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“Measuring Intangible Assets and Their Contribution to Growth”

Complementarities in capital formation and production: Tangible and intangible assets across Europe

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This paper investigates capital formation with a view at various tangible and intangible assets across Europe and assesses in particular to what extent there are complementarities between various factor inputs, incorporating both tangible and intangible capital. While there is ample and comparably congruent literature on drivers of and barriers to investment, there is mixed evidence on complementarities among assets.

Based on novel data on investments in intangible assets (especially non-National Account intangibles), we applied various methodological approaches to assess to what extent there are complementarities among different asset types, i.e. investment in one asset type affecting the success (productivity) of an investment in another. In particular, we shed light on such complementarities at different aggregation levels by estimating translog production functions at macro- and micro-level.

First, we have estimated a general translog production function at macro-economic level (across 15 EU Member States, observations for 1995 to 2015) based on tangible and two types of intangible capital). Conceptually, we were most interested in the interaction terms of the translog function as the corresponding parameter estimates could indicate the existence of pairwise complementarities between different components of the deployed capital, in particular between NA and non-NA intangible capital (i.e. intellectual property products and economic competencies). At comparably high aggregation level, we did find some evidence for the existence of complementarities between tangible and non-NA intangible capital as well as between NA and non-NA intangibles.

We have then turned our analytical attention to the firm-level and rerun the translog production function approach used already at the macro-level, i.e. splitting up the capital component and putting emphasis on the interaction term(s) between tangible and intangible capital inputs (and subcategories thereof). Evidence suggests that higher degrees of interaction between investment in tangible and intangible capital tends to be directly related to labour productivity, thus pointing to some complementarities in the corresponding capital formation. In fact, when looking at the interaction between tangible and intangible assets (aggregated at that level), we find evidence of significant complementarities, which is reassuring with a view at our initial hypothesis and, moreover, also confirms the finding at macro-level.

With a view at further refining our firm-level analyses, we have gradually disaggregated the individual asset types further and re-estimated the translog production function accordingly. Apparently, when zooming in deeper, evidence suggests that certain types of tangible and/or intangible assets can be either complements or substitutes, or may have no obvious relations whatsoever. In fact, we found evidence of tangible and intangible assets being complements (e.g. machinery and equipment with R&D as well as software and databases with training and organisational structures). However, we also found that some capital formation might be a substitute for investing in other asset types as, for instance, investing on tangible assets such as land and buildings or machines related to knowledge assets such as organisational structures. In turn, we did not find strong evidence for such substitutional relations among various types of intangible (knowledge) capital. In fact, most of the investments in intangible asset types seem to be rather complementing each other (esp. software, training and organisational capital). Regarding policies that aim at stimulating investment, our analysis pointing to the possible existence of complementarities demonstrates that there is no golden rule applicable across industries and countries to define what is a ‘balanced mix’ of investments in various types of assets. Policy support that aims at stimulating investment in certain assets (while excluding others) may therefore fall short in unlocking its own full potential. When looking at the portfolio of investments in tangible and intangible asset types, at whatever aggregation level, there is no golden rule that could be applied to define what is a ‘balanced mix’. In fact, this depends on many external and firm-specific aspects. Policy support that aims at stimulating investment in certain assets (while excluding others) may therefore fall short in unlocking its own full potential. For instance, subdued investment trends in Europe might only be effectively tackled by means of policy initiatives stimulating e.g. the spending on high-tech equipment, in-house R&D, etc. if the latter are indeed the types of assets companies are lacking the most, i.e. underinvestment in such assets benchmarked against a hypothetically optimal capital formation (balanced investment portfolio). Accordingly, policy initiatives in terms of R&D, FDI, tech-transfer / technological diffusion, Global Value Chains (i.e. competition / industrial policies), etc. would need to be well aligned and rather flexible in their scope to ensure that all sorts of relevant investments can indeed be financed through the corresponding initiatives. However, too often such initiatives focus on certain types of assets only (often biased towards investments in assets that can be used as collateral), thus falling short to encompass in particular non-NA intangible assets such as training, organizational capital, etc., which we have found to be complementary to other crucial assets (e.g. software). Accordingly, it is not about shifting emphasis in terms of stimulating investments from tangible to intangible or certain subcategories of intangibles. We would advocate for a flexible approach in terms of supporting investment, covering conceptually a wide array of asset types, including those labelled as non-NA assets (such as e.g. training, organizational structures, etc).