Contracts and technology adoption. Am Econ Rev 97 (3), 916–943.
Acemoglu, D., Carvalho, V.M., Ozdaglar, A., Tahbaz-Salehi, A., 2012. The network origins of aggregate fluctuations. Econometrica 80 (5), 1977–2016.
Acemoglu, D., Johnson, S., Mitton, T., 2009. Determinants of vertical integration: financial development and contracting costs. Journal of Finance 64 (3), 1251–1290.
Alfaro, L., Garcia-Santana, M., 2017. Credit Supply Shocks, Network Effects,and the Real Economy. Working Paper. Harvard Business School.
Arcand, J., Berkes, E., Panizza, U., 2015. Too much finance? Journal of Economic Growth 20 (2), 105–148.
Barro, R., Lee, J.-W., 2013. A new data set of educational attainment in the world, 1950–2010. J Dev Econ 104, 184–198.
Barrot, J.-N., Sauvagnat, J., 2016. Input specificity and the propagation of idiosyncratic shocks in production networks. Quarterly Journal of Economics 131 (3), 1543–1592.
Bartelme, D., Gorodnichenko, Y., 2015. Linkages and Economic Development. NBER Working Papers, 21251. National Bureau of Economic Research, Inc.
Beck, T., Demirguc-Kunt, A., Levine, R., 2003. Law and finance: why does legal origin matter? J Comp Econ 31 (4), 653–675.
Beck, T., Levine, R., 2002. Industry growth and capital allocation: does having a market- or bank-based system matter? J financ econ 64, 147–180.
Beck, T., Levine, R., Loayza, N., 2000. Finance and the sources of growth. J financ econ 58 (1–2), 261–300.
Berlemann, M., Wesselhoft, J., 2014. Estimating aggregate capital stocks using the perpetual inventory method. a survey of previous implementations and new empirical evidence for 103 countries. Review of Economics 64, 1–34.
Bigio, S., La'O, J., 2016. Financial frictions in production networks. NBER Working Papers, 22212. National Bureau of Economic Research, Inc.
Borio, C., Kharroubi, Upper, C., Zampolli, F., 2015. Labour reallocation and productivity dynamics: financial causes, real consequences. BIS Working Papers, 534. Bank for International Settlements.
Carvalho, V.M., 2014. From micro to macro via production networks. Journal of Economic Perspectives 28 (4), 23–48.
Cecchetti, S., Kharroubi, E., 2012. Reassessing the impact of finance on growth. BIS Working Papers, 381. Bank for International Settlements.
Cecchetti, S., Kharroubi, E., 2015. Why does financial sector growth crowd out real economic growth? BIS Working Papers, 490. Bank for International Settlements.
Cetorelli, N., Gambera, M., 2001. Banking market structure, financial dependence and growth: international evidence from industry data. Journal of Finance 56 (2), 617–648.
Ciccone, A., 2002. Input chains and industrialization. Rev Econ Stud 69 (3), 565–587.
Deidda, L., Fattouh, B., 2002. Non-linearity between finance and growth. Econ Lett 74 (3), 339–345.
Demirguc-Kunt, A., Feyen, E., Levine, R., 2013. The evolving importance of banks and securities markets. World Bank Econ Rev 27 (3), 476–490.
Dewachter, H., Tielens, J., Van Hove, J., 2017. Credit Supply Shock Propagation and Amplification in the Real Economy: Firm-Level Evidence. mimeo. KU Leuven.
Di Giovanni, J., Levchenko, A.A., Mejean, I., 2014. Firms, destinations and aggregate fluctuations. Econometrica 82 (4), 1303–1340.
Dias, D.A., Marques, C.R., Richmond, C., 2015. Misallocation and Productivity in the Lead Up to the Eurozone Crisis. International Finance Discussion Papers, 1146. Board of Governors of the Federal Reserve System.
Ductor, L., Grechyna, D., 2015. Financial development, real sector, and economic growth. International Review of Economics & Finance 37 (3), 393–405.
Easterly, W., Islam, R., Stiglitz, J., 2000. Explaining growth volatility. WB Working Papers. World Bank.
Fadinger, H., Ghiglino, C., Teteryatnikova, M., 2016. Income Differences and Input-Output Structure. CEPR Discussion Papers, 11547. C.E.P.R. Discussion Papers.
Fisman, R., Love, I., 2003. Trade credit, financial intermediary development, and industry growth. Journal of Finance 58 (1), 353–374.
Fisman, R., Love, I., 2007. Financial dependence and growth revisited. J Eur Econ Assoc 5 (2–3), 470–479.
Fleming, M., 1955. External economies and the doctrine of balanced growth. Economic Journal 65 (June), 241–256.
Gopinath, G., Kalemli-Ozcan, S., Karabarbounis, L., Villegas-Sanchez, C., 2017. Capital allocation and productivity in south europe. Quarterly Journal of Economics 132 (4), 1915–1967.
Gorton, G., Ordoñez, G., 2016. IGood booms, bad booms. NBER Working Papers, 22008. National Bureau of Economic Research.
Hirschman, A.O., 1958. The strategy of economic development. New Haven, CT: Yale University Press.
Javorcik, B.S., 2004. Does foreign direct investment increase the productivity of domestic firms? in search of spillovers through backward linkages. American Economic Review 94 (3), 605–627.
Jones, C., 2011. Intermediate goods and weak links in the theory of economic development. American Economic Journal: Macroeconomics 3 (2), 1–28.
Jones, C.I., 2017. The Productivity Growth Slowdown in Advanced Economies. ECB Forum on Central Banking 2017. European Central Bank.
Kroszner, R., Laeven, L., Klingebiel, D., 2007. Banking crises, financial dependence, and growth. J financ econ 84 (1), 187–228.
La Porta, R., de Silanes, F.L., Shleifer, A., 2008. The economic consequences of legal origins. J Econ Lit 46 (2), 285–332.
La Porta, R., de Silanes, F.L., Shleifer, A., Vishny, R., 1998. Law and finance. Journal of Political Economy 106 (6), 1113–1155.
Laeven, L., Velencia, F., 2012. Systemic Banking Crises: An Update. IMF Working Paper, 12/163. International Monetary Fund.
Law, S.H., Singh, N., 2014. Does too much finance harm economic growth? Journal of Banking & Finance 41 (April), 36–44.
Levine, R., 2005. Finance and Growth: Theory and Evidence. In: Aghion, P., Durlauf, S. (Eds.), Handbook of Economic Growth. Elsevier, Amsterdam, pp. 865–934. Volume 1, chapter 12
Manganelli, S., Popov, A., 2013. Financial dependence, global growth opportunities, and growth revisited. Econ Lett 120, 123–125.
Pagano, M., Pica, G., 2012. Finance and employment. Economic Policy 27 (3), 5–55.
Rajan, R.G., Zingales, L., 1998. Financial dependence and growth. American Economic Review 88 (3), 559–586.
Rioja, F., Valev, N., 2004. Does one size fit all? a reexamination of the finance and growth relationship. J Dev Econ 74 (2), 429–447.
Rousseau, P.L., Watchel, P., 2011. What is happening to the impact of financial deepening on economic growth? Econ Inq 49 (1), 276–288.
Scitovsky, T., 1954. Two concepts of external economies. Journal of Political Economy 62 (2), 143–151.
Tobin, J., 1984. On the efficiency of the financial system. Lloyds Bank Review 153, 1–15.
World Bank, 2017. Measuring and analyzing the impact of GVCs on economic development. Technical Report. World Bank Group, Washington, D.C.

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