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Global INTAN Invest

Intangible Assets in the Global Economy

Better Data for Better Policy

Quarterly estimates of intangible investments: methods and data description

Technical report

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Luiss Business School

Villa Blanc, Via Nomentana, 216 - 00162
Roma
T +39 06 85 22 51
luissbs@luissbusinessschool.it

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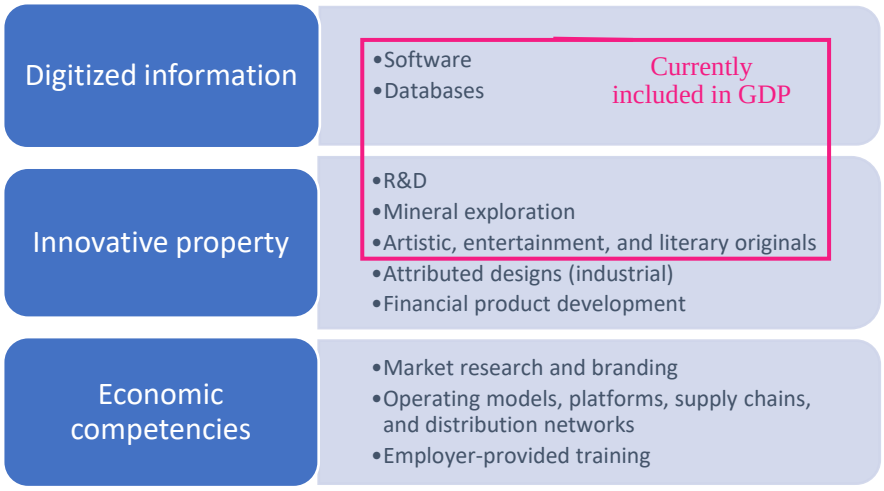
1 Introduction

This report provides an overview of the sources and methods adopted to build the first set of quarterly estimates of the list of intangible assets proposed by Corrado, Hulten and Sichel (2005) (CHS onwards). So far, main research efforts have been devoted to generating annual measures of intangibles, and there is not much on intangible investments at higher frequency. Therefore the estimates provided by this project are the first quarterly measures of CHS intangibles produced up to now.

Table 1: Intangible Capital: Broad categories and types of investment



Source: Corrado, Hulten, and Sichel (2005, 2009).

In official calculations of GDP, there has been a relatively recent recognition of certain intangible assets including R&D, mineral exploration, computer software (blended with internally produced databases), and entertainment, artistic, and literary originals—the assets "boxed" in table 2. The remaining assets are not yet included in GDP by official macroeconomic statistics. Following this distinction we organize the description of the sources and method adopted to generate quarterly level measures of CHS intangibles distinguishing between those already included in the asset boundary of ational Accounts (National Account Intangibles, NA Intangibles onwards) and those not yet included in GDP (Non National Account Intangibles, Non-NA Intangibles onwards).

The quarterly database is built following on the same structure as the EUKLEMS&INTANProd but with no industry detail because of the lack of information at such level of disaggregation. Consistent with annual data, quarterly investment in NA intangibles is primarily based on official data sources, while Non-NA intangibles need to be estimated. In addition, similar to annual calculations, total GFCF in intangible assets is obtained adopting a bottom-up approach: we estimate GFCF by asset type first, and then we get total GFCF aggregating across assets. However,

the quarterly non-national accounting calculation for each asset is not a replica of the annual calculation at a quarterly frequency, as most of the data sources used for annual estimates are only available at a yearly frequency. Instead, for the quarterly measures we resort to indicators of the short-term dynamics of intangible investment. Therefore, to generate quarterly data, we rely on benchmarking techniques, which allow us to produce quarterly estimates consistent with annual data and coherent with the short-term development of the quarterly indicators. Benchmarking methods are the best practice for compiling quarterly national accounts (Eurostat, 2013; IMF, 2018) and are commonly used by statistical institutes.

At this stage of the project, we have collected data on quarterly national accounts, including gross fixed capital formation (GFCF) in intellectual property products (IPP). As for Non-NA intangibles, we have constructed quarterly series – in current prices and chain-linked volumes - of the purchased and the own-account components of investment in brand, design, organizational capital and new financial products for the majority of EU Member States, the US, and the United Kingdom. The full geographical coverage of the quarterly estimates of intangibles will be the main goal of the second phase of the project in spring 2024.

The report describes the current status of the calculation of quarterly intangible investment at current prices. It is organized as follows: section 2 illustrates the main data sources and methods for measuring quarterly NA intangibles. Section 3 provides information about the estimate of the quarterly Non-NA intangibles. Section 4 reports some evidence of the first results based on the newly estimated quarterly intangibles. Section 5 describes the next steps to complete the construction of quarterly database on intangible investment at current prices and in volume terms.

1.1 National accounts variables: data sources and estimation methods

Consistently with annual data, current prices quarterly estimates for all variables included in national accounts are gathered from official data sources.

The main data sources for the European Union economies are national accounts available from the Eurostat database in the section "Economy and finance" [National accounts (ESA 2010) (namq10)].[1] UK data are sourced from the OECD databases and data for the US from the Bureau of Economic Analysis (BEA).

Geographical and time coverage is almost complete for current prices and chain-linked volumes.

[1] In particular, we exploit the following data from the Eurostat databases:
- "Gross fixed capital formation with AN_F6 asset breakdowns [NAMQ_10_AN6]"
- "Employment A*10 industry breakdowns [NAMQ_10_A10_E]"
- "Gross value added and income A*10 industry breakdowns [NAMQ_10_A10]"

There are some exceptions for some countries. No data on quarterly GFCF by asset type is available for Belgium (nor from Eursotat or national data sources). As for IPP at current prices, data for Cyprus starts from 2014-Q1 and for Ireland 2020-Q1 and 2020-Q2 are missing. On the contrary, for every country, variables in previous year prices are only available for the non seasonally and calendar-adjusted series.

Considering intangible assets, the major limitation for the European countries is that quarterly GFCF is only available for total IPP, with no details on the asset components (R&D, computer software and databases, mineral exploration and evaluation, and artistic and entertainment originals). Although the calculation of total intangible investment at current prices does not require IPP disaggregated by asset type, such details are useful to improve the quality of series in volume terms and growth accounting calculation. Future work will be devoted to investigating the possibility of calculating quarterly IPP disaggregated by asset type.

2 Non-National Accounts variables: data sources and estimation methods

The annual data includes estimates of GFCF, capital stock and related measures for the whole set of CHS intangible assets illustrated in Table 1.

At this stage, we have constructed quarterly estimates at current prices and chain-linked volumes for all Non-NA intangibles except firm-specific human capital..

Consistently with annual data and national accounts methodology, for Design, Brand, and Organizational capital, we generate estimates covering both purchased and own account components (i.e., an estimate of the value of intangible assets that economic units produce for their own final use), and we get total GFCF as the sum of the two components. However, new financial products are produced exclusively on own-account.

2.1 Benchmarking Techniques for Quarterly National Accounts[2]

The calculation of quarterly GFCF in intangible assets relies on the benchmarking approach widely used to produce quarterly national accounts.[3]

Generally, quarterly data sources rely on a more limited set of information than annual data. For this reason, quarterly data may present non-negligible differences in levels and dynamics compared to annual data, or may only be available as index numbers. Consequently, the annual data provide the most reliable information on the overall level and long-term trend for the national accounts

[2] This section draws heavily on Eurostat (2013) and IMF (2018).

[3] Detailed description for this procedure can be found in the IMF manual (2018, chapter 6) and in the Eurostat manual (2013, chapter 8).

variables, while the quarterly data source provides the only available explicit information about the short-term dynamics.

On the other hand, the quarterly and annual estimates for a national accounts variable should be temporally consistent (e.g., the sum of the four quarters of a quarterly series at current prices must be equal to the value of the corresponding year in the annual series). This normally entails forcing the quarterly estimates to be consistent with their annual counterparts because annual series are estimated based on more exhaustive and robust data sources.

Benchmarking methods in the national accounts are used to derive quarterly series that are consistent with their corresponding annual totals (*benchmark*) and, at the same time, preserve the short-term movements of quarterly economic *indicators* as much as possible. In addition, benchmarking methods compute quarterly extrapolation to derive the quarterly estimates for quarters for which annual benchmarks are not yet available ("forward series").

Benchmarking also has the nice feature that the extrapolated quarterly series can be used to produce preliminary estimates of annual GFCF at current prices, simply aggregating across quarters. This is possible because quarterly forward series levels are consistent with the last year estimated in the annual series. Also, the annual series in volume terms can be extrapolated to the most recent years using the volume indicators implicit in the quarterly calculation.

The Eurostat manual on QNA classifies benchmarking methods as follows:

a. Methods when no quarterly data are available;

b. Direct methods;

c. Indirect methods

2.1.1 Methods when no quarterly data are available

Methods that do not rely on quarterly indicators should only be used when only annual data are available. In this case, quarterly estimates are derived either by a weighted disaggregation of the available annual data according to some purely mathematical criterion (such as the smoothing method proposed by Boot, Feibes, and Lisman, 1967), or by using time series models. In either case, the only objective is to provide sufficiently smooth quarterly estimates consistent with the annual data. Time series methods, in particular ARIMA models, can also be used to extrapolate a QNA time series when there is no data on quarterly indicators for the latest periods.

The IMF and Eurostat manuals on quarterly national accounts clarify that such methods are very much a last resort, and compilers of quarterly series should do their utmost to obtain and use a quarterly indicator that has some relationship with a QNA variable to be estimated.

2.1.2 Direct methods

Direct methods benchmark preliminary quarterly estimates of a QNA variable, or a quarterly indicator, to the corresponding annual benchmarks, using a mathematical procedure. In the case of a flow variable, as investment, this takes the form of spreading the differences between the annual benchmark and the sum of the quarterly estimates over a year by maximizing, or minimizing, an appropriate criterion that ensures that the aggregation constraint is satisfied whilst minimizing the changes to the dynamic of the preliminary quarterly estimates or the quarterly indicators.

The IMF and Eurostat manuals on QNA compilation recommend using proportional benchmarking methods with movement preservation of indicators to derive QNA series, while methods based on simply rescaling the quarter indicator to the annual totals should be avoided.[4]

Among the several proportional methods of temporal disaggregation, the two most widely used are those known as proportional Denton method (Denton, 1971) and its extensions and the proportional Cholette-Dagum method (see Cholette and Dagum (1994); Dagum and Cholette, 2006). The Denton technique keeps the ratio of the benchmarked series to the indicator (the so-called quarterly BI ratio) as constant as possible subject to the constraints provided by the annual benchmarks. The adjustment to the quarterly indicator follows thus a purely mechanical scheme, with no explicit statistical models or assumptions describing the behavior of the series involved.

An alternative solution to the Denton approach is the proportional Cholette–Dagum method with autoregressive (AR) extrapolation. Cholette and Dagum (1994) proposed a benchmarking method based on the generalized least squares regression model grounded on a statistical model that allows for (a) the presence of bias and autocorrelated errors in the indicator and (b) the presence of nonbinding benchmarks. A particular case of the Cholette-Dagum framework is the proportional benchmarking method with first-order autoregressive error (or AR(1) error). The Denton method can be regarded as a particular (approximate) case of the Cholette–Dagum regression-based model.

The proportional Denton and Cholette-Dagum methods tend to generate quite similar results when annual constraints exist ("back-series") but differ in extrapolation, when there are no annual totals ("forward series"). In extrapolation, Denton generates benchmarked series with quarter-to-quarter growth rates that are identical to those in the indicator. Cholette-Dagum, instead, calculate automatically bias-adjusted extrapolation based on the historical relationship between the annual

[4] Methods based on rescaling, such as the pro rata approach, produces unacceptable discontinuities from one year to the next (the so-called step problem) and therefore does not preserve the movements in the indicator from the fourth quarter of one year to the first quarter of the next. Techniques that introduce breaks in the time series seriously hamper the usefulness of QNA by distorting economic developments and possible turning points. They also thwart forecasting and constitute a serious impediment for seasonal adjustment and trend analysis.

variable and the quarterly indicator.[5]

2.1.3 Indirect methods

Indirect methods estimate values for a quarterly variable by modelling the relationship between (annualized) preliminary quarterly estimates of a QNA variable, or a quarterly indicator, and the corresponding annual benchmarks using an explicit regression-based approach. The most widely used method is the one proposed by Chow and Lin (1971) and its extensions. In the Chow-Lin approach, estimates for the quarters of the latest year, for which no annual benchmark data exist, are directly obtained from the quarterly regression model and the quarterly residuals are inferred. The Chow-Lin approach has several nice features, including the possibility of evaluating the precision of the estimates by means of all the standard regression analysis tools. On the other hand, its implementation is much more complicated and time-consuming than the proportional Denton and Cholette-Dagum techniques.

2.2 Benchmarking Techniques for Intangibles

To calculate quarterly intangible investment for non-national accounts assets we rely on direct proportional methods. Using regression-based models, such as Chow-Lin, is simply not feasible because its implementation would require running regression for 30 countries and eight different asset types for each country (considering that the calculation is done separately for purchased and own-account components). The estimates presented in this report are obtained with the Cholette-Dagum method. We have also started to perform a battery of checks on the validity of quarterly indicators for the purchased and the own account components.[6]

Consistent with international best practices, we try to avoid using purely mathematical or time-series techniques that do not use quarterly indicators as much as possible. The only possible exception could be the calculation of the most recent quarters of the own-account components for EU countries, as discussed below.

2.3 Brand, design and organisational capital: purchased components at current prices

The annual intangible investments variables (the benchmarks), are taken from the last release (2024) of the EUKLEMS&INTANProd database[7]. Our first choice as an indicator for GFCF at current prices is the quarterly index of turnover for the industries that are the major producers of each asset. Whenever possible we prefer to use indicators that are seasonally and calendar adjusted.

[5] We implement the procedure on RStudio with the package "tempdisag" (Sax and Steiner, 2013).
[6] The validation of the indicator is based on analysing the dynamic of the benchmark-indicator ratio and directly comparing the growth rates of benchmarks and indicators.
[7] The 2024 release will be made available to the users by the end of June 2024

The data sources are different according to different countries:

- For EU 27 the main reference is the the dataset "Turnover in services - quarterly data [STS_SETU_Q]" from Eurostat website. Seasonally and calendar adjusted data are available. The only countries that are could not be covered using the Eurostat database are the Netherlands and Ireland, for which we will collect turnover indices from the national statical offices.
- For the United Kingdom we get quarterly variables from the dataset "Monthly Business Survey turnover of services industries" from the Official National Statistics. Seasonally adjusted data are not available.
- For US we get quarterly variables from the dataset "Quarterly Services Survey" by the US Census Bureau. Seasonally adjusted data are not available.

Turnover variables are downloaded for the NACE Rev. 2 industries reflecting the production of intangible investments: codes M702 for Organizational Capital, M71 for Design and M73 for Brand. [8]Any missing data due to lack of coverage in the data sources has been replaced with imputed value derived as follows::

1. If the series is missing through the whole period, then we directly impute the available series of a higher aggregate industry, following the crosswalk in Table 2.

2. If the series is truncated, then we use the dynamic of the higher aggregate to retropolate the series starting from the last period (year-quarter) for which both are available.[9]

3. If the series shows a gap in the middle, we still use the dynamic of the higher aggregate to estimate the missing years-quarters, as in case 2, but using a constrained retropolation approach.

Table 2: Industries' crosswalk for imputation of missing values

Asset	Industry (1st choice)	Industry (2nd choice)	Industry (3rd choice)	Industry (4th choice)
Organizational Capital	**M702**	**M69_M702**	**M69**	**M_STS**
Design	**M71**	**M_STS**	**M69_M702**	**M69**
Brand	**M73**	**M_STS**	**M69_M702**	**M69**

After the imputation procedure we end up with the following availability for quarterly frequency:

[8] Please notice that for UK the industry codes are as follows: 70.2 for Organizational Capital (CDID code JQ3Q), 71 for Design (CDID code JQ3R) and 73 for Brand (CDID code for JQ3S). For US we have: 5416 for Organizational Capital, 5414 for Design and 5418 for Brand. For US also aggregated industry 54 (corresponding to NACE Rev. 2 M_STS) has been used for interpolation purposes.

[9] For the sake of clarity, if industry M702 is available only from 2015 Q1 to 2023 Q1, then we can use M69_M702, if fully available, from 2010 Q1 to 2014 Q4 after we have multiplied each year-quarter value for a re-scaling factor given by the ratio of the M702 value over the M69_M702 value both at time 2015 Q1.

- From 2010 first quarter to 2023 fourth quarter for EU 27.
- From 2001 first quarter to 2023 fourth quarter for UK.
- From 2003 first quarter to 2023 fourth quarter for US.[10]

Once we get full series for our indicator variables, we can proceed to implement the benchmarking technique. As a result, we get quarterly estimates of intangibles assets in purchased terms up to 2023, first or second quarter, depending on the availability of the indicator.

2.4 Brand, design and organisational capital: own-account components at current prices.

The annual estimates of the own account components of investment in Brand, Design, Organisational Capital and New Financial Products adopt a sum-of-cost approach. In a nutshell, this consists in computing firms' expenditures for workers employed in occupations that are relevant for each asset and then adjusting these expenditures for some key factors. These factors include the amount of time that workers spend producing assets that are accumulated within a firm (which is achieved through time-use assumptions), accounting for non-labour related costs of the production of the relevant asset (using so-called blow-up factors) and performing a sold-output adjustment for industries that produce the asset for other industries.

To be consistent with the annual data, estimating the quarterly indicators for the own account components requires detailed employment data by type of occupation to calculate the proper indicator for the volume component of GFCF. Then, the indicator for GFCF at current prices is obtained by multiplying the volume indicator for an appropriate deflator.

For European countries, the only source for employment disaggregated by type of occupation available at quarterly frequency is the EU Labour Force Survey (LFS), while for the US we use the Current Population Survey (CPS, the US equivalent to the LFS). In the LFS, occupations are available at the three-digit level of the 2008 International Standard Classification of Occupations (ISCO) for all countries. This level of detail is the same at which annual estimates (which use the EU Structure of Earning Survey as the main data source) are implemented. This is crucial to guarantee that the quarterly indicators are consistent with the annual benchmarks and generate high-quality quarterly GFCF. Table A1 in the Appendix shows the list of occupations that are assumed to be engaged in producing own account intangibles and the corresponding time-use assumptions by asset.

[10] To be noticed that Brand and OrgCap would be available from 2003. Design series is truncated from 2003 to 2012, but can apply some retropolation procedure in order to impute values from a higher series. Hence all the three indicators for purchased components for US will be then available from 2003.

For each asset i, the calculation for each quarter is as follows:

1. Compute the amount of total employment (number of persons employed) for each relevant occupational group j (identified at three-digit ISCO) involved in producing the asset i, EMP^i_j.

2. Apply the occupation-specific time-use assumptions used for annual calculations to each occupation's employment to measure the employment essentially engaged in asset production ($AdjEMP^i_j$):

$$AdjEMP^i_j = EMP^i_j * t^i_j$$

Where t^i_j is the percentage of working time that occupational working group j spends on own-account production of asset i.

3. Calculate total time-use adjusted employment for each asset, $AdjEMP^i$, by aggregating across occupations:

$$AdjEMP^i = \sum j\ AdjEMP^i_j$$

4. Express total time use-adjusted employment as index number with 2015 as reference year, $IAdjEMP^i$, dividing each quarter by the average value in 2015.

5. Multiply the volume indicator $IAdjEMP^i$ calculated at step 4 by the correspondent deflator for asset i expressed as index number with the reference year 2015, $IDefl^i$, to get the quarterly indicator for current price GFCF in the own-account component for asset i, $QIndCP^i$:

$$QIndCP^i = IAdjEMP^i * IDefl^i\ vvv$$

The price index used for step 4 refers to the service producer price indexes (SPPIs) for the relevant industries (i.e., those most relevant for the production of each intangible asset type), as discussed above with reference to the turnover indexes. Similar to the turnover indexes, we have implemented an imputation procedure based on imputing missing data using higher aggregation level series. For Bulgaria, Portugal, and Slovakia, there are no SPPIs and we have used the implicit deflator of GFCF in IPP from national accounts.

For the European countries, the above calculation requires micro-data from the EU Labour Force Survey (LFS). The timeliness of LFS microdata from Eurostat is not very satisfactory. Currently, only data up to Q4.2021 are available. To extend the indicators up to the most recent quarters, in the current version of the database we have extrapolated the LFS-based indicators using the dynamic of the indicators for the purchased components. Future work will use ARIMA model to extrapolate the quarterly series for the most recent quarters and compare the results using the two different

approaches.

2.5 Brand, design and organisational capital: chain-linked volumes.

Quarterly series in volume terms (chain-linked volumes) are needed to analyze investment from a time-series perspective and as input to the growth accounting calculation.

Although the same principles apply to both quarterly and annual price and volume measures, quarterly calculation faces some complications deriving from the different frequency of observation and the requirement that quarterly and annual figures should be made consistent with each other. In particular, consistency between quarterly and annual price and volume measures is only guaranteed when annual and quarterly changes are aggregated using the same system of weights and the same index number formula and chain-linking method.

Price and volume decomposition requires a set of deflators for each detailed components (each asset, in our case), a system of weights to aggregate the detailed components, and an index formula and a chain-linking technique. Regarding the deflators, for non-national accounts intangibles, we have used the SPPIs benchmarked to annual deflators for intangible GFCF as the primary input, as described in the calculation of the indicators for the own account components. As for IPPs, we have adjusted quarterly IPP deflators from official national accounts to make them consistent with the annual ones from the analytical module of EUKLEMS&INTANProd, which incorporates harmonized deflators for ICT assets (including software) whose product quality change component is harmonized across countries.

As for the system of weights and the index number formula, we have used the Laspeyres index with the annual overlap technique for European countries and quarterly Fisher indexes with the one-quarter overlap technique for the US.[11] Using these techniques guarantees that chain-linked series of non-national accounts intangibles are consistent with their annual counterpart and with the national accounts assets (because national accounts use Laspeyres indices in European countries and Fisher indices in the US).

3 Empirical Evidence

3.1 Evidence at the asset level and benchmarking calculations

In this section we provide some evidence on a selection of indicators used to generate estimates of quarterly Non NA intangibles to evaluate their capability to capture the dynamics of the annual

[11] A detailed description of these techniques can be found in chapter 8 of the IMF Quarterly National Accounts Manual (IMF 2018.

estimates of Non NA intangibles. Figures 1 to 6 show the comparison between the annual estimates, the selected indicator used to generate the quarterly measure and the quarterly estimate of Purchased Organizational Capital for a sample of six countries (Germany, France, Italy, Spain, UK and US). Additional evidence on Brand and Design is provided in the Appendix.

Notice that the dynamics of quarterly benchmark estimate is coherent with the quarterly indicator thus confirming the robustness of the estimates generated by means of the benchmarking approach.

Figure 1: Organizational Capital in purchased components in Germany.

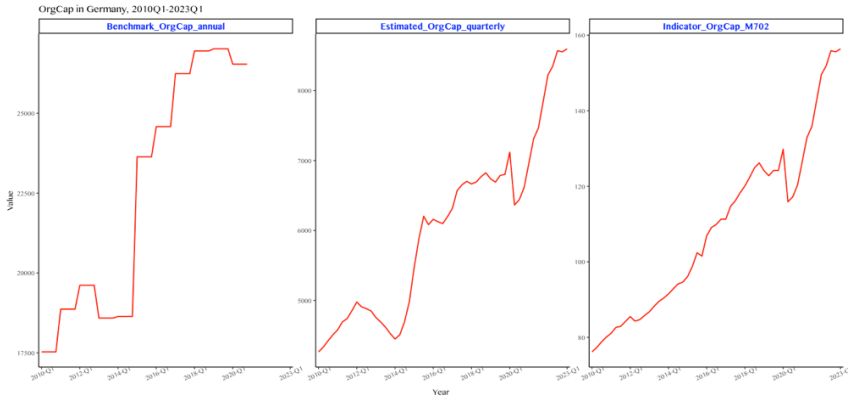


Figure 2: Organizational Capital in purchased components in France.

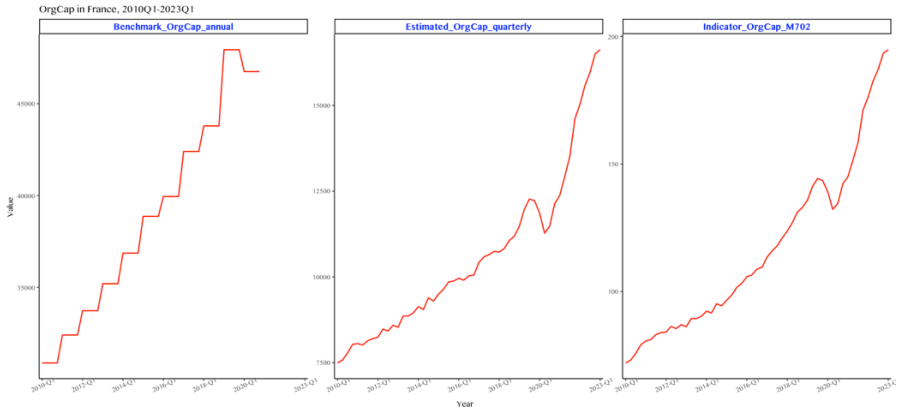


Figure 3: OrgCap in purchased components in Italy.

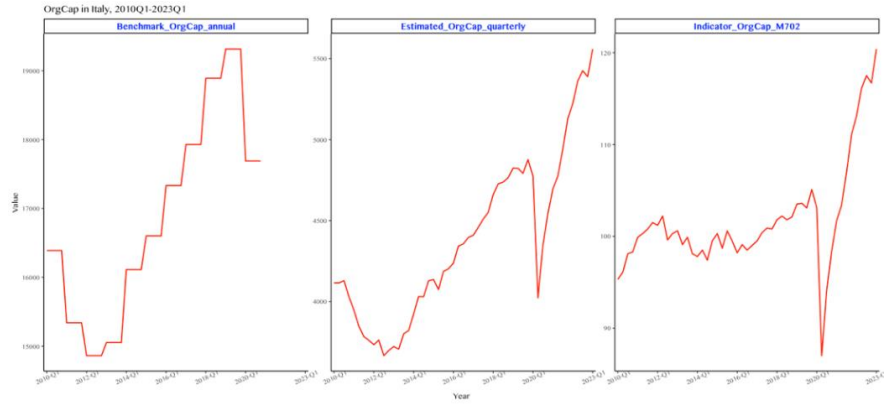


Figure 4: OrgCap in purchased components in Spain.

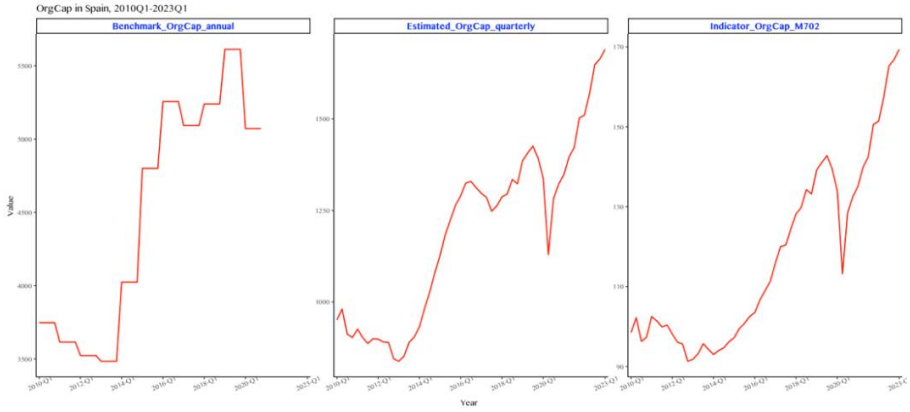


Figure 5: Organizational Capital in purchased components in UK.

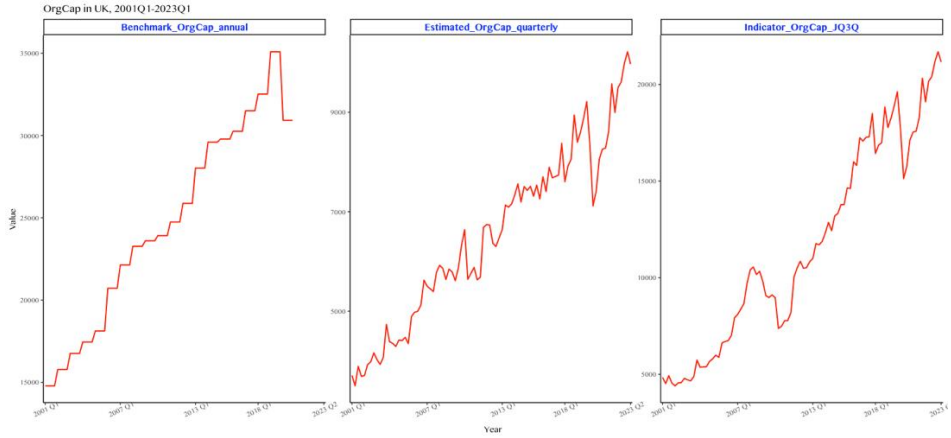
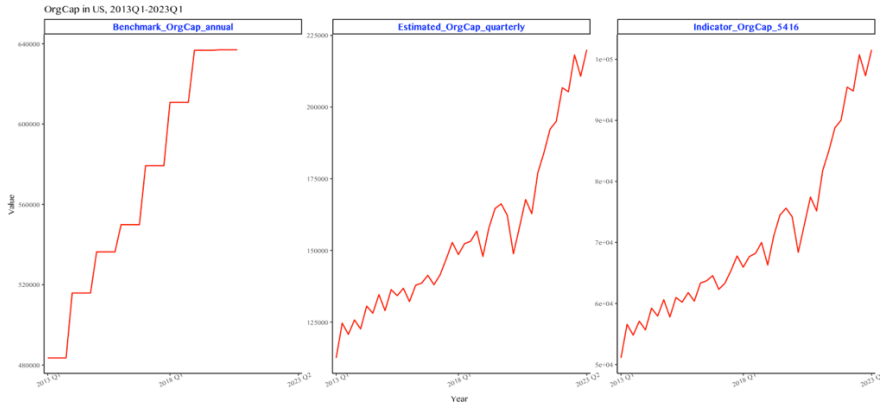


Figure 6:Organizational Capital in purchased components in US.


OrgCap in US, 2013Q1-2023Q1
Benchmark_OrgCap_annual
Estimated_OrgCap_quarterly
Indicator_OrgCap_5416
Value
Year

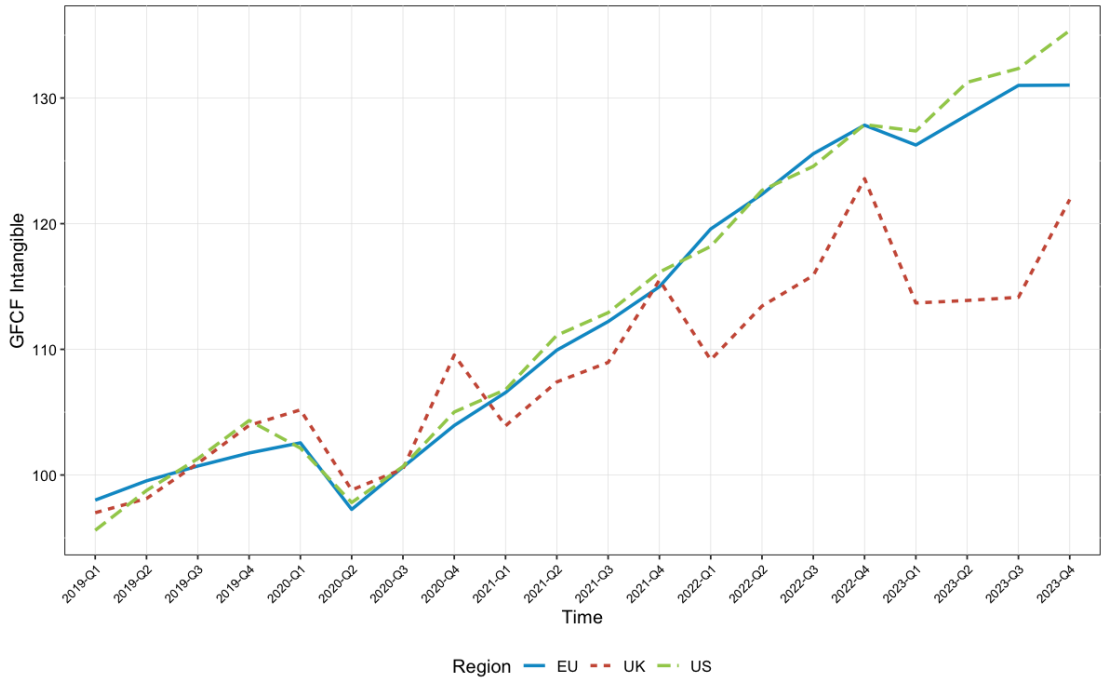
3.2 Evidence on quarterly intangible dynamics 2020-2023

This section illustrate first evidence about the newly estimated quarterly intangible investments at current prices for 24 European Union member countries[12] as a whole, UK and US over the period Q1- 2010 to Q2 – 2023[13].

Figure 7 shows the dynamics of quarterly intangible investment in current prices for the EU, UK and US over the period Q12019-Q32023. Intangible investment slowed down significantly with the outburst of the COVID19 pandemic in Q2-2020 in the three geographical regions. The downturn of intangibles recovered rather quickly in the following quarters, corroborating the assumption that intangible investment are relatively resilient to macroeconomic shocks (Corrado et al 2021). Intangible investments grew at a similar pace in the EU and the US until Q4-2022 and slowed down in both regions in Q3-2023. In the last three quarters of 2023, instead, the accumulation of intangible assets grew qith a faster pace in the US than in the EU. The dynamic in the UK decoupled from the other two regions starting from Q1-2022, and showed an overall slower trend.

Figure 7: Quarterly Intangible Investments: EU, UK and US

(index number 2019=100)



[12] The EU aggregate refers to 24 European economies: Germany, France, Luxemburg, Netherlands, Czechia, Estonia, Croatia, Hungary, Lithuania, Latvia, Poland, Romania, Slovenia, Slovakia, Denmark, Finland, Sweden, Greece, Spain, Italy, and Portugal.

[13] Notice that for the sake of the exposition the charts below refer only to the time span Q1 2019 – Q2 2023, but the full sample is available from the xlsx file attached to this deliverable.

Figure 8 provides evidence on the dynamics of tangible and intangible investment in the EU, UK and US. This results support the assumption of a relatively higher resilience to economic shocks of intangible assets compared to tangibles. This is mainly the case for the US where during the recovery phase after the COVID19 crisis intangibles increased by almost 40% compared to 2019 while the tangibles by 18%.

Figure 9 shows a further decomposition of intangible investment into NA and Non NA components to get the sense of the characteristics of intangible assets not yet included in GDP over the business cycle and calculated using the indicators described in section 2.

Figure 8: Tangible vs Intangible Investments: EU, UK and US

(index number 2019=100)

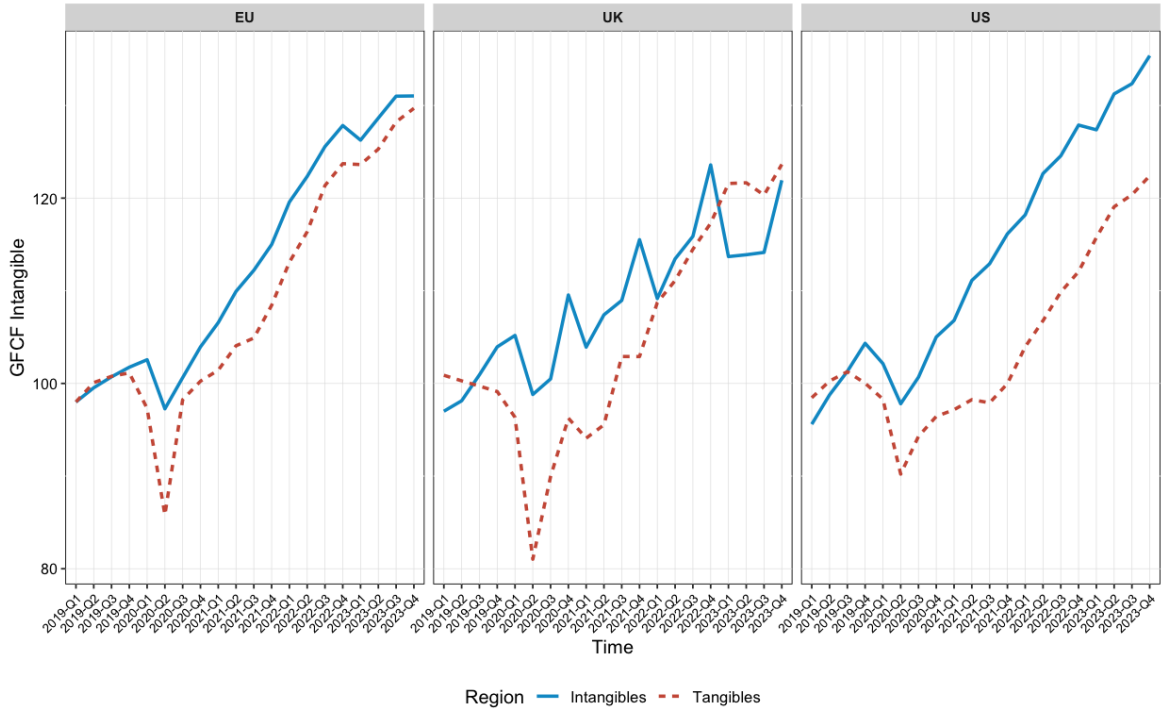
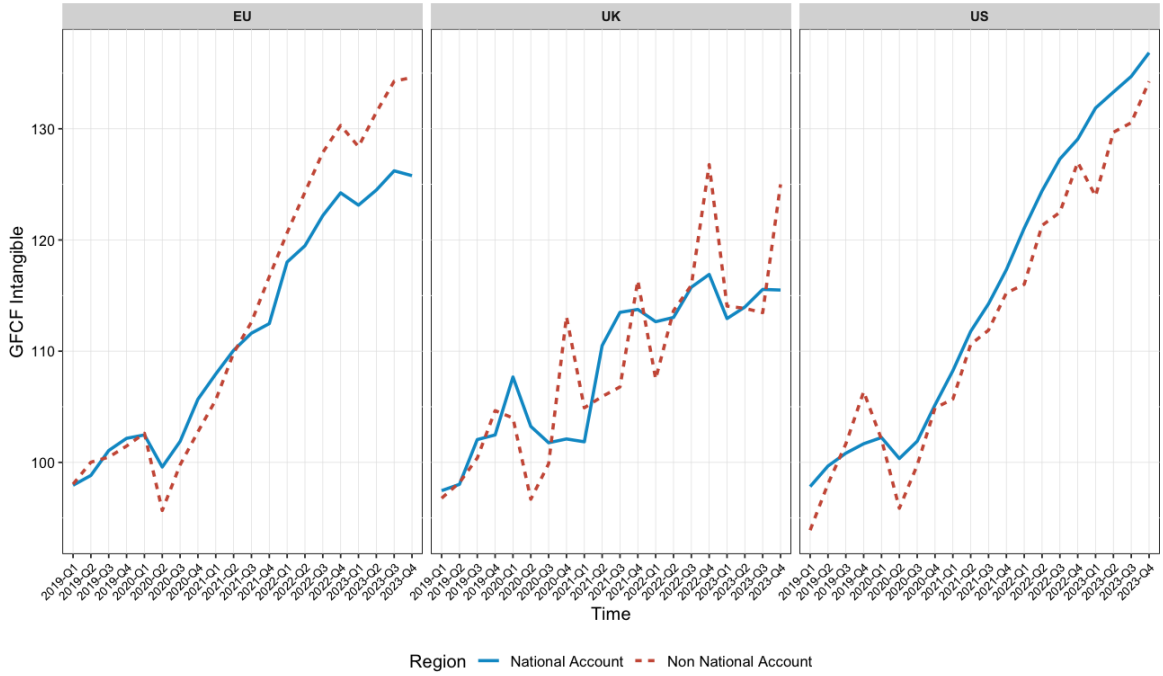


Figure 9: NA vs Non NA Intangible Investments: EU, UK and US

(index number 2019=100)



4 Next Steps

The results illustrated in this report represent the first step in constructing harmonized quarterly estimates of investment in intangible assets for EU countries, the UK, the US, and Japan. The next step of the project will be completing the country and asset coverages, refining and validating quarterly indicators, and harmonizing the seasonal and calendar adjustment across all countries.

The first priority is completing the asset coverage calculating quarterly estimates for firm-specific human capital using an indicator based on information on training activities available from the LFS.

The major gap in Eurostat's national accounts data is missing data for Belgium, and we will investigate the availability of country-specific sources for quarterly national accounts. We will also investigate the possibility of producing quarterly estimates separately for R&D, Computer software and databases, and Other intellectual property products. This might be obtained either by finding asset-specific quarterly indicators and replicating the benchmarking procedure implemented for non-national accounts assets or disaggregating IPP into the component assets using the corresponding shares from the annual series.

The major country gap for non non-national accounts intangibles is the lack of the own-account components for Ireland and Austria, which are not calculated because there are no annual estimates

of the own-account components for these two countries. This is because the national statistical institutes do not allow users to have access to the SES microdata from Eurostat. We will investigate possibilities of obtaining the data needed for annual and quarterly calculation directly from Statistics Ireland and Statistics Austria.

Validation of the chosen indicators for current price quarterly intangibles will be based on comparing their capacity to replicate the dynamic of annual intangible investment with that of alternative indicators. For the purchased components, we will use employment base indicators multiplied by a proper deflator. For the own-account components, instead, we will calculate alternative indicators at current prices as employment multiplied by wages (as available from the LFS).

For the own account components, we will also investigate the possibility of using ARIMA models to extrapolate the quarterly series for the most recent quarters not covered by the LFS microdata instead of using the same indicator as the purchased component.

Finally, we will improve the treatment of seasonal and calendar adjustments..The current approach is to use seasonally and calendar-adjusted (SCA) indicators only when they are available from the official data sources (e.g., turnover indices). This approach hampers cross-country comparability because for some countries (notably the UK), the turnover data we use are only available as non-seasonally and calendar-adjusted series. In addition, the own account components are not seasonally and calendar-adjusted either because the quarterly employment indicators we calculate from the LFS are raw data and not SCA series. Future work will be devoted to producing harmonized SCA series of intangible investments for all countries and assets.

5 References

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6 Appendix

Below we provide further evidence on the results for the purchased component of Brand and Design for a selected sample of countries to get the sense of the coherence of the quarterly estimates with respect to the annual measures of intangibles.

Figure A1: Brand in purchased components in Germany.

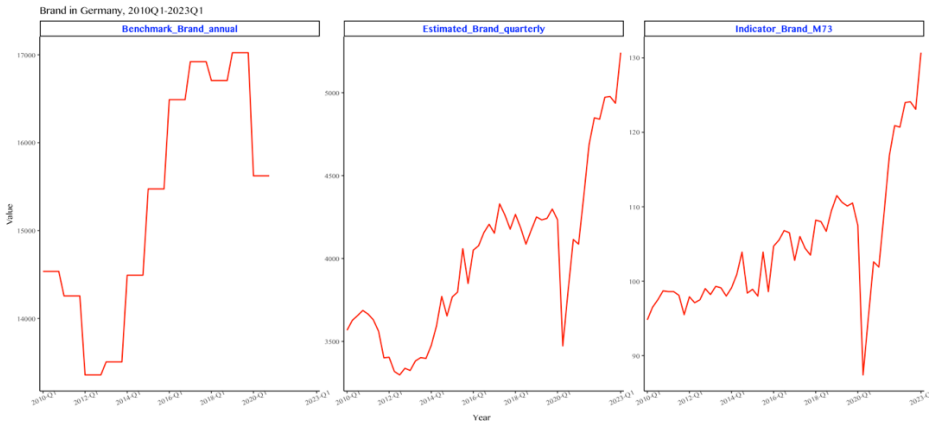

Figure A2: Brand in purchased components in France.

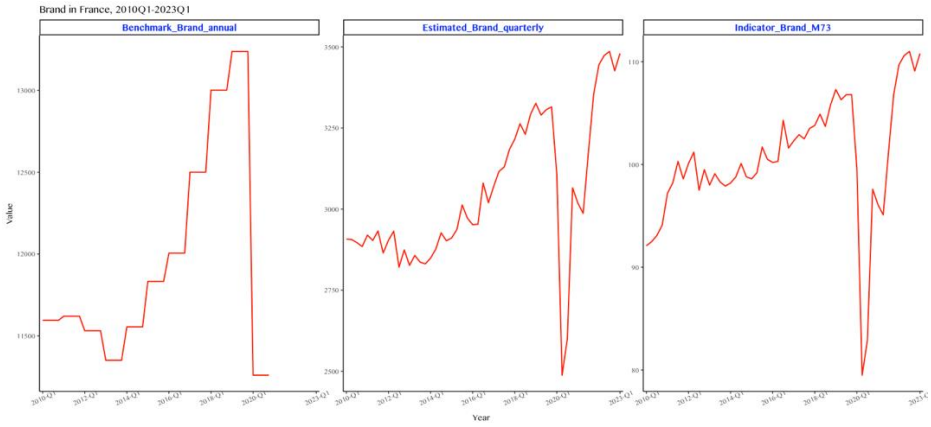

Figure A3: Brand in purchased components in Italy.

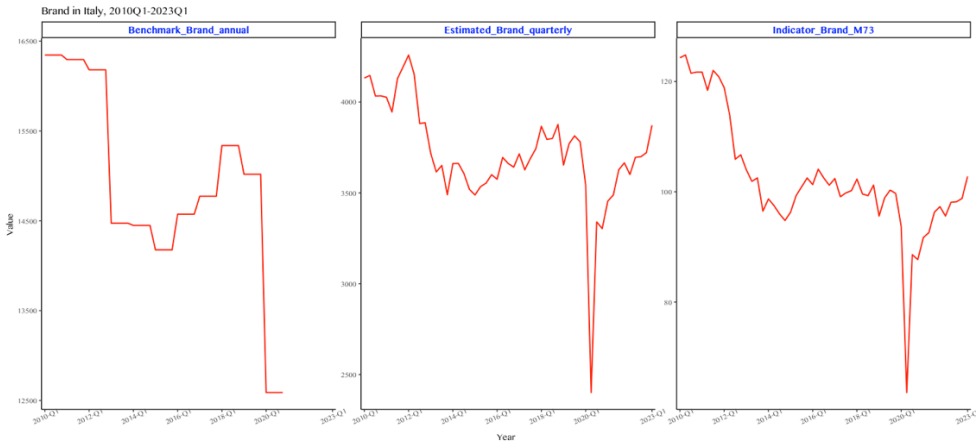

Figure A4: Brand in purchased components in Spain.

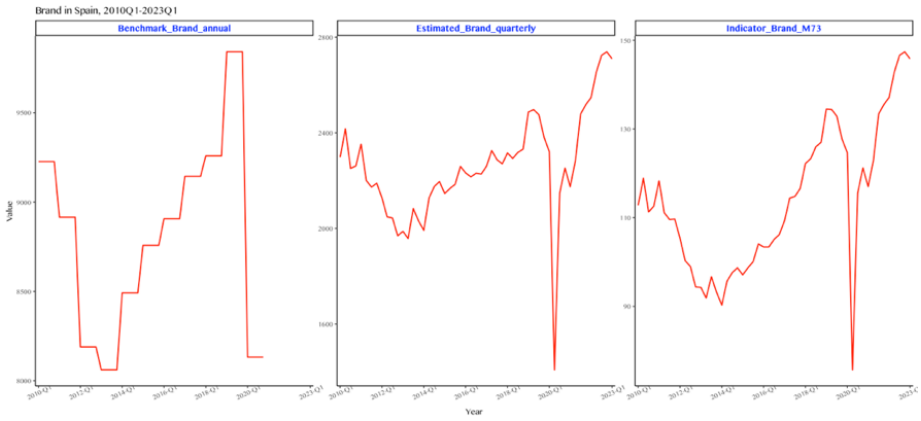

Figure A5: Brand in purchased components in UK

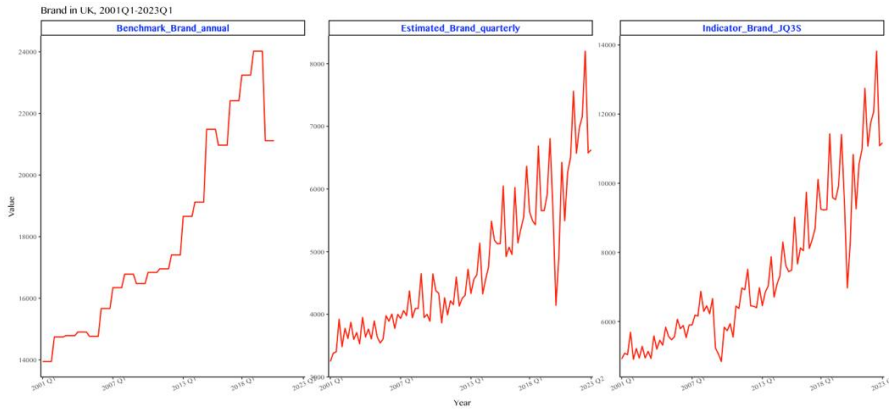

Figure A6: Brand in purchased components in US

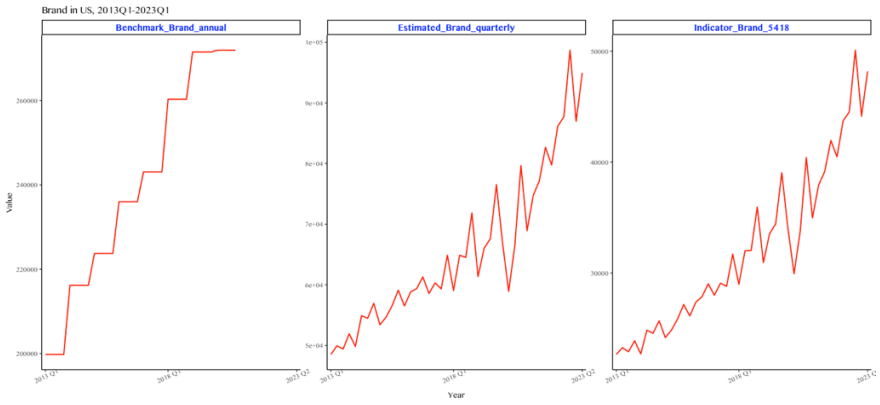

Figure A7: Design in purchased components in Germany

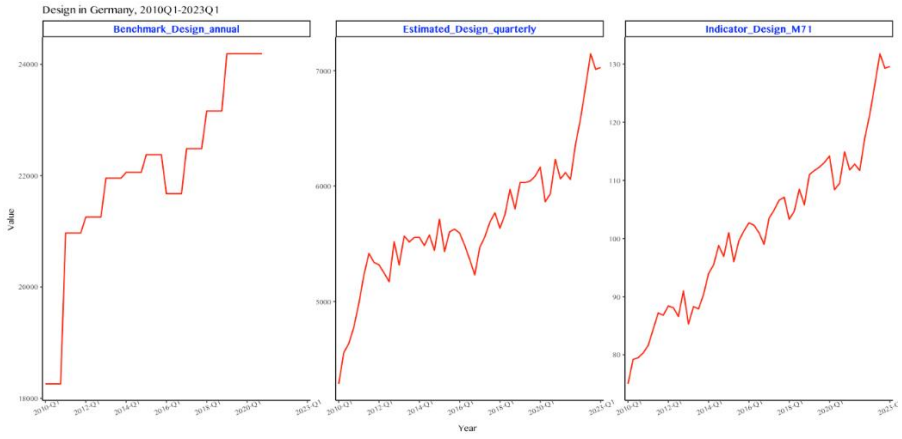

Figure A8: Design in purchased components in France

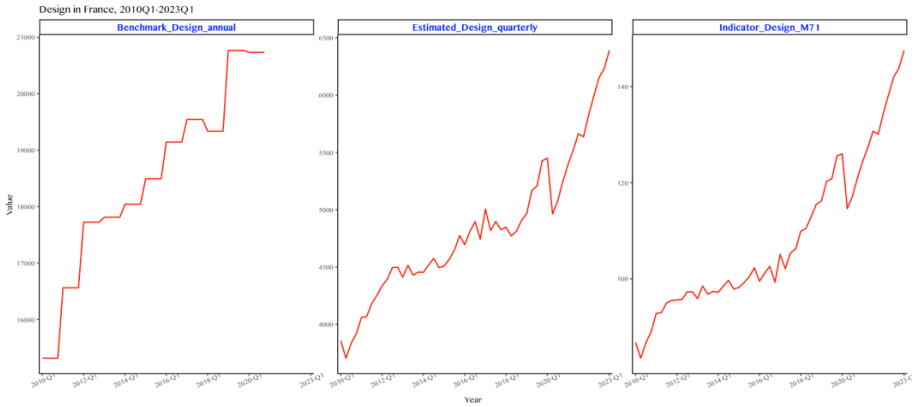

Figure A9: Design in purchased components in Italy

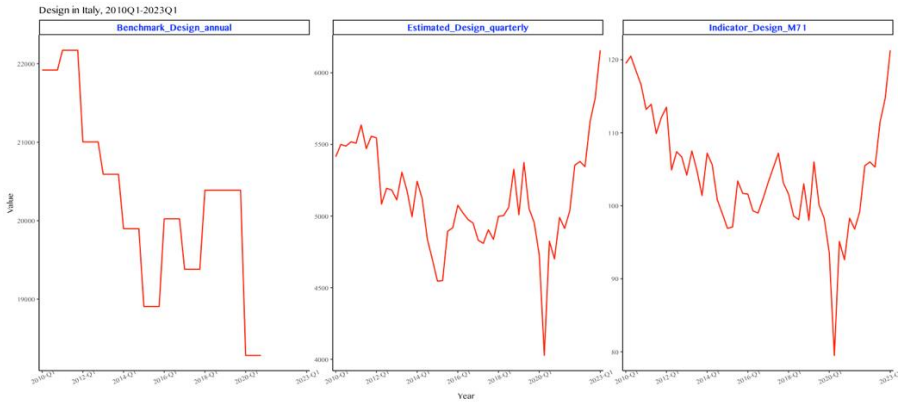

Figure A10: Design in purchased components in Spain

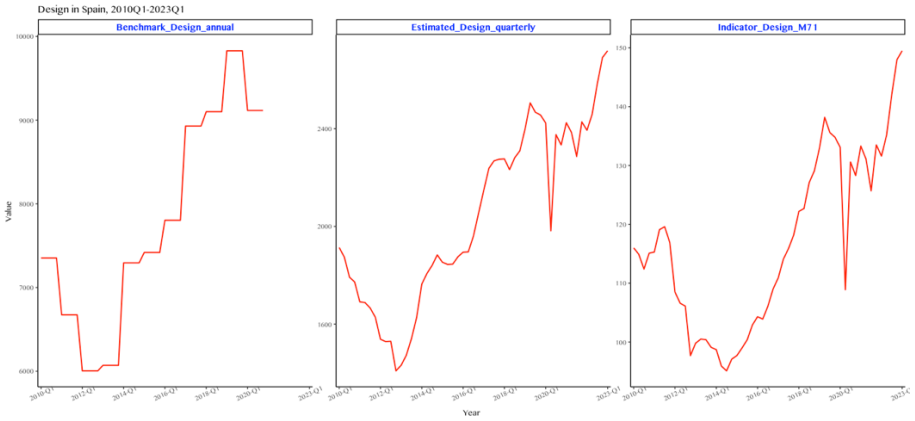

Figure A11: Design in purchased components in UK

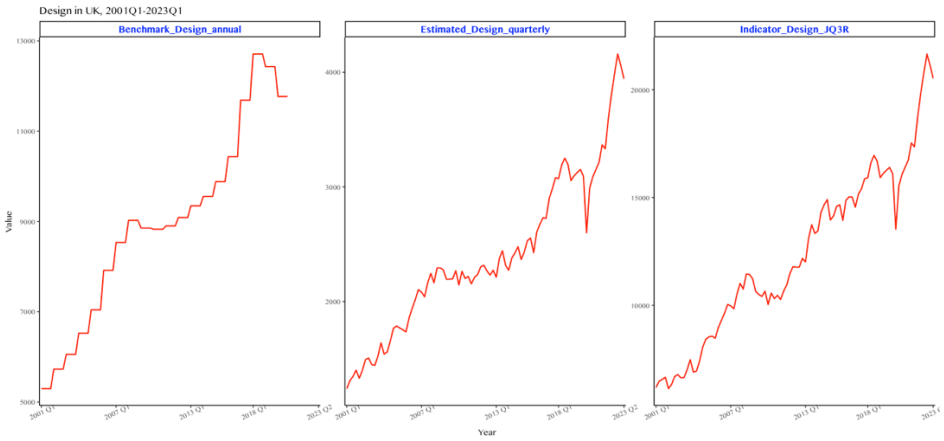

Figure A12: Design in purchased components in US

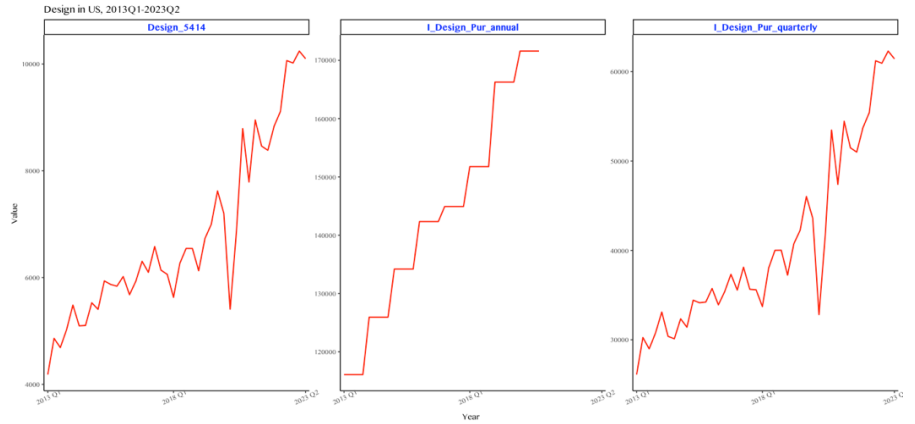

Table 3: Relevant occupations producing own account intangibles and time-use factors.

ISCO-08 Minor Group	ISCO-08 Sub-major Group	Occupation Description	Time-use Assumptions (%)			
			Org Cap	Brand	Design	New Fin Prod
1	**1**	**Managers**				
11	**11**	**Chief executives, senior officials and legislators**				
111	11	Legislators and senior officials	20%	0%	0%	0%
112	11	Managing directors and chief executives	20%	0%	0%	0%
12	**12**	**Administrative and commercial managers**				
121	12	Business services and administration managers	20%	0%	0%	0%
122	12	Sales, marketing and development managers	20%	15%	0%	0%
13	**13**	**Production and specialised services managers**				
131	13	Production managers in agriculture, forestry and fisheries	20%	0%	0%	0%
132	13	Manufacturing, mining, construction, and distribution managers	20%	0%	0%	0%
133	13	Information and communications technology service managers	20%	0%	0%	0%
134	13	Professional services managers	20%	0%	0%	0%
14	**14**	**Hospitality, retail and other services managers**				
141	14	Hotel and restaurant managers	20%	0%	0%	0%
142	14	Retail and wholesale trade managers	20%	0%	0%	0%
21	**21**	**Science and engineering professionals**				
211	21	Physical and earth science professionals	0%	0%	0%	50%
212	21	Mathematicians, actuaries and statisticians	0%	0%	0%	50%
214	21	Engineering professionals (excluding electrotechnology)	0%	0%	25%	0%
216	21	Architects, planners, surveyors and designers	0%	0%	25%	0%
24	**24**	**Business and administration professionals**				
241	24	Finance professionals	0%	0%	0%	25%
243	24	Sales, marketing and public relations professionals	0%	50%	0%	0%
33	**33**	**Business and administration associate professionals**				
331	33	Financial and mathematical associate professionals	0%	0%	0%	25%

Source: Authors' elaborations.

Note: Time-use percentages for New Financial Products are only relevant for the corresponding occupations employed in the Financial and insurance activities industry.