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Why does financial sector growth crowd out real economic growth?

Stephen G Cecchetti and Enisse Kharroubi*

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Abstract

In this paper we examine the negative relationship between the rate of growth of the financial sector and the rate of growth of total factor productivity. We begin by showing that by disproportionately benefiting high collateral/low productivity projects, an exogenous increase in finance reduces total factor productivity growth. Then, in a model with skilled workers and endogenous financial sector growth, we establish the possibility of multiple equilibria. In the equilibrium where skilled labour works in finance, the financial sector grows more quickly at the expense of the real economy. We go on to show that consistent with this theory, financial growth disproportionately harms financially dependent and R&D-intensive industries.

Keywords: Growth, financial development, credit booms, R&D intensity, financial dependence

JEL classification: D92, E22, E44, O4

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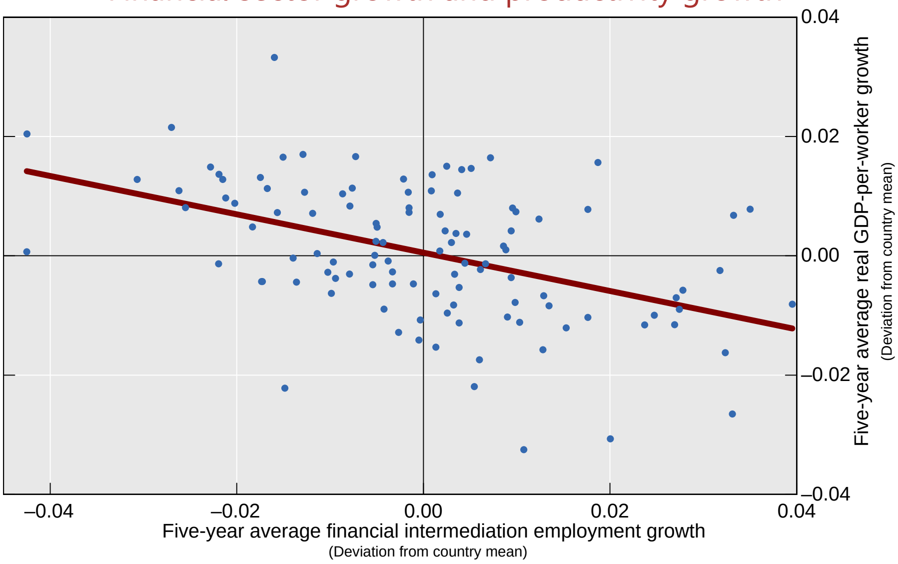
1. Introduction

In an earlier paper, we investigated how financial development affects aggregate productivity growth and concluded that the level of financial development is good only up to a point, after which it becomes a drag on growth, and that a fast-growing financial sector is detrimental to aggregate productivity growth (Cecchetti and Kharroubi 2012). This second result is summarised in Graph 1, which plots the five-year average GDP-per-worker growth on the vertical axis and the five-year average growth in the financial sector's share in total employment on the horizontal axis (both as deviations from their country means).

Graph 1
Financial sector growth and productivity growth[1]



[1] Graphical representation of $\Delta y_{i,t+5,t} = \alpha_i + \gamma \Delta fd_{i,t+5,t} - \delta y_{i,t} + \varepsilon_{i,t}$ for a sample of countries over the period 1980–2009, where $y_{i,t}$ is the log of output per worker in country i in year t; $\Delta y_{i,t+5,t}$ is the average growth in output per worker in country i from time t to $t+5$; $\Delta fd_{i,t+5,t}$ is the average growth in financial intermediation employment share in country i from time t to $t+5$; β_i is a vector of country dummies; and $\varepsilon_{i,t}$ is a residual. Country sample: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Korea, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom and the United States.

Sources: Cecchetti and Kharroubi (2012), Graph 5.

As we show in the earlier paper, the result that financial booms are a drag on growth is robust to the inclusion of a wide variety of conditioning variables.[1] Moreover, the effects are economically significant. For example, specifically, we establish that if, over the 2005 to 2009 period, Irish financial

[1] This result holds in particular when the initial *level* of financial development – i.e. financial sector size – is controlled for. This paper therefore stresses that the debate on finance and growth should move from the relationship between the level of finance development and growth (see Levine 1997, 2005 for detailed surveys) to the relationship between the growth of finance and economic growth.

sector employment had been flat rather than growing 4.1% per year, it would have shaved 1.4 percentage points off of the –2.7% productivity decline.

The purpose of this paper is to examine why financial sector growth harms real growth. We begin by constructing a model in which financial and real growth interact, and then turn to empirical evidence. In our model, we first show how an exogenous increase in financial sector growth can reduce total factor productivity growth.[2] This is a consequence of the fact that financial sector growth benefits disproportionately high collateral/low productivity projects. This mechanism reflects the fact that periods of high financial sector growth often coincide with the strong development in sectors like construction, where returns on projects are relatively easy to pledge as collateral but productivity (growth) is relatively low.

Next, we introduce skilled workers who can be hired either by financiers to improve their ability to lend, increasing financial sector growth, or by entrepreneurs to improve their returns (albeit at the cost of lower pledgeability).[3,4] We then show that when skilled workers work in one sector it generates a negative externality on the other sector. The externality works as follows: financiers who hire skilled workers can lend more to entrepreneurs than those who do not. With more abundant and cheaper funding, entrepreneurs have an incentive to invest in projects with higher pledgeability but lower productivity, reducing their demand for skilled labour. Conversely, entrepreneurs who hire skilled workers invest in high return/low pledgeability projects. As a result, financiers have no incentive to hire skilled workers because the benefit in terms of increased ability to lend is limited since entrepreneurs' projects feature low pledgeability.[5] This negative externality can lead to multiple equilibria. In the equilibrium where financiers employ the skilled workers, so that the financial sector grows more rapidly, total factor productivity growth is lower than it would be had agents coordinated on the equilibrium where entrepreneurs attract the skilled labour.[6] Looking at welfare, we are able to show that, relative to the social optimum, financial booms in which skilled labour work for the financial sector, are sub-optimal when the bargaining power of financiers is sufficiently large.

[2] Building on Pagano (1993), we model changes in financial sector growth as changes in financial transaction costs.

[3] Goldin and Katz (2008) document the spectacular ascendancy of finance amongst (male) Harvard graduates in the 1990s and the 2000s.

[4] See Philippon (2007) for a model where human capital is allocated between entrepreneurial and financial careers, and where entrepreneurs can innovate but face borrowing constraints that financiers can help to alleviate. Cahuc and Challe (2009) also develop an analytical model focusing on the allocation of workers between financial intermediation and production sectors in the presence of asset price bubbles. However, none of these papers is concerned with growth.

[5] In the extreme case where the return to high productivity projects is not pledgeable at all, there is then no benefit for financiers to hire skilled workers since this would increase the ability to lend to entrepreneurs who are simply unable to borrow.

[6] See Baumol (1990) and Murphy et al. (1991) for early contributions showing how the allocation of talent may be inefficient in the presence of rent seeking activities and the implications for growth.

Turning to the empirical results, we move beyond the aggregate results in Graph 1 and examine industry-level data. Here we focus on manufacturing industries and find that industries that are in competition for resources with finance are particularly damaged by financial booms. Specifically, we find that manufacturing sectors that are either R&D-intensive or dependent on external finance suffer disproportionate reductions in productivity growth when finance booms. That is, we confirm the results in the model: by draining resources from the real economy, financial sector growth becomes a drag on real growth.

The remainder of the paper is divided into four parts, followed by a brief conclusion. In Sections 2 and 3, we describe the model that guides our thinking about the relationship between growth in the financial sector and growth in the real sector. In the simpler model of Section 2, financial sector growth is exogenous and we examine some comparative statics. The more complex model, in which there is skilled labour and the growth rate of the financial system is endogenous, is developed in Section 3. This model exhibits multiple equilibria. We study those equilibria and examine their welfare ordering. Then, in Section 4, we move to the empirical analysis. Building on the seminal paper by Rajan and Zingales (1998), we study 33 manufacturing industries in 15 advanced economies. We find unambiguous evidence for very large effects of financial booms on industries that either have significant external financing needs or are R&D-intensive. We report estimates that imply that a highly R&D-intensive industry located in a country with a rapidly growing financial system will experience productivity growth of something like 2 percentage points per year less than an industry that is not very R&D-intensive located in a country with a slow-growing financial system.

2. The simple model

To show how financial sector growth can become a drag on real growth we begin by constructing a model with two groups of agents, financiers and entrepreneurs. Half the entrepreneurs have access to high-productivity, while the other half can only engage in low-productivity projects. But, mirroring the real world where high-productivity projects are inherently riskier and more difficult to finance, we assume that these entrepreneurs are less able to pledge their future returns as collateral to potential financiers. That is, high-productivity projects are less tangible than low productivity projects. Furthermore, financiers face a cost of recovery in the case a borrower defaults. When this cost of recovery falls, financiers lend more, raising the growth rate of finance. But, this financial sector growth favours the low productivity/high collateral sector, thereby reducing total factor productivity growth.

The remainder of this section starts with the general setup, before proceeding to derive the quantity and price of borrowing, the resulting profits, and finally the growth rate of the economy.

2.1 The general framework, returns and pledgeability

Consider a small open economy with a unit mass of agents. Half the agents are entrepreneurs and the other half are financiers. Entrepreneurs and financiers each have an endowment at time t labelled e_t and f_t respectively. (We will ignore time subscripts before we get to the growth section.)

Agents live for a single period with non-overlapping generations. At the beginning of each period, entrepreneurs make borrowing decisions and financiers make lending decisions. At the end of each period, entrepreneurs reap returns from investments and repay their loans. Financiers do the same. Profits are then divided between consumption and savings, with the latter constituting the endowment of the next generation at the beginning of the next period.

At the beginning of each period, an equal number of entrepreneurs are assigned to one of two types of projects, which we label a and b with gross return $R_a>R_b>1$. In addition to the projects differing in their rates of return (type a greater than type b), they also vary based on the extent to which the return can be pledged as collateral for a loan. But the return that can be pledged is less than 1. Denoting the pledgeable return to type i projects ρ_i, we have $\rho_i<1<R_i$. Furthermore, we assume, realistically, that the high-productivity projects are more difficult to pledge, $\rho_A<\rho_B$.[7,8]

Turning to financiers, they can store their endowment from one period to the next, but obtain no return. That is, storing one unit at the beginning of a period yields one unit at the end of the period. Moreover, they face no pledgeability constraint, so they can borrow from the rest of the world at the world opportunity cost of capital which is normalised to one. Furthermore, each financier is matched randomly at the beginning of each period with one entrepreneur.

2.2 Borrowing

To continue, denote the gross cost per unit of borrowing and the amount of borrowing (both to be determined in equilibrium) as r_l and d, respectively. Now an entrepreneur will only borrow if the cost of borrowing is less than the return. That is, so long as $r_l \leq R_i$. When this is the case, the entrepreneur borrows as much as possible up to the limit imposed by the pledgeability constraint. This constraint ensures that the entrepreneur will be better off paying back than defaulting.

To determine this level of borrowing, note that an entrepreneur assigned a type i project who repays a loan of size d, will have profit equal to $(e+d)R_i - r_l d$. That is, the endowment (e) plus the amount

[7] The model is completely deterministic, but mirrors a risk-neutral case with unlimited liability.

[8] See Holmström and Tirole (1997) for a micro-foundation of the pledgeable return based on the existence of ex ante moral hazard.

borrowed *(d)* times the project return *(R_i)* minus the repayment *($r_l d$)*. (We ignore the time subscripts until the section on growth.)

Conversely, a defaulting entrepreneur will have return equal to $(e+d)(R_i-\rho_i)$ – the size of the project $(e+d)$ times the difference between the return (R_i) and the portion pledged (ρ_i). Furthermore, in the event of default, the financier recovers a fraction p of the loan. So, in the event of default, the entrepreneur's profit equals $(e+d)(R_i-\rho_i) - pr_l d$. Looking at this expression, we see that defaulting pays less when either pledgeability (ρ_i) is high or the financier recoups a larger fraction of the loan (p is high).

Comparing the profit with and without default, we can write the no-default constraint as

(1) $$(e+d)R_i - r_l d \geq (e+d)(R_i - \rho_i) - pr_l d\,.$$

Turning to the financier, we assume that recovering a fraction p of the loan made to a defaulting entrepreneur, costs the financier $c\ln\left(\frac{1}{1-p}\right)$ where c is a positive scalar.[9] The optimal choice for p is then the solution to this simple maximization problem:

(2) $$\max_p \; pr_l d - c\ln\left(\frac{1}{1-p}\right)d\,.$$

which yields $(1- p^*)\, r_l=c$. Substituting this into (1), the no-default constraint is

(3) $$d_i \leq \left(\frac{\rho_i}{c-\rho_i}\right)e \text{ for } i=a,b$$

As an aside, note that this expression is always positive. That is, $c>\rho_a,\ \rho_b$. If it were not, the inequality in (1) would always be strict. That is the entrepreneur would never default.

To continue, given that (3) binds when the cost of borrowing is less than the project return, and that entrepreneurs would never borrow if the cost of borrowing were to exceed the project return, an entrepreneur assigned a type i project with an endowment **e** will borrow an amount

(4) $$d_i^* = \left(\frac{\rho_i}{c-\rho_i}\right)e\text{, when } r_l \leq R_i \text{, and 0 otherwise.}$$

It will be useful later to note that c and d_i^* move in opposite direction. So, as the cost for the financier to recoup their loan in the case of default c falls, the level of borrowing d_i^* goes up.

9 See Aghion, Banerjee and Piketty (1999) for a similar modelling of the no-default constraint as solving for ex post moral hazard.

Furthermore, the increase in d_i^* for a given drop in c will be larger, the larger is ρ_i. So, in the event that there is financial innovation that improves the technology the financier has to recoup defaulted loans, this will drive up lending by more the more pledgeable the entrepreneurs' assets.

2.3 Profits and the cost of capital in equilibrium

Using the result in equation (4) we can write the type i entrepreneur's total return, π_i^e, as

(5) $$\pi_i^e = R_i e + (R_i - r_l)d_i^* = R_i e + (R_i - r_l)\left(\frac{\rho_i}{c-\rho_i}\right)e$$ when $r_l \leq R_b$ and 0 otherwise.

Turning to the financier, recall that their endowment is f, they can borrow as much as they want at unit cost, and that they are matched randomly with entrepreneurs. A financier lending to a type i entrepreneur will lend d_i^*, either borrowing $d_i^* - f$ if it is positive, or storing the difference if it is not. Using the result in equation (4), we can write the financier's total return π_i^f, as

(6) $$\pi_i^f = r_l d_i^* + (d_i^* - f) = f + (r_l - 1)\left(\frac{\rho_i}{c-\rho_i}\right)e$$, when $1 \leq r_l \leq R_i$, and 0 otherwise.

Note that for the first part of this expression to hold, it must be profitable for entrepreneurs to borrow and for financiers to lend. This is why the condition $1 \leq r_l \leq R_i$ must be satisfied.

We now turn to the determination of the equilibrium cost of capital. Following the literature on the determination wages on the labour market, we assume that the cost of capital is determined as the outcome of a bilateral bargaining game between one financier and one entrepreneur. Given that an i-type entrepreneur always earns $R_i e$ just by investing the initial endowment, and given that the financier has a costless storage technology, the cost of lending satisfies

(7) $$r_{l,i}^* = \arg\max_{r_l} \left[\pi_i^f - f\right]^\alpha \left[\pi_i^e - R_i e\right]^{1-\alpha}$$

where α denotes the bargaining power of the financier relative to that of the entrepreneur. The solution to (7) is the bargaining-power-weighted average of the return to the entrepreneur (=R_i) and that to the financier (=1)

(8) $$r_{l,i}^* = \alpha R_i + (1-\alpha).$$

The intuitive result is that the higher the bargaining power of the financier, α, the higher the cost of borrowing for entrepreneurs.

2.4 Growth

We now have all the elements necessary to examine the determinants of growth in this economy. Introducing time subscripts, we write the endowment of the entrepreneur at the beginning of period t as e_t. Recalling that half are assigned a type a project and half are assigned a type b project, the average total return of each entrepreneur is $\frac{1}{2}\left(\pi_a^e + \pi_b^e\right)$. Denoting s the saved fraction of profits, the dynamics of the entrepreneurs' endowment is

(9) $$e_{t+1} = s\frac{\pi_a^e + \pi_b^e}{2}e_t \,.$$

Using equations (5) and (8), this can be written as

(10) $$\frac{1}{s}\frac{e_{t+1}}{e_t} = \frac{R_a + R_b}{2} + (1-\alpha)\left[\frac{R_a - 1}{2}d_a^* + \frac{R_b - 1}{2}d_b^*\right]\frac{1}{e_t}$$

The expression for the evolution of the financiers' endowment is equivalent, and can be written as

(11) $$\frac{1}{s}\frac{f_{t+1}}{f_t} = 1 + \alpha\left[\frac{R_a - 1}{2}d_a^* + \frac{R_b - 1}{2}d_b^*\right]\frac{1}{f_t} \,.$$

Taken together, equations (10) and (11) characterise the growth rate of the aggregate economy. To see this, first denote $k_t = e_t + f_t$, the aggregate endowment (which we can think of as the level of capital in the economy). We can now write the growth rate of the economy as

(12) $$\frac{1}{s}\frac{k_t}{k_{t+1}} - 1 = \frac{e_{t+1} + f_{t+1}}{e_t + f_t} = \left[\left(\frac{R_a + R_b}{2} - 1\right)\left(1 + \frac{d_a^* + d_b^*}{2}\right) - \left(\frac{R_a - R_b}{2}\frac{d_b^* - d_a^*}{2}\right)\right]\frac{1}{e_t + f_t} \,.$$

The first term on the right-hand-side of (13), $\left(\frac{R_a + R_b}{2} - 1\right)\left(1 + \frac{d_a^* + d_b^*}{2}\right)$, equals the growth rate that the economy would experience if the two types of projects had identical pledgeability characteristics (if $\rho_a = \rho_b$). The second term, $\left(\frac{R_a - R_b}{2}\frac{d_b^* - d_a^*}{2}\right)$, adjusts for the fact that the two types of projects differ in their pledgeability and hence will support different levels of financings. It measures total factor productivity.

This leads us to the primary result:

A reduction in the cost, c, of recovering claims from defaulting entrepreneurs raises the growth rate of financiers but reduces aggregate total factor productivity by raising disproportionally investment in the low-productivity/high collateral projects.

To see this, first note from equation (11) the dynamics of the financiers' endowment, that since both d_a and d_b rise when c falls, this growth rate must increase. Second, turning to aggregate growth, note from equation (12) that total factor productivity moves inversely with the product $(R_a - R_b)(d_b^* - d_a^*)$ And recall from equation (4) that a decline in c drives up borrowing by more the higher ρ, so the difference $(d_b^* - d_a^*)$ will go up, driving aggregate productivity down.[10]

3. The model with skilled labour

The exercise in Section 2 is one in which changes in the growth rate of the financial sector, the real economy and, hence, total factor productivity are driven by changes in the exogenous parameter c that characterises the cost for financiers of recovering claims from defaulting borrowers. In this section, by introducing skilled labour that can be employed either by financiers to lower the cost *c* or by entrepreneurs to raise the return to investment *R*, we allow for endogenous changes in growth rates that depend on which sector employs skilled workers.

Following some preliminaries, we next derive the decentralised equilibrium of the economy, including the level of profits, the cost of capital and the wage rate for skilled workers. We then proceed to examine how this compares to the social optimum, showing how it can be inefficient, allocating too much skilled labour to finance. And finally, we examine the relationship of growth in finance to total factor productivity growth.

3.1 The framework

The economy is now populated by an equal number of entrepreneurs, financiers and skilled workers. Entrepreneurs can now choose to invest either in a type a or type b project. As is the case of the model of Section 2, type a are more productive but less pledgeable; so $R_a > R_b$, and $\rho_A < \rho_B$. Running a type a project requires hiring one skilled worker. Denoting the number of skilled workers hired by the entrepreneur as $L_e = \{0,1\}$ the return to the entrepreneur can be expressed as

(13) $$R(L_e) = R_b(1 - L_e) + R_a L_e ;$$

and the pledgeable return writes as

(14) $$\rho(L_e) = \rho_b(1 - L_e) + \rho_a L_e .$$

[10] Put another way, the impact of a change in c on the growth rate of the economy depends on the first derivative of d_a and d_b with respect to c. From equation (4) we see that this is negative. The second result depends on the second cross-partial derivative of d_a and d_b with respect to c and ρ, which is also negative.

Financiers can hire skilled workers. When they do, it reduces the cost of recovering claims from defaulting entrepreneurs. When this cost, c is lower, financiers can lend more, earning higher profits. As in the case of the entrepreneurs, financiers can chose to hire one skilled worker. When they do, the cost to recover claims on defaulting entrepreneurs falls from $\bar{c}$ to $\underline{c}$, where $\bar{c} > \underline{c}$. Denoting the number of skilled workers hired by the financier as $L_f=\{0,1\}$ the cost to recover claims on a defaulting entrepreneur can be expressed as

(15) $$c(L_f) = \bar{c}(1 - L_f) + \underline{c}L_f .$$

To complete the characterisation of the model, we turn to the timing of decisions and actions:

1. Entrepreneurs and financiers take a hiring decision and entrepreneurs choose a project type. The wage rate to be paid to skilled workers is then determined.
2. Entrepreneurs and financiers are randomly matched as was the case previously: each entrepreneur gets randomly matched with one financier, and the cost of borrowing is determined by the bargaining game between the two.
3. Hiring, lending/borrowing and investment decisions are executed.
4. Entrepreneurs reap their output, pay back financiers and skilled workers get paid by entrepreneurs or financiers depending on whom they worked for.
5. Agents make their consumption-saving decisions. A fraction s of final income is saved and becomes the next generation's initial endowment.

With this in hand, we now turn to the solution of the model.

3.2 The decentralised equilibrium

We solve for the equilibrium by backward induction, starting with the decisions taken within the match between an entrepreneur and a financier, assuming the decision to hire a skilled worker has already been taken. Then, after solving the decision taken within the match, we look at the decision to hire a skilled worker.

To do this, we begin by deriving expressions for the entrepreneur's and financier's profits prior to the payment of wages to the skilled workers. For the entrepreneur with endowment e, who hires L_e skilled workers and borrows from a financier that hires L_f skilled workers, this is

(16) $$\pi_e(L_e, L_f) = eR(L_e) + [R(L_e) - r_l]d(L_e, L_f) ,$$

where, as in (4),

$$d(L_e, L_f) = \frac{\rho(L_e)}{c(L_f) - \rho(L_e)} e$$

and r_l is the cost of capital such that $R(L_e) > r_l$.

For a financier with endowment f who hires L_f skilled workers and lends to an entrepreneur with endowment e, who hires L_e skilled workers, total returns prior to wage payments equal

(17) $$\pi_f(L_e, L_f) = f + [r_l - 1]d(L_e, L_f) .$$

where the cost of capital r_l satisfies $1 < r_l < R(L_e)$.

Using these two expressions we can now compute the equilibrium cost of capital from the bargaining game in the same way as in equation (7):

(18) $$r_l^*(L_e) = \arg\max_{r_l} \left[\pi_f(L_f) - f\right]^{\alpha} \left[\pi_e(L_e) - R(L_e)e\right]^{1-\alpha} .$$

And the solution is again

(19) $$r_l^*(L_e) = \alpha R(L_e) + (1 - \alpha) .$$

Looking at (19), we see immediately for the case in which a financier matched with an entrepreneur that hired a skilled worker the equilibrium cost of borrowing is higher. That is $r_l^*(1) > r_l^*(0)$.

Substituting (19) into (16) and (17) yields the entrepreneurs' and financiers' total return before wage payments:

(20) $$\begin{aligned} &\pi_e(L_e, L_f) = [R(L_e) + (1 - \alpha)(R(L_e) - 1)d(L_e, L_f)] \\ &and \\ &\pi_f(L_e, L_f) = f + \alpha(R(L_e) - 1)d(L_e, L_f) \end{aligned} .$$

Using the expressions in (20) we can compute the equilibrium wage rate offered to skilled workers. Assuming that the market for skilled workers is perfectly competitive, an entrepreneur's ability to pay a wage rate w_e and a financier's ability to pay a wage rate w_f depend on the additional profit the worker generates by hiring such a worker. An entrepreneur's profit before wage payment is $\pi_e(1, L_f)$ with a skilled worker and $\pi_e(0, L_f)$ without. Analogously, a financier who hires a skilled worker obtains profits before wages of $\pi_f(L_e, 1)$ and $\pi_f(L_e, 0)$ otherwise. Entrepreneurs' and financiers' ability to pay for skilled workers therefore satisfy the following conditions:

(21) $w_e(L_f) = \pi_e(1, L_f) - \pi_e(0, L_f)$ and $w_f(L_e) = \pi_f(L_e, 1) - \pi_f(L_e, 0)$.

Depending on which of these is higher, w_e or w_f, skilled workers will end up working either for the entrepreneurs or the financiers.

To continue, write the difference in the high and low return projects as $\Delta R = R_a - R_b$, the equivalent difference in pledgeability as $\Delta\rho = \rho_b - \rho_a$, and the difference between the high and low cost of recovering loans from defaulted borrowers as $\Delta c = \bar{c} - \underline{c}$. Furthermore, to simplify the algebra, we normalise $\Delta\rho = \Delta c$.[11] Using (20) and (21) we can derive the conditions for skilled labour to be hired by one sector or the other. Specifically, if $w_e(L_f = 0) > w_f(L_e = 1)$, then there is a decentralized equilibrium where entrepreneurs hire labour at the expense of financiers. Analogously, when $w_f(L_e = 0) \geq w_e(L_f = 1)$, the decentralised equilibrium is one in which financiers hire skilled labour.

Working this out, yields the following: skilled workers end up in the entrepreneurial sector if and only if

(22) $$(c^* - \alpha\rho_a)\frac{\Delta R}{R_b - 1} > \left[(1-\alpha) + \frac{\rho_a}{\underline{c} - \rho_a}\right]\Delta\rho,$$

where $c^* = \left(1 - \frac{\alpha\rho_a}{\underline{c} - \rho_a}\right)\bar{c} + \frac{\alpha\rho_a}{\underline{c} - \rho_a}\underline{c}$

Similarly, skilled workers are hired by financiers if and only if

(23) $$(\underline{c} - \alpha\rho_a)\frac{\Delta R}{R_b - 1} < \left[(1-\alpha) + \frac{\rho_b}{\underline{c} - \rho_b}\right]\Delta\rho.$$

To help understand these conditions, first note that an entrepreneur's ability to pay for skilled workers depends on whether the financier that the entrepreneur is matched with has hired one. The reason is that this affects the amount of capital the entrepreneur can raise from the financier. Interestingly, when the financier hires a skilled worker, this has two opposing effects on the wage rate an entrepreneur can offer to skilled workers. First, it raises w_e because entrepreneurs can now borrow more since the cost of recovery in default is lower. But it reduces the wage rate w_e because the increase in the borrowing capacity is lower when a skilled worker is hired since the entrepreneur then invests in a less pledgeable project. To see which of these dominates, we can compute

(24) $$w_e(L_f = 1) - w_e(L_f = 0) = \left[\rho_a\Delta R - \left(\frac{R_b - 1}{\underline{c} - \rho_b}\right)(\underline{c} + \rho_b)\Delta\rho\right]\frac{(1-\alpha)\Delta\rho}{(\underline{c} - \rho_a)(\bar{c} - \rho_a)}e.$$

[11] The parameters ρ and c play a similar role in the model: they both influence the financier's incentive to lend. This equivalence is our rationale for assuming $\Delta\rho = \Delta c$.

Looking at (24), we see that the entrepreneurs' ability to pay for skilled workers decreases with the number of skilled workers in the financial sector whenever the difference in pledgeability of type a and type b, $\Delta\rho = \rho_b - \rho_a$ is sufficiently large relative to the difference in returns, $\Delta R = R_a - R_b$. The result for financiers is similar: the financier's ability to pay for a skilled worker depends on whether she is matched with an entrepreneur that has hired one. The wage difference in these two cases is given by

(25) $$w_f(L_e = 1) - w_f(L_e = 0) = \left[\rho_a \Delta R - \left(\frac{R_b - 1}{\bar{c} - \rho_b} \right) \left(\bar{c} + \rho_b \frac{\bar{c} - \rho_a}{\underline{c} - \rho_b} \right) \Delta\rho \right] \frac{\alpha \Delta\rho}{(\underline{c} - \rho_a)(\bar{c} - \rho_a)} e$$

As was the case for the entrepreneurs, from (25) we can conclude that a financier's ability to pay for skilled workers decreases with the number of skilled workers in the entrepreneurial sector whenever the difference in pledgeability between the two types of projects is sufficiently large relative to the differences in returns. Importantly, if both entrepreneurs' and financiers' ability to pay skilled workers decreases when the other hires a skilled worker, there can be multiple equilibria. Indeed, for the equilibrium conditions (22) and (23) to hold simultaneously, we need

(26) $$\frac{\rho_a}{\underline{c} - \rho_a} < \frac{\underline{c} + \rho_b}{\rho_b}.$$

The condition in (26) is more likely to hold the less pledgeable type a projects are relative to type b, and the higher the cost of recovery for financiers when they do not hire skilled labour. That is, multiple equilibria are more likely the lower ρ_a, the higher ρ_b, and the higher $\underline{c}$. To understand why multiple equilibria arise here, recall that an entrepreneur's ability to pay for skilled labour depends on how many skilled workers are hired in the financial sector. The fewer skilled workers in finance, the higher the wage entrepreneurs will be able to offer. To put it differently, it is as if the more workers entrepreneurs hire, the higher the wage they can offer. And, what is true for entrepreneurs is true for financiers. This form of increasing returns arises from the fact there is a complementarity between the entrepreneur's pledgeability and the financier's cost of recovering in default: a higher plegdeability amplifies the benefits of a lower cost of recovering in default. The existence of increasing returns creates the potential for a labour market inefficiency that can lead to too many skilled workers being allocated to one sector or the other. With this in mind, we now turn to the computation of social optimum, which allows us to determine the conditions under which the labour market allocates skilled labour inefficiently.

3.2 The social optimum and inefficiency of the decentralised equilibrium

We now examine the socially optimal allocation of skilled labour across the two sectors. We start by defining the social welfare function, W, as the sum of the entrepreneur and financier total profit prior to wage payments,

(27) $$W(L_e, L_f) = \pi_e(L_e, L_f) + \pi_f(L_e, L_f).$$

Using the result from (21), we can write this as

(28) $$W(L_e, L_f) = f + \left[R(L_e) + (R(L_e) - 1)\right]d(L_e, L_f).$$

Maximizing (28) subject to $L_e + L_f = 1$ yields the social optimum.

To obtain the result, we compare social welfare when entrepreneurs hire skilled labour, $W(L_e = 1, L_f = 0)$, with the level when financier's do, $W(L_e = 0, L_f = 1)$. The two relevant expressions are given by

(29) $$\begin{aligned} &W(L_e = 1, L_f = 0) = R_a + (R_a - 1)\frac{\rho_a}{\underline{c} - \rho_a} \\ &and \\ &W(L_e = 0, L_f = 1) = R_b + (R_b - 1)\frac{\rho_b}{\underline{c} - \rho_b} \end{aligned}.$$

From this we conclude that it is socially optimal to allocate skilled labour to the financial sector, $W(L_e = 0, L_f = 1) > W(L_e = 1, L_f = 0)$, if and only if

(30) $$\frac{\Delta R}{R_b - 1} < \left(\frac{\Delta\rho}{\underline{c} + \Delta\rho}\right)\left(\frac{\underline{c} + \rho_b}{\underline{c} - \rho_b}\right).$$

When the inequality in (30) does not hold, the social optimum is one in which entrepreneurs hire skilled workers.

Finally, we turn to the comparison of the social optimum and the decentralised equilibrium. By the condition (30) with (23) we can see if there are times when the decentralised equilibrium inefficiently allocations labour to finance. The result is that this happens when α, the bargaining power of the entrepreneurs is sufficiently large.

To see this, note that the inefficiency occurs when both

(31) $$\frac{1}{\underline{c} + \Delta\rho}\frac{\underline{c} + \rho_b}{\underline{c} - \rho_b} \le \left(\frac{\underline{c}}{\underline{c} - \rho_b} - \alpha\right)\frac{1}{\underline{c} - \alpha\rho_b}$$

and

(32) $$\frac{1}{\underline{c}+\Delta\rho}\frac{\underline{c}+\rho_b}{\underline{c}-\rho_b} \leq \left(\frac{\underline{c}}{\underline{c}-\rho_a}-\alpha\right)\frac{1}{c^*-\alpha\rho_a}.$$

The first of these is where the socially optimal allocation of labour to finance is more restrictive than in the decentralised equilibrium. When this condition holds, there are cases where skilled labour is allocated to the financial sector while the economy as a whole would be better-off if skilled labour was allocated to entrepreneurs. The second condition is where the allocation of labour to entrepreneurs in the decentralised equilibrium is more restrictive than in the social optimum. This second condition ensures that skilled labour misallocation always happens to the detriment of entrepreneurs and in favour of financiers. Looking at (31) we can see that, given that the right-hand side of the inequality is increasing in α, the inequality holds when α is sufficiently large. Analogously, looking at (32) and noting that the right-hand side is increasing in α, the inequality holds when α is sufficiently large.

Intuitively, the larger the bargaining power of financiers, the more attractive is the financial sector compared to the entrepreneurial sector. Hence with a large bargaining power, the equilibrium where skilled workers work for the financiers is more likely, even though this implies that entrepreneurs carry out a type b project which is less productive.

3.3 Financial sector growth and total factor productivity growth

We now turn to growth. Following the notation of section 2.4, the initial endowments of entrepreneurs and financiers in period t are e_t and f_t, respectively; he economy's aggregate endowment is the sum of these two $k_t=e_t+f_t$; and the economy's saving rate is given by s. Defining the growth rate of the financial sector as $\Delta f_t = \frac{1}{s}\frac{f_t}{f_{t+1}}$, and using the expressions for total profits (21), combined with that for the equilibrium for the about of lending, we can write the dynamics of the financier's endowment as

(33) $$\Delta f_t(L_e, L_f) = 1+\alpha(R(L_e)-1)\left(\frac{\rho(L_e)}{c(L_f)-\rho(L_e)}\right)\frac{1}{f_t}.$$

For the economy as a whole, where the growth is $\Delta k_t = \frac{1}{s}\frac{k_t}{k_{t+1}}$, we have

(34) $$\Delta k_t(L_e, L_f) = 1+(R(L_e)-1)\left(\frac{c(L_f)}{c(L_f)-\rho(L_e)}\right)\frac{1}{e_t+f_t}.$$

We can use these two expressions to establish when the financial sector grows more quickly and when it grows more slowly. And, then look at how this relates to total factor productivity growth. On the first of these, compare equation (33) for the case where skilled labour is allocated to the entrepreneurial sector, $L_e = 1$ and $L_f = 0$, with the one where skilled workers are hired by financiers, $L_e = 0$ and $L_f = 1$. The result is that the financial sector grows more quickly, $\Delta f_t(L_e = 0, L_f = 1) > \Delta f_t(L_e = 1, L_f = 0)$, when

$$\text{(35)} \qquad \frac{\Delta R}{R_b - 1} < \frac{\underline{c} + \rho_b}{\underline{c} - \rho_b}\frac{\Delta\rho}{\rho_a}.$$

What this says is that if the difference in the pledgeability of the high and low return projects is large relative to their difference in return, then the financial sector grows more quickly.

Turning to total factor productivity growth, in the simpler model of section two, this was the weighted average of the projects undertaken by entrepreneurs. Unlike that case, here there is no composition effect since all entrepreneurs either hire skilled labour and engage in high-return (low pledgeability) projects or they do not and engage in low-return (high pledgeability) projects. From this, it immediately follows that total factor productivity growth is high when skilled labour is allocated to entrepreneurs and it is low when skilled labour is allocated to financiers.

With this in mind, we now look at the relationship between the condition for the decentralised equilibrium to be the one with skilled labour going to finance and the condition for the financial sector to grow more quickly. That is, we derive the condition under which (24) implies (36). This is the case when

$$\text{(36)} \qquad \left[\frac{(1-\alpha)\underline{c} + \alpha\rho_b}{\underline{c} - \rho_b}\right]\left(\frac{\Delta\rho}{\underline{c} - \alpha\rho_a}\right) < \frac{\underline{c} + \rho_b}{\underline{c} - \rho_b}\frac{\Delta\rho}{\rho_a}$$

This condition depends on relative bargaining power of the two parties in the wage negotiation game. To obtain intuition about the result, we look at the two extremes, $\alpha=0$ where entrepreneurs have all the power, and $\alpha=1$ where financiers do. In the first case, $\alpha=0$, the condition (36) holds so long as $\rho_a < \underline{c} + \rho_b$, which is always true. So, in the case where entrepreneurs are able to set wages unilaterally, high financial growth is associated with low economic growth.

Turning to the case where wages are set by financiers, when is $\alpha=1$, (36) simplifies to

$$\text{(37)} \qquad \frac{\rho_a}{\underline{c} - \rho_a} < \frac{\underline{c} + \rho_b}{\rho_b},$$

which is exactly the expression for the existence of multiple equilibria, (26).

From this we can conclude that when there are multiple equilibria, the one in which skilled workers are hired by financiers to reduce the cost of recovering claims from defaulting entrepreneurs will be have higher financial growth and lower real growth.

4. The empirical investigation

Two main conclusions emerge from the models of the previous two sections. First, at the aggregate level, financial sector growth is negatively correlated with total factor productivity growth. Second, this negative correlation arises both because financial sector growth disproportionately benefits to low productivity/high collateral sectors and because there is an externality that creates a possible misallocation of skilled labour. Our earlier paper, Cecchetti and Kharroubi (2012), provides empirical evidence for the first of these. We now turn to the second.

The model predicts that financial sector growth benefits disproportionately more to sectors with higher collateral. Given that collateral correlates negatively with the reliance on external finance, we posit that financial sector growth should benefit disproportionately less to industries with higher dependence on external finance. Next, the key to figuring out which sector are most likely to be damaged from financial sector growth requires that we look for the sectors that are competing with finance for inelastically supplied skilled labour. Given that financial sector growth is skilled-labour-intensive[12] and given that skill-intensive sectors are also R&D-intensive, this leads us to the hypothesis that R&D-intensive industries – aircraft, computing and the like – will be disproportionately harmed when the financial sector grows more quickly. By contrast, industries such as textiles or iron and steel, which have low R&D intensity, should not be adversely affected. Using these insights, we now provide a brief description of the data we use, before turning to the empirical specification, and finally to some results.

4.1 The data

Our analysis focuses on disaggregated data on productivity in manufacturing sectors from 15 advanced OECD countries. To get some sense of which sectors are being harmed by financial sector growth, we require two types of detailed data. The first measures financial sector growth and the second quantifies the extent to which an individual industry is competing with finance for resources. We now

[12] Philippon and Reshef (2009) provide empirical evidence that, over the past 30 years, the US banking industry has become relatively skilled-labour-intensive. Philippon and Reshef (2013) extend the analysis to cross-country data.

examine each of these in turn. Starting with financial sector growth, we consider two types of indicators. The first focuses on banks alone – the ratio of banking assets to GDP, for example -- and the second on the financial system more broadly – including measures such as total private credit to GDP. In each case, we compute the average growth rate from 2000 to 2008 for each of these. Graph 3 plots a set of six indicators for the 16 countries in our sample. Note that Japan has experienced negative growth for all the indicators considered. For Germany, growth is weak, with some indicators showing a modest rise and others a modest fall. Switzerland exhibits a virtually stable level of finance (remember that this is the growth rate, not the level of development). Unsurprisingly, Spain shows a strong boom that is invariant to the way it is measured. So far, this is as expected. What is surprising is the fact that there are the booms in Denmark and Sweden – larger, even, than those in the United Kingdom and the United States.[13]

Turning to industry-specific characteristics, we concentrate on two different indicators: industry external financial dependence and industry R&D intensity. We measure external financial dependence as the median ratio across firms belonging to the corresponding industry in the United States of capital expenditures minus current cash flow to total capital expenditures. And R&D intensity is the median ratio across firms belonging to the corresponding industry in the US of R&D expenditures to total value added. The financial dependence measure gives an indication of an industry's needs (or difficulties) in raising external finance and as such can be considered as a proxy for the borrowing constraints the industry could potentially face. By contrast, R&D intensity gives us an indication of reliance on skilled labour. For example, assets in more R&D-intensive industries are more likely to consist of labs filled with highly trained researchers and specialised equipment. Put differently, R&D-intensive industries demand highly skilled labour. We follow Rajan and Zingales (1998) in measuring industry characteristics using US data. This approach, which is forced on us by data availability, assumes that differences across industries are driven largely by differences in technology that are the roughly similar in all countries. Given that our sample is for advanced OECD economies with substantial cross-border trade, this seems an innocuous assumption.[14]

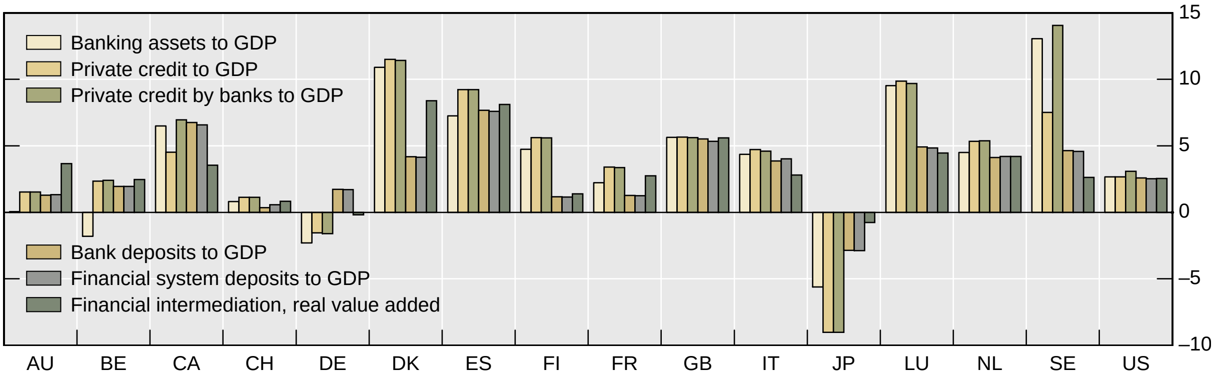
[13] See Greenwood and Scharfstein (2012) for a detailed analysis of financial sector growth in the US.

[14] More precisely, the working assumption is that the ranking of industries according to financial dependence or R&D intensity is country-invariant.

Graph 2

Financial sector growth in advanced economies

2000–08 average, in per cent



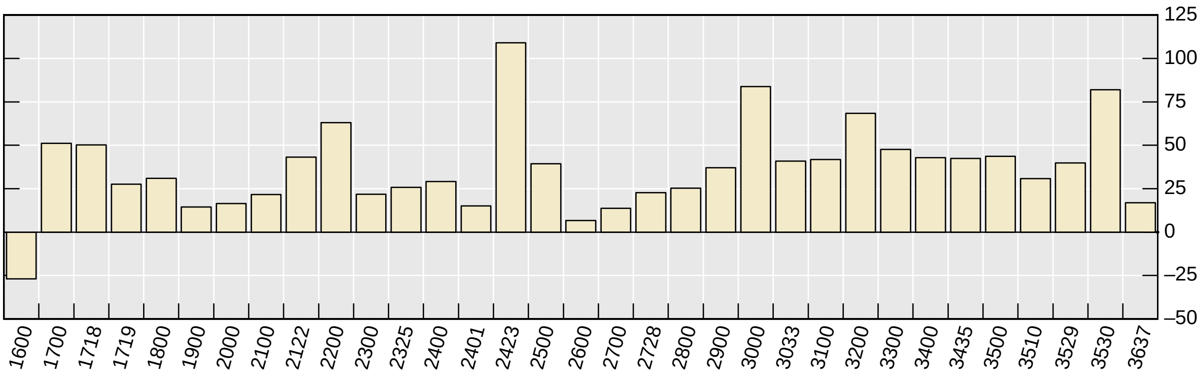
AU = Australia; BE = Belgium; CA = Canada; CH = Switzerland; DE = Germany; DK = Denmark; ES = Spain; FI = Finland; FR = France; GB = United Kingdom; IT = Italy; JP = Japan; LU = Luxembourg; NL = Netherlands; SE = Sweden; US = United States.

Sources: World Bank Financial Structure and Development database; authors' calculations.

Graph 3

Financial dependence in manufacturing industries[1]

In per cent



[1] Capital expenditure in excess of internal cash flows as a percentage of capital expenditure. For the meaning of the industry codes, see Appendix Table A1.

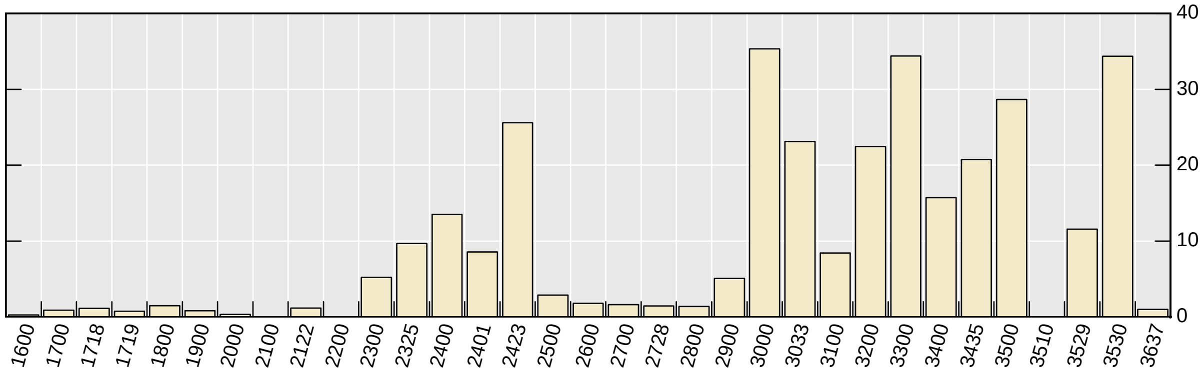
Sources: Raddatz (2006); authors' calculations.

Graphs 3 and 4 report the industry-level measures. Starting with external finance in the first of the two graphs, we measure financial dependence as the fraction of investment financed from external sources over the 1980–89 period. With the exception of tobacco (industry 1600), all the industries have internal cash flow that is insufficient to finance capital investment. And in only one other case, pharmaceuticals (industry 2423), is there investment in the presence of negative cash flow. For most of the remaining 31 manufacturing industries in our sample (listed in Appendix Table A1), financial dependence is less than 50%, meaning that the majority of capital expenditures is financed using internal funds. Turning to R&D intensity in Graph 5, the picture is somewhat different. (The correlation between the measures plotted in Graphs 4 and 5 is less than 0.7.) Here we plot the ratio of average R&D expenditure to value added for the period 1990–99. Looking at the graph, we can divide industries into two distinct groups: one with very low and one with very high R&D intensity. In the first group are tobacco (1800), textiles (1700), printing (2200), basic metals (2700) and shipbuilding (3510), while the second includes communications equipment (3200), medical instruments (3300) and aircraft industries (3530). In the latter group, R&D expenditures can be as large as one third of total value added. Note also that the size for these two groups is fairly different: out of the 33 industries in our sample, 22 display R&D expenditures of less than 10% of value added. By contrast, only three industries devote more than 30% of their value added to R&D expenditures.[15]

Graph 4

R&D intensity in manufacturing industries[1]

In per cent



[1] Ratio of R&D expenditure to total value added. For the meaning of the industry codes, see Appendix Table A1.
Sources: OECD Structural Analysis database; authors' calculations.

4.2 The empirical specification and the results

As in the previous two cases, our sample forms a panel. While there is a time dimension to our data – we use averages for the 2000–08 period – the variation comes across countries and industries. For the countries, data limitations mean sticking with the OECD. And for industries, we are restricted to manufacturing sectors. Following Rajan and Zingales (1998), the following regression allows us to test for the effects of interest:

(38) $$\frac{\ln(y_{ic}^{08}) - \ln(y_{ic})}{8} = \beta_i + \beta_c + \gamma c_i \times g_{fc} - \delta \ln\left(\frac{y_{ic}}{y_c}\right) + \varepsilon_{ic},$$

[15] Table A1 reports information on the external financial dependence and R&D intensity of the industries in the sample.

where the dependent variable is the average growth rate in labour productivity over the eight years from 2000 to 2008 in industry i of country c, measured as the ratio of industry real value added to industry total employment; β_i and β_c are industry and country fixed effects; $c_i \times g_{fc}$, the interaction variable of interest, is the product between industry i's intrinsic characteristic and country c's financial sector growth; and finally, we control for initial conditions by including the log ratio between labour productivity in industry i in country c and labour productivity in the overall manufacturing sector in country c at the beginning of the period, i.e. in 2000.[16,17]

We estimate equation (38) using a simple ordinary least squares (OLS) procedure, computing heteroskedasticity-consistent standard errors. This brings up the possibility of simultaneity bias. As noted earlier, the variable representing industry characteristics – financial dependence or R&D intensity – is based entirely on US data. This reliance on the United States mitigates the possibility of reverse causation, as it seems quite unlikely that industry growth outside the US is caused by the characteristics of industries in the US. In addition, as noted earlier, financial development growth is measured at the country level, whereas the dependent variable is measured at the industry level. Again, this reduces the scope for reverse causality as long as each individual industry represents a small share of total output in the economy.

As for the quantitative implications of these estimates, we ask what the difference in productivity growth is between a sector with low financial dependence located in a country whose financial system is growing slowly and a sector with high financial dependence located in a country whose financial system is growing rapidly, all else equal. The row labelled "Difference-in-difference effect" in Table 3 reports the results from this experiment. The estimates are roughly –2.5%, meaning that productivity of a financially dependent industry located in a country experiencing a financial boom tends to grow 2.5% a year slower than a financially independent industry located in a country not experiencing such a boom. This is quite a large effect, especially when compared with the unconditional sample mean and volatility of labour productivity growth of 2.1% and 4.3%, respectively. With regard to R&D intensity, the results in Table 4 are quite similar to those in Table 3. Again, industry labour productivity growth is significantly negatively correlated with the interaction term, this time measured as the product of industry R&D intensity and financial sector growth. Financial booms disproportionately

16 The choice of this time period has no significant implications for the results. It is, however, useful in dealing with possible reverse causality issues, as industry characteristics are measured during time periods prior to 2000. Data availability forces us to focus on manufacturing.

17 This methodology has been used to study, for example, implications of financial sector composition, bank- versus market-based, on industry growth (Beck and Levine (2002)) and how financial (under)development affects industry volatility (Raddatz (2006)).

harm highly R&D-intensive industries. Again, the results are fairly robust to the measure of financial sector growth, and the coefficient on the catch-up term is negative and close to that in Table 3.

Table 3

Industry productivity growth, financial dependence and financial development growth[1]

Dependent variable: labour productivity growth	(1)	(2)	(3)	(4)	(5)	(6)
Interaction (financial dependence and private credit to GDP growth)	**–1.145***** *(0.366)*					
Interaction (financial dependence and financial system deposits to GDP growth)		**–1.511***** *(0.524)*				
Interaction (financial dependence and private credit by banks to GDP growth)			**–1.004***** *(0.312)*			
Interaction (financial dependence and banking system deposits to GDP growth)				**–1.424***** *(0.510)*		
Interaction (financial dependence and banking assets to GDP growth)					**–-0.982***** *(0.339)*	
Interaction (financial dependence and growth in financial intermediation value added)						**–2.030*****
						(0.555)
Log of initial relative labour productivity	**–0.027*** *(0.014)*	**–0.026**** *(0.013)*	**–0.027*** *(0.014)*	**–0.026**** *(0.013)*	**–0.028**** *(0.014)*	**–0.027**** *(0.012)*
Difference-in-difference effect	**–2.53%**	**–2.63%**	**–2.83%**	**–2.53%**	**–2.74%**	**–2.81%**
Observations	335	335	335	335	335	349
R-squared	0.357	0.346	0.360	0.344	0.354	0.360

The dependent variable is the average annual growth rate in labour productivity per worker for the period 2000–08 for each industry in each country. Initial relative labour productivity is the ratio of industry labour productivity per worker to total manufacturing labour productivity per worker in 2000. Financial dependence is the median fraction of capital expenditures not financed with internal funds for US firms in the same industry for the period 1980–89. The interaction variable is the product of variables in parentheses. Robust standard errors are in parentheses. All estimations include country and industry dummies. Significance at the 1/5/10% level is indicated by ***/**/*.

[1] Country sample: Austria, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan, Luxembourg, the Netherlands, Spain, Sweden, Switzerland and the United Kingdom.

Sources: Raddatz (2006); OECD Structural Analysis database; World Bank Financial Structure and Development database; authors' calculations.

Table 4

Industry productivity growth, R&D intensity and financial development growth[1]

Dependent variable: labour productivity growth	(1)	(2)	(3)	(4)	(5)	(6)
Interaction (R&D intensity and private credit to GDP growth)	**–1.753***** *(0.590)*					
Interaction (R&D intensity and financial system deposits to GDP growth)		**–2.794***** *(0.937)*				
Interaction (R&D intensity and private credit by banks to GDP growth)			**–1.327***** *(0.502)*			
Interaction (R&D intensity and banking system deposits to GDP growth)				**–2.665***** *(0.912)*		
Interaction (R&D intensity and banking assets to GDP growth)					**–1.104*** *(0.568)*	
Interaction (R&D intensity and growth in financial intermediation value added)						**–3.560***** *(1.117)*
Log of initial relative labour productivity	**–0.032**** *(0.014)*	**–0.029**** *(0.013)*	**–0.030**** *(0.014)*	**–0.029**** *(0.013)*	**–0.030**** *(0.014)*	**–0.030**** *(0.012)*
Difference-in-difference effect	**–2.05%**	**–2.49%**	**–1.91%**	**–2.41%**	**–1.43%**	**–2.87%**
Observations	312	312	312	312	312	323
R-squared	0.349	0.347	0.344	0.345	0.334	0.359

The dependent variable is the average annual growth rate in labour productivity per worker for the period 2000–08 for each industry in each country. Initial relative labour productivity is the ratio of industry labour productivity per worker to total manufacturing labour productivity per worker in 2000. R&D intensity is the average for the ratio of R&D expenditures to value added for US industries for the period 1990–2000. The interaction variable is the product of variables in parentheses. Robust standard errors are in parentheses. All estimations include country and industry dummies. Significance at the 1/5/10% level is indicated by ***/**/*.

[1] Country sample: Austria, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan, Luxembourg, the Netherlands, Spain, Sweden, Switzerland and the United Kingdom.

Sources: OECD Structural Analysis database; World Bank Financial Structure and Development database; authors' calculations.

Comparing the results in Tables 3 and 4, it is fair to say that the latter are less robust. While all estimates of the coefficients on the interaction terms are clearly negative, in the case of R&D intensity the magnitude varies by a factor of more than 3 depending on the measure of financial sector growth. One reason for this could be the distribution of R&D intensity across industries. Because quite a few industries engage in virtually no R&D, the discriminatory power of the interaction term is likely to be low.

As far as the quantitative implications of these results are concerned, excluding the estimates in column 5, the difference-in-difference effect is estimated to be between –1.9 and –2.9%. That is to say, a sector with high R&D intensity located in a country whose financial system is growing rapidly grows between 1.9 and 2.9% a year slower than a sector with low R&D intensity located in a country whose financial system is growing slowly. This supports the conclusion we reached using the financial dependence variable: the effect is large.

4.3 Robustness

There is a variety of plausible alternative interpretations for our industry-level results. We examine four in some detail. First, there is the possibility that the negative impact of financial growth on industry-level productivity growth arises from the level of financial development itself. If financial sector growth and the level of financial development are negatively related (larger financial sectors tend to grow more slowly) and the size of the financial sector is positively related to industry productivity growth, then we would mistakenly attribute to financial sector growth a negative effect that in reality reflects the positive effect of the financial development level. Second, we look at the impact of monetary policy. Financial sector growth is likely to be related to the stance of monetary policy and the cost of capital: the more accommodative monetary policy and the lower the cost of capital, the faster the financial sector will grow. Since monetary policy is most accommodative during periods when aggregate growth is low, this raises the possibility that what we are finding is essentially monetary policy acting counter-cyclically. Third, there is the potential impact of fiscal policy. If fiscal deficits crowd out private credit extension, then again we could be confounding an aggregate cyclical policy with what we believe to be a cross-sectional effect. Lastly, it may be important to control for the extent to which the economy is actually a net importer of both capital and goods, as this could influence the availability of resources and have a differential impact on the productivity performance of more financially constrained sectors.

Appendix tables A2 and A3 present estimates for the coefficient on the interaction term in which a variety of variables are added to our baseline regression, equation (38). Overall, the results reported in the previous section are confirmed in terms of both statistical and economic importance. Financial sector growth is detrimental to industries that face tighter financial constraints or are more R&D-intensive. That said, we note several interesting secondary results: the productivity of industries with higher financial dependence has grown disproportionately faster in countries with tighter monetary policy (Appendix Table A2, column (3)); a higher cost of capital (Appendix Table A2, column (4)); or a more restrictive fiscal policy, measured as the ratio of the fiscal deficit to GDP (Appendix Table A3, column (8)). Likewise, the productivity of industries with higher R&D intensity has grown disproportionately faster in countries with tighter fiscal policy (Appendix Table A3, column (6)); or higher trade or current account balance (Appendix Table A3, columns (8) and (9)).

5. Conclusion

In this paper, we study the real effects of financial sector growth and come to two important conclusions. First, the growth of a country's financial system is a drag on productivity growth. That is, higher growth in the financial sector reduces real growth. In other words, financial booms are not, in general, growth-enhancing, likely because the financial sector competes with the rest of the economy for resources. Second, using sectoral data, we examine the distributional nature of this effect and find that credit booms harm what we normally think of as the engines for growth – those that are more R&D-intensive. This evidence, together with recent experience during the financial crisis, leads us to conclude that there is a pressing need to reassess the relationship of finance and real growth in modern economic systems.

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Table A1

Industry characteristics

Industry code[1]	Description	External financial dependence[2]	R&D intensity[3]
1600	Tobacco products	–27.00%	0.26%
1700	Textiles	51.08%	0.88%
1718	Textiles, textile products, leather and footwear	50.20%	1.12%
1719	Textiles and textile products	27.61%	0.73%
1800	Wearing apparel, dressing and dyeing of furniture	30.99%	1.47%
1900	Leather, leather products and footwear	14.50%	0.80%
2000	Wood and products of wood and cork	16.39%	0.31%
2100	Pulp, paper and paper products	21.64%	0.00%
2122	Pulp, paper, paper products, printing and publishing	43.18%	1.14%
2200	Printing and publishing	63.08%	0.00%
2300	Coke, refined petroleum products and nuclear fuel	21.80%	5.21%
2325	Chemical, rubber, plastics and fuel products	25.82%	9.67%
2400	Chemicals and chemical products	29.15%	13.51%
2401	Chemicals excluding pharmaceuticals	15.07%	8.55%
2423	Pharmaceuticals	109.10%	25.58%
2500	Rubber and plastics products	39.32%	2.86%
2600	Other non-metallic mineral products	6.68%	1.79%
2700	Basic metals	13.63%	1.60%
2728	Basic metals and fabricated metal products	22.73%	1.43%
2800	Fabricated metal products, except machinery and equipment	25.26%	1.35%
2900	Machinery and equipment, nec	37.04%	5.06%
3000	Office, accounting and computing machinery	83.78%	35.34%
3033	Electrical and optical equipment	40.87%	23.13%
3100	Electrical machinery and apparatus, nec	41.80%	8.43%
3200	Radio, television and communication equipment	68.33%	22.45%
3300	Medical, precision and optical instruments	47.62%	34.38%
3400	Motor vehicles, trailers and semi-trailers	42.94%	15.73%
3435	Transport equipment	42.50%	20.75%
3500	Other transport equipment	43.69%	28.67%
3510	Building and repairing of ships	30.81%	0.00%
3529	Railroad equipment and transport equipment, nec	39.87%	11.56%
3530	Aircraft and spacecraft	82.03%	34.35%
3637	Manufacturing, nec, and recycling	16.91%	0.97%

[1] ISIC Rev 3 classification. [2] External financial dependence is the ratio of capital expenditures minus cash flows to capital expenditures. [3] R&D intensity is the ratio of R&D expenditures to value added.

Sources: OECD (2011); Raddatz (2006); authors' calculations.

Table A2

Industry productivity growth, financial dependence and financial development growth[1]

Dependent variable: labour productivity growth	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Log of initial relative labour productivity	**–0.027***	**–0.027****	**–0.027***	**–0.027***	**–0.026***	**–0.024****	**–0.027***	**–0.027***	**–0.027***
	(0.014)	*(0.013)*	*(0.014)*	*(0.014)*	*(0.014)*	*(0.011)*	*(0.014)*	*(0.014)*	*(0.014)*
Interaction (financial dependence and private credit by banks to GDP growth)	**–1.004*****	**–1.581*****	**–1.056*****	**–1.102*****	**–0.964*****	**–1.544*****	**–1.058*****	**–1.016*****	**–0.988*****
	(0.312)	*(0.436)*	*(0.320)*	*(0.338)*	*(0.356)*	*(0.364)*	*(0.344)*	*(0.310)*	*(0.318)*
Interaction (financial dependence and initial private credit by banks to GDP)		**0.108***							
		(0.058)							
Interaction (financial dependence and average real short-term interest rate)			**0.027***						
			(0.016)						
Interaction (financial dependence and average real long-term interest rate)				**0.046***					
				(0.026)					
Interaction (financial dependence and average CPI inflation rate)					**–0.005**				
					(0.017)				
Interaction (financial dependence and average fiscal balance to GDP)						**0.023****			
						(0.011)			
Interaction (financial dependence and average government expenditures to GDP)							**0.001**		
							(0.002)		
Interaction (financial dependence and average trade balance to GDP)								**0.239**	
								(0.248)	
Interaction (financial dependence and average current account to GDP)									**0.001**
									(0.002)
Observations	335	335	335	335	335	335	335	335	335
R-squared	0.360	0.375	0.366	0.369	0.360	0.382	0.361	0.362	0.361

The dependent variable is the average annual growth rate in labour productivity per worker for the period 2000–08 for each industry in each country. Initial relative labour productivity is the ratio of industry labour productivity per worker to total manufacturing labour productivity per worker in 2000. Financial dependence is the median fraction of capital expenditures not financed with internal funds for US firms in the same industry for the period 1980–89. The interaction variable is the product of variables in parentheses. Robust standard errors are in parentheses. All estimations include country and industry dummies. Significance at the 1/5/10% level is indicated by ***/**/*.

[1] Country sample: Austria, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan, Luxembourg, the Netherlands, Spain, Sweden, Switzerland and the United Kingdom.

Sources: Raddatz (2006); OECD, *Economic Outlook* and Structural Analysis database; World Bank Financial Structure and Development database; authors' calculations.

Table A3

Industry productivity growth, R&D intensity and financial development growth[1]

Dependent variable: labour productivity growth	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Log of initial relative labour productivity	**–0.030**** *(0.014)*	**–0.030**** *(0.014)*	**–0.031**** *(0.014)*	**–0.030**** *(0.014)*	**–0.031**** *(0.013)*	**–0.027**** *(0.012)*	**–0.030**** *(0.014)*	**–0.027**** *(0.013)*	**–0.030**** *(0.013)*
Interaction (financial dependence and private credit by banks to GDP growth)	**–1.327***** *(0.502)*	**–1.616*** *(0.825)*	**–1.301**** *(0.554)*	**–1.221**** *(0.608)*	**–1.046*** *(0.606)*	**–2.185***** *(0.675)*	**–1.187*** *(0.611)*	**–1.468***** *(0.508)*	**–1.287**** *(0.510)*
Interaction (financial dependence and initial private credit by banks to GDP)		**–0.052** *(0.106)*							
Interaction (financial dependence and average real short-term interest rate)			**0.036** *(0.031)*						
Interaction (financial dependence and average real long-term interest rate)				**0.057** *(0.054)*					
Interaction (financial dependence and average CPI inflation rate)					**–0.040** *(0.031)*				
Interaction (financial dependence and average fiscal balance to GDP)						**0.035*** *(0.020)*			
Interaction (financial dependence and average government expenditures to GDP)							**–0.003** *(0.005)*		
Interaction (financial dependence and average trade balance to GDP)								**1.220**** *(0.496)*	
Interaction (financial dependence and average current account to GDP)									**0.008*** *(0.005)*
Observations	335	335	335	335	335	335	335	335	335
R-squared	0.360	0.375	0.366	0.369	0.360	0.382	0.361	0.362	0.361

The dependent variable is the average annual growth rate in labour productivity per worker for the period 2000–08 for each industry in each country. Initial relative labour productivity is the ratio of industry labour productivity per worker to total manufacturing labour productivity per worker in 2000. R&D intensity is the average for the ratio of R&D expenditures to value added for US industries for the period 1990–2000. The interaction variable is the product of variables in parentheses. Robust standard errors are in parentheses. All estimations include country and industry dummies. Significance at the 1/5/10% level is indicated by ***/**/*.

[1] Country sample: Austria, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan, Luxembourg, the Netherlands, Spain, Sweden, Switzerland and the United Kingdom.

Sources: OECD, *Economic Outlook* and Structural Analysis database; World Bank Financial Structure and Development database; authors' calculations.