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MIND THE FINANCING GAP: ENHANCING THE CONTRIBUTION OF INTANGIBLE ASSETS TO PRODUCTIVITY

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ABSTRACT / RESUME

Mind the financing gap: Enhancing the contribution of intangible assets to productivity

Intangible assets are an important driver of productivity and ultimately output growth. Yet, despite their aggregate rise in the past decades, productivity has continued to grow modestly in the majority of OECD countries. This is in part because many firms – particularly young and small ones - are often held back from building up intangible assets, as financing their production or acquisition is more difficult than for tangibles. Building on the analytical framework recently developed by the OECD (Demmou, Stefanescu and Arquié, 2019; Demmou, Franco and Stefanescu, 2019) and extending the empirical analysis, the paper provides evidence that easing financing restrictions is particularly beneficial for productivity in sectors that rely more intensively on intangible assets, indirectly pointing to the existence of a "financing gap" due to financial frictions. This aggregate productivity impact reflects both increases in the productivity of each firm and better allocation of labour across firms. Recognizing cross-country differences in the structure of financial systems, the policy discussion focuses on how to make the three main sources of external finance available to firms -- bank lending, equity financing, and direct government support -- more suited to fit the needs of an intangible-based economy. Finally, the paper briefly discusses the extent to which the COVID-19 crisis may have created specific challenges for intangible investment, making policy interventions in these areas more relevant and urgent.

JEL classification codes: D24, G30, O30, O47.

Keywords: Intangible assets, finance, productivity

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Attention au besoin de financement des entreprises: Renforcer la contribution des actifs immatériels à la productivité

Les actifs immatériels sont un moteur important de la productivité et, en définitive, de la croissance de la production. Pourtant, malgré leur augmentation au cours des dernières décennies, la productivité a continué de croître modestement dans la majorité des pays de l'OCDE. Cela s'explique en partie par les plus grandes difficultés de financement rencontrées par de nombreuses entreprises, en particulier les jeunes et les petites entreprises, lors de la production ou l'acquisition d'actifs immatériels comparé à celles rencontrées lors de l'accumulation d'actifs matériels. En s'appuyant et étendant le cadre analytique récemment développé par l'OCDE (Demmou, Stefanescu et Arquié, 2019 ; Demmou, Franco et Stefanescu, 2019), l'article montre que l'assouplissement des restrictions de financement est particulièrement bénéfique à la productivité des secteurs qui dépendent le plus intensivement des actifs immatériels, apportant indirectement des éléments en faveur de l'existence d'un besoin de financement (financing gap) dû aux frictions financières. Cet impact agrégé sur la productivité traduit à la fois une amélioration de la productivité au niveau de chaque entreprise et une meilleure de l'allocation de la main-d'œuvre entre les entreprises. Reconnaissant l'existence de disparités entre les pays en matière de structure des systèmes financiers, la discussion sur les politiques publiques est axée sur les mesures qui permettraient de rendre mieux adaptées aux besoins d'une économie basée sur l'immatériel les trois principales sources de financement externe des entreprises (prêts bancaires, financement par actions et soutien direct du gouvernement). Enfin, l'article examine brièvement les défis spécifiques générés par la crise du COVID-19 et la mesure avec laquelle la nécessité d'agir pour soutenir l'investissement immatériel est devenu encore plus opportune et urgente.

Classification JEL : D24, G30, O30, O47.

Mots clés: actifs immatériels, finance, productivité

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Mind the financing gap: Enhancing the contribution of intangible assets to productivity

By Lilas Demmou and Guido Franco[1]

1. Introduction

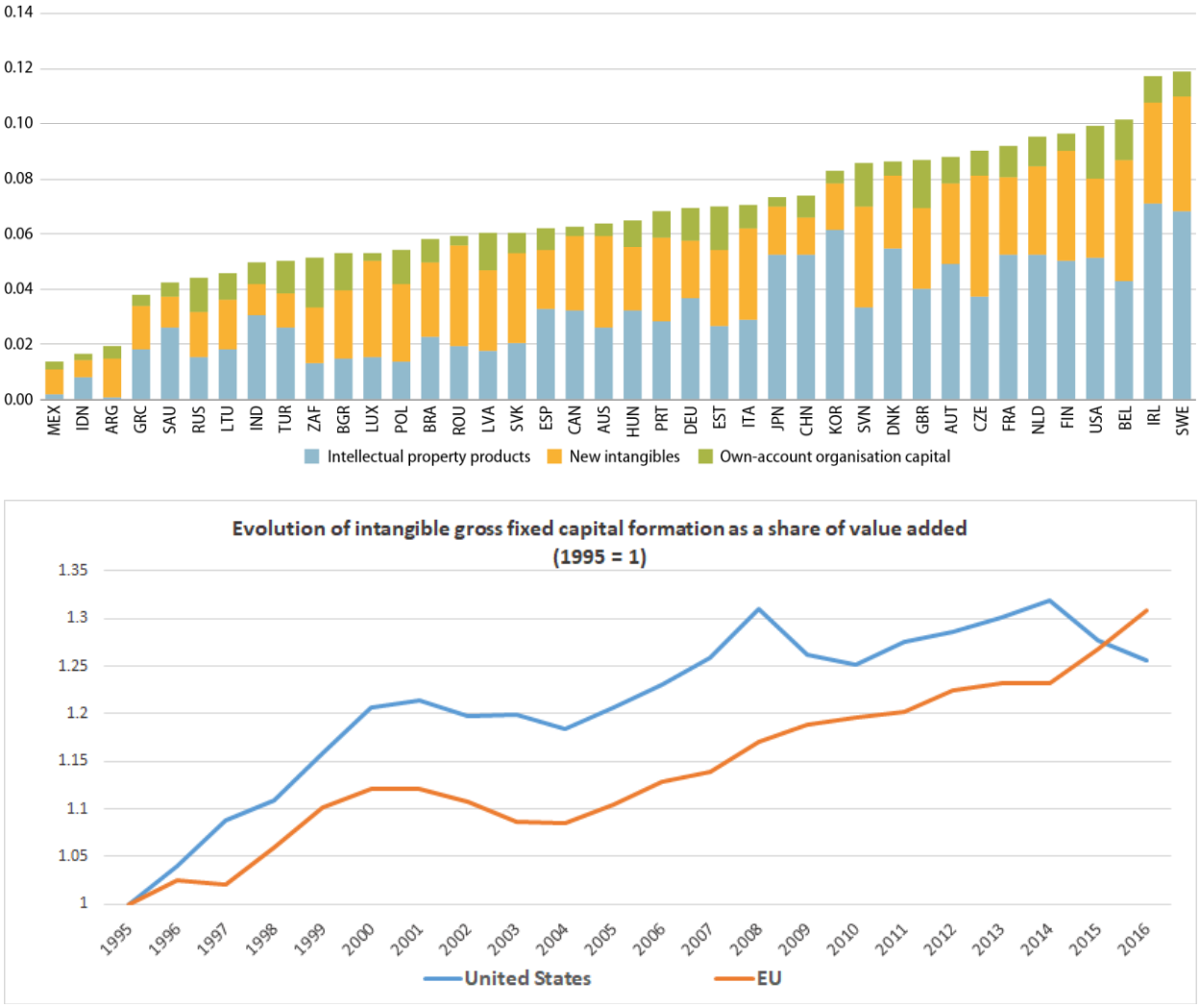
1. Intangible assets are widely acknowledged as the main source of future growth. Aside from investments in R&D, patents or software, which are key drivers of innovation, other types of intangible assets, such as databases, designs, managerial skills, and organisation and distribution networks, have become increasingly relevant. These strategic investments are at the heart of firms' competitiveness and productivity, largely due to their complementarity with digital technologies and their positive contribution to MFP. They also have the potential to increase the resilience of economies to large shocks exploiting the flexibility that the use of digital technologies provides (e.g., via teleworking arrangements and swift reorganisation of productive activities). As a result, the shift in the composition of investment toward intangible assets has the potential to reverse the productivity growth slowdown observed in many advanced economies and to foster the recovery following the COVID-19 shock.

2. Yet, international comparisons reveal significant cross-country differences in investment in intangibles, suggesting that there might be scope for further growth (Figure 1). While a portion of differences across countries may depend on sectoral specialisation and the related economy-wide scope for intangible investment, as well as on specific institutional settings (Andrews and De Serres, 2012;

[1] Lilas Demmou and Guido Franco are members of the Policy Studies Branch of the OECD Economics Department (lilas.demmou@oecd.org; guido.franco@oecd.org). The authors are indebted to Irina Stefanescu (from the Board of Governors of the Federal Reserve System), co-author of previous papers in the project linking finance, intangible assets and productivity, for her contribution during the initial stages of this paper, as well as to Saloua Benami, Francesco Losma and Yehuda Porath (all at the OECD Economics Department at the time of writing) for their inputs. The authors are grateful to Giuseppe Nicoletti (from the OECD Economics Department) for his guidance, insightful suggestions and valuable discussions. The authors would also like to thank for helpful comments Laurence Boone, Luiz de Mello, Alain de Serres, Martin Borowiecki (all from the OECD Economics Department), Sara Calligaris, Alexander Himbert, Francesco Manaresi, Dirk Pilat (all from the OECD Directorate for Science, Technology and Innovation), Kris Boschmans, Alison Weingarden (both from the OECD Centre for Entrepreneurship, SMEs, Regions and Cities), Ana Cinta Gonzales Cabral, Pierce O'Reilly (from the OECD Centre for Tax Policy and Administration), Cecilia Jona-Lasinio, Valeria Patella, Silvia Sopranzetti (Italian 2021 G20 Presidency), Carol Corrado (from the Conference Board), Jonathan Haskel (from the Imperial College London), delegates to the OECD Working Party 1 and participants to the G20 Seminar series organised by the Italian G20 Team in preparation to the 2021 G20 Italian Presidency. Sarah Michelson Sarfati (OECD Economics Department) provided excellent editorial support.

Andrews and Criscuolo, 2013), it is likely that financing conditions play a key role in shaping investment in intangibles.[2]

Figure 1. Intangible assets gross fixed capital formation varies across countries and over time



Note: The top panel shows the variation across countries of intangible assets' gross fixed capital formation (and its components) as a share of value added. Intangible assets' gross fixed capital formation is computed using a combination of data sources and a novel methodology described in Annex A; due to data availability, the training component of intangible investment is excluded. The bottom panel shows the evolution of intangible gross fixed capital formation as a share of value added for the United States and the European Union, using INTAN-Invest data and following the methodology proposed by Corrado et al. (2016). All the variables employed to build the ratios of interest are measured in constant 2015 prices.

Source: OECD calculations on INTAN-Invest, OECD, National Use Tables, World Bank, PWT and ILO data.

3. Typically, intangible assets have specific characteristics – uncertain returns, non-rivalry, large synergies, low redeployability – that tend to increase information asymmetries and make their use as collateral difficult, so that their financing is more complex than that of tangibles. The difficulty of financing intangibles with traditional equity and bank sources partly explains firms' increasing reliance on private

[2] Based on INTAN-Invest country-sector varying data, a simple empirical exercise in the spirit of Mathieu and van Pottelsberghe de la Potterie (2008) shows that sectoral specialisation only accounts for one third of cross-country differences in intangible investment.

equity instruments and retained earnings, as opposed to debt and public equity (Cecchetti and Schoenholtz, 2017). While such difficulties have been known for a long time, leading to substantive research on financing start-ups and innovation (OECD, 2020a), the shift of advanced economies towards intangible-intensive growth has made the problem more pertinent.[3] Enhancing the ability of OECD countries' financial systems to provide sufficient and affordable financing for investments in intangible assets has the potential to raise productivity overall.

4. Against this background, this paper investigates two closely related issues with the aim to help OECD economies to grasp growth opportunities related to intangible assets. First, it assesses the extent to which financing barriers affecting firms in intangible-intensive sectors undermine their productivity performance and examines whether the COVID-19 outbreak has dampened or magnified the challenges related to intangibles financing (OECD, 2020b). Second, it discusses the wide range of policies that could contribute to ease access to finance for intangible-intensive firms and more generally to broaden the uptake of intangible investment in the whole corporate sector, possibly leading to stronger productivity growth. Financial frictions that hold back intangible investment may also create challenges other than productivity for policy makers, not explicitly investigated in the paper (Box 1).

5. The empirical analysis provides a comprehensive assessment of the impact of financial frictions on the productivity of intangible-intensive sectors, building on a conceptual and methodological framework recently developed at the OECD. Indeed, it combines the results from two earlier papers examining the issue at the sectoral level (Demmou, Stefanescu and Arquié, 2019) and at the firm level (Demmou, Franco and Stefanescu, 2020), supplemented by new analysis looking at how financial frictions also shape the reallocation of resources from least to most productive firms in innovative sectors. Relative to earlier work, the analysis has been homogenised across these three levels – sector, firm and cross-firm -- to better link the various findings. The main findings indicate that easing financing restrictions is particularly beneficial for productivity in sectors that rely more intensively on intangible assets, as firm-level productivity in intangible-intensive sectors is slowed down and the ability of the most successful firms in these sectors to expand is thwarted, indirectly pointing to the existence of a "financing gap" due to financial frictions.

6. Next, building on a simple accounting framework (Demmou et al., 2021a), the analysis shows that the potential impact of the COVID-19 crisis is ambiguous. On the one side, consistent with the diverse ability to rely on innovative technologies and teleworking arrangements, as well as with their tendency to rely on internal funds, intangible-intensive sectors are predicted to be better positioned to weather the crisis compared to traditional sectors, confirming that intangible capital is critical to strengthen firms' resilience. On the other side, intangible-intensive firms may face even stronger constraints following the depletion of cash and equity buffers to countervail the decline in sales, weakening potentially the strength of the recovery if intangible investment significantly slows down in the aftermath of the shock.

7. Recognizing cross-country differences in the structure of financial systems, the policy discussion focuses on the three main sources of external finance available to firms – government support, equity financing and bank credit. Underpinned by simulations based on our empirical analysis, available evidence from the literature, and the description of successful country-specific experiences, we discuss policy-levers that authorities could exploit to make each source of finance more supportive of intangible investment. As intangible assets are often complementary in production and their most appropriate financing sources may differ, a cross-cutting approach to financial market reform could be useful to unlock the potential of these assets. The following set of policy measures is particularly relevant:

- *Intangible-friendly COVID-19 related support.* If well designed and directed, the large COVID-19 related fiscal stimulus packages could accelerate the shift towards a knowledge-based economy while fostering the recovery. Indeed, the provision of loans and loan guarantees, the development of schemes featuring equity-type capital injections and the preservation of direct public support to

[3] For instance, see Hall and Lerner (2010) for a review of the literature and Haskel and Westlake (2018).

innovative businesses could contribute to attenuate the disruptions caused by the COVID-19 outbreak and ease the frictions hampering intangibles investment.

- *Standard innovation policies that would benefit investment in intangibles.* The development of venture capital markets, which are an important source of finance for start-ups and intangible-intensive firms at early stages of their life-cycle, and a fine-tuning of government direct and indirect support of high growth SMEs could further ease the financing frictions faced by innovative firms.
- *Financial market framework policies.* Progressing on the European Capital Market Union, reducing the preference to use debt over equity, easing access to IPOs, ensuring that the structure of equity markets is supportive of the provision of patient and engaged capital, and enhancing stock market liquidity and financial literacy could spur both the demand and supply of equity with beneficial effects on the ability of firms to finance intangible-intensive projects, as equity investors are more willing than banks to take risks even without strong collateral.
- *Policies to widen financing options for investment in intangibles.* Ensuring efficient liquidation of intangibles and providing incentives to bank credit backed by intangibles could increase their collateral value and ease access to bank finance. At the same time, better tailoring financial reports and accounting standards to the specific features of intangibles would enable both banks and equity investors to make better informed decisions when allocating resources. Moreover, the expansion of well-designed R&D tax incentives and government funding to other types of intangibles might also be considered for assets displaying positive externalities (e.g., organisational capital and workers' training).

Box 1. Related economic challenges

The increased relevance of intangible assets combined with the financing gap that limits intangible investment may generate additional economic challenges.

A competition challenge. The rise of intangibles occurred simultaneously with the increase in industry concentration (Bajgar et al., 2019) and the widening of the productivity gap between frontier and laggard firms (Andrews et al., 2016), potentially leading to the risk of undesired "winner takes all" dynamics in digital sectors. Indeed, the difficulties that intangible-intensive SMEs and start-ups face in accessing external capital and financing innovative projects could severely impair their ability to enter the market, grow, and compete with incumbents (Berlingieri et al., 2020).

A financial stability challenge. The shift of OECD economies toward intangibles may also have incentivised banks to reallocate their portfolios from commercial loans to real estate lending (Dell'Ariccia et al., 2017), increasing macro-stability risks and the relative size of low productivity sectors in the economy.[4] This tendency has been further strengthened by the tighter prudential regulation implemented in the aftermath of the financial crisis, according to which the amount of reserves banks are required to keep depends on the type of loan they hold on their balance sheets -- loans secured against intangibles are considered riskier and, thus, require holding relatively more reserves to back them.

A monetary challenge. The increasing share of investment devoted to intangibles and the relatively small portion of it that is financed by bank lending potentially weakens monetary policy transmission channels, as investment is less responsive to changes in interest rates (Crouzet and Eberly, 2019).

[4] For instance, in the United States, the surge of firms' intangible investment could explain up to 20% of this reallocation over the 1977-2010 period (Dell'Ariccia et al., 2017).

A wage dispersion challenge. The economies of scale related to intangible capital are at the heart of the success of "superstar firms". This trend may relate to the decline in the labour share if a larger fraction of output is produced by more productive firms with higher profits (Autor et al., 2019; Schwellnus et al., 2018) and to the rising inequality among workers if superstar firms also pay consistently higher wages and/or if they cluster in thriving cities (Haskel and Westlake, 2018).

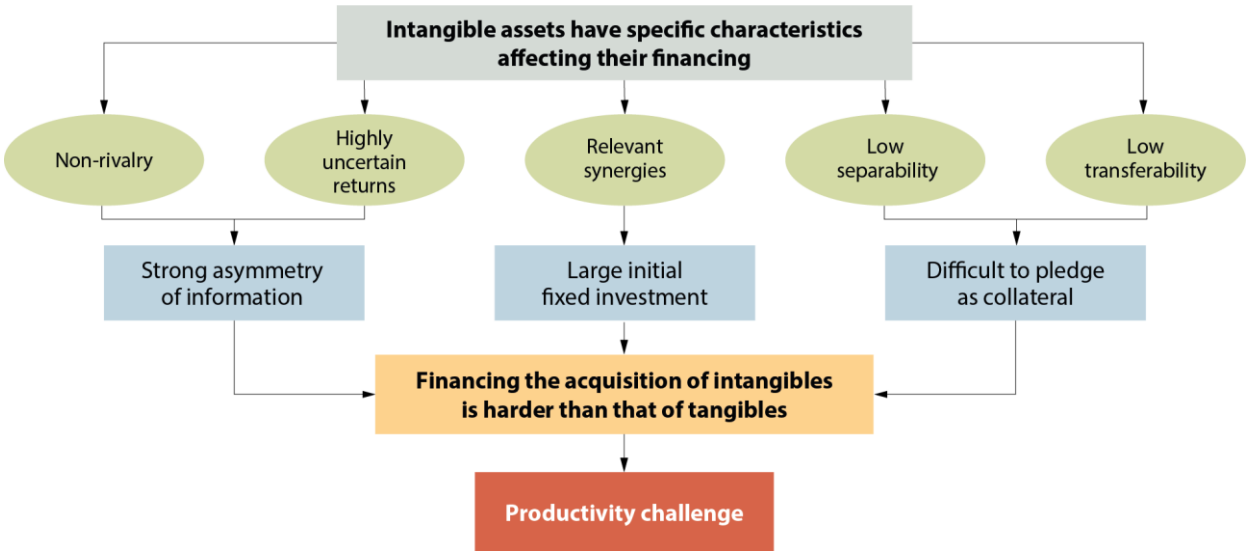
8. The paper proceeds as follows. Section 2 briefly presents the OECD conceptual and empirical framework linking finance, intangible assets and productivity, as well as the main findings on the productivity impact of intangibles assets' financing gap and the specific challenges for intangible investment in the context of the COVID-19 crisis. For the sake of exposition, the text is purposely concise; further details on the methodology, descriptive statistics and a wide range of robustness checks and extensions are provided in annexes and background papers. Section 3 discusses policy solutions to make the banking sector, financial markets and government financing more suited to fit the needs of an intangible-based economy. Section 4 concludes and summarizes the main policy areas for action.

2. Intangible assets financing gaps

2.1. Finance, intangibles and productivity: a review of the OECD framework

9. Intangible assets have specific characteristics that make their financing more difficult than that of tangibles (Figure 2).[5] These characteristics include high information asymmetries, low pledgeability as collateral, and strong investment indivisibilities:

Figure 2. The challenge of financing intangibles



Source: OECD.

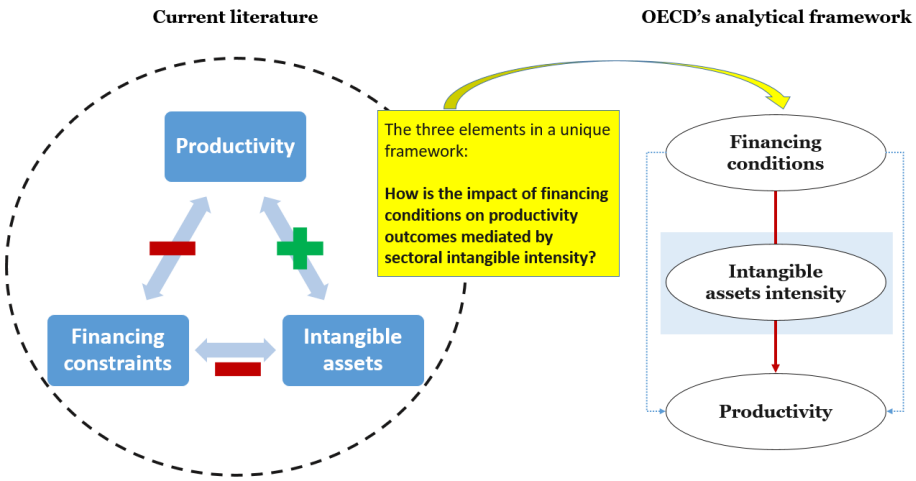
[5] A number of theoretical and empirical studies corroborate this narrative. For instance, when faced with financial constraints, firms cut their investment in R&D to reduce liquidity risks (Aghion et al., 2010; Aghion et al., 2012) and, more broadly, invest less in intangibles (Garcia-Macia; 2017; Duval et al., 2020), especially if they are young and small (Brown et al., 2009; and Hall and Lerner, 2010). Consistently, they are more likely to invest in tangibles in order to increase their debt capacity, providing a guarantee and an enforceable outside option for creditors (Almeida and Campello, 2007; Campello and Hackbarth, 2012).

- Asymmetry of information makes it more difficult for an external investor to evaluate the quality of and the risks associated with innovative projects, making the return on investment and the valuation of assets highly uncertain (Himmelberg and Petersen, 1994; Scherer and Harhoff, 2000; Barth et al., 2001). Furthermore, many innovative practices generate non-rival knowledge, which could be easily imitated by competitors or appropriated by the financier (Nelson, 1959; Arrow, 1962); it follows that intangible-intensive firms are reluctant to reveal their innovative ideas to capital market participants, further reducing the quality of the signal concerning these projects (Anton and Yao, 2002; Gans et al., 2002).
- Financial intermediaries usually require collateral to reduce information asymmetries and moral hazard risks, as low quality borrowers are less willing to pledge assets to signal their creditworthiness (Karapetyan and Stacescu, 2016). However, intangible assets are more difficult to pledge as collateral when searching for external capital. Compared to tangible assets, their valuation is more volatile and at least certain categories of intangibles tend to be firm-specific (i.e., low transferability). Therefore, intangible assets are harder to redeploy and have a significantly lower liquidation value, reducing the share debtors can capture in case of default (Brown et al., 2009; Hall and Lerner, 2010).
- Higher information asymmetry and lower *collateralisation make the divergence between the internal* and external costs of capital particularly large for intangible assets. The necessity to rely heavily on internal finance could hence be an important obstacle to innovation, especially for small and medium sized enterprises, which often cannot access equity markets. Indeed, the complementarity among the various types of intangible assets, and between tangible and intangible capital, implies that large initial investments are needed to achieve intangibles' full potential and many companies lack sufficient internal resources to sustain such sizeable fixed and often irreversible costs.[6]

10. In light of these specific features, access to finance is likely to play a critical role in shaping productivity outcomes. Given the strong productive potential of intangible assets (Hall, 2011; Crass and Peters, 2014), the aggregate productivity benefits arising from the relaxation of financing frictions are potentially larger in intangible-intensive sectors than elsewhere in the economy. The OECD developed a new analytical framework linking finance, intangible assets and productivity to test this hypothesis (Figure 3). Accordingly, the impact of financing conditions on productivity is mediated by sector-level intangible intensity by explicitly accounting for the interplay of these three phenomena, which until now have only been gauged empirically two by two or connected indirectly (Manaresi and Pierri, 2017; Duval et al., 2020).

[6] For instance, Sorbe et al. (2019) shows that to fully reap the benefits from digitalisation firms have to reorganize their processes, and improve their management practices and workers skills.

Figure 3. The finance-intangibles-productivity linkages



Source: Demmou, Stefanescu and Arquié (2019); Demmou, Franco and Stefanescu (2020).

11. The empirical strategy is structured in three complementary parts (Box 2). Upfront, building on Demmou, Stefanescu and Arquié (2019), a sectoral-level analysis draws the attention to the macroeconomic implications that financial development has for intangible-intensive sectors, pointing to possible imbalances that are now being amplified by the increasing use of new, often intangible-based, technologies. The second part (based on Demmou, Franco and Stefanescu, 2020) and the third part deal with the two distinct channels that could drive the aggregate results:

- a **within-firm effect**, if financing frictions dampen firms' productivity more in sectors intensive in intangible assets, and
- a **between-firm (allocative efficiency) effect**, if financing frictions hinder aggregate productivity by impeding the most productive firms within each industry to grow and gain market shares, especially in intangible-intensive industries.

12. The empirical implementation relies on two main ingredients. First, we use a sectoral measure characterizing the use of intangible capital in each industry by taking into account a wide range of intangible assets – including databases, copyrights, designs, trademarks, and organisation and distribution networks, which are increasingly important in firms' production function (Demmou, Stefanescu and Arquié, 2019; Figure C.1). This measure is intended to capture the potential share of intangible assets in each sector, independent of financing conditions; to this end, it is based on data for U.S. listed firms during 1990-2006, and the U.S. is excluded from the estimation sample to ensure exogeneity.[7]

13. Second, we exploit both aggregate and firm-specific proxies for financial conditions. At the macroeconomic level, we use a multidimensional index of financial development (computed by the IMF), capturing the overall availability of finance in a country-year; the index measures the depth, access and

[7] This strategy relies on two assumptions: i) the production function for a given sector implies an optimal asset mix between tangible and intangible and the ranking of sectors according to that measure carries over other countries and ii) US publicly *listed* firms during the pre-crisis period face less difficulties in raising the external capital they need to invest, so that their demand for intangible assets should approximate the optimal sectoral asset mix. Confirming that this measure is akin to a structural sectoral feature, the ranking among sectors in terms of intangible intensity is almost constant over time, despite the overall sharp increase of the stock of intangibles. Operationally, following Demmou, Stefanescu and Arquié (2019), intangible intensity is measured as the median sector level value of the ratio between the sum of intangible assets and the sum of total assets (tangible and intangible) over the 1990-2006 period for each U.S. listed firm with available data in Compustat.

efficiency of both financial institutions and financial markets (Svirydzenka, 2016). At the firm level, three different measures are used (Demmou, Franco and Stefanescu, 2020): i) simple financial ratios (e.g. financial leverage ratio, interest coverage ratio, cash holdings over total assets and cash flow over total assets), ii) unweighted composite indices (collapsing information from eight financial variables), and iii) weighted composite indices (using various sets of weights from the literature).[8] The use of an interaction term between financing conditions and intangible intensity to assess if the former have a greater effect on productivity dynamics in more intangible-intensive sectors. Importantly, all models include a full set of controls and fixed effects to ensure a tight identification and reduce the risk of omitted variable bias.

Box 2. The OECD empirical framework

Aggregate analysis (building on Demmou, Stefanescu and Arquié, 2019)

To identify the aggregate impact of financing conditions on the productivity outcomes of intangible-intensive sectors, we use an identification strategy inspired by Rajan and Zingales (1998) and similar in spirit to a Diff-in-Diff approach. The analysis exploits cross-sector differences in intangible intensity to capture the exposure of each industry to financial frictions, which are in turn proxied by a country-time varying measure of financial development. Analytically:

$$MFP_{cst} = \beta_0 + \beta_1 \left(FinDev_{c,(t-1)} * IntangIntens_s\right) + \beta_4 \left(\boldsymbol{X}_{c,(t-1)} * IntangIntens_s\right) + \delta_{cs} + \delta_{ct} + \delta_{st} + \epsilon_{cst} \quad (1)$$

The subscripts *c, s, t* stand for country, sector and time, respectively. The dependent variable is log multi-factor productivity calculated from the OECD-STAN database; $FinDev$ stands for financial development - proxied by the comprehensive IMF index (Svirydzenka, 2016) - and *IntangIntens* is the structural sectoral measure computed on Compustat data and completely exogenous to the productivity sample.

The model includes country by sector, country by time, and sector by time fixed effects to control for country-sector specific time invariant characteristics, as well as all shocks at the country and sector level. To further ensure that our estimates are not driven by other country level phenomena which differentially affect sectors according to their intangible intensity, we complete the model with several common determinants of productivity, which are potentially correlated with financial development, each interacted with intangible intensity - the vector of controls $\boldsymbol{X}$ includes GDP growth, government R&D, public capital stock, trade openness, skills availability, and labour market regulation. The main advantage of the adopted methodology is that it rules out endogeneity concerns; however, it does so at the cost of exclusively providing a differential effect between intangible-intensive and non-intensive sectors (as the main effects of the interaction term are absorbed by the fixed effects).

Within-firm effect (building on Demmou, Franco and Stefanescu, 2020)

We test the hypothesis that the impact of financial constraints on productivity at the firm level is more binding in intangible-intensive industries compared to non-intensive ones by estimating the following saturated panel fixed effects model:

$$MFP_{icst} = \beta_0 + \beta_1 FC_{ics,(t-1)} + \beta_2 \left(FC_{ics,(t-1)} * IntangIntens_s\right) + \beta_3 \boldsymbol{X}_{ics,(t-1)} + \beta_4 \left(\boldsymbol{X}_{ics,(t-1)} * IntangIntens_s\right) + \delta_i + \delta_{cst} + \epsilon_{icst} \quad (2)$$

The subscripts *i, c, s, t* stand for firm, country, sector and time, respectively. The dependent variable MFP is the log of firm level total factor productivity estimated through the GMM Wooldridge (2009) value added

[8] Composite indices capturing firms' financial constraints are described in Table C.1.

based procedure. The variable FC captures financial constraints at the firm level (see Table C.1), while $IntangIntens_s$ is again our sector level intangible intensity measure. The vector X includes a set of firm level controls - namely, the log of total assets, EBITDA (earnings before interest, taxes, depreciation and amortisation) and age; δ_i indicates firm fixed effects and δ_{cst} country by sector by time dummies. All firm level data are obtained from the 2017 vintage of the OECD-Orbis dataset.

We proceed as follows to minimize the natural concerns with respect to the potential endogeneity plaguing the relationship between financing frictions, intangible assets, and productivity. First, we use an extremely rich fixed effects structure: identification occurs by exclusively exploiting within firm variation in a given country-sector-year cell. Indeed, firm fixed effects absorb the unobserved firm-specific heterogeneity that might simultaneously affect financial conditions and production, and allow us to focus on productivity changes over time compared to the firm-level mean, abstracting from all cross-sectional differences in productivity levels across firms. The triple interacted country-sector-year fixed effects control for the effects of all time varying shocks at the country-sector level. Second, we include all firm level regressors with a time lag to further reduce the simultaneity bias and use the usual set of firm level controls employed by the literature, together with their interactions with intangible intensity, to control for the potential omitted variable bias arising from firm time-varying characteristics.

Between-firm effect

To study the allocative efficiency channel, we adopt a standard model of firm dynamics, which predicts that firms with higher productivity should attract more labour and grow faster in size, if there are no barriers impeding market forces from allocating resources optimally. Replicating the approach of Adalet McGowan et al. (2017), we estimate the following equation:

$$\begin{aligned} EmplGrowth_{icst} = {} & \beta_0 + \beta_1 MFP_{ics,(t-1)} + \beta_2 \left(MFP_{ics,(t-1)} * IntangIntens_s\right) \\ & + \beta_3 \left(MFP_{ics,(t-1)} * FinDev_{c,(t-1)}\right) + \beta_4 \left(MFP_{ics,(t-1)} * IntangIntens_s * FinDev_{c,(t-1)}\right) \\ & + \beta_5 \boldsymbol{X}_{ics,(t-1)} + \delta_{cst} + \epsilon_{icst} \end{aligned} \quad (3)$$

where the notation is consistent with that of Equation 2, $EmplGrowth$ stands for employment growth, calculated as the yearly difference in log employment levels, $IntangIntens$ and $FinDev$ are defined as in Equation 1, and the triple interacted country-sector-year fixed effects control for the effects of all time varying shocks at the country-sector level. The vector $\boldsymbol{X}$ includes firm level profitability, total assets and age. We also estimate alternative specifications including firm fixed effects to control for all time invariant firm characteristics, as well as all interactions between firm level controls, intangible intensity and financial development to rule out the possibility that the differential effect of productivity is due to other firm-specific features.

Finally, to account for the potential bias coming from the mismeasurement of the contribution of intangible capital to MFP either at the sector or firm level, we replicate all the three steps of the analysis using labour productivity. Results are qualitatively unchanged.

2.2. Finance, intangibles and productivity: empirical findings

2.2.1. Aggregate productivity effect

14. Results at the sectoral level confirm that intangible-intensive sectors benefit relatively more from financial development (Table 1). The magnitude of the differential impact is large. A one-standard deviation increase in our financial development index -- approximately equivalent to moving from Greek to Swedish levels – implies a productivity improvement that is 3.5% larger in intangible-intensive sectors compared to traditional ones (Table 1, specification 1). Figure 4 shows the excess increase in productivity that a country

would experience in intangible-intensive sectors when moving from a given level of financial development to the highest observed level: the simulation implies a productivity improvement that is approximately 9% larger in intangible-intensive sectors compared to traditional ones for low financial development countries and around 4% larger for countries starting from an average financial system development.

15. These findings are robust to the addition of macro controls interacted with intangible intensity (Table 1, specification 3). This extension reduces the potential concern that they are driven by non-financial country-level phenomena correlated with financial development and potentially having a differential impact on the productivity performance of intangible-intensive sectors. Further, the results are also robust to interacting financial development with the traditional measure of external finance dependence (Rajan and Zingales, 1998), which proxies for the extent to which each sector may be financially constrained due to its reliance on external funding to invest (Table 1, specifications 2 and 4). Accordingly, these two sectoral features are not substitutes but rather could complement each other in amplifying the effect of financial conditions on productivity.[9]

Table 1. Aggregate productivity effect

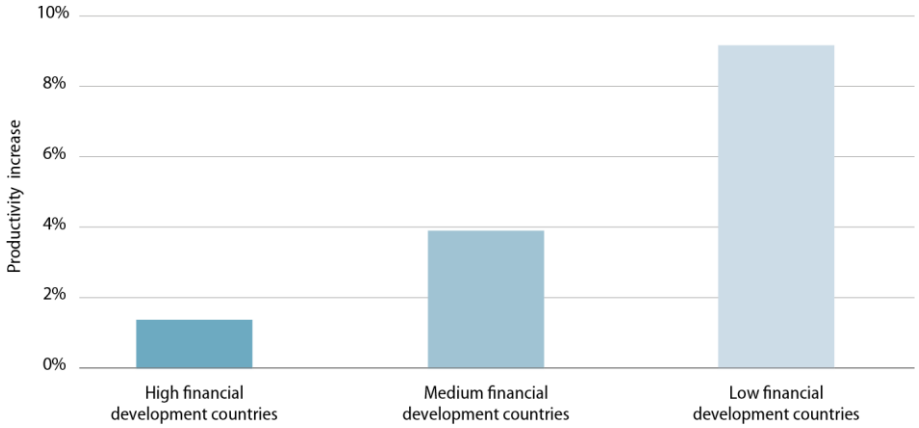
Dependent Variable: Log MFP				
	(1)	(2)	(3)	(4)
Financial Development * Intangible Intensity	**0.207****	**0.234*****	**0.354*****	**0.380*****
	(2.5)	**(2.8)**	**(4.2)**	**(4.5)**
Financial Development * External Finance Dependence		0.298***		0.313***
		(3.2)		(3.3)
Observations	13,491	13,491	13,246	13,246
R-squared	0.912	0.912	0.912	0.912
Aggregate Controls Interacted with IntK	NO	NO	YES	YES
Country * Sector FE	YES	YES	YES	YES
Country * Year FE	YES	YES	YES	YES
Sector * Year FE	YES	YES	YES	YES

Note: T-statistics in parentheses; standard errors clustered at the country-year and sector-year level. Significance Level: *10%, **5%, ***1%. The dependent variable is sector level multifactor productivity. Financial development is proxied by a multidimensional index (from the IMF) capturing the overall availability of finance in a country-year. Sectoral intangible intensity (Figure C.1) is measured as in Demmou, Stefanescu and Arquié (2019); it is used as a binary variable with respect to the average sector. External Finance Dependence is computed as in Rajan and Zingales (1998). The aggregate controls included in model (2) and (4) are GDP growth, government R&D, public capital stock, trade openness, skills availability and labour market regulation. The estimation is based on Equation 1 and builds on the framework developed in Demmou, Stefanescu and Arquié (2019); it is carried over the 1990-2015 period and includes 28 countries (AUS, AUT, BEL, CAN, CZE, DEU, DNK, ESP, EST, FIN, FRA, GBR, GRC, HUN, IRL,ISL, ITA, JPN, LUX, LVA, MEX, NLD, NOR, POL, PRT, SVK, SVN, SWE).
Source: OECD calculations on STAN, Compustat, OECD, World Bank and IMF data.

[9] In fact, the two sector-level variables, intangible intensity and external finance dependence, are poorly correlated (e.g. correlation coefficient around 0.1; see Demmou, Franco and Stefanescu, 2020). To rule out the possibility that the findings are the outcome of a purely statistical relation, we conduct a placebo test in which the values of Financial Development (Intangible Intensity) are replaced with random draws from a normal distribution parameterized on the mean and variance of the true Financial Development (Intangible Intensity) and the outcome is reassuringly not significant. Finally, we check the consistency of the findings when estimating a more parsimonious GLS model allowing the inclusion of the main effects of the interaction term. These results are available upon request.

Figure 4. Financial development benefits productivity more strongly in intangible-intensive industries

Productivity gains (in high relative to low intangible-intensive sectors) from moving to best practices



Note: Based on the first specification in Table 1, the figure shows the differential productivity increase in intangible-intensive sectors compared to traditional sectors following an increase in financial development to the highest level according to the IMF index (average value of the index during the sample period; benchmark country: USA).
Source: OECD calculations on STAN, Compustat and IMF data.

2.2.2. Within-firm productivity effect

16. The within firm channel operates via the ability of firms to finance their innovative projects and thus increase their productivity, either by improving the quality of their products or the efficiency of their production processes. Limited internal funds and/or constraints on external financing could impair the implementation of firms' productivity-enhancing strategies, particularly in intangible-intensive sectors, due to the additional difficulty to finance intangibles.

17. Relying on financial ratios and their combinations through indices to capture financial constraints at the firm level, the baseline findings confirm that firms in intangible-intensive sectors benefit relatively more from sound financial conditions (Table 2). These results, which are consistent with respect to a wide range of robustness checks, hold independently of the firm-level financial constraints measure chosen and further support the claim that intangible intensity captures an important dimension of the relative exposure of industries to financing frictions (see Table C.1 and Table C.2).[10]

18. The magnitude of the effect is again substantial. Compare two firms, one at the 75th and one at the 25th percentile of the financial constraints distribution; their difference in terms of financial constraints explains 14.4% of their variation in productivity if they operate in intangible-intensive sectors, against 11% in traditional ones (Table 2, specification 4; Figure 5). This 3.4 percentage point differential effect implies a 31% increase in the relevance of financing frictions when moving from a traditional sector to an intangible-intensive one. Moreover, the magnitude of the effect is broadly consistent across the various proxies of financing constraints.

[10] As shown explicitly in the background technical paper (Demmou, Franco and Stefanescu, 2020), the results are also consistent with the following robustness checks: the use of a continuous measure for intangible intensity; the inclusion of an interaction between financing constraints and external finance dependence; labour productivity as dependent variable; alternative data cleaning strategies; exclusion of poorly covered or largest countries in Orbis; the estimation of cross-sectional models, as well as of a dynamic model of productivity growth.

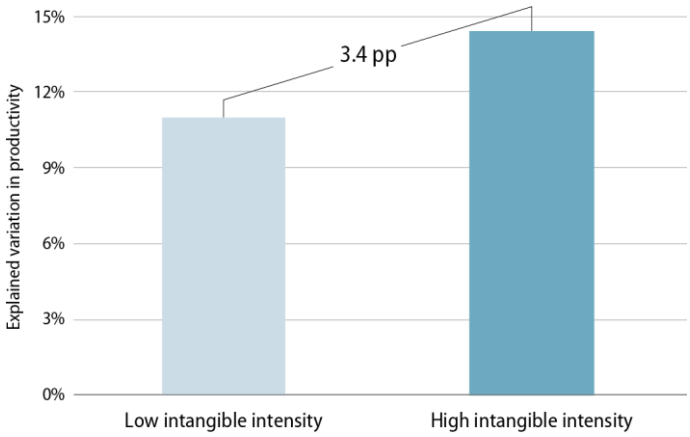
Table 2. Within-firm effect

Dependent Variable: Log MFP						
	(1)	(2)	(3)	(4)	(5)	(6)
Financial Indicator Type		Simple Ratios		Unweighted Index	Weighted Indices	
Financial Indicator	Financial Leverage Ratio	Interest Coverage Ratio **(-)**	Cash Holdings over Assets **(-)**	DFS_vB	WW_num	SAFE_v1
Financial Constraints	**-0.037*** **	**-0.007*** **	**-0.153*** **	**-0.032*** **	**-0.976*** **	**-0.020*** **
	(-16.4)	**(-19.5)**	**(-53.4)**	**(-114.8)**	**(-108.6)**	**(-137.9)**
Financial Constraints * Intangible Intensity	**-0.043*** **	**-0.002*** **	**-0.052*** **	**-0.010*** **	**-0.310*** **	**-0.004*** **
	(-13.5)	**(-4.1)**	**(-13.1)**	**(-25.2)**	**(-24.2)**	**(-22.3)**
Observations	10,443,551	10,443,551	10,040,817	8,098,713	7,459,986	9,994,179
R-squared	0.806	0.806	0.809	0.816	0.818	0.811
Firm Controls & Interactions	YES	YES	YES	YES	YES	YES
Country * Sector * Year FE	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES

Note: T-statistics in parentheses; standard errors clustered at the firm level. Significance Level: *10%, **5%, ***1%. The dependent variable is the log of firm-level total factor productivity, estimated according the GMM Wooldridge (2009) approach. In models (1), (2) and (3), financial constraints at the firm-level are proxied by simple financial ratios: financial leverage (ratio of financial debt over total assets); the inverse of the interest coverage ratio (ratio of EBITDA over interest payments, divided by 1000 to adjust coefficient's scale); the inverse of cash to total assets (ratio of cash holdings over total assets). In models (4), (5) and (6), financing constraints at the firm-level are proxied by a different composite financial constraint index; a detailed description is presented in Table C.1. Sectoral intangible intensity (Figure C.1) is measured as in Demmou, Stefanescu and Arquié (2019); it is used as a binary variable with respect to the average sector. The firm level controls included in all specifications are: total assets, EBITDA and age, together with their interactions with intangible intensity. The estimation is based on Equation 2 and builds on the framework developed in Demmou, Franco and Stefanescu (2020); it is carried out over the 1995-2015 period and includes firms located in 29 countries (AUS, AUT, BEL, CHN, DEU, DNK, ESP, EST, FIN, FRA, GBR, GRC, HUN, IDN, IND, IRL, ITA, JPN, KOR, LUX, LVA, NLD, POL, PRT, RUS, SVN, SWE, TUR, ZAF).
Source: OECD calculations on Orbis and Compustat data.

Figure 5. Easing financial constraints is more beneficial for firm productivity in intangible-intensive sectors

Effect on productivity of moving from a high to a low level of financial constraints



Note: Based on the fourth specification in Table 2, the figure shows the portion of the variation in productivity explained by moving from a high (75th percentile in the distribution of firms' financial constraints) to a low (25th percentile) level of financial constraints.
Source: OECD calculations on Orbis and Compustat data.

2.2.3. Between-firm productivity effect

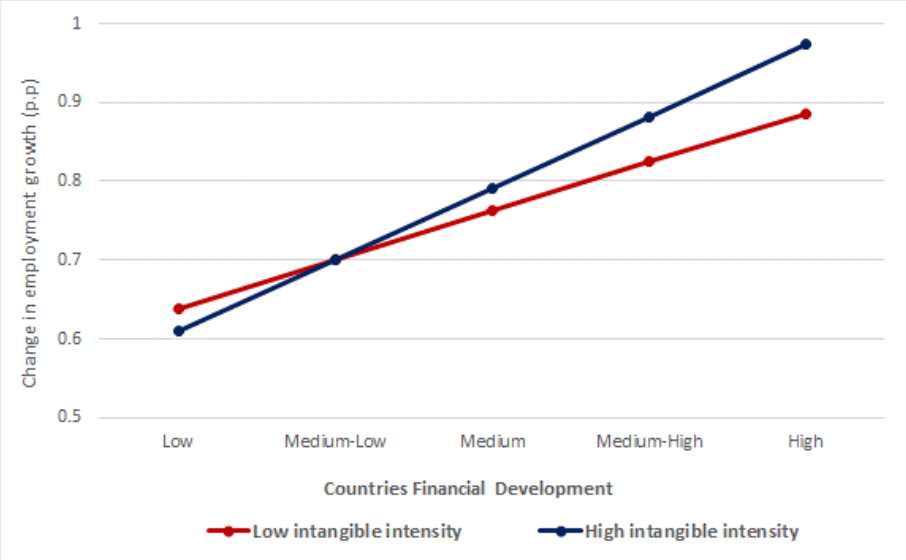
19. The between-firm channel operates via the ability of the most productive firms to attract more resources and gain larger market shares than the least productive ones. Overall, consistent with our priors, higher productivity is generally associated with stronger firm-level employment growth: high productivity firms have on average an employment growth that is 0.9 percentage point higher than low productivity firms (Table 3, specification 1).[11]

20. Financial conditions are a critical factor that may influence the continuous reallocation process among producers with different productivity levels and growth potential (Midrigan and Xu, 2014; Moll 2014; Larrain and Stumpner, 2017; Gopinath et al., 2017). The empirical analysis shows that a deep financial system tends to reduce the barriers impeding an efficient allocation of resources, reinforcing the link between productivity and firm growth (Table 3, specification 2). Also, the impact of financial development on reallocation is larger in intangible-intensive sectors, as evidenced by the positive and statistically-significant coefficient on the triple interaction between lagged productivity, intangible intensity and financial development (Table 3, specification 3).

21. Interpreting results causally, moving from a relatively low (e.g., Latvia, Slovakia) to the highest (U.S.) financial development level, the contribution of productivity to employment growth increases by 60% in intangible-intensive sectors and by 40% in traditional ones (Figure 6). These findings are robust to the inclusion of firm fixed effects, which allow to test whether a deep financial system is particularly important in translating firms' productivity improvements into employment gains in intangible-intensive sectors (Table 3, specification 4).[12]

Figure 6. Financial development allows productive firms to grow faster, but more so in intangible-intensive sectors

Effect of a 10% increase in productivity on employment growth at different levels of financial development



Note: Based on the third specification in Table 3, figure presents the marginal effect of productivity on employment growth at different levels of financial development in both high (blue line) and low (red line) intangible-intensive sectors.
Source: OECD calculations on Orbis, Compustat and IMF data.

[11] Firms at the 75th (25th) percentile of the productivity distribution are taken as a proxy for a representative high (low) productivity company.

[12] Finally, we also check the consistency of our findings using a sector-level framework, based on the so-called OP gap to assess the extent of misallocation in each country-sector-year. The outcome is presented in Annex B.

Table 3. Between-firm effect

Dependent Variable: Employment Growth				
	(1)	(2)	(3)	(4)
Productivity	**0.087*** **	**0.048*** **	**0.051*** **	**0.171*** **
	(258.5)	**(28.4)**	**(19.5)**	**(37.4)**
Productivity * Financial Development		**0.050*** **	**0.041*** **	**0.011***
		(23.8)	**(12.4)**	**(1.9)**
Productivity * Intangible Intensity			**-0.009** **	**-0.013** **
			(-2.5)	**(-2.2)**
Productivity * Intangible Intensity * Financial Development			**0.019*** **	**0.047*** **
			(4.4)	**(6.4)**
Observations	10,461,578	10,461,578	10,461,578	10,461,578
R-squared	0.051	0.051	0.051	0.219
Firm Controls (Size, Age, Profitability)	YES	YES	YES	YES
Country * Sector * Year Fixed Effects	YES	YES	YES	YES
Firm FE	NO	NO	NO	YES

Note: T-statistics in parentheses; standard errors clustered at the firm level. Significance Level: *10%, **5%, ***1%. The dependent variable is employment growth, calculated as the yearly difference in log employment levels. Productivity is measured as the log of firm-level total factor productivity, estimated according the GMM Wooldridge (2009) approach. Sectoral intangible intensity (Figure C.1) is measured as in Demmou, Stefanescu and Arquié (2019); it is used as a binary variable with respect to the average sector. Financial development is proxied by a multidimensional index (from the IMF) capturing the overall availability of finance in a country-year. All specifications include country by sector by year fixed effects, as well as a set of firm-level controls (total assets, EBITDA and age), while model (4) also includes firm fixed effects. The estimation is based on Equation 3; it is carried out over the 1995-2015 period and includes firms located in 29 countries (AUS, AUT, BEL, CHN, DEU, DNK, ESP, EST, FIN, FRA, GBR, GRC, HUN, IDN, IND, IRL, ITA, JPN, KOR, LUX, LVA, NLD, POL, PRT, RUS, SVN, SWE, TUR, ZAF). Source: OECD calculations on Orbis, Compustat and IMF data.

2.3. Finance and intangibles: new challenges and opportunities related to the COVID-19 outbreak

22. The COVID-19 outbreak generates new opportunities to harness intangible assets potential, but also increases the challenges related to their financing. On the one side, due to their organisational and financial characteristics, intangible-intensive firms tend to be more resilient to shocks like the COVID-19. On the other side, the same factors at the heart of this resilience could become a source of difficulties during the recovery, slowing down intangible-investment in the aftermath of the crisis, leading to the premature exit of potentially viable innovative firms and reducing market contestability following lower entry rates.

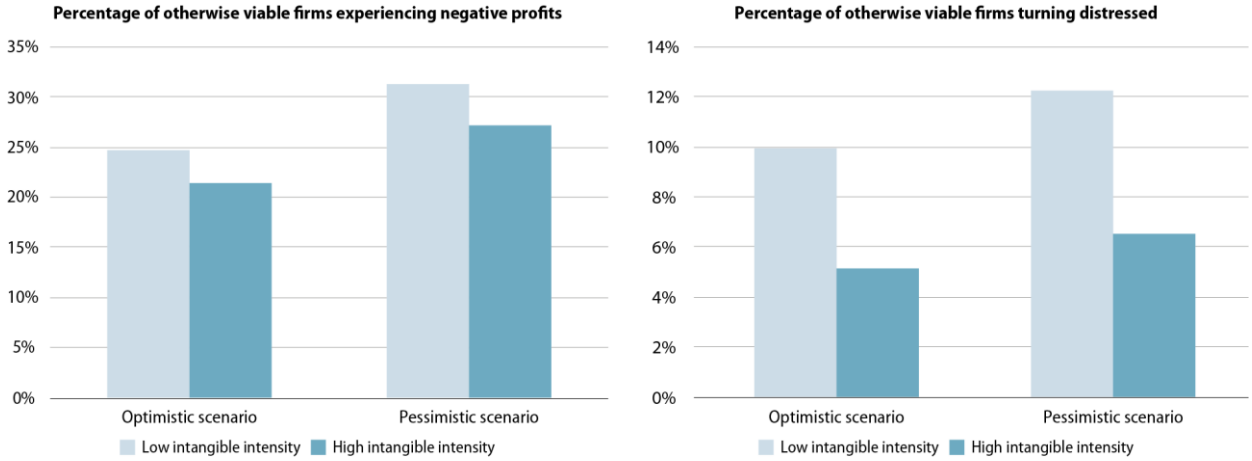
2.3.1. Intangible-intensive firms are better positioned to weather the COVID shock…

23. OECD analysis (Demmou et al., 2021a) predicts that intangible-intensive sectors are better positioned to weather the crisis compared to traditional sectors (Figure 7).[13] First, consistent with the diverse ability to rely on innovative technologies, firms operating in intangible-intensive sectors faced on average a less severe sales shock, so that they are estimated to experience a slightly lower decline in profitability and a relatively smaller portion of those firms is expected to report losses. This is because such technologies allow a better and quicker adaptation to the new social distancing norms that are likely to prevail in the short to medium term and facilitate the reorganisation of supply chains that have been

[13] The figure reports average results and hence does not reflect the heterogeneity that might exist within group of sectors (e.g. certain high intangible intensity industries, like aircraft manufacturers, have been vulnerable to the shock).

disrupted by the crisis. Second, intangible-intensive firms tend to rely prevalently on internal funds to finance investment and thus to be less leveraged and to hold larger cash and equity buffers; as a result, they are better placed to service their debt and have a lower probability of becoming distressed during the COVID-19 crisis.

Figure 7. The impact of COVID-19 along the intangible intensity dimension



Note: Based on the accounting framework developed in Demmou et al. (2021a), the figure shows the predicted impact of the COVID-19 outbreak one year after the implementation of the first confinement measures on both high and low intangible-intensive sectors. The left panel reports the percentage of firms experiencing losses, while the right panel the percentage of distressed firms (i.e., firms whose book value of equity is predicted to turn negative). Notice that the sample is restricted ex-ante to firms having both positive profits and book value of equity in the 2018 reference year and that, for the sake of exposition, the y-axis scale varies among panels.
Source: OECD calculations on Orbis and Compustat data.

2.3.2. ...but challenges related to the financing and the growth of intangibles might be heightened in the aftermath of the crisis

The risk of a slowdown in intangible investment

24. The evidence presented above suggests that intangible-intensive firms could be relatively more resilient to the COVID-19 shock. Yet, this stronger resilience could also come at the price of a subsequent slow-down of their investment path due to increased financing constraints. As firms are using their cash reserves to cover operating expenses during the confinement and post-confinement period, and given the difficulty to finance intangibles through traditional external sources, they may have to reduce critical investments until they buffer again enough financial resources – a process that might take time given the reduced profit streams and uncertainty around future sales.

25. The COVID-19 shock may also lead to a change in the composition of investment. Financially-constrained firms may prioritize investment in pledgeable assets to offset the tightening of financial conditions, resulting in an even stronger cut-back of intangible investment (Munro and Lamb, 2020; Paunov and Planes-Satorra, 2020). This tilting towards tangible investment may be even more widespread for at least two reasons. First, intangible investment is often irreversible, takes more time to translate into sales compared to physical capital and has more uncertain returns, so that it appears particularly unappealing in the current context.[14] The other potentially aggravating factor is linked to the necessarily loose monetary

[14] For instance, Barrero et al. (2017) and Bansal et al. (2019) provide evidence that R&D investments are highly sensitive to uncertainty; Barrero et al. (2020) stresses that the same may hold for other types of intangible capital.

policy implemented to contrast financial markets turmoil, which may favour a reallocation of resources towards collateralized tangible-intensive firms; indeed, while a low level of interest rates encourage investments across the board, intangible-intensive firms would be relatively disadvantaged due to the low collateral value of their assets and the higher difficulties to accumulate savings in a low interest rate environment (Caggese and Perez-Orive, 2019).

The risk of a premature exit of distressed but potentially viable intangible-intensive firms

26. Despite higher resilience, the share of otherwise viable firms turning distressed remains sizeable in intangible-intensive sectors. The premature exit from the market of those firms could have permanent consequences on economic growth, as the economic costs of business failures might be particularly high for these firms. First, intangible assets like buyer-supplier trust, lender-borrower relationships, organisational effectiveness, employee-firm relations would require large sunk investments and time to be re-built if destroyed by the crisis. Second, the liquidation value of intangible capital tends to be low, especially for intangible assets which are firm-specific and hence not easy to be transferred.

27. An additional source of financial distress for companies heavily relying on purchased intangibles could stem from a large write down of the value of these assets. Indeed, indefinite-lived intangible assets and Goodwill, which usually reflects intangible capital not captured by accounting numbers in M&A activity, are not amortised regularly and the widespread disruptions following the COVID-19 shock could have created a gap between the original book value and their market value. Such situation would further decrease earnings and subsequently equity capital, weakening even further intangible-intensive firms ability to remain in the market and invest during the recovery.

The risk of lower market contestability/competition

28. COVID-19 related disruptions also generate a challenge with respect to the entry of new intangible-intensive start-ups and its potential impact on the competitive environment. The uncertain economic environment is expected to strongly reduce entry rates, hinting at the risk of a potential "lost generation" of companies.[15] A collapse of enterprise births could have long-lasting effects on innovation and aggregate employment, as new entrants tend to bring disproportionately more new products or processes to the market, make more intensive use of intangible capital and increase competition and market contestability. Moreover, the shock could also induce a rise in the strategic acquisition of distressed companies, a phenomenon already observed in the aftermath of the Great Financial Crisis. While being acquired can often be the optimal solution for innovative entrants which do not find it convenient to go public, an increase in M&A activity may have unintended effects on the competitive environment and business dynamism, especially in an intangible-based economy characterized by strong network effects.

3. Policies to close the intangible financing gap

29. The available evidence highlights that the global shift towards intangible-intensive growth creates new financing challenges for firms, which are likely to have been exacerbated by the COVID-19 shock. In particular, the specific financing frictions faced by intangible-intensive firms imply that they might not be able to exploit their growth opportunities in full, and the higher cost of capital might deter the entry of new

Moreover, business investment in R&D tends historically to move in parallel to GDP, corroborating that economic downturns have a global negative impact on innovation investments (Paunov, 2012).

[15] For instance, firm creation in March and April 2020 dropped by 70% in Portugal, 46% in Hungary, 54% in France and 57% in Turkey compared to the same months of the prior year (Calvino et al., 2020). Similarly, 20 000 new companies were missing in Italy due to the COVID-19 shock, when comparing the first half of 2020 with the same period of 2019 (Formai et al., 2020).

innovative firms. This section discusses policies that could contribute to closing the resulting financing gap by improving the provision of three sources of financing for firms: state financial support to knowledge activities, equity-based and bank-based financing.

3.1. Government financing for a knowledge-based economy

30. Governments finance a portion of business sector investment in intangibles, either directly through transfers, grants and loans or indirectly through tax incentives. Government support schemes can help reduce the gap in the financing of intangible assets by allowing companies to invest in innovative activities with potentially relevant economy-wide positive spillovers. Moreover, following the COVID-19 outbreak and the strong fiscal stimulus packages adopted to counteract the economic consequences of the pandemic, governments could play an even broader role in facilitating intangibles financing and the shift towards a knowledge based economy.

3.1.1. Government support in normal time

Government indirect support to innovation

31. R&D tax incentive schemes are a common tool widely used by governments to support innovation.[16] Overall, they relax financial constraints affecting intangible investment (OECD, 2020c), by reducing its cost for the eligible company and thus fostering within-firm productivity. Indeed, R&D tax incentives have a stronger productivity impact in sectors dependent on external finance, on financially constrained firms as well as on small and young companies with previously relatively low levels of R&D investment (Kasahara et al., 2014: Kobayashi, 2014; OECD, 2021a). Yet, their effects on business dynamism and the efficient allocation of resources across firms are less clear. The reduction in financing constraints at the firm level allows to enlarge the pool of companies contributing to intangible production (Castellacci and Lie, 2015). But the extent of tax subsidies that firms obtain and their distribution across firm types is highly dependent on the design of R&D tax incentives (Appelt, et al. 2019; OECD, 2021b). Credits could disproportionately favour large incumbents, slowing down the reallocation process and resulting in weaker business dynamism in R&D-intensive sectors (Bravo-Biosca, Criscuolo and Menon, 2013; Appelt et al., 2016; OECD 2020h).

32. The appropriate design of R&D tax schemes could make them more suited to help innovative and intangible-intensive SMEs close the financing gap in intangibles. As even young and dynamic SMEs often have relatively low profits, especially at the early stage of their life-cycle, credits tend to be ineffective when limited to tax income liabilities, so it is critical to ensure they can be carried forward (i.e. the unused part of the tax credit to be applied to tax liabilities in future years), refunded (i.e. the unused part of the credit is directly payable to the company) or redeemed against payroll and social security contributions (Appelt et al., 2016). In particular, refundability tends to have a stronger impact on R&D private investments compared to carry-over (Poschel, 2019), as the effectiveness of the latter is impaired by the time lag between the innovation-related expenses and the exploitation of the benefits related to the tax credit, which may be even more relevant than the generosity of the credit (Elschner et al., 2009).[17] Moreover, it is worth noticing that the simple provision of more generous R&D tax credits based on firms' size, which is applied in several OECD and G20 countries to offset the implicit relative advantage large incumbents may have, might lower incentives to grow, with detrimental aggregate productivity effects.

[16] R&D tax incentives can provide relief to the input to the innovation process (i.e. expenditures incurred by firms) or to the output (i.e. to the returns from the R&D investment). This section focuses on the former.

[17] Yet, while carry-forward options are frequently available, it is less the case of refundable options. For instance, only 14 out of the 30 OECD countries that provided tax support for R&D in 2017 offered refundable tax credits or equivalent incentives. See OECD, 2020g for details.

33. Whether current expenditures-based tax incentives schemes should be expanded to cover a wider range of intangible assets is still a pending question. Indeed, currently, tax incentives largely target only R&D-related expenditures (e.g., labor expenses for R&D personnel, the acquisition of software used for R&D, licenses and IP rights for R&D; OECD, 2019a). Extending the schemes does not come without challenges (OECD, 2021a). First, it might be difficult to implement, given the difficulty to monitor the eligible spending and the risk of inappropriate classification of expenses in order to take advantage of the tax credit.[18] Second, such extension could give rise to tax planning opportunities and generates BEPS risk (e.g. marketing expenses or advertising can be relocated easily from one subsidiary of the firm to another). Third, tax incentives may also lead to significant deadweight losses if they subsidize activities that would have taken place also absent the incentives.

34. The extent to which such an extension is desirable depends critically also on the type of asset. With respect to intangible assets which do not display large positive externalities (e.g. marketing and advertising), and which might even be engaged by the firm in order to create barriers to entry, ensuring the conditions for financing by the financial markets seems a better option than subsidizing those expenditures. In contrast, investment in the economic competencies of workers (in particular lifelong training, apprenticeships and managerial skills), which display high social returns, could theoretically be considered as relevant.[19]

Government direct support to intangible investment

35. Direct government support for innovation can play an important role, often complementary to tax incentives, in reducing the financing gap in intangibles, and especially so with respect to young firms lacking alternative financing sources (Hottenrott and Lopes-Bento, 2014; Mateut, 2018). Direct funding for R&D can come in several forms: grants directly to the company, loans from a government agency (often with conditions as to when they must be repaid and/or forgiven), government loan guarantees (see below the section on banking), and government support to start-up firms (OECD, 2019b; OECD, 2021a). In addition to providing funds, government support entails a positive certification effect. To be selected, firms go through an official evaluation, which involves information disclosure reducing the information asymmetries faced by traditional financial intermediaries.[20] The design of the support is again key to ensure its effectiveness. In particular, beneficiary firms should be targeted on the basis of their age and growth potential, reducing the risk of simply picking winners which would have been successful even without the support (Berlingieri et al., 2020).

36. An important advantage of direct government funding is the possibility to widen the range of intangibles investments that are supported, a feature which is notably relevant in light of the complementarity among the various types of intangibles. Beyond financing R&D, governments may provide direct fund to support young firms with respect to the assessment of the technical feasibility of their innovative projects, to ensure the conditions for commercialisation and access to consulting services, as well as to train entrepreneurs who may lack market and commercial expertise. Finally, fostering collaboration across firms is another way to ease SMEs financing constraints. In fact, given the complementarity among the various types of intangible assets, the development of partnership agreements allows to mutualise the high initial fixed costs and to benefit from knowledge spillovers. Clusters and

[18] For instance, the classification of indirect costs of R&D (not eligible for the tax credit) as R&D might have led to significant tax advantages in the U.S. (Laplante et al., 2019).

[19] The range of public policies aimed at strengthening skills training is large and goes beyond the scope of this paper. A detailed discussion of these policies is available, for instance, in Bassanini et al. (2007) and McCall et al. (2016).

[20] Supporting this narrative, based on an analysis of approved and denied subsidy requests from a sample of Belgian SMEs, Meuleman and De Maeseneire (2012) show that obtaining support for R&D investment results in better access to long-term debt and more equity financing.

business incubators help to create further opportunities for such partnership and collaborative research between intangible-intensive firms (OECD, 2019c).

Government support to skills formation

37. The increasingly knowledge-based nature of the economy implies substantial changes in firms' organisational structures and thus in the skills workers are required to have, making support to investments in job training even more appealing. Among several potential schemes, the most common are a tax allowance for education or training expenditures, a tax credit against relevant spending or a tax exemption for income accrued by specific groups such as apprentices (CEDEFOP, 2009; Torres, 2012; OECD, 2017a).[21] An alternative option consists in favouring the establishment of Employment Funds. In this setting, firms pay mandatory fees to the fund, which creates rights to finance employee training, creating incentives to involve their workers in training to recoup their investment. Contributions to the fund are settled according to firms' characteristics (e.g. size), so that a kind of mutualisation mechanism helps SMEs to upgrade their worker skills, with potentially broader positive consequences. Box 3 provides a more detailed overview of the instruments governments could use to ease barriers to firms investment in training.[22]

38. Targeted programs to advance management and leadership skills are also critical to guide SMEs through the transition to an intangible, digitalised economy and the subsequent changes in businesses processes. Sound managerial practices are associated with a more efficient diffusion of digital technologies (Andrews et al., 2018) and higher productivity (Bloom et al., 2017). While governments cannot directly affect firms' managerial performance, they can act as a catalyst by investing in networks to enable small businesses to learn from each other and from world-leading firms. For instance, the United Kingdom is providing funds to incentivise exchanges between mentors from frontier companies and SMEs, and launched a "Small Business Leadership Programme" to grant small business leaders access to leadership training, building on existing world class training programmes (UK Government, 2019). Moreover, governments could encourage the adoption of good managerial practices in public administrations and government-owned enterprises, with potential spillovers reaching the private sectors, and ensure product markets remain competitive, hence providing firms with the right incentives to improve managerial performances.

39. An increasing demand for innovation would also require a steady increase in human capital supply, going beyond on-the-job training and the upskilling of the current workforce. Governments' action could be organised along three main areas:

- First, policy makers should aim at reducing barriers impeding talented but disadvantaged individuals to become innovators. As a matter of fact, there is large evidence that students from disadvantaged backgrounds tend to underperform their peers with more favourable socio-economic conditions, irrespective of innate abilities, and that disadvantaged schools have fewer resources both in terms of educational staff and material; increased school quality and closing regional divides could hence provide large benefits, and especially so in the aftermath of an asymmetric shock such as the COVID-19 outbreak.

[21] For instance, about half of the EU Member States have already established tax incentives in the corporate income tax for education and training. Noteworthy, even in the absence of tax allowances or tax credits, education and training expenditures are treated as an expense from an accounting point of view and thus are typically deducted immediately, which would constitute already a more generous tax treatment compared to other capital investments.

[22] Though beyond the scope of this paper, it is worth mentioning that an adequate supply and quality of training programmes is key to ensure their effectiveness; for instance, tripartite commissions (workers, employers, governments) could help to develop relevant training courses and guarantee minimum quality standards.

- Second, fostering the expansion university programs to increase training in science, technology, engineering and mathematics (STEM) could increase both the quantity and quality of inventors as well as the diffusion of an effective use of digital technologies (Bloom et al., 2019).
- Third, striving for a better labour market inclusion of women and migrants could also turn out to be an effective innovation policy by potentially increasing the pool of skilled workers and, as a result, also decreasing innovation costs due to lower equilibrium wages.

Box 3. Easing barriers to firms investment in job training

Human capital accumulation goes beyond education and investment in lifelong training and managerial skills is increasingly important to adapt workers skills to technological change. However, it is often not easy to finance, and adults learning and training programs receive much less funding then other education areas; for instance, in OECD countries, governments contribute for less than one fourth to adult learning expenditures and employers bear almost half of the cost (OECD, 2019d). Governments could use a wide range of instruments to reduce financial barriers and overcome market failures generating an inefficient under-provision of on-the-job training, incentivising firms to upgrade their workforce skills.

The most commonly used tools are subsidies and tax incentives, which could help reducing the direct costs of training. They could take various forms. For instance, firms offering training to their workers will have lower social contributions to be paid in Spain, while they could obtain tax credit rights in Argentina or a compensation between 50% and 100% of training costs in Estonia (with a maximum cap and also depending on worker characteristics). Subsidies and tax incentives could also decrease the indirect costs of training for firms, and in particular wage payments during training periods. For instance, the *Credito di Imposta Formazione 4.0* program in Italy is based on a tax incentive that covers 40% of wage payments (with a maximum cap) for the whole duration of specific types of training; similarly, the *Jinzai Kaihatsu Shien Joseikin* in Japan is an example of a subsidy to reimburse wage expenses during training, and its size varies depending on firms' size and the type of training.

A set of complementary policies could reduce the opportunity costs related to training as well as potential liquidity constraints. While not widely used, job rotation schemes, which help finding a replacement worker for the duration of the training, could be particularly useful to support SMEs in reducing the damages from foregone production. Similarly, firms may not be willing to train workers if unsure to gather the benefits of training and the inclusion of payback clauses in training arrangements (e.g. firms can recover part of the investment if a worker leaves soon after training) could mitigate these concerns. Moreover, due to limited access to external financing, SMEs may face tight financing constraints pushing for a delay or omission of workers training, and targeted government loans could provide the necessary bridge financing. For instance, in Korea, firms could obtain a loan covering 90% of the expenses related to training facilities.

Further, governments could incentivise firms to set resources aside for future training by contributing to pooled training levies or funds. Such incentives could involve levy-grant schemes, in which firms contributing to the funds are incentivised to undertake the training themselves through grants larger than initial contributions (e.g. France, Italy, Korea), or levy-exemption schemes, in which the cost of training is deducted from tax payments (e.g. Australia, Canada and the United Kingdom). Alternatively, the fund could be structured as a simpler revenues generating scheme and governments use the funds to provide general training to employees (e.g. SENAI scheme in Brazil). In this occurrence, training rights may also be fully attached to the worker and disembodied from the firm. For instance, in France the personal training account scheme (CPF, *Compte personnel de formation*) allows workers to carry those rights to another firm when they change jobs. Against the threat of labour poaching, such a provision might be more favourable to job mobility and the efficiency of labour allocation compared to

the use of contractual arrangements that prevent workers from moving to a competitor or to a framework in which training rights are limited to the current employment position (OECD, 2019a).

Source: OECD (2019d), "Getting Skills Right: Future-Ready Adult Learning Systems", *Getting Skills Right*, OECD Publishing, Paris.

3.1.2. Government support in COVID-19 time

40. Governments' swift reaction has been decisive to help firms dealing with the disruptions associated with the COVID-19 outbreak (OECD, 2020b). Policies that help to preserve continuity of firms' operations, such as the widespread and temporary support measures implemented by governments in the form of wage subsidies, loans, grants and debt and tax deferrals, have been critical to address the immediate liquidity needs and avoid the destruction of productive capital that would follow the liquidation of otherwise viable businesses (Demmou et al., 2021b). The prospect of the availability of a vaccine in 2021 has contributed to progressively shift policy makers' focus from the emergency to the recovery. The large fiscal needs call for cost-effective spending and an evolution towards more targeted support once the outlook improves. If well directed, current COVID-19 related government support, which facilitates financing through a variety of sources (e.g., loan guarantees, equity-type instruments), could contribute to ease these frictions and become an opportunity to accelerate the shift towards a knowledge-based economy.

41. Government loan, grant and loan guarantee programmes play a key role in addressing liquidity shortages, but it is unclear whether they have the potential to support investment in intangibles, in particular by dampening "the tyranny of collateral". On the one side, many lending programmes – particularly those directed towards SMEs – rely on banks to allocate funds and require them to take on additional credit risk (OECD, 2020b; OECD, 2020d). This might be particularly damaging for intangible-intensive firms, which tend to rely on unsecured loans associated with higher risk for banks. On the other side, several programmes permit banks to retain only a small portion of credit risk exposure through loan government-backed guarantees. Such guarantees could (at least partially) substitute for collateral availability and help to reduce the gap existing between loans secured by tangible assets and unsecured loans. For instance, under the new ECB's collateral easing measures framework, national Central Banks can accept as collateral loans distributed to small and medium-sized enterprises (SMEs) that benefit from government guarantee schemes (De Guindos and Schnabel, 2020).[23]

42. Several countries have also developed support schemes featuring equity-type capital injections, which could be particularly beneficial in supporting the activity of intangible-intensive firms facing credit constraints, given the inherent advantage of equity financing for innovation. To limit governance issues, such support could take the form of preferred stocks that provide higher priority when it comes to dividends, but limited rights in terms of voting, mitigating the resistance of shareholders that do not wish to dilute their ownership. Moreover, given the difficulties for the government to manage a large number of small equity claims, quasi-equity type of financing that do not require a close monitoring of supported companies might be better suited for SMEs (Blanchard et al., 2020). Also, it is important to ensure that these measures are state-contingent and include mechanisms to incentivise all parties to wind down support when economic conditions improve (OECD, 2020e; OECD, 2020f).[24]

43. Some countries have already taken actions to countervail the observed decline in angel investors and venture capital activity, which could further impair SMEs innovative potential (Paunov and Planes-

[23] However, one drawback of loan guarantees schemes is that it contributes to increase firms leverage which could lead some of them in a situation of debt overhang (Demmou et al., 2021a). This risk may remain lower for intangible-intensive firms given their lower leverage ratios.

[24] For a detailed discussion on advantages and disadvantages of government equity injections during the COVID-19 see OECD (2020f).

Satorra, 2020; OECD, 2021a).[25] For example, France set-up a EUR 4 billion fund to support start-up liquidity, Germany has announced a tailored start-up aid programme, expanding and facilitating venture capital financing, and the United Kingdom has announced a co-financing fund for innovative companies facing financial difficulties (Calvino et al., 2020). Another potential policy option consists in increasing tax deductions for individuals investing in start-ups (Formai et al., 2020).

44. To avoid a scale down in innovative activities during the pandemic, direct public support to business investment warrants to be preserved. Indeed, there is evidence that these support schemes are more effective when they are stable over time, as firms tend to hesitate to invest in additional R&D if they are uncertain of the durability of government support (UNCTAD, 2020). In the short-term, digital adoption by SMEs may require a specific attention. While digitalisation could favour the efficient implementation of remote work policies and speed up the recovery, financing constraints plaguing small and young firms reduce their ability to weather the crisis and undertake such investments. To mitigate those barriers to invest in digital technologies, several countries have established support to ease the adoption of new processes (e.g. use of selling tools, digital communications, adjusting production facilities to respond to current market shortages) (Paunov and Planes-Satorra, 2020).[26] Along similar lines, offering financing facilities for SMEs and start-ups to engage in investment in skills, e.g. through online training, becomes an even more relevant policy priority to prevent skills depreciation and reduce the scarring effects of the crisis.

45. Overall, government support plays a pivotal role in addressing the market failures related to intangibles financing and thus contributes to foster an intangible-oriented, fast and sustainable recovery from the COVID-19 outbreak while building resilience with respect to new shocks. However, private financing remains the best option for assets which do not display positive externalities and governments can act indirectly by establishing the conditions to ease the financing of intangible assets by equity investors and banks.

3.2. Financial markets for a knowledge-based economy

46. Equity investors, who take a broader view on companies' growth opportunities and are relatively more willing to take risks, are the main suitable source of financing for intangibles (Brown et al., 2012; Hsu et al., 2014; Acharya and Xu, 2017). Several policy actions could contribute to better align financial markets with the needs of the knowledge economy. First, it is critical to establish the appropriate set of framework conditions allowing the deepening of equity markets where they are still underdeveloped and ensuring that the structure of equity markets is supportive of the provision of patient and engaged capital. Second, the development of venture capital markets, which are the most natural source of finance for start-ups and intangible-intensive firms at early stages of their life-cycle.

3.2.1. Framework policies to develop equity markets

Increasing the size of equity markets

47. Equity market is still underdeveloped in several OECD and G20 countries, with potential negative consequences for intangible investment and productivity. Overall, simulations based on OECD empirical analysis confirm that the size of the equity market matters for productivity dynamics, especially in intangible-intensive sectors. More specifically, a one standard deviation increase in the market

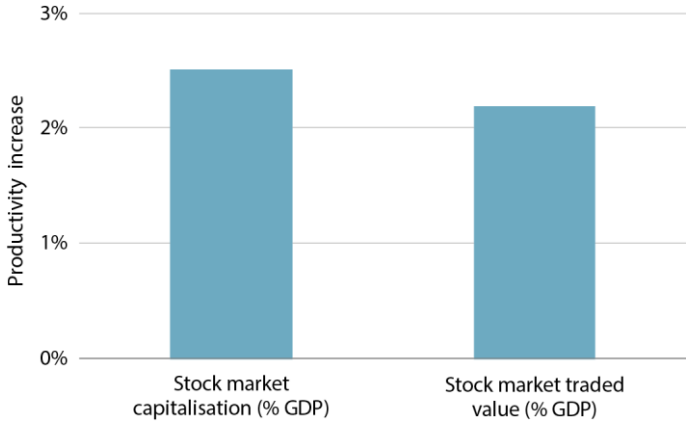
[25] For instance, venture capital (VC) investments in new companies declined by 60% in China and 5644% in Ireland in the first quarter of 2020 compared to the first quarter of 2019. Early-stage seed investments fell over the same period by 86% in China and 38% in the United States in March and April 2020 (Paunov and Planes-Satorra, 2020).

[26] For instance, Enterprise Ireland provides vouchers and grants for companies to acquire training or advisory services related to the continued operation of their businesses during the current pandemic and to strengthen businesses' use of the internet as an effective channel for business development.

capitalisation to GDP ratio (or in the stock value traded over GDP ratio) – approximately equivalent to moving from Portuguese to Australian equity market characteristics – implies an increase in productivity that is 2.5% (2.2%) higher in intangible-intensive sectors than in traditional ones (Figure 8).

Figure 8. Deep equity markets benefit especially intangible-intensive sectors

Productivity gains (in high relative to low intangible-intensive sectors) from improving the size of equity markets



Note: Based on the first and second specifications in Table C.3, the figure shows the differential productivity increase in intangible-intensive sectors compared to traditional sectors following a one standard deviation increase in either market capitalisation to GDP or stock market traded value to GDP ratios (World Bank). The estimation is carried over the 1990-2015 period.
Source: OECD calculations based on STAN, Compustat and World Bank data.

48. A potential barrier to the development of equity markets arises from the fact that several countries have established tax systems which favour debt financing over equity financing by allowing interest payment deductibility. This tax bias in favour of debt creates distortions in companies' financing choices, leading to a relatively lower demand for equity finance and to a potential misallocation of resources. Currently, given the low interest rates, the value of interest rate deductions is low, reducing the tax bias towards debt. However, the tax bias would rise with higher interest rates, and addressing it could spur the development of equity markets, increasing their size, and reducing financing constraints on intangibles investment (Nassr and Wehinger, 2016).[27]

49. Several OECD and G20 countries are tackling the issue, and three main options have been implemented or are under discussion: the complete removal of interest payment deductibility by developing a comprehensive business income tax; the introduction of a limit on the amount of debt eligible for tax deductions (e.g., Germany and Italy); and the allowance of a deduction on returns on equity (e.g. Belgium, Italy, Latvia and Portugal) reducing the tax wedge between the two sources of financing. Importantly, these types of tax reforms require strong international coordination, in light of tax planning arrangements used by multinationals (especially intangible-intensive ones). Past and upcoming work by the OECD on Base Erosion and Profit Shifting is already providing directions for action in this area (OECD, 2015b).

50. The low levels of stock market turnover and the relatively low level of financial literacy in certain countries could be other complementary explanations for their under-sized equity markets (Dlugosch et al., 2020). Low stock market liquidity makes it difficult for both domestic and foreign investors to participate in equity markets, limiting the supply of equity funds. Similarly, higher financial literacy may also affect the

[27] In fact, as debt financing tends not to be well suited for intangible investment, firms strongly relying on intangibles would be relatively disadvantaged in obtaining funds for their innovative projects, while sizeable resources are diverted towards non-profitable investments that become possible thanks to the implicit subsidy (Fatica et al., 2013).

demand of equity capital (Van Rooij et al., 2011; Boschmans and Pissareva, 2017). For instance, an increased awareness of the various equity instruments, such as the issuance of preferred shares, would allow entrepreneurs to obtain the additional financing they need without fearing to lose control of the company.

51. Besides the small size and liquidity of most of their capital markets, European countries also face specific challenges with respect to the strong segmentation along national boundaries. Progress on the Capital Market Union (CMU) agenda would deepen financial integration and ease access to equity financing. Equity investors' home bias would be reduced (Darvas and Schoenmaker, 2017) and companies located in countries where equity markets are less developed (e.g. South and Eastern Europe) would have higher financing opportunities. Furthermore, a unified capital market would improve the transparency, comparability, and reliability of the information provided by firms to financial bodies, increasing external investors' confidence (Verón and Wolff, 2016), thereby attracting a wider range of investors and increasing the resources available to European innovative firms.[28]

Harnessing the potential of long-term equity investors

52. There is a large heterogeneity across different types of equity holders, and their ability to support investment in intangibles may vary with their characteristics. The nature of intangible assets requires investors who can devote the resources necessary to collect detailed information on firms, spread risk over a diversified portfolio, and patiently invest in the most promising ones. These features are broadly associated with the business model of institutional investors, hinting that their increasing ownership shares in the last decades may have made the financial market more suited to support an intangible-based economy.[29] However, institutional investors are heterogeneous: pension plans and banks are typically long-term oriented while the opposite holds for mutual funds or hedge-funds, whose short term horizon may pressure managers to focus on immediate returns, reducing innovation investments (Lee, 2005, Davies et al., 2014).

53. Furthermore, the concomitant expansion of passive (e.g. index-linked) investment strategies may lead to an increase in equity holders' time horizon and risk diversification, but at the cost of reducing monitoring and information-enhancing research, with uncertain effects on innovation. Closely related, the rise of common ownership by institutional owners across competing companies within industries may entail positive effects with respect to the market failures related to intangibles non-rival nature and hence spur intangible investment: even if spillovers to competitors are predicted to be high, these investors would also benefit from the advantages obtained by competitor firms in light of their cross-holdings (Haskel and Westlake, 2018).[30]

54. Policy makers could increase the availability of patient, engaged and productive capital either by favouring the relative expansion of specific innovation-friendly investors or by altering equity holders' incentives. The reduction of specific regulations limiting pension and insurance funds' ability to invest in equity (while establishing an efficient risk monitoring system) could contribute to rebalancing capital supply towards long-term investments. Similarly, a revision of accounting and disclosure rules with respect to the reporting of intangible investment on the balance sheet would allow investors taking more informed decisions; for instance, the capitalisation of intangible expenses could contribute to reduce the impact of

[28] The varying nature of insolvency regulation could also act as a barrier towards the objective of a unified capital market (Bhatia et al., 2019). A first step to converge towards a minimum EU standard has been taken with the Directive on Restructuring and Insolvency.

[29] For instance, Aghion et al. (2013) and Brossard et al. (2013) provide causal evidence that ownership by institutional investors tends to increase both the amount and the productivity of R&D expenditure.

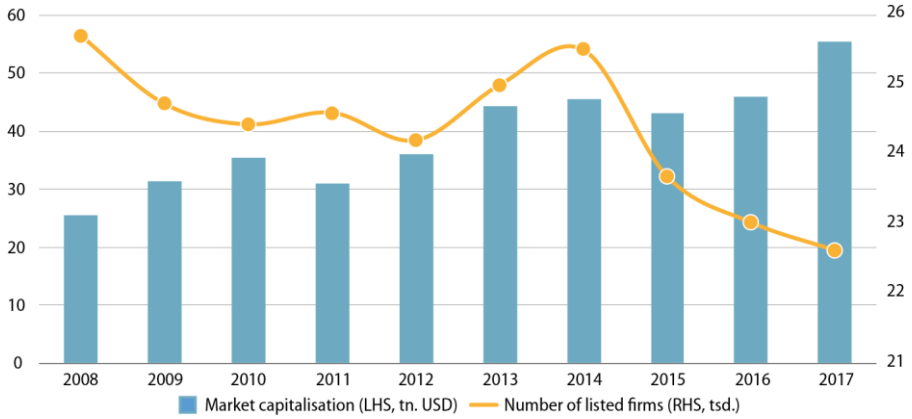
[30] However, potential anti-competitive outcomes could offset these benefits (Azar et al., 2018) and need to be closely monitored by Competition Agencies.

short-termism on the financing of intangibles, as managers would not be tempted to cut intangible costs to meet market expectations with respect to profit objectives.[31] Additional possible policy levers are a preferential tax treatment for capital gains arising from long term investment, which has already been established in some countries, and the granting of more voting rights to owners holding shares for a relatively longer period or actively engaged in companies' governance.[32]

Reviving initial public offerings (IPOs) for SMEs

55. Recent trends in capital markets worldwide suggest that equity markets are providing decreasing resources to SMEs: while the overall capitalisation of equity markets has been rising, the number of IPOs and the number of listed companies have declined in several countries (Figure 9). Capitalisation is becoming increasingly concentrated in large firms and the majority of businesses do not raise equity at all. Given the high costs to be incurred in order to go public, high-growth and innovative small firms often have little or no access to equity markets, precluding them from accessing an important source of external financing.

Figure 9. The number of listing decreases while market capitalisation rises



Note: The left y-axis shows the overall market capitalisation of OECD countries listed domestic companies, in current USD. The right y-axis shows the number of listed companies in OECD countries. Both values are taken at the end of the reference year.
Source: OECD calculations based on World Bank data.

56. The shift towards a knowledge economy may have further impaired the attractiveness of traditional public equity for intangible-intensive companies. Private equity is increasingly perceived as an efficient tool to foster innovation (Cecchetti and Schoenholtz, 2017) and takeovers are soaring (Bajgar et al., 2018). SMEs and innovative entrants, not having the resources and size to take advantage of intangibles complementarities, lack the strength to compete in an economy dominated by relatively few giant firms and more often consider being acquired as an optimal solution, also reinforcing the potential "winner-takes-all" dynamics connected to intangible capital and thus creating new challenges for Competition Agencies.[33]

[31] The revision of accounting and disclosure rules is more extensively discussed in section 3.3.2.

[32] Receipt of such grants or the extent of the preferential tax treatment may be also conditioned on other characteristics, such as holdings' size, in order to incentivize engagement in the governance of the firm.

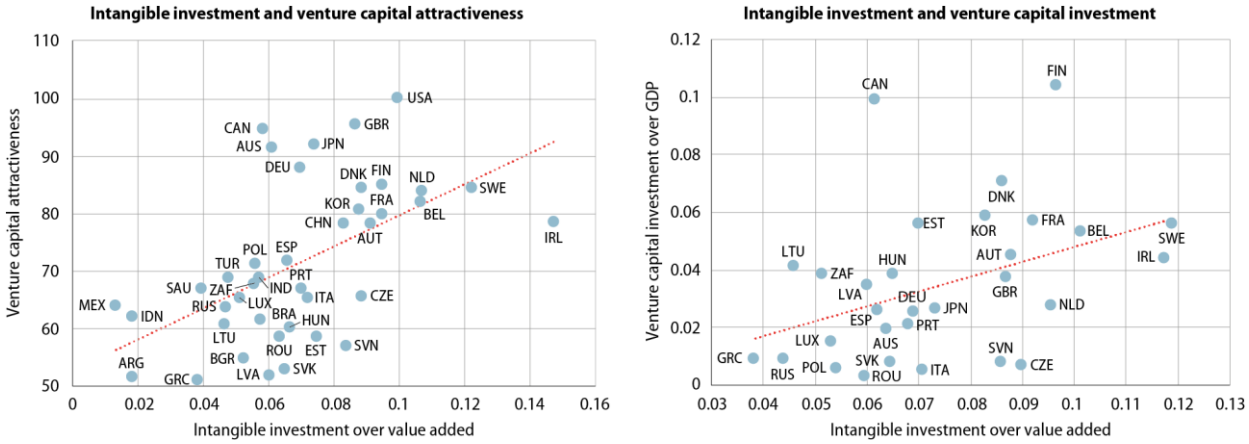
[33] For instance, Galston and Hendrikson (2018) argue that antitrust enforcers should not only take into account acquisition of targets which have high revenues or employment, but also of relatively smaller firms that are potentially important for competition from a dynamic perspective, because of the data they own or their growth potential.

57. Easing access to IPOs by reducing administrative burdens and costs can partially offset the size bias affecting equity markets and provide intangible-intensive SMEs a viable alternative to buyout; moreover, it would also foster early-stage financing by widening the range of exit options for venture capital investors. For instance, the Prospectus Regulation adopted in the European Union, which streamlines listing requirements for small enterprises (EPRS, 2019), is a first step in this direction. Furthermore, an improvement in the reporting of intangible assets could play a relevant role in reducing the information asymmetries that induce capital providers to focus on blue chips.

3.2.2. Venture capital: the best-suited source of financing for innovation, but not a panacea

58. Venture capitalists play a key role in bridging the financing gap of young innovative firms, and the global shift towards an intangible-based economy further increases their relevance. In line with this, Figure 10 provides evidence of a positive correlation between either venture capital supply or overall venture capital attractiveness and intangible investment.

Figure 10. Venture capital markets and countries' intangible investment



Note: The figure shows the correlation between intangible assets gross fixed capital formation and venture capital development. Intangible assets' gross fixed capital formation is computed using a combination of data sources and a novel methodology described in Annex A; due to data availability, the training component of intangible investment is excluded. Venture capital development is proxied by venture capital investment as a share of GDP (OECD) in the right panel and by a broader measure of venture capital attractiveness (IESE Business School and EMLYON Business School) in the left panel. Due to data availability, variables in the right (left) panel are averaged over the 2011-2015 (2014-2015) period. The USA are excluded from the right panel for readability, as their extremely high VC to GDP ratio would impede a clear visualisation of graph; their inclusion, however, would further strengthen the correlation.
Source: OECD calculations on OECD, National Use Tables, World Bank, PWT, ILO, IESE Business School and EMLYON Business School data.

59. The positive impact of venture capital (VC) on the financing of intangible investment and productivity is expected to work through several channels. First, a deep VC market internalizes start-ups' highly risky profile and lack of track records; in fact, the provision of funds by stage is particularly suited for start-up firms strongly relying on intangibles, as it allows investors to closely follow and update their knowledge on the potential of the project, delaying follow-on investment until information is revealed, and thus reducing uncertainty (Haskel and Westlake, 2018). Second, the intense scrutiny performed by venture capitalists allows them to select the firms with the highest growth potential and entails positive consequences from an allocative efficiency perspective, as they offer opportunities for the implementation of new ideas and radical innovations which would not be otherwise funded. Furthermore, VC acts as a signal that allows other financial intermediaries to invest; the certification effect of being backed by VC

attenuates asymmetry of information and increases the probability that institutional equity holders invest in the company (Jeppsson, 2018).

60. Most advanced economies have implemented multi-pronged policies to nurture their VC ecosystems. However, despite progress, achievements have often fallen short of objectives, as highlighted by the relatively small number of successful programs (Annex D). While venture capital markets grow under specific conditions which are often difficult to reproduce, there is still a set of policy levers that authorities could use to foster their development and exploit their potential. Direct government intervention in the VC market has been found to be beneficial, especially when the industry is at its infant stage (Lerner, 2010). Currently, most advanced economies have progressively shifted towards a model based on co-investment funds and funds-of-funds that seek to leverage private investment, as government funding is most effective when disciplined by private VC management, given that it strengthens commercial objectives and knowledge of the sector (Wilson, 2015). Indeed, successful venture capital companies are generally highly specialized in specific sectors, reinforcing the idea that a deep knowledge of the market is critical to invest optimally and guide start-ups in their early stages.

61. Several countries are also using tax incentives to promote venture capital markets and business angel lending (OECD, 2016). Tax relief on capital gains, special provisions concerning the roll over or carry forward of capital gains and losses, as well as a preferential tax treatment (e.g., tax deductions) for seed financing, appear valuable options, though the efficacy of these tax supports for venture capital is mixed, as they may raise equity issues, and they can be difficult to target, structure, and design appropriately (Wilson, 2011). More generally, an environment favourable to foreign investors could also temporarily compensate for the incompleteness of domestic VC markets (e.g., Yozma Initiative, see Annex D), which also benefit from a competitive environment favouring entrepreneurial attitude – i.e. sound IP rights (Gilson, 2003), insolvency regimes that do not over-penalise entrepreneurial failure (Armour and Cumming, 2006) and employment protection legislation that is flexible enough to promote experimentation while at the same safeguarding workers commitment in order to allow firms investing in human capital (Wasmer, 2006; Andrews and Criscuolo, 2013).

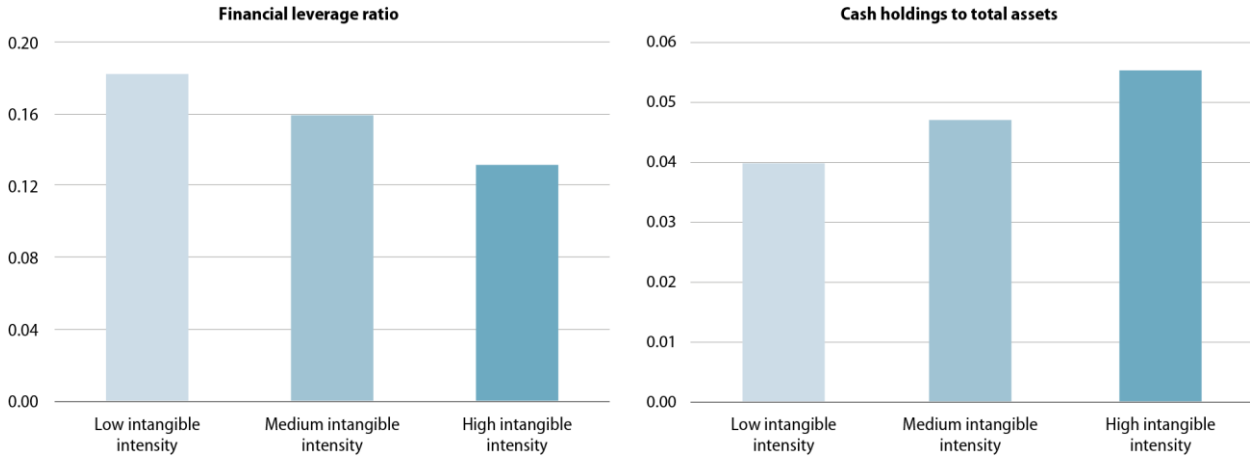
62. Crowdfunding is a potential tool to complement venture capital markets in funding start-ups, especially at their initial stages (Annex E; OECD, 2019b). The utility of crowdfunding for young innovative firms goes beyond their immediate financing needs. Indeed, it entails marketing advantages, as it tends to raise public attention on the company (Mollick, 2014), and thus to act as a signal for more traditional financial intermediaries about the attractiveness of a business project or of a newly designed and patented product (Colombo and Shafi, 2016). In turn, venture capitalists could play a key role in reducing the information asymmetries faced by the crowd (Wang et al., 2019), further strengthening the complementarity between VC and crowdfunding, which is also reflected in the growing appeal of crowdfunding platforms for professional investors.

63. Overall, venture capital has appealing characteristics to ease the intangible asset financing gap, and its development should be a priority in government industrial policies aimed at reversing the productivity slowdown. Yet, it is worth stressing that it should not be viewed as a panacea. It targets specific sectors and operates at small scale, suggesting that it alone would not be able to address the broad needs of an increasingly knowledge-based economy and that a broader and complementary approach aimed at developing other segments and features of the equity market is of great importance.

3.3. Bank financing for a knowledge-based economy

64. Banks allocate loans based on screening procedures to identify companies that are able to service debt, using firms' physical and financial assets as collateral to reduce moral hazard and the risks inherent in the act of lending. This business model makes banks *a priori* ill-suited to support the needs of an intangible-intensive economy. A reflection of this is that firms operating in innovative industries tend to rely relatively more on internal finance and less on debt finance (Figure 11).

Figure 11. Firms operating in intangible-intensive sectors rely less on debt financing



Note: The figure shows the median financial leverage ratio (financial debt over total assets; left panel) and the median cash holdings ratio (cash holdings over total assets; right panel) across firms grouped according to terciles of sectoral intangible intensity. Calculations encompass the 1995-2015 period.
Source: OECD calculations on Orbis and Compustat data.

65. Still, the potential for banks to finance intangible investments could be raised by considering a range of policy actions. Specifically, measures to increase the pledgeability of intangible assets as collateral and reduce information asymmetries between banks and intangible-intensive firms could help reduce the gap between internal and external financing that plagues investment decisions of innovative firms, with potential benefits for productivity.

3.3.1. Encouraging the redeployability of intangible assets

Use of intellectual property rights and IP-backed loans

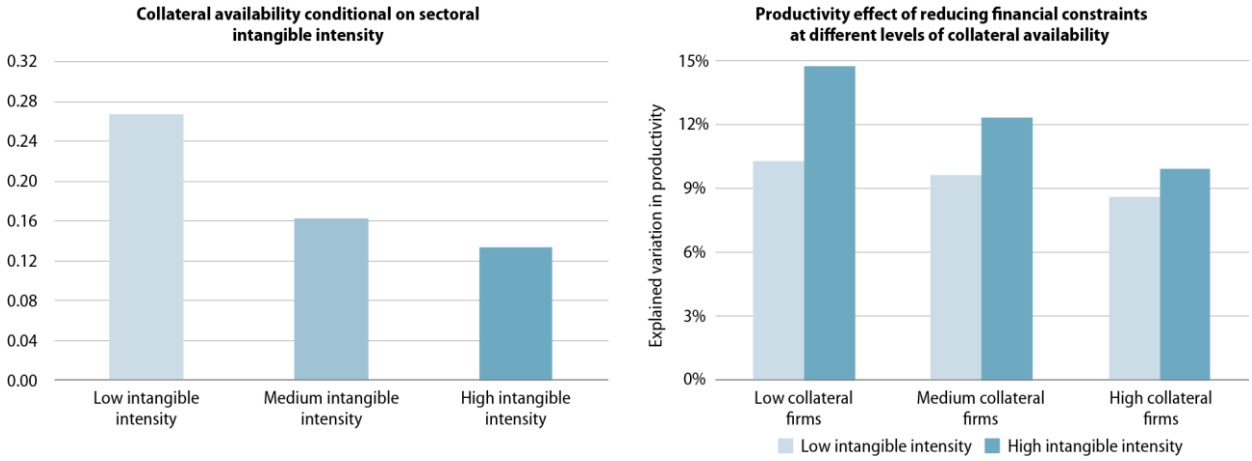
66. Firms in intangible-intensive sectors have fewer tangible assets to be used as collateral (Figure 11, left panel), and increasing collateral availability could benefit productivity by enabling innovative firms to access bank finance. Indeed, when the productivity effect of financing frictions is conditioned on the availability of collateral, the differential between high and low intangible-intensive sectors tends to vanish for highly collateralized firms (Figure 11, right panel).

67. The pledgeability of intellectual property rights (IPR) has already opened new funding channels for intangible-intensive firms.[34] First, assets protected by IPR -- such as patents, trademarks, copyrights and design rights – can serve as collateral when searching for bank financing (Amable et al., 2010). Second, innovative firms can use the cash flow streams deriving from licensing or royalties to secure loans (Brassell and King, 2013). Moreover, IPR may also serve as a signalling mechanism for small and young companies to reveal the quality of the firm's management, and its technological capabilities, easing the access to various alternative sources of finance (Francis et al., 2012; Robb and Robinson, 2014).[35]

[34] As indirectly reflected by the positive correlation between sound IPR and intangible investment (Figure C.2).

[35] For instance, start-ups with IP-backed loans tend to raise more equity capital than those without (Hochberg et al., 2018). Along similar lines, recent causal evidence suggests that start-ups "winning the patent lottery" by drawing more lenient examiners have better access to bank and VC finance (Farre-Mensa et al., 2020).

Figure 12. Collateral availability along the intangible intensity dimension and its impact on the finance-productivity nexus



Note: The left panel shows the median tangible assets over total assets ratio across firms grouped according to terciles of sectoral intangible intensity (Figure C.1). Based on the first specification in Table C.4, the right panel presents the productivity effect of relaxing financing constraints for firms with different availability of collateral, distinguishing between high and low intangible-intensive sectors. Collateral availability at the firm level is proxied by the ratio of tangible fixed assets to total assets. Calculations encompass the 1995-2015 period.
Source: OECD calculations on Orbis and Compustat data.

68. While the pledgeability of IPR is increasing in OECD and G20 countries, small and medium-sized enterprises do not face the same opportunities as large firms in exploiting IP-backed loans, despite greater financing needs. SMEs find it harder to protect their intellectual property via patenting, as they often face relevant capacity constraints: for instance, applying for patents requires the payment of specific fees and regular communication with patent officers enforcing deadlines, which are generally better handled by expensive patent consultants (OECD, 2011; Johnson et al., 2018). Furthermore, evidence from the U.S. suggests that IP-backed loans primarily benefit well-established companies with a great deal of reputational capital, even though banks tend to impose higher loan spreads and apply stricter credit standards when granting such loans (Loumioti, 2012).

69. Policy interventions aimed at increasing the use of IP-backed loans should take these patterns into account and provide specific support to SMEs (OECD, 2011, OECD 2015a). For example, public authorities may establish programmes such as state guarantees linked to either the enterprise or the asset, subsidies granted through development banks, and a combination of the two, aimed at strengthening private sector engagement (Box 4). These programs contribute to expanding the availability of IP-backed lending for financially-constrained firms by reducing bank-firm information asymmetries and substituting for the lack of tangible collateral characterizing the initial stage of the firms' life-cycle. Further, they also provide temporary support to banks, allowing them to eventually write down losses generated during the learning period necessary to build knowledge on the use of IP-backed loans (Brassell and Boshmans, 2019).[36] However, to enhance their effectiveness, policy makers need to ensure that resources are allocated only to high-potential SMEs and to take into account potential moral hazard issues arising from

[36] Supporting this narrative, recent research suggests that state guarantees and co-funding programmes can be effective at increasing SMEs access to finance, reducing the cost of funding (OECD, 2017b), and in some case improving long-run productivity (Bertoni et al., 2018).

state guarantees (Ono et al., 2013; D'Ignazio and Menon, 2013).[37] A portion of the risk should remain allocated to banks and the temporary nature of the support should be clearly codified.[38]

70. Prudential regulation might create an additional barrier to the development of loans secured against intangibles. IP-backed loans are perceived as riskier and do not contribute to the calculation of banks' regulatory capital. As a consequence, banks have lower incentives to issue such loans and the cost of capital for intangible-intensive firms increases, leading to a reallocation of banks' portfolios from commercial loans to real estate lending (Dell'Ariccia et al., 2017). Revising Basel III regulation to account for the new financing needs of corporations, while ensuring financial stability, is likely to be a long and complex process, also requiring international cooperation. Meanwhile, an alternative could be to allow banks to transfer part of the risk from their balance sheets to those of insurance companies, which can take a broader economic view on risks under Solvency II regulation. This requires establishing a legal framework allowing banks and insurance companies to collaborate in backing IP-backed loans, a direction currently investigated, for instance, by the British Business Bank (British Business Bank, 2018).

Box 4. IP backed loans: country-specific experiences

- In **the U.S.** the rise of IP backed loans has been largely underpinned by unregulated lenders in the private sector – i.e. investment banks – that did not face the same regulatory constraints as commercial banks for valuing KBC as collateral (OECD, 2015a). The share of secured syndicated loans collateralised by intangibles in total secured loans has risen from 11% to 24% in the 1997-2005 period (Loumioti, 2012).
- **France** – The French public investment bank Bpifrance provides uncollateralized loans and bank loan guarantees to SMEs to support their digitalisation. Investment in intangibles is supported, including intellectual property and software.
- **Germany** - Germany has introduced specific debt-based instruments. The Bavaria Digital initiative provides digital SMEs with loans on favourable terms for a total amount of up to EUR 1 million. In order to reach many SMEs, the application process was streamlined to reduce the administrative burden, and parts of the application cost are covered by a non-refundable grant from the State of Bavaria.
- In **China** the active market for IP-backed financing relies on massive government support, involving in particular the State Intellectual Property Office (SIPO) and the Ministry of Finance. Chinese banks are encouraged to establish in-house evaluation methods and separate lines of credit for intangible-backed loans. A number of funds based in areas with concentrations of highly innovative SMEs have been established with the goal of favouring local IP-backed credit (Brassell and Boshmans, 2019).
- In **South Korea**, the Korea Development Bank (KDB) plays a pivotal role thanks to the "Techno Banking" initiative which included: a) IP Purchase Loans that can be used by new ventures to purchase Intellectual Property; b) IP Mortgage Loans; and c) Technology IP Commercialisation finance. The KDB also offers a fund for distressed IPs to increase their recovery in case of loan default. The Korean government also enacted a series of credit guarantee programs to support intangible-backed financing, and an insurance scheme for SMEs (OECD, 2015).
- In 2014, **Singapore** established a legal framework to authorize IP backed loans through the IP Financing Scheme, (IPFS) relying on a panel of qualified valuers approved by the Intellectual Property Office of Singapore (IPOS) to certify the value of the patent combined with a system

[37] For instance, there is evidence that firms participating in state guarantees programs have a higher probability of default in subsequent years compared to their peers (D'Ignazio and Menon, 2013).

[38] A recent UK reform of guarantee schemes in this direction has proven to be successful (Allinson et al., 2013).

of sharing risk with the lending bank, the Government partially underwriting the loan (OECD, 2015; APEC, 2018).

Establishing the conditions for an efficient IP market

71. Strictly related to the use of IP as collateral, strengthening the liquidity of the IP market would improve the chances of matching sellers and buyers as well as of establishing the right valuation in case of bankruptcy (Roth, 2008; OECD, 2015b). This in turn could increase incentives for bank lending. Available evidence suggests that firms' borrowing tends to increase when the secondary market for patents becomes more liquid, and the more so for start-ups owning relatively more re-deployable (less firm-specific) patents (Hochberg et al., 2018; Serrano and Ziedonis, 2018).[39]

72. Despite the development of various IP market places and intermediaries, the IP market lacks transparency and liquidity, and remains fragmented (Harhoff, 2009; Terroir, 2014). For instance, most IP deals are negotiated in a bilateral (licensing) or closed (auction) environment, making it difficult to assess the value of a patent and to establish good matching between buyers and sellers (Andrews and De Serres, 2012). The expansion of companies specializing in the assertion of patents, i.e. specializing in the collection of patent license fees while not creating IP themselves (Non Practising Entities), can also be potentially damaging for bank financing of innovation, as the systematic use of lawsuits to collect damages increases the uncertainty around the value of the assets (Eisenberg and Ziedonis, 2010).[40] Increasing the reliability of IP markets by raising the quality of patents or disclosing knowledge information, promoting IP infrastructure and creating sovereign patent funds are all relevant domestic policies to support the development of IP markets and thus reduce the uncertainty for lenders on whether they would be able to liquidate assets at the appropriate value in case of failure (OECD 2015b).

73. Differences in IPR legislation and enforcement across jurisdictions creates additional uncertainty for the innovator and thereby the lender, undermining the reliability of using intangibles as collateral for banks, and potentially affecting firms' investments in intangibles. For instance, uneven levels of national patent protection across EU members and the lack of a uniform enforcement system create a risk of parallel litigation with possibly divergent outcomes (EPO, 2017).[41] It follows that harmonisation of patent protection enforcement across countries could contribute to better access to bank finance for intangible-intensive firms and promote trade in high-IP industries in Europe and elsewhere.

Reviewing insolvency regimes

74. Well-designed insolvency frameworks may facilitate access to credit for high-productivity firms and the orderly restructuring or exit of low productivity ones. The ability to scale operations down rapidly in case of failure, releasing resources to other, more productive firms, contributes positively to aggregate productivity performance via the reallocation channel (Adalet McGowan and Andrews, 2017). International comparisons reveal large differences across countries in the design of insolvency regimes, with the evolution of indicator's values from 2010 to 2016 hinting that recent reforms enhanced policy design (Adalet McGowan and Andrews, 2018).

[39] However, the effect dissipates for highly firm specific patents. To get a glance of the magnitude of the effects, the authors show that, at the mean "redeployability" value, a one percentage point increase in patent trading is associated with an increase in the predicted debt rate of 1.10 percentage points, or 15 percent of the average annual debt rate in the sample.

[40] However, they could also deepen the market for ideas by acting as patent brokers (Hagiu and Yoffie, 2011).

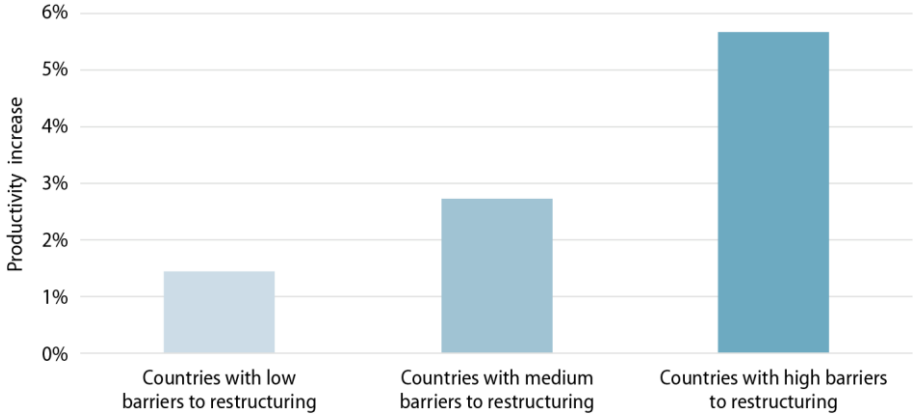
[41] For example, computer software is relatively easy to patent in the United States, while in Europe there is a clear distinction between programs that represent a technological innovation, which can be protected with a patent, and those that are non- technological and thus non-patentable (Jarboe and Ellis, 2010).

75. These effects on productivity can be expected to be stronger in intangible-intensive industries, as the risk of failure is greater there due to the prevalence of innovative projects. Indeed, empirical evidence based on OECD analysis shows that productivity gains from moving to the regime with the lowest barriers to efficient corporate restructuring increase with a sector's intensity in intangible assets (Figure 13). Therefore, improving insolvency regimes is a priority area in increasingly knowledge-based economies.

76. Moreover, the liquidation of intangible assets can be susceptible to a relatively quick and significant value erosion, posing additional challenges for insolvency design.[42] It follows that specific arrangements are required to increase creditors' chances of recovering the outstanding debt and improve the efficiency of insolvency processes. First, given the complementarity between the various types of intangible assets (Hotchkiss et al., 2008), liquidation should be carried out in bundles, so as to avoid the reduction in value associated with the loss of synergies across the various assets. Second, the peculiarities of intangibles require also retaining the associated skilled people to maximize the liquidation value. However, these arrangements imply a close collaboration and trust between the failing firm and its creditors, which may result in long proceedings, increasing uncertainty. In this context, SMEs may find it hard to bear the cost of dispute resolution mechanisms related to intangibles due to their lower administrative capacity, and targeted support might be needed -- for instance, informal out-of-court procedures, which typically avoid the procedural complexities and timelines of court proceedings, are often associated with better outcomes for SMEs (World Bank, 2018).

Figure 13. Intangible-intensive sectors benefit most from sound insolvency regimes

Productivity gains (in high relative to low intangible-intensive sectors) from moving to the regime best suited to reduce barriers to corporate restructuring



Note: Based on the fourth specification in Table C.3, the figure shows the differential productivity increase in intangible-intensive sectors compared to traditional sectors following an increase in insolvency regime soundness to the highest level according to the World Bank index latest year (2019). The estimation is carried over the 2007-2015 period due to data availability.
Source: OECD calculations based on STAN, Compustat and World Bank data.

3.3.2. Policies to reduce firm-bank information asymmetries

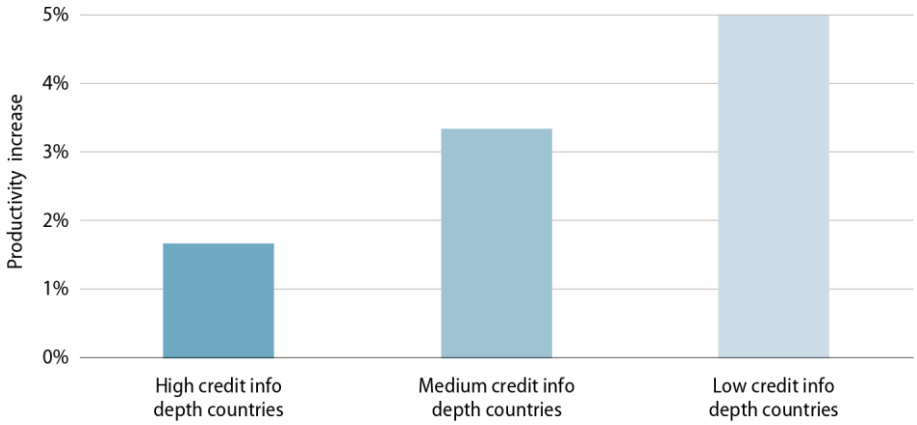
77. A critical step to increase the confidence of banks and financial agents when investing in innovative companies consists of reducing the information gap characterizing intangible assets. The availability of historical credit information is one of the external elements used by banks to assess the probability that a firm will repay debt. It allows a better screening of firms' health, reducing moral hazard, and contributing to

[42] The quick erosion of the intangibles' value when Kodak filed for bankruptcy is illustrative of this issue: eleven months before Kodak filed for bankruptcy, a portion of its patent portfolio was valued as high as $4.5 billion, but those assets were eventually sold for only $94 million (Johnson et al, 2018).

a better allocation of resources. Evidence drawn from OECD empirical analysis confirms that the more access banks have to in-depth information on firms' credit history, the more financial constraints are relaxed with a positive productivity effect, with the impact being larger in intangible-intensive sectors relative to other sectors (Figure 14).

Figure 14. Intangible-intensive sectors benefit most from banks' access to in-depth credit information

Productivity gains (in high relative to low intangible-intensive sectors) from moving to the highest level of credit information depth



Note: Based on the third specification in Table C.3, the figure shows the differential productivity increase in intangible-intensive sectors compared to traditional sectors following an increase in the depth of credit information to the highest level according to the World Bank index latest year in the sample (2014). The estimation is carried over the 2007-2014 period due to data availability.
Source: OECD calculations based on STAN, Compustat and World Bank data.

78. In the absence of credit records, past bank-firm links and IPRs signalling firms' quality, banks often use two other sources of information to assess the financial health of firms and decide whether to grant credit: balance sheet information and financial reports. However, current accounting rules do not allow intangibles created internally by the firm to be listed on the balance sheet, while disclosure rules on intangibles are not yet well established and no consensus exists on the valuation method. As a result, financial and accounting reports tend to become increasingly less relevant at providing accurate pictures of intangible-intensive firms (Lev, 2018, OECD 2012).

Improving valuation standards for intangible assets

79. The increased relevance of intangibles has generated a wide debate on potential changes in accounting rules. However, as of yet there is no consensus on the most efficient way to proceed and many types of intangibles are still treated as simple expenses (Brassel and Boschmans, 2019). The full recognition of intangibles on balance sheets is not a trivial exercise, in light of the inherent contradiction between certain accounting principles and the properties of intangibles -- for instance the requirement that investment should achieve commercial and precisely identifiable returns (Box 5).

80. The existence of several competing methods for valuing intangibles generates further uncertainty and requires the setting of internationally homogeneous rules, while current valuations performed by consulting firms and experts do not rely on standard definitions (Box 5; OECD, 2012). Several institutional initiatives have been taken recently to reduce the opacity of intangible investment and these should be pursued, such as the consultation launched by the UK financial reporting council (FRC, 2019). In 2019 the

International Valuation Standards Council (IVSC) published new global guidelines for valuing intangibles in a comprehensive way.

Box 5. Accounting rules and evaluation methods for intangible investment

Accounting rules

The disclosure of information regarding intangible assets varies depending on accounting standards firms use.

Under the General Accepted Accounting Principles (GAAP) rules, US-based firms cannot capitalize intangibles development costs in light of uncertainty of their future income stream, their complex measurement, and the difficulties in perfectly matching costs and revenues. Hence, limited information about intangible investments is disclosed to the market.

On the contrary, firms required to draft their financial statements under the International Financial Reporting Standards (IFRS), such as European listed companies, have to capitalize intangibles-related investments (under the IAS 38 principles) if some criteria are met. More precisely, the IAS rule makes the distinction between the research and development parts of R&D. On the one hand, the former is too uncertain and therefore all research-related investments must be considered as costs. On the other hand, development costs entail a higher probability of becoming a source of revenues, and therefore can be capitalized subject to criteria based on:

- the technical feasibility of the product under development;
- the intention and availability of financial resources to complete its development;
- the ability of the firm to use or sell the product;
- the ability to specify how the product will generate future economic benefits;
- the ability to reliably measure the expenditures to develop the product.

Valuation methods

Different valuation methods are used to report intangibles, without consensus on the best approach:

- The cost method considers the value that would have been present on a company's balance sheet if the assets in question were tangible. However, it can be very difficult to isolate the costs relating to a specific group of assets with precision.
- The income approach relies on estimates of expected extra future benefits associated with the use of the assets. A risk-weight method is used to calculate discounted cash flows. However, it is not well-suited to assets with a high risk of failure (implying zero revenues), and the evaluation is more uncertain for young businesses with less-established cash flows.
- The market comparison approach is based on a comparison with sales of similar assets. This approach is the most appropriate way to identify the market value, but it is strongly limited by the lack of liquidity of IP markets.

The technical obsolescence of intangibles is also very specific and heterogeneous across assets and adds an additional layer of complication. In some cases depreciation can be faster than for tangibles (as currently suggested for R&D), while in others the value of intangible assets may increase over time (for instance in case of network effects).

Fostering financial disclosure

81. While changes in accounting rules might take time to materialize, a simpler way to reduce information asymmetries with respect to intangibles is to improve firms' corporate disclosure by providing

a qualitative but standardised description of intangible asset holdings. It is still debated whether disclosure is effective for firms relying heavily on intangibles, as the non-rival nature of knowledge assets exposes these companies to the risk of being imitated, offsetting at least some of the benefits from a reduction in financing frictions (Andrews and De Serres, 2012; Andrews and Criscuolo, 2013). Nonetheless, evidence tends to support the idea that the benefits are larger than the costs, with an efficient IPR system playing a complementary role in reducing imitation by competitors.

82. Overall, R&D expenditure as a share of value added appears to grow faster in countries with higher-quality corporate disclosure to shareholders (Carlin and Mayer, 2013) and companies tend to voluntary disclose more information on R&D expenses when they have the possibility to do so (Chen et al., 2017). In turn, greater corporate disclosure is associated with a lower spread for innovative firms (Bonsall et al., 2017) and a more efficient allocation of capital towards the most promising projects, as investors rely on detailed information to back their decisions (Verrecchia, 200; Beyer et al., 2010). Recent studies also show that R&D disclosure could substitute for other information on borrowers that usually stems from tight bank-firm relationship (Saidi and Zaldokas, 2016), and this effect is expected to be stronger when the narrative information is easily readable for banks (Hofman and Kleimeier, 2019).[43]

4. Conclusion

83. Financing intangible investment raises specific challenges that often impede to fully exploit the growth and resilience opportunities associated with these assets. The ability of many firms, particularly young and small, to invest in these assets is limited and generates a financing gap, i.e. the volume of investment in intangible assets is lower than what would be desirable from a social perspective. Such a financing gap could be further amplified in the aftermath of the COVID-19 outbreak, as intangible-intensive firms have depleted their cash and equity buffers to weather the crisis, significantly reducing their main sources of financing for future intangible investment.

84. The policy discussion stresses the complementarity among different potential sources of financing -- government support, equity markets and bank loans – and provides a menu of targeted policies to unlock the productivity and the resilience potential of intangibles. Figure 15 summarizes the main policy objectives (green boxes) and areas for action (white boxes). The policy discussion conveys three main insights:

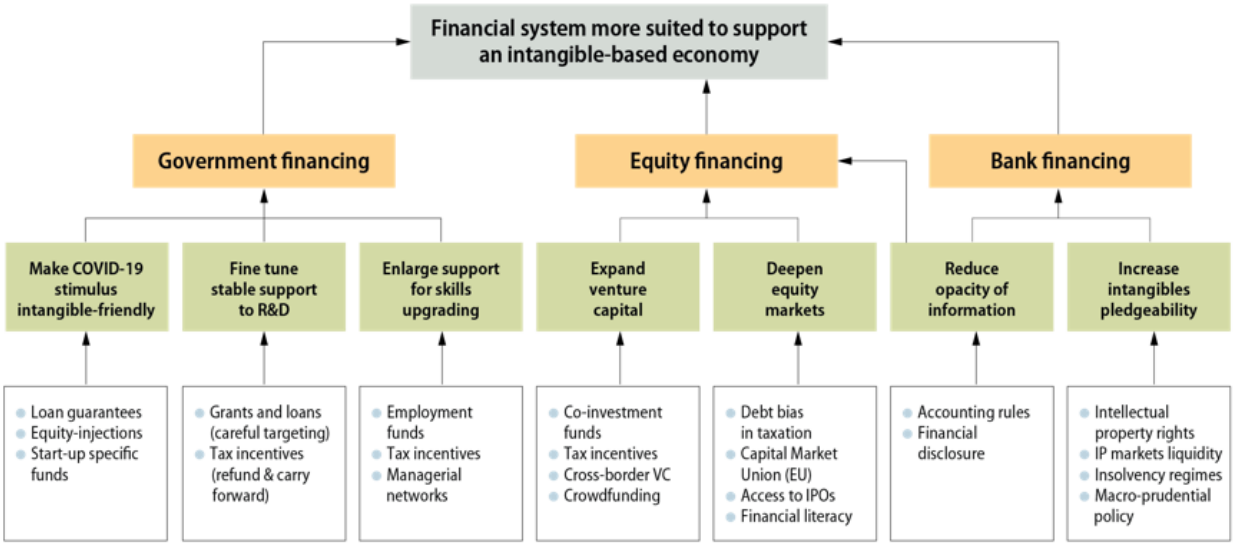
- The critical role of intangible capital for the recovery and for building resilience calls for a continuation of swift government actions to ease intangible-intensive sectors' access to various source of finance through different support mechanisms (e.g. loan guarantees and equity-type instruments).
- The public financing of innovation, often aimed at reducing the investment gap in innovative activities, could be further fine-tuned to play a bigger role at relaxing financing constraints faced by intangible-intensive firms, notably start-ups and SMEs. Government support for expenditures on other (non-R&D related) types of intangible assets showing positive externalities, e.g. skill formation, could also be considered subject to design considerations and evaluations to ensure value-for-money.
- In many OECD and G20 countries access to equity finance is still limited, pointing to the necessity to deepen equity markets when they are underdeveloped (e.g. by progressing on the European Capital Market Union, reducing the preference to use debt over equity, easing access to IPOs) and to ensure that their structure is well-suited for intangible-intensive firms (e.g., by reducing specific

[43] Financial disclosure plays a specific role also in equity markets, as it reduces principal-agent issues, which are particularly intense for intangibles (OECD, 2012) and strengthens managerial incentives to invest (Roychowdhury et al., 2019).

regulations that limit long-term oriented institutions' ability to invest in equity and establishing the conditions for an active venture capital market).

- There is room to further exploit the potential of the banking sector to finance codified and transferable intangibles. Measures aimed at reducing asymmetry of information (e.g. improving accounting standards) and intangibles' collateralisation (e.g., IP backed loans), as well as ensuring efficient liquidation of intangibles (e.g., revision of insolvency procedures and development of IP markets) are key to encourage banks to enhance their lending toward intangible-intensive firms.

Figure 15. Policies to close the financing gap in intangible assets: a summary



Source: OECD.

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Annex A. A new methodology to extend the estimation of intangible investment to a wider range of countries

The measurement of intangible investment at the country level is often constrained due to data availability, in particular with respect to organisational capital. The OECD is developing a new methodology to extend its measurement to a wider range of countries, including emerging G20 economies. The methodology builds on Corrado et al. (2016), who provide estimates for a set of advanced economies, and it is adjusted to fit data availability also following insights from Chen (2017).

The new OECD measure encompasses the 2011-2015 period and allows to distinguish investment in "Intellectual Property Products" from other types of intangible investment – i.e., "Design, Brand Equity and Purchased Organisation Capital" (e.g., "New Intangibles") as well as "Own Account Organizational Capital".[44]

Intellectual Property Products

The estimation of investment in Intellectual Property Products (IPP) is standard and based on national accounts data on gross fixed capital formation, obtained either from OECD statistics or from countries' official National Accounts statistics.

Design, Brand Equity and Purchased Organisation Capital (New Intangibles)

Following Corrado et al. (2016), *Use Tables at purchasers' price* (either from the OECD or from National Statistics) are used to retrieve economies' intermediate consumption of three products: i) management consultancy services that are used to proxy expenditures on "Purchased Organisation Capital" (POC); ii) architectural and engineering services, technical testing and analysis services that are used to proxy expenditures on "Design"; iii) advertising and market research services that are used to proxy expenditures on "Brand Equity". Next, to obtain the investment in "Design, Brand Equity and Purchased Organisation Capital", these expenditures are capitalised using a weighted average (across assets types) of the capitalization factors estimated in Corrado et al. (2016).

For some countries, however, the Use Table at purchasers' price reports only a broader category of expenditures, i.e. the intermediate consumption of "Professional, Scientific and Technical services" (PTS). Given that the three above-mentioned products represent a sizeable component of PTS, their value is estimated as follows. First, the ratio of the value of intermediate consumption of the specific products over the value of the use of all PTS products is computed when detailed data are available. Second, the yearly

[44] For China, the calculations rely on inputs from Mrs Janet Hao, senior economist at the Conference Board. The methodology used is close to the one presented in the next paragraphs, but not perfectly overlapping due to data specific features.

median across countries of the ratio is calculated. Third, the year-specific ratio factor is multiplied by PTS expenditures to proxy for expenditures "Design, Brand Equity and Purchased Organisation Capital".[45]

Own-Account Organization Capital

An expenditure approach similar in spirit to the methodology developed by Chen (2017) is adopted to estimate the own-account component of organization capital (OOC), computed as the capitalized value (e.g., 20%) of managers' compensation. Managers' compensation at the country-year level is obtained as the product of the number of managers by managers' average wage. The number of managers is extracted from the ILO *Employment by sex and occupation* dataset. The main source for managers' wage data is the *ILO Mean nominal monthly earnings of employees by sex and occupation* dataset. For countries with incomplete data series over time, missing values are imputed, assuming that the ratio of the number of managers over the total labour force or the ratio of managers' wage over the average wage of workers is the same as in the closest year with available data.[46]

[45] An additional preliminary step is required to obtain an estimate for countries lacking a comparable *Use Table at purchasers' price*. In this occurrence, the intermediate consumption of PTS from OECD *Input-Output Tables* (IOTs) is used, scaled with an appropriate adjustment factor linking IOTs and Use Tables.

[46] Notice that for India and Japan data on managers' compensation are not available and are imputed exploiting the median ratio between managers' wage and workers' wage in the sample as well as country-specific information on workers' wage.

Annex B. Allocative efficiency effect: sector-level analysis

Olley and Pakes (1996) propose a static decomposition of aggregate productivity levels into a common and an allocation component. The common component reflects the unweighted average of productivity across all firms in the economy. The allocation component measures the impact of productivity reallocations across firms. Analytically:

$$\boldsymbol{\Omega_{cst}} = \overline{\omega_{cst}} + \sum_{i=1}^{N} (\omega_{icst} - \overline{\omega_{cst}})(s_{icst} - \overline{s_{cst}}) = \boldsymbol{\overline{\omega_{cst}}} + \boldsymbol{Cov(s_{it}, \omega_{it})} \quad (4)$$

where ω_{it} and s_{it} are respectively firms' productivity and size, while $\overline{\omega_{cst}}$ and $\overline{s_{cst}}$ are respectively the unweighted mean within each country-sector-year. The second term of the right hand side is the so called "covariance term" or "OP gap" (allocation component). If the covariance term is positive, it implies that firms with above average productivity display above average size, or that, conversely, if negative, firms characterized by below average productivity are more important in the determination of aggregate productivity. In other words, the higher the OP gap, the more efficient the allocation of resources across firms within sectors.

The decomposition does not depend on any particular choice of the weights, as size could be measured in terms of inputs or output, and of the productivity measure (labour productivity or TFP). Yet, as it is considered more reliable in the literature, we adopt the simplest definition, using the number of employees as a proxy for size and the log of value added over employees to measure productivity. Moreover, it is independent from the level of the analysis (e.g., the reference group may be other than the country-sector-year triple) and still holds if expressed in terms of growth rates, so that it can be used to track shifts in the productivity distribution (changes in the unweighted mean component) and market shares reallocations (changes in the covariance).

While the investigation is carried as a simple robustness, it is worth clarifying in advance that the Orbis dataset has coverage and representativeness issues when aggregating at higher levels. To reduce their impact on the analysis, we select only relatively well-covered countries and years (2006-2015 period), focus on a permanent sample of firms to rule out spurious entry and exit, and keep only country-sector-year cells with more than 5 observations to avoid our measure to be driven by only a couple observations.

To test whether sound financial condition are particularly beneficial to achieve an efficient allocation of resources in intangible-intensive sectors, we estimate a saturated Rajan and Zingales (1998) model, almost identical to the one presented with respect to the aggregate sector-level analysis:

$$OPgap_{cst} = \beta_0 + \beta_1 (FinDev_{c,(t-1)} * IntangIntens_s) + \beta_4 (\boldsymbol{X}_{c,(t-1)} * IntangIntens_s) + \delta_{cs} + \delta_{ct} + \delta_{st} + \epsilon_{cst} \quad (5)$$

where notation is consistent with the one of Equation 1. The dependent variable is the covariance between size and productivity in a country-sector pair in a given year, while the vector $\boldsymbol{X}$ includes several controls (GDP growth, credit and labour market regulations, skills diffusion, government R&D) to ensure our estimates are not driven by other country level phenomena differentially affecting sectors according to their intangible intensity.

As shown in Table B.1, results confirm the outcome of the firm dynamics model, showing that the allocation of resources in intangible-intensive sectors tends to be superior in countries with developed financial systems (positive β_1).

Table B.1. Between-firm effect, sector level analysis

Dependent Variable: OP Gap		
Intangible Intensity: IntK_cat (0-1)	(1)	(2)
Financial Development * Intangible Intensity	**0.336*** **	**0.346*** **
	(2.66)	**(2.71)**
Observations	5,430	5,400
R-squared	0.921	0.922
Aggregate Controls Interacted with Intangible Intensity	NO	YES
Country * Sector FE	YES	YES
Country * Year FE	YES	YES
Sector * Year FE	YES	YES

Note: T-statistics in parentheses; standard errors clustered at the country-year and sector-year level. Significance Level: *10%, **5%, ***1%. The dependent variable is the covariance term of the Olley and Pakes decomposition. Financial Development is proxied by the composite IMF index. Sectoral intangible intensity (Figure C.1) is measured as in Demmou, Stefanescu and Arquié (2019); it is used as a binary variable with respect to the average sector. The aggregate controls included in model (2) are GDP growth, credit and labour market regulations, skills diffusion, government R&D; each control is also interacted with intangible intensity. Due to data availability, the estimation is carried over the 2006-2015 period.
Source: OECD calculations on Orbis, Compustat and IMF data.

Annex C. Additional tables and figures

Table C.1. Summary of financial constraints indices

Financial constraints index	Included components	Weighting scheme	Relative/Absolute values	Reference group	Calculation details
DFS_B (*Baseline*)	• Total assets • Age • Financial leverage ratio • Cash to assets ratio • Interest coverage ratio • Returns on assets • Current ratio • Equity over liabilities ratio	Unweighted -- based on the methodology developed by Musso and Schiavo (2008)	Deviation from the median of the reference group	Country-Sector	Sum of the scores (rescaled 0-10)
DFS_B2				Country-Sector	Number of variables for which the firm is in the more constrained category (rescaled 0-10)
DFS_PCA				Country-Sector	Principal components analysis of the scores (rescaled 0-10)
WW_num	• Cash flow over total assets • Total assets • Long term debt over total assets • Profitability (0-1 dummy) • Sales growth • Average sales growth in industry	Components are weighted extrapolating out of sample coefficients from Whited and Wu (2006)	Absolute value	No reference group	Numerical value
WW_cat			Deviation from the median of the reference group	Country-Sector	Deciles of the distribution
SAFE_v1	• Total assets • Leverage ratio • Cash holdings over total assets • Interest coverage ratio • Tangible fixed assets over total assets	Components are weighted extrapolating out of sample coefficients from Ferrando and Ruggeri (2015)	Absolute value	No reference group	Deciles of the distribution
SAFE_v2			Deviation from the median of the reference group	Country-Sector	Deciles of the distribution

Source: Demmou, Franco and Stefanescu (2020).

Table C.2. Within firm effect, alternative financial indicators

Dependent Variable: Log MFP					
	(1)	(2)	(3)	(4)	(5)
Financial Indicator Type	Simple Ratios	Unweighted Indices		Weighted Indices	
Financial Indicator	Cash Flow over TotAssets (-)	DFS_vB2	DFS_PCA	WW_cat	SAFE_v2
Financial Indicator	**-0.369*** **	**-0.021*** **	**-0.036*** **	**-0.025*** **	**-0.019*** **
	(-112.9)	**(-93.8)**	**(-124.9)**	**(-122.1)**	**(-137.3)**
Financial Indicator * Intangible Intensity	**-0.121*** **	**-0.006*** **	**-0.011*** **	**-0.007*** **	**-0.004*** **
	(-25.5)	**(-20.2)**	**(-25.6)**	**(-23.0)**	**(-22.5)**
Observations	10,428,942	8,098,713	8,098,713	7,459,986	9,994,179
R-squared	0.807	0.807	0.816	0.818	0.811
Firm Controls (Size, Age, Profitability) & Interactions	YES	YES	YES	YES	YES
Country * Sector * Year Fixed Effects	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES

Note: T-statistics in parentheses; standard errors clustered at the firm level. Significance Level: *10%, **5%, ***1%. The dependent variable is the log of firm-level total factor productivity, estimated according the GMM Wooldridge (2009) approach. In model (1), financial conditions at the firm-level are proxied by the inverse of the cash flow to total assets ratio. In models (2), (3), (4) and (5), financing conditions at the firm-level are proxied by a different composite financial constraints index; a detailed description is presented in Table C.1. Sectoral intangible intensity (Figure C.1) is measured as in Demmou, Stefanescu and Arquié (2019); it is used as a binary variable with respect to the average sector. The firm level controls included in all specifications are: total assets, EBITDA and age, together with their interactions with intangible intensity. The estimation is based on Equation 2 and builds on the framework developed in Demmou, Franco and Stefanescu (2020); it is carried over the 1995-2015 period and includes firms located in 29 countries (AUS, AUT, BEL, CHN, DEU, DNK, ESP, EST, FIN, FRA, GBR, GRC, HUN, IDN, IND, IRL, ITA, JPN, KOR, LUX, LVA, NLD, POL, PRT, RUS, SVN, SWE, TUR, ZAF).
Source: OECD calculations on Orbis and Compustat data.

Table C.3. Policy regressions

Dependent Variable: Log MFP				
	(1)	(2)	(3)	(4)
Policy Variable	Market Capitalisation to GDP	Value of Stock Traded to GDP	Depth Credit Info	Resolving Insolvency
Policy * Intangible Intensity	**0.001****	**0.001*****	**0.001*****	**0.002*****
	(2.5)	**(2.6)**	**(3.7)**	**(2.7)**
Observations	11,017	12,041	5,513	5,967
R-squared	0.925	0.920	0.951	0.944
Country-Sector FE	YES	YES	YES	YES
Country-Year FE	YES	YES	YES	YES
Sector-Year FE	YES	YES	YES	YES

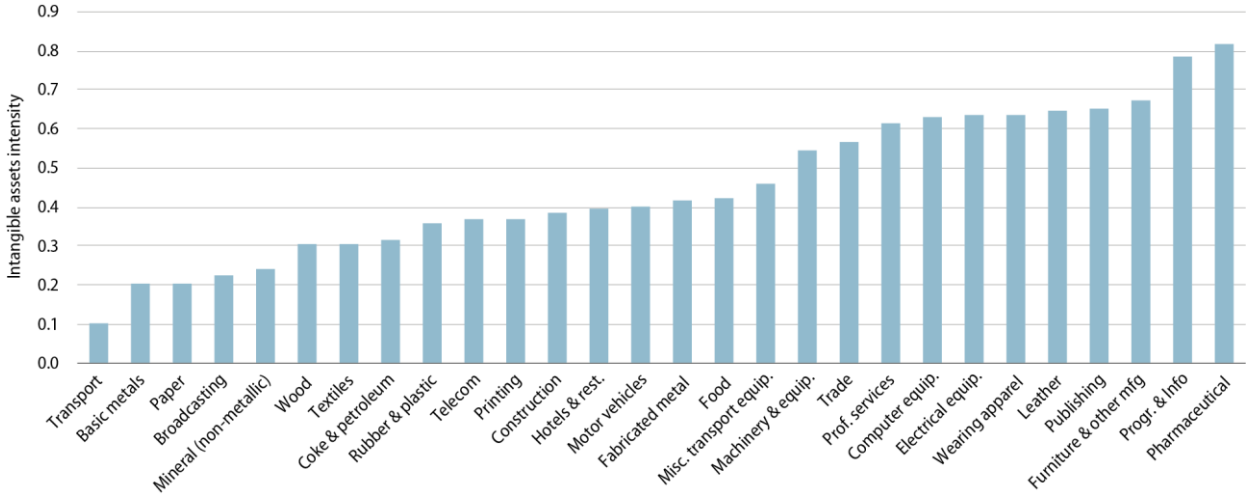
Note: T-statistics in parentheses; standard errors clustered at the country-year and sector-year level. Significance Level: *10%, **5%, ***1%. The dependent variable is sector level multifactor productivity. Sectoral intangible intensity (Figure C.1) is measured as in Demmou, Stefanescu and Arquié (2019); it is used as a binary variable with respect to the average sector. Market capitalisation to GDP and value of stock traded to GDP are respectively the stock market capitalisation divided by GDP and the value of stock traded in the market to GDP. The depth of credit information index measures rules affecting the scope, accessibility, and quality of credit information available through public or private credit registries, while the resolving insolvency indicator reflects the time, cost and outcome of insolvency proceedings involving domestic entities as well as the strength of the legal framework applicable to judicial liquidation and reorganisation proceedings. The estimation is based on Equation 1, but replacing financial development with the financial policy variable of interest, and builds on the framework developed in Demmou, Stefanescu and Arquié (2019); it is carried over the 1990-2015 period in specifications (1) and (2), while over the 2007-2015 period in models (3) and (4) due to data availability. It covers up to 28 countries (AUS, AUT, BEL, CAN, CZE, DEU, DNK, ESP, EST, FIN, FRA, GBR, GRC, HUN, IRL, ISL, ITA, JPN, LUX, LVA, MEX, NLD, NOR, POL, PRT, SVK, SVN, SWE).
Source: OECD calculations on STAN, Compustat and World Bank data.

Table C.4. The collateral channel

Dependent Variable: Log MFP	
	(1)
Financial Constraints Index: DFS_vB	**Collateral channel**
Financial Constraints Index	**-0.031*** **
	(-72.8)
Financial Constraints Index * Intangible Intensity	**-0.012*** **
	(-21.2)
Financial Constraints * Intangible Intensity * Collateral	**0.012*** **
	(7.5)
Collateral	-0.391***
	(-60.1)
Intangible Intensity * Collateral	-0.089***
	(-8.9)
Financial Constraints * Collateral	0.010***
	(9.8)
Observations	8,077,514
R-squared	0.816
Firm Controls (Size, Age, Profitability) & Interactions	YES
Country * Sector * Year Fixed Effects	YES
Firm FE	YES

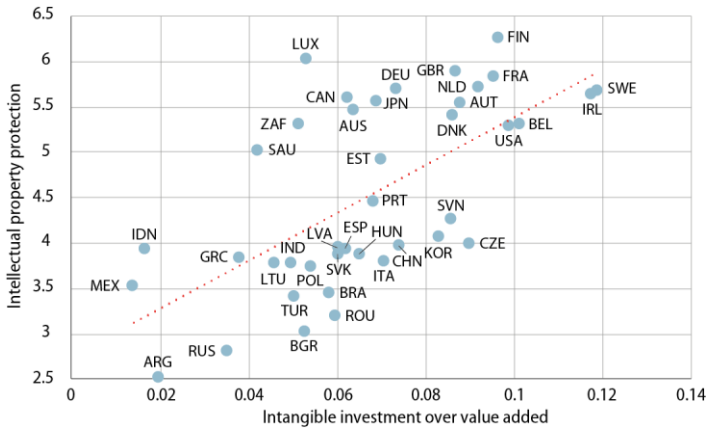
Note: T-statistics in parentheses; standard errors clustered at the firm level. Significance Level: *10%, **5%, ***1%. Total factor productivity is estimated according to the GMM Wooldridge (2009) approach, while financial constraints at firm-level are proxied by our baseline index, "DFS_vB". Sectoral intangible intensity (Figure C.1) is measured as in Demmou, Stefanescu and Arquié (2019); it is used as a binary variable with respect to the average sector. Collateral availability at the firm level is proxied by the ratio of tangible fixed assets to total assets. The firm level controls included in all specifications are: total assets, EBITDA and age, together with their interactions with intangible intensity and collateral availability. The estimation is based on an extension of Equation 2 (i.e., a triple interaction between financial constraints, intangible intensity and collateral availability) and builds on the framework developed in Demmou, Franco and Stefanescu (2020); it is carried over the 1995-2015 period and includes firms located in 29 countries (AUS, AUT, BEL, CHN, DEU, DNK, ESP, EST, FIN, FRA, GBR, GRC, HUN, IDN, IND, IRL, ITA, JPN, KOR, LUX, LVA, NLD, POL, PRT, RUS, SVN, SWE, TUR, ZAF).
Source: OECD calculations on Orbis and Compustat data.

Figure C.1. Intangible intensity by sector



Note: The figure reports sectoral intangible intensity computed on the basis of Compustat data U.S. listed firms. Intangible intensity is measured as the sum of intangible assets over the sum of total assets over the 1990 to 2006 period for each U.S. listed firm with available data in Compustat; firm level estimates are aggregated at sector level by taking the median-firm intangible intensity ratio of each sector.
Source: Demmou et al. (2019).

Figure C.2. Intellectual property rights and countries' intangible investment



Note: The figure shows the correlation between intangible assets gross fixed capital formation and intellectual property rights protection. Intangible assets' gross fixed capital formation is computed using a combination of data sources and a novel methodology described in Annex A; due to data availability, the training component of intangible investment is excluded. The intellectual property rights protection series is obtained from World Bank data. Both series are averaged over the 2011-2015 period.
Source: OECD calculations on OECD, National Use Tables, World Bank, PWT and ILO data.

Annex D. Lessons from venture capital successful experiences

Israel

The government has been a catalyst of the venture capital industry with the establishment of the Yozma program, which allocated the right set of incentives to all the market participants (Gilson, 2003). The Yozma Venture Capital Ltd., publicly owned and worth 100 million US $, acted as follows:

- It helped promising firms to attract foreign investment by committing US$ 8 million every US $20 million provided by the private investors, which had the chance to re-purchase the publicly held capital at a fixed rate after 5 years. Foreign entities were also granted a series of tax incentives and looser regulation (Baygan, 2003).
- It established a business relationship with leading academic institutions and technology incubators, as well as a club (Yozma III CEO Club) which allowed senior managers and successful entrepreneurs to meet and exchange knowledge.
- Consistent with the idea that when the government engages directly in venture capital activity achieves lower outcomes compared to private venture capitalists or co-funded investments managed by privates, it relied on international partners for all investment decisions, and never engaged directly (Lerner, 2010; Grilli and Murtinu, 2012).
- It favoured the development of complementary entities, aimed at training small firm's management, assessing domestic and international markets, advising and financing smart scientists and entrepreneurs (Baygan, 2003).

The risk-taking culture characterizing Israelis, the extensive stock of high quality human capital, the leadership and organisational skills as well as network relationships developed when serving in the military forces, and the strong links with U.S. investors are the main idiosyncratic demand factors that matched the increasing supply of venture capital (OECD, 1997; de Fontenay and Carmel, 2004; Avnimelech and Teubal, 2006).

United States

The purpose of the Small Business Innovation Research (SBIR) program was to complement, rather than substitute, private investment, given that the US venture capital market was already well established and effective in 1980s. The Small Business Innovation Development Act (1982) obliged eleven large federal agencies involved in external research financing to allocate a small percentage of their budget to small, domestic and independent firms. The program was organized through subsequent "Phases". Phase I award was simply intended to help entrepreneurs determine the feasibility of their projects. The federal agency then selected only the most promising start-ups and awarded them with a more significant Phase II grant, aimed at assisting entrepreneurs in the development of their business plans. The agency did not receive any equity or participation in exchange, but the awardee had to provide a report documenting the technology under development (OECD, 1997; Lerner, 1999).

Overall, the program achieved its objectives. Howell (2017) finds that venture capitalists are more inclined to invest in grant recipient firms, the awardees will produce more patents and revenues, and that this effect is magnified for financially constrained firms. In line with this, Lerner (1999) shows that firm enrolled in the SBIR program grew significantly more in terms of sales and employees compared to their peers during the period 1985-1995; yet, the positive effect was limited to firms located in counties with solid venture capital activity, emphasizing the complementarity between private and public financing. Further, again according to Howell (2017), the effectiveness of the program has been largely due to the reduction in uncertainty associated with Phase I, which allowed companies to undertake ex-ante more research on the viability of their idea and better define their business project through a small grant.

Finland

The history dates back to 1967, when the Bank of Finland became the main shareholder of the first Finnish VC fund named Sponsor, which was followed in the same year by another government-started fund called SITRA. The initial public stimulus did not achieve its objectives and hence the government implemented several complementary measures:

- It allowed the adoption of the Limited Partnership legal status, which attracted foreign investors (Luukkonen, 2006; Owen and Mason, 2019).
- It established catalyzing centers linked to North America and Asia, and created programs aimed at assisting entrepreneurs in evaluating the value and readiness of their projects.
- It enacted an accelerator program called Vigo designed to bridge the gap between early stage innovative firms and international finance (WEF, 2014), and promoted the merge of three universities in the Helsinki area in order to create the Aalto University as an hub of innovation and entrepreneurial culture
- It developed the the Nasdaq First North Growth Market, explicitly designed for small growing companies, allowed a viable exit strategy for venture capital investors.
- It established a new fund backed by Tekes, the Finnish Funding Agency for Technology and Innovation, with the goal of assisting start-ups and invest together with foreign venture capitalists (Owen and Mason, 2019).

Annex E. Crowdfunding and Blockchain technologies: a complementary source of finance for start-ups?

Opposite to venture capital, crowdfunding consists in the commitment of a small amount of money by a large group of financially unsophisticated individuals via the use of open on-line platforms. Platforms provide the infrastructure for the transaction, leading therefore to complete financial disintermediation of investment (Schwienbacher and Larralde, 2012; Belleflamme et al., 2014; OECD, 2015a). In addition to financing undertaken by not-for-profits organisations (i.e., the patronage model), crowdfunding arrangements can take three forms:

- First, the reward-based model, according to which investors receive a reward for their commitment either in the form of donation or of preferential access to and prices for the new product.
- Second, the lending model, which resembles pee-to-peer lending: investors receive just a promise of repayment after a predefined period of time of the capital loaned plus some interests.
- Third, the equity model, in which investors receive a share of the company and become effectively shareholders.

Specific legal frameworks have been developed to support the equity model, an example being the 2012 Jumpstart Our Business Startups Act (JOBS Act), which allows entrepreneurs and small business owners to sell limited amount of equity in their companies to a large number of investors and companies not to disclose financial statements if they have less than 1000 shareholders.

The rate of success of these initiatives, as well as the procedures that help entrepreneurs raising money for their projects and the best crowdfunding model to finance innovation, are not yet fully investigated. However, there is preliminary evidence on specific characteristics the legal framework and involved firms should have to increase the probability of success. Hornuf and Schwienbacher (2017) show that a too strong investment protection (i.e., restrictive exemptions to costly prospectus drafting and high registration requirements) reduces the amount of money raised. Mollick (2014) finds that crowdfunding platforms manage to consistently reduce information asymmetries. With respect to companies exploiting the crowdfunding equity model, Ahlers et al. (2015) suggest that retaining equity and disclosing information about the business model to the “crowd” is interpreted as a positive signal. More generally, Agrawal et al. (2011) find that, even though crowd-funders may be geographically dispersed, geographical proximity still plays a relevant role as local investors tend to participate at earlier stages.

Blockchain technologies also have the potential to play a role in firm funding in the future, though both their uses and the study of such uses are in early stages. O’Dair and Owen (2019) suggest that Blockchain is being used by many new music ventures as a means of raising capital through crowdfunding in various ways. One common method is using Blockchain to issue and sell “tokens’’ (cryptocurrency), some of which can be used for services or community participation, and others which have no utility beyond showing fan engagement with the company or artist (Sehra et al., 2017). The certification by independent online analysts can both lead to successful initial tokens sales, and predict long-run token performance in the secondary market, an expression of the “wisdom of the crowds” (Lee et al., 2018). These examples show that Blockchain is already being used to loosen financial constraints for entrepreneurs through crowdfunding and independent certification, and to enable ventures that would not otherwise have formed.