Growing Inequality:
A novel integration of
transformations research

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D2.1 Report on definition and measurement of GI-NI key concepts within EU data sources

WP2 Data harmonisation for integrated analysis

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Abstract

This report presents a critical overview of how the key concepts of the GI-NI project –i.e. technological change, globalisation, inequality and skills- are measured, relying on existing EU or international databases. Each concept is operationalised building on a set of measures that will be used to perform the project's different tasks. The advantages and drawbacks are set both from conceptual and measurement perspectives for each measure. With these lessons in mind, the report lists and discusses alternative measures whenever possible, relying on either different measurement frameworks or alternative data sources.

List of abbreviations

AES	Adult Education Survey
CVTS	Continuing Vocational Training Survey
ECS	European Company Survey
EEA	European Environmental Agency
EHIS	European Health Interview Survey
ESCO	European classification of Skills, Competences, Qualifications and Occupations
ESES	European Structure of Earning Survey
EU-LFS	European Labour Force Survey
EU-SILC	European Statistics on Income and Living Conditions
HBS	Household Budget Survey
HFCS	Household Finance and Consumption Survey
ICT	Information and Communication Technologies
JVS	Job Vacancy Statistics
O*NET	Occupational Information Network
PIAAC	OECD Programme for the International Assessment of Adult Competencies
PISA	OECD Programme for International Student Assessment
UOE	United Nations Educational, Scientific and Cultural Organisation (UNESCO), the Organisation for Economic Cooperation and Development (OECD) and Eurostat joint Data Collection
ISCED	International Standard Classification of Education
ISCO	International Standard Classification of Occupations
NACE	European Classification of Economic Activities
WIOD	World Input Output Data

1. Introduction

This report sets out to **review the measurement framework of the core concepts used within GI-NI** –*Growing Inequality: a novel Integration of transformation research* - project relying on European data sources. This project aims to investigate both the societal and economic impacts of **three salient transformations**: 1) rapid emergence and diffusion of digital technologies, 2) new forms of international trade and foreign investment, including global production networks and fragmentation of production, and 3) rapid increases in mobility and migration. These changes come with real opportunities for social fairness and prosperity but with challenges that need to be addressed. The main concern is the unequal distribution of opportunities across the different segments of the society ranging from economic inequalities (i.e. income and wealth) to unbalances in the individual's capabilities (e.g. education, health) to adapt to these changes. GI-NI aims to look at the interrelationship between technological change, globalisation and migration and its impact on skills and inequality of the employed population.

This report builds upon this **objective** to provide the measurement framework of the core concepts of GI-NI by reviewing the definition of the indicators for measuring each concept as well as discussing the relevance of each measure. It is worth pointing out that technological change, globalisation, skills, and inequality are multifaceted concepts lacking consensual agreement on their definitions and measurements. Further differences are also worth emphasizing across disciplines (e.g. economics and sociology) mostly when considering the concepts of skill and inequality. Such inconsistencies are not considered herein but tackled in a previous GI-NI report that aims to integrate the understanding of the GI-NI concepts across disciplines (Dekker et al., 2021). For the purpose of measurement, the operationalising of each concept follows the dominant definition, while the choice between different measures is mainly dictated by the research question to be tackled in GI-NI and by data availability.

Cross-comparability across European countries is the main common feature for the set of measures presented in this report. The next sections review the measures of the GI-NI concepts that will be used to perform EU and international analysis. All the sections have more or less the same structure, starting with the concept definition, and then the measures are presented in boxes providing the data source to compute the measure, presentation of the measure, listing the major advantages and drawbacks, and providing main references. It is worth pointing out that the measures outlined in this report are far from covering all the indicators/variables that will be used to perform the different tasks in the GI-NI project. The report highlights the measures of the core concepts –i.e.

technological change, globalisation, migration, inequality and skills- and weighs the data adequacy in relation to each conceptual framework. Finally, the listed measures are likely to change throughout the duration of the project and, more precisely, throughout the development and the refinement of the research questions tackled as this report was prepared at the earlier stage of the project realisation.

2. Technological change

Total Factor Productivity (TFP) growth is used as the standard measure of technological progress following the mainstream definition of technological progress as the growth of output unexplained by the growth in inputs –the Solow residuals- (Solow, 1957). TFP is then computed as the difference between output growth and sales-share weighted average of input growth rates. As a proxy of technological progress, this measure has the advantage of side-stepping the measurement problems posed by the heterogeneity of innovation across sectors and periods; On the flipside, such measure does not provide the operative mechanism of technological progress. TFP growth can be driven either by increasing the efficiency of capital or labour in production or by reallocating tasks from labour to capital or vice versa (Autor and Salomons, 2018). The measure suffers, as well, from other shortcomings that are not addressed in the construction of TFP, such as factor utilisation variations over the cycle or variations in unobserved factor usage (Huo et al., 2020).

The most commonly used indicator of technological change is the **expenditures in R&D** (Research & experimental Development), defined as creative and systematic work undertaken in order to increase the stock of knowledge-including the knowledge of humankind, culture and society- and to devise new applications of available knowledge (Frascati Manual, OECD 2015). This definition measure presents the shortcoming of measuring innovative input that does not necessarily lead to innovative output. Furthermore, adopting this indicator entails an optimistic bias when assessing the employment impact of innovation as it is highly correlated with labour-friendly product innovations (Barbieri et al., 2019). On the other hand, this indicator presents the advantage of being collected on a regular basis from companies' accounts relying on an internationally recognised methodology[1] that allows cross-country and over-time comparisons. Another strand of measures includes **product and**

[1] The definition and measurement framework of R&D statistics is given by the Frascati Manual (OECD, 2015) which is used by Eurostat as well for data collection and survey design.

process innovations or the **number of patents** as proxies for technological progress. Innovation measures are usually collected at the firm level relying on innovation surveys such as the Community Innovation Survey. Patents can only measure the share of patented innovations, which could largely differ from the actual innovation output due to firm-specific innovation strategies or patent requirements.

GI-NI concept: technological change

Operationalisation: Expenditures in R&D

Data source: Eurostat data aggregates[2] based on data collected through sample or census surveys, from administrative registers or a combination of sources

Measure: Domestic Expenditure on R&D (GERD) which accounts for both current and capital expenditure on R&D activities in a given economy. Expenditure can be expressed as a percentage of GDP or in PPPs and per inhabitant. The breakdown is available also by sector of performance: business enterprise, government, higher education, and private non-profit. Statistics are available at different geographical levels (NUTS 0, 1 and 2) starting from 2005.

Limitations: It covers only the expenditure and investment side of technological change, not fully capturing the impact on the economy, labour market and society more in general

Alternative measures:

- R&D personnel and researchers (from Eurostat); captures impact on labour market
- Employment in technology and knowledge-intensive sectors (from Eurostat); captures impact on the labour market
- Patent applications (from Eurostat); alternative measure for investment in innovation
- Households with access to the internet at home (from Eurostat); captures impact on society at the individual level
- Investment of Tangible and intangible assets (from EUKLEMS); alternative measure for investment in innovation, based on firms' activities and available at the sectoral level
- Investment in robotics constructed from the IFR (International Federation of Robotics)[3] database which allows to compare robot delivery numbers across country-industry pairs and over time.
- Digital intensity at occupational level (based on ESCO and ISCO classifications); capture the impact on the labour market, and provide details at occupational levels on changing skills needs

Sources:

Jalles, J. T. (2010). How to measure innovation? New evidence of the technology–growth linkage. *Research in Economics*, 64(2), 81-96.

Sredojević, D., Cvetanović, S., & Bošković, G. (2016). Technological changes in economic growth theory: Neoclassical, endogenous, and evolutionary-institutional approach. *Economic Themes*, 54(2), 177-194.

OECD. (2021). The impact of Artificial Intelligence on the labour market: What do we know so far? (OECD Social, Employment and Migration Working Papers No. 256)

[2] https://ec.europa.eu/eurostat/web/science-technology-innovation/data/database
[3] https://ifr.org/free-downloads/

GI-NI concept: technological change

Operationalisation: TFP growth

Source: EU KLEMS database

Measure: Relying on the growth accounting approach set by Jorgenson et al. (1987), TFP is computed as the difference between output growth and sales-share weighted average of input (capital and labour) growth rates. Inputs include capital (K), labour (L), Energy (E), materials (M) and services (S) for individual industries.

Advantage: The EU KLEMS data is available at a detailed industry level but also at a higher level of aggregation, such as the country level. The last data release (2019) covers 40 detailed industries according to NACE Rev2 and 12 industry aggregates (including the total economy). In terms of country coverage, data is available for the 28 European countries. The EU KLEMS database provides long historical time series and can estimate TFP based on the growth accounting method.

Limitations: Being a residual measure, TFP growth may also include the effects from changes in unmeasured inputs, such as research and development and other intangible investment. Measurements errors in inputs and outputs are likely, as well, to be included in the measure of TFP growth.

Alternative measures: Three alternative databases provide measures of TFP growth: Penn World Table (PWT)[4]**,** The Conference Board Total Economy Database (TED)[5] and the OECD Productivity Statistics[6]. All the productivity databases share the same primary data, often provided by national statistical offices, and methodological choices drive the main differences. For instance, the EU KLEMS methodology relates volume measure of gross output to primary and intermediate inputs while the OECD methodology presents value-added based productivity indicators by relating gross value added to the labour and capital inputs used in order to compute productivity measures for different representations of the production process.

Sources:

Stehrer, R, A Bykova, K Jäger, O Reiter and M Schwarzhappel (2019), "Industry Level Growth and Productivity Data with Special Focus on Intangible Assets", wiiw Report on methodologies and data construction for the EU KLEMS Release 2019, The Vienna Institute for International Economic Studies.

Adarov, A., & Stehrer, R. (2019). *Tangible and Intangible Assets in the Growth Performance of the EU, Japan and the US* (No. 442). wiiw Research Report.

Gouma, R., & Inklaar, R. (2021). Comparing productivity growth across databases.

Jorgenson, D., Gollop, F.M., and Fraumeni, B. (1987) *Productivity and US economic growth*. Cambridge,Mass.: Harvard University Press.

O'Mahony, M., & Timmer, M. P. (2009). Output, input and productivity measures at the industry level: the EU KLEMS database. *The economic journal*, 119(538), F374-F403.

[4] https://www.rug.nl/ggdc/productivity/pwt/
[5] https://www.conference-board.org/data/economydatabase/
[6] https://www.oecd.org/sdd/productivity-stats/

3. Globalisation

Globalisation is a multifaceted concept encompassing economic, political and cultural dimensions. A broad definition is given by Caselli (2012), who defines it as a "process of growing interaction and interdependence between economies, societies and nations across large distances". A working definition to operationalise this complex concept is proposed by Sturgeon (2013), who defines economic globalisation as "The inward and outward flow of goods, services, and investment across national borders, along with the functions —including functions related to innovation — that enterprises and organisations use to set up, support, and manage these flows". Available measures or proxies for globalisation rely, to some extent, on the different facets outlined in this definition. As such, traditional trade measures in goods and services are widely used as indicators of globalisation, along with foreign direct investment flows and stock and portfolio investment stocks and flows. More encompassing indicators are available such as the KOF Globalisation Index[7] introduced by Dreher (2006), which measures globalisation for every country in the world along the economic, social and political dimensions.

The concept of **global value chains** (GVCs) can provide a more integrated and general conceptual framework for globalisation indicators as outlined by Sturgeon (2013). GVCs can be defined as a series of stages of developing a product or service that is sold to consumers, with each stage adding value and with at least two stages being produced in different countries (Antràs, 2020). The concept of GVC allows considering the entire range of activities that create and commercialise products and services by tracing back the whole chain of work. However, the operationalisation of the concept is challenging because available trade data usually provide information on the originating/destination location of goods and services but not how they are produced and how they will be used. Two databases fill the gap by tracing value-added trade flows across countries relying on customs offices data and on input-output tables to construct global input-output tables: i) the World Input-Output Database (WIOD)[8] and; ii) the OECD Inter-Country Input-Output tables (ICIO)[9]. These databases provide the primary data for most GVCs measures.

[7] http://www.kof.ethz.ch/globalisation/.
[8] https://www.rug.nl/ggdc/valuechain/wiod/
[9] https://www.oecd.org/sti/ind/inter-country-input-output-tables.htm

GI-NI concept: globalisation

Operationalisation: Openness to Trade

Source: World Integrated Trade Solution (WITS)[10] – World Bank

Measure: Openness to trade is the standard indicator to capture the exposure of an economy to international trade. It is computed as the ratio between trade (i.e., import and export) and GDP, and it can either include both trade in goods and in services or only one of the two.

Limitations: By construction, the openness to trade indicator is affected by cyclical swings of the GDP (e.g., 2008/2009 financial crisis), and it discounts not only for the size of a country but also for its level of economic development, thus becoming increasingly difficult for a developed country to be classified as 'open' to trade. Moreover, the trade of goods and services is not the only dimension of globalisation; the movement of financial capitals, for instance, is another key component. Openness to trade also presents the drawback of double-counting: if a country imports, for instance, components to produce final products that are exported, the value of the components is included in the numerator twice (since the value of the exported final products incorporates the value of the required components)

Alternative measures:

- EU direct Investment positions (from EUROSTAT); captures investment and financial capitals.
- Foreign control of enterprises (from EUROSTAT); captures investment and market penetration of foreigners.
- Foreign affiliates of EU enterprises (from EUROSTAT); captures investment and market penetration abroad.
- Globalisation Index (Swiss Economic Institute - KOF)[11]; composite index comprising 25 indicators that represent the key socioeconomic components of global integration.
- Economic Openness (Vienna Institute for International Economic Studies - WIIW); index that distinguishes between 'real' and 'financial' openness as well as 'de-facto' and 'de-jure' measures of openness.

Sources:

Shangquan, G. (2000). Economic globalization: trends, risks and risk prevention. *Economic & Social Affairs, CDP Background Paper*, 1, 1-8.

Hummels, D., Ishii, J., & Yi, K. M. (2001). The nature and growth of vertical specialization in world trade. *Journal of international Economics*, 54(1), 75-96.

Gräbner, C., Heimberger, P., Kapeller, J., & Springholz, F. (2021). Understanding economic openness: a review of existing measures. *Review of World Economics*, 157(1), 87-120.

[10] https://wits.worldbank.org/

[11] https://kof.ethz.ch/en/forecasts-and-indicators/indicators/kof-globalisation-index.html

GI-NI concept: globalisation

Operationalisation: Female employment embodied in imports and exports

Data Source: World Input-Output Database (WIOD)[12]

Background: Trade leads to specialisation due to differences in comparative advantage. In conventional trade theories, such specialisation emerges at the level of industries: Country A specialises in industry 1, Country B in industry 2. This can have implications for employment opportunities for female workers (both in an absolute sense and relative to male workers) if the two industries differ from each other in terms of the gender composition of their workforces.

In addition, rapid improvements in information and communication technology have made specialisation within industries an important phenomenon over the past two decades. Firms can now relocate part of their activities to other countries while continuing to perform other activities in places where they were done already. Given that some activities are more 'female labour-intensive' than others, this type of specialisation might either reinforce the asymmetric effects of industry specialisation on female employment or mitigate these. We will study the joint impacts of both types of specialisation by constructing two indicators for countries: Female employment in imports and female employment in exports.

Measure: In the literature (e.g. Koopman et al., 2014; Los et al., 2016; Miroudot and Ye, 2021), indicators have been developed that use global input-output tables to determine the value-added contributions by industries in (other) countries to the value of a country's imports and its exports. Given that the data required is available, these indicators can, in a straightforward way, be adapted to determine the employment of male and female workers in industries and occupations associated with the imports and exports of a country.

Advantages: This measure's major advantage is that it considers that production processes have increasingly become organised as global value chains. Just looking at the employment mix by gender in the industry from which imports are sourced or the industry that exports would give a very partial (and probably distorted) indication of the impacts of trade. All indirect effects (also in countries and industries upstream in the production process are taken into account.

Limitations: The industry and occupational detail in the data are not as high as one would wish for. Given the nature of the data, the assumption has to be made that production processes for exported products are identical to those for products sold (by the same industry) on domestic markets, while micro-economic evidence shows that this is not in line with reality.

Sources

Koopman, R., Z. Wang and S.-J. Wei (2014), " Tracing Value-Added and Double Counting in Gross Exports", *American Economic Review*, 104, 459–494.

Los, B., M.P. Timmer and G.J. de Vries (2016), "Tracing Value-Added and Double Counting in Gross Exports: Comment", *American Economic Review*, 106, 1958–1966.

Miroudot, S. and M. Ye (2021), "Decomposing Value Added in Gross Exports", *Economic Systems Research*, 33, 67-87.

Timmer, M.P., S. Miroudot and G.J. de Vries (2019), "Functional specialisation in trade", *Journal of Economic Geography*, 19(1), 1-30.

[12] Recently, the OECD has published an updated version of its OECD-ICIO database, which has many things in common with WIOD. The same goes for the recently launched Figaro-database constructed by Eurostat. Most probably, WIOD will not be updated in the GI-NI project period, while updates of OECD-ICIO and/or Figaro might be. Before we start the empirical analyses for a task, we will consider which of these databases would be most useful to address it, given the data availability situation at that time. A summary overview of the similarities and differences is given in the Appendix.

GI-NI concept: globalisation

Operationalisation: Import penetration

Data Source: World Input-Output Database (WIOD)[13]

Background: An increase in the penetration of imports can have either negative or positive effects on the labour market outcomes for a given worker. Traditionally, the negative implications have been stressed. If the imports of products produced by the industry in which a worker is employed increase, he/she is more likely to witness a wage reduction or to become unemployed. Imports can positively impact the imports of products used by the industry where a worker is employed increases. Our measures of import penetration will go beyond the traditional focus on industries from which products are imported but focus on the types of occupations involved in producing these. If a worker's occupation is increasingly involved in producing the imports bundle, their labour outcomes might be affected negatively. If, however, mainly workers with other occupations produce these, their labour outcomes might be affected positively.

Measure: The (change in) labour income of foreign workers with the same occupation embodied in imports divided by domestic labour income of workers with the occupation of the worker considered will be used as the (change in) import penetration of the type that most probably has negative implications. The (change in) labour income of foreign workers with other occupations embodied in imports divided by domestic labour income of workers with the occupation of the worker considered will be used as the (change in) import penetration of the type that most probably has positive labour market outcome implications.

Advantages: The major advantage of this measure is that it takes into account that production processes have increasingly become organised as global value chains. This implies that countries do not only specialise in industries but also in functions within industries (see Mudambi, 2008; Timmer et al., 2019). Thanks to modern internet-based technologies, a German firm can decide to offshore its fabrication activities to e.g. China (where this can be done in a cheaper way than in Germany) while continuing to have its R&D, logistics management and marketing in Germany. Consequently, German fabrication workers might face import competition for their jobs, while German R&D workers and marketers might see increases in demand for their activities since the relocation of the fabrication activities makes the output of the firm cheaper. Traditional industry-level import penetration indicators (e.g. Autor et al., 2013) cannot deal with functional specialisation within industries

Limitations: the data have less industry detail than the data on the basis of which import penetration is conventionally measured. In dealing with the data, the assumption has to be made that production processes for exported products are identical to those for products sold (by the same industry) on domestic markets, while micro-economic evidence shows that this is not in line with reality.

Sources

Autor, D., D. Dorn and G.H. Hanson (2013), "The China syndrome: Local labor market effects of import competition in the United States", *American Economic Review*, 103(6), 2121-2168.

Feenstra, R.C. and A. Sasahara (2018), "The 'China shock' exports and US employment: A global input–output analysis", *Review of International Economics*, 26(5), 1053-1083.

Mudambi, R. (2008), "Location, control and innovation in knowledge-intensive industries", *Journal of Economic Geography*, 8(5), 699-725.

Timmer, M.P., S. Miroudot and G.J. de Vries (2019), "Functional specialisation in trade", *Journal of Economic Geography*, 19(1), 1-30.

[13] https://www.rug.nl/ggdc/valuechain/wiod/?lang=en; The database presentation is available in the Appendix

4. Migration

Migration refers to the movement of people from one state to the other to stay in the host state for a minimum length of time, for reasons related to work, family and study, or because of conflict, persecution and disaster (OIM, 2020). In the EU context, a distinction is to be made between (external) migration and (intra-EU) mobility. **Mobility** refers to the movement of labour from one state to the other within Europe as one of the four freedoms (goods, capital, services, and labour) of the European Single Market. A further distinction to consider is between immigration which refers to the action by which a person establishes his or her usual residence in the territory of a Member State, and emigration referring to the action by which a person ceases to have his usual residence in the Member State for a given period. This distinction is worth pointing out as migration is investigated in terms of impact on the host country as well as on the origin country. Indeed, and as an example, rising inequalities in the origin country are likely to increase emigration flows or at least migration intentions, while immigrations flows may lead/exacerbate inequalities in the host country. In the GI-NI project, both perspectives are considered though the focus is mostly on the effects of immigration in the host country in terms of labour market inequalities.

GI-NI concept: migration

Operationalisation: migration intentions

Data source: Gallop World Poll[14]

Background: intentions to migrate can have several aspects – i) aspirations to emigrate to another country in a hypothetical scenario or ii) concrete plans for moving.
As such, migration intentions measure potential emigration rather than actual migration behaviour. Nevertheless, migration intentions and subsequent migration behaviour are correlated (e.g., Creighton, 2013; van Dalen & Henkens, 2013), which is why migration intentions are relevant.

Measures: in the Gallup World Poll, emigration aspirations are measured using the following question:

- WP1325: *Ideally, if you had the opportunity, would you like to move permanently to another country, or would you prefer to continue living in this country?* Answer categories: Like to move to another country*Like to continue living in this country*(DK)*(Refused)

Those with emigration aspirations are also asked to which country they plan to move, which is a measure of emigration plans:

[14] The database presentation is available in the Appendix

- WP6880: *Are you planning to move permanently to (response in WP3120) in the next 12 months, or not?* Answer categories: Yes - will move in next 12 months*No*(DK)*(Refused)

Those with emigration plans are also asked whether they are making preparations for the move

- WP9455: *Have you done any preparation for this move? For example, applied for residency or visa, purchased the ticket, etc.)?* Answer categories: Yes*No*(DK)*(Refused)

Advantages: the questions in the GWP ask about three degrees of migration intentions: aspirations (desires), plans, and preparations. This information is available over time for countries at different levels of development, which allows for global analysis and analysis over time. The survey is very rich, which allows for heterogeneity analyses (by income groups, age, gender, and education cohorts, country levels of development, EU mobility, migration intentions of individuals from third countries wanting to move to the EU). The survey asks individuals with migration intentions to which country they would like to move, which makes it possible to consider the characteristics of the destination country (i.e., the pull factors of migration).

- It is possible to use the survey as a country-level panel.
- The GWP also includes its own measure of inequality.
- The GWP includes information on whether the respondents have family and friends abroad, which allows constructing a measure of networks.

Limitations:

- The survey does not follow the same individuals over time, and a true individual-level panel analysis is not possible.
- There is no information on whether the respondent plans to move alone or with their family members (if any).
- The survey does not include information on actual migration.
- Information for migration and plans is available only for a very small percentage of the sample (since many respondents report aspirations to move in a hypothetical scenario, but few have made concrete plans and preparations), which limits the ability to have large statistical power for such analyses.
- Survey item non-response limits the number of observations.

Sources

Cai, R., N. Esipova, M. Oppenheimer, and S. Feng. (2014). International migration desires related to subjective well-being. *IZA Journal of Migration* 3:8.

Creighton, M. J. (2013). The role of aspirations in domestic and international migration. *The Social Science Journal*, 50(1), 79-88.

Ivlevs, A. (2015). Happy moves? Assessing the link between life satisfaction and emigration intentions. *Kyklos*, 68(3), 335-356.

Migali, S., & Scipioni, M. (2018). A global analysis of intentions to migrate. European Commission, JRC111207.

Otrachshenko, V., & Popova, O. (2014). Life (dis) satisfaction and the intention to migrate: Evidence from Central and Eastern Europe. *The Journal of Socio-Economics*, 48, 40-49.

Van Dalen, H. P., & Henkens, K. (2013). Explaining emigration intentions and behaviour in the Netherlands, 2005–10. *Population Studies*, 67(2), 225-241.

GI-NI concept: migration

Operationalisation: Occupational segregation by country of birth

Data source: European Labour Force Survey - EUROSTAT

Background: Occupational segregation occurs when some demographic groups are distributed in different occupations in proportions that differ from the percentage of participation in the labour market (no difference implies complete/full integration). Thus, it can be considered one of the manifestations of inequality in the labour market. The concentration of a group in a few occupations may bring advantages or disadvantages depending on whether those occupations are high or low paid, which will result in higher or lower well-being for the group (Alonso-Villar and Del Río, 2017). Polarisation between occupations explains a large proportion of the increase in wage inequality (Mouw and Kalleberg, 2010). The two most frequently analysed variables in the literature on occupational segregation are gender and race.

Both a one-dimensional and a two-dimensional study of occupational segregation can be conducted when studying occupational segregation: occupational segregation by gender, occupational segregation by country of birth and occupational segregation by gender and country of birth.

The results obtained show which demographic group suffers the greatest vulnerability. Besides, the study of segregation allows for the identification of labour niches for each demographic group. Therefore, it is possible to know whether the different demographic groups are competing with each other (i.e., they are substitutes).

Measure: The segregation study is carried out on the employed population, which can be classified according to gender and/or country of birth. Occupations are considered at the two-digit level of the ISCO-08 classification, and the list includes 43 occupations. ISCO-88 classification is used before 2011, so the codes associated with this classification should be converted to ISCO-08 codes. Data are from the European LFS.
Segregation is measured through different indices:

- Local segregation indices compare the occupational distribution of each demographic group with the occupational structure, showing the segregation corresponding to each collective.
- Global segregation indices consider the overall segregation existing in the labour market as weighed measures of the local segregation indices.

In addition, the contribution of each demographic group to the overall segregation can get.

Advantages:

- The EU-LFS provides quarterly results on labour participation of people aged 15 and over.
- It uses ISCO classification at a 3-digit level.
- It records the same set of characteristics in each country. Therefore, country comparisons between EU countries are possible.
- It offers regional information using NUTS2.
- Different survey editions allow for the analysis of trends over time.
- Comparing with other European Union data sets:

Table 1 Comparison between SES, EWCS and EU-SILC

	Structure of Earnings Survey (SES)	European Working Condition Survey (EWCS)	EU-Statistics on Income and Living Conditions (SILC)
Periodicity of collection	Every 4 years	Every 5 years	Annual
ISCO classification	1-digit level	4-digit level	2-digit level
Region	NUTS1	NUTS2	NUTS1

Limitations: The EU-LFS is not an individual longitudinal panel but a cross-sectional and longitudinal household sample survey. Therefore, it does not provide information on the full working life of each individual.

Sources

Alonso-Villar, O. and Del Río,C. (2017). Local segregation and well-being. *Review of Income and Wealth*, 63(2), 269-287.

Mouw, T. and Kalleberg, A. (2010). Occupations and the structure of wage inequality in the United States 1980 to 2000s. *American Sociological Review*, 75, 402-431.

GI-NI concept: migration

Operationalisation: Occupational mobility of native workers

Data source: European Labour Force Survey - EUROSTAT

Background: Occupational mobility (or occupational labour mobility) refers to changes in individual occupational status. It refers to vertical labour mobility (usually moving to a higher-ranked occupation, climbing the occupational ladder), not to horizontal mobility (same occupation, but different jobs in the same or in another sector of activity).

Measure: The occupational mobility is usually measured by changes in the workers' International Standard Classification of Occupations (ISCO) categories. The occupational mobility of native workers is considered as a shift of native workers from manual (blue-collar) to non-manual (white-collar) occupations. The occupational categories are previously split into two categories, according to the ISCO-08 two-digit classification. Although this mobility may have its origin in multiple factors (attributes of individuals in terms of human capital; technological progress and innovation that lead to the creation of new occupations that replace older ones, etc.), we are interested in one of them: the arrival of migrant workers to the labour market. So, we study the possible effect that the growing percentage of immigrants has on the occupational change of native workers.

Advantages:

- The EU-LFS provides quarterly results on labour participation of people aged 15 and over.
- It uses ISCO classification at 3-digit level.
- It records the same set of characteristics in each country. Therefore, country comparisons between EU countries are possible.

- It offers regional information using NUTS2.
- Different survey editions allow for the analysis of trends over time.
- The educational attainment of workers can be taken into account.
- A gender perspective can be included.

Limitations: Every occupation requires a different mix of knowledge, skills, and abilities, and is performed using a variety of activities and tasks. When studying occupational mobility, we must create a manual/non-manual occupation classification because the EU-LFS does not offer information on the occupational requirements. That is, it does not contain any set of variables or detailed elements that describe what various occupations require.

The O*NET data source describes these distinguishing characteristics of an occupation for the US. It includes information about typical activities required across occupations. Task information is often too specific to describe an occupation or occupational group. The O*NET approach is to identify generalised work activities (GWAs) and detailed work activities (DWAs) to summarise the broad and more specific types of job behaviours and tasks that may be performed within multiple occupations. Using this framework makes it possible to use a single set of descriptors to describe many occupations. Contextual variables such as the physical, social, or structural context of work that may impose specific demands on the worker or activities are also included in this section.

Sources:

Aldaz, L. and Eguía, B. (2016). Immigration and Occupational Mobility of Native Workers in Spain. A Gender Perspective, *Journal of International Migration and Integration*, Springer, vol. 17(4), pages 1181-1193, November.

Peri, G. and Sparber, C. (2009). Task specialization, immigration and wages. *American Economic Journal: applied Economics*, 1(3), 135-169.

5. Inequality

Inequality is a multidimensional concept, encompassing many forms of distance among individuals, including their economic status, opportunities (and access), and rights. Defining and operationalising all the inequality-related dimensions is therefore extremely challenging. “Whereas income is merely one of the means of good living” (Sen, 2006), the statistics which the inequality literature is concerned with have been primarily that of economic/monetary variables (i.e. wage, income, wealth, consumption). Going beyond the economic/monetary dimension involves referring to the differences in opportunities, including those of accessing/affording goods and services, and the implied outcomes. This last concept touches many fields, distinguishing between public and private goods/services, such as health, education and training, transport, communication, financial services. A part of the literature highlights that the **distribution of burdens** (e.g. criminality, unemployment, and marginalisation) is likely to increase social inequality. Both the distribution of goods and burdens,

in a broad sense, can be classified under the umbrella concept of social inequality. In this context, specific types of inequalities emerge over time, as the relatively new "digital inequality" and "environmental inequality" have to be added. Similarly, horizontal inequality, namely the one related to individual characteristics such as family/social background, age, gender, sexual orientation, ethnicity, disability, religion, etc., should be considered. Finally, it is worth mentioning the **political inequality** (as suggested by the 10th Sustainable Development Goal): an unequal influence over decisions made by political bodies, to the extent that is closely related to differences in the distribution of political resources, can lead to the exclusion of particular groups from participating in political processes.

Inequality in the field of **quality of life and well-being** has recently received attention and challenges the use of economic/measures as indicators of social progress and welfare. Different forms of inequality are strictly interconnected. For example, environmental inequality leads to inequality in education levels: in particular, it has been found that air pollution has negative effects on adolescents' attendance rates and test scores (e.g. Lavy et al., 2014). By threatening students' physical and mental health, environmental pollution causes them to be negatively influenced in the process of acquiring knowledge (e.g. Mizen et al., 2020). Another example is given by digital inequalities that can exacerbate health inequalities: in times of Covid-19, poor digital skills and limited access to digital tools correlated with less use of the internet for both communication and information purposes related to the pandemic (e.g. Nguyen, 2021).

Far from being exhaustive, in what follows, some inequality measures are selected, focusing on the **economic/monetary concept of inequality** (but also on other dimensions as specified below). It is worth to stress that, for inequalities not related to monetary variables, it is rare to find the commonly known inequality indexes like the Gini index, to cite an example. The concept itself of inequality is approximated by cross-group differences expressed in numbers of individuals (e.g., having certain characteristics or behaving in a certain way). Whereas cross-group differences can be calculated on most of the variables available, instead, to construct the typical inequality indexes, data need to be of a specific kind (e.g. income, consumption wealth, level of education attainment, examination marks, the severity of symptoms, consumption of unhealthy substances, expenditure in digital tools, number of hours spent in unhealthy spaces, etc.). For this reason, when inequality in education, health, digitalisation and environment are discussed, the variables cited in the literature or in this paragraph may not be directly used. Certain transformations of the data are needed.

GI-NI concept: inequality

Operationalisation: Income distribution[15]

Data source: Eurostat aggregates from EU SILC or, as an alternative, from EU SILC microdata, HFCS and/or HBS

Measure: For the distribution of income, Eurostat presents a series of 24 aggregated measures (including distribution by quantiles, mean and median income, the share of people having income greater or equal to a specific national threshold, transitions of income) by different groups.

Limitations: The Eurostat set of aggregate measures is already very rich, and the possible limitations depend on the research question posed. As limitations (examples): i) each measure, taken alone, can have methodological drawbacks (e.g. considering the mean without referring, as well, to the median can be misleading); ii) no measure is computed at NUTS1 level (neither at NUTS2); iii) the reference concept of the abovementioned measures is income (of a various kind), consumption and/or wealth are not considered.

Alternative measures (and relative advantages): i) with using EU-SILC microdata, in principle, the list of possible measures of the income distribution can be extended *ad libitum* (e.g. for different quartiles, deciles, percentiles, the specific national threshold can be modified, also taking into account different groups); ii) the measures can be computed, as well, for NUTS1 level[16]; iii) using different datasets containing information on consumption and wealth (e.g. Eurostat "Household Budget Survey" and European Central Bank "Household Finance and Consumption") the analysis can be enriched. The advantages of computing measures on consumption and wealth lie in the fact that these measures are more stable and less subject to the economic cycle. On the other hand, consumption (wealth) is easier (more difficult) to be reported and suffer less (more) from underreporting. In turn, the use of datasets other than EU SILC has other limitations in terms of coverage (see Table 2 for a comparison between these datasets).

Table 2 Comparison between EU-SILC, HFCS and HBS

	EU SILC	**HFCS**	**HBS**
Time	2006-2020	2010, 2014, 2017	2010, 2015
Countries	28	22	23 in 2010 and 25 in 2015
NUTS	1	1 and 2 depending on the country	1
Income	Yes	Yes	Yes, but limited
Consumption	No	Yes	Yes
Wealth	Yes, but limited	Yes	No

[15] https://ec.europa.eu/eurostat/web/income-and-living-conditions/data/database

[16] NUTS2 level is not reachable because the access to this information is not given with EU-SILC microdata and can be accessed only under certain conditions).

GI-NI concept: inequality

Operationalisation: income inequality

Data source: Eurostat aggregates[17] (from EU SILC) or, as an alternative, EU SILC microdata HFCS and/or HBS

Measure:
For income inequality indexes, Eurostat presents a series of 11 aggregated measures: five types of income quintile share ratio S80/S20 for different types of income, three income quantile share ratios (S80/S50, S50/S20, S40/S100) and three Gini coefficient for different types of income. In the definition of Eurostat "The S80/S20 income quintile share ratio is based on a comparison of the income received by the top quintile and that received by the bottom quintile of the population. By contrast, the Gini coefficient measures the extent to which the distribution of income differs between a perfectly equal distribution and full inequality".

Limitations:
The Eurostat set of aggregate measures is already very rich and the possible limitations depend on the research question posed. As limitations (examples): i) each measure, taken alone, can have methodological drawbacks (e.g. it is possible to have the same Gini index for different S80/S20 income quintile share ratios and the other way round); ii) only one measure is computed at NUTS1 level (none at NUTS2); iii) the reference concept of the abovementioned measures is income (of a various kind), whereas consumption and/or wealth are not considered.

Alternative measures (and relative advantages): i) with using EU-SILC microdata, in principle, the list of possible measures of the income distribution can be extended ad libitum (e.g. Gini coefficient on market income, Gini coefficient before and after income taxes and/or social security contributions, etc. along with other indices, Theil index, Palma ratio, etc.); ii) the measures can be computed, as well, for NUTS1 level; iii) using different datasets containing information on consumption and wealth (e.g. Eurostat "Household Budget Survey" and European Central Bank "Household Finance and Consumption") the analysis can be enriched. The advantages of computing measures on consumption and wealth lie in the fact that these measures are more stable and less subject to the economic cycle. On the other hand, consumption (wealth) is easier (more difficult) to be reported and suffer less (more) from underreporting. In turn, the use of datasets other than EU SILC has other limitations in terms of coverage (see table of comparison among the three datasets).

Sources:
Bellù, L. G., & Liberati, P. (2006). Theil Index and Entropy Class Indexes. (Analytical tools No. 51) FAO

Coultler, P. (1989). *Measuring Inequality: A Methodological Handbook*. Routledge & CRC Press.

Eliazar, I. (2015a). The sociogeometry of inequality: Part I. *Physica A: Statistical Mechanics and Its Applications*, 426, 93–115.

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Eliazar, I. (2016). Visualizing inequality. *Physica A: Statistical Mechanics and Its Applications*, 454, 66–80.

Eliazar, I. (2018). A tour of inequality. *Annals of Physics*, 389, 306–332.

Mukhopadhyay, N., & Sengupta, P.P. (2021). *Gini Inequality Index: Methods and Applications*. Chapman and Hall/CRC.

[17] https://ec.europa.eu/eurostat/web/income-and-living-conditions/data/database

GI-NI concept: inequality

Operationalisation: Education /training inequality

Data source: Eurostat aggregated[18] or, as an alternative, LFS microdata, PISA[19] or PIAAC[20].

Measure: the measures generally used by the literature (summarised in "definition") for taking into account the differences among groups in the education/training field may include differences in the participation rate, in the enrolment rate, in the dropout rate, mean and median years of schooling/training, mean and median educational/training attainment, literacy rate (very similar to the ones used in the skill domain).

The number of measures provided by Eurostat is already very rich and can provide a quite wide overview of the between-groups differences concerning different dimensions of their education/training/attainments. Eurostat proposes two wide sets of measures (participation in education/training and educational outcomes). These two sets can cover most of the above-mentioned measures both for pupils, students and adults.

Limitations: i) the measures considered may have as a limitation the fact that being expressed, generally, in terms of the absolute or relative number of individuals belonging to a certain group (e.g. the number of individuals participating in adult education by sex, or age) are not suitable to construct the commonly used inequality indices (but with some exceptions); ii) only in limited cases they are already computed at NUTS1 or NUTS2 level; iii) data on literacy (also in specific sectors) are scarce.

Alternative measures (and relative advantages): i) conventional inequality measures, such as Gini Index or Lorentz curve, constructed as well as for different groups, can be calculated, starting from microdata on attainment level (EU SILC or EU LFS); ii) the measures can be computed, as well, for NUTS1 level; iii) conventional inequality measures, such as Gini Index or Lorentz curve, constructed as well as for different groups, can be calculated, starting from PISA or PIIAC microdata, on literacy/numeracy (and similar concepts) in different domains. These measures can complement the above-mentioned ones and provide more synthetic kind of information.

Sources:

Barro, R.J., & Lee, J.W. (2013). A New Data Set of Educational Attainment in the World, 1950-2010. *Journal of Development Economics*, 104, 184–198.

Dumas, A., & Silber, J. (2021). On the measurement of educational attainment and inequality with ordinal variables. *Education Economics*, 29(2), 158–172.

Thomas, V., Wang, Y., & Fan, X. (2001). *Measuring education inequality: Gini coefficients of Education*. (Vol. 2525) World Bank Institute.

Ziesemer, T. (2011). What Changes Gini Coefficients of Education? On the dynamic interaction between education, its distribution and growth. (MERIT Working Papers No. 053) United Nations University - Maastricht Economic and Social Research Institute on Innovation and Technology.

[18] https://ec.europa.eu/eurostat/web/education-and-training/data/database
[19] https://www.oecd.org/pisa/data/
[20] https://www.oecd.org/skills/piaac/data/

GI-NI concept: inequality

Operationalisation: Health inequality

Data source: Eurostat[21] (from European Health Interview Survey – EHIS[22]) or, as an alternative, EHIS microdata.

Measure: Differences among groups/unequal distribution of the health outcomes and treatments/lifestyle (also among different groups). These measures are generally used in the literature to take into account the differences among groups in the health field and may include differences in life/death-related risk factors, individual behaviour and lifestyle, nutrition, physical and social environment, quality of personal and work life, access to health services, and quality of this latter (also among different groups). Eurostat presents a long list of variables on health, often by groups. More specifically on a) health status; b) health determinants; c) healthcare; d) disability; e) causes of death; f) accidents at work. The number of measures provided by Eurostat is already very rich and can provide a quite wide overview of the between-groups differences concerning different dimensions of their health.

Limitations: i) the measures considered may have as a limitation the fact that being expressed, generally, in terms of absolute or the relative number of individuals belonging to a certain group (e.g. the number of individuals having long-standing treatments) are not suitable to construct common inequality indices (but with exceptions); ii) only in limited cases they are already computed at NUTS1 or NUTS2 level.

Alternative measures (and relative advantages): i) conventional inequality measures, such as Gini Index, Lorentz curve et similia, as well as, for different groups can be calculated, starting from EHIS microdata (e.g., Gini index on the consumption of alcohol or tobacco). These measures can complement the above-mentioned ones and provide more synthetic information; ii) the measures can be computed, as well, for NUTS1 level.

Sources:

Balaj, M., McNamara, C.L., Eikemo, T.A., & Bambra, C. (2017). The social determinants of inequalities in self-reported health in Europe: Findings from the European social survey (2014) special module on the social determinants of health. *European Journal of Public Health*, 27(1), 107-114.

Devaux, M. (2015). Income-related inequalities and inequities in health care services utilisation in 18 selected OECD countries. *European Journal of Health Economics*, 16(1), 21-33.

Goesling, B., & Firebaugh, G. (2004). The Trend in international health inequality. *Population and Development Review*, 30(1), 131–146.

Lagravinese, R., Liberati, P., & Resce, G. (2020). Measuring health inequality in US: A composite index approach. *Social Indicators Research*, 147, 921–946.

GI-NI concept: inequality

Operationalisation: digital inequality

Data source: Eurostat aggregated[23] (from ICT Household and LFS+UOE)

Measure: Unequal access/acquisition/distribution of digital technology/tools and skills. These measures are usually used in the literature to take into account the differences among groups in the digital field and include access to digital technologies and tools, the usage/exploitation of online resources and the acquisition of relevant digital skills. As far as ICT usage by individuals (and by enterprises) is concerned, Eurostat presents a

[21] https://ec.europa.eu/eurostat/web/health/data/database
[22] https://ec.europa.eu/eurostat/web/microdata/european-health-interview-survey
[23] https://ec.europa.eu/eurostat/web/digital-economy-and-society/data/database

wide set of measures (e.g., encompassing: a) connection to the internet and computer use; b) internet use; c) e-commerce; d) e-government). As far as digital skills are concerned, Eurostat reports measure specific abilities in the domain of individuals' computer skills.

Limitations: i) the "ICT usage" measures, only in limited cases, are already computed at NUTS1 or NUTS2 level; ii) the set of measures regarding the digital skills covers only 2021; iii) the measures considered may have as a limitation the fact that being expressed, generally, in terms of absolute or the relative number of individuals belonging to a certain group (e.g. the number of individuals using the internet or having a certain digital skill) is not suitable to construct common inequality indices.

Alternative measures: i) using the ICT household microdata is possible to compute the measures at NUTS1 level (and by other subgroups of interest); ii) using alternative datasets, like PIAAC, the list of digital skills may be broader (with the caveat that the coverage is limited to OECD countries and to some specific years); iii) inequality indices can be constructed alternatively relying on individual consumption/expenditure in digital devices (from the microdata of HBS) or from the level of digital skill achieved (if available) in PISA/PIAAC microdata.

Sources:

Hargittai E., Piper A. M., & Morris, M. R. (2019). From internet access to internet skills: Digital inequality among older adults. *Universal Access in the Information Society*, 18(4), 881–890.

Ho C. & Tseng S. (2006). From digital divide to digital inequality: the global perspective. *International Journal of Internet and Enterprise Management*, 4(3), 215-227.

Nguyen M.H., Hargittai E. & Marler W. (2021) Digital inequality in communication during a time of physical distancing: The case of COVID-19. *Computers in Human Behaviour*, 120.

Rykov Y., Nagornyy O. & Koltsova, O. (2017). Digital Inequality in Russia Through the Use of a Social Network Site: A Cross-Regional Comparison. In D. A. Alexandrov, A. V. Boukhanovsky, A. V. Chugunov, Y. Kabanov, & O. Koltsova (Eds.), Digital Transformation and Global Society. Springer International Publishing.

Ono H. & Zavodny M. (2007). Digital inequality: A five-country comparison using microdata. *Social Science Research*, 36(3), 1135–1155.

GI-NI concept: inequality

Operationalisation: Environmental inequality

Data source: Eurostat data based on data collected by the EEA – European Environmental Agency[24]

Measure: Unequal distribution of environmental risks and hazards (e.g. exposition to air or water pollution) and of access to natural resources and other ecosystem services (e.g. land, parks and freshwater). Eurostat collects many measures about the environment, but they refer to macro-level (including air emission inventories, air emissions accounts, biodiversity, environmental goods and services sector, chemicals, material flows and resource productivity, physical energy flow accounts, environmental protection expenditure, environmental taxes, water), whereas microdata are very scarce.

Limitations: Availability of data at the micro-level that imposes to rely on proxy measures from different datasets or to link different sources of information.

Alternative measures: i) possible use of the Eurostat EU-SILC ad hoc module[25] "wellbeing", conducted in 2013, that includes questions to the individuals about their satisfaction with recreational/green areas and with the

[24] https://ec.europa.eu/eurostat/web/environment/data/database

living environment; ii) possible use of the Eurobarometer on "Sustainable Development and Environmental Concerns"[26] conducted in 2002 (possibly too old) on which are the main concerns of the individuals on various environmental topics; iii) possible use of the EEA macro data to be imputed to the EU SILC micro database via the NUTS1 level that is a common variable to the two datasets to construct inequality-like indices.

Sources:

Downey, L., Dubois, S., Hawkins, B., & Walker, M. (2008). Environmental inequality in metropolitan America. *Organization & Environment*, 21(3), 270–295.

Fernandez, I. C., & J., Wu (2016). Assessing environmental inequalities in the city of Santiago (Chile) with a hierarchical multiscale approach. *Applied Geography*, 74, 160–169.

Schule, S. A., Gabriel, K. M., & Bolte, G. (2017). Relationship between neighbourhood socioeconomic position and neighbourhood public green space availability: An environmental inequality analysis in a large German city applying generalized linear models. *International Journal of Hygiene and Environmental Health*, 220(4), 711–718.

Shao, S., Liu, L., & Tian, Z. (2021). Does the environmental inequality matter? A literature review. *Environmental Geochemistry and Health*, 1-24.

6. Skills

6.1 Introduction

The concept of skill is a **multidimensional and dynamic construct**, differently defined across disciplines. Green (2011) proposes an integrated approach and defines skill as any 'personal quality' that is productive of value, *expandable* (capable of being enhanced by training and development) and *social* (that is socially determined). Our interest lies in the first and second features, namely how skills are used within jobs and how they can be improved by training and development when the job skills are not aligned with the job holder skills'. Indeed, the dynamism of both skill supply and demand – driven by increasing educational attainment, technological change and innovation from the supply side and by globalisation markets and changes in work organisation from the demand side – are likely to induce misalignment/suboptimal match between skill supply and skill demand, labelled as skills mismatch.

Measures of mismatch can be sub-dived into macro and micro measures. Macro-level measures correspond to the gap between available skills in the market (approximated by education or qualifications) and the composition of vacancies. Micro-level measures are computed either from

[25] https://ec.europa.eu/eurostat/web/income-and-living-conditions/data/ad-hoc-modules
[26] https://search.gesis.org/research_data/ZA3670

the employee or employer data sources. At the employee level, skill mismatch refers to a situation where workers' skills are over (under) the level of skills requested to do their job under current market conditions (Handel, 2003, OECD, 2017). A further distinction to be considered is between **vertical mismatch** where the level of education/ skills does not match the requirement of the job and **horizontal mismatch** where the worker's field of study does not match the occupation's one. From the employer's perspective, skills mismatch corresponds to skill gaps and skill shortages (McGuinness et al., 2018)). Skill gaps describe the situation whereby the employer believes that workers do not have the requested set of skills to perform the tasks and duties of their current job adequately, while skill shortages relate to situations where employers have difficulties filling vacancies due to a lack of qualified candidates.

The measurement framework of skills is not consensual, and there is a tendency to consider skills that are measured- skills that are **credentialed with qualifications** (Felstead et al., 2017). This leads to an interchangeable use of skills and education/qualification-related wording. Nevertheless, it is important to separate the two concepts: education and qualification cannot fully account for the differences in the possible skill gains or losses in the period following the education/qualification attainment. As suggested by Vandeplas and Thum-Thysen (2019), differences between skills and education/qualifications can arise as a result of skills development through non-formal or informal training (e.g. training on-the-job, which raises one's skills beyond his/her qualifications) or skills depreciation over the lifetime (e.g. because of changes in skills demands or insufficient maintenance or use of skills).

6.2 Aggregated measures from Eurostat

Table 3 Skill supply/demand/development statistics[27]

GI-NI concept	Measure	Data source	Limitations and possible extensions
Skill supply	Indirect/proxy measures related to education and training	Eurostat aggregates from LFS and UOE	A limited number of variables are at NUTS2 level (but starting from microdata, they can be computed). From a methodological point of view, the concept of skill supply is approximated by the concept of education and training with the possibility of conveying misleading conclusions, as stated in the references mentioned in the overview
	Self-reported information of skill supply related to ICT usage (12 variables) and to language skills (12 variables)	Eurostat aggregates from the EU survey on the use of ICT in households and by individuals and from the AES	Limited number of variables are at NUTS2 level (but starting from microdata, they can be computed). From a methodological point of view, data on skills are collected based on the self-evaluation of individuals. The literature on the subjective methods for constructing skill-related measures indicates that, compared to objective methods, the former can be more biased. Furthermore, other datasets can be used (e.g. PIAAC)
Skill demand	Indirect/proxy measures of skill demand (e.g. young people by educational and labour status, labour status of young people by years since completion of highest level of education, employment of ICT specialists and in research and development)	Eurostat aggregates from LFS, EU survey on ICT usage and e-commerce in enterprises and UOE	A limited number of variables are at NUTS2 level (but starting from microdata, they can be computed). From a methodological point of view, the concept of skill demand is approached by demand-side labour market variables
	Direct measure of skill demand provided by i) the share of people in current job, in total employment, and ii) job vacancies statistics	Eurostat aggregates from LFS and JVS	A limited number of variables are at NUTS2 level (but starting from microdata, they can be computed).
	Self-reported measures provided by digital skills-ICT usage and e-commerce in enterprises	Eurostat aggregates from the EU survey on ICT usage and e-commerce in enterprises.	A limited number of variables are at NUTS2 level (but starting from microdata, they can be computed). Using self-reported data by the enterprise side, instead of that reported by workers, seems to find greater agreement in the literature as it is stated that companies know better than workers what skills are required for a certain position. However, in this case, the skills referred to are limited and could be

[27] The list of measures presented in this table are available via the following link: https://ec.europa.eu/eurostat/web/skills/data/database

			extended by referring to other datasets.
Skill development	Self-reported measures related to the participation in education and training	Eurostat aggregates from different data sources (e.g. EU-LFS, UOE data, EU survey on ICT usage and e-commerce in enterprises, CVTS)	A limited number of variables are at NUTS2 level (but starting from microdata, they can be computed)

Table 4 Skill mismatch statistics

GI-NI concept	Measure	Data source	Limitations
Vertical skill mismatch	Over-qualification rate defined as employed persons who have attaint tertiary education (ISCED 2011 level 5-8) and who work in occupations for which a tertiary education level is not required	Eurostat aggregates from EU-LFS	The concept of skill is approximated by education. The data are available at the country and at the sectoral levels but at a very aggregated level (NACE Rev. 2, 1-digit). No information is available at the regional level.
Horizontal skill mismatch	Job mismatch by field of education is defined as the discrepancy between a person's current occupation and their field of education related to the highest level of education.	Eurostat aggregates from EU-LFS	horizontal skills mismatch cannot be calculated for all persons in employment because the information about the field of education is only collected if the person has successfully completed his/her highest level of education within the last 15 years. Therefore, the data cover only people in employment aged 15 to 34 years who have attaint at least secondary education (ISCED levels 3 to 8) and persons in employment aged 25 to 34 years who have attaint tertiary education (ISCED level 5 to 8).

6.3 Micro-level measures

GI-NI concept: skills

Operationalisation: skill shortages

Data source: European Company Survey[28] (2013 and 2019)

Measure: Hiring difficulties reported by the establishment. The management is asked the following questions:

- [KOSKILL] (2013): Does the management encounter difficulties in finding employees with the required skills? Answers coded on two-item scale: yes/no.
- [FINDSKILL] (2019): How difficult is it for this establishment to find employees with the required skills? Answers coded in four-item scale: Not at all difficult, not very difficult, fairly difficult, very difficult.

Advantage: The ECS is the only European data source reporting the establishments' hiring difficulties with information freely available for all the EU countries. The survey also has a set of trend questions (e.g. hiring difficulties) that allow comparison over time.

Limitations: Though employer surveys are more accurate to provide information on skill requirement and thus on skill shortages, this measure has to be complemented with indirect measures to disentangle genuine shortage from other forms of shortages as outlined by Brunello and Wruuck (2020). Such measures cover price measures (wage growth), volume measures (employment growth or vacancy rate) and work intensity measures. The ECS does not include such indirect measures. Furthermore, the survey does not report what the establishment requires level or type of skills to measure the gap between the required skills and those of the workforce.

Alternative measures: Skill shortages can be measured indirectly using alternative data sources such as the EU-LFS or EU-SILC in combination with occupational databases such as O*NET. The OECD index of skill shortages relies on this method by first computing an occupational indicator based on information on hourly wage growth, employment growth and growth of hours worked by occupation retrieved from EU-LFS and EU-SILC and secondly, this indicator is translated into a skill index using the O*NET database (OECD, 2017).

References:

Brunello, G., and Wruuck, P. (2021). Skill shortages and skill mismatch: A review of the literature. *Journal of Economic Surveys*, 35(4), 1145-1167.

OCDE (2017), Getting Skills Right: Skills for Jobs Indicators, Getting Skills Right, Éditions OCDE, Paris.

GI-NI concept: skills

Operationalisation: excess of demand over supply for specific skills

Data source: Vandeplas and Thum-Thysen (2019) with European Business and Consumer Surveys (EU-BCS data)

Measure: Share of employers in manufacturing, services and construction reporting that labour shortages are a major factor limiting their production. A composite measure of shortages is

[28] The database presentation is available in the Appendix

constructed as the weighted average of three sectors (construction, industry and services), weighting each sector by its share in value-added.

Limitations: No data on NUTS2, but starting from microdata, they can be computed). Furthermore, using the share of employers as a proxy for skills demand does not allow to distinguish skills shortages from more general labour shortages. Other datasets can be used (even less complete in terms of coverage can be used), such as Eurofound's European Company Survey (ECS) or Manpower Talent Shortage Survey.

Alternative measures: Skill shortages can be measured indirectly using alternative data sources such as the EU-LFS or EU-SILC in combination with occupational databases such as O*NET. The OECD index of skill shortages relies on this method by first computing an occupational indicator based on information on hourly wage growth, employment growth and growth of hours worked by occupation retrieved from EU-LFS and EU-SILC and secondly, this indicator is translated into a skill index using the O*NET database (OECD, 2017).

Sources:

Brunello, G., & Wruuck, P. (2021). Skill shortages and skill mismatch: A review of the literature. *Journal of Economic Surveys*, 35(4), 1145–1167.

CEDEFOP. (2015). Skill shortages and gaps in European enterprises. CEDEFOP.

Strietska-Ilina, O. (2009). Skill shortages in Cedefop (ed.) Modernising vocational education and training, I. Office for Official Publications of the European Communities.

Vandeplas, A., & A. Thum-Thysen. (2019). Skills Mismatch and Productivity in the EU. (DG Economic and Financial Affairs Discussion Paper N. 100) European Commission.

GI-NI concept: skills

Operationalisation: skill mismatch

Data source: European Company Survey[29] (2019)

Measure: Subjective matching question by which employers are asked to answer the following questions:

- [SKILLSMATCH] How many employees have the skills that are about right to do the job?
- [OVERSKILL] How many employees have higher skills than is needed in their job?
- [UNDERSKILL] How many employees have a lower level of skills than is needed in their job?

Advantages: The question wording allows the estimation of the extent to which skill mismatch occurs within the company (% of employees/number of employees). Furthermore, the survey provides valuable information on human resources and workplace practices put in place to enable skill utilisation/overcome skill mismatch (e.g. questions about training, motivation, autonomy)

Limitations:

- A possible disadvantage of matching questions is that they may reflect managers' subjective view of their satisfaction as to whether their skills demands have been met rather than whether they have been objectively met.

[29] The database presentation is available in the Appendix

- Missing information on employees: the advantage of asking employees to self-report the utilisation of their perceived skills is that it is often possible to combine answers with other individual-level variables such as job satisfaction, occupation, education level etc., to see which types of employees consider themselves to be using their skills.
- Missing information on which specific skills are concerned by the mismatch
- Skill mismatch related questions are available only in the last edition of the ECS, making comparison over time impossible.

Alternative measures: In contrast to subjective methods relying on self-reported skill mismatch either by the employer or by employees, objective measures compare workers' skill level to the required skill level at work. Departing from a measure of skill intensity or skill proficiency, the individual skill levels are compared to occupational skill requirements to classify them into well-matched, under-skilled and over-skilled. This approach is permitted only with international large-scale assessment surveys such as PIAAC, which provide detailed measures of skill proficiency in different domains –literacy, numeracy and problem solving - and of skills use at work.

Sources:

Baiocco, S., Kilhoffer, Z. & Niang, M.M. (2020), The measurement of skills needs, skills transferability and skills imbalances with data from international surveys, web sources and web-based surveys (Deliverable 12.1), Leuven, H2020 InGRID-2 project.

Warhurst, C., & Luchinskaya, D. (2018). Skills utilisation: definition, theories, approaches and measures. Working Paper. Dublin: Eurofound.

7. Institutional resilience

7.1 Background

Resilience has become a focal point of policy and academic debate in the last decade. The concept encompasses a wide variety of policy fields, international institutions, and levels of governments – all with different ideas about how to conceptualise, measure, and achieve resilience (Chandler and Coaffee, 2017). Although some scholars discard resilience as merely a buzzword and aimless jargon, others argue that resilience is a new approach that should not be overlooked. Regardless of such debates, resilience has entered academic discourse and thus should be taken seriously. Most definitions of resilience have in common the presumption that the world is unpredictable and insecure. The consequences of events are hard to calculate. Because of the interconnectedness of the world, as evidenced by the COVID-19 pandemic, they also spread rapidly, meaning that several regions can be affected by events taking place far away. For many, the response to this uncertainty has been to focus on **resilience building** in an attempt to minimise such consequences or avoid a crisis altogether. In other instances, resilience is usually seen as a response to something negative. **Resilience thinking** is thus based on an understanding of the world as

inherently unstable and turbulent (Ansell et al., 2017), with unlimited unforeseen consequences (Chandler, 2014). As there is no way for anyone to have all the information necessary to make the best possible choices (Simon, 1991), one must make do with limited knowledge. Building resilience can thus be seen as a way to prepare for this unpredictability. Put simply, to be resilient is to be less vulnerable to emergent circumstances like economic shocks, health pandemics, the collapse of ecological systems, democratic decline, etc.

There is still a lack of consensus about how to define resilience. Etymologically, it can be traced back to the classical Latin words resilienta ("an action of rebounding") and resilio ("to bounce back") (Rogers, 2017). Both roots denote a **sense of elasticity** – the ability to return to a previously defined shape. Consequently, resilience can be defined as "the ability of a system to 'bounce back' after disruption" (Malkki and Sinkkonen, 2016: 282). In other words, a resilient subject or system has the ability to withstand and survive shocks without changing anything about itself. The problem with such a definition is that it represents a particularly narrow view of resilience. Additionally, such a conceptualisation assumes that returning to the previous state is both desirable and possible. Changes to the environment in which the system is embedded may make a return to the status quo difficult or impossible. Another conceptualisation of resilience highlights a system's ability to adapt to ensure a better fit with its environment. Consequently, conceptualisations of resilience have evolved from those emphasizing how to remain unchanged when faced with shocks and stresses and how to quickly restore functioning to those emphasizing how to change, adapt, and promote social and agential transformation (Joseph, 2019). Resilience can thus be said to function on **a scale with three aggregates**: (1) resilience as persistence or recovery, (2) resilience as adaptation, and (3) resilience as transformation. Such an understanding of resilience shows the importance of adding a temporal scale to the resilience debate (Frigotto et al., 2022). In short, the longer a system or subject experiences a state of stress or turbulence, the more likely the system or subject is to adapt or transform in order to lessen discomfort (Chelleri et al., 2015).

When anticipating the future is difficult, one alternative strategy is resilience. Several authors have suggested that effective organisational adaptation requires resilience (Hamel and Valikangas, 2003; McCann et al., 2009). In a wide reading of the literature on resilience, Ansell and Trondal (2018) identified two broadly different conceptions of resilience with important implications for how organisations adapt. The first conception is static resilience; the second conception is dynamic resilience. In the face of shifting conditions, governing organisations adopting a strategy of static resilience will take steps to maintain and restore equilibrium conditions. Because this is a strategy of resisting change, incremental change that enhances or supports or does not threaten equilibrium conditions is likely to be prioritised. Hence this strategy encourages institutional path-dependence. To

maintain equilibrium conditions, this logic is likely to strive to get back to basics or "stick to the knitting"—reducing uncertainty and complexity to achieve order and stability. From this perspective, resilience is enhanced by improving the "fitness" of the organisation with new conditions. To do this, planning is likely to be a distinct formal activity that strives to anticipate how the organisation can successfully adapt to change. In addition, to improve stability, the organisation is likely to maintain dedicated "buffering" capacity (organisational units and resources whose core task is protecting the organisation from changing conditions).

In the logic of **dynamic resilience, stability and change** are not such sharply drawn distinctions (Easton, 1965; Farjoun, 2010). Governing organisations use stability to help them change and use change to help them to stabilise. No clear "equilibrium" between the organisation and its environment is easily discerned, and the organisation appears to be continually changing as a "reforming organization" (Brunsson and Olsen, 1993). Dynamic resilience emphasises the importance of building flexibility into institutional arrangements by absorbing complexity and incorporating requisite variety. Hence it emphasises the importance of maintaining multiple repertoires that can be flexibly redeployed to meet changing circumstances. Rather than the sharp distinction between minor path-dependent incremental change and major exogenously produced punctuated change, this logic anticipates endogenous change that continuously reconfigures the organisation. Existing elements are conserved but organised in new arrangements as a response to changing circumstances. The strategy of dynamic equilibrium also suggests that the contrast between anticipation and resilience, although a useful analytical distinction, may be a false choice. A classic reference here is March (1991), who distinguished between learning how to do better what you already do (exploitation) and learning about new opportunities or about how to do new things (exploration).

This contrast between **static and dynamic resilience** is merely an ideal type (Ansell and Trondal, 2018). In practice, the two strategies are often combined, revealing a complex interplay between resilience and institutional change. A study of the German Ministry of Finance's response to the recent financial crisis provides a good example (McCowan, 2017). This classic bureaucratic hierarchy maintained impressive stability in the face of this turbulence, making this a case of path dependence. However, the study shows that the Ministry's hierarchical structures were not particularly flexible in adapting to the circumstances of the crisis. As a result, temporary and informal collegial structures (networks) emerged to meet the challenge. These collegial structures were far more flexible and effective than the otherwise dominant hierarchical structure. This case exemplifies the importance of hybrid organisational solutions.

Frigotto et al. (2022) refer to **three basic principles at the heart of resilience: property, process, and/or outcome**. First is the interplay between stability and change, with resilience being located at an intersection between the two. Second, the relationship between resilience antecedents or triggers, what they term 'adversity', versus the degrees of change or 'novelty' that result from the adaptation to such internal or external adversities. In this context, the authors refer to three types of resilience per the degree of novelty, namely: absorptive (low novelty/a return to the old normal); adaptive (medium novelty/change within limits or threshold); and transformative (high novelty/renewal, including the delineation of new limits or threshold). Third, temporality, taking into account process-related aspects that occur before (foresight), during (a mechanism) and following (outcome) a disruptive event or adversity. Finally, it is noted that resilience is not only a multifaceted phenomenon but also a multi-scaled one (macro-meso-micro levels), and thus there is a need to unpack how these levels co-evolve and influence one another over time.

7.2 Definition of institutional resilience

We refer to **institutional resilience** in the GI-NI project as the ability of the formal and informal arrangements (regulative, normative and cultural-cognitive) shaping social life and social relations within a given society/polity to adapt to changing external circumstances whilst, at the same time, maintaining function and a sense of identity, i.e. to ensure some degree of stability during the change/adaptation process. As for the sub-concept of **institutional absorptive capacity**, this is a measure of a system's (and its constitutive agents) dynamic ability to learn (Cohen & Levinthal, 1990), both during stable or normal periods characterised by incremental change (exploitation) as well as in the context of more disruptive or turbulent events requiring the adoption of an explorative approach (March, 1991). A key factor here pertains to the focal system's ability to identify, assimilate, transform, and/or use externally generated knowledge as well as practical insights. Learning is an important antecedent for, and driver of, resilience (cf. Kayes, 2015), as individuals, groups, and entire systems exploit and/or explore how current or existing arrangements, ideas, practices, norms and values can be altered or transformed in order to improve their fit with changing environmental circumstances.

7.3 Data sources

- World Bank Governance indicators[30]
- OECD "How's life? Well-being?"[31]

8. Socio-cultural foundation, including socio-cultural arrangements

8.1 Background

Broadly speaking, socio-cultural factors pertain to the shared *values*, *norms* and *attitudes* within a given group or society. These are important because they help determine social behaviour and social relations between individuals and within and between groups, including firms. One of the difficulties in examining the effects of socio-cultural dimensions on the institutional fabric of societies pertains to the lack of a precise and commonly understood definition of culture (McGrath et al., 1992). Anthropologists suggest that culture is related to the ways in which societies organise social behaviour and knowledge (Hall, 1973). Hofstede (1980; 2001) defines cultural values as the collective programming of the mind which distinguishes the members of one human group from another and their respective responses to their environments. In a seminal study about values and related sentiments of people in over 50 countries around the world, Hofstede identified six key dimensions of national cultures:

1. *Power Distance*, related to the different solutions to the basic problem of human inequality;
2. *Uncertainty Avoidance*, related to the level of stress in a society in the face of an unknown future;
3. *Individualism versus Collectivism*, related to the integration of individuals into primary groups;
4. *Masculinity versus Femininity*, related to the division of emotional roles between women and men;
5. *Long Term versus Short Term Orientation*, related to the choice of focus for people's efforts: the future or the present and past.

[30] http://info.worldbank.org/governance/wgi/
[31] https://data.oecd.org/gga/trust-in-government.htm

6. *Indulgence versus Restraint*, related to the gratification versus control of basic human desires related to enjoying life (Hofstede ,1980; 2001; 2011; further details below).

In a similar but more recent study analysing the relationship between 400 socio-cultural indicators and national competitiveness (productivity, economic development, business and government efficiency, innovation capacity and infrastructure) in 37 countries, Apsalone and Šumilo (2015) identified **six relevant socio-cultural factors**: Collectivism and Hierarchy; Future, Cooperation and Performance Orientation; Self-expression; Monochronism and Rationality; Economic Orientation; and Social structure. Their findings show that the first factor – Collectivism and Hierarchy – was found to reduce international competitiveness, whereas the other five were demonstrated to have positive effects.

Yet another take on the theme is found in different schools within a strain of literature broadly labelled **Varieties of Capitalism** (VoC). These are traditions that developed from so diverse sources as comparative institutional and political analysis, historical demography, and evolutionary geography. Two of these schools will be mentioned here: (1) The demographic tradition drawing on the works of Todd (1990; 2011; 2019) and (2) the classical VoC-tradition as developed by Hall & Soskice (2001).

Todd (1990) originally distinguishes between two variables for analysing the social fabric: **equality and authority**. His data stem from historical censuses and historical monographs and enable him to establish hegemonic family types down to NUTS 3 for all of Western Europe (Todd, 1990) and later also for the Eurasian continent (Todd, 2011). Todd then claims that these hegemonic family values found in the nations and regions of study represent the cultures as these guide individuals' socialisation in the societies in question. In this, Todd echoes Hofstede's notion of culture as the software of the mind, pointing at the family as its reproductive node. In its simplest form, he combines these variables in a dichotomised model with four options, as shown in table 5.

Table 5 Family types as identified by authority and equality

		Equality	
		Egalitarian	Non-egalitarian
Authority	Strong	Communitarian	Stem
	Weak	Egalitarian nuclear	Absolute nuclear

When tested on European data on educational and socio-economic achievements, the Todd model seems to yield impressive results (Duranton et al., 2009). Todd (2019:xiii), in his proposed taxonomy of innovative propensity, labels countries as they deviate negatively from the Anglophone sphere. Concerning collectivism, Todd distinguishes between the Stem family and the Communitarian family models. The **stem family model** is the type of three-generational family model dominating most of the Germanic-speaking realm of Europe along with an important part of the periphery in France, Northern Italy and Northern Spain (Catalonia, the Basque Country and Galicia) along with Asian countries such as Japan and South Korea. Stem family societies are generally wealthy, institutionally stable and favourable to incremental innovation and long-term investment strategies. Their family model has an important modelling effect on business and working life organisation, most extremely exemplified with the Japanese model of tailoring corporations according to its ideals of lifelong commitment, more relevant in the GI-NI context as exemplified by the role of the qualified German worker, and of the Scandinavian legislation on working life and working conditions.

The **communitarian family type** dominates large parts of former Eastern Europe and is considered hegemonic in Russia and China. From a developing point of view, it seems to present important obstacles to economic and social progress through its insistence on generational authority and geographical and social mobility restrictions. Both aspects are copied on to institutions guiding economic and political behaviour. In Western Europe, the communitarian family is most typically found in the Third Italy. Here it has been listed to explain the economic success of this region (Piore & Sabel, 1984), but then by pointing at the specific role its networking capacities have come to serve innovative and absorptive practices of its industries and its workforce (Bamford, 1987). It is not obvious how these lessons can be transformed to cope with changing institutional challenges in space and time (Bianchi, 1998).

While Todd starts from analysing families, Hall & Soskice (2001:9) take the firm as their point of departure, stating that "[i]n any national economy, firms will gravitate toward the mode of coordination for which there is institutional support". Following up, they argue that the logic of this postulate applies to individuals and governments alike. Hall & Soskice (2001:7) identify five dimensions as crucial to determine the type of capitalism that can be found to characterise a given society at the national level of analysis.

1. *Industrial relations*
2. *Vocational training and education*
3. *Corporate governance*
4. *Inter-firm relations*
5. *Employer-employee relations*

Using these dimensions, the authors identify two distinct groups of economies mostly pertaining to OECD economies, Liberal Market Economies (LME) and Coordinated Market Economies (CME). This two-dimensional model has served as a *point de repère* for most later VoC studies, though the labelling soon became criticised for being too simplistic and static (Hancké et al., 2007). Thus, recent years have witnessed many VoC models being developed, also to encompass economies outside of the OECD realm. Comparing Todd and Hall & Soskice, we observe that Todd's Stem family societies are identical with Hall & Soskice's CME category, while Todd's absolute nuclear societies compare to Hall & Soskice's LMEs.

When assessing the role of socio-cultural arrangements in different aspects of life, including politics and the economy, two central concepts in the literature are **social capital and social networks**. *Social capital* is the tangible and virtual resources that facilitate actors' attainment of goals and accrue to actors through the social structure (Portes, 1999). *Social networks* are generally defined by a set of actors (individuals and organisations) and a set of linkages between those actors (Brass, 1992). Social networks are a set of relationships that can define a community's perception, whether a business community or a more general notion of community in society (Anderson and Jack, 2002). Thus, society is a series of connected or 'tied' nodes (Narayan and Pritchett, 1999). This broad conception of social networks and social capital implies that the dynamics of economic exchange are socially embedded (Granovetter, 1985). As distinct from a rational choice perspectives, the **social embeddedness** perspective emphasises that, in embedded contexts, agency, that is, the ability to garner novel/entrepreneurial ideas and the resources to develop them, is shaped by implicit norms and social mores. Thus, social capital is conceptualised as a set of resources embedded in relationships (Burt, 1992). In the context of inequality, it is important to note that the exploitation of social capital by any one person or agent, even within contextual rules, implies both winners and losers (Anderson and Jack, 2002).

Related to this idea, Portes and Landolt (2000) identified **four negative consequences of social capital**: exclusion of outsiders, excess claims on group members, restriction on individual freedoms and downward levelling of norms. These authors point out that the same strong ties that enable group members to obtain privileged access to resources bar others from securing the same assets. In a similar vein, the particularistic preferences granted to members of a clan or circle of friends are commonly at the expense of the universalistic rights of others. This phenomenon of unequal rights to valuable and scarce resources often frame the differences among business/entrepreneurial groups or among entrepreneurs in different regions or countries. This view of social capital is closely associated with the emphasis placed by Coleman (1993) on community

structures as a mechanism of social control, which, in turn, is also linked with the predominant culture (norms, values and identities) in a specific society.

8.2 Measures

To a large extent, socio-cultural dimensions help determine the institutional fabric of societies. The latter, in turn, act as a mediator between global processes like globalisation, migration and technological change and the local effects (e.g. degree of inequality, labour market structure, skill levels), on both individuals (micro) and organisations (meso), accrued to these macro-level processes.

The resilience of the different socio-cultural systems (modes of capitalism). Todd model: Duranton et al (2009). Hall&Soskice/Amable model: Pinto et al (2019). For a time-series model (Hall&Soskice): (Schneider & Paunescu 2012).

Power Distance has been defined as the extent to which the less powerful members of organisations and institutions (like the family) accept and expect that power is distributed unequally. This represents inequality (more versus less) but is defined from below, not from above. It suggests that a society's level of inequality is endorsed by the followers and leaders. Power and inequality, of course, are extremely fundamental facts of any society. All societies are unequal, but some are more unequal than others. For a more complete review, the reader is referred to Hofstede (2001) and Hofstede et al. (2010). The statements refer to extremes; actual situations may be found anywhere in between the extremes, and the association of a statement with a dimension is always statistical, never absolute.

Individualism vs collectivism: Individualism on the one side versus its opposite. As a societal, not an individual characteristic, collectivism is the degree to which people in a society are integrated into groups. On the individualist side, we find cultures in which the ties between individuals are loose: everyone is expected to look after him/herself and his/her immediate family. On the collectivist side, we find cultures in which people from birth onwards are integrated into strong, cohesive in-groups, often extended families (with uncles, aunts, and grandparents) that continue protecting them in exchange for unquestioning loyalty and oppose other ingroups. These features are generally understood as social instability and difficulties with making institutions of authority legitimate.

Social capital is measured as the *overall levels of trust* in society, at different levels, amongst citizens, between citizens and government representatives and political elites, between citizens and professional groups, or between managers and employees (within firms/public organisations).

8.3 Data sources

- World Bank Governance indicators[32]
- OECD Trust in government data"[33]

9. Concluding remarks

This report aimed to critically review the measures of the core concepts of the GI-NI project. To this end, and for each of the following topics - technological change, globalisation, migration, inequality and skills - the conceptual background was clarified before defining the measures used, the data source, and the advantages and drawbacks of the measures. The objective is to investigate the adequacy of existing EU data sources with the measurement framework defined for each concept. The following remarks summarise this investigation:

- Regarding the topics addressed in GI-NI, Eurostat provides a very rich set of indicators to make cross-country comparisons between the European States. Using aggregated data directly from the Eurostat web portal presents the shortcoming of being aggregated at a higher level (country level or broad sector categories) than the individual one. Furthermore, these data are rarely available at the regional level as outlined for many indicators.
- However, available data characteristics limit the possibilities to tackle research questions that need to be addressed at the micro-level. For such analysis, the measures have to be computed from micro-surveys (e.g. EU-LFS or EU-SILC). European surveys are mainly cross-sectional with anonymisation rules that may limit the exploitation of the full data potential. For instance, though the EU-LFS collects the place of birth of each interviewed individual, this variable is recoded in large categories (e.g. EU15, North Africa) because of confidentiality concerns. This aggregation may limit the scope of migration analysis, for instance. Other EU micro-data sources such as the EWCS and the ECS provided by Eurofound, though providing very rich information – respectively on employees' and employers'- have the drawback of the varying questionnaires, small sample size and cross-sectional data configuration

[32] http://info.worldbank.org/governance/wgi/
[33] https://data.oecd.org/gga/trust-in-government.htm

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Appendix

Presentation of the data sources not available through Eurostat sources

EU KLEMS	
Overview	EU KLEMS was initiated as a research project funded by the European Commission, Research Directorate General as *part of the 6th Framework Programme*, Priority 8, "Policy Support and Anticipating Scientific and Technological Needs". Its original name was "*Productivity in the European Union: A Comparative Industry Approach*". The EUKLEMS acronym stands for **EU** level analysis of capital (**K**), labour (**L**), energy (**E**), materials (**M**) and service (**S**) inputs. The initial project lasted from 2003-2008 and was developed by 18 European research institutes under the coordination of the University of Groningen. After the end of the Framework Project the EU KLEMS database underwent various updates in 2009, 2011, 2012 and 2016. The database provides measures of economic growth, productivity, employment creation, capital formation and technological change at the industry level for all European Union member states from 1970 onwards. The input measures include various categories of capital, labour, energy, material and service inputs. Productivity measures are developed, in particular with growth accounting techniques.
Reference year	Data are available annually for the period 1995-2017 (though coverage might differ across countries)
Geographical coverage	28 EU Member States, Japan and the US

World Input-Output Database (WIOD)	
Overview	The World Input-Output Database (WIOD) is a publicly available database (www.wiod.org), constructed by an FP7-funded consortium led by the University of Groningen. By harmonizing data on national production structures (supply and use tables; input-output tables) as constructed by national statistical institutes and linking these to data on international trade in goods (UN Comtrade) and in services (from UN, OECD and Eurostat), input-output tables for the world were constructed. These can be viewed as quantitative descriptions of the world's production structure and its links with users of final products anywhere in the world. Associated data on environmental pressures of production (emissions of greenhouse gases, energy use by type, water use, etc.) and on socio-economic aspects of production (employment, labour income, etc.) are available at the same level of industry detail. Recently, the data on employment have been disaggregated into employment and labour income by business function and gender, allowing for studies into functional specialization and impacts of trade on gender inequality. The data in WIOD is available at current prices and in prices of the previous year. This allows for disentangling quantity and price effects. Two releases of WIOD are available, the 2013 release and the 2016-release. There are minor differences in coverage. The main difference is related to the use of the System of National Accounts 2008 in the source data for the 2016-release, while the source data for the 2013-release had mainly been based on the System of National Accounts 1993.
Reference year	Data are available annually, for the periods 1995-2011 (WIOD-2013) and 2000-2014 (WIOD-2016)

Geographical coverage	27 EU Member States, the United Kingdom, Switzerland, Norway, USA, Canada, Mexico, Brazil, Turkey, Russia, China, Taiwan, South Korea, Japan, India, Indonesia, Australia and a "region" labelled "Rest of the World".

Gallup World Poll	
Overview	The Gallup World Poll (GWP) is an annual survey in about 150 countries (or areas) worldwide, representing over 98% of the world's population aged 15 and older. The survey is nationally representative. The survey was designed and conducted by the Gallup Organization, and data have been collected since 2005/6. The survey is incredibly rich and asks a plethora of questions related to household and individual socio-demographics, opinions and attitudes, well-being, and actual and intended behaviours. Interviews are conducted via the phone in in countries where telephone coverage is widespread (Northern America, Western Europe, developed Asia, and Gulf Cooperation Council (GCC) countries). Data are collected using face-to-face interviews in Central and Eastern Europe, much of Latin America, former Soviet states, nearly all of Asia, the Middle East and Africa.
Target population	Respondents aged 15 and older are the target population for this survey.
Target sample	Usually, GWP surveys typically aim to have at least 1,000 individuals per country per year.
Sample design	Procedures differed between countries, depending on whether a face-to-face or telephone survey mode was used. In the case of face-to-face interviews, depending on the availability of population information from Census or other data, in a first stage, Gallup selected clusters (Primary Sampling Units (PSUs)) based on a stratified single stage or multiple-stage cluster design. Gallup used a stratified single stage cluster design and selected PSUs using simple random sampling in countries where only limited population information was available at the strata level. The second stage included household selection using random route procedures. In the third stage, the respondent selected an adult randomly (aged 15+) within the household to be interviewed. In the case of telephone surveys, Gallup uses random digit dialling (RDD) or a nationally-representative list of numbers. Both landlines and cell phones are sampled. In a second stage, the respondent is selected either by the last birthday method or by random selection (among household members aged 15 and older).
Sample size	The Gallup World Poll (2005/6-2020) sample size comprises 2,323,501 observations. In small areas, such as Puerto Rico, the survey polls 500 respondents, while large countries such as Russia and China feature at least 2000 respondents. In some countries, the GWP over-samples respondents in major cities or areas of special interest. Different individuals are polled each year, which implies that the survey presents a collection of cross-sections rather than a panel.
Reference year	Data are available for reference years 2005/6-2020. However, key questions for the analysis in Task 5.1. For example, migration intention questions have been available since 2005/6, while consistent income and employment status information were available in 2009.
Geographical coverage	150 countries around the world, at different levels of development

European Company Survey[34](2019)

[34] https://www.eurofound.europa.eu/surveys/european-working-conditions-surveys-ewcs

Overview	Eurofound and Cedefop joined forces to carry out the fourth European Company Survey (ECS) in 2019. The ECS 2019 collects data in over 20,000 establishments on workplace practices with regard to work organisation, human resource management, skills use, skills strategies, digitalisation, direct employee participation and social dialogue. It allows for the identification of those bundles of workplace practices that work particularly well in creating win–win outcomes: situations where workers are facilitated and motivated to use their skills to the full, share their knowledge and insights with colleagues and management, and identify opportunities to improve both themselves and the work process as a whole, allowing establishments to thrive.
Target population	Senior managers in charge of personnel and, where present, official employee representatives in establishments with 10 or more employees in all sectors involved in 'market activities'
Target sample	The sample size targets of MM interviews differ by country, they range from 250 in small countries to 1,500 in larger countries
Sample design	Procedures differed between countries, using the best quality sampling frame that was available. Sampling was always stratified by establishment/company size and a broad sector of activity (manufacturing, construction and services). In countries with an establishment-level sampling frame, stratified random probability sampling was applied. In countries with a company-level sampling frame, stratified random probability sampling was applied, and subsequently, a screening procedure was used to select up to three establishments in multi-establishment companies randomly.
Sample size	A total of 21,869 management interviews were completed, ranging from 122 in Cyprus to 1,498 in Italy. A total of 3,073 employee representative interviews were carried out, ranging from 3 in Cyprus to 467 in Finland. Finally, for 1,835 establishments, both a management interview and an employee representative interview were completed, ranging from 2 in Ireland to 284 in France.
Reference year	Data are available annually for the years 2004, 2009, 2013, 2019
Geographical coverage	27 EU Member States and the United Kingdom

World Governance Indicators database	
Overview	The WGI are a research dataset initiated by Daniel Kaufmann (Natural Resource Governance Institute (NRGI) and Brookings) and Aart Kraay (World Bank, Development Economics) in 1999. The database reports aggregate and individual governance indicators, combining the views of a large number of enterprise, citizen and expert survey respondents in industrial and developing countries. They are based on over 30 individual data sources produced by a variety of survey institutes, think tanks, non-governmental organizations, international organizations, and private sector firms of governance. The six following dimensions of governance are considered: -Voice and Accountability -Political Stability and Absence of Violence/Terrorism -Government Effectiveness -Regulatory Quality -Rule of Law -Control of Corruption
Reference year	Data are available annually for the period 1996-2020 (though coverage might differ across countries)
Geographical coverage	200 countries and territories

Overview	The OECD "Trust Survey" monitors people's trust across different institutions and levels of government across OECD countries. It poses a set of situational questions to nationally representative samples in order to assess the role of different drivers of public trust. Survey modules ask about people's political participation, satisfaction with public services, and their evaluation of government action on key long-term challenges (e.g. climate change, automation, and digitalisation).
Reference year	Data are available annually for the period 2017-2020
Geographical coverage	OECD countries

Comparison between WIOD, OECD-ICIO and the Figaro databases

In terms of the basic philosophies adopted in the construction of the global input-output tables, WIOD-2013, WIOD-2016, the OECD-ICIO and Figaro databases are very similar (although not identical). The construction procedures all start from the perspective that the data should be compatible with national accounts data rather than with bilateral trade data (the two types of data are not consistent with each other). The table below summarises the similarities and differences between the three databases (situation in December 2021).

	WIOD-2013	**WIOD-2016**	**OECD-ICIO**	**Figaro**
Years covered	1995-2011 (annual)	2000-2014 (annual)	1995-2018 (annual)	2010-2019 (annual)
Number of countries	40 + 'Rest of the World'	43 + 'Rest of the World'	60 + 'Rest of the World'	46 + 'Rest of the World'
Number of industries	35	54	45	64 for EU, UK and US, 30 for other countries. 2018-2019 more aggregated.
Split between processing trade and other activities	no	no	yes, for China and Mexico	no
Tables in constant prices	yes	yes	no	no
Compatible employment data	yes (splits by occupation)	yes (splits by occupation)	no	yes (no splits)

GI-NI PROJECT IDENTITY

Project name

Growing Inequality: a novel integration of transformations research — GI-NI

Coordinator

Nederlandse Organisatie Voor Toegepast Natuurwetenschappelijk Onderzoek TNO, Netherlands

Consortium

CNAM – CEET, Centre d`études de l´emploi et du travail (France)
University of Groningen (Netherlands)
Centre for European Policy Studies (Belgium)
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