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Measuring Gender Equality

A Multidisciplinary Analysis of Some EU Countries

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Editors

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Preface

Over the last century, the issue of gender equality has become increasingly central to the political agenda of national and local governments, international organizations, and social movements. The European Union has been shown to be particularly sensitive to this issue, as evidenced by numerous documents. We want to recall here only four of the most important ones:

- The joint declaration 'Gender Equality as a Priority of the European Union Today and in the Future' was proposed at the initiative of the Austrian presidency of the Council of the European Union by the presidency trio of Estonia, Bulgaria, and Austria (14309/18). It was signed at the informal meeting of gender equality ministers on October 12, 2018, in Vienna, and is supported by twenty-seven EU Member States. The joint declaration aims to reaffirm gender equality as a priority in the European Union. The twenty-seven signatories called for a high-level standalone EU gender equality strategy and a full realization of the dual approach combining gender mainstreaming and specific actions.
- The Gender Action Plan for 2016–2020 (GAP II) stressed the need for the full realization of women's and girls' full and equal enjoyment of all human rights and fundamental freedoms, the achievement of gender equality, and the empowerment of women and girls. Overall, the evidence shows that communities are more prosperous and peaceful when women are given equal opportunities and access to resources and decision-making. The EU wants to assist partners effectively using this transformative potential.
- The Gender Action Plan for the period 2021–2025 (GAP III) aims to accelerate progress in empowering women and girls and safeguard gains made on gender equality during the 25 years since the adoption of the Beijing Declaration and its Platform for Action. It makes the promotion of gender equality a priority of all external policies and actions; it offers a roadmap for working together with stakeholders at national, regional, and multilateral levels; it steps up action in strategic thematic areas; it calls for the institutions to lead by example; and it ensures the transparency of the results.

- The European Parliament decision T9-0276/2021 is a resolution of the gender dimension in the cohesion policy. Members considered that gender mainstreaming should be implemented as a horizontal principle in all EU programs, activities, measures, and actions, as well as in all EU-funded projects and policies, including the cohesion policy. The parliament underlined the importance of a cohesion policy in promoting equality between people and regions, including gender equality, and in implementing a European strategy for gender equality. Members emphasized the need to adopt a gender equality strategy with clear ambitions and targets at the national and regional levels and to develop awareness-raising programs on the benefits of gender equality and equal opportunities for socioeconomic growth and sustainable development. It is recommended that Member States consider gender equality measures in the process of designing and validating programs and identifying priority areas that contribute to gender equality and sustainable development for each programming phase.

Although the European Union is more advanced in tackling these issues than other international institutions, there is an increasing tendency worldwide to define quantifiable targets for equality and to measure each country's distance from them. No country in the world has achieved gender equality yet, and international studies show that closing the gender gap will still take a long time, especially in some parts of the world where gender differences are still highly marked. The long and tremendous experience of COVID-19 has further prolonged this process; it has slowed down the reduction of gender gaps, more in some domains than in others, showing the fragility of the results already achieved, the weakness of gender policies, and the need to reinforce them. All this makes it necessary to have indicators that measure gender inequality and support gender policies identifying priorities for action both at the national and regional levels. Over the past thirty years, measuring gender equality became a crucial task addressed by numerous international organizations such as the United Nations, the World Economic Forum, and the European Institute for Gender Equality. These organizations proposed different indicator systems to monitor the progress in reducing the gap between women and men, giving quantitative support to decision-makers for defining priorities and evaluating the effectiveness of gender policies. However, these indicators of gender equality or inequality (in a word, (in)equality) are bound to specific reports published by the organizations that produced them.

This book is one of the outcomes of the 'Regional Gender Equality Measurement in the European Union' (ReGem, regem.unige.it) project funded by the European Union through the Jean Monnet Erasmus+ program, and it consists of two parts. After an outline of the object of measurement in Chapter "Gender Equality, Equity, and Equal Opportunities", the topic of measuring complex social phenomena using indicators is addressed in Chapter "The Complexity of Social Phenomena and the Construction of Indicators". A review of the most renowned indicators of gender (in)equality is proposed in Chapter "The Main Indicators of Gender Inequality",

while Chapter frames "Gender Equality as an EU Strategy", concluding the book's first part.

The second part of the book presents the regional analysis carried out in the ReGem project concerning four major EU countries (Italy, France, Spain, and Germany) in an attempt to reproduce the Gender Equality Index (GEI) of the European Institute for Gender Equality from a regional perspective (Regional-GEI or R-GEI). Chapter "Subnational Level Data to Measure Gender (in)Equality in the EU: Opportunities and Limitations of Official Datasets", comments on the importance of introducing a regional perspective in the analysis of gender (in)-equality and the actual availability of Eurostat data for this purpose. Chapter "Comparative Analysis of Regional Gender Disparities", reports the results of a regional quantitative analysis for the countries under study, aiming to show the effectiveness of regional perspective in examining gender differences and evaluating the quality of the information provided by the R-GEI index. The book concludes with two chapters, "Gender-Responsive Regional Policies: Gender Budgeting" and "Gender-Responsive Regional Fiscal Policies: The Labour Market", which provide a political perspective on several topics of extreme interest for regional policy-making.

This is the first book to organically deal with gender (in)equality measurements. However, its scope is not to propose an exhaustive review of all the theories or experiences on the topic but, rather, to provide basic knowledge for those who want to approach gender (in)equality research from a quantitative, indicator-based perspective. This book is published in open access thanks to funds made available by the European Union's Erasmus+ program, hoping that it can become a valuable teaching and research tool for the broadest audience. Among our goals for the near future is to prepare teaching materials built on this volume, and we invite you to seek advancement in this work.

We want to thank all those who made the realization of this book possible: the other authors of the chapters whose expertise enabled us to propose a multidisciplinary volume, the students who participated in the series of seminars and workshops organized as part of the ReGem project who helped us to define better the contents of the book, the colleagues who advised us in the various drafts of the volume and, last but not least, our families who supported us in this project.

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Gender Equality, Equity, and Equal Opportunities

Giulia Nanni

1 Understanding Gender Equality

The history of equality is part of our existence. It constitutes one of the fundamental pillars of democracy and is a principle expressed in all great international declarations. However, its meaning is not obvious. Equality is not a natural entity but a generic concept that needs to be specified to have meaning (Bobbio, 1977). If the adjective 'equal' indicates an entity with the same characteristics as another entity, we first need to clarify what/who and for which aspect equality operates (Olivetti, 2007). For example, we are familiar with the 1789 Declaration of the Rights of Men and [Male] Citizens. It is considered one of the greatest recognitions of human freedom and dignity, and is the source of inspiration for numerous constitutional charters. However, the Declaration was only addressed and formulated by men and male citizens. Two years later, Olympe de Gouges published the Declaration of the Rights of Women and Female Citizens to claim legal and judicial equality for women by extending the principles of the French Revolution to them as well. In response, women's associations and their newspapers were banned, and Olympe de Gouges was guillotined—'for forgetting the virtues befitting her sex and meddling in the affairs of the Republic'. This clarification allows us to point out that the Declaration of the Rights of Men and Citizens is still considered one of the milestones in the history of the recognition of rights, effectively excluding half of the population: women.

This book elaborates on the issue of measuring equality between men and women. However, this is insufficient. The principle of equality described above considers two entities to be equal, which in this case are not; any two different people are inevitably different.

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In its evolution, the concept of equality led to the distinction between 'formal' and 'substantive' equality. The former refers to equality under the law: the most widespread legal principle in constitutions and necessary to guarantee the impartiality of the law both in content and application for both those who govern and those who are governed. Thus, the more that laws are general, abstract, and applicable only for the future, and for an indefinite number of times, the higher the chances of guaranteeing equality (Olivetti, 2007). However, as history shows, equal treatment is not sufficient to achieve full equality when there is basic discrimination between the subjects considered. To remedy de facto inequalities, we need to promote forms of substantive equality: laws capable of challenging the principle of formal equality to protect people who are physically, culturally, socially, and economically disadvantaged or underrepresented in certain areas. Interventions condisedered 'special' targeting only a small group of people, but never arbitrary due to the principle of reasonableness. A 'reasonable inequality' derives from and preserves the very principle of equality (Olivetti, 2007). In short, formal equality imposes equal treatment, while substantive equality provides and allows for a redistribution of resources to counteract de facto inequalities. Both are necessary to achieve equality between individuals with different entities and living conditions.

Similarly, the simplest definition of inequality is 'differences among people in their command over social and economic resources', but, to be useful, we must go further and specify inequality: (a) of what, (b) among whom, and (c) how it is summarised (Osberg, 2001). When we talk about inequality (or equality), we risk involving the value system by establishing which differences between people are more important. However, in this book, to measure these phenomena, we are not interested in establishing what is more or less important; rather, we are interested in highlighting what inequality persists and characterises issues of fact between women and men.

We commonly define the issue of equality between men and women as gender[1] equality and refer to a state in which access to rights or opportunities is not affected by gender. A social condition in which women and men share equal rights (formal equality) and a balance of power, status, opportunities, and rewards (substantive equality). Gender equality can be broadly operationalised by men and women having (1) equitable access and use of resources; (2) equitable participation in

[1] First used in 1955 by psychologist and sexologist John Money, the term 'gender' identifies the social construction of biological sex. The male and female stereotypes represent the general consensus on the roles assigned to men and women, the patterns of our masculinity and femininity. However, this distinction did not have much relevance until the 1970s, when gender was reinterpreted by feminist scholars as not only a social but also a political construction of gendered roles. According to anthropologist Rubin (1975), the 'sex/gender system' is held responsible for the exploitation of women because it underpins the sexual division of labour, where women are assigned to reproduction while men are assigned to production. Gender status persists over time because the difference of gendered bodies is linked to representations that differentiate duties, pleasures, roles, expectations, constraints, and opportunities (Volpato, 2013; Priulla, 2016). Aspects also supported by everyday experience in which men enjoy more resources and power than women (Ridgeway, 2011).

relationships, the household, the community, and political arenas; and (3) safety or freedom from violence (Rolleri, 2012: 4).

Alongside the concept of gender equality, we frequently find the concept of equal opportunities; breaking down barriers to achieving substantive equality is often tantamount to creating opportunities where they are lacking. While it is true that the removal of barriers applies to all forms of discrimination (e.g. sex, race, religion, political opinion), the concept of equal opportunities is usually associated with fighting gender discrimination.

In antithesis, by gender inequality, we refer to a social status in which people's rights, responsibilities, and opportunities are determined by whether they are born male or female (Slade, 2008). Thus, to speak of 'gender' is, above all, to name the asymmetry between women and men which is present at all levels and at all times in social life. For many, gender inequality belongs more to the past or to very different cultural systems, distant from the Western ones. On the contrary, the world is deeply divided and organised by gender to limit the potential of women in particular, but also of men, to contribute to their full potential. Certainly, forms of discrimination against women and girls have decreased, but many continue to deprive them of their basic rights and opportunities. Even when women obtain significant rights, a long historical tradition prevents their concrete expression. These limitations are the result of several intricately connected, historical, and culturally specific processes (Berreman, 2001; Slade, 2008; Grown, 2008; Ridgeway, 2011) in which biological sex is the category of difference described at birth. We now know that the variability of individual differences cannot simply be categorised into the psychological traits of male and female groups. Empirically, we can detect more differences between two people of the same gender than between men and women taken as a whole. However, thinking in categorical terms minimises within-category differences and maximises between-category differences (Volpato, 2013). Moreover, this is further reinforced by everyday life which consolidates aspects of cultural genesis to the point of appearing natural. We learn unconsciously in the first years of life through gender rules and divisions. Years in which learning is a central aspect of existence and the demands for adaptation to imposed models are stronger than at any other age of life: behaviour considered appropriate to sex is encouraged, others repressed. Later, once this happens, moving away and disregarding social expectations and pressures will cost and hurt everyone in personal terms (Priulla, 2016).

Certainly, women and men are not entirely passive subjects who are unable to recognise the patterns imposed by society and distance themselves from them. However, being aware of gender constructions allows us to acquire greater knowledge and critical capacity about our choices, as well as reminding us that they can never be decontextualised from the social structure in which they were made. This is because we make choices and exercise individuality within the limits and constraints imposed by personal circumstances, the structural distribution of rules, norms, resources, and the inequalities of power and privilege they generate (Folbre, 1994; Kabeer, 2016). Of course, not all women are subject to the same degree of discrimination, and some are better able to identify and cope with it than others, but this does not mean that they are not all included in it.

As with the analysis of the relationship between sex and gender, feminist[2] thought has produced numerous insights and critical analyses on the issue of equality. In fact, the inclusion of women as equals in patriarchal societies through the recognition of equal capacities between men and women has involved adapting the latter to the male model in force (Lonzi, 1974). Men and women are not equal, although we recognise that many of the differences between them are merely a consequence of the cultural processes in their societies. However, this difference should not involve a value judgement, but rather a social structure that allows both to interact as equals (Fraser & Honneth, 2007), respecting and valuing differences. While the male gender enjoys far greater privileges than the female gender, it finds itself caught up with expectations and pressures that do not always allow for the expression of individuality. For example, the containment of emotions often demanded by the male gender may lead to an inability to identify, describe, and feel certain emotions, such as fear, empathy, and tenderness (Volpato, 2013). Adolescents will have to acquire the rough manners required for the toughness of adulthood, and their entire existence will be punctuated by tests of masculinity aimed at confirming their membership in the male group (Priulla, 2016). Men are encouraged to control their feelings to be less vulnerable and maintain their position of dominance (Volpato, 2013). Therefore, equal opportunities for all means creating a society based on the concepts of equality and difference simultaneously. The two concepts do not contradict each other because, at the opposite of equality, there is inequality, while at the opposite of difference, there is assimilation. The principle of equality in totality (formal and substantial) generates and restores justice. Differences are recognised as inherent in human existence, and equal opportunities enable it to be respected. Therefore, equal opportunities become necessary for the full development of all human beings, for the realisation of a just society, and for the challenge of our time.

Another important clarification concerns the link between the concepts of modernisation and development and the concept of women's empowerment. According to Walby (2020), modernisation does not necessarily mean reduced gender inequality, and the same applies to development (Duflo, 2012). Certainly, these can play an important role in reducing inequalities; gender equality improves when poverty decreases (Duflo, 2012). However, this was insufficient. Walby (2020) distinguished between domestic and public gender regimes and, within the public, between the

[2]Feminism is a movement advocating for women's social, political, legal, and economic rights equal to those of men. From its inception, feminism did not aim at political power or the economic system, but fought against inequality, aiming to challenge the exercise of power with which men want to direct women's conduct. To speak of feminism in the singular is also misleading, as it risks making what is in fact a panorama of varied, heterogeneous, and sometimes even opposing thoughts appear as a single one. However, the basic principles of all feminisms, albeit in different ways and with different analyses, are the fight against patriarchy and the realisation of a world in which women are considered equal to men. In the 1980s, feminist thoughts and analyses gave rise to gender studies, a strand of interdisciplinary studies that placed gender representations and gender identity as central categories of analysis.

neoliberal and social democratic forms of regimes.[3] Moreover, she pointed out the existence of an important division between them. However, according to her, 'the patriarchal strategy of the exclusion of women under private patriarchy was transformed into the segregation and subordination of women in the public sphere. This transformation includes the socialisation of domestic labour, the increased representation of women in the polity, the individualisation of intimacy, and the state regulation of domestic violence' (Walby, 2020: 417). Thus, domestic forms of exclusion and power continue to be practised in public life. In view of this, the author concludes that 'the depth of gendered democracy and the strength of feminism and its alliances are key to the outcome of the trajectory of change in modernity and capitalism' (Walby, 2020: 428).

Likewise, according to some studies, when we consider economic development as a sufficient condition for women's advancement, we risk overestimating what women can do in a world characterised by de facto discrimination, gender bias, and structural barriers to their capabilities (Chant & Sweetman, 2012; Duflo, 2012). If we recognise gender inequality as a structural condition, we understand that it is not possible to rely on the capacities of individuals alone. In contrast, we need to consider the distribution and redistribution of resources, which involves institutions, governments, and society as a whole (Chant & Sweetman, 2012). We need to reverse the order of reasoning: gender equality is a prerequisite for achieving real and sustainable development, not the other way around (Duflo, 2012; Chant & Sweetman, 2012; Kabeer, 2016).

2 Gender Capability Approach

While mentioning the topic of development and capabilities, we consider it useful to elaborate on the functioning and capabilities approach first pioneered by economist and philosopher Amartya Sen (1988, 1992) and later explored from a gender perspective by feminist philosopher Martha C. Nussbaum (2001). In the context of development economics, this approach provides a relevant framework in which to conceptualise and assess phenomena such as poverty, inequality, and well-being. The main feature of this approach is the focus on what people are actually able to do and be, that is, on their capabilities. According to Sen, the goals of well-being, justice, and development should be conceptualised in terms of people's functioning capacities: their actual opportunities to undertake the actions and activities they want to engage in to be who they want to be. According to Sen, only when we possess the opportunities (capacities) to lead the kind of life we prefer do we really have a choice: fasting decided upon despite having access to food is a choice; fasting related to lack of food is not. Thus, we see the list of capabilities as a long list of functioning opportunities that are always right to possess, regardless of what we choose to

[3] For a more detailed analysis, please see: Walby (1990, 2020).

do. After all, living a life in which we have not used all opportunities present does not see us as harmed by the possibility of choosing a life in which we would have used them instead (Nussbaum, 2001).

The capability approach distinguishes between means, understood as goods and services, and functions and capabilities. Furthermore, it considers that the relationship between these is influenced by three groups of factors: personal (e.g. physical condition, gender, intelligence, etc.), social (e.g. public policies, gender roles, etc.), and environmental (e.g. climate, geographical location, etc.) factors. They all influence how people can convert the characteristics of 'means' into 'functioning'. A personal factor, such as a physical disability, for example, could make the means-bicycle unnecessary to enable functional mobility. Similarly, if a person does not have a physical disability but lives in a country where women are prohibited from cycling (social factor), the bicycle is unlikely to be capable of enabling mobility for a woman. Alternatively, if a person does not have a physical disability, lives in a country where cycling is not forbidden, but there are no paved roads (environmental factors), bicycles will still not be able to provide mobility. Thus, although we know what assets a person owns or can use, we do not have sufficient information to know what functions they can achieve. To understand this, we need other information about the person and the circumstances in which they live. Thus, in the assessment of capabilities, all circumstances that influence people's choices become relevant (Robeyns, 2005). In this regard, both Sen (1990) and Nussbaum (2001) focus on the social norms and traditions that shape women's preferences and influence their choices and aspirations. The capability approach urges us to examine real lives in material and social contexts. 'Is X satisfied?' or 'How many resources do X control?' are not fundamental questions. We need to ask, 'What X is capable of doing and being?' Besides investigating whether a person is satisfied with doing what he/she does, it is necessary to understand what he/she does and what he/she could do, that is, what opportunities and freedoms that person has. Similarly, in addition to being interested in what resources surround X, we also need to understand how these come into action, enabling X to act (Nussbaum, 2001).

Similarly, Sen's work on the capability approach is closer to economic reasoning and akin to quantitative measurements, whereas Nussbaum's work is more in line with humanities. Nussbaum's work focuses more on understanding people's hopes, desires, aspirations, motivations, and decisions, with particular attention to the status of women (Robeyns, 2005). The author uses the capability approach based on the basic assumption that no country in the world treats women as well as men. She argues that international policy and economic thinking should also be attentive to gender-specific issues to adequately address issues such as poverty and development. Attention to capabilities is closely linked to attention to human equality. According to Nussbaum (2001), discrimination on the basis of race, religion, gender, nationality, caste, or ethnicity is considered a failure of the ability to associate. For her, freedom is not only a matter of possessing fundamental rights but also requires the conditions to exercise them. If circumstances also influence people's inner lives (what they hope for, what they love, what they fear, etc.) as well as their external choices, a person can be considered satisfied with their condition for many reasons

other than the concrete presence of well-being. Frequent examples include habit or adaptation: our vision is adapted to the only life we have the real possibility of living. This adaptation has a greater impact on women's life choices than men because of the greater disadvantage and powerlessness they experience in everyday life. Women often do not invest enough in human capital and make bad decisions because they have been led to believe that they cannot do things that others (men) can do. In other words, disadvantaged groups internalise their status and make choices that perpetuate it (Nussbaum, 2001).

Moreover, according to Nussbaum (2001), in the assessment of capabilities, they are all important and have different qualities. For example, the absence of political freedom cannot be compensated for by high economic growth. However, at the same time, all capabilities are interrelated; schooling affects work, which affects the family, and so on. The author identifies three types of capacity: fundamental (or basic), internal, and combined. Basic capabilities consist of individuals' innate equipment. Internal capacities consist of the stages of development of the person sufficient to perform the required functions (e.g. learning to speak, play, love). Finally, combined capacities refer to internal capacities combined with external conditions that are suitable for exercising a function. The latter applies to all faculties that, once developed, require other capacities to function. For example, in a totalitarian regime, people have an internal capacity but not the combined capacity to express their thoughts (Nussbaum, 2001).

Sen's and Nussbaum's approaches are closely related in many respects and at the same time differ on some issues.[4] However, despite the different categories and terminologies, both believe that the focus, especially on policy choices, should be on combined capabilities. Once again, they stress the importance of the context of people's lives: legal norms, but also and above all norms of education, customs, morals, and religion, have a huge impact on the opportunities of individuals.

3 Feminist Contribution on Equality Issue

To summarise the contribution of feminism to the equality issue, we refer to the four conventional waves.[5]

The first wave, so-called 'feminism of equality', began in the nineteenth century with the women's suffrage movements and remained predominant until the end of the Second World War (Gilmore, 2007). This movement demanded equal treatment of women and men and set itself the goal of opening up existing social structures to

[4] For a more detailed analysis, please see Robeyns (2005).

[5] To speak of 'waves' of feminism is to simplify the heterogeneity of feminist thought. Over time, feminist analyses have overlapped and integrated, making an absolute division between a before and an after impossible. However, such a schematisation helps us to synthesise concepts and highlight the strands of thought that have stood out more than others in different historical periods.

women as well. According to feminists of this wave, since men and women are born equal, they deserve the same rights. Historically, we have been in a period of struggle for universal suffrage and more general formal equality.

The second wave began in the 1960s with women's liberation movements (Gilmore, 2007). This historical period saw the emergence of first 'feminism of difference' in Europe and then 'cultural feminism' in the United States. According to this movement, conforming to the male model, women would reproduce their subordination. This strand of thought intended to denounce the systematic oppression of women by the patriarchal regime and affirm 'sexual difference' (Irigaray, 1974; Melandri, 2012). Thus, the aim was to build a new politics and society based on differences, and to give space to women's voices.

The third wave of feminism occurred in the early 1990s and is the one in which the greatest heterogeneity of feminist approaches developed. According to Evans (2015), the confusion surrounding what constitutes third-wave feminism is in some ways its defining characteristic. If the first wave focused more on women's rights (formal equality), the third wave was born with the intention of fighting and confronting the issues that arose and developed during those years. The category 'woman' and the 'man-woman' differences are no longer the only ones at the centre of the debate and subjectivities that had previously remained on the margins emerge (e.g. black women, migrant women, queer subjectivities, etc.). During the third wave, postmodern feminism, transfeminism, ecofeminism, and cyber-feminism developed. In addition, the peculiar claims of black feminism, Indian feminism, and lesbianism have taken place.

Within this enormous variety of 'situated' reflections, we go into more detail about two approaches: the so-called 'postmodern feminism' and the intersectional feminism.

Postmodern feminism integrates both postmodern and post-structuralist theories. This approach differs significantly from its predecessors in that it considers gender as well as gender as a social construct. According to Butler (2002), even material things such as the body are subject to processes of social construction. Thus, even sex is neither natural nor completely determined and definable (Frug, 2014). Sex is a tool that does not fully determine what can be done. Therefore, if individuals can constitute multiple, overlapping, intersecting, and contradictory identities, there is no single solution to approach/solve the problem of women's oppression. According to the critique of postmodern feminist theories, such approaches deconstruct and highlight the limitations of previous approaches but do not propose any alternative ways of action.

According to Crenshaw (2013), reflections made up to that point by Western feminism were exclusively about white women without considering aspects relevant to other women. According to Crenshaw (2013), black women were excluded from both feminist and anti-racist discourses because they did not consider the experience of the interaction of gender and race discrimination. This experience is larger and more complex than the mere sum of experiences of sexism and racism. With the same principle, in addition to gender and race, intersectionality reminds us of considering all other categories of discrimination: ethnic, sexual, and class.

After 2010, some began to speak of a fourth wave of feminism, currently underway. A shift enabled by the Internet has facilitated the creation of a global community of feminists who use the Internet to both discuss and activate (Munro, 2013). Feminism is considered even more inclusive than its predecessor, as it is open to men for the first time.

4 The International Framework

Without claiming it to be exhaustive, we summarise the evolution of the concept of gender equality in the international context.[6]

The principle of equal rights between men and women was first enshrined in 1945 with the establishment of the United Nations (UN).[7] Subsequently, several instruments were developed with the intention of abolishing gender inequalities.[8] However, this has not been sufficient to ensure equality between men and women.

In 1975, the United Nations celebrated International Women's Day for the first time. The aim was to highlight the persistence of discrimination against women in most parts of the world and to promote increased efforts to achieve equality between women and men. In the same year, the United Nations convened the first International Women's Conference, which was attended by 131 states and 4000 NGO representatives.

However, in 1979, with the adoption of the Convention on the Elimination of All Forms of Discrimination against Women (CEDAW),[9] the first real watershed emerged. More than 40 years later, this convention remained the most important international legally binding instrument for women's rights. It covers all forms of discrimination against women, promotes special measures to ensure their full development and advancement, and guarantees the exercise and enjoyment of human rights and fundamental freedoms on an equal basis with men. It defines discrimination against women as 'any distinction, exclusion or restriction made on the basis of sex which has the effect or purpose of impairing or nullifying the recognition, enjoyment or exercise by women, irrespective of their marital status, on a basis of equality of men and women, of human rights and fundamental freedoms in the

[6] For more on the work of the United Nations for the advancement of women from 1945 to 1996, please see: United Nations, The United Nations and the Advancement of Women 1945–1996, New York, United Nations Department of Public Information, 1996.

[7] Charter of the United Nations signed on 26 June 1945, in San Francisco, and entered into force on 24 October 1945

[8] To name a few: the creation of the Sub-Commission on the Status of Women at the UN (February 1946); the Convention on the Political Rights of Women (adopted in March 1953); Declaration on the Elimination of Discrimination against Women (adopted in November 1967); etc.

[9] CEDAW (Convention on the Elimination of all Forms of Discrimination Against Women) was adopted in 1979 by the UN General Assembly and is often described as an international law on women's rights.

political, economic, social, cultural, civil or any other field' (Art.1). According to CADAW, approving laws is not enough; governments must ensure the effective exercise of these rights by women. In the preamble, it states the need for a change in the traditional roles of men and women, in society and in the family, to achieve perfect equality between men and women. Finally, it sets up a Committee of Experts to monitor the implementation of the Convention and the actual situation of women in all signatory countries. Even today, the Committee regularly draws general recommendations, but is tailored to each country, with the aim of promoting the development of the principles of CEDAW. Thus, by ratifying the Convention, states commit themselves to eliminating all discrimination practiced by individuals, bodies, and organisations by creating appropriate measures to ensure the full development of women.

Another important step was the World Conference on Human Rights in Vienna in 1993,[10] where women's rights were identified as an indivisible part of universal human rights. A few years later, in 1995, during the Fourth World Conference on Women, another important document, the Beijing Declaration and Platform for Action, was drafted.[11] In addition to reaffirming the importance of gender equality as an integral part of social justice and human rights, the platform identified 12 critical areas[12] and subsequent strategic objectives to empower women and eliminate the discrimination they face. The conference also elaborated on the concept of gender mainstreaming, first introduced 10 years earlier at the third World Conference on Women.

Gender mainstreaming is defined as:

> the process of assessing the implications for women and men of any planned action, including legislation, policies, or programs, in all areas and levels. It is a strategy for making women's and men's concerns and experiences an integral dimension of the design, implementation, monitoring, and evaluation of policies and programs in all political, economic, and societal spheres so that women and men benefit equally and inequality is not perpetuated. The ultimate goal is to achieve gender equality.[13]

Its principles include paying attention to gender differences in all aspects of life; the responsibility at the highest levels of the system to translate gender mainstreaming into practice and to monitor its results; the need to make every effort to broaden women's participation at all levels of decision-making; and the institutionalisation of gender mainstreaming through concrete actions, mechanisms, and processes in all areas of the United Nations system. According to these

[10] From 14 to 25 June 1993, the United Nations World Conference on Human Rights was held in Vienna. At its conclusion, the representatives of 171 States unanimously adopted a Declaration and Programme of Action for the promotion and protection of human rights in the world.

[11] From 4 to 15 September 1995, the Fourth World Conference on Women was held in Beijing, at the end of which two documents were approved: the Declaration and the Platform for Action.

[12] The twelve critical areas are women and poverty, education and training, health, violence against women, armed conflict, economy, power and decision-making, institutional mechanism, human rights, media, environment, and the girl child.

[13] Ecosoc Agreed Conclusion 1997/2

principles, gender mainstreaming on the political agenda is neither a substitute for the need for targeted and specific policies and programs for women nor for positive legislation towards them. Finally, they emphasise the need for clear political will and the allocation of adequate human and financial resources to translate the concept into practice. In short, gender mainstreaming is the process of putting equal opportunities at the centre of the political agenda, from local to international.

Even the United Nations High Commissioner for Human Rights (OHCHR) has highlighted the desire to offer new forms of protection and greater attention to women's human rights, recognising the need to look at the problem of discrimination on the basis of sex as an essential moment for the fulfilment of individual and collective rights; the sexual dimension has been recognised as fundamental in the processes of conceptualisation, implementation, and evaluation of human rights policies and for the choice of objectives and priorities to be followed at the international level (Degani, 2001). No longer protection policies in a defensive sense that see women as subjects to be protected, but actions to recognise and enhance the specificity of which both genders are bearers (Biemmi, 2014).

While the concept of gender equality was strongly associated with the concept of human rights in the 1990s, a further evolution in the 2000s saw gender equality being linked to the concept of development. According to the UN Millennium Declaration, promotion of gender equality and empowerment of women are effective tools to fight poverty, hunger, and disease, and to stimulate development that is truly sustainable.[14] The World Economic Forum (WEF) considers gender inequality a relevant aspect in preventing men and women from realising their full potential (Lopez-Claros & Zahidi, 2005).

In 2010, given the persistence of gender inequality in the world, the UN General Assembly created UN Women, a specific body with the task of addressing challenges such as gender equality and women's empowerment. In 2015, the UN 2030 Agenda for Sustainable Development also included among its 17 goals 'achieve gender equality and empower all women and girls'.[15] Therefore, we note the clear affirmation of the need to build a society in which women and men work together to achieve a world in which all can enjoy equality, equity, development, and peace. Indeed, within the framework of UN gender mainstreaming, there is a plan to adopt women's perspectives in international peacekeeping and security operations. Thus, the possibility of participating on an equal basis in all peace process operations becomes an integral part of the principle of equality between men and women.

Reducing the focus from the international to the European context, we notice as in recent years the European Union has also reaffirmed the need to address gender equality. For example, every year since 2014, the European Commission has published a report which monitors the state of equality between women and men by examining certain macro-areas. It is also noteworthy that the Council of Europe

[14] A/RES/55/2

[15] For more on Goal 5: Achieve gender equality and empower all women and girls, please see: https://www.un.org/sustainabledevelopment/gender-equality/.

adopted its first international legal instrument to prevent and combat sexism and its manifestations.[16] According to the report, gender equality is fundamental to the protection of human rights, functioning of democracy, and good governance. Thus, in 2019, the Council of Europe also defined sexism for the first time: 'sexism is a manifestation of historically unequal power relations between women and men, which leads to discrimination and prevents the full advancement of women in society'.

Sadly, the latest European report is far from encouraging. This report is the first of the new Strategy for Gender Equality 2020–2025. It sets out the EU's achievements and gives inspiring examples from the Member States and EU-funded projects for each of the strategy's five key areas: being free from violence and stereotypes; thriving in a gender equal economy; leading equally throughout society; gender mainstreaming and funding; and promoting gender equality and women's empowerment across the world.[17] According to the Report, most indicators of gender equality have levelled out for several years, and where progress has been made, it has been quite slow. Progress in gender equality in decision-making has been stalled. Moreover, gender gaps in employment, remuneration, and unpaid care persist. Unfortunately, there is still a long way to go to end gender-based violence. In addition, the COVID-19 pandemic has disproportionately affected women's lives and exacerbated existing inequalities between women and men in almost all areas of life, both in Europe and beyond. There is ample evidence that the hard-won achievements of past years have been 'rolled back'. Many stakeholders are concerned that it will take years or even decades to overcome the setbacks of gender equality caused by the pandemic.

While the importance of achieving gender equality is constantly reiterated by international institutions, the efforts made to date are still insufficient. Moreover, all studies agree that no country in the world has achieved equality between women and men (UN, 2021; WEF, 2021).

5 The Cross-Cutting Nature of the Gender Issue

How do countless forms of gender discrimination arise, and are they reinforced? Based on the functioning of the human mind, there are operations of simplification, generalisation, and abstraction which enable both learning and the organisation of experience. Thus, stereotypes[18] are naturally utilised by our cognitive processes.

[16] CM/Rec(2019)

[17] For the latest report published in 2021, please see 2021 report on gender equality in the EU, European Commission.

[18] The term stereotype refers to a simplified and schematic representation of things, people, groups, places, etc., based on a generalisation that is independent of direct observation of individual cases and even precedes it (Cosenza, 2016).

Psychology and social sciences have investigated the role played by stereotypes in the relations between groups of people. They stated that the stereotype consists of a rigid and simplified set of characteristics that the members of one social group attribute to another social group, without further investigation, critical reasoning, or empirical verification. Moreover, this group is considered a unique set with no exceptions (Cosenza, 2016). 'Women are more sensitive than men', or 'men are less inclined to care than women', are gender stereotypes. As natural processes of our mind, stereotypes are necessary cognitions that cannot be eliminated. However, we must point out that stereotypes are not necessarily negative, and to avoid making them, we must be careful not to attribute any value judgement to simplifications. When this does not happen, stereotypes become the cognitive core of prejudices which, in contrast, always attribute judgements and evaluations. These judgements precede experience and observation (Mazzara, 1997). 'Because women are more sensitive, they are better caregivers than men' is a prejudice. Thus, laden with often negative meanings, prejudices are able to guide society's actions and behaviour, turning into discrimination. The prejudice 'women are better caregivers than men' becomes the basis for the widespread belief that women are better suited than men to caring professions and that, as a result, most of these professions are actually performed by women (Cosenza, 2016).

Recognising the link between stereotypes and discrimination allows us to better understand how discrimination can lurk everywhere, in every aspect of life, and be repeated over time with extreme ease. Language can therefore exist and become a privileged vehicle for the affirmation and reiteration of discriminatory cultural codes. Warning: sexism does not reside in the language itself but in the way we use it. The relationship between thought and word means that language has the intrinsic property of conditioning the way we think and the process of constructing reality. Therefore, we are wary of those who consider the issue of using a non-sexist language to be a non-priority and of little importance.

Looking at the transversal nature of gender discrimination, we proceed in macro-areas. These correspond to the domains of the Gender Equality Index (GEI) used in the following sections: work, money, time, power, knowledge, health, and violence.

5.1 Work

Work is the social arena in which decisions about the distribution of material resources are made, and through which individuals have access to positions of authority and power (Ridgeway, 1992). Thus, by the term 'work' we generally mean paid activity performed outside the home, in the productive or public sphere. By contrast, domestic and care work is not considered part of the economy and has become invisible in global accounting systems (Slade, 2008). Instead, if we wanted to, we could calculate its economic value using the 'non-expenditure' method: how much would we spend if we had to hire one person to do all the domestic and care work we need? By referring to the market prices of the same services, we can

calculate the amount. However, we choose not to do so, continuing to leave domestic and care work out of the labour market.

Over the years, women have increasingly entered the world of paid work, yet the system of gender inequality has reshaped itself so that it has managed to persist (Balbo, 2008; Ridgeway, 2011). According to the 2021 Global Gender Gap Report, the Economic Participation and Opportunity constitute the second-largest gender gap among the four components of the index. Only 58.3% of this gap has been closed so far. 'Globally, considering population-weighted averages, almost 80% of men aged 15–64 are in the labour force versus only 52.6% of women of the same age group' (WEF, 2021: 13). Moreover, in Europe, we find lower levels of employment and higher levels of underemployment for women (EIGE, 2021). Thus, women encounter discrimination in employment even before they enter it: they are less employed, have fewer opportunities, and have higher rates of unemployment and nonparticipation in employment. The labour market is certainly influenced by the economic-productive system, supply, and demand; however, gender norms and stereotypes are key pillars of gender inequalities in the world of work (EIGE, 2021). In many countries, the dimension of work is still closely linked to the male universe; societies stigmatise a man who does not work, while they are not at all surprised if a woman does not work. On the contrary, for women, work appears more as an option, a right that is not yet fully recognised and on which there are doubts and reservations. The expected social role of adult men is that of workers, whereas the role of women is more related to the family context. Many societies are more likely to disapprove of women with young children who work than women without children who do not work. Moreover, domestic and care work performed by women is a crucial resource, even in the welfare models of developed economies. The main example is the family welfare system in Mediterranean Europe (Italy, Spain, Greece, Portugal), which is characterised by a limited supply of public care services and attribution of responsibilities to the family, precisely because of the low participation of women in the labour market (Liebfried, 1992; Millar & Warman, 1996). Not by chance, the role of housewives arose with industrial capitalism, complementing the model of men who were exclusively dedicated to paid work. Men's high productivity was also guaranteed by the absence of tasks outside paid work. This asymmetry has left deep traces in the organisation of today's societies, in some more than in others, despite social changes. In Europe, one of the main barriers to women's equal participation in the labour force is the unequal distribution of care, family, and other household tasks (EIGE, 2020), which is far from new. Balbo spoke of a double presence as early as 1978. According to her, women are absent or present, and in what ways in the labour market remain conditioned by the extent and quality of their family work. Women experience a life of 'dual presence' within a social system organised in such a way as to make full use of women's labour potential at some stages of their lives, their potential to perform for their families at others, and the possibility of using a combination of both at yet another stage. However, no man has experienced anything comparable (Balbo, 2008).

In addition, when women manage to overcome the barriers to accessing work, they experience discrimination which negatively affects their quality of work

(Richardt, 2008; Slade, 2008; Ridgeway, 2011). One of the discriminations women face in employment is 'horizontal segregation'. This social phenomenon leads to the concentration of women in some specific sectors of economic activity and in a limited number of professions. Social stereotypes and organisational rigidities produce both forms of exclusion in the labour supply and condition women's preferences in their occupational choices. Many female-dominated occupations correspond to traditional care roles, such as teachers, nurses, secretaries, and domestic workers. Moreover, these occupations have generally less advantageous characteristics than male-dominated ones: low job profiles, low pay, and few career opportunities. We also find this trend in Europe (EIGE, 2019).

An additional challenge is the gender gap in senior and managerial positions in the private and public sectors. 'Vertical segregation' (commonly known as 'glass ceiling') refers to all the barriers that prevent women from accessing the highest levels of the corporate hierarchy. Obstacles fought by law but were hard to die for. Even in developed economies, there are no professional areas in which the top positions are equally distributed between women and men. For instance, in the United States, women are in just 42% in senior and managerial positions; in Sweden, 40%; in the United Kingdom, 36.8%; in France, 34.6%; in Germany, 29%; in Italy and the Netherlands, 27%; in Korea, 15.6%; and in Japan, 14.7% (WEF, 2021).

In Europe, motherhood still conflicts with careers in an obvious manner. The gap between women and men in couples with children highlights how unpaid care duties remain a major obstacle for women taking on paid jobs (EIGE, 2021). Having children for a woman increases both the likelihood of working part-time rather than full-time, and the likelihood of not working at all. Maternity is seen as an obstacle to professional engagement as it entails care duties that make mobility and career development more problematic. In contrast, fatherhood does not seem to conflict with career advancement; the largest gender gap in full-time equivalent employment in 2019 was among couples with children, with 62% of women, compared with 89% of men, in this family grouping working full time (EIGE, 2021). In many countries, the absence of services to reconcile productive and care work hinders women's return to the labour market after having children. Similarly, when family resources are insufficient to meet the cost of childcare or babysitting, women give up or reduce their work commitments. In literature, we find the concept of 'opportunity costs': if women have to bear costs equal to or higher than the wages they receive to carry out a job, the 'opportunity cost' of their employment is so high that it is not worthwhile or not worthwhile at all to start or continue working (Pruna, 2007). Not by chance, European countries with more female employment and a higher fertility rate have invested more in work-life balance policies (e.g. Sweden, Denmark, and the Netherlands). Moreover, very short working hours can lead to lower wages and limit career opportunities. Thus, the world of work provides men with much higher-earning opportunities than women do.

Aspects not investigated at the international and European levels in the best-known indices, but interesting in our opinion, are those of under- and over-education, mobbing, work-related stress, and sexual harassment in the workplace. According to an analysis of over- and under-education in Italy, it is mainly men who

have a more qualified occupation in relation to their level of education, while it is mainly women, young, and university graduates, who are more likely to have jobs that require lower education than they have (Alaimo et al., 2019). In Italy, women are most affected by mobbing, work-related stress, and sexual harassment in the workplace (Pruna, 2007). Another aspect revealed by the in-depth study of the Italian context concerns the influence of the 'territory' variable on gender inequality. International documents often refer to the differences between rural and metropolitan contexts. However, it might also be useful to consider other aspects, for example, in Italy, for a woman being born and living in a northern rather than a southern region means having very different opportunities and conditions for participation in the labour market (Alaimo & Nanni, 2018a; Alaimo et al., 2019).

All of this shows that women's propensity to participate in the labour market is not sufficient to guarantee their participation. This participation is also enormously correlated with the propensity that society has towards women's work. Moreover, we can say that it is not sufficient to investigate the general presence of women in the labour market to assess the state of the art in this dimension, let alone its possible changes. In contrast, more detailed analyses which also consider the quality of the work itself are needed.

Unfortunately, gender gaps in both labour participation and income are likely to increase after the COVID-19 crisis. As reported, the disproportionate burden of household and care responsibilities was already an important driver of these gaps even before the pandemic. Data analysis reveals that school closures during the pandemic have been one of the main causes for women to reduce working hours and labour participation, as childcare responsibilities still fall predominantly on them (WEF, 2021). Studies also show particularly high burnout levels among female healthcare workers with children younger than 12 years, who are struggling to manage the dual burden of increased workload and more care duties (Duarte et al., 2020). Moreover, the COVID-19 crisis is distinctive in its gendered impact across the employment sectors. As women are over-represented among 'essential' workers (the health and care sectors, victim support services, education, and food retail), they were among the most exposed to COVID-19 and experienced higher levels of work-related stress and emotional exhaustion (Barello et al., 2020).

Work is also closely linked to other areas. Work enables individuals' economic independence and has a cascading impact on the remaining aspects of life. The presence of women in the labour market influences the market itself but also changes the welfare system, family structures, parental relations, traditional roles, and demographic trends. Thus, greater gender equality in the labour market also leads to greater equality in politics, economic and social organisation, society, and family.

5.2 Money

When we talk about money and gender discrimination, we immediately refer to the pay gap: for the same job, position, and working hours, men's wages are on average

higher than those of women (WEF, 2021; EIGE, 2021). According to the 2021 Global Gender Gap Report, estimated earned income is at parity only in a handful of developing countries, while among advanced economies, the best-performing country, Sweden, still has an approximately 18% gap between the incomes of men and women. Although the right to equal pay for equal work or work of equal value has been a cornerstone of EU treaties for more than 60 years, and despite a wealth of policies to redress gender inequality of income, on average, women still earn less than men. According to Eurostat, in the EU in 2019, gross hourly earnings for women were, on average, 14% lower than for men (EIGE, 2021). This gap can only be explained, to a small extent, by personal and/or workplace differences. Most of this difference is evidence of discrimination: different economic treatments between two individuals of equal productivity but of different genders.

Some scholars explore the phenomenon of the 'feminisation of poverty',[19] arguing that even a condition such as poverty presents inequalities to the detriment of women. Europe is seriously concerned about this phenomenon: lone mothers earn less than lone fathers, but the highest income gap is between single women and single men, with women earning less than men. Women are more likely to be in unpaid, low-paid, or temporary jobs than men. In addition, income inequality increases throughout life, and women receive lower pensions than men do. Known as the gender pension gap, this phenomenon has multiple causes, such as fewer years of employment due to the motherhood penalty, job segregation, differences in pension systems, and work intensity and pay over a lifetime (EIGE, 2015). If pensions are the most important source of income for older people, the gender pension gap results in a higher risk of poverty for pension-age women. Moreover, single women of old age cannot rely on survivor pensions or the income of a partner (EIGE, 2021).

5.3 Time

We can also reflect on the differences in leisure time between men and women. When work inside and outside the family is added, women have less free time than men do. This inequality emerges both in adult couples with an unequal distribution of family burdens, and among young people with daughters who participate more in domestic work than sons (Del Boca et al., 2012). The amount of time spent in paid

[19]The 'feminisation of poverty' was first coined in the 1970s, but did not make its major breakthrough into the development lexicon until the mid1990s. A critical catalyst was the Fourth UN Conference on Women in 1995 when eradicating the 'persistent and increasing burden of poverty on women' was adopted as one of the 12 critical areas of the Beijing Platform for Action (Chant, 2008). According to Williams and Lee-Smith (2000: 1), 'The feminisation of poverty is more than a slogan: it is a marching call that impels us to question our assumptions about poverty itself by examining how it is caused, manifested and reduced, and to do this from a gender perspective'.

work, rest and recreation, or caring for others has knock-on effects on many other aspects of a person's life, including health, as already mentioned (EIGE, 2021). In the 1970s, women in all Western countries reported higher levels of subjective well-being than did men. Subsequently, we witnessed a progressive decline in female happiness to the point where men reported higher subjective well-being, an apparent paradox considering the progressive emancipation of women. However, the increase in the total volume of work to be done outside and inside the home has led to deterioration in their well-being (Krueger, 2007). By contrast, men have benefited most from women's entry into the world of work. They have benefited from the improvement in the family's economic conditions due to their partner's income, and they have only slightly increased the amount of time devoted to domestic and care tasks without compromising their leisure time (Del Boca et al., 2012).

5.4 Power

By power or political empowerment, as this area is also often called, we mean equal representation in decision-making structures and the ability of women and men to influence decision-making. Most political systems in the world possess de jure equality, yet women's political participation varies from country to country (Richardt, 2008) and they are never equally represented. Men control access to resources, dominate senior global and national positions (international organisations, governments, and private companies), and are key players in the social, economic, and political choices of countries, possessing greater status and power than women (Richardt, 2008; Slade, 2008; Best & Luvender, 2015). Not surprisingly, according to the 2021 Global Gender Gap Report, the area where gender gaps remain the widest is power/political empowerment, and even the best performing country, Iceland, still has to close 24% of this gap. Of the 35,500 parliament seats across the 156 countries covered by the Global Gender Gap index, only 26.1% of them are held by women. Women are similarly under-represented in ministerial positions: only 22.6% of the over 3400 ministers worldwide are women. Looking at the highest political position in a country, very few women have served as heads of state in the last 50 years. In 81 of the 156 countries assessed in the report, there has never been a woman in this position, including countries considered relatively progressive with respect to gender equality, such as Sweden, Spain, the Netherlands, and the United States (WEF, 2021). The European context also reveals its criticalities in the area of political participation: women account for only one in three members of EU national parliaments. They remain substantially underrepresented in corporate boardrooms (30% in 2021). Moreover, in large companies, fewer than one in 10 board presidents or CEOs are women. Thus, despite women's growing involvement in research funding, media content, and sports policies, their opportunities to influence decisions in these sectors remain limited (EIGE, 2021).

In addition to numerical inequality, women experience vertical and horizontal segregation in political participation, as in the labour market. When women reach

senior positions, they often administer more traditionally to women. These differences constitute elements of inequality and discrimination. In a fully-fledged democracy, all citizens have the same opportunity to vote, be elected, and participate in the decision-making process. On the contrary, a predominantly male-dominated polity decides on a lack of women's perspective, way of thinking, and discussion.

According to Norris (2005), there are three main strategies to facilitate equal political representation: rhetorical, equal opportunity, and positive action policies. Rhetorical strategies are merely symbolic and generally refer to the signing of international conventions on gender equality and equal opportunity. Equal opportunity policies are more concrete and include real initiatives to promote equality between men and women in the political sphere. Positive action policies seem to be the most significant in terms of results and are divided into three categories: (A) quotas of seats reserved for women established by electoral law, (B) quotas of women established by law in the candidate lists of all political parties, and (C) gender quotas decided autonomously by individual parties.

The area of political representation is also strongly connected to others. Equality between men and women in the political sphere feeds on and supports equality in the economic, social, and family spheres, and vice versa. Not surprisingly, women participate more in political life in countries with more developed family policies (Donà, 2006). Moreover, political representation and general access to decision-making are increasingly included among the social determinants of health (SDH) (Bhui, 2018; McCartney et al., 2021). Alternatively, it is a health policy determinant (Ottersen et al., 2014). According to the 2020 WHO report, the gap in life expectancy is related to the degree of political equity, and the benefit is greater for men (WHO Regional Office for Europe, 2020). In addition, according to Van de Velde et al. (2013), a high degree of gender equality at the macro level, especially with more women in political decision-making, is associated with lower levels of depression in both women and men.

In the EU strategy on gender equality 2020–2025, gender balance in decision-making is one of the three main pillars, emphasising the importance of having women in leadership positions in all political, economic, and social areas (EC, 2020). In addition, in this area, regulatory reforms are indispensable for the development of new gender sensitivity, but unfortunately, they are not sufficient. Formal changes are not enough if they are not accompanied by cultural and substantive changes in society.

5.5 Knowledge

Knowledge or education, as this area is also often called the sector, is the most effective tool for implementing gender equality in the context of social, political, and working life. According to the Beijing Platform, non-discriminatory education benefits both girls and boys, a perspective capable of creating more equal relations between women and men, focusing on both genders and breaking down their current

crystallisation. Rigidity can inhibit personal aspirations.[20] In addition to stressing the importance of gender equality in these areas, the platform specifies the areas of action to achieve it. It is necessary to ensure equal access to education, eliminate illiteracy among women, improve women's access to vocational training, scientific and technical education, and lifelong learning, implement non-discriminatory education and training systems, provide resources to change the education system, and promote lifelong learning of women and girls.[21]

According to the 2021 Global Gender Gap Report, the gender gaps in knowledge and education are nearly closed. In Educational Attainment, 121 countries out of 156 considered have closed at least 95% of their gender gaps. Of these, more than one-third of the sample (64 countries) had already achieved at least 99.5% gender parity. The trend is also reversed in some cases; on average, there is virtual parity in secondary education, and women actually exceed men in tertiary education attainment. In 2018, 40.6% of women and 35.6% of men in the world were enrolled in tertiary education, a sign that women are pursuing education as a channel for advancement (WEF, 2021). However, tracking the gender gap in education in developed economies through access indicators alone is misleading in terms of results. In such cases, a more detailed analysis allows us to detect the persistence of any gender gap. Here is an example; according to the 2021 Global Gender Gap Report, Italy has achieved 99.9% parity in education. However, according to more structured studies in the specific Italian context, the modernisation of female education is far from complete (Alaimo et al., 2019). The main problem is the so-called 'educational segregation'. This segregation consists of a sexist subdivision inherent in the school system, which leads students of both sexes to be channelled into traditionally masculine courses and the others into traditionally feminine courses. In Italy, for example, there are no formal gender-specific barriers to entry into the different fields of education, yet self-segregation persists that limits individual interests, especially those of women, within the fields considered most suitable for their gender. Thus, we find almost entirely female and male curricula. This aspect is already present in secondary education and further exacerbated in tertiary education and subsequent careers. The divide is clear between the humanities, considered to be a female domain, and the technical-scientific domain, attended largely by boys (Alaimo et al., 2019). This trend was also observed in the rest of the European countries (EIGE, 2021). Moreover, according to the latest European report, this segregation does not improve: the previously upward trend in the proportion of men studying the humanities has plateaued, as has an upward trend in the proportion of women studying engineering, science, technology, and mathematics (EIGE, 2021). Obviously, the phenomenon of educational segregation affects both genders; however, it is more discriminatory for women since the faculties traditionally associated with them are the most penalised in the labour market in terms of employment opportunities and salaries.

[20] Objective B. Education and training of women, point 96—Beijing Platform for Action, 1995

[21] Strategic Objectives B.1 to B.6—Beijing Platform for Action, 1995

In addition, according to several Italian studies, educational qualifications affect the fate of women more than that of men. Tertiary education for women increases their opportunities to enter, stay, and achieve the highest qualifications in the labour market. In contrast, the lack of adequate educational credentials penalises women more than men (Pruna, 2007; Zajczyk et al. 2011; Del Boca et al., 2012). Similarly, the advantages linked to the social class to which they belong have a greater centrality for the female gender than for the male gender because it can facilitate overcoming the prejudices that penalise them (Zajczyk et al., 2011). Empirical evidence shows that education also impacts health by influencing behaviour, including the use of preventive health services (OECD, 2006). Furthermore, according to the WHO, educational policies have the potential to substantially improve health (WHO, 2015).

6 Health and Gender-Specific Medicine

For a long time, the theme of health has focused on access to food and healthcare, reproductive facilities, and safety, more generally on the integrity of the person (Richardt, 2008). In the 2000s, there was an increased focus on reproductive health (Slade, 2008). However, considering indicators such as the integrity of the person, access to food, and healthcare puts the developed economies in a good position, as we can imagine. Not surprisingly, according to the 2021 Global Gender Gap Report, health and survival are the second-best sub-indexes in terms of progress towards gender parity globally. Moreover, 'countries' performances are significantly more concentrated; scores vary among a concentrated set of values between just 93% and 98%. The fact that populous countries such as India and China perform below average contributes to reducing the global average result[22] (WEF, 2021: 11). Thus, this analysis shows that a majority of countries perform well, with an apparent unsatisfactory global average result only because of a few, albeit numerous, countries in the world. However, if we look further into the area of health by considering indicators of greater well-being, the picture becomes more complex. According to the European Institute for Gender Equality (2021), significant gender inequalities persist in the health domain, including major disparities in life expectancy and

[22] In this case, 'The main driver of cross-country variation is the skewed sex ratio at birth. In China, there are 0.88 female births for every male birth; in Azerbaijan and Vietnam, 89%; in Armenia, 90%; in India, 91%; and in Pakistan, 92%, lower than a natural and biological relatively constant ratio of about 94%. These ratios can be attributed to the norms of son preference and gender-biased prenatal sex-selective practices. China and India together account for about 90%-95% of the estimated 1.2 million to 1.5 million missing female births annually worldwide due to gender-biased prenatal sex selective practices. Further, China, India, and Pakistan register excess female mortality rates (below age 5) related to neglect and gender-biased postnatal sex selection practices. The estimated number of 'missing women' was 142.6 million in 2020, twice as much as in 1970, when the number of missing women was estimated at 61 million' (WEF, 2021: 13).

self-assessed health status. There are also major gender differences in health-related behaviours. Men tend to engage more in risky behaviours, such as smoking and excessive drinking. They are less involved in healthy activities, including physical activity and eating fruits and vegetables. In fact, in its analyses, the EIGE considers not only access to health services and health status, but also health behaviour, mental health, and disability. The results show that the largest gender inequalities are found in health behaviours, confirming that gender norms and relations affect health behaviours (EIGE, 2021).

The idea that sex may influence health is a relatively recent concept. Medicine has historically maintained an androcentric bias, and attention to women's health has focused solely on aspects related to reproduction. For a long time, for example, medicine has dealt with the prevention and treatment of diseases through the study of male-only cases, and the results of these studies have been carried over to the female population. Except for specific female pathologies related to the breast, genital apparatus, and reproductive capacity, medicine has taken the male experience as the general rule, underestimating female peculiarities (Dubini, 2016). Thus, in this context, the concept of gender medicine has created a space. It was born with the aim of limiting inequalities of study, attention, and treatment between men and women. It also aims to recognise and value their differences to guarantee the best care for all. According to gender medicine, the differences between the sexes in terms of health are not only and exclusively related to biological characteristics, but also to social, cultural, and relational characteristics that determine different responses to diseases. Gender medicine advocates taking care of the person in a way that considers all the differences, whether they are anatomophysiological, biological-functional, psychological, social, and cultural. As already mentioned, all areas of an individual's life are connected, and to consider gender in the area of health means to consider the evaluation of the living conditions and economic and social roles of men and women. For instance, the burden of unpaid care is increasingly being regarded as a determinant of health. Work–life conflicts affect mental health, and where policies exist to ease the burden of care on women, we find lower levels of gender inequality in health (Palència et al., 2017). Considering all this, the less advantageous conditions in which women live compared to men are inevitably reflected in their health conditions, which are empirically poorer due to fewer resources, less employment, more workload, and more violence on the part of men (Dubini, 2016). The burden of unpaid care is increasingly being regarded as a determinant of health.

Since 2000, the need to examine health from a more comprehensive perspective has been endorsed by the World Health Organization (WHO). The WHO includes gender medicine in the Equity Act, which states that the principle of equality does not only concern access to care for women and men but also the adequacy and appropriateness of care with respect to gender. In 2002, the Department of Gender and Women's Health (GWH) was established, a watershed initiative in which the WHO recognised sex (its biological aspect) and gender (its sociocultural aspect) as both important determinants of women's and men's health and illness. Thus, according to WHO, roles, responsibilities, social positions, and access to resources influence health and well-being. Therefore, any health program must consider these

factors. In contrast, with a neutral, non-gender-oriented approach, health policy is methodologically incorrect and discriminatory; if men and women fall ill differently, different treatments must be designed and implemented.

Still, on the subject of health, another consideration to be debunked concerns life expectancy. According to estimates, women tend to live longer than men do globally (WEF, 2021). This is even considered as a 'positive note' in the survey on gender inequality (WEF, 2021: 13). However, does this data really tell us something positive? According to an Italian study, women live longer than men, but their life expectancy in good health is lower (Alaimo & Nanni, 2018b). Although women have fewer risk-taking behaviours, they fall ill more often, especially for chronic diseases, use health services more often, consume more drugs, especially antidepressants, and often suffer from gender-based violence. Therefore, considering the indicator of life expectancy can tell us little about people's health. On the contrary, healthy life expectancy focuses on a specific issue and, not surprisingly, sees women in a gap position. Other studies on self-reported health[23] confirm this gap: women tend to report worse health than men (Boerma et al., 2016; Nesson & Robinson, 2019). In Europe, 66% of women and 71% of men perceive their health as good or very good. Moreover, among adolescents, this gap is more pronounced, with 30% of girls and 39% of boys rating their health as excellent (EIGE, 2021).

Considering the issue of women's health, we also encounter the phenomenon of male- and gender-based violence against women. A violation of women's human rights, which affects their lives, causes trauma, illness, and death.

7 Male Violence Against Women

Gender-based violence refers to violence that women suffer because they are women. In the vast majority of cases, the perpetrator is a man; however, there are situations in which violence against women is perpetrated by other subjectivities, including women.[24] Male violence against women is an expression of historical inequality between the sexes and can only be understood and combined on the basis of its ineliminable specificity. It is a crime endemic to all societies, regardless of class, culture, religion, education level, income, age group, or ethnicity. Violence against women is one of the biggest public health problems worldwide, and an epidemiological reality through a series of structural and institutional conditions affects the mortality, morbidity, and quality of life of women, representing the root of many chronic diseases, obstetric complications, and psychiatric disorders (Dubini,

[23] Self-reported health is a person's subjective evaluation of their current health status (Lorem et al., 2017).

[24] We can also consider gender-based violence as violence that a woman exerts on her partner in lesbian relationships. Even a female couple can reproduce an asymmetrical division of roles in which one is subordinate to the other.

2016). According to the 2014 Global Status Report on Violence Prevention,[25] one in five women worldwide reported having been sexually abused as a child, while one in three women had been a victim of physical or sexual violence by an intimate partner in her lifetime. Violence against women and girls acts both directly by promoting chronic diseases and premature death, and indirectly, other major causes of death (heart disease, stroke, cancer, and HIV/AIDS) are the result of adopting risky behaviours (smoking, alcohol and drug abuse, risky sex) in an attempt to cope with the psychological impact of violence (WHO, 2014).

The historical definition of gender-based violence is contained in the UN Declaration on the Elimination of Violence against Women[26]:

> Any act of gender-based violence that results in, or is likely to result in, physical, sexual or psychological harm or suffering to women, including threats of such acts, coercion or arbitrary deprivation of liberty, whether occurring in public or in private life. (Art.1)

Thus, in 1993, for the first time, violence against women was internationally recognised as a manifestation of historical inequality in power relations between men and women. This inequality has resulted in the domination of one over the other, the discrimination of women, and their impediment to progress. At this point, gender-based violence moves from the private dimension of crime to the public dimension of human rights violations.

The manifestations of violence against women are innumerable; some are better known and/or more easily identifiable, while others are less so. However, each violent act can be traced to one of four types of violence if experienced by adult women or five (the same plus one) if children are subjected to violence. Physical violence is the easiest to recognise. It includes any act intended to hurt or frighten the victim and cause injury, in most cases. Sexual violence includes all the unwanted acts in the sphere of sexuality. They can be sexual acts, as well as physical, verbal, and visual. Such acts are violence when they are experienced by the woman as a threat, attack, humiliation, or loss of control in intimate contact. They can be imposed by force or obtained through the fear of future repercussions and/or psychological conditioning. Economic violence includes all attitudes implemented with the aim of preventing economic independence of the partner. Although it is common, it remains poorly understood. It includes, for example, actions aimed at preventing the seeking or keeping of work, economic commitments obtained by deception, deprivation or control of salary, and family expenses. Psychological violence includes all verbal and non-verbal attitudes (e.g. persistent communicative closure) that are intimidating, threatening, harassing, denigrating, etc. When we consider children to all these, we add ‘witnessed violence’. The latter refers to seeing, hearing, or perceiving a parent perpetrating violence against another. This

[25] The global status report on violence prevention 2014 reflects data from 133 countries. It is the first report of its kind to assess national efforts to address interpersonal violence: child maltreatment, youth violence, intimate partner and sexual violence, and elder abuse.

[26] UN, 1993—Declaration on the elimination of violence against women (No. 48/104), New York

form of violence is almost unknown to outsiders but has the same impact on children as direct violence.

Almost 20 years after the 1993 UN Declaration, the Council of Europe Convention on Preventing and Combating Violence against Women and Domestic Violence,[27] commonly referred to as the Istanbul Convention, was approved in 2011. An internationally binding normative instrument for those who sign it, in which we find the most recent definition of gender-based violence:

> Violence against women is understood as a violation of human rights and a form of discrimination against women and shall mean all acts of gender-based violence that result in, or are likely to result in physical, sexual, psychological, or economic harm to women, including threats of such acts, coercion or arbitrary deprivation of liberty, whether occurring in public or in private life (Art.3/a)

New in the Convention affirms the principle of liberty—that is, the right of women to live free from violence.

In summary, male and gender-based violence against women is a structural, cultural, and transversal phenomenon. It is structural because it is gender-based, cultural because it reflects and reinforces the roles that society assigns to men and women according to their sex, and transversal because it affects every country, ethnicity, age, religion, educational qualification, social class, and so on.

8 What if There Were Others?

This is still not enough to highlight all aspects of life in which gender inequalities and discrimination can occur. For instance, gender roles and prejudices also impact sports; women worldwide have fewer opportunities than men. There are few sports in which women can become professionals, and when they can, the number of positions is limited and the pay is significantly lower. According to Kosofsky (1993), this inequality is linked to social reasons and not differences in athletic ability due to biological differences.

Gender stereotypes impact children by changing their perceptions of themselves and their expectations, interests, and dreams. According to Bian et al. (2017), this occurred from the age of six. Six-year-old girls are less likely than their male peers to believe that members of their gender are 'really/really smart', so much so that they give way to their peers, moving away from activities and games deemed appropriate for 'really/really smart' children. According to a study, common stereotypes associate high-level intellectual abilities (brilliance, genius, etc.) with men more than with women, discouraging the latter from pursuing many prestigious careers (Bian et al., 2017). The gap that separates girls from their potential, negatively impacting their dreams as early as 6 years of age, has been called 'the dream gap' by one of the

[27] EC, 2011—Council of Europe Convention on preventing and combating violence against women and domestic violence (CETS No. 210), Istanbul

world's largest toy companies. Again, the issue of representativeness is important: from an early age, children are asked what they would like to be when they grow up and build up an idea in their imagination, dreaming of what they would like to become. Thus, existing models can identify with a difference in their ability to imagine themselves in a certain role rather than another. According to a recent study, story-based interventions may be sufficient to challenge young girls' negative stereotypes of female intellectual abilities (Buckley et al., 2021).

9 Final Considerations

When looking at gender inequality and the tools for its measurement, we often find the term 'gender gap', which refers to systematic differences in the outcomes of men and women on a variety of issues, ranging from economic opportunity and participation, political empowerment, and education to health and well-being (Richardt, 2008). This definition makes it possible to identify the four dimensions classically considered when measuring the gender gap: education, economics, politics, and health. However, as mentioned, a division of domains has been chosen in this text in line with the focus chosen by the EGEI surveys. Based on this choice, the economic dimension is divided into work, money, and time. In addition, the dimensions of violence are introduced. Health and, albeit under different names, politics and education remain unchanged.

The choice of domains and indicators cannot be separated by a careful consideration of the reference context. Indeed, if inequality affects or affects every aspect of life, different contexts may require different reflections. For instance, if we want to measure gender equality on the African continent, it is important to note the difference between men and women with respect to attainment of the primary school-leaving certificate. This is because many girls do not have access to schooling in many African countries. In contrast, in Western countries, where there is compulsory schooling, we can ignore the indicator relating to the attainment of the primary school-leaving certificate, while it is relevant to focus on the division of study fields with respect to the sexes (science for men, humanities for women). Similarly, if we want to measure gender equality in China, it is important to be able to identify the phenomenon of 'selective abortions', a phenomenon caused by the one-child policy that has been in force in China for several years. In contrast, referring to the European context, this aspect is irrelevant. It is important to investigate whether inequality exists with respect to healthy life expectancy as an important goal of our societies.

Approaching the measurement of gender equality by reflecting on the context allows us to point out any gaps in the availability of data and the consequent limitations of such a survey as well as perhaps promoting its collection. Subsequently, the resulting survey allows us to highlight the phenomenon, understand its evolution or involution over time, and structure intervention policies targeted to the

specificity of the framework. The latter aspects promote social justice, democracy, growth, well-being, and competitiveness in a given country.

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The Complexity of Social Phenomena and the Construction of Indicators

Leonardo Salvatore Alaimo

1 Introduction

For many years, indicators have been considered a niche topic in the literature. In recent decades, this issue has become central to the scientific debate and has been discussed in any conference or workshop on the measurement and analysis of socioeconomic phenomena. Indicators are not a specific and exclusive topic of the natural or social sciences, but are used and constructed everywhere, and their functions in contemporary societies are widespread (Maggino et al., 2021).

To fully understand the importance of the concept of indicators in social sciences, their connection to the concepts of complex systems and measurement must be analysed and understood. Humanity has always had the need to know and understand reality and the phenomena defining it to achieve goals and satisfy needs and aspirations. Therefore, the need to generate knowledge is a defining feature in our lives. Consequently, the relationship between people and knowledge has always been a crucial topic in the reflection of scholars in every scientific discipline. Knowing reality refers to measuring reality. Measuring reality involves addressing complex systems and phenomena. Measuring complex phenomena involves dealing with indicators (Maggino & Alaimo, 2022). In the following pages, we try to describe these concepts.

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2 Complexity and Complex Systems

2.1 Complexity: A Possible Definition

In recent decades, complexity has become a mainstream topic in different contexts and disciplines (e.g. physics, chemistry, biology, sociology, and psychology). The increasing attention to this concept coincided with the evolution of science, corresponding to the transition from *classical* to *modern* science (for details, see Alaimo, 2022). However, complexity in science has no precise meaning or unique definition (Érdi, 2008). As Morin (1985) states, the analysis of complexity cannot be addressed using a preliminary definition; there is no such thing as one complexity but different *complexities*. The influence of different disciplines on its conceptualisation has meant that this term has profoundly different meanings. Complexity does not belong to a particular theory or discipline, but rather to a *discourse about science* (Stengers, 1985). The term complex is often inappropriately used. We can understand its meaning by examining the differences from the concept of *complicated*, often used as a synonym, to refer to the difficulty in handling a situation or understanding a concept (Maggino & Alaimo, 2021). When dealing with particularly difficult situations or phenomena hard to explain, one tends to define them generically as 'complex' or 'complicated', giving these two concepts the same meaning. However, these two terms have profoundly different meanings, as reflected in their etymologies (De Toni & Comello, 2010; Letiche et al., 2012). 'Complicated' comes from the Latin *cum plicum*, in which the term *plicum* indicates the fold of a sheet. This term indicates something folded, which can be explained and understood by its unfolding. By contrast, 'complex' derives from the Latin *cum plexum*, where *plexum* means knot and weave. It refers to something woven, knotted, with interweaving, composed of many interconnected parts: 'compound' (Alaimo, 2021a, 2021b). Understanding a complicated phenomenon requires the adoption of an analytic approach; we must *unfold* the phenomenon in its creases and understand its basic components. Thus, understanding this phenomenon comes from understanding its components. It is always possible to achieve an understanding of a complex phenomenon, although this may seem difficult.

> For instance, think of an embroidered tablecloth on a laid table and napkins that have the same embroidery, but it is not visible because they are folded. The embroidery on the latter will be immediately evident when we open them up by undoing the folds. The same thing happens when we try to solve a complicated problem: in order to understand it in its entirety (the embroidery hidden between the folds of the napkin), we have to identify its components (the folds of the napkin) and understand them (unfold them). (Maggino & Alaimo, 2022: 44)

Complex phenomena require a synthetic/systemic approach. We cannot understand the *plexum* simply by analysing its components; we must try to understand it as a whole.

> Think of a nice jumper, with an intricate weave and many different colors. If we split up the jumper weave in its basic threads, we obtain a set of threads whose analysis does not help recreate the original system of the original jumper. In other words, if we consider the

Table 1 Main differences between complex and complicated

	Complex	Complicated
Etymology	*cum plexum:* something woven, knotted, with interweaving; composed of many interconnected parts; compound	*cum plicum*: indicates something folded, that can be explained and understood by unfolding its folds
Approach to knowledge	Synthetic/systemic approach: understand the phenomenon as a whole	Analytic approach: understand the individual components of the phenomenon

> individual threads taken individually (adopting an analytic approach) we do not have a vision of the jumper, which comes from their interweaving. (Maggino & Alaimo, 2022: 44–45)

As Capra (1996) highlights, different approaches are necessary to understand complexity:

> The properties of the parts can be understood only within the context of the larger whole. . . . Systems thinking is contextual, which is the opposite of analytical thinking. Analysis means taking something apart in order to understand it; systems thinking means putting it into the context of a larger whole. (Capra, 1996: 29–30)

The affirmation of the synthetic approach is one of the most important advances in twentieth-century science, closely linked to the awareness of understanding complexity using analysis:

> Systems science shows that living systems cannot be understood by analysis. The properties of the parts are not intrinsic properties but can be understood only within the context of the larger whole. (Capra, 1996: 37)

A synthesis is not a reduction of reality but a stylisation highlighting the characteristics that arise from the interconnections among the elements defining a complex phenomenon. A complex phenomenon can sometimes be considered *difficult* because it cannot be explained. However, this difficulty does not depend on the complex nature of the phenomenon, but on the attempt to understand it using an analytical approach, merely breaking it down into its essential components rather than analysing it as a whole. We also need to clarify that a complex view of reality does not necessarily mean having a *complete* view of reality. The latter indicates that all components of a phenomenon are included with no missing data. However, having all the elements available and analysing them is not sufficient to understand a complex phenomenon. The latter can only be understood through the interconnections of the elements (Table 1).

2.2 Complex Systems and Complex Adaptive Systems

The word complex is often associated with *system*, a term used in common languages, and many scientific disciplines. Generally, a system can be defined as a set of elements that stand in interaction (Bertalanffy, 1968). More precisely, according

to Meadows (2009), it can be considered 'an interconnected set of elements that is coherently organized in a way that achieves something' (Meadows, 2009: 11). This definition highlights the main components of a system: *elements*, *interconnections,* and *functions*. A system is a collection of interconnected elements with a purpose. A system has its own behaviour, different from its parts, evolving over time according to changes that can concern the system and each of its essential components. Obviously, these changes could be shocking and unexpected. Most systems are able to withstand the impact of drastic changes thanks to one of their fundamental characteristics, *resilience*, that is the 'system's ability to survive and persist within a variable environment' (Meadows, 2009: 76).

> A system can be defined as an organic, global and organized entity, made up of many different parts, aimed at performing a certain function. If one removes a part of it, its nature and function are modified; the parts must have a specific architecture and their interaction makes the system behave differently from its parts. Systems evolve over time and most of them are resilient to change. (Alaimo, 2022: 21)

A complex system exhibits specific characteristics. It consists of a great variety of elements; this means that the elements are not only numerous, but also different from each other, making it difficult to understand. Moreover, elements are often other systems, which are in turn formed by systems, and so on. Complex systems are based on a *systemic hierarchy* that allows the control of elements, ensuring that they act in a coordinated and harmonious manner. They are ruled by what Haken (1983) defined as the *slaving principle*: the elements at a lower hierarchical level are slaves to the upper level and the overall system. In a complex system, the *interconnections* among elements are more important than the elements themselves. A high density and a variety of interconnections are typical. Complex systems consist of many different elements and relations, which can be analysed only in a synthetic way. In a complex system, elements and connections, besides being numerous, vary and differ. A particular category of complex systems is the so-called complex adaptive system (CAS), an open system consisting of various elements interacting with each other in a linear and non-linear way, which constitutes a unique and organic entity capable of evolving and adapting to the environment (Waldrop 1992). Holland (1992) underlined how all CASs share the same three characteristics: *evolution*, *aggregate behaviour,* and *anticipation*. They have the capacity to evolve and *learn*; they can adapt to the environment and change by processing information and building models capable of assessing whether adaptation is useful. Thus, they can survive.

> As time goes on, the parts evolve in Darwinian fashion, attempting to improve the ability of their kind to survive in their interactions with the surrounding parts. This ability of the parts to adapt or learn is the pivotal characteristic of complex adaptive systems. (Holland, 1992: 19)

Complex adaptive systems present an aggregate behaviour that does not simply come from the behaviours of its elements, but *emerges* as a novelty from the interactions of the parts, as Morin (1977) affirms:

> For the immune system, this aggregate behaviour is its ability to distinguish self from others. For an economy, it can range from the GNP to the overall network of supply and demand; for

> ecology, it is usually taken to be the overall food web or the patterns of flow of energy and materials; for an embryo, it is the overall structure of the developing individual; for the brain, it is the overt behaviour it evokes and controls. (Holland, 1992: 19–20)

In addition to these two characteristics, there is a third that is difficult to understand: the typical ability of complex adaptive systems to anticipate changes. To adapt to changing circumstances, CASs develop rules that anticipate the consequences of certain responses. 'At the simplest level, this is not much different from Pavlovian conditioning: "If the bell rings, then food will appear"' (Holland, 1992: 20). Of course, the effects of such anticipation are complex, especially when a large number of elements are conditioned in different ways. Moreover, anticipation can cause large changes in aggregate behaviour, even when they do not come true.

'The anticipation of an oil shortage, even if it never comes to pass, can cause a sharp rise in oil prices, and a sharp increase in attempts to find alternative energy sources' (Holland, 1992: 20). Socioeconomic phenomena are CASs, consisting of a network of elements that interact with each other and with the environment. They are multidimensional and evolve by modifying their dimensions and the links between them. Therefore, knowledge of these phenomena must consider their complex nature. For this reason, measurements in the social sciences have typical characteristics that differ from those in the natural sciences. This requires the definition of systems of indicators capable of capturing the different aspects of the phenomena analysed. As can be easily understood, these systems are dynamic because they must adapt to changes in the measured phenomena.

The emergence of the concept of complexity has introduced many important innovations in the relationship between human beings and knowledge. In particular, the need for a new way of looking at reality emerges: the importance of going beyond empirical evidence and trying to grasp at the same time the whole and the individual components that compose it.

3 Measurement in the Social Sciences

Scientific knowledge is the result of a dialogue between logic and evidence, that is, it is generated from the interaction of two levels of scientific analysis: the *theoretical–formal level*, in which theories and hypotheses are developed and abstract concepts with their mutual relations are specified; and the *empirical level*, in which hypotheses are verified through empirical data (Maggino, 2017). Knowledge develops from the interaction, necessary and unavoidable, between the theory and observations realised by measurement. An empirical observation becomes a datum when evaluated within a theoretical framework. Thus, different types of data can be generated from the same empirical observations based on different theoretical frameworks, which are systems for comparing observations with one or more models. The relationship between the model and the observed data is the product of the measurement (Alaimo, 2022). If empirical observations are consistent with the model, it can

be concluded that the latter provides a good description of reality. Different models can represent reality with different levels of accuracy. At the same time, they are *falsifiable*; it is not possible to prove their truth because there is always a context in which a specific model can be inconsistent.

3.1 Measurement: Definitions and Main Aspects

The concept of measurement has an ancient origin. We can find the first definition of measurement in Book V of Euclid's Elements: measuring an attribute of an Object A means taking a reference Object B (called the unit of measurement) and determining how many times B is contained in A. Generally, measurement can be defined as the evaluation of the extension of a property in relation to a certain standard, the unit of measurement (Michell, 1999). Some attributes, such as velocity, height, and length, present a specific internal structure, namely, a quantitative structure. Consequently, these attributes were defined as quantities. Specific instances of a quantity are called the magnitudes of that quantity (e.g. the height of a person is the magnitude of the quantity, height). The magnitudes of a quantity are measurable because, based on the quantitative structure, they stand in relations/ratios to one another that can be expressed as numbers. A measurement can be defined as 'any method by which a unique and reciprocal correspondence is established between all or some of the magnitudes of a kind and all or some of the numbers, integral, rational, or real' (Russell, 2009: 176). This statement is the basis of the so-called representational approach, according to which 'measurement is the numerical representation of facts regarding the entities measured. A highly appreciated definition and a starting point for the reflections of other scholars is that of Stevens: measurement is the assignment of numerals to objects or events according to rules' (Stevens, 1946: 677). Based on Stevens' statement, for instance, Blalock (1968) defines measurement as a general process by which numbers are assigned to objects so that it is also understood which types of mathematical operations can be legitimately used. According to these definitions, measurement is an activity that determines a shift from the plane of reality in which we observe phenomena to the plane of numbers in which we try to encode them. This activity is meaningful and necessary. The rules of Stevens' definition must ensure that the translation is as faithful as possible so that any mathematical operations performed on objects are legitimate, as specified by Blalock. To ensure their meaningfulness, measures must be based on uniform procedures to collect, score, and report numerical results. In other words, they must be standardised. This ensures that possible foreign components representing the error of observation are isolated or minimised. Two types of error can be distinguished. The random error refers to all those factors that interfere with the measurement of any phenomenon and are ineradicable in the process. This type of error influences the reliability, that is, the consistency of a measurement model in terms of the degree of accuracy and precision with which the instrument measures and the ability to produce consistent measurements. The lower the random error, the higher the level

of reliability. The effects of such an error are completely systematic, and as a result, an instrument affected by it may overestimate or underestimate the magnitude of an attribute measured in a certain object. The systematic error determines the level of validity of the process, that is, the ability of a measurement procedure to measure what is intended to measure. There can be two types of systematic errors: methodological errors, that is, the error of definition/detection of the attribute to be observed, and the specific errors introduced by the observer in the use of the observation procedure. The lower the systematic error, the higher is the validity. Random error causes one measurement to differ slightly from the other because it is linked to unpredictable changes that occur during the process. The systematic error always affects measurements by the same amount or proportion, assuming a measurement is taken in the same way each time; it is predictable. Random errors cannot be eliminated; however, most systematic errors can be reduced. To reduce errors, all measurements must rely on a set of assumptions of different types (Alaimo, 2022):

- *Theoretical assumptions* related to the meanings given to the phenomenon measured.
- *Procedural assumptions* related to the rules of correspondence used in assigning numbers to observations.
- *Statistical assumptions* related to the main characteristics of statistical methods can be used for the analysis.

Compliance with these assumptions makes standardised measures.

3.2 *Measurement in the Social Sciences: Systems of Indicators and Their Construction*

'When social scientists use the term measurement it is in a much broader sense than the natural scientists do' (Lazarsfeld, 1958: 100). With this statement from his well-known article "Evidence and Inference in Social Research" (1958), Lazarsfeld emphasises that in the social sciences, measurement has a typical character, which makes them not comparable to the natural sciences. The author made an essential contribution to the study and analysis of measurements in social sciences. He defined 'operationalisation' as the process through which theory and abstract concepts are translated into (measurable) variables. The variable is, therefore, the operationalised property of an object, since the concept to be operationalised must be applied to an object. 'Between concept, property, and variable there is the same link that exists between the weight (concept), the weight of an object (property), and the weight of an object measured through the balance (variable)' (Alaimo, 2022: 47–48).

Measurement in the social sciences is influenced by objects. Socioeconomic phenomena are complex adaptive systems, and, consequently, the approach to understanding them must take into account their nature. Measuring these phenomena means trying to understand their nature, understanding each of them as a whole. In

this field, dealing with measurements means dealing with systems of indicators. What is an indicator? This can be considered as the result of the translation of reality to the plane of numbers. The term is often used synonymously with an index, but its meanings are profoundly different. The meaning of the term index is *anything useful to indicate*, and it is used in statistics with multiple meanings. The indicator is what relates concepts to reality (Maggino, 2017: 92). Horn (1993) defined indicators as purposeful statistics. An index becomes an indicator only when its definition and measurement occur within the ambit of a conceptual model. Given the complex and multidimensional nature of socioeconomic phenomena, their analysis involves the identification of different basic indicators connected in a system. Each indicator constitutes what is currently measured, with reference to a specific aspect or dimension of a phenomenon. A system of indicators is not a simple collection of measures, but a complex system. Indicators within a system are interconnected, and new properties typical of the system emerge from these interconnections. The development of systems of indicators must strictly follow a set of rules codified in a step-by-step process, the so-called hierarchical design (Maggino, 2017), which is a specification of Lazarsfeld's operationalisation. The starting question is, what is the phenomenon to be studied? Defining a phenomenon is not an easy task, based on a process of abstraction influenced by different factors, such as the sociocultural and spatial-temporal context in which the phenomenon is studied. Consequently, various definitions are possible and legitimate. Indeed, the definition of phenomena is subjective because it always depends on the researchers' point of view, on the *small windows* through which they observe reality and make hypotheses on it. Evidently, it is necessary to prevent this subjectivity from becoming arbitrary, involving no relationship with reality. The second step is the identification of latent variables, each of which is an aspect to be observed. These reflect the nature of the phenomenon, which is consistent with the conceptual model. Based on its level of complexity, a variable can be described by one or more factors. The different factors of each variable are referred to as dimensions. This concept is complex and theoretical. It is possible to handle profoundly different situations. The latent variable can assume only one underlying dimension. In other situations, we can deal with latent variables with two or more dimensions. Once the latent variables and their dimensionality are identified, the next phase consists of the selection of basic indicators. We can adopt a single indicator approach by measuring each latent variable using a single indicator. This approach could be weak because it is based on the assumption of direct correspondence between one latent variable and one indicator. Generally, the multi-indicator approach is preferable, in which, for each latent variable, several indicators are identified and selected. This approach increases measurement accuracy and precision, compensating for random errors.

The rigorous application of hierarchical design and adherence to its underlying assumptions enables the creation of a system of indicators suitable for measuring a particular phenomenon. One of the main assumptions concerns the specification of the model of measurement. The measurement model describes the relationship between a construct and its indicators. We can deal with two models: the *reflective* and the *formative* (Curtis and Jackson, 1962; Blalock, 1964; Diamantopoulos &

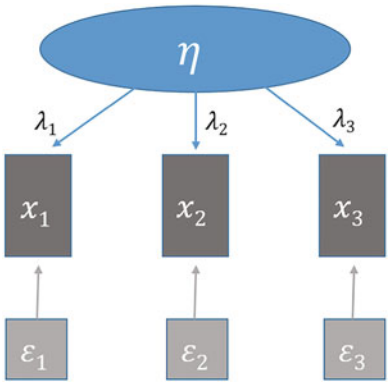

Fig. 1 Reflective measurement model: An example with three indicators and one latent variable

Siguaw, 2006; Diamantopoulos et al., 2008). In reflective measurement models, causality is from the construct to the measures, that is, measures are considered the effects of an underlying latent construct (Bollen & Lennox, 1991). The following equation explains this relationship:

$$x_i = \lambda_i \eta + \varepsilon_i$$

where x_i is the i-th indicator, η is the latent variable, λ_i is the coefficient capturing the effect of the latent variable on the i-th indicator, and ε_i is the measurement error for the i-th indicator. Figure 1 summarises the main components of the reflective model.

In this model, indicators reflect the latent variable and correspond to the linear functions of the underlying construct and measurement error. Each indicator has a specific error term, assumed to be mutually independent ($\text{cov}[\varepsilon_i, \varepsilon_j] = 0$ for $i \neq j$) and unrelated to the latent variable ($\text{cov}[\varepsilon_i, \eta] = 0 \ \forall \ i$). Thus, changes in the latent variable cause variations in all indicators simultaneously, and all indicators must be positively correlated. Internal consistency is fundamental: correlations between indicators are explained by the measurement model, and two uncorrelated indicators cannot measure the same construct (Bollen, 1984). This model is typical in psychometric research, such as in the measurement of attitudes. 'Let's suppose we want to measure the intelligence of a group of individuals using the results obtained by each of them in a series of tests. In this hypothesis, it is quite evident that the intelligence of each individual influences the result of the tests and not vice versa. As a consequence, we expect that the results of an individual to the different tests are quite the same and, from a statistical point of view, correlated with each other (because they are determined by the same latent variable). If a test gives a completely different result, it does not measure that specific construct' (Alaimo, 2022: 55–56). Formative models typically measure socioeconomic phenomena in which indicators cause a latent variable (Curtis & Jackson, 1962; Land, 1970). 'Let's suppose we want to measure the gender inequality. We must start with its definition: we can say that it refers to systematic differences in the outcome of men and women on a variety of issues ranging from economic participation and opportunity, political

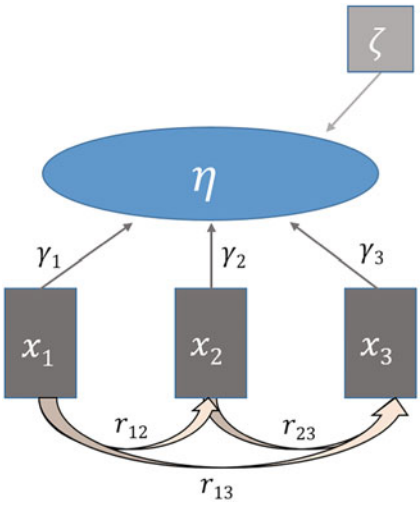

Fig. 2 Formative measurement model: An example with three indicators and one latent variable

empowerment, and educational attainment to health and well-being. In this case, by means of the definition, we already identify the components that form the concept and, consequently, the indicators to be selected. According to this definition, a measure of the gender inequality must take into account economic participation and opportunity, political empowerment, and educational attainment to health and well-being and use at least one indicator to measure each of them. If one of these dimensions is not taken into account, the concept of gender gap changes' (Alaimo, 2022: 58). Figure 2 shows the main components of the formative models.

The model is specified by the following equation:

$$\eta = \sum_{i=1}^{n} \gamma_i x_i + \zeta$$

where x_i is the i-th indicator, η is the latent variable, γ_i is the coefficient capturing the effect of the i-th indicator on the latent variable, and ζ is the measurement error that includes all remaining causes of the construct not represented in and not correlated to the indicators ($\text{cov}[x_i, \zeta] = 0$). Indicators do not present specific measurement error terms (Edwards and Bagozzi, 2000). According to this model, indicators are not replaceable; thus, changing an indicator will change the construct. Correlations among indicators are not explained by the measurement model, and internal consistency is of minimal importance; formative indicators might correlate positively or negatively, or lack any correlation (Bollen, 1984). There is a heated debate in the literature on the use of these two models. In particular, authoritative scholars have strongly criticised and opposed the use of formative measurement models (Howell et al., 2007; Wilcox et al., 2008; Edwards, 2011). Other scholars have strongly supported the effectiveness of formative models (Bollen, 2007; Diamantopoulos et al., 2008; Bollen & Diamantopoulos, 2017). The debate in the literature continues

to be animated, and it is not the aim of this paper to report this in detail. It is important to clarify that the choice of the measurement model does not depend directly on the researcher, but only on its appropriateness to the phenomenon that one intends to study. If the direction of the relationship is from the construct to the measures, we have a reflective model: by contrast, if the direction of the relationship is from the measures to the construct, we have a formative model (Coltman et al., 2008; Alaimo, 2022).

A system of indicators is a complex system, the analysis and understanding of which require approaches that allow more concise views. As Lazarsfeld (1958) states, the concept needs to be reconstituted, and all indicators within the system must be brought back to a synthesis. Synthesising data responds to a range of cognitive and practical needs, which is justified by the fact that knowledge of complex phenomena involves some form of *reductio ad unum* (Sacconaghi, 2017). From a methodological point of view, synthesis can concern different aspects of a multi-indicator system (Maggino, 2017):

- The synthesis of *statistical units* aims to aggregate the units in order to create macro-units for comparison, with reference to the indicators of interest. The statistical methods that allow for this are part of the *cluster analysis*. In this chapter, we will not dwell on these techniques, the literature of which is vast and deserves a separate discussion (for more information about cluster analysis, see Landau et al., 2011; Hennig et al., 2015; Maharaj et al., 2019).
- The synthesis of *statistical indicators* aims to aggregate the values referring to several indicators for each unit of observation, obtaining a synthetic measure. From a technical point of view, the statistical methods used in this case can belong to two different approaches: aggregative–compensative and nonaggregative.

Obviously, these two aspects are not mutually exclusive; however, it is often necessary to do both for a full understanding of reality (Alaimo, 2022). This chapter focuses on the synthesis of statistical indicators.

3.3 Synthesis of Multi-indicators Systems

As pointed out previously, the complex and multidimensional nature of socioeconomic phenomena requires the adoption of different measures to analyse and understand them. The measurement process in the social sciences is associated with the construction of systems of indicators, which makes it possible to measure phenomena that would not otherwise be measurable. Similar to the phenomena they must measure, these systems are also complex adaptive systems. The complex nature of such systems requires a synthetic approach to understand the phenomena as a whole. This implies the use of various basic indicators and criteria for summarising them. A basic indicator can be defined as an indirect measure of a phenomenon that cannot be directly measured. From this perspective, an indicator is not simply raw

statistical information, but represents a measure organically linked to a conceptual model aimed at describing different aspects of reality. It can be defined as a constructed variable related to a specific aspect or dimension of a complex phenomenon. Synthetic indicators are obtained by properly synthesising elementary indicators according to established criteria and rules. It is right to emphasise the adverb properly: in fact, if the construction of a synthetic index is not done according to specific steps and rules (i.e. properly), the resulting measure may inadequately represent reality and lead to misleading conclusions. Synthetic indicators have been widely used in the literature and various fields. The main purpose of their success is informative. It is easier for the public to understand a synthetic indicator (a single measure) than many elementary indicators.

Before analysing the main methods for synthesising multi-indicator systems in detail, it is necessary to formalise them mathematically. Generally, they consist of a set of measures (the basic indicators) at different measurement scale levels, observed on a set of statistical units. In its simplest form, a system of indicators is a matrix of data $\boldsymbol{X}$ typical of multivariate statistics:

$$\boldsymbol{X} \equiv \left\{ x_{ij} : i = 1, \ldots, N; j = 1, \ldots M \right\} \equiv \begin{pmatrix} x_{11} & \cdots & x_{1M} \\ \vdots & \ddots & \vdots \\ x_{N1} & \cdots & x_{NM} \end{pmatrix}$$

where the $i = 1, \ldots, N$ rows represent the statistical units, the $j = 1, \ldots, M$ columns represent the indicators, and the generic unit x_{ij} represents the determination of the j-th indicator in the i-th unit. We must clarify that in this study, we consider the simplest formalisation of the synthesis question, in which we do not deal with the temporal dimension. Indeed, in most cases, the multi-indicator systems are in the form of *three-way data time arrays* of type 'same objects × same variables × times', algebraically formalised as follows:

$$\boldsymbol{Y} \equiv \left\{ y_{ijt} : i = 1, \ldots, N; j = 1, \ldots M; t = 1, \ldots, T \right\}$$

where indices i, j, and t indicate the units, indicators, and times, respectively, and x_{ijt} is the value of the j-th indicator observed in the i-th unit at time t-th. These data structures are characterised by a greater complexity of information, consisting of the fact that multivariate data are observed at different times (D'Urso, 2000). In this chapter, we chose not to deal with the synthesis of three-way data time arrays, the complexity of which requires deeper knowledge of the subject (for an overview of the main synthetic methods for three-way data time arrays, see, e.g. Alaimo (2022)).

Given the bi-dimensional data matrix $\boldsymbol{X}$, the goal of the synthesis is to obtain a vector $\boldsymbol{v} \equiv \{v_i\}$ with N statistical units, in which the generic element v_i represents the synthetic value of the i-th unit with respect to all the J indicators:

$$\boldsymbol{X} \equiv \begin{pmatrix} x_{11} & \cdots & x_{1M} \\ \vdots & \ddots & \vdots \\ x_{N1} & \cdots & x_{NM} \end{pmatrix} \boldsymbol{v} \equiv \{v_i\} \equiv \begin{pmatrix} v_1 \\ \vdots \\ v_N \end{pmatrix}$$

Focusing on how to obtain the synthesis of indicators from a technical point of view means focusing on the arrow of the previous equation. In the literature, there are two different approaches to synthesis: aggregative-compensative, and non-aggregative. It should be clarified that one approach is not better than the other; each has pros and cons, and their use also (and especially) depends on the nature of the indicators. This is a crucial point. As clarified in the previous pages, indicators within a system can belong to different levels of the scale of measurement (Stevens, 1946). This is a relevant issue because the properties of the indicator determine the type of statistical tool that can be used to study it, and consequently, influence the choice of method of synthesis for a system of indicators. However, this issue is often underestimated. The aggregative-compensative approach is the dominant framework in the literature. As the name suggests, it consists of the mathematical combination (or aggregation) of a set of indicators by applying methodologies known as composite indicators (Saisana & Tarantola, 2002; Nardo et al., 2005; OECD, 2008). It is evident that the assumption underlying the construction of a composite is the possibility that the basic indicators are mathematically combinable and therefore cardinal. Despite such evidence, in the literature, several studies deal with nominal or ordinal indicators as if they were cardinal, using for their synthesis tools that are inappropriate to their level of scale (for instance, the arithmetic or geometric mean). Over the years, research has focused on identifying methods suitable for dealing with systems of indicators at different scaling levels. Thus, the so-called non-aggregative approach gradually became widespread: the synthetic indicator was obtained without any aggregation of the basic indicators. Different methodologies have been proposed within this approach, such as social choice theory (Sen, 1977; McLean, 1990, Arrow, 2012) or multi-criteria analysis (Nijkamp & van Delft, 1977; Macoun & Prabhu, 1999; Belton & Stewart, 2002; Ehrgott et al., 2005; Zopounidis & Pardalos, 2010). In particular, the partially ordered set (poset) theory (Neggers & Kim, 1998; Schroder, 2002) has become a reference, as evidenced by the large number of studies using this method for both ordinal (see, for instance, Fattore, 2016, Alaimo et al., 2022b, 2023, Fattore & Alaimo, 2023) and mixed (see Bruggemann & Patil, 2011; Kerber, 2017; Alaimo et al., 2021a, 2021b, 2022a) indicator systems. In the following pages, we focus on the aggregative-compensative approach and on systems in which all indicators are cardinal.

3.4 The Aggregative-Compensative Approach

As specified previously, the aggregative-compensative approach involves the aggregation using a mathematical function of the basic indicators. Therefore, a composite indicator is a measure based on sub-indicators that have no common meaningful unit

of measurement, and there is no shared method of weighting these sub-indicators. Synthesis is a measure not necessarily a number. This can be an image, as highlighted by the literature on the use of metaphoric images for the representation of phenomena (Tufte, 2001; Lima, 2013). Some authors (for instance, Diener & Suh, 1997) have criticised the choice of constructing a single composite index, pointing out that a more appropriate choice would be to use a dashboard. This is an open issue in the literature, and we can find arguments supporting composites or against them. A dashboard allows one to avoid an arbitrary choice of the functional form and weighting scheme and to observe a phenomenon from multiple points of view. However, this does not allow for a simple and direct understanding of the phenomenon under consideration. Constructing a composite is not an easy task and involves the implementation of different steps and a series of decisions and choices: the selection of basic indicators, whether and how to normalise them, and which aggregation procedure to choose. Although guided by knowledge of the phenomenon, most of these choices are subjective and, therefore, often considered non-scientific. This is one reason composite indicators have been considered a niche field in the literature for many years. Beyond these critics, composites are widely disseminated and used in the scientific literature and policymakers. We must clarify that there is no universal method for the construction of composites that must be guided by expert knowledge of the phenomenon.

The construction of a composite indicator is a step-by-step process (Nardo et al., 2005; OECD, 2008):

- Definition of the phenomenon
- Selection of the basic indicators
- Exploratory analysis of basic indicators
- Normalisation of individual indicators
- Aggregation of the normalised indicators
- Index validation

The steps are hierarchically ordered; therefore, the next step presupposes the previous step. The first two steps are theoretical, but they are not considered separate from the statistical-methodological ones (the other three).

In the previous pages, we discussed that measurement in the social sciences begins with the definition of the phenomenon. The concept must always be referred to and inserted within a theoretical framework that provides meaning. Particular attention should be given to the measurement model as we have seen in the previous pages. The choice of the measurement model depends on the appropriateness of the phenomenon to be measured and on the nature and direction of the relationships between constructs and measures (Alaimo, 2022). All socioeconomic phenomena require a formative measurement model. Therefore, in the following pages, we assumed that we deal with formative measurement model. The reflective measurement model is most widely used in the psychological and management sciences. The synthetic approaches and methods that allow us to deal with reflective models differ from those typical of the formative. One of the main methods in reflective models is undoubtedly factor analysis (Spearman, 1904; Thurstone, 1931; Cattell, 1978). It

must be clear what the composite wants to measure. If a phenomenon is poorly defined, it will certainly be poorly measured. However, the opposite was not true. If the phenomenon is well-defined and the matrix is composed of indicators of good quality, it is not necessarily the case that the composite index is valid (e.g. if the methodology used is not consistent with the indicators).

The selection of indicators is a delicate step that cannot be conducted independently of the others. The choice of basic indicators is based on a theoretical framework. Therefore, the approach used is based on a reasoned selection of the indicators included in the system. One question that must be addressed is, how many indicators should we consider? There are no unequivocal answers to this question. The general rule is that all dimensions of the phenomenon must be represented and measured using at least one indicator. Consequently, each latent variable can be defined and measured by using a single indicator. This single indicator approach is weak and assumes the existence of direct correspondence between one latent variable and one indicator. It is preferable to adopt a multi-indicator approach, that is, using several indicators for each dimension. This approach allows the overcoming (or at least reduction) of problems produced by the single indicator approach. In fact, using multiple indicators increases the measurement accuracy and precision, allowing one to compensate for random errors. Simultaneously, the risk is that the indicators are redundant. Redundancy can be defined as the excess of significant elements and information compared to what is strictly necessary for the correct understanding of a message. It is often intentional to increase the probability of complete reception of the message, even in the presence of noise or disturbances. The redundancy of indicators in a system can be useful in increasing the reliability of the measurement; the multi-indicator approach reduces the random error. However, we often encounter systems with too many indicators in which synthesis may not be significant or even possible. Therefore, it was necessary to reduce the number of indicators. There is not always a valid rule for this choice that should always be made with the theoretical framework and measurement model in mind. Dealing with a reflective measurement model, if it is necessary to eliminate indicators from the system, we can begin with those that are not correlated with the others because they do not measure the latent reflective variable considered. But even if we eliminated one indicator correlated with the others, we would have no change in the latent variable which 'causes' the indicators and remains unchanged. However, the formative models are different. The exclusion of an elementary indicator always affects the latent variable and, consequently, the composite indicator. This is because the indicators 'cause' the latent variable and remove (or add) one change (perhaps even slightly) the latent variable. Moreover, if we wanted or needed to eliminate an indicator, it would be more appropriate to act on indicators that are highly correlated with each other rather than to eliminate an indicator not correlated with the others and that, consequently, measures a different aspect of the phenomenon. In general, we need to choose a number of indicators that allow us to adequately represent the desired conceptual dimension, avoiding redundancy and ensuring the reduction of error by finding a compromise between possible redundancies caused by overlapping information and the risk of losing information (Salzman, 2003).

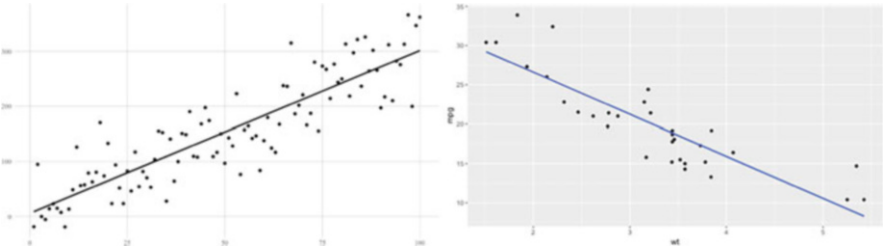

Fig. 3 Examples of linear correlation

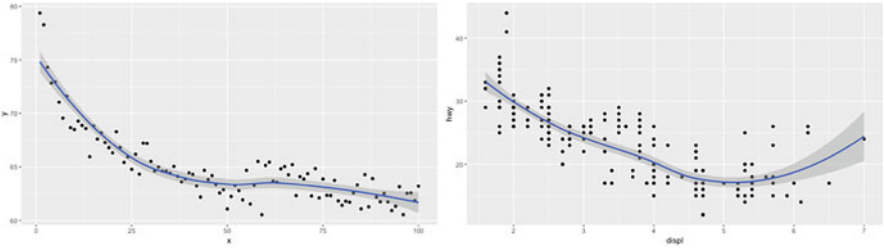

Fig. 4 Examples of non-linear correlation

The exploratory analysis of basic indicators is an important methodological step that aims to answer important questions. Is the latent structure of the synthetic index well defined? Are the chosen indicators sufficient to describe the phenomenon? It involves the application of multivariate statistical techniques to study the latent structure of data and analyse the relationships among the indicators within the system. The traditional approach involves the study of correlations between elementary indicators and principal component analysis (PCA). The term correlation in statistics indicates a reciprocal relationship between phenomena; in particular, it refers to the reciprocal relationship between two quantitative characteristics. Given two quantitative characters, X and Y, there is a positive correlation or concordance between them when they tend to increase or decrease together; in other words, when as one increases (or decreases), so does the other. There is a negative correlation or discordance when; as one variable increases, the other tends to decrease. Correlation is a symmetrical concept that does not refer to a cause-and-effect link but to the tendency of one variable to change in relation to another. When discussing the correlation, two aspects must be considered: the type of relationship between the two variables and the form of the relationship. The relationship can be linear if (in extreme simplicity) one graphically represents the double distribution through a scatter plot, the cloud of points approximates a straight line, as in the examples reported in Fig. 3.

There is a non-linear correlation if one by graphically represents the double distribution through a scatter plot, the cloud of points will have a non-linear (curvilinear) trend, as in the examples reported in Fig. 4.

Regarding the form of the relationship, we need to consider the direction, which can be positive (if as one variable increases, so does the other) or negative (if as one variable increases, the other decreases), and the magnitude, which refers to the strength of the relationship between the variables. Correlation coefficients are used to express the relationship between two variables in terms of both magnitude and direction. The correlation coefficient takes values within the range $[-1, 1]$:

$$-1 \leq \phi \leq +1$$

- The maximum value 1 in the case of perfect positive correlation
- The minimum value -1 in case of perfect negative correlation
- the value 0 in case of uncorrelation.

For exploratory analysis, the most commonly used coefficients for analysing the correlation between two variables X and Y are as follows:

1. Pearson correlation coefficient $r_{X,Y} = \frac{\text{cov}(X,Y)}{\sigma_X \sigma_Y}$

   where $\text{cov}(X, Y)$ are the covariances, σ_X is the standard deviation of X, and σ_Y is the standard deviation of Y.

2. Spearman's rank correlation coefficient $\rho_{X,Y} = 1 - \frac{6 \sum_{i=1}^{N} d_i^2}{N\left(N^2 - 1\right)}$

   where $d_i = r(x_i) - r(y_i)$ is the difference between the two ranks of the i-th observation.

3. Kendall rank correlation coefficient $\tau = \frac{(c-d)}{(c+d)}$

   where c is the number of concordant pairs and d is the number of discordant pairs.

Although important, correlations are not decisive; in the context of constructing synthetic indicators, they can be considered as a guide. The first thing to consider is the measurement model, remembering that it depends not on an arbitrary choice of the researcher but on the definition of the phenomenon and the consequent nature of the latent variable. The importance of studying correlations is evident in the case of a reflexive measurement model. In fact, the indicators, in this case, are a 'reflex' of the latent variable. Thus, the correlation between the indicators is explained by the measurement model, and the two uncorrelated indicators cannot measure the same latent variable. Therefore, correlation analysis allows for the exclusion of indicators unrelated to the latent variable. In the case of formative models, the study of correlations is equally important. In this case, the internal consistency of the indicators is of minimal importance, and two unrelated indicators can be relevant to the same construct. Simultaneously, two highly correlated indicators are likely to measure the same aspect of the phenomenon (redundancy). PCA is a multivariate statistical technique used in the composite indicator field for various purposes:

- To identify the dimensionality of the phenomenon
- To define the weights
- As an aggregation method

This technique was first described by Karl Pearson (1901), and was later independently developed and named by Harold Hotelling (1933). Let us consider data matrix $\boldsymbol{X}$ with N statistical units and M cardinal indicators, as previously described. The aim of PCA is to take the M variables $V_1, \ldots, V_M$ and find linear combinations of these to produce principal components $Z_1, \ldots, Z_M$ that are uncorrelated:

$$Z_j = \sum_{i=1}^{M} a_{ij} V_i \qquad j = 1, 2, \ldots, M$$

The weights a_{ij} are chosen such that the principal components Z satisfy the following conditions:

- They are uncorrelated (orthogonal).
- The first principal component accounts for the maximum possible proportion of the variance of the set of original variables, the second principal component accounts for the maximum of the remaining variance, and so on, until the last component absorbs all the remaining variance that is not accounted for by the preceding components.

$$a_{1j} + a_{2j} + \ldots + a_{Mj} = 1 \qquad j = 1, 2, \ldots, M$$

PCA just involves finding the eigenvalues λ_j of the covariance matrix $\boldsymbol{C}$:

$$\boldsymbol{C} = \begin{bmatrix} c_{11} & \cdots & c_{1M} \\ \vdots & \ddots & \vdots \\ c_{M1} & \cdots & c_{MM} \end{bmatrix}$$

where the diagonal element c_{ii} is the variance of V_i and c_{ij} is the covariance of variables V_i and V_j. The eigenvalues of matrix $\boldsymbol{C}$ are the variances in the principal components. There were M eigenvalues. Negative eigenvalues are not possible in a covariance matrix. An important property is that the sum of the variances of the principal components is equal to the sum of the variances of the original variables.

$$\lambda_1 + \lambda_2 + \ldots + \lambda_M = c_{11} + c_{22} + \ldots + c_{MM}$$

Before performing PCA, the original variables were commonly standardised to have zero means and unit variances to avoid one variable having an undue influence on the principal components. Thus, matrix $\boldsymbol{C}$ takes the form of a correlation matrix. In this case, the sum of the diagonal terms, and hence the sum of the eigenvalues, is equal to M, which is the number of variables. The correlation coefficients of the principal components Z with the variables V are defined *loadings*, r_{Z_j,V_i} (for a more

Table 2 Example: System of three cardinal indicators observed in four units

	V_1	V_2	V_3
A	108	21.23	8.66
B	89	23.56	8.92
C	90	21.56	8.76
D	112	21.96	8.62

in-depth discussion of PCA, e.g. see Denis, 2021). In exploratory analysis, PCA has only a descriptive purpose. In particular, if the variance explained by the first component is high, most of the indicators correlate and represent a single aspect of the phenomenon. This leads to the conclusion that we can consider only one latent factor and then construct a single composite. Otherwise, if the variance explained by the first component is not very high, there are several groups of indicators representing different aspects of the phenomenon, and consequently, this seems to highlight the presence of more than one latent factor and the necessity of constructing more than one composite. There is no precise threshold; in general, if the first component explains more than 50% of the total variance, we can consider only one latent construct present (Alaimo & Maggino, 2020). The absence of correlation among the components is an useful property because it implies that the principal components measure different statistical dimensions in the data. It must be noted that PCA does not always work in the sense that a large number of original variables are reduced to a small number of transformed variables. Indeed, if the original variables are uncorrelated, the analysis does nothing. The best results were obtained when the original variables were highly correlated, positive, or negative. This is a crucial finding. The first principal component, resulting from PCA, is often used as a composite indicator. However, it represents highly intercorrelated indicators and neglects others. Therefore, many highly important but poorly intercorrelated indicators may not be represented by the composite index. In a formative model, this is not a good strategy because an indicator not correlated with the others measures a different aspect of the phenomenon.

At this point, we focus on the technical steps of normalisation and aggregation. To facilitate their explanation, we used an example of a system of three indicators and four units, as reported in Table 2.

Normalisation is required to make indicators comparable because they often present different measurement units and ranges. The objective is to transform them into pure numbers. Given the original data matrix $\mathbf{X}$, the objective is to obtain a matrix $\mathbf{R} \equiv \{r_{ij}\}$ where r_{ij} is the normalised value of the j-th indicator for the i-th unit. Normalisation is a very delicate step because it can change the distribution and the internal variability of the indicators. There are various normalisation methods. We report some of the most common normalisation methods, each of which has advantages and disadvantages. Choosing one rather than another affects synthesis. This problem can be partially overcome by performing a robustness analysis to evaluate the effects of the different procedures on the results obtained.

However, from a conceptual point of view, normalisation does not solve the problem of combining different measures, of *mixing apples and oranges* (Alaimo, 2022).

In normalisation, it is necessary to define the polarity of the basic indicators, that is, the sign of the relationship between the indicator itself and the phenomenon. Therefore, the type of composite we want to construct defines the polarity. In other words, some indicators may be positively related to the phenomenon to be measured (positive polarity), whereas others may be negatively related (negative polarity). For instance, if we want to construct a composite whose increase coincides with an improvement in well-being, job satisfaction would have a positive polarity, while the unemployment rate would be negative. On the contrary, if we want to construct a composite whose increase indicates a worsening of well-being, job satisfaction would have negative polarity, while the unemployment rate would be positive. After normalisation, all indicators must have positive polarity, that is, an increase in the normalised indicators corresponds to an increase in the composite index (Maggino, 2017: 166). If some indicators have a negative polarity, they must be inverted. There are two main methods for inverting polarity:

1. The linear transformation involves taking the complement with respect to the maximum value. Given the original data matrix $\boldsymbol{X}$, it is calculated as follows:

$$x'_{ij} = \max_i \left(x_{ij}\right) - x_{ij}$$

where x_{ij} is the value of the j-th indicator in the i-th unit, $\max_i \left(x_{ij}\right)$ is the maximum value of the j-th indicator, and x'_{ij} is the inverted value. This is the simplest technique, which allows us to save the same distances between units with different origins. It is particularly used with ranking, standardisation, and rescaling normalisation methods.

2. The non-linear transformation consists of taking the reciprocal of the value. Given the original data matrix $\boldsymbol{X}$, it is calculated as follows:

$$x'_{ij} = \frac{1}{x_{ij}}$$

where x_{ij} is the value of the j-th indicator in the i-th unit, and x'_{ij} is the inverted value. This technique, typically used with indicisation, has been criticised because it modifies the distances between units and requires all values greater than 0.

Table 3 reports the results of the two inversion procedures for indicator V_3.

A particular situation is the so-called double polarity, in which we observe an indicator presenting a positive polarity below a certain threshold and a negative polarity above it, or vice versa. Examples of such indicators are female-to-male ratios, that is, the ratio between the percentage of females and the percentage of males. These indicators are particularly used for measuring the gender gap (WEF,

Table 3 Example: System of three cardinal indicators observed in four units; linear and non-linear inversion of polarity for indicator V_3

	V_1	V_2	V_3	V'_3(linear)	V'_3(non-linear)
A	108	21.23	8.66	0.26	0.115
B	89	23.56	8.92	0.00	0.112
C	90	21.56	8.76	0.16	0.114
D	112	21.96	8.62	0.30	0.116

Table 4 Example: System of three cardinal indicators observed in four units: ranking normalisation

	V_1	V_2	V_3
A	3	1	2
B	1	4	4
C	2	2	3
D	4	3	1

2021): they have a positive polarity up to the value of 1 (which expresses gender equality between women and men); from 1 on, the polarity is reversed. Dealing with double polarity, we can use the triangular transformation

$$x'_{ij} = \left|\lambda_{x_j} - x_{ij}\right|$$

where x_{ij} is the value of the j-th indicator in the i-th unit, x'_{ij} is the inverted value, and λ_{x_j} is the value of the j-th indicator in which the polarity inverts (the threshold).

If all the indicators present the same unit of measurement and similar ranges or are expressed as percentages or ratios, a good choice is no normalisation, that is, aggregating the data of the original matrix. However, in most cases, we do not deal with such a situation; hence, we need to normalise.

Ranking

The normalised values of the j-th indicator are obtained by ranking its values in all statistical units:

$$r_{ij} = rank\left(x_{ij}\right)$$

Thus, r_{ij} is the rank of the i-th unit in the ranking corresponding to the j-th indicator. If two or more units have the same value, several procedures can be used to assign a rank. One of the most widely used methods consists of assigning the same rank equal to the mean of the ranks they would have had in the case of different values. The transformation to ranks purifies indicators from the measurement unit. Its main advantage is that it is unaffected by the presence of outliers in the original data. However, ranking assumes the same distance between every unit, and consequently, the differences between units cannot be evaluated because absolute level information is lost. In Table 4, we report the results of ranking normalisation for the reported example.

Table 5 Example: system of three cardinal indicators observed in four units; min–max normalisation

	V_1	V_2	V_3
A	0.83	0.00	0.14
B	0.00	1.00	1.00
C	0.04	0.14	0.47
D	1.00	0.31	0.00

Re-scaling or Min–Max

The normalised values of the j-th indicator were re-scaled in the range $[0, 1]$ as follows:

$$r_{ij} = \frac{x_{ij} - \min\limits_i \left(x_{ij}\right)}{\max\limits_i \left(x_{ij}\right) - \min\limits_i \left(x_{ij}\right)}$$

where $\max\limits_i \left(x_{ij}\right)$ and $\min\limits_i \left(x_{ij}\right)$ are, respectively, the minimum and maximum values (commonly the observed values in the N statistical units) that represent the possible range of the j-th indicator. Reporting an indicator in the range $[0, 1]$ can be an advantage, giving an easy-to-read representation. Moreover, the range of indicators with very little variation will increase, which will contribute more to the composite (this is evident in the example in Table 5). The main drawback is that being based on the range, it is sensitive to outliers. In Table 5, we report the results of the min–max normalisation for the reported example.

Standardisation or z-scores

The normalised values of the j-th indicator were obtained as z-scores, converting the indicator to a common scale with 0 mean and standard deviation equal to 1, as follows:

$$r_{ij} = \frac{x_{ij} - \mu_j}{\sigma_j}$$

where $\mu_j = \frac{\sum_{i=1}^{N} x_{ij}}{N}$ and $\sigma_j = \sqrt{\frac{\sum_{i=1}^{N} \left(x_{ij} - \mu_j\right)^2}{N}}$ are the arithmetic mean and standard deviation of the indicator j-th. The main advantage of this method is that it reports the indicator to a standard Gaussian distribution and, consequently, simplifies the analysis. The main drawback is the presence of negative values, which can be a limitation of some aggregation methods (i.e. geometric mean). In Table 6, we report the results of the z-score normalisation for the reported example.

Indicisation

The normalised values of the j-th indicator are obtained as percentage ratios between the original values and a reference, as follows:

Table 6 Example: System of three cardinal indicators observed in four units: z-scores normalisation

	V_1	V_2	V_3
A	0.399	−0.822	−0.597
B	−1.214	1.436	1.343
C	−1.129	−0.502	0.149
D	0.739	−0.114	−0.896
μ_j[a]	103.300	22.078	8.740
σ_j[a]	11.776	1.032	0.134

[a]Arithmetic mean and standard deviations of indicators are calculated based on the original values reported in Table 2

Table 7 Example: System of three cardinal indicators observed in four units: indicisation

	V_1	V_2	V_3
A	96.429	90.110	97.085
B	79.464	100.000	100.000
C	80.357	91.511	98.206
D	100.000	93.209	96.937

$$r_{ij} = \frac{x_{ij}}{x_{oj}} * 100$$

where x_{oj} is the reference value selected for the j-th indicator, which generally corresponds to the maximum observed or to a general benchmark. This method makes it possible to decouple indicators from the unit of measurement and to preserve the relative distance between different units. The main drawback of this method is its high sensitivity to outliers. In Table 7, we report the result of the indicisation for the example reported using the maximum value observed in each indicator as a reference value.

The following step is the aggregation of normalised indicators, that is, the composition of the normalised indicators into a single synthetic index. In the literature, many methods have been proposed for constructing composites (there is no objective of this chapter to report a review of all aggregation methods and procedures in the literature; for more detailed information, see Saisana & Tarantola (2002), OECD (2008), and Maggino (2017)). Each method has its advantages and disadvantages; there is no such thing as the best method. The method used has an impact on the results obtained, in particular, the definition of the importance of each individual indicator (weighting) and the identification of the technique for synthesising the indicators.

The choice of weighting has a large impact on the values and consequently on the meaning of the composites. Thus, it is essential to understand the effects of one choice on another. In the literature, there are different approaches to the weighting issue, which can be traced to three categories (Gan et al. 2017):

- Giving to all the indicators the same weight (equal weighting)
- Weights derived from the statistical characteristics of the data and attributed as the result of a statistical method, for instance, principal component analysis (statistic-based weighting)
- Weights assigned to individual indicators based on the judgments of the public or experts (public/expert opinion-based weighting)

No agreed-upon methodology exists to weigh basic indicators. The simplest weighting strategy, that is, attributing equal weight to all basic indicators, considering them equally important (Nardo et al., 2005) is the most commonly used. This method is not without criticism, especially from those who consider a possible misconception of the underlying logic according to which the weight assigned to a variable can be directly interpreted as a measure of its importance to the value of the composite (Becker et al., 2017: 12). The statistical method, for instance, using the results of PCA, is very questionable because most of the time it is based on the correlations among basic indicators and, as we have seen, their interpretation changes according to the measurement model. It is likely that the best method is based on the opinions of stakeholders and experts. When the latter cannot be used, a good strategy could be to select a limited number of robust indicators, giving them the same weight (Alaimo, 2022).

Aggregation methods can be classified according to various criteria (Gan et al., 2017). One of the main classifications is based on the degree of toleration/substitutability among the basic indicators. The components of a synthetic index are called substitutable if a deficit in one component can be compensated for by a surplus in another. The assumption of component substitutability implies the adoption of additive aggregation methods (e.g. arithmetic mean). The components are defined as nonsubstitutable if no compensation is allowed between them. In this case, multiplicative (e.g. geometric mean) or noncompensative methods are adopted. Thus, this conceptual assumption has an important effect on the other steps of the construction of the composites, in particular, the selection of the aggregation function. Based on this classification criterion, we can distinguish between the following:

- *Additive aggregation methods:* They employ functions that sum the normalised values of the basic indicators to form a composite index. The most widely used additive method is the *weighted arithmetic mean*. Given the normalised matrix $\boldsymbol{R} \equiv \{r_{ij}\}$, the value of the composite indicator C_i for generic unit i-th is obtained as follows:

$$C_i = \frac{\sum_{j=1}^{M} r_{ij} w_j}{M}$$

where w_j is the weight of the j-th indicator. The weights must satisfy the following constraints: $w_j > 0$ and $\sum_{j=1}^{M} w_j = 1$. In the case of equal weighting, that is, $w_j = \frac{1}{M}$, we have the simple arithmetic mean. This technique implies full compensability such

Table 8 Example: System of three cardinal indicators observed in four units; min–max normalisation; arithmetic and geometric mean aggregation

	V_1	V_2	V_3	C_i (arithmetic)	C_i (geometric)
A	0.83	0.00	0.14	0.323	0.000
B	0.00	1.00	1.00	0.667	0.000
C	0.04	0.14	0.47	0.217	0.138
D	1.00	0.31	0.00	0.437	0.00

that poor performance in some indicators can be compensated for by sufficiently high values in other indicators.

- *Multiplicative aggregation methods*: Multiplicative functions are used on the normalised values of basic indicators to form a composite index. The most widespread method is the *weighted geometric mean*. Given the normalised matrix $\mathbf{R} \equiv \{r_{ij}\}$, the value of the composite indicator C_i for generic unit i-th is obtained as follows:

$$C_i = \sqrt[M]{\prod_{j=1}^{M} r_{ij}^{w_j}}$$

where w_j is the weight of the j-th indicator. The weights must satisfy the following constraints: $w_j > 0$ and $\sum_{j=1}^{M} w_j = 1$. In the case of equal weighting, that is, $w_j = \frac{1}{M}$, we have a simple geometric mean. Geometric mean-based methods only allow compensability between indicators within certain limitations (partially compensative) because of the *geometric-arithmetic mean inequality* (Beliakov et al., 2007), which limits the ability of indicators with very low scores to be fully compensated for by indicators with high scores.

In Table 8, we report the results of the aggregation using simple arithmetic and geometric means for the values normalised with min-max (Table 5).

Additive and multiplicative methods imply total and partial compensation, respectively, among the basic indicators. The compensability issue is not only methodological but also, and above all, conceptual. Choosing one approach over the other affects not only the values of the composite but also, and more importantly, the interpretation of the phenomenon being measured. For instance, looking at the Human Development Index (UNDP, 1990), if we admit full compensability, we implicitly affirm that a surplus in education can compensate for a deficit in health. This is highly questionable. However, if we affirm the non-compensability of the basic indicators, we risk crushing the results of our synthesis. A possible solution identified in the literature (Casadio Tarabusi & Guarini, 2013; Mazziotta & Pareto, 2016) is the adoption of a partially compensative method, that is allowing compensation 'up to a certain point'; however, the question would arise as to what is the permissible and tolerable threshold of compensability.

The Benefit of the Doubt (BoD) approach is an aggregative method for composite indicator construction (Cherchye et al., 2007; Rogge, 2018) based on Data

Envelopment Analysis (DEA), a linear programming technique that is useful for measuring the relative efficiency of decision-making units on the basis of multiple inputs and outputs (Farrell, 1957; Charnes et al., 1978). The efficiency of a set of indicators can be adapted to construct a synthetic indicator using input-oriented DEA. The synthetic measure is obtained as the weighted sum of the normalised indicators relative to a benchmark. More precisely, it is defined as the performance of a single unit divided by the performance of the benchmark:

$$\mathrm{BoD}_i = \frac{\sum_{j=1}^{M} r_{ij} w_{ij}}{r_{ij}^*}$$

where $\boldsymbol{r_{ij}}$ is the normalised value of the j-th indicator for the i-th statistical unit according to the min–max procedure, $\boldsymbol{w_{ij}}$ is the corresponding weight, and $\boldsymbol{r_{ij}^*}$ is the benchmark given by the following:

$$r_{ij}^* = \max_{r_{i\in[1,\ldots,N]}} \sum_{j=1}^{M} r_{ij} w_{ij}$$

The identification of the optimal set of weights guarantees that each unit is associated with the best possible position compared to all the others. Optimal weights were obtained by solving the following equation:

$$\mathrm{BoD}_i^* = \max_{w_{ij}} \frac{\sum_{j=1}^{M} r_{ij} w_{ij}}{\underset{k\in[1,\ldots,N]}{max} \sum_{j=1}^{M} r_{kj} w_{kj}}, \forall i = 1, \ldots, N$$

under the constraint that the weights are non-negative, and the result is bounded [0, 1]. The most favourable weights were always applied to all observations. The main advantages of this method are related to the DEA solution. Because the weights are specific for each unit, cross-unit comparisons are not possible, and the values of the scoreboard depend on the benchmark performance. Another drawback is the multiplicity of the equilibria. Hiding the problem of multiple equilibria prevents the weights from being uniquely determined (even if the composite indicator is unique). The optimisation process could lead to many 0-weights if no restrictions were imposed on the weights.

The construction of a composite involves different subjective choices: the selection of individual indicators, choice of aggregation model, and weights of the indicators. All these subjective choices are the bones of the composite indicator, and together with the information provided by the numbers themselves, shape the message communicated by the composite indicator (OECD, 2008). The effectiveness of a composite index also depends on testing its assumptions, which is the purpose of the validation. It evaluates the robustness of the composite index in terms of its capacity to produce correct and stable measures and its discriminant capacity (Maggino, 2017). The robustness of a composite index is assessed by uncertainty

analysis, which focuses on how uncertainty in the input factors propagates through the structure of the composite index and affects the results. The sensitivity analysis focuses on how much each individual source of uncertainty contributes to the output variance (Saisana et al., 2005). Used during composite construction, these procedures help in indicator selection, add transparency to the index construction process, and explore the robustness of alternative composite index designs and rankings. The discriminant capacity of a composite index is assessed by exploring its capacity to discriminate between units and/or groups, distributing all the units without any concentration of individual scores in a few segments of the continuum, showing values that are interpretable in terms of selectivity through the identification of particular reference values or cut-off points (Maggino & Zumbo, 2011).

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The Main Indicators of Gender (in)Equality

Enrico di Bella and Christian Suter

1 A Brief Overview of Gender (in)Equality Measurement

The topic of gender (in)equality[1] is increasingly at the centre of international debate due to its numerous implications on our society's socioeconomic context. Indeed, gender equality is one of the determinants of economic growth, human capital development, and more generally, a sustainable development model (Kabeer & Natali, 2013; Moorhouse, 2017; Profeta, 2017; Maceira, 2017). Several initiatives have been undertaken at the international level to support greater gender equality. In 2015, the W20 group was established at the summit of the world's top 20 economies (G20) with the primary objective of empowering women by ensuring that they play a prominent role in the G20 process. Another noteworthy initiative was the inclusion of gender equality among the 17 Sustainable Development Goals (Goal #5) identified by the UN in Resolution A/RES/70/1 on 25 September 2015:

> Gender equality is not only a fundamental human right, but a necessary foundation for a peaceful, prosperous and sustainable world... .Providing women and girls with equal access to education, health care, decent work, and representation in political and economic decision-making processes will fuel sustainable economies and benefit societies and humanity at large.

[1] The term '(in)equality', which is used in this chapter, serves to highlight the different approaches used to measure gender inequality. Some indicators emphasise the gender difference or gap that is to be reduced, while others set the goal of gender equality that is to be achieved.

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To plan effective policies and act consciously, it is essential to have appropriate measurement and monitoring tools. While the first gender (in)equality indicators were developed at the national level in the 1970s and the 1980s (e.g. United States Commission on Civil Rights, 1978; Sugarman & Straus, 1988),[2] corresponding measures were not implemented at the international and global levels until the mid-1990s. Currently, a wide range of comparative gender (in)equality indicators are available, developed, and promoted by scientific research and academic institutions, international organisations (e.g. the United Nations, the World Economic Forum, etc.), civil society associations, official (national) bodies, and private companies. However, these indicators often refer to specific areas (e.g. the fields of education, health, or economic power), and there are only a few measures that attempt to provide a systemic and multidimensional view of the phenomenon (see Plantenga et al., 2009; Barnat et al., 2019 and Cascella et al., 2022, for more in-depth reviews).

The development of gender (in)equality indicators at the international level began in the early 1980s with the publication of several studies and reports on the situation of women by UN agencies. The two reports Compiling Social Indicators on the Situation of Women (United Nations, 1984a) and Improving Concepts and Methods for Statistics and Indicators on the Situation of Women (United Nations, 1984b) are particularly important milestones. On the one hand, these reports provide a stock-taking of existing data, methodologies, and indicators on the relative status of women. On the other hand, they outline a research agenda for developing and improving gender-related indicators and measures in several domains, notably families and households, education, labour force participation, income, health, socioeconomic status, and social mobility.

The UNDP Gender Development Index (GDI), launched in 1995, is the first global multidimensional measure of gender (in)equality. This measure, inspired by and based on the Human Development Index (HDI), was, however, still restricted to selected societal spheres—those included in the HDI, that is, health, education, and standard of living. Similarly, the Gender Inequality Index (GII), which combines the three dimensions of reproductive health, female empowerment, and the labour market, published by the UNDP yearly since 2013, follows—and is limited to—the traditional HDI approach. Only in the 2000s were more comprehensive measures capable of capturing the complexity of gender (in)equality at an international (global) level. The most widely used comprehensive global measure is the Global

[2]The Gender Equality Index proposed by Sugarman and Straus (1988) and updated by Di Noia (2002) is a multidimensional measure including 24 indicators aggregated into three sub-indices (economic, political, and legal equality indices) and computed for each of the 50 US states. Within the context of the present study, other comparative sub-national (regional, state) measures are also worth mentioning, notably the Gender Equality Index of Mexican States suggested by Frias (2008), the Synthetic Index of Gender Inequality of Spanish regions of Bericat and Sánchez (2008), the Regional Gender Equality Monitor for the EU regions by the Joint Research Center (Norlen et al., 2019), the Regional Gender Equality Index (R-GEI) of di Bella et al. (2021), and the Extended Regional Gender Gaps Index (eRGGI) of Cascella et al. (2022) for the Italian regions.

Gender Gap Index (GGGI) of the World Economic Forum (WEF), developed by Hausmann et al., in 2006. This index covers the four dimensions of economic participation and opportunity, educational attainment, health, and political empowerment, and is measured by 14 variables. GGGI is available for approximately 150 countries worldwide and is updated annually. Another more recent measure with a similar broad coverage is the SDG Gender Index launched in 2018 by Equal Measures 2030. This index is directly related to the Sustainable Development Goals framework, which includes 56 indicators covering 14 of the 17 Sustainable Development Goals (EM2030, 2022).[3] A final global measure, slightly more focused than the measures discussed above, is the Women's Economic Opportunity Index (WEO), published in 2009 and 2011[4] by The Economist Intelligence Unit, covering five dimensions: labour policy and practice; access to financing, education, and training; women's legal and social status; and general business environment, measured by 31 indicators (EIU, 2010).

In addition to these global measures, two indices of gender (in)equality have been developed, specifically for European countries. First, the European Gender Equality Index (EGEI), suggested by Bericat (2012), focuses on access to structural resources (determining the social status of women and men) and is calculated for 27 European countries. The index is composed of three dimensions or sub-indices (education, work, power) measured by 18 indicators employing ratios of female/male achievement rates of the respective resources. The index, initially calculated for 2009, was updated by Bericat and Sánchez-Bermejo (2016) for 2000–2011.[5] Second, the Gender Equality Index (GEI) developed by the European Institute for Gender Equality (EIGE) addresses gender gaps in various domains that are policy-relevant at the EU level. Its conceptual framework distinguishes eight domains, of which six (work, money, knowledge, time, power, and health) are covered by the overall index. The six domains are composed of 14 subdomains, measured using 31 indicators. The GEI was published for the first time in 2005 and has been updated regularly every 2 or 3 years since then.

Although the development of such comprehensive gender (in)equality measures is quite recent, the origins of gender (in)equality measures and analyses date back to the early postwar period. There is a long social sciences tradition of conceptualising and measuring gender (in)equality. Research on social stratification and social mobility (e.g. Grusky, 2008) and ascriptive inequalities (e.g. Reskin, 2003) in particular have contributed to developing various gender (in)equality indicators and measures shedding light on the complex interplay of inequality mechanisms operating at different levels (individual, interpersonal, institutional, organisational,

[3] The 2018 pilot version was restricted to six countries. The first complete global version including 129 countries was published in 2019. The most recent update is the 2022 report with data and analyses for 144 countries.

[4] Unfortunately, no more recent updates of the WEO seem to be available.

[5] Since then, however, this index has not been updated.

national, and global) and in different societal spheres (economic, social, political, legal, and cultural) for a long time.

Among the first (in)equality indices established by academics and social science scholars, we find segregation measures that were discussed as early as the beginning of the twentieth century. Among them is the classical index of dissimilarity suggested by Duncan and Duncan (1955) in their methodological analysis of the strengths and weaknesses of different segregation indices. Since the 1960s, the dissimilarity index has become the most widely used measure of (gender) segregation. A good example is Jacobs's (1989) study of the long-term historical trend of occupational sex segregation in the United States during the twentieth century. One of the strengths of the dissimilarity index is its simplicity—the index is easy to apply and interpret, which indicates the proportion of women or men that should be shifted (between fields of work, fields of study, occupational positions) to achieve equal ratios. Therefore, the index has also been called the index of displacement. Over the past decades, the dissimilarity index has been continuously refined and improved: for instance, the standardisation proposed by Gibbs (1965) and Jacobs (1989) to control for differences in the marginal distributions (e.g. the number and size of fields of work); the index of association suggested by Charles (1992) and Charles and Grusky (1995), allowing for field-specific comparisons; or the inclusion of homemaking and the economically inactive population by Cohen (2004) and Hook and Pettit (2016). An important advantage of segregation measures, particularly within the context of our study, is that they can be easily calculated at the regional, sub-regional, and local levels.[6] This is also due to the fact that the first studies employing segregation measures focused on patterns of residential segregation, particularly regarding race and ethnicity, such as between blacks and whites in the United States. A weakness of segregation measures is that they are domain-specific and are mostly restricted to the fields of employment and education. While they can capture important sub-areas (and are, therefore, included in the GEI as sub-indexes for work and education), segregation indicators are not able to cover the complexity and multi-dimensionality of overall gender equality.

In addition to the segregation indices, there are several other domain-specific gender (in)equality indicators. For instance, two recent promising initiatives in the legal field are the OECD Social Institution and Gender Index (SIGI) and the Global Index on Legal Recognition of Homosexual Orientation (GILRHO). The Social Institution and Gender Index was launched in 2009 and updated in 2012, 2014, and 2019. The SIGI originally covered five dimensions: discriminatory family codes, restricted physical integrity, restricted access to productive and financial resources, restricted civil liberties, and son bias. The last version of the global SIGI (published in 2019) includes four dimensions (the son bias dimension has been dropped), measured by 16 different indicators. Dimensions, sub-dimensions, and individual indicators were equally weighted and aggregated using exponential and logarithmic

[6] For a recent example, see Ravazzini and Suter (2016).

functions, allowing for partial (and varying) substitution for increases and decreases in the different (sub-) dimensions (for more details, see OECD, 2019).

The Global Index on Legal Recognition of Homosexual Orientation (GILRHO) was developed by Kees Waaldijk at Leiden University, and was first published in 2014. This measure is a simple summary index based on eight indicators covering different aspects of decriminalisation of homosexual acts, anti-discrimination legislation, and partnership and family rights for same-sex couples. Work on the GILRHO seems to be still in progress, and although the construction and aggregation of the index are quite simple and no systematic methodological validation has yet been provided, the index is interesting because it broadens the concept of gender equality to include LGBT+ issues (for more details, see Waaldijk, 2019 and Badgett et al., 2019).

In the following paragraphs, some of the most comprehensive and internationally disseminated equality, inequality, and gender gap indicators will be discussed. Specifically, the Global Gender Gap Index (GGGI) of the World Economic Forum (WEF, 2022), the Gender Development Index (GDI) of the United Nations (UNDP, 2022a; 2022b), the Gender Inequality Index (UNDP, 2022a and 2022b), and the Gender Equality Index (GEI) of the European Institute for Gender Equality (EIGE, 2017; 2022) will be analysed. All these represent a representative selection of the different approaches and calculation methods used by leading international organisations to measure gender (in)equality.

2 The Global Gender Gap Index of the WEF

The Global Gender Gap Index (GGGI) was introduced by the World Economic Forum (WEF) in 2006 as a tool to measure the extent of gender inequality, tracking its evolution over time at the country level in 146 countries (2022 edition). It explores the gender gap across 14 variables, organised into four key categories (pillars or sub-indices): economic participation and opportunity, educational attainment, health and survival, and political empowerment (Table 1).

GGGI is constructed using a four-step process (WEF, 2022):

Convert to ratios. Initially, all data are converted to female-to-male ratios to ensure that the index captures the gaps between women's and men's attainment levels rather than the levels themselves. For instance, if an indicator records 115 for men and 104 for women, the female-to-male ratio is 1.143 (120/105), thus identifying the male value as being 14.3% higher than the female value.

Data truncation at parity benchmark. Female-to-male ratios are pure numbers (i.e. without a unit of measure) that identify a parity situation if their value equals 1 (or any other stated 'equality benchmark') or an inequality condition for values that differ from the equality benchmark. Although the female-to-male ratios can record disparities above or below 1, in the GGGI, the ratios obtained above are truncated at

Table 1 GGGI pillars indicators and data sources (WEF, 2022)

Pillar	Indicator	Data sources
Economic participation and opportunity	Labour-force participation rate	International Labour Organization (ILO), ILOSTAT database, modelled estimates
	Wage equality for similar work	World Economic Forum, Executive Opinion Survey (EOS)
	Estimated earned income	International Labour Organization (ILO), ILOSTAT database; International Monetary Fund (IMF), World Economic Outlook; World Bank, World Development Indicators database
	Legislators, senior officials and managers	International Labour Organization (ILO), ILOSTAT database
	Professional and technical workers	International Labour Organization (ILO), ILOSTAT database
Educational attainment	Literacy rate	UNESCO, UIS.Stat education statistics data portal. When not available, data is sourced from United Nations Development Programme, Human Development Reports, most recent year available
	Enrolment in primary education	UNESCO, UIS.Stat education statistics data portal
	Enrolment in secondary education	UNESCO, UIS.Stat education statistics data portal
	Enrolment in tertiary education	UNESCO, UIS.Stat education statistics data portal
Health and survival	Sex ratio at birth	World Bank, World Development Indicators database
	Healthy life expectancy	World Health Organization (WHO), Global Health Observatory database
Political empowerment	Women in parliament	Inter-parliamentary Union
	Women in ministerial positions	Inter-parliamentary Union
	Years with female/male head of state (last 50)	World Economic Forum's calculations

the equality benchmark.[7] For all indicators, except for the two health indicators, this equality benchmark is considered to be 1, meaning equal values for women and men. In the case of the sex ratio at birth indicator, the equality benchmark was set at 0.944,[8] and in the case of the healthy life expectancy indicator, the equality

[7] Two scales can be considered to capture gender equality. One is a negative-positive scale that captures the extent and direction of the gender gap and penalises situations of imbalance by giving the highest score to situations of perfect equality. The second, which is the one chosen by the WEF, is a one-sided scale that measures how close women are to achieving parity with men, but does not reward or penalise countries that have a gender gap in the opposite direction.

[8] It is known that the natural value of the male/female (or sex-ratio) ratio at birth in humans is around 1.06 males born for every female. Deviations from this ratio may be indicative of the presence of

benchmark was set at 1.06.[9] As such, parity is achieved if, on average, women live 5 years longer than men do.

Calculation of subindex scores. The third step in the process is to calculate the weighted arithmetic average of the indicators within each sub-indicator to derive the corresponding summary scores. First, the sub-indicator scores were normalised to equalise their standard deviations.[10] Next, the scores of each sub-indicator are aggregated into a single value through a weighted average whose weights are determined by the ratio of 0.01 to the standard deviation of each indicator. This determines how much the indicator has to vary in relation to its standard deviation, resulting in a one percentage point change in the indicator. These four values are then expressed as weights that sum to one to calculate the weighted average of the four indicators.[11]

Calculation of final scores. For all sub-indices, the highest possible score is 1 (or 100%, i.e. perfect gender equality or gender gap closure), and the lowest possible score is 0 (or 0% or maximum inequality), thus tying the scores between inequality and baseline equality. A simple arithmetic average of each subindicator score was used to calculate the Global Gender Gap Index. This final value also varies between 1 and 0, thus allowing for a comparison of ideal standards of equality as well as relative country rankings.

The latest available data on the GGGI (WEF, 2022) indicate a closing of the gender gap worldwide of 68.1%. Looking at the evolution of the index over time since the first edition in 2006 for the 102 countries featured in all reports, a steady and generalised increase in gender equality can be observed. However, according to the WEF Working Group's calculations, full equality between men and women (i.e. complete closure of the gender gap) will only be achieved in 132 years. Although no country in the world, among the 146 considered in the 2022 edition of the report has achieved gender parity, some are closer to closing the gender gap: Iceland (90%), Finland (86%), Norway (84.5%), and Sweden (82.2%). Besides these Scandinavian countries, the areas of the globe that are most close to closing the gender gap are North America (with an average score of 76.9%), Europe (76.6%), and Latin America and the Caribbean (72.6%). The region where the gap is widest is South Asia, with Pakistan and Afghanistan having the lowest parity scores worldwide (56.4% and 43.4%, respectively). In general, however, each area of the globe presents very different situations with much higher/lower than the mean values for

factors related to gender inequality such as sex-selective abortions, infanticide or birth registration problems.

[9]This ratio is obtained by comparing the maximum life expectancy for women reported in the UN Gender Related Development Index of 87.5 years and the corresponding value for men of 82.5.

[10]The arithmetic mean of the different non-standardised indicators would implicitly give more weight to the measure with the greatest variability (i.e. with the highest standard deviation value).

[11]For example, if the three indicators of a sub-domain had standard deviations of 0.10, 0.14, and 0.20, the corresponding ratios of 0.01 to the standard deviations would be 0.10, 0.07, and 0.05. The corresponding weights are obtained by relating each of these values to their total (0.10 + 0.07 + 0.05 = 0.22): 0.10/0.22 = 0.45; 0.07/0.22 = 0.32; 0.05/0.22 = 0.23.

some countries: Rwanda (Sub-Saharan Africa), for example, has a GGGI score of 81.1% and Nicaragua (Latin America and the Caribbean area) of 81.0%, ranking sixth and seventh in the world, respectively.

3 The United Nations Gender Development Index

The Gender Development Index (GDI) is a macroeconomic development indicator published in 1995 by the United Nations Development Programme (UNDP) to assess the quality of life of member countries (UNDP, 2022a). It measures gender inequalities concerning the achievement of three fundamental aspects of human development: an individual's health status (long and healthy life), education level (knowledge), and living conditions (standard of living). The GDI is an indicator derived from the Human Development Index (HDI), as it is given by the ratio of HDI indices calculated separately according to gender, and represents the HDI for the female gender as a percentage of the HDI for the male gender. The indicator was calculated for 174 countries (2021/22 edition), grouped into five groups based on the achieved level of gender equality.[12] To understand how the GDI is calculated, it is necessary to first specify a method for calculating the HDI (UNDP, 2022a).

3.1 The United Nations Human Development Index

The Human Development Index (HDI) measures average achievement in key dimensions of human development. According to the UNDP, necessary prerequisites for a person to fulfil themselves in life are: a long and healthy life, knowledge, and a decent standard of living (UNDP, 2020). Achieving high levels of HDI for a country means ensuring optimal conditions for its citizens to freely make their own life choices. The HDI considers three dimensions, each measured through a specific index and one global index, the HDI (Table 2). The long and healthy life dimension is measured by the life expectancy index, which is based on life expectancy at birth. The knowledge dimension is described by the education index which is derived from two elementary indicators (expected years of schooling and mean years of schooling). A decent standard of living is assessed using the gross national income index

[12]The five groups are identified on the basis of the absolute deviation of the Gender Development Index from gender equality, $100 \cdot |GDI - 1|$. Countries with values less than or equal to 2.5% are considered countries with high equality in HDI index results between women and men and are classified as group 1. Group 2 identifies countries with high average equality between the HDI indices of the two genders (values between 2.5% and 5%); Group 3 includes countries with average equality between the HDI indices of women and men (values between 5% and 7.5%); Group 4 identifies countries with low average equality of indicators (values between 7.5% and 10%); finally, Group 5 includes countries with low equality of HDI gender indicators (values above 10%).

Table 2 HDI dimension, indicators and data sources (UNDP, 2020)

Dimension	Dimension index	Indicator	Description	Minimum	Maximum	Data sources
Long and healthy life	Life expectancy index	Life expectancy at birth	Average number of years a newborn can expect to live based on the mortality rates recorded in the year in question	20 years	85 years	United Nations Department of Economic and Social Affairs (UNDESA)
Knowledge	Education index	Expected years of schooling	Average number of years of education a school-age child can expect to receive based on current enrolment rates	0 years	18 years	United Nations Educational, Scientific and Cultural Organization (UNESCO) Institute for Statistics; ICF Macro Demographic and Health Surveys; United Nations Children's Fund (UNICEF); Multiple Indicator Cluster Surveys; Organisation for Economic Co-operation and Development (OECD)
		Mean years of schooling	Average number of years of education an individual can expect to receive after the age of 25	0 years	15 years	UNESCO Institute for Statistics, Barro and Lee (2018), ICF Macro Demographic and Health Surveys, UNICEF Multiple Indicator Cluster Surveys and Organisation for Economic Co-operation and Development (OECD)
A decent standard of living	GNI index	Gross National income per capita	Gross National income per capita at purchasing power parity	100 USD	75,000 USD	World Bank, International Monetary Fund, United Nations Statistics Division

which is based on gross national income per capita in USD at parity of purchasing power (PPP). All three dimension indices were combined into the Human Development Index.

The HDI was constructed using a two-step process (UNDP, 2022b):

Calculation of indicators for each dimension. The life expectancy at birth indicator, the expected years of schooling indicator, and the mean years of schooling indicator are firstly normalised to a range between 0 and 1 through the min-max transformation:

$$ {}_jI_i^N = \frac{{}_jI_i - \min\left({}_jI\right)}{\max\left({}_jI\right) - \min\left({}_jI\right)} $$

being ${}_jI_i$ the score for the j-th indicator for the i-th country, $\max({}_jv)$ and $\min({}_jv)$ are the maximum and the minimum score for each indicator (goalposts) defined on the basis of realistic expectations and empirical evidence (Table 3). The life expectancy index corresponds exactly to the normalised life expectancy at birth indicator, whereas the education index is the arithmetic mean of the two normalised expected years of schooling and mean years of schooling indicators. To account for the marginally decreasing effect of higher income values, the GNI is obtained by normalising the natural logarithm (ln) of the actual, minimum, and maximum values of the GNI per capita at PPP:

$$ \mathrm{GNI}_i^N = \frac{\ln(\mathrm{GNI}_i) - \ln(100)}{\max(75{,}000) - \min(100)} $$

Aggregation of size indices to obtain the HDI index. Finally, the human development index results from the geometric mean of the three-dimensional indicators:

$$ \mathrm{HDI} = \left(I_{\text{Life Expectancy}} \cdot I_{\text{Education}} \cdot I_{\text{GNI}}\right)^{1/3} $$

The equal weighting of the three-dimensional indices in the calculation of the synthetic HDI index stems from the consideration that the three dimensions (long and healthy life, knowledge, and a decent standard of living) contribute in a balanced manner to human development. The use of a geometric mean instead of a simple arithmetic mean is linked to considerations regarding the lower compensatory effect of this aggregation method (OECD & JRC, 2008).

3.2 The United Nations Gender Development Index

The Gender Development Index (GDI) is derived from the HDI and is expressed as the ratio of the HDI of the female gender to that of the male gender. Although the

Table 3 HDI dimension, indicators, and data sources (UNDP, 2020)

Dimension	Dimension index	Indicator	Description	Data sources
Health	Female reproductive health index	Maternal mortality ratio (MMR)	Number of maternal deaths per 100,000 births in a given period due to complications of pregnancy or childbirth. The MMR is used to measure women's access to health care	World Health Organization (WHO), United Nations International Children's Emergency Fund (UNICEF), United Nations Population Fund (UNFPA), World Bank Group and United Nations Population Division
		Adolescent birth rate (ABR)	Number of births to women aged 15–19 per 1000 women in that age group. The ABR index measures early fertility, which poses health risks to mothers and children, as well as a lack of higher education	United Nations Department of Economic and Social Affairs (UNDESA)
Empowerment	Female/male empowerment index	Female and male population with at least secondary education (SE)	Proportion of women and men aged 25 years and over with at least a secondary school degree	United Nations Educational, Scientific and Cultural Organization (UNESCO) Institute for Statistics, Barro and Lee (2018)
		Female and male shares of parliamentary seats (PR)	Represents the representation of women in parliaments	Inter-Parliamentary Union (IPU)
Labour market	Female/male labour market index	Labour force participation rate (LFPR)	Share of the working age population, aged 15–64, of a country that is actively engaged in the labour market	International Labour Organization (ILO)

dimensions considered by the GDI are the same as those of the HDI, its calculation requires a gender breakdown of the four elementary indicators.

The main technical problem in calculating gender-specific indicators relates to the estimated earned income produced by women compared with that produced by men. The female wage bill share is calculated as follows (UNDP, 2020):

$$S_f = \frac{W_f/W_m \cdot EA_f}{W_f/W_m \cdot EA_f + EA_m}$$

where W_f/W_m is the ratio of female-to-male wages, EA_f represents the female share of the economically active population, and EA_m is the male share. The male share of salary is calculated as follows:

$$S_m = 1 - S_f.$$

The estimated female per capita income $\left(\text{GNI}_{pc_f}\right)$ is obtained from the Gross National Income per capita (GNI_{pc}) first multiplied by the female wage share S_f and then divided by the female share of the population, $P_f = N_f/N$:

$$\text{GNI}_{pc_f} = \text{GNI}_{pc} \cdot S_f/P_f.$$

The estimated male per capita income is obtained in the same way:

$$\text{GNI}_{pc_m} = \text{GNI}_{pc} \cdot S_m/P_{m.}$$

where $P_m = 1 - P_f$ is the male population share.

The indicators were normalised separately by gender using the same procedure described in the previous paragraph and using the same minimum and maximum values as those used for the construction of the HDI, except for life expectancy at birth, whose goalposts are set at 22.5–87.5 for females and 17.5–82.5 for males. The values of the female and male HDI indices are given by the geometric mean of the size indices for each sex:

$$\text{HDI}_f = \left(I_{\text{Health}_f} \cdot I_{\text{Education}_f} \cdot I_{\text{Income}_f}\right)^{1/3}$$

$$\text{HDI}_m = \left(I_{\text{Health}_m} \cdot I_{\text{Education}_m} \cdot I_{\text{Income}_m}\right)^{1/3}$$

and the Gender Development Index is expressed as the ratio of the HDI of the female gender to that of the male gender:

$$\text{GDI} = \frac{\text{HDI}_f}{\text{HDI}_m}$$

It may occur (and in practice, it does) that the GDI takes values greater than 1 (or 100%) if $\text{HDI}_f > \text{HDI}_m$.

The latest GDI report (UNDP, 2022a) reports a global value of 95.8% and identifies 'Latin America and the Caribbean' as the region with the highest GDI with a score of 98.6%, followed by 'East Asia and the Pacific' with 97.8%, 'Europe and Central Asia' with 96.1%, 'Sub-Saharan Africa' with 90.7%, 'Arab States' with 87.1%, and 'South Asia' with 85.2%.

4 The United Nations Gender Inequality Index

The Gender Inequality Index (GII) is another indicator promoted by the United Nations to assess the development of member countries (UNDP, 2022a). It represents an index of inequality that measures gender-based disadvantages with respect to three fundamental dimensions of human development: health, empowerment, and labour market. The GII is derived from the Inequality-adjusted Human Development Index (IHDI), an indicator given by the geometric mean of the previously analysed dimensional indices but adjusted for inequality (UNDP, 2022b). The GII provides a better explanation for the differences in the distribution of the results of the basic indices between men and women. The GII varies between 0 and 1: the higher its value, the greater the gender inequality and loss in human development.

Each of the dimensions mentioned above can be expressed through appropriate indicators that are necessary for the calculation of GII (Table 4).

GII is constructed using a five-step process (UNDP, 2022b):

Treatment of zeros and extreme values. The GII extensively uses geometric and harmonic means to construct synthetic measures of elementary indicators because of the peculiar characteristics of these methods (OECD and JRC, 2008). Because it was not possible to calculate the geometric mean with zero values, a minimum value of 0.1% was set for all the sub-indicators listed above. In addition, the maximum value for the maternal mortality ratio was set at 1000 deaths per 100,000 births and the minimum value at 10. This choice stems from the fact that it is reasonable to assume that countries with maternal mortality ratios above 1000 deaths do not differ in their ability to create more or less favourable conditions for maternal health. Similarly, in countries with 10 or fewer deaths, the differences can be attributed to chance.

Aggregating across dimensions within each gender group, using geometric means. Indicators were aggregated for each sex by using the geometric mean. For females, the aggregation is derived from the following formula:

$$G_F = \sqrt[3]{\left(\frac{10}{\text{MMR}} \cdot \frac{1}{\text{ABR}}\right)^{\frac{1}{2}\cdot(PR_F \cdot SE_F)^{\frac{1}{2}\cdot \text{LFPR}_F}}},$$

while for the male gender, the formula is:

Table 4 List of indicators of the Gender Equality Index (EIGE, 2022)

Domain	Sub-domain	No	Indicator and reference population	Description	Source
Work	Participation	1	Full-time equivalent employment rate (%, 15+ population)	The FTE employment rate is a unit to measure employed people in a way that makes them comparable even though they may work a different number of hours per week. A full-time worker is counted as one FTE, while a part-time worker gets a score in proportion to the hours they work	Eurostat, EU LFS, EIGE's calculation using microdata
		2	Duration of working life (years, 15+ population)	The duration of working life indicator measures the number of years a person aged 15 is expected to be active in the labour market throughout their life	Eurostat, EU-LFS (lfsi_ dwl_a)
	Segregation and quality of work	3	People employed in education, human health and social work activities (%, 15+ workers)	Percentage of people employed in education and in human health and social work economic activities out of total employed (based on NACE rev. 2)	Eurostat, EU-LFS (lfsa_ egan2)
		4	Ability to take an hour or two off during working hours to take care of personal or family matters (%, 15+ workers)	Percentage of people who consider it 'very easy' to take an hour or two off during working hours to take care of personal or family matters	Eurofound, EWCS, EIGE's calculation using microdata

(continued)

Table 4 (continued)

Domain	Sub-domain	No	Indicator and reference population	Description	Source
		5	Career prospects index (points, 0–100)	The Career Prospects Index combines the indicators of employment status (self-employed or employee), type of contract, prospects for career advancement as perceived by the worker, perceived likelihood of losing one's job and experience of downsizing in the organisation. It is measured on a scale from 0 to 100, where the higher the score is, the higher the job quality is	Eurofound, EWCS, EIGE's calculation using microdata
Money	Financial resources	6	Mean monthly earnings (PPS, working population)	Mean monthly earnings in PPS, in the sectors of industry, construction and services (except public administration, defence, compulsory social security) (NACE_R2: B-S_X_O, total age group, working in companies of 10 employees or more)	Eurostat, SES (earn_ses10_20), (earn_ses14_20), (earn_ses18_20)
		7	Mean equivalised net income (PPS, 16+ population)	Equivalised disposable income in PPS is the total income of a household, after tax and other deductions, available for spending	Eurostat, EU-SILC (ilc_di03)

(continued)

Table 4 (continued)

Domain	Sub-domain	No	Indicator and reference population	Description	Source
				or saving, divided by the number of household members converted into equalised adults	
	Economic situation	8	Not at risk of poverty,[3] 60% of median income (%, 16+ population)	Reverse indicator of 'at-risk-of-poverty rate'.	Eurostat, EU-SILC (ilc_li02)
		9	S20/S80 income quintile share (16+ population)	Calculated as 1/'S80/S20 income quintile share ratio' × 100	Eurostat, EU-SILC, Eurostat calculations at EIGE's request
Knowledge	Attainment and participation	10	Graduates of tertiary education (%, 15+ population)	Educational attainment measures the share of people with a high level of education among men and women. People with tertiary education as their highest successfully completed level (levels 5–8), percentage of total 15+ population	Eurostat, EU-LFS, EIGE's calculation using microdata
		11	People participating in formal or non-formal education and training (%, 15+ population)	Percentage of people participating in formal or non-formal education and training out of total 15+ population	Eurostat, EU-LFS, EIGE's calculation using microdata
	Segregation	12	Tertiary students in the fields of education, health and welfare, humanities and the arts (tertiary students) (%, 15+ population)	Percentage of people who are studying F01—education, F02—arts and humanities and F09—health and welfare, in ISCED 5–8 levels of education	Eurostat, education statistics (educ_enrl5), (educ_uoe_enrt03)

(continued)

Table 4 (continued)

Domain	Sub-domain	No	Indicator and reference population	Description	Source
Time	Care activities	13	People caring for and educating their children or grandchildren, elderly people, or people with disabilities, every day (%, 18+ population)	Percentage of people involved in at least one of these caring activities outside of paid work every day: care for children, grandchildren, elderly people, or disabled people	Eurofound, EQLS, EIGE's calculation using microdata
		14	People doing cooking and/ or housework, every day (%, 18+ population)	Percentage of people involved in cooking and/ or housework outside of paid work, every day	Eurofound, EQLS, EIGE's calculation using microdata
	Social activities	15	Workers doing sporting, cultural or leisure activities outside of their home, at least daily or several times a week (%, 15+ workers)	Percentage of working people doing sporting, cultural or leisure activities at least every other day (daily + several times a month out of the total)	Eurofound, EWCS, EIGE's calculation using microdata
		16	Workers involved in voluntary or charitable activities, at least once a month (%, 15+ workers)	Percentage of working people involved in voluntary or charitable activities, at least once a month	Eurofound, EWCS, EIGE's calculation using microdata
Power	Political	17	Share of ministers (% of women, men)	Share of ministers	EIGE, Gender Statistics Database, WMID
		18	Share of members of parliament (% of women, men)	Share of members of parliament	EIGE, Gender Statistics Database, WMID
		19	Share of members of regional assemblies (% of women, men)	Share of members of regional assemblies	EIGE, Gender Statistics Database, WMID
	Economic	20	Share of members of boards in largest quoted companies, supervisory board or board of	Share of members of boards in largest quoted companies	EIGE, Gender Statistics Database, WMID

(continued)

Table 4 (continued)

Domain	Sub-domain	No	Indicator and reference population	Description	Source
			directors (% of women, men)		
		21	Share of board members of central bank (% of women, men)	Share of board members of central bank	EIGE, Gender Statistics Database, WMID
	Social	22	Share of board members of research funding organisations (% of women, men)	Members of the highest decision-making bodies of research funding organisations	EIGE, Gender Statistics Database, WMID
		23	Share of board members in publicly owned broadcasting organisations (% of women, men)	Share of board members in publicly owned broadcasting organisations	EIGE, Gender Statistics Database, WMID
		24	Share of members of highest decision- making body of the national Olympic sport organisations (% of women, men)	Share of members of highest decision-making body of the 10 most popular national Olympic sport organisations	EIGE, Gender Statistics Database, WMID
Health	Status	25	Self-perceived health, good or very good (%, 16+ population)	Percentage of people assessing their health as 'very good' or 'good' out of total	Eurostat, EU SILC (hlth_ silc_01)
		26	Life expectancy in absolute value at birth (years)	Life expectancy at a certain age is the mean additional number of years that a person of that age can expect to live	Eurostat (hlth_hlye)
		27	Healthy life years in absolute value at birth (years)	Healthy life years measures the number of remaining years that a person of a specific age is expected to live without any severe or	Eurostat (hlth_hlye)

(continued)

Table 4 (continued)

Domain	Sub-domain	No	Indicator and reference population	Description	Source
				moderate health problems	
	Behaviour	28	People who do not smoke and are not involved in harmful drinking (%, 16+ population)	Percentage of people who are not involved in risk behaviour, i.e. don't smoke and are not involved in heavy episodic drinking	Eurostat, EHIS. Eurostat calculations at EIGE's request
		29	People doing physical activities and/or consuming fruit and vegetables (%, 16+ population)	Percentage of people who are physically active for at least 150 minutes per week and/ or consume at least five portions of fruit and vegetables per day	Eurostat, EHIS. Eurostat calculations at EIGE's request
	Access	30	Population without unmet needs for medical examination (%, 16+ population)	Self-reported unmet needs for medical examination	Eurostat, EU SILC (hlth_ silc_08)
		31	People without unmet needs for dental examination (%, 16+ population)	Self-reported unmet needs for dental examination	Eurostat, EU SILC (hlth_ silc_09)

$$G_M = \sqrt[3]{1 \cdot (PR_M \cdot SE_M)^{½ \cdot \mathrm{LFPR}_M}}$$

Aggregation between gender groups, using the harmonic mean. The female and male indices were aggregated using the harmonic mean to create an equally distributed gender indicator:

$$\mathrm{HARM}(G_F, G_M) = \left[\frac{(G_F)^{-1} + (G_M)^{-1}}{2}\right]^{-1}$$

Using the harmonic mean of within-group geometric means captures the inequality between women and men and adjusts for the association between dimensions, that is, it accounts for the overlapping inequalities in dimensions.

Calculation of the geometric mean of the arithmetic means for each indicator. The standard to be used for the calculation of gender inequality is obtained by aggregating the female and male indicators using equal weights (i.e. treating both genders equally) and aggregating the indices across dimensions:

$$G_{\overline{F},\overline{M}} = \sqrt[3]{\overline{\text{Health}} \cdot \overline{\text{Empowerment}} \cdot \overline{\text{LFPR}}}$$

where:

$$\overline{\text{Health}} = \left(\sqrt{\frac{10}{\text{MMR}} \cdot \frac{1}{\text{ABR}}} + 1 \right) / 2,$$

$$\overline{\text{Empowerment}} = \frac{\sqrt{PR_F \cdot SE_F} + \sqrt{PR_M \cdot SE_M}}{2}$$

$$\overline{\text{LFPR}} = \frac{\text{LFPR}_F + \text{LFPR}_M}{2}$$

The $\overline{\text{Health}}$ index is not given by the average of the corresponding male and female indices but should be interpreted as half the distance to the standards set for the reproductive health sub-indicators: fewer maternal deaths and fewer teenage pregnancies.

Calculation of the GII Index. Finally, the GII is given by:

$$\text{GII} = 1 - \frac{\text{HARM}(G_F, G_M)}{G_{\overline{F},\overline{M}}}$$

The GII can take values from 0 (lowest degree of inequality) to 1 (highest degree of inequality).

In the latest available edition of the index (UNDP, 2022a), the global score is 0.465, and the countries with the lowest GII are Denmark (0.013), Norway (0.016), Switzerland (0.018), Sweden (0.023), the Netherlands (0.025), and Finland (0.033). The countries with the highest scores are Chad (0.652), the Central African Republic (0.672), Afghanistan (0.678), Nigeria (0.680), Papua New Guinea (0.725), and Yemen (0.820). At the regional level, the ranking was as follows: Europe and Central Asia (0.227), East Asia and the Pacific (0.337), Latin America and the Caribbean (0.381), South Asia (0.508), Arab States (0.536), and Sub-Saharan Africa (0.569).

5 The Gender Equality Index of the European Institute for Gender Equality

The Gender Equality Index (GEI) of the European Institute for Gender Equality (EIGE) assesses progress in gender equality relative to the EU policy context. Specifically, the EIGE's GEI measures the distance between the EU and its member states to achieve gender equality. The theoretical framework of the GEI considers eight dimensions, but only six are used to construct the synthetic indicator of gender equality: work, money, knowledge, time, power, and health. In addition, the violence domain describes gender-based violence and the Intersectional Inequalities domain studies gender inequality within specific population groups (people with disabilities, migrants, etc.), but these two domains are not directly considered in the GEI calculation. The 31 variables used to measure the GEI originate from seven data sources, five sample surveys, and two official Eurostat databases:

- European Union Labour Force Survey (EU-LFS, source: Eurostat)
- European Working Conditions Surveys (EWCS, source: Eurofound)
- European Quality of Life Survey (EQLS, source: Eurofound)
- European Union Survey on Income and Living Conditions (EU-SILC, source: Eurostat)
- European Health Interview Survey (EHIS, European Health Survey, source: Eurostat)
- Education statistics database (source: Eurostat)
- Women and men in decision-making (WMDM, source: EIGE, Gender Statistics Database)

The 31 variables define 31 sub-indicators, divided into 14 sub-dimensions representing the 6 main dimensions (Table 1) of EIGE's GEI, synthesised in a single indicator. EIGE's GEI was constructed using a four-step process (EIGE, 2017):

Calculation of Gender Gaps The first step in constructing EIGE's GEI is to calculate the gender gaps $\Upsilon_{(X_{it})}$ for each country and variable:

$$\Upsilon_{(X_{it})} = \left| \frac{\tilde{X}_{it}^{W}}{\tilde{X}_{it}^{a}} - 1 \right|$$

The calculation is carried out for a variable X relative to an i-th country in the time period t, in order to obtain scores for women $(\tilde{X}_{it}^{W})$ compared to the average of the values taken by the same variable for women and men $(\tilde{X}_{it}^{a})$ or the total $\left(\tilde{X}_{it}^{T}\right)$ in the same country and reference period.

The absolute value of the gender gap is taken into account in such a way as to avoid offsetting effects between women and men. In fact, a country might score high on gender equality only because the negative performance of women in one variable is compensated for by the equally low performance of men in another variable. For

reasons of interpretability, the indicator is subsequently reversed by considering its complementary value: $1 - \Upsilon_{(X_{it})}$. The gender gap is a relative indicator in the range [0,1], where 1 indicates the achievement of complete gender equality, and any value below 1 expresses some degree of inequality between women and men.

Calculation of the Correction Coefficient The correction coefficient $\propto_{(X_{it})}$ represents a further element of transformation of the original variables that makes it possible to consider the specific country context by comparing the scores countries have achieved for each indicator. These coefficients make it possible to contextualise the gender equality results that each country achieved in comparison to other European countries. Given a time interval (e.g. scores for indicators for 2005, 2010, 2012, and 2015, as in the case shown below), the correction coefficient for a given indicator can be formulated as follows:

$$\propto_{(X_{it})} = \left(\frac{\tilde{X}_{it}^{T}}{\max\left\{ \tilde{X}_{i2005}^{T}, \tilde{X}_{i2010}^{T}, \tilde{X}_{i2012}^{T}, \tilde{X}_{i2015}^{T} \right\}} \right)^{1/2}$$

where $\max\left\{ \tilde{X}_{i2005}^{T}, \tilde{X}_{i2010}^{T}, \tilde{X}_{i2012}^{T}, \tilde{X}_{i2015}^{T} \right\}$ the maximum values observed for the indicator in the years considered in relation to the various EU-28 countries.

Correction coefficients were applied to most of the variables. Indicators in the power domain were not corrected because they represent percentages. This means, for example, that perfect equality is only achieved when women and men are equally represented.

Calculation of Initial Metrics The metric combining the values of each variable for women and men, $\Gamma_{(x_{it})}$, can be expressed as:

$$\Gamma_{(X_{it})} = 1 + \left[\propto_{(X_{it})} \cdot \left(1 - \Upsilon_{(X_{it})} \right) \right] \cdot 99$$

This metric has no measurement units and a range of variation between 1 and 100. A value of 100 indicates the achievement of gender equality, whereas a value of 1 denotes the presence of absolute inequality between women and men. Therefore, the metric removes any distortions arising from the presence of different scales or units of measurement, making all indicators comparable to the various domains, sub-domains, countries, and time considered in the analysis.

Calculation of sub-domain, domain, and GEI indices. The procedure proposed by the EIGE involves aggregating the indices at the subdomain level through an unweighted arithmetic mean. The synthesis of the sub-domain indicators into domain indicators is obtained through an unweighted geometric mean, whereas the GEI index is obtained as a weighted geometric mean of the domain indicators with a vector of weights, determined by a panel of experts, equal to work = 0.19, money = 0.15, knowledge = 0.22, time = 0.15, power = 0.19, health = 0.10. The final GEI metric for i-th ($i = 1, \ldots, 27$) country in s given year t is

$$\mathrm{GEI}_i^t = \prod_{d=1}^{6} \left(\prod_{s=1}^{ns_d} \left(\frac{1}{nv_{s_d}} \sum_{v=1}^{nv_{s_d}} \Gamma(X_{itv}) \right)^{\frac{1}{ns_d}} \right)^{w_{\mathrm{AHP}_d}}$$

where d is the identifier of the six domains, s is the subdomain identifier per domain, ns_d is the number of subdomains in the d-th domain, nv_{s_d} is the number of indicators in the s-th subdomain of the d-th domain, v is the identifier of the v-th variable, and w_{AHP_d} is the expert-defined weight for the d-th domain. EIGE's GEI can take values from 0 (lowest degree of equality) to 100 (highest degree of equality).

In the latest available edition of the index (EIGE, 2022), the average GEI score for the EU is 68.6, grown by 5.5 points since 2010. The countries with the highest scores were Sweden (83.9), Denmark (77.8), the Netherlands (77.3), Finland (75.4), and France (75.1), whereas those with the lowest scores were Greece (53.4), Romania (53.7), and Hungary (54.2). The countries that improved most of their scores since 2010 were Luxemburg (+10.2), Italy (+11.7), and Malta (+11.2), whereas lower improvements were recorded for the Czech Republic (1.6), Hungary (+1.8), and Finland (+2.3). The domain of power is the driving force for gender equality in almost all Member States. In 15 Member States it has determined more than 60% of the progress made since the 2021 Index. Luxembourg (+ 6.3 points), Lithuania (+ 6.1 points), and Belgium (+ 6.0 points) made the most headway to gender balance in decision-making.

6 Conclusions

In this chapter, we concisely present the long process that led to the definition of gender (in)equality measures and some of the most significant internationally used indicators. The review proposed here is not exhaustive, but has been constructed to provide an understanding of the most common approaches to measuring gender (in)equality to date. At the end of this discussion, some interesting insights emerged.

Firstly, it can be observed that the indicators herein discussed are sex-based rather than gender-based indicators. Sex refers to the set of biological attributes of humans and animals. Gender refers to the socially constructed roles, behaviours, expressions, and identities of girls, women, boys, men, and gender-diverse people. Recently, attempts have been made to measure gender-and non-sex-based (in)equalities. However, since sexual identity is an aspect that is part of people's personal and subjective spheres, it is difficult to find data, especially on international scales, that allow for the actual quantification of such a form of (in) equality.

The second point is related to the common feature of the indicators presented herein using systems of indicators that are subsequently aggregated into synthetic indicators. Using batteries of indicators is a crucial element for measuring the different components of gender equality. Each indicator provides information on gender (in)equality, which is related but different from that provided by the other indicators. The use of articulated sets of indicators also allows for a better assessment

of progress in reducing inequalities, thereby avoiding the risk of policies aimed at the specific improvement of a few key indicators. A common adage often used in this context is the 'Goodhart's Law', which, in its 1997 version by Strathern (1997), quotes 'When a measure becomes a target, it ceases to be a good measure'. Goodhart was a British economist who, in 1975, commented on some of the Thatcher government's policies and pointed out the error in defining policies to be monitored based on specific targets. In other words, policy actions should improve the context in which the indicators are measured and not make up the indicator. Typical examples include indicators of women's political empowerment. Legislation mandating equal representation of women in legislative assemblies is common in several countries, and undoubtedly brings benefits in terms of gender equality. However, the corresponding indicator shows parity dictated by normative impositions and not a social context leading to equal gender representation in legislative bodies. The loss of the index's indicating capacity becomes evident when one looks at side indicators to those that have become a target, such as 'women presidents of parliamentary commissions', which, in most countries with law-enforced gender parity in the number of parliamentary seats, reveals that the gender gap in political empowerment still persists. Therefore, the target seems to have been reached, but the problem of unequal gender-based political empowerment is not solved, and the 'good' indicator loses most of its original meaning.

Another relevant point concerns the object of measurement, which is not always the same for all indicators presented here. In some cases, the intention is to measure some degree of inequality (e.g. GGGI and GEI); in other cases, an attempt is made to assess the existence of equal opportunities for women and men (e.g. GDI and GII). Equal opportunities are now a fundamental standard for measuring (in)equalities (see, among others, Sen, 1995). However, the idea that equality between men and women is reached when women make choices identical to men is as forced as believing that there is equality if all boys play football and none play basketball. When we examine the gender (in)equality picture in a broader way, it can be seen that these indicators focus on the output of inequality rather than its causes. In an ideal world, everyone should have the same opportunity to freely make choices that could even result in a legitimate difference between men and women. Gender inequality stems from cultural problems and long-established stereotypes about the roles of women and men in society. Cultural change is slow, taking generations to accomplish, and it is not surprising that the timeframe for closing the gender gap is secular; we have to wait for the prejudices of current generations to be overcome by future generations. Therefore, one has to wonder whether today's society feeds or fights these prejudices and whether we are building a world where boys and girls are freer to make their own choices than their parents and grandparents. The perpetuation of gender prejudice and stereotypes is one of the main limitations of cultural renewal. The family context is undoubtedly the most critical one, but besides this, consider two other socially relevant environments: virtual social media and real social media. Algorithms that define what content to show to social media users follow commercial principles that reaffirm established prejudices in mass culture and feed a strongly gender-biased market. What ethical criteria do the algorithms follow?

Is it possible to imagine a way of exploiting them to prevent stereotypes from being repeated, and hence perpetuating the conditions that have led to today's gender inequality? Even the working environment can perpetuate gender inequality. In a masculinist organisational system, decision-making is heavily centralised, and the chain of command is highly hierarchical. The prolonged absence of a key member from this system (e.g. for parenthood) becomes a problem for the company. A feminist organisational system envisages a diffuse distribution of competencies in which all employees are important, but the absence of a member, even for prolonged periods, can be easily dealt with, and the company structure itself simplifies the reintegration of the employee after parental leave. If women are left with the burden of caring for their homes and children, and if the organisational model is a masculinist one, it is clear that they are disadvantaged. A question that can be asked is whether the reduction of a gender wage gap indicator corresponds to an improvement in women's opportunities in the labour market or whether women make an additional effort to achieve better results in an environment that is hostile to them. These indicators do not tell us, or do so only in part. The indicators proposed in the literature fail to measure something more complex than the output of gender (in)equality or to capture those aspects of the genuine progress of society towards a condition of equal opportunity between men and women. In other words, these indicators do not try to understand whether a cultural change leading to gender inequality reduction is taking place or the strength of the power of gender stereotypes and prejudices in society. It is clearly a measurement problem, a technical limitation for the construction of indicators, linked to our inability to know the choices that each person would like to take, in contrast with the one that they make.

A third point that emerges from the review of the indicators presented here concerns the completeness of the construct 'gender (in)equality' definition. Although it is theoretically possible to develop the concept across different domains, the operationalisation process leading to the identification of the indicators to be used to measure this concept is severely limited by data availability. The presence of the Eurostat in the EU has allowed the development of a homogeneous system of statistics in member countries that makes complex comparative analyses possible. It should, therefore, come as no surprise that an analysis conducted in a limited area such as the EU can go into much greater detail than when the study area is the whole world. When the focus is moved to a global scale, with countries that do not possess solid national statistical offices, the number of indicators that can be used to describe gender (in)equality is limited.

Other critical aspects concern the interpretation of gender (in)equality indicators. Being mostly female-to-male ratios, in some cases the rankings may produce unexpected results. Consider two countries with very different levels of human development: one with a high score and the other with a low HDI score. A country with a lower HDI may have a higher rank in terms of gender (in)equality than a country with a higher HDI if the women living in the first country are, in proportion to men, less disadvantaged than women in the other country, even if they have much lower indicator scores than the latter. As a purely illustrative example, consider Country A, with an average income of $1000 for women and $1200 for men, and

Country B, with average incomes of €10,000 and €13,000 for women and men, respectively. Country A, with a female-to-male ratio of 0.83, is ranked higher than Country B, with a ratio of 0.77. Another element that needs to be considered when interpreting gender (in)equality data is how to interpret the improvement of an indicator. Of course, and it is the standard interpretation, a gender-based index may record an improvement when women's conditions ameliorate compared to men's. However, it is also possible that the improvement in the gender-based indicator is linked to a worsening of male indicators, which is greater than the worsening of female indicators. Reading and interpreting the data on indicators of gender (in)equality always requires caution.

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Gender Equality as EU Strategy

Sara Preti and Enrico di Bella

1 The EU Framework on Gender Equality

Gender equality is an increasingly topical issue, but it has deep historical roots. The principle of gender equality found its legitimacy, even if limited to salary, in the 1957 Treaty of Rome, establishing the European Economic Community (EEC). This treaty, in Article 119, sanctioned the principle of equal pay between male and female workers. The EEC continued to protect women's rights in the 1970s through equal opportunity policies. These policies referred, first, to the principle of equal treatment between men and women regarding education, access to work, professional promotion, and working conditions (Directive 75/117/EEC); second, to the principle of equal pay for male and female workers (Directive 76/207/EEC); and finally, enshrined the principle of equal treatment between men and women in matters of social security (Directive 79/7/EEC). Since the 1980s, several positive action programmes have been developed to support the role of women in European society. Between 1982 and 2000, four multiyear action programmes were implemented for equal opportunities. The first action programme (1982–1985) called on the Member States, through recommendations and resolutions by the Commission, to disseminate greater knowledge of the types of careers available to women, encourage the presence of women in decision-making areas, and take measures to reconcile family and working life.[1] The second action programme (1986–1990) proposed

[1] De Vivo, A. *Uno sguardo di genere sull'Europa: cinquant'anni di politiche di genere*, edited by Fondazione Nilde Iotti

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interventions related to the employment of women in activities related to new technologies and interventions in favour of the equal distribution of professional, family, and social responsibilities (Sarcina, 2010). The third action programme (1991–1995) provided an improvement in the condition of women in society by raising public awareness of gender equality, the image of women in mass media, and the participation of women in the decision-making process at all levels in all areas of society. The fourth action programme (1996–2000) strengthened the existing regulatory framework and focused on the principle of gender mainstreaming, a strategy that involves bringing the gender dimension into all community policies, which requires all actors in the political process to adopt a gender perspective. The strategy of gender mainstreaming has several benefits: it places women and men at the heart of policies, involves both sexes in the policymaking process, leads to better governance, makes gender equality issues visible in mainstream society, and, finally, considers the diversity among women and men.[2] Among the relevant interventions of the 1990s, it is necessary to recall the Treaty of Maastricht (1992) which guaranteed the protection of women in the Agreement on Social Policy signed by all Member States (except for Great Britain), and the Treaty of Amsterdam (1997), which formally recognised gender mainstreaming. The Treaty of Amsterdam includes gender equality among the objectives of the European Union (Article 2) and equal opportunity policies among the activities of the European Commission (Article 3). Article 13 introduces the principle of non-discrimination based on gender, race, ethnicity, religion, or handicaps. Finally, Article 141 amends Article 119 of the EEC on equal treatment between men and women in the workplace. The Charter of Fundamental Rights of the Nice Union of 2000 reaffirms the prohibition of 'any discrimination based on any ground such as sex' (Art. 21.1). The Charter of Fundamental Rights of the European Union also recognises, in Article 23, the principle of equality between women and men in all areas, including employment, work, and pay. Another important intervention of the 2000s is the Lisbon strategy, also known as the Lisbon Agenda or Lisbon Process. It is a reform programme approved in Lisbon by the heads of state and governments of the member countries of the EU. The goal of the Lisbon strategy was to make the EU the most competitive and dynamic knowledge-based economy by 2010. To achieve this goal, the strategy defines fields in which action is needed, including equal opportunities for female work.[3] Another treaty that must be mentioned is that of Lisbon in 2009, thanks to which previous treaties, specifically the Treaty of Maastricht and the Treaty of Rome, were amended and brought together in a single document: the Treaty on European Union (TEU) and the Treaty on the Functioning of the European Union (TFEU). Thanks to the Lisbon Treaty, the Charter of Fundamental Rights has

[2]Council of Europe (1998). *Gender Mainstreaming: Conceptual framework, methodology and presentation of good practices.* Available at: http://www.unhcr.org/3c160b06a.pdf

[3]The other core thematic areas recognised by the Lisbon strategy are innovation and entrepreneurship, welfare reform and social inclusion, human capital and job retraining, liberalisation of labour and product markets, and, finally, sustainable development.

assumed a legally binding character (Article 6, paragraph 1 of the TEU) both for European institutions and for Member States when implementing EU law. The Treaty of Lisbon affirms the principle of equality between men and women several times in the text and places it among the values and objectives of the union (Articles 2[4] and 3 of the TEU). Furthermore, the Treaty, in Art. 8 of the TFEU, states that the Union's actions are aimed at eliminating inequalities, as well as promoting equality between men and women, while Article 10 of the TFEU provides that the Union aims to 'combat discrimination based on sex, racial or ethnic origin, religion or belief, disability, age, or sexual orientation'. Concerning the principle of gender equality in the workplace, the Treaty, in Article 153 of the TFEU, asserts that the Union pursues the objective of equality between men and women regarding labour market opportunities and treatment at work. On the other hand, Article 157 of the TFEU confirms the principle of equal pay for male and female workers 'for equal work or work of equal value'. On these issues, through ordinary procedures, the European Parliament and the Council may adopt appropriate measures aimed at defending the principle of equal opportunities and equal treatment for men and women. The Lisbon Treaty also includes provisions relating to the fight against trafficking in human beings, particularly women and children (Article 79 of the TFEU), the problem of domestic violence against women (Article 8 of the TFEU), and the right to paid maternity leave (Article 33). Among the important documents concerning gender equality is the Roadmap (2006–2010). In 2006, the European Commission proposed the Roadmap for equality between women and men,[5] in addition to the priorities on the agenda, the objectives, and tools necessary to achieve full gender equality. The Roadmap defines six priority areas, each of which is associated with a set of objectives and actions that makes it easier to achieve them. The priorities include equal economic independence for women and men, reconciliation of private and professional life, equal representation in the decision-making process, eradication of all forms of gender-based violence, elimination of stereotypes related to gender, and promotion of gender equality in external and development policies.[6] The Commission took charge of the commitments included in the Roadmap, which were indirectly implemented by the Member States through the principle of subsidiarity and the competencies provided for in the Treaties (Gottardi, 2013). The 2006–2010 strategy of the European Commission is based on a dual approach: on the one hand, the integration of the gender dimension in all community

[4] 'The Union is founded on the values of respect for human dignity, freedom, democracy, equality, the rule of law and respect for human rights, including the rights of persons belonging to minorities. These values are common to the Member States in a society in which pluralism, non-discrimination, tolerance, justice, solidarity, and equality between women and men prevail' (TEU, Article 2).

[5] The Roadmap for Gender Equality (2006–2010) derives from the framework strategy for equality between women and men (2001–2005) and takes stock of this strategy, underlining the improvements required.

[6] For further details, see the Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions, titled 'A Roadmap for equality between women and men 2006–2010' (COM (2006) 92).

policies and actions (gender mainstreaming), and on the other, the implementation of specific measures in favour of women aimed at eliminating inequalities. In 2006, the European Council approved the European Pact for Gender Equality which originated from the Roadmap. The European Pact for Gender Equality identified three macro areas of intervention: measures to close gender gaps and combat gender stereotypes in the labour market, measures to promote a better work–life balance for both women and men, and measures to strengthen governance through the integration of the gender perspective into all policies. In 2006, Directive 2006/54/EC of the European Parliament and Council regulated equal opportunities and equal treatment between male and female workers.[7] Specifically, the Directive aims to implement the principle of equal treatment related to access to employment, professional training, and promotion; working conditions, including pay; and occupational social security approaches.[8] On 21 September 2010, the European Commission adopted a new strategy to ensure equality between women and men (2010–2015). This new strategy is based on the experience of Roadmap (2006–2010) and resumes the priority areas identified by the Women's Charter[9]: equal economic independence, equal pay, equality in decision-making,[10] the eradication of all forms of violence against women, and the promotion of gender equality and women's empowerment beyond the union. The 2010–2015 Strategic Plan aims to improve the position of women in the labour market, but also in society, both within the EU and beyond its borders. The new strategy affirms the principle that gender equality is essential to supporting the economic growth and sustainable development of each country. In 2010, the validity of the Lisbon Strategy ended, the objectives of which were only partially achieved due to the economic crisis. To overcome this crisis, the Commission proposed a new strategy called Europe 2020, in March 2010. The main aim of this strategy is to ensure that the EU's economic recovery is accompanied by a series of reforms that will increase growth and job creation by 2020. Specifically, Europe's 2020 strategy must support smart, sustainable, and inclusive growth. To this end, the EU has established five goals to be achieved by 2020 and has articulated the different

[7] Directive 2006/54/EC derives from the Roadmap and the European Stability Pact.

[8] For further details, see Directive 2006/54/EC of the European Parliament and of the Council of 5 July 2006 on the implementation of the principle of equal opportunities and equal treatment of men and women in matters of employment and occupation, available at DIRECTIVE 2006/54/EC.

[9] It is a declaration by the European Commission which renews its commitment to promoting the principle of equality between women and men, in Europe and the rest of the world. The Women's Charter was adopted on the 2010 International Women's Day and in commemoration of the 15th anniversary of the UN World Conference on Women. See the Communication from the Commission COM (2010) 0078 for more details.

[10] Concerning equality of decision-making, the Commission notes that in most member countries, women continue to be under-represented in decision-making places and company management, both in the public and private sectors, despite making up almost half of the workforce and more than half of the new university graduates (Chamber of Deputies, Gender equality: initiatives of the parliaments of the European Union, n. 107 XVI Legislature, 25 September 2012).

types of growth (smart, sustainable, and inclusive) in seven flagship initiatives.[11] Among the latter, the initiative 'an agenda for new skills and jobs', in the context of inclusive growth, is the one most closely linked to gender policies and equal opportunities; in fact, it substantially aims to increase employment rates for women, young, and elderly people. The strategic plan for 2010–2015 was followed by a strategic commitment in favour of gender equality 2016–2019, which again emphasises the five priority areas defined by the previous plan. Strategic commitment, which contributes to the European Pact for Gender Equality (2011–2020),[12] identifies the key actions necessary to achieve objectives for each priority area. In March 2020, the Commission presented a new strategic plan for equality between women and men for 2020–2025. This strategy defines a series of political objectives and key actions aimed at achieving a 'union of equality' by 2025. The main objectives are to put an end to gender-based violence and combat sexist stereotypes, ensure equal opportunities in the labour market and equal participation in all sectors of the economy and political life, solve the problem of the pay and pension gap, and achieve gender equality in decision-making and politics.[13] From the summary of the regulatory framework presented, for the European Economic Community first, then for the European Community, and finally for the European Union, gender equality has always been a fundamental value. Interest in the issues of the condition of women and equal opportunities has grown over time and during the process of European integration, moving from a perspective aimed at improving the working conditions of women to a new dimension to improve the life of the woman as a person, trying to protect her not only professionally but also socially, and in general in all those areas in which gender inequality may occur. The approach is extensive and based on legislation, the integration of the gender dimension into all policies, and specific measures in favour of women. From the non-exhaustive list of the various legislative interventions, it is possible to note a continuous repetition of the same thematic priorities which highlights, on the one hand, the poor results achieved by the implementation of the policies, but, on the other hand, the Commission's willingness to pursue the path initially taken. Among the achievements in the field of gender equality obtained by the EU, there is certainly an increase in the number of women in the labour market and the acquisition of better education and training. Despite progress, gender inequalities have persisted. Even though women surpass

[11] For further details, see the Communication from the Commission, titled 'Europe 2020—A European strategy for smart, sustainable and inclusive growth' (COM (2010) 2020).

[12] The European Pact on Gender Equality 2011–2020 of the Council of the European Union reaffirms the Union's commitment to promoting the principle of equality between women and men and defines three priority objectives aimed at eliminating the gender gaps in employment and social protection, promoting a better work–life balance for women and men, combat all forms of violence against women. The Union urges all Member States to pursue these objectives in the development of their gender policies.

[13] For further details, see the Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, 'A Union of Equality: Gender Equality Strategy 2020–2025' (COM (2020) 152).

men in terms of educational attainment, gender gaps still exist in employment, entrepreneurship, and public life (OECD, 2017). For example, in the labour market, women continue to be overrepresented in the lowest-paid sectors and underrepresented in top positions (according to the data released in the main companies of the European Union, women represent only 8% of CEOs[14]).

2 Measuring Gender Equality and Monitoring the Progress of EU Policies

The principle of gender equality is fundamental to achieving the EU's objectives of growth, employment, and social cohesion. The existence of a positive relationship between gender equality, growth, and employment was confirmed by several studies, such as that published by the European Institute for Gender Equality[15] and titled 'Gender Equality Boosts Economic Growth'.[16] As we have just seen, gender equality is one of the fundamental principles of EU law. Initially, policies on gender equality concerned economic perspectives, including pay and employment; however, attention has been focused on all aspects of social life. In 1996, the European Commission implemented a strategy of gender mainstreaming, in addition to specific measures directed at women, to reach the goal of gender equality. In 2006, the Council of the European Union on the review of the implementation by the Member States and the EU institutions of the Beijing Platform for Action—indicators of institutional mechanisms[17] declared that a formal commitment to the strategy of gender mainstreaming is not sufficient to reach the goal of gender equality and that practical action in all government policy areas at all levels is needed.[18] In particular, the Council calls on Member States to strengthen efforts toward mainstream gender equality in all relevant areas by applying tools and methods, such as gender budgeting, gender equality plans, and gender impact assessments, and promoting their use in practice. This paragraph describes in detail the practical tools and methods necessary to reduce gender inequality.

[14] Chamber of Deputies, gender legislation and policies, n. 62 XVIII Legislature, 2 March 2022.

[15] According to this study, 'improvements to gender equality would generate up to 10.5 million additional jobs by 2050 and the EU employment rate would reach almost 80%. EU Gross Domestic Product (GDP) per capita would also be positively affected and could increase up to nearly 10% by 2050'.

[16] EIGE (2017), Gender Equality Boosts Economic Growth, EIGE, Vilnius. Available at: https://eige.europa.eu/news-and-events/news/gender-equality-boosts-economic-growth

[17] See Council Conclusions on Review of the implementation by the Member States and the EU institutions of the Beijing Platform for Action - Indicators in respect of Institutional Mechanisms for more details.

[18] EIGE (2016), Gender Impact Assessment: Gender Mainstreaming Toolkit, EIGE, Vilnius. Available at: https://eige.europa.eu/gender-mainstreaming/toolkits/gender-impact-assessment

2.1 *Gender Budgeting: Definition, Objectives, and Developing Steps*

'Gender budgeting' is a tool for implementing a gender mainstreaming strategy in the budgetary process. As defined by the Gender Equality Glossary drawn up by the Council of Europe,[19] 'Gender mainstreaming is the (re)organization, improvement, development, and evaluation of policy processes so that a gender equality perspective is incorporated in all policies at all levels and all stages, by the actors normally involved in policymaking'. Hence, gender budgeting is an integration of gender perspective into the budgetary process. Gender budgeting was developed in the mid-1980s; the first country to adopt it was Australia in 1984, followed by South Africa in 1994. Subsequently, other countries, both at the central and local government levels, have promoted and used gender budgeting, including Canada, the UK, France, Israel, Italy, Switzerland, Norway, Sweden, and Denmark. The dissemination of gender budgeting was promoted in 1995 with the Beijing Platform for Action during the Fourth World Conference on Women.[20] On this occasion, gender budgeting was presented as a necessary tool to support public and private institutions. In 2001, the European Union accepted this indication, which was ratified by the resolution[21] of the European Parliament in 2002/2198 (INI). Another European initiative to include the gender perspective in the policy process is the resolution of the European Parliament on 25 February 2010[22] which establishes the need for systematic monitoring of the integration of the gender perspective in legislative and budgetary decision-making processes. Another resolution of 2019[23] focused on the integration of the gender dimension in EU fiscal policies, calling on commissions and member states to fully implement the gender budget. A gender perspective was also integrated into the context of the European project using the Horizon 2020 programme. With horizontal Europe, there is a strong emphasis on tools to mitigate gender inequalities and promote gender equality. Finally, in 2020, the EIGE published an operational toolkit to produce the gender budget for EU funds, an instrument capable of strongly orienting the management of economic resources both in the programming phase (*ex ante*) and in the monitoring phase (mid-term and *ex post*) of projects financed with European funds. Gender budgeting

[19] See www.coe.int for more details.

[20] For further details, see the Official United Nations World-Wide Web page of the Fourth World Conference on Women at https://www.un.org/womenwatch/daw/beijing/fwcwn.html.

[21] In 2003, a report and a motion for a resolution on gender budgeting were presented to the European Parliament by the Commission for Women's Rights and Equal Opportunities. For further details, see the European Parliament resolution on gender budgeting—building public budgets from a gender perspective (2002/2198(INI)).

[22] For further details, see the European Parliament resolution of 25 February 2010 on the 13th session of the United Nations Human Rights Council (P7_TA(2010)0036).

[23] For further details, see the European Parliament resolution of 15 January 2019 on gender mainstreaming in the European Parliament (2018/2162(INI)).

now takes place in more than 40 countries worldwide, and it has been developed and implemented in a wide variety of ways.[24] Gender budgeting aims to recognise and evaluate the potentially discriminatory effects of public policies on women, which could increase the gender gap in the economic, political, social, and cultural spheres. The purpose of gender budgeting is not to produce separate budgets for women and men or to promote programmes specifically aimed at women but rather to influence public budgets. Based on the gender budget, there is the consideration that there are differences between men and women as regards the needs, conditions, situations, opportunities for life, work, and participation in decision-making processes and therefore, policies are not gender-neutral but, on the contrary, have a differentiated impact on men and women. According to the abovementioned European Parliament resolution on gender budgeting (2002):

> gender budgeting implies that in all budget programmes, measures, and policies, revenue or expenditure in all programmes and actions should be assessed and restructured in order to ensure that women's priorities and needs are taken into account on an equal basis to those of men, the final aim being to achieve equality between men and women.

The objectives of gender budgeting also include greater efficiency and effectiveness in the design of public policies and greater equity, which means fair and balanced budgetary policies aimed at reducing gender inequalities and promoting equal opportunities for men and women. Gender budgeting also provides greater transparency regarding the redistribution of public resources. Furthermore, gender budgeting does not represent an additional budget system compared to the existing ones; rather, it consists of a series of additional analytical tools, also aimed at verifying whether gender equity has been reduced, increased, or remained unchanged. As suggested by a report on gender budgeting (2002/2198(INI)), the European Commission set up a working group composed of experts on gender budgeting to produce an information document that represents an overview of the gender budgetary process. The document presents methodological guidelines, provides indicators or benchmarks, and collects the most relevant experiences of the gender budgetary process. The document can be consulted by all those regularly involved in public planning and budgeting processes. There is no single methodology for preparing gender budgeting; countries and institutions at the international and national levels have followed and developed different methods of analysis. However, it is possible to define common guidelines in the preparation of budget analysis from a gender perspective. Gender budgeting can be realised in both the preliminary balance (*ex ante* evaluation) and final balance (*ex post* evaluation). Gender budgeting is aimed at policymakers, institutional personnel, and communities. Through gender budgeting, policymakers can make resource allocation policies more efficient; the personnel of the public bodies through the budget are involved and stimulated to manage services from a gender perspective. Finally, for the community, gender budgeting represents a form of social accountability. Generally,

[24] Council of Europe, Final Report of Group of Specialists on Gender Budgeting. Directorate of Human Rights, Council of Europe, Strasbourg, 2005. Available at: https://rm.coe.int/1680596143

the gender-budgeting process is divided into several stages. The first phase corresponds to context analysis. In this phase, the area of concern and its population were analysed. All demographic characteristics of the population are described, paying particular attention to sex. Depending on the organisation and the activities carried out by the public institution that draws up gender budgeting, other characteristics of the population and the reference environment may be examined. Usually, this phase includes, in addition to the analysis of sociodemographic characteristics, the analysis of economic development, labour market participation, unpaid work, care provision, practices to improve work-life balance, environmental protection, and quality of life. The purpose of this first phase is to describe the context and identify potential demand, that is, the needs of the population in terms of services and sectors in which gender inequality is most evident. Once existing gender inequalities are identified, it is important to understand why they exist. This phase uses indicators that measure gender inequalities, which allows a better understanding of the socioeconomic conditions of individuals. During this phase, internal information relating to the organisation is also collected, such as the gender composition of the government bodies and the participation of women in decision-making processes. The implementation of contextual analysis requires the availability of data disaggregated by gender. Useful data broken down by sex include the Gender Equality Index,[25] which provides data from all EU Member States in the eight areas of work, money, knowledge, time, power, health, violence against women, and intersecting inequalities; the EIGE's Gender Statistics Database,[26] which contains gender statistics from all over the EU and beyond, at the EU, Member State and European level; and Eurostat gender statistics.[27] The second phase of the gender budgetary process is programming analysis. This phase involved planning interventions and related expenditures, focusing on the gender perspective. These interventions are intended to change the reference context and subsequently translate it into budgetary choices and, therefore, into the formulation of accounting documents. In this phase, it is fundamental to choose documents from which to obtain the information necessary for intervention planning. Generally, especially for the first editions, the analysis begins with relevant legislation. Initially, the information is collected from the institutional structure and the main European and national regulatory documents; then, the documents at a regional or local level are consulted, depending on the administration responsible for the budget.[28] Other sources that need to be examined

[25] EIGE (2019a), Gender Inequality Index, EIGE, Vilnius. Available at: https://eige.europa.eu/gender-equality-index.

[26] EIGE (2019b), Gender Statistics Database, EIGE, Vilnius. Available at: https://eige.europa.eu/gender-statistics/dgs.

[27] Eurostat (2019), Gender Statistics, Eurostat, Brussels. Available at: https://ec.europa.eu/eurostat/statistics-explained/index.php/Gender_statistics.

[28] ISFOL, Research Group for Equal Opportunities and Against Discrimination, Rosiello A., Salvucci M., A., Guidelines for the preparation of the Gender Report, 2013. For further details, see https://oa.inapp.org/xmlui/bitstream/handle/20.500.12916/1619/ISFOL_Linee%20guida%20per%20la%20redazione%20del%20Bilancio%20di%20Genere.pdf?sequence=1&isAllowed=y.

include documents of a strategic and programmatic nature (such as training and work plans or plans for equal opportunities) and economic-financial forecast documents (such as financial law). The main purpose of this phase was to identify measures dedicated to women and those that could indirectly have a gender impact. The third phase of the gender budget is the reclassification of expenditure. Specifically, this phase consists of evaluating the balance sheet documents (preliminary and final balance sheets and management balance sheets) from a gender perspective. To this end, it is necessary to carry out a reclassification of expenditure according to criteria that make it possible to re-aggregate the budget items in topics of relevance to gender. Additionally, in this case, the choice of classification is not unique and is linked to the type of institution. Often, the gender budget provides for four macro-categories of expenditure: expenditures on measures directed at women (e.g. measures for female entrepreneurship or anti-violence centres); spending on measures that have an indirect impact on gender (e.g. micro-credit interventions in support of businesses aimed at disadvantaged people, which also impact women as they are included in this type of person); significant expenditures for the economic and social context (interventions aimed at promoting gender equality and equity through an improvement of the environment–enabling environment, e.g. specific support interventions for reconciliation of work and family life or for the construction of nurseries, which improve the system in general but also the lives of women, more frequently involved in family care jobs); and neutral expenditures, which do not affect the gender gap (e.g. depreciation, interest and debt repayments, royalties, and utilities). The last step of the gender budgetary process was the evaluation phase. In this phase, the activities carried out by the institution and the management of related resources are qualitatively described. The purpose was to assess the gender impact of the interventions carried out by the institution, highlighting their strengths and weaknesses. The evaluation phase is necessary as it allows improvements to be made to the gender budgetary process, for example, by providing a fairer allocation of public economic resources. In conclusion, gender budgeting implies a gender-based assessment of budgets, a gender perspective at all levels of the budgetary process, and reclassification of revenues and expenditures to promote gender equality. Therefore, this policy instrument allows for the reallocation and mobilisation of resources for the empowerment of women. Gender budgeting results in a much broader and more appropriate strategy with the long-term aim of achieving gender equality.

2.2 *Gender Equality Plan (GEP): Definition, Objectives, and Developing Steps*

As stated in the Communication for a reinforced European research area,[29] the European Commission called on Member States to create policies that encourage gender equality and invited them to develop gender-mainstreaming strategies and/or Gender Equality Plans (GEPs). Gender equality does not mean that men and women must be equal, but that women must have access to the same opportunities while retaining their diversity. According to the EIGE definition, the GEP represents 'a set of commitments and actions that aim to promote gender equality in an organization through a process of structural change'. This scope can be achieved by acting on human resource development strategies, institutional governance, allocation of research funding, institutional leadership and decision-making, and research programmes.[30] In the specific context of research organisations and higher education institutions, the EU Commission defines three different objectives for the GEP: the first is to conduct impact assessment/audits of procedures and practices to identify gender bias; the second is to implement innovative strategies to correct any gender bias; and the last is to set targets and monitor progress via qualitative and quantitative indicators. Hence, the EU Commission promotes gender equality actions and the integration of gender dimensions in universities and research institutions as well as in Horizon 2020 programmes and projects. Currently, the Gender Equality Plan represents a basic requirement for participation in the Horizon Europe programme.[31] This new requirement is consistent with the aforementioned European Strategy for Gender Equality 2020–2025 of the European Commission; indeed, the strategy announced the ambition for a GEP requirement for participating organisations. In September 2021, the European Commission published a guide on GEPs for the Horizon Europe programme[32] to support organisations in meeting the GEP eligibility criterion, which establishes the basic requirements for a GEP. The guide refers to existing materials and resources that support gender equality in the research and innovation (R&I) field. Specifically, it refers to gender equality in academia and

[29] For further details, see the Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, 'A Reinforced European Research Area Partnership for Excellence and Growth' (COM(2012)392).

[30] Brodolini (2017). Gender equality plans in the private and public sectors in the European Union. Retrieved from: https://www.europarl.europa.eu/RegData/etudes/STUD/2017/583139/IPOL_STU(2017)583139_EN.pdf.

[31] According to the provisions of the European Commission, organisations that apply for Horizon Europe funds are required to have a Gender Equality Plan in place; however, if the organisations already have other plans, these can be considered equivalent to a GEP. These strategic documents must comply with the recommendations and advice suggested by the European Commission and must be updated accordingly to ensure full alignment and effectiveness.

[32] The Horizon Europe Guidance on Gender Equality Plans (GEPs) is available on the webpage of the Italian Agency for the Promotion of European Research (APRE) at the following link: https://apre.it/wpcontent/uploads/2021/10/KI0221806ENN.pdf.

research (GEAR), a tool developed by the EIGE and the Commission's directorate-general for research and innovation, which includes additional advice, case studies, and resources for developing a GEP. Regarding gender budgeting, the building process of GEP can be divided into different phases or steps. In general, there were six phases. The first step consists of a preliminary phase that concerns the familiarisation of the GEP concept; during this phase, the team responsible for the GEP must contextualise the institution, starting with the type of institution, since the implementation of gender equality policies may differ from public institutions, research organisations, or universities. The second step consists of an assessment of the status quo of gender equality within the organisation. In this analysis phase, data broken down by sex about staff and students were collected,[33] and procedures, processes, and practices were critically assessed to identify gender inequalities, gender bias, and their causes. The data used can be secondary data, so the information has already been collected (e.g. by the Human Resources department or another function within the organisation), or it can be primary data, that is, data originated for the first time (e.g. by conducting surveys among staff members or interviews/group discussions with representatives of all levels of staff).[34] The analysis phase, also called the audit phase in the Horizon Europe Guidance for GEPs, should consider the relevant legislation and policies concerning gender equality and non-discrimination at the EU, national, and regional levels. The third step is represented by the planning phase. This step involves setting the objectives and targets and defining the actions and measures for the GEP. The team responsible for drafting the GEP should involve people in senior management and leadership positions to decide on the area of intervention that the plan must address, in addition to those defined by the European Commission. During this phase, the allocation of financial and human resources and assignment of responsibilities for the delivery of the GEP are also defined, and the timelines necessary for its implementation are estimated. In the planning phase, quantitative and qualitative indicators are identified, which are represented by numbers such as units, prices, proportions, or ratios, and are disaggregated by gender, whereas qualitative indicators are based on descriptive information and represent people's judgements or perceptions. In the fourth step, denoted as the implementation phase, previously planned activities are implemented. This phase also includes the implementation of awareness and support activities aimed at expanding the network of stakeholders that support GEP implementation, both inside and outside the organisation. The second to last step involves the monitoring and evaluation phase, in which the progress achieved against the aims and objectives is assessed. As mentioned before, the planning phase provides a list of quantitative and qualitative indicators, and the same statistical measures should be

[33] The collection of gender disaggregated data is pivotal to developing effective gender-sensitive and evidence-based policies.

[34] The Gender Equality Audit and Monitoring (GEAM) offers a collection of measurement instruments that can be adapted for any organisation. The GEAM database is available at the following link: https://geam.act-on-gender.eu/database-ls-questionnaire-modules.

considered to continuously monitor the progress of the organisation. Examples of quantitative indicators are the number of women and men in top leadership positions, the share of women and men among employed researchers, the number of women and men attending GEP activities, the average number of years needed for women and men to make career advancements, and gender pay gap reduction. These indicators allow us to compare any progress achieved in the field of gender equality with the initial conditions of the organisation. Instead, qualitative indicators evaluate the strategic institutional changes resulting from GEP. Examples of qualitative indicators include the adoption of permanent gender equality initiatives, the institutionalisation of work–life balance actions, and the establishment of gender equality committees. Monitoring and evaluation activities allow for improvements in interventions defined in the planning phase. The interventions' adjustments could be useful for the last phase, in which the organisation should develop and implement a new GEP based on the experiences, learning, and findings achieved in the monitoring and evaluation phases. The European Commission defines four minimum process-related requirements regarding the eligibility criterion of the GEP.[35] The first is represented by the publication of a formal document on the institution's website that must be signed by the top management. The second requires a commitment to financial and human resources and expertise in gender equality to implement the strategic plan. Third, a GEP must be built by collecting and analysing sex-disaggregated data on staff; moreover, organisations should report their progress annually using specific indicators. The last criterion requires the organisation to provide awareness training on gender equality and unconscious gender biases to its personnel and decision-makers. These criteria are mandatory and must be applied to public institutions, research organisations, and higher education establishments. The European Commission has defined a set of recommended content-related elements. Specifically, a GEP should address the following fields: work-life balance and organisational culture, gender balance in leadership and decision-making, gender equality in recruitment and career progression, integration of the gender dimension into research and teaching content, and measures against gender-based violence.[36] The objectives and measures of the GEP must be SMART[37] (specific, measurable, achievable, realistic, and time-bound). 'Specific' means that objectives and measures should answer basic questions such as who, what, how, when, where, and why; 'measurable' consists of identifying quantitative and/or qualitative indicators and the related objectives; 'achievable' indicates that the GEP must ensure that the

[35] See the Horizon Europe—Work Programme 2021–2022, published by the European Commission for more details.

[36] For further details on the content-related requirements, see the gender equality in academia and research (GEAR) action toolbox, available at the following link: https://eige.europa.eu/gender-mainstreaming/toolkits/gear/step-step-guide.

[37] SMART criteria were originally proposed as a management tool for project and programme managers to set goals and objectives (Doran 1981 and others), but these days the SMART criteria have been well accepted in the field of monitoring and evaluation and have become an engrained, common best practice approach in developing indicators.

objectives and measures are not out of reach and can be achieved; 'realistic' means the GEP must ensure that objectives and measures are relevant to the organisation and that they are achievable with the resources available; and 'time-related' suggests that the GEP must indicate the period within which the objectives and measures can be achieved. In conclusion, regarding gender budgeting, the GEP promotes gender equality through a process of structural change; indeed, this policy instrument strives to sustainably transform organisational processes, cultures, and structures R&I that is highly segregated by gender and marked by significant gender gaps.[38]

2.3 Gender Impact Assessment (Ex Ante Evaluation)

Before proceeding with the description of the gender impact assessment process, it is necessary to establish a premise on the concept of the indicator. An indicator represents a statistic that has been standardised or has a reference point to enable comparisons across the population.[39] An example of a gender indicator is the number of female parliament members (MPs), expressed as a percentage of all MPs. As we have seen in the previous paragraphs, indicators can be quantitative or qualitative; the first ones are measures of quantities or amounts and can be expressed as units, prices, proportions, and ratios. Qualitative indicators represent people's judgements, perceptions, or beliefs about a subject and can be expressed as statements, paragraphs, case studies, and reports. These types of indicators complement and cross-validate one another. Indicators, especially quantitative ones, should be disaggregated according to a variable of interest to show differences among target subgroups. One of the most common criteria for disaggregation is the gender variable. Indicators can be classified in different ways, and it is possible to differentiate between quantitative and qualitative indicators as well as between input, output, and outcome indicators. The planning of policies, strategies, projects, programmes, or other types of initiatives may require input, output, and outcome indicators. Input indicators concern the resources devoted to an intervention, including financial and human resources, and the means necessary to implement the intervention. For example, data on how much money is spent on a new mathematics programme represent an input indicator. Output indicators relate to the immediate results concerning tangible products and services delivered when a policy, programme, or project is completed. For example, how many people participate or how many textbooks are delivered represent output indicators. Outcome indicators, also called impact indicators, measure the results and changes that the intervention could have on the beneficiary population in the long term. An example of an

[38] For further details, see She Figures, a document published by the European Commission that presents data on gender equality objectives in the field of Research and Innovation policy.

[39] UN ESCAP, Regional core set of gender statistics and indicators for Asia and the Pacific, United Nations Economic and Social Commission for Asia and the Pacific, Bangkok (2013)

outcome indicator is defining whether the introduction of a new curriculum raises students' test scores. All these indicators can be used in progress to monitor the implementation of the programme, and after the programme is completed, to evaluate its results. Impact evaluations can be performed to compare different subgroups of beneficiaries, such as female and male recipients. In the context of gender equality, constructing a system of indicators requires the collection and separation of data and statistical information by gender. For example, we will have data on how much money is spent by gender, on participation by gender, or on whether the introduction of a new curriculum raises test scores among female and male students. In recent years, policymakers and project managers have focused on controlling and measuring the inputs and outputs of a programme or project rather than assessing their impacts (Gertler et al., 2016). Currently, focus has shifted from input and output indicators to outcomes and long-term results. Government agencies and ministries increasingly request impact indicators to show that a programme or project works to obtain funding. Outcome indicators improve the allocation of government resources and identify the most effective policies or programmes to reach one or more specific goals. Furthermore, the outcomes and results allow policymakers to inform policy decisions and facilitate public awareness. Evaluating the impact of a programme or project should also involve the use of input and output indicators, and not simply outcome indicators. Without these indicators, the impact evaluation will produce only a 'black box' that identifies whether the predicted results are achieved; it would not be possible to explain why this was the case (Gertler et al., 2016). Impact evaluation can be applied to planned, ongoing, or completed projects, programmes, or policies; hence, assessment can be performed before or after a programme is implemented. In the first case, called ex ante evaluation, the assessment predicts the impacts of a programme using data before programme implementation; in the second case, called ex post evaluation, the programme outcomes are examined once the programme has been implemented. Having said that, we can introduce Gender Impact Assessment. The assessment of gender impact measures the tangible results that the intervention could have on the effective equality of women and men. The Gender Impact Assessment requires a set of gender-sensitive indicators that should be prepared before the implementation of the intervention. These indicators assess the different impacts and changes that the intervention could impose on the daily lives of women and men. More precisely, the Gender Impact Assessment (GIA) is a useful tool for implementing gender mainstreaming strategies. According to the definition of the Gender Equality Glossary drawn up by the Council of Europe,[40] the GIA represents a policy tool for the screening of a given policy proposal[41] 'to detect and assess its differential impact or effects on women and men, so that these imbalances can be redressed before the proposal is endorsed'. Therefore, the GIA

[40] See www.coe.int for more details.

[41] In 2006 the Council of the European Union in its conclusions called on the Member States to regularly use the Gender Impact Assessment not only for the drafting of policy plans, but also for laws, policy programmes, projects, budgets, concrete actions, bills, and reports or calls for research.

must be applied in the early stages of policymaking, and for this reason, it is defined as an ex ante evaluation method.

The GIA involves two different analyses: the first concerns the current gender-related position in relation to the valuation policy, and the second concerns the projected impacts on women and men once the policy has been implemented. The main purpose of this method is to achieve relevant impacts, both in policy design and planning, and to ensure adequate equality outcomes. As for the budget, even government policies and legislation are not gender-neutral; indeed, they often have different impacts on men and women, leading to a strengthening of gender inequalities in the economic, social, and cultural fields. These different effects on gender must be identified during the design phase. According to the guidelines of the European Commission,[42] the GIA process should involve civil servants working for governmental, regional, or local offices, departments, or ministries, initiating a new norm or policy. It is worth noting that the application of gender impact assessment is a learning process, and there is no common regulation or model within public administration at the European level. However, even if there is no common approach, it is possible to identify six phases or steps of the GIA process that are always identical. The first step investigates the purpose and scope of the policy proposal, and the second step identifies its gender relevance to beneficiaries and stakeholders. During this second phase, it is necessary to identify the target group and predict whether the policy proposal can influence the social situation or the position of women and men representing the target group. The gender impact could be direct or indirect, depending on whether the proposed policy is directly targeted at women and men in the target group. The stakeholders involved in the GIA process are functional and competent. Functional stakeholders are individuals or legal entities relevant to the success of a project, having governance or project management functions, or even just the ability to influence the project. Competent stakeholders are individuals or legal entities (such as central bodies for gender equality, feminist and women's organisations, and gender experts) able to provide useful information on beneficiaries and the socio-cultural context. Competent stakeholders can provide disaggregated data by gender, statistics, and information that complement the data of the body carrying out the Gender Impact Assessment process. The third phase is gender-sensitive analysis. The purpose of this phase is twofold: first, gender-sensitive analysis seeks to understand the current situation for the target groups and how this situation could evolve without public intervention, and finally, the analysis attempts to measure how the planned intervention should change the existing situation. Similar to what has been seen for gender budgeting, this phase requires the collection of information and data disaggregated by sex to analyse the current status, roles, and relations of the target group in the intervention areas considered by the planned policy. To gain a deeper understanding of the current

[42] EIGE, European Institute for Gender Equality. 2017. Gender Impact Assessment—Gender Mainstreaming Toolkit. Available at: https://eige.europa.eu/gender-mainstreaming/toolkits/gender-impact-assessment

situation of women and men, it is recommended to integrate statistics with qualitative insights. At this stage, it is necessary to identify the inequalities between women and men in the access to essential resources (such as education, work, careers, health, time, money, power, information, new technologies, etc.) to eliminate existing gender gaps, or at least significantly reduce them. Furthermore, it is necessary to consider inequalities in the exercise of fundamental rights (civil, social, and political) based on their sex or gender roles. For this purpose, it is essential to consider the structures where gender inequalities occur: division of labour, organisation of private life, and citizenship. The fourth step involves measuring the effects of the planned policy and identifying whether the gender impact is positive, neutral, or negative. For example, a planned policy has a positive gender impact if it increases the participation of women in the public sphere, contributes to reducing existing gender gaps, or eliminates gender stereotypes. In this phase, it is possible to assign a weight to the effects of the proposed policy. The fourth step also identified a list of indicators for measuring the progress of gender equality. In the last step of the GIA process, the evidence that emerged was collected, and specific proposals were made to improve the policy to be implemented.

In conclusion, an effective GIA process involves an assessment of gender inequalities, recognition of the effects of those inequalities, and, subsequently, a tailored response in policies and practices. Subsequently, the process was evaluated based on the results. However, the GIA goes beyond an analysis of the existing situation as it also includes a perspective dimension; this means that an assessment of gender equality is necessary even after the adoption of legislative or policy measures. A GIA process should be applied by public services, institutions, and civil society, as it helps decision-makers choose between other policies or projects and methodologies. Specifically, the assessment of gender impact allows us to avoid an unconscious increase in gender inequalities, rebalance gender equality, strengthen evidence-based policymaking, and lead to better governance.

3 Ex Post Evaluation of the Gender Impact

In addition, there are other methodologies that can be applied to evaluate programme outcomes once a programme has been implemented. Ex post evaluation measures the actual outcomes of a programme or project; hence, it reflects reality and does not represent predictions. Ex post evaluation might have higher costs than ex ante evaluation because it requires the collection of data on the actual impacts of the intervention, and there could be an additional cost in the ex post evaluation which consists of the failure of the programme. For these reasons, it is recommended to perform both analyses, and compare ex ante predictions with ex post estimations. Before describing ex post evaluation methodologies, it is necessary to introduce the counterfactual problem. The impact of a programme is not given by the difference between the situation observed after programme implementation and the situation observed before implementation. Programme impacts could have occurred anyway

for reasons other than intervention. Consider a socioeconomic development programme with the objective of increasing the income of employers in a specific geographic area. To this end, the programme provides for the organisation of professional training courses by which participants will acquire new skills necessary for their jobs. The mere observation of the increase in income after the participants completed the programme was not sufficient to establish causality. Employees' income might have increased even if the participants had not followed the training course—for example, because of changing labour market conditions, or because of one of the other factors that can affect income. Thus, the impact of a programme can be defined as the difference between what is observed in the presence and absence of the intervention. Mathematically, the causal impact of a programme is given by the following formula (Gertler et al., 2016):

$$\beta = (Y|P = 1) - (Y|P = 0)$$

where β represents the impact or causal effect of programme P on outcome Y and which is given by the difference between the outcome with programme ($Y|P = 1$) and the same outcome without the programme ($Y|P = 0$). Therefore, we would like to measure an outcome (e.g. income) simultaneously for the same observation (in this case, an individual), both with and without participation in a programme. It is worth noting that while the first term of this comparison is observable, the second term is hypothetical. If the intervention had been implemented, it would not have been possible to define what would have happened to programme participants if the programme had not existed. A recipient's outcome in the absence of intervention is called a counterfactual situation or result. Mathematically, the term ($Y|P = 0$) in the impact evaluation formula represents a counterfactual. The observability of only one of the two results constitutes 'a fundamental problem in causal inference' (Holland, 1986). This problem can be solved by estimating the counterfactual value. To this end, it is necessary to use comparison groups, more often referred to as 'control groups'. The identification of comparison groups is a key challenge in impact evaluation. The objective was to identify a group of programme participants (treatment group) and a group of non-participants (comparison or control group) who were statistically identical if the programme did not exist. Thus, if the two groups had the same characteristics,[43] it was possible to affirm that the programme alone contributed to the differences in the outcome (Y) between the two groups. However, to achieve this goal, the following three conditions must be satisfied. First, not every observation in the treatment group needs to be equal to every observation in the control group. It is necessary that, on average, the characteristics of the two

[43] The only difference between the treatment and the control group is that the members of the treatment group participate in the programme, while the members of the control group do not participate.

groups are the same.[44] Second, the two groups should react to the intervention in the same way, and finally, they cannot be exposed to other programmes during the evaluation period. There are two possible methods to estimate the counterfactual. The first one consists of a pre-post comparison in which the outcomes of programme participants are compared before and after the implementation of a programme ('before-and-after comparison'). Instead, the second consists of a comparison between observations that choose to enrol or not to enrol in a programme; this method is called a 'with-and-without comparison', characterised by selection bias. For many public policies, there is no coincidence between the set of eligible observations and that exposed to an intervention. Generally, only some eligible subjects decide to enrol in a programme. This results in a self-selection process that determines the selection bias. The choice to enrol in a programme is often determined by the differences in the starting conditions of eligible observations. The analyst must attempt to make the selection bias null. In doing so, we consider the average causal effects in the population or specific subgroups. The existence of a plurality of subjects, some exposed and others not exposed to the intervention, allows the identification of the average causal effects. Moreover, these effects are typically the objects of interest for policymakers. Based on this premise, we can describe the different approaches to ex post impact evaluation. Specifically, we will examine the randomised evaluations, regression discontinuity signs (RDD), difference in differences (DiD), and matching methods.

3.1 Randomised Selection Methods

Randomised evaluation is an exception to other impact evaluation methods whereby the selection process is conducted by randomly assigning units to the treatment and control groups. This means that every eligible observation of treatment has the same probability of treatment selection. Hence, in randomised evaluations, the selection bias was zero by construction. Furthermore, with many observations, the random selection process produces two statistically equivalent groups. In other words, the treatment and comparison groups have the same averages for all observed and unobserved characteristics. The estimation of counterfactual in randomised selection methods is strong; thus, randomised methods are internally valid.[45] Furthermore, this evaluation tool has external validity because the results can be generalised to the population of all eligible units (Khandker et al., 2009). In a randomised evaluation, the average effect of the intervention was estimated through the difference between

[44] For example, the average income in the treatment group should be equal to the average income in the control group.

[45] An evaluation is internally valid if it uses a valid comparison group. This condition ensures that the differences in outcomes across the treatment and control group are a function of the programme only and do not depend on other confounding elements.

the average outcomes obtained by the observations, which were exposed and not exposed to the intervention. Mathematically, the impact of a programme is given by the following formula:

$$\text{Impact} = \Delta Y = \overline{Y}_{\text{treated}} - \overline{Y}_{\text{control}}$$

This method is often used when there is excess demand to enrol in the programme and resources are scarce; hence, there are a limited number of programme places available, in which randomised assignment represents a fair allocation rule that can be easily explained by project managers or policymakers. In other cases, the use of randomised methods is limited to interventions that represent pilot projects or programmes. The intervention was implemented on a small scale, with the specific purpose of evaluating its effectiveness, before it was rolled out to the entire eligible population. For example, this is a clinical drug-testing scenario.

Dahl et al. (2021)[46] conducted an experiment in which observations were randomly assigned to treatment and control groups. Specifically, the authors try to verify whether the integration of women into teams that were traditionally all male can change men's stereotypical attitudes about gender (e.g. gender productivity, gender roles, and gender identity). To this end, the authors randomly assigned female soldiers to some squads (but not others) during boot camps in the military in Norway and compared the gender attitudes of men among the treatment and control groups at the end of the boot camp. The findings of this experiment reveal that men's attitudes toward gender-related questions become more egalitarian thanks to their interaction with women. This type of experiment, based on a randomised selection method, avoids some limitations related to reverse causality, self-selection, and unobserved heterogeneity.[47] Another study conducted by Hoogendoorn et al. (2013)[48] estimated the impact of gender diversity on team performance. Specifically, the authors conducted a field experiment with random assignment of observations to teams, conditional on their gender, and measured their performance in terms of sales and profits. The results of this study show that business teams with an equal gender mix perform better than all-male teams do.

[46] Gordon B. Dahl, Andreas Kotsadam, and Dan-Olof Rooth, Does Integration Change Gender Attitudes? The Effect of Randomly Assigning Women to Traditionally Male Teams, *The Quarterly Journal of Economics*, Volume 136, Issue 2, May 2021, pp. 987–1030. Available at: https://doi.org/10.1093/qje/qjaa047

[47] A very similar field experiment based on a random selection process of observations was conducted by Finseraas et al. (2016). For further details, see Finseraas, H., Johnsen, Å. A., Kotsadam, A., and Torsvik, G. (2016). Exposure to female colleagues breaks the glass ceiling—Evidence from a combined vignette and field experiment. *European Economic Review*, 90, 363–374.

[48] Hoogendoorn, S., Oosterbeek, H., & Van Praag, M. (2013). The impact of gender diversity on the performance of business teams: Evidence from a field experiment. *Management Science*, *59*(7), 1514–1528

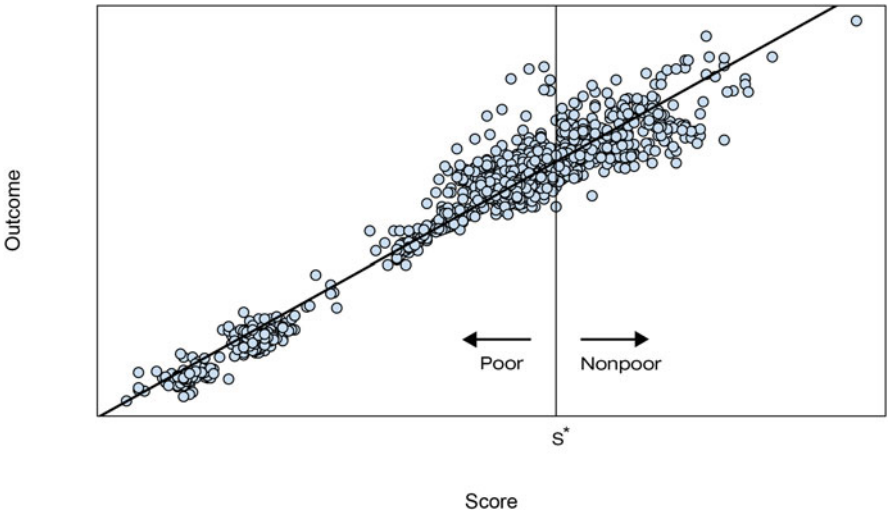

Fig. 1 Regression discontinuity designs—RDD. Source: Authors

3.2 Regression Discontinuity Designs

The evaluation method of regression discontinuity signs (RDD) is applied to a particular class of programmes such as social programmes. These programmes provide for rationing based on a threshold or cutoff score which can be represented by a given value of an index/variable or by a given position in a ranking. Observations below (above) the threshold participate in the programme. In contrast, observations above (below) the threshold are excluded. Let us consider a poverty program. This programme has as its target group poor households identified by a poverty score or index. The programme authorities determine a threshold (S^*) below which households are considered to be poor and hence can enrol in the programme. On the contrary, households above the threshold are identified as non-poor and are therefore excluded, as shown in Fig. 1. The estimated equation was $Y_i = \beta S_i + \varepsilon_i$.

The eligibility cutoff represents a discontinuity point, and a situation such as randomisation occurs around it. That is, the observations exposed to the intervention immediately below the threshold are equivalent to those not exposed immediately above it for both observable and unobservable characteristics. In that case, the comparison between the treatment and control groups was conducted around the threshold; more precisely, the difference in the average outcome for the treaties immediately below the threshold and that of the non-treated ones immediately above the threshold identifies the effect of the policy. Mathematically, the effect of the policy (β) is given by the ratio of the difference in the outcomes of the treated (observations just below the threshold) and non-treated (observations just above the threshold) groups, weighted by the difference in the values of the variable that determines programme eligibility (S_i).

$$\beta = \frac{Y^- - Y^+}{S^- - S^+}$$

If we move further away from the threshold, the differences across eligible and non-eligible observations increase; however, we know how different they are due to the eligibility criteria, and hence, we can control for these differences. Compared to other approaches, the RDD requires a large evaluation sample because it estimates the policy effect only around the cutoff score. The statistical power of the analysis increased as the bandwidth around the cutoff increased because more units were included in the analysis. Another limitation of the RDD method is that the analyst, to estimate the programme impact correctly, must consider the functional form (linear, quadratic, cubic, etc.) of the relation between the eligibility criteria and the outcome of interest because the impacts could be sensitive to the functional form. In conclusion, the RDD method guarantees internal validity; indeed, the control group is valid because the observations are similar around the cutoff. However, the RDD method has limited external validity because the results obtained cannot be generalised to the entire population but only locally in the neighbourhood around the eligibility threshold.

This ex post impact assessment method has been used by several authors. For instance, Vaccaro (2018)[49] adopted a combination of regression discontinuity design and difference-in-differences approaches to test the impact of Swiss policy on gender wage discrimination. Specifically, the author tried to evaluate whether the unexplained gender wage gap decreased after the introduction of the government policy. Since the anti-discriminatory policy was free of charge and voluntary, but was strongly recommended for firms with more than 50 employees, the author exploits the discontinuity of this rule to analyse whether these firms tend to reduce gender wage discrimination. The results confirm that the unexplained wage gap of firms subject to regulation (with at least 50 workers) decreased after the introduction of the Swiss policy. Another study by Bagues and Campa (2021)[50] attempted to identify the causal impact of gender quotas in Spain. The Equality Act, introduced in March 2007, modified Spanish electoral law to improve the gender balance in elected political offices. More precisely, this new regulation requires political parties to field female candidates in at least 40% of the seats they contest. To measure the effectiveness of this law, the authors implemented an RDD model by comparing municipalities slightly below and above the relevant population cutoff. Since the regulation was first implemented in municipalities with more than 5,000 inhabitants and then in those with more than 3,000 inhabitants, the authors used these values for the population thresholds. In both studies, the results were determined by the new

[49] Vaccaro, G. (2018). Using econometrics to reduce gender discrimination: Evidence from a difference-in-discontinuity design. In *2nd IZA workshop: Gender and family economics*, New York

[50] Bagues, M., & Campa, P. (2021). Can gender quotas in candidate lists empower women? Evidence from a regression discontinuity design. *Journal of Public Economics*, *194*, 104,315

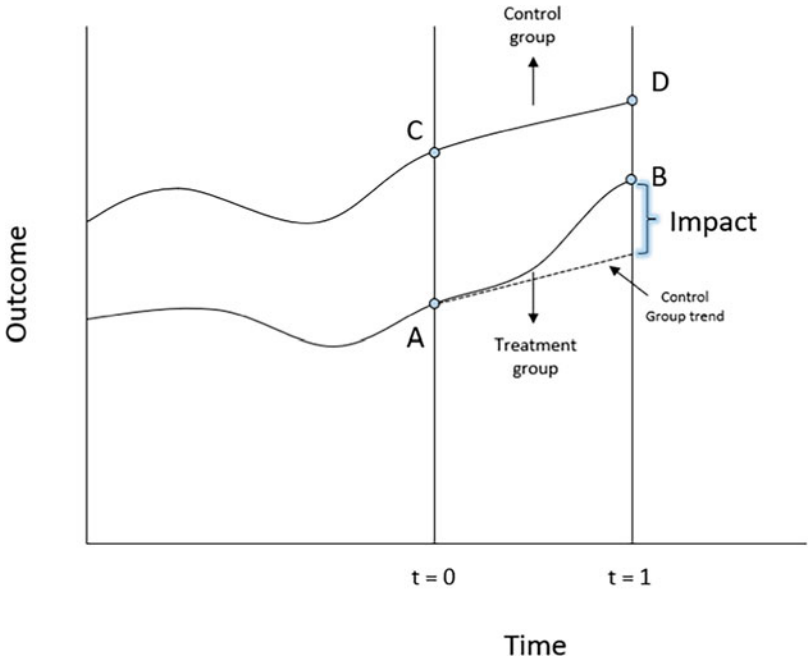

Fig. 2 Difference-in-differences—DiD. Source: Authors

policy or regulation because no other interventions were implemented based on these thresholds in the relevant period of analysis.

3.3 Difference-in-Differences

The DiD method can be applied if the analyst has longitudinal data or data relating to observations repeated over time on treated and non-treated groups for periods before and after the intervention. This is necessary because the DiD method measures the effect of the policy by comparing the difference in outcomes before and after the implementation of the policy (first comparison, over time) between the treated and non-treated groups (second comparison, between the treatment and control groups). Because the impact of the programme is computed as the difference between two differences, the method is also called double difference (DD). This method combines the two approaches that can be used to estimate the counterfactual: before and after comparisons, and with and without comparisons, as previously described, which allows for a better estimation of the counterfactual. Figure 2 clarifies the difference-in-differences methodology.

For example, consider an initial baseline survey administered to both nonparticipants and participants. After the intervention, a follow-up survey was conducted for

both groups. Therefore, as usual, we have a treatment group made up of observations of those who enrol in the programme, and a comparison group that is not enrolled. On the time axis, in correspondence with $t = 0$, we observe the outcomes of the treatment group (A) and the control group (C) before the implementation of the programme, whereas in correspondence with $t = 1$, we observe their outcomes (B and D) after the programme has been implemented. The estimation of policy effects is given by the difference in the mean outcomes for the treatment group (B–A) minus the difference in the mean outcomes for the control group (D–C), as expressed by the following equation:

$$\text{DiD impact} = (B - A) - (D - C)$$

Mathematically, the policy effect is given by:

$$\beta = \left(\overline{Y}_{\text{treat,after}} - \overline{Y}_{\text{treat,before}}\right) - \left(\overline{Y}_{\text{control,after}} - \overline{Y}_{\text{control,before}}\right)$$

As we have seen before, a selection bias occurs when comparing participants and non-participants because the choice to enrol in a programme is often determined by differences in the starting conditions of the eligible observations. Therefore, the differences in outcomes across the treatment and control groups may be determined by their different characteristics rather than by the programme. However, the DiD method assumes that many unit characteristics remain constant over time. Therefore, the DiD analysis controls for both the observed and non-observed time-invariant conditions. Another limitation of this approach is the strong assumption that no other factors can affect the treatment group during the intervention. If other factors were present, the impact estimation would be invalid or biased.

Caliendo and Wittbrodt (2022)[51] implemented a DiD model to analyse the impact of the German minimum wage on the gender gap. Specifically, the authors adopted a regional DiD approach, considering the variation in the degree to which female employees are affected by the minimum wage. This model measures the effect of the intervention by comparing the difference in gender-specific wages before and after the implementation of the reform, and between treated (high-bite regions) and non-treated (low-bite regions). This study reveals the effectiveness of the minimum wage in reducing gender wage disparities, especially in regions where women are strongly affected by the minimum wage. Another study by Baltrunaite et al. (2014)[52] analysed the impact of the Italian reform of gender quotas (law introduced in 1993) in candidate lists on the average quality of elected politicians through a DiD model. Specifically, the authors considered municipalities that were exposed to gender quotas as the treatment group and those which never voted with gender quotas as

[51] Caliendo, M., & Wittbrodt, L. (2022). Did the minimum wage reduce the gender wage gap in Germany? *Labour Economics*, 78, 102,228.

[52] Baltrunaite, A., Bello, P., Casarico, A., & Profeta, P. (2014). Gender quotas and the quality of politicians. *Journal of Public Economics*, *118*, 62–74.

the control group. This approach allows us to measure the effectiveness of the new law by comparing the change in the average education level of municipal councillors across the treatment and control groups immediately before and after the introduction of the reform. The key finding of this study is that the reform of gender quotas is associated with an increase in the quality of elected politicians.

3.4 Matching

Matching methods require that all variables X responsible for the selection bias are observed by the analyst. Under this assumption, matching is a robust method for estimating the mean effect on treaties. This method consists of matching each observation enrolled in a programme to observations that are not enrolled and have the same characteristics X. Usually, matching methods use an indicator called the Propensity Score (Rosenbaum & Donald, 1983) which computes the probability that an observation will be treated according to its observable characteristics. The propensity score assumes values between 0 and 1, and for each treated and non-treated unit, it summarises the information on the set of variables X, because these variables affect the likelihood of participating in the programme. The first step in the application of the propensity score is to conduct representative and highly comparable surveys to identify the individuals who participated in the programme and those who did not; matching requires a large dataset with extensive information on background characteristics for all units. Second, the analyst estimates the probability that each individual participates in the programme and assigns a propensity score value to all observations; thereafter, observations in the treatment group are matched with observations not enrolled in the programme that have the most similar propensity score. Finally, the effect of the programme will be measured by the mean of the differences between the outcomes observed for the treated observations and their matched comparison observations which represent the control group. Figure 3 illustrates how the matching methods work. Let us consider a programme whose purpose is to provide financial support to the unemployed. Figure 3 shows the distributions of the propensity score, that is, the probability of the units to enrol in the programme, for all the treated units (light blue distribution), and all the non-treated units (white distribution).

As we can see from Fig. 3, the propensity score distributions do not overlap perfectly; indeed, there is a lack of common support between the treated and non-treated groups. In other words, not all treatment units are matched to non-enrolled units, which implies that the external validity of the matching method is limited. Considering the extreme values of the distributions or tails, a subset of observations cannot be matched. Therefore, the matching procedure allows for a robust estimation of the average effect of the treatment, limited to the subset of treated and non-treated units that lie in the common space of the propensity score index which summarises their observed characteristics (X). Matching methods present several limitations. First, they require a large sample of units and, despite

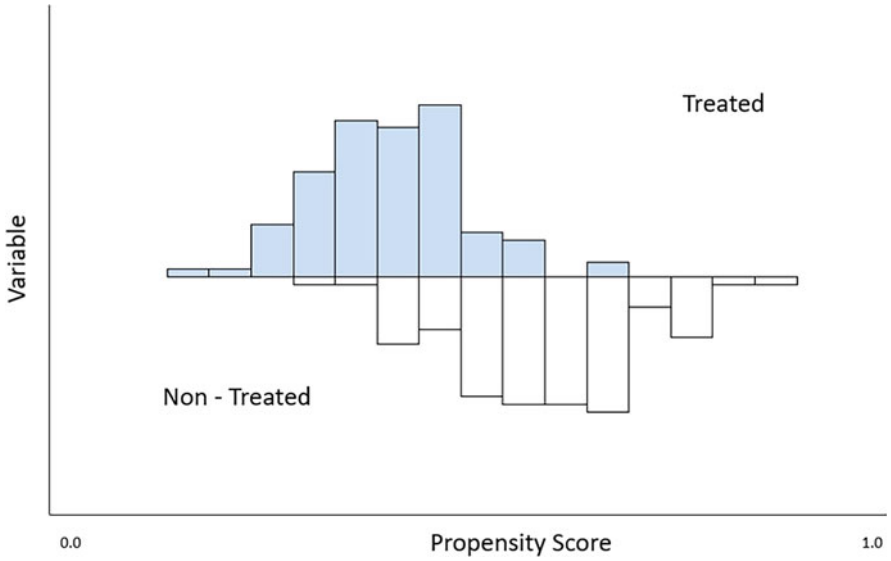

Fig. 3 Matching. Source: Authors

this, it is not certain that all enrolled units matched non-enrolled ones. Furthermore, this method is based on the strong assumption that there are no unobservable characteristics in the treatment and control groups. For this reason, it is suggested to use matching methods in combination with one of the other approaches previously discussed.

Several authors have used this econometric approach. For instance, Frölich (2007)[53] used propensity score matching to examine the gender wage gap among college graduates in the UK. A similar study conducted by Meara et al. (2020)[54] applied a matching method to estimate the gender pay gap in the USA.

4 Conclusions

The first part of the chapter summarises the legal framework for gender equality by illustrating the main interventions from the European Economic Community to the European Union. Gender equality has always been a fundamental value for the

[53] Frölich, M. (2007). Propensity score matching without conditional independence assumption—with an application to the gender wage gap in the United Kingdom. *The Econometrics Journal*, *10*(2), 359–407

[54] Meara, K., Pastore, F. & Webster, A. (2020). The gender pay gap in the USA: A matching study. *Journal of Population Economics 33*, 271–305. Available at: https://doi.org/10.1007/s00148-019-00743-8

European Union, and interest in this topic has grown over time. Initially, the priorities of the European Commission were related to ensuring equal conditions and opportunities for women and men in the working environment. Later, the subsequent policies extended their area of intervention to create a gender-equal society. One of the most innovative interventions is the fourth action programme (1996–2000) which focuses on the principle of gender mainstreaming and suggests that policymakers, not only those in the field of gender equality, should bring a gender perspective across all policy fields. This principle is relevant for policymakers at all levels. In the second part of this chapter, practical tools and methods necessary to reduce gender inequalities are described in detail. Specifically, we illustrated the gender budgeting and gender equality plan which represent operational tools for implementing the gender mainstreaming strategy. The last section focuses on the impact evaluation of policies that promote gender equality. We analysed the GIA in detail, which consists of an ex ante evaluation of the policy impacts. Finally, we illustrated ex post evaluation methodologies such as randomised methods, regression discontinuity design, and differences in differences and matching methods. The main purposes of this contribution are summarising the main interventions on gender equality, illustrating the operational tools that effectively contribute to reducing gender inequalities, and introducing the main methods of policy evaluation that promote gender equality. The complexity of the impact evaluation processes and the relevance of their design should be clear to readers, even before the implementation of the policy itself.

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Subnational Level Data to Measure Gender (in)Equality in the EU: Opportunities and Limitations of Official Datasets

Enrico di Bella and Fabrizio Culotta

1 Introduction

Data-driven decision-making is a process in which metrics and data guide policymakers' strategies and actions. Empirical evidence plays a crucial role in policymaking since it offers substantial ground for planning, evaluating, and challenging policies. The correct interpretation of a complex phenomenon requires information that data, and their analysis, can offer. Wider data availability allows a richer interpretation of the social phenomena under study and a better decision-making process. Larger data availability can translate into at least two forms: a larger number of variables available or a deeper territorial level detail. In this chapter, we focus mainly on this second point, particularly on the role of regional data for policymaking and the availability of data at subnational levels in the main European datasets.

Country-level analyses can mask territorial disparities, particularly when synthetic indicators are used. The national average score can hide the territorial heterogeneity of a phenomenon, compensating for the low scores of some regions and high scores for others. Analyses at the regional level are therefore necessary if the dispersion of a phenomenon within a country hints at disparities that should be addressed through policymaking. Territorial differences within countries are due to numerous causes (e.g. Kaasa et al., 2014; Marelli, 2007), whose origins are often controversial and lost in history. In Italy, for instance, it has been repeatedly verified that most social phenomena have a marked territorial difference between the north and south of the country as a consequence of its relatively recent unification in 1861 and unequal socioeconomic growth in the subsequent one and half century. In Germany, the separation between the Federal Republic of Germany (West Germany)

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and the German Democratic Republic (East Germany) from 1949 to 1990 resulted in significant social differences, traces of which are still visible in many socioeconomic analyses at the subnational level. Even countries that emerged as modern states at the end of the Middle Ages and have a long tradition of national identity, such as France or Spain, record some differences at the territorial level. Generally, no country has some form of internal heterogeneity. Regardless of the degree of territorial analysis, it is possible to identify forms of inequality or segregation based on the territory's economic, social, or environmental characteristics.

These different origins of territorial disparities make regional studies relevant because they can integrate the conclusions drawn at the national level by revealing divergences in socioeconomic outcomes and unmasking the role of local factors affecting the performance of that territory. They can also help identify clusters, that is, the presence of multiple but homogeneous groups of regions. The findings from a regional analysis can inform policymakers of the possible risks and opportunities related to implementing economic policies. For example, the sectorial distribution of firms can reveal the possibility of asymmetric effects from industrial policies designed at the national level. Indeed, the labour market is one of the domains that most interact with others; work choices depend on education; and it influences income and work–life balance with further effects on the other domains of gender (in)equality.

Similarly, information on the geographical distribution of workers' skills can provide information on the population targeted at the local level. A detailed set of information at the local level can also reveal the role of cultural institutions in shaping regional disparities (Fortin, 2005; Alesina et al., 2013; Kushi & McManus, 2018).

Having information at the regional level is also important for verifying the conditions implicitly assumed when nationwide policies are implemented. As is often the case, national policies disregard geographical heterogeneity by embracing a space-neutral approach (Altavilla & Caroleo, 2013; Iammarino et al., 2019). This policy paradigm implicitly assumes that the economic structure of a country is uniformly reproduced at the subnational level. The validity of this one-size-fits-all approach cannot be questioned, at least in the long run, when territorial differences are expected to level out. Forces driving economic growth, such as innovation, usually originate in some developed core areas and then propagate towards developing peripheral regions (Blanchard & Katz, 1992). Of course, the (speed of) propagation strictly depends on the mobility of productive factors. Thus, the assumption of factor mobility is central to the correct implementation of space-neutral policies (Iammarino et al., 2019). Accordingly, information on the mobility conditions of workers, capital, and entrepreneurship can reveal mobility frictions that influence the spread of new economic opportunities. Violations of mobility assumptions would invalidate, at least partially, their original scope. For example, when dealing with gendered issues in the labour market (see Chapter "Gender-Responsive Regional Fiscal Policies: The Labour Market"), the empirical literature highlights the role of different commuting attitudes in explaining gender gaps (Perales & Vidal, 2015; Gimenez-Nadal & Molina, 2016; Nisic, 2017; Petrongolo

& Ronchi, 2020; Fuchs et al., 2021; Le Barbanchon et al., 2021). Compared to men, women value the geographical closeness of job opportunities because a higher share of family responsibilities ties women to the area where they live.[1] Under this limiting condition, information about vacancies and workers at the regional level is crucial for the effectiveness of gender-responsive policies. If the effects of a policy correlate with economic performance at the regional level, it is likely that place-neutral policies will exacerbate regional disparities.

Currently, regional disparities remain larger than before the 2008 crisis (European Commission, 2022). Difficulties in triggering developmental paths in less-developed regions are responsible for the persistence of territorial differences. Space-based policies cope better with persistent regional differentials because the intervention is based on regional demographic and economic characteristics (Iammarino et al., 2019). The compensative effect between developed and developing regions, typical of space-neutral policies, no longer operates in the context of place-based policies. Regional policies are called actions to reduce structural disparities and restore regional convergence. Regional cohesion policies, as promoted by the EU, will play a crucial role in this respect, as they stress the role of local communities in reaching national and community-wide goals. However, while space-neutral policies generally do not require information at the subnational level (if not, ex post, in the monitoring phase), space-based policies (in general, and European cohesion policies in particular) require a rich set of information at the subnational level to be fully implemented and effective.

Despite the rich availability of gender (in)equality indicators at the national level (see Chapter "The Main Indicators of Gender (in)Equality"), studies on gender equality indexes at the regional level are scarce due to limited data availability. Early examples were provided for Norwegian municipalities (Kjeldstad & Kristiansen, 2001). Not surprisingly, Scandinavian countries, such as Norway and Sweden, have a long tradition of regional policies (Rönnblom, 2005). Other studies have focused on Spanish regions (Peinado & Céspedes, 2004; Bericat Alastuey & Sánchez Bermejo, 2008; Fernández-Sáez et al. 2016; Gil-Lafuente et al., 2019) and provinces (Martin and Garvi, 2009). Regarding Italian territory, see Amici and Stefani (2013) and Costantini and Monni (2006). More recently, Hippe and Perrin (2017) studied gender inequality in human capital across the EU regions (NUTS 1[2])

[1] The so-called household responsibility hypothesis (Gimenez-Nadal & Molina, 2016), for which a disproportionate burden of household responsibility on women requires shorter commute times. This makes more difficult for them to work any distance away from home compared to men.

[2] The European Union has established a common classification of territorial units for statistics, known as 'NUTS', in order to facilitate the collection, development, and publication of harmonised regional statistics in the EU. This hierarchical system is also used for socioeconomic analyses of the regions and the framing of interventions in the context of EU cohesion policy. The NUTS classification is hierarchical in that it subdivides each Member State into three levels: NUTS 1, NUTS 2, and NUTS 3. The second and third levels are subdivisions of the first and second levels. A Member State may decide to add further levels to the hierarchy by subdividing NUTS level 3. Some of the existing administrative units used for the requirements of the hierarchical NUTS classification are listed in Annex II to Regulation (EC) No 1059/2003.

over 1900–1960. Castellano and Rocca (2019) constructed an index of the gender gap in the labour market at the NUTS 1 level for 31 European countries. The results from 2013 highlight a strong regional variability across various labour market outcomes. Dijkstra et al. (2019) measured gender gaps in terms of female disadvantages and achievements for over 270 NUTS 2 in the European Union. The results confirm that gender gaps are more prominent in regions with higher unemployment rates, whereas female achievement is greater in regions with a higher GDP per capita. The EU Regional Gender Equality Monitor at the Joint Research Center (Norlen et al., 2019) provides a regional-level analysis of the UE. Finally, di Bella et al. (2021) adapted the multifaceted GEI indicator (EIGE, 2017) to Italy's regional context. See Cascella et al. (2022) for an extension of the GEI at the regional level. The results from the R-GEI confirmed that gender equality varies substantially within European member countries. Finally, Perrin (2021) represents the first attempt to extend the regional analysis over a long time horizon by building an indicator at the county level for France since the 1850s. Aimed at investigating the long relationship between the gender gap and economic growth, the work concludes that France's north-south divide already existed at that time. Gender equality is positively associated with economic performance. Northern counties, where the gender gap is narrower, experience higher economic growth rates. Persistent regional differences in economic outcomes can thus lead to persistent sex differences between women and men.

2 Datasets for Gender (in)Equality Measurement: The Eurostat Collection

Eurostat provides several microdata sources for analysing gender (in)equality in the EU. Microdata are survey records that contain primary information on individuals, households, and business entities. The increasing availability of microdata satisfies the need for more detailed information, bringing considerable advantages compared to secondary data published in tabular form on the Eurostat portal. Being the records of individual questionnaires, suitably anonymised in such a way as to preserve the privacy of the respondents, microdata make it possible to conduct complex statistical analyses that would otherwise be impossible. Hypotheses and theories can be tested on different subsets of the population, whether distinguished according to their territorial area of reference or according to some socioeconomic criteria. Using a 'rich-in-details dataset' allows researchers to analyse data concerning the specific socioeconomic aspects of society. This occurs when a given survey questionnaire is augmented with ad hoc modules to retrieve information on a specific phenomenon. Another case is when a given survey increases territorial representativeness by considering subnational levels. A further extension of a standard survey is the inclusion of a longitudinal dimension, which allows one to track the dynamics of individual entities over time. The various innovations that statistical institutes make

in the data provision process move in a fourth direction: a cross-country dimension. The harmonisation of national surveys and the conducting of the same surveys across member countries provides a broader perspective of researchers and other stakeholders. The resulting comparative analysis sheds light on the similarities and differences that converge and diverge across countries.

Eurostat has a specific mandate and long tradition of coordinating survey activities across EU member states, candidates, and EFTA countries. In doing so, it ensures standardisation in the definitions and measurements of the countries involved in the sample surveys so that the data are comparable. Access to these data is possible through a special request for scientific purposes.[3] Different Eurostat surveys focus on different aspects of individuals' economic and social activities, such as income structure, health conditions, labour market outcomes, vocational training, time use in daily life, and adoption of ICT devices.

In this chapter, to be consistent with what will be discussed in the next section, we discuss only the Eurostat surveys used in EIGE's GEI framework (EIGE, 2022). The selection comprises the European Consumer Household Panel (EHCP) and the European Union Survey on Income and Living Conditions (EU-SILC) for household income and living conditions, the European Union Labour Force Survey (EU-LFS) for labour market statistics, the Structure of Earning Survey (SES) for the structure of earnings, the Harmonised European Time Use Surveys (HETUS) for the use of daily time, and the European Health Interview Survey (EHIS). Eurofound data, although important for gender analysis in Europe and used by the EIGE at the national level, are not listed here because these surveys are not sufficiently representative at any subnational level because of their limited sample size.

2.1 ECHP and EU-SILC

In 1991, Eurostat set up a task force to obtain information on households and individual income from national registers and household income surveys, and to check whether the available output could be harmonised ex post. The failure of this approach led to the launch of a specific EU survey—the ECHP. It was conducted for eight yearly waves, between 1994 and 2001. As of 2003, the European Statistics on Income and Living Conditions (EU-SILC) inherited the characteristics of the former ECHP. Currently, the EU-SILC represents the primary data source covering household income and living conditions in the EU, from labour market status to poverty and social activities. Similar to the ECHP, the EU-SILC is a panel survey consisting of interviews held with households and individuals year after year. The interviews covered various topics, ranging from sociodemographic information to household

[3] These are based on the original microdata which are confidential information accessible by means of direct identifiers. Once anonymization procedures are applied, the original survey data become non-confidential and can be released publicly.

income and finance, working life, housing, social relations, and health. The survey was conducted at the European level and involved 14 Member States.[4] The survey was conducted both across and within the households. The household module contains demographic information, income and financial conditions, children, accommodations, and durables. The personal file contains a section for the job search activity if unemployed, for the training activity if employed, and for social relations and life satisfaction. Furthermore, owing to the longitudinal dimension of the sampling design, it is possible to extract information on the social dynamics of the surveyed units repeatedly over time.

Regarding the gender gap, the EU-SILC represents an essential source of information concerning the characteristics of women within the household environment, especially for their focus on labour and housing conditions, deprivation, and social activities. These additional aspects can provide new insights into gender-related differences. The information provided by the EU-SILC is reported at the regional level (NUTS 2). This feature offers a detailed level of analysis. Thus, the EU-SILC is a valuable source of microdata for regional analysis, and it represents an important source for the construction of the GEI across countries since it is used in the entire construction of the money domain, both for economic resources and financial resources subdomains, and the health Access subdomain.

2.2 EU-LFS

The European Labor Force Survey (EU-LFS) is a collection of national LFS gathered by Eurostat, and it is the data source on which the official labour market statistics for employment, unemployment, and inactivity of individuals aged 15+ years across European countries since 1983.

As a collection of national LFS, the EU-LFS interviewed household members to capture information about their current and past employment experiences. They gather information on demographics, labour market status, employment characteristics of the main job as well as secondary employment, atypical work, previous work experience and employment status, working hours, job search activities and methods, education and training, and income decile. Regarding the gender gap, the EU-LFS provides information not only about the different incidences of activity and inactivity between men and women, but also about employment characteristics for the employed population and job-search activities for unemployed individuals. Thus, the EU-LFS represents the primary data source for analysing the gender gap in the labour market across European countries. The EU-LFS is adopted in

[4]The first wave of 1994 comprised the following twelve countries: Belgium, Denmark, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal, Spain, and the UK. Austria and Finland joined in 1995 and 1996, respectively. Sweden joined in 1997 despite the ECHP having been derived from the Swedish Living Conditions Survey itself.

constructing the GEI, mainly for the domains of work, time, and knowledge. The EU-LFS captures the one-year-before-employment situation. This information is usually rearranged in terms of transitional probabilities for the ins and outs of unemployment, employment, and inactivity. Thus, gender-related differences are expected to emerge in such transitional contexts. Moreover, it provides information up to the provincial level (NUTS-3) and is therefore suitable for regional analysis.

2.3 EU-SES

The European Structure of Earning Survey (EU-SES) represents a European survey of enterprises and employee characteristics, with the corresponding earning structure. Enterprises were sampled only if they operated in the private sector with at least ten employees. It provides detailed information on wage levels and registers the benefits and taxes connected to the employment contract. The set of variables considered by the EU-SES distinguishes among firm-specific (e.g. employee size, economic sector), worker-specific (e.g. education, professional type, seniority), and other contract-specific variables (including holidays, social contributions, taxes, and allowances). The informative content of the EU-SES helps trace the dynamics of remuneration components, the effects of employment policies, and labour costs across (countries' fiscal regimes of) European countries.

The survey was conducted at the NUTS 1 level, that is, across territorial macro areas, which implies severe limitations for using these data in a regional analysis. Two additional reasons do not make EU-SES suitable for the regional transposition of EIGE's GEI: time frequency and the sampling scheme. Relating to the first point, unlike data from EU-SILC and EU-LFS that are available yearly, the EU-SES has a four-year frequency. Relating to the sampling scheme, we note that since enterprises are sampled only if operating in the private sector with at least ten employees, this hinders the possibility of tracking the dynamics of the gender gaps in those regions characterised by a relatively high presence of (very) small firms. The larger the portion of women employed in these firms, the larger their underrepresentation in the EU-SES dataset. If a firm's size is unevenly distributed across regions, the estimated regional dispersion in gender gaps is biased. This consideration is more substantial if one considers that local employment opportunities are women usually showing lower (geographical) commuting profiles than men (Gimenez-Nadal & Molina, 2016; Petrongolo & Ronchi, 2020; Le Barbanchon et al., 2021; Fuchs et al., 2021).

2.4 HETUS

The Harmonised European Time Use Survey (HETUS) is a collection of national time use surveys. HETUS represents a unique dataset provided by Eurostat regarding the time use of European citizens, made recently in 2017, available for scientific

purposes. The main objective of this survey was to quantify the time spent on various activities at daily frequency. The overall HETUS questionnaire contains, in fact, around two thousand variables. Starting in 2000, covering the years 1998–2006, the survey was conducted once every 10 years. The second wave of 2010 was conducted from 2008 to 2015 across 15 EU and three non-EU countries.[5] The sample of participants comprises 0.047% of the European resident population, corresponding to 120 thousand households, of which more than one-third are from Poland (27 thousand) and Italy (17 thousand). Among the surveyed countries, Germany and the Netherlands showed the lowest values in terms of sample size. The survey instrument is divided into three main parts: the household questionnaire, the individual questionnaire, and the time diary, registering activities in ten-minute time slots. Individual activities are classified according to the activity coding list (ADL), that is, the official 2-digit[6] classification adopted by Eurostat to characterise the daily activities of individuals.

HETUS is an important source of information for understanding social phenomena. Given its focus on individuals' daily activities, the HETUS dataset allows for a deeper analysis of the gender gap in terms of time use. Thus, HETUS content can be exploited to identify further dimensions in which men and women exhibit different attitudes. Not surprisingly, the HETUS dataset was adopted to show different commuting attitudes between women and men. See Anxo et al. (2011) and Gimenez-Nadal and Alberto (2022) for the multicountry studies. See also Gimenez-Nadal and Molina (2014, 2016) for a regional study focusing on Spain and the Netherlands at the subnational level. They concluded that women commute less than men do because of their larger share of family responsibilities, limiting the possibility of finding employment over a longer search radius. In addition, information extrapolated from HETUS can also help to characterise in more detail the inactivity among the working-age population, the distribution of tasks within households (e.g. cooking and family care), and the impact of cultural differences within the European population. Despite the detailed set of information regarding individual daily activities, wave 2010 does not present any regional breakdowns, with countries being the only possible territorial partition (at NUTS 0 level) of the population. Therefore, it is not of interest if the analysis of the gender gap is conducted only at the national level.

[5] The 15 EU countries, representing the entire first wave (2000) of HETUS, are Austria, Belgium, Germany, Estonia, Greece, Finland, France, Hungary, Italy, Luxembourg, the Netherlands, Poland, Romania, Spain, and the UK. The three extra-EU countries are Norway, Serbia, and Turkey.

[6] The specific domains (one-digit) of ADL are personal care, employment, study, household and family care, voluntary work and meeting, social life and entertainment, sports and outdoor activities, hobbies and computing, mass media, travel, and, residually, unspecified time. The new version of 2018, used for the third wave of 2020, further expands the two-digit ADL-2008 to a three-digit structure to classify the daily activities of individuals.

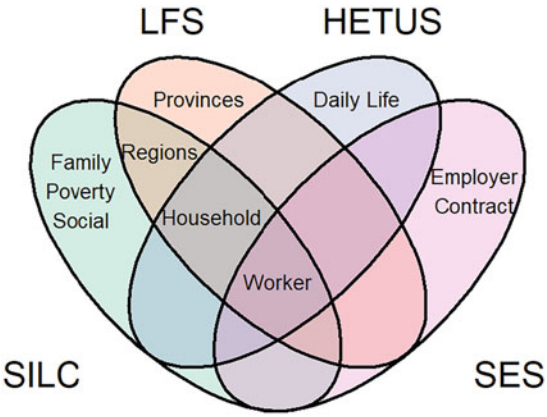

Fig. 1 Eurostat surveys (EU-SILC, EU-LFS, SES, HETUS) intersecting elements. Source: authors' elaboration

2.5 EHIS

The European Health Interview Survey (EHIS) consists of four modules on health status, healthcare use, health determinants, and socioeconomic background variables for EU citizens coded into three categories (natives, EU citizens, and others) and by five-year bands (starting with 15–17, 18–19). The EHIS targets a population aged at least 15 years and living in private households. The regional detail is limited in this survey, being only available in Wave 3 (2019) for Belgium, Bulgaria, Czechia, Denmark, Germany, Estonia, Ireland, Spain, Croatia, Hungary, Italy, Lithuania, Austria, Poland, Portugal, Slovenia, Slovakia, Finland, Sweden, and Serbia; removed for the other countries in Wave 3; and not available in previous waves. Health data belong to special (sensitive) categories. Access to microdata on health requires justification of substantial public interest.

2.6 On the Integration Among Eurostat Data Sources

A set of shared variables across these surveys highlights the opportunity for the joint use of different data sources. However, while EU-SILC and EU-LFS can be exploited for regional analysis and SES allows analysis across macro areas, HETUS can only be used for a cross-country comparison. Figure 1 shows the different elements of the surveys (dimensions, territorial levels, units of measurement). Each survey does not exclusively cover a single element, but some are common to multiple surveys, such as education and worker conditions. Overall, what emerges from Fig. 1 shows that efforts to include the regional dimension in SES and HETUS are likely to enrich future regional analysis. Additional information about employment relations and daily life can enrich the variables considered when constructing synthetic indicators of gender equality.

3 Limitations of Official Datasets for Gender (in)Equality Measurement at the Regional Level in the EU

The first obvious prerequisite for a regional analysis of gender (in)equaliy is the availability of data collected at the regional level. Although it is seemingly obvious, this prerequisite has two implications. First, if a survey is not structured to provide regionally representative estimates, its use is limited and only possible after imputing regional values according to specific statistical criteria. For instance, if the statistical representativeness of the sample is built at the NUTS 1 level, it is valid only at the territorial level. The joint analysis of data at the regional (NUTS 2) and macro area (NUTS 1) levels must be accommodated with ad hoc statistical methods. For instance, as a simpler solution, NUTS 2 values can be equalled to the NUTS 1 average for all regions belonging to a specific macro area, or more appropriately, region-specific values can be estimated using more sophisticated small-area estimation models. However, an analysis conducted at the macro-area level would remain valid only on a potential, ideal ground because, in most countries, the level of practical decision-making corresponds to the national or regional level. Furthermore, official statistics are often commented on as if they come from census data and are free of sampling errors. However, this is not the case, and it must always be borne in mind that most of these statistics are estimates that originate from survey data, and that they have a degree of uncertainty due to their sampling nature. Estimates at the regional level have precision (think of the standard errors of the estimates) that is necessarily lower than at higher hierarchical levels, at least because of the smaller sample size. Therefore, moving from a national to a regional analysis requires an evaluation of the consistency of estimates to assess whether territorial differences can be considered statistically significant. In addition, evaluating the completeness of information may result in the selection of alternative measures because a given indicator may be inappropriate when applied to a regional context. This may happen, for example, in the case of an extension of a variable originally designed at the national level to the regional level. For instance, the indicator of women on boards of listed companies makes sense in a national analysis but not from a regional perspective. The economic reference area of a listed company cannot be ascribed to a specific region; in any case, this is hardly the region where the company has its head office. Datasets used to construct the nationwide indicator may not include, by design, information at the subnational level (e.g. HETUS). In addition, different privacy regimes for microdata protection may reduce the number of countries involved in cross-country analysis. Instead, the problem of time misalignment among different datasets, which occurs when the construction of a synthetic indicator involves different data sources, may alter the reference year of some (groups of) variables.

A similar discussion is valid for differences in time frequency. Table 1 provides an overview of the distinctive features of the Eurostat survey data. The four selected datasets cover different time spans. In addition, the time frequencies differed. It ranges from yearly to 4 (SES) or 10 years (HETUS). Ideally, one would like to merge

Table 1 Comparison of selected Eurostat survey datasets

Survey	Population	Content	Years (frequency)	Max NUTS detail	Notes
ECHP/ SILC	Households members	Income and living conditions	1994–2001/ 2004–2020[a] (yearly)	NUTS 1[b] NUTS 2	
LFS	Individuals aged 15+	Labour market status	1983–2020 (yearly)	NUTS 3	
HETUS	Households members	Daily activity	2010[c] (ten years)	NUTS 0	
SES	Employees	Structure of earnings	2002–2018 (four years)	NUTS 1	

Notes: [a] Panel for 2005–2019; [b] Germany; [c] collected in 2008–2015

the contents of different datasets that share the same time span, time frequency, and territorial disaggregation. Failures in doing so lead to the inappropriateness of some Eurostat datasets or variables originally included in the design of the synthetic indicator. At the extreme, it can lead to structural changes in terms of domains and subdomains. Modifications in the structure of the indicator, for example, of the R-GEI (di Bella et al., 2021), are not immediate and straightforward tasks. Instead, they require full scrutiny of the content of the various survey questionnaires and, when replacements occur, coherence with the scope of the indicator.

4 From GEI to R-GEI in a Cross-Country Setting

As specified in the Introduction, this book stems from the EU Erasmus+ programme-funded project ReGem (Regional Gender Equality Measurement in the EU[7]), inspired by the work by di Bella et al. (2021) to investigate gender equality at the regional level in Italy, France, Spain, and Germany. Instead of proposing a brand-new gender equality index based on additional statistical sources than those proposed by the EIGE (Norlen et al., 2019), the ReGem project sought to understand to what extent the EIGE's GEI could be declined at the regional level by using the same data sources of GEI by constructing what di Bella et al. (2021) called Regional-GEI or R-GEI, but for a broader study area. In their work limited to Italy, di Bella et al. (2021) identified that only 10 out of 31 variables of EIGE's GEI could also be measured at the regional level using the same definitions and data as the original nationwide GEI. Other variables could not be measured at the regional level because they were meaningless if rescaled at that territorial level or were based on surveys not designed for regional representativeness. The authors identified 14 alternative variables using the same data sources as the GEI or data from the Italian Institute of Statistics (Istat). However, the authors did not find a suitable substitution for these

[7] Project website: regem.unige.it

seven variables. The domain that required the most relevant revisions was power because, from a regional perspective, most of the original indicators lost their relevance. For instance, the national-level indicator 'percentage of women ministers or having a seat in parliament' power subdomains has been replaced by a regional/local variant 'share of women in regional boards' or 'share of municipal and regional women assessors and women city mayors' using data from Italian administrations.

In the ReGem project, it was decided to make a replication of the variable selection process that di Bella et al. (2021) conducted for Italy for the four countries in the study area, but without adding country-specific data sources to the Eurostat databases. The final result (Table 2) substantially confirmed the results by di Bella et al. (2021), leading to the identification of 12 local-national equivalent variables, nine 'close to the original' alternatives derived from Eurostat databases, and 9 variables for which it was impossible to find, among Eurostat databases, valuable substitutes. Unfortunately, accessing micro-data from the EHIS survey was impossible due to the sensitive nature of the respondents' health data and the availability of regional-level data limited to Italy and Germany. Furthermore, for Germany, most datasets, including the LFS and EU-SILC data, are only available at the NUTS 1 level; therefore, in the analyses presented in the next chapter, the country was excluded from the analysis.

5 Conclusions

Regional analysis is an important approach for identifying areas within a country in which the gender gap is most pronounced. Limiting the analysis to a national assessment may mask the extreme situations behind an intermediate value. However, going from a national to a regional analysis of gender inequality is a complex process, especially when conducting a cross-country analysis. The reformulation of variables measured at the national level at the regional level may run into issues that are not immediately resolvable. In some cases, it may happen that the national indicator does not make sense when defined at the local level or that the data used for the national indicator are not representative at the regional level. It is then necessary to assess whether a suitable variable exists to replace the original variable within the alternative datasets. This is often possible by using specific national surveys, but without any guarantee that, in a cross-country analysis, there is homogeneity of definition and measurement between different countries. It may also happen that no suitable variables are found to replace the original ones, and thus, there is only partial coverage of the regional index compared to the national one.

The ReGem project focused on four key countries of the European Union, verifying that, although in a context coordinated by Eurostat, there are differences between surveys and inhomogeneity of territorial detail between countries within the same survey. At present, if one wants to remain within the logic of the GEI, the reference indicator for comparing gender equality between EU countries, it seems inevitable to integrate Eurostat sources with data from national surveys, as done by

Table 2 R-GEI variables in EIGE'S GEI framework

RGEI Source at NUTS2*	Same as GEI	NA	Same as GEI	NA	NA	EU-LFS (Ad hoc module 2018)	NA	EU-SILC	EU-LFS (Ad hoc module 2019)			
R-GEI description (measure, population)	Same as GEI	NA	Same as GEI	NA	NA	People caring for and educating their children, elderly, or disabled people (%, 18+ population)	NA	Workers regularly attending leisure activities outside their home (cinema, concerts, sports) (%, 16+ workers)	Workers involved in voluntary or charitable activities during the last 12 months (%, 16+ population) (%, 16+ workers)			
GEI source	EU-LFS	EU-LFS	EU-LFS	EWCS	EWCS	EWCS	EWCS	EWCS	EWCS			
GEI description (measure, population)	Full-time equivalent employment rate (%, 15+ population)	Duration of working life (years, 15+ population)	Employed people in education, human health, and social work activities (%, 15+ employed)	Ability to take one or two working hours off to take care of personal or family (%, 15+ workers)	Career prospects index (points 0–100)	People caring for and educating their children or grandchildren, elderly, or disabled people every day (%, 18+ population)	People doing cooking and/or housework every day (%, 18+ population)	Workers doing sport, cultural or leisure activities outside their home several times a week or at least daily (%, 15+ workers)	Workers involved in voluntary or charitable activities at least once a month (%, 15+ workers)			
Sub-domain	**Participation**		**Segregation and quality**			**Care activities**		**Social activities**				
Domain	**Work**					**Time**						
RGEI Source at NUTS2*	Same as GEI	Same as GEI	NA	NA	NA	Same as GEI	Same as GEI	EU-SILC	Same as GEI	Same as GEI	Same as GEI	
RGEI description (RGEI measure)	Same as GEI	Same as GEI	NA	NA	NA	Same as GEI	Same as GEI	Monthly earnings (mean, working population 15–64)	Same as GEI	Same as GEI	Same as GEI	
GEI source	EU SILC	EU mortality tables	EU-SILC	EHIS	EHIS	EU-SILC	EU-SILC	EU-SES	EU-SILC	EU-SILC	EU-SILC	
GEI description	Self-perceived good or very good	Life expectancy at birth	Healthy life expectancy at birth	People not smoking and not	People doing physical	Population without unmet needs for	Population without unmet needs	Monthly earnings in PPS (mean, working	Equivalised net income	Not-at-risk-of-poverty as 60% median income	Income distribution as S20/S80 (%,	

(continued)

Table 2 (continued)

RGEI Source at NUTS2*	Same as GEI	NA	Same as GEI	NA	NA	EU-LFS (Ad hoc module 2018)	NA	EU-SILC	EU-LFS (Ad hoc module 2019)		
(GEI measure)	health (%, 16+ population)	(years, population)	(years, population)	involved in harmful drinking (%, 16+ population)	activities and/or consuming fruits and vegetables (%, 16+ population)	medical examination (%, 16+ population)	for dental examination (%, 16+ population)	population [aged <65])	(mean, 16+ population)	(%, 16+ population)	16+ population)
Sub-domain	**Status**			**Behaviour**		**Access**		**Financial resources**		**Economic resources**	
Domain	**Health**							**Money**			
RGEI source at NUTS2*	Same as GEI	Same as GEI	Same as GEI	NA	NA	NA	EU-LFS	EU-LFS	EU-LFS	EU-LFS	EU-LFS
RGEI description (RGEI measure)	Same as GEI	Same as GEI	Same as GEI	NA	NA	NA	Women in supervisory positions (large companies, 50+ employees	Women in supervisory positions (finance and insurance) sectorsmployees)	Women in supervisory positions (scientific activities)	Women in supervisory positions (information and communication)	Women in supervisory positions (arts, entertainment, recreation, incl. sports)
GEI source	EU-LFS	EU-LFS	EU education statistics	EIGE database	EIGE database	EIGE database	EIGE database	EIGE database	EIGE database	EIGE database	EIGE database
GEI description (GEI measure)	Graduates of tertiary education (%, 15+ population)	People participating in formal and non-formal education and training (%, 15+ population)	Tertiary students in the fields of education, health and welfare, humanities and art (%, 15+ population)	Share of ministers (%, women and men)	Share of members of parliament (%, women and men)	Share of regional assemblies (%, women and men)	Share of boards in largest quoted companies (%, women and men)	Share of board members of central banks (%, women and men)	Share of board members of research funding organisations (%, women and men)	Share of board members of publicly-owned broadcasting organisations (%, women and men)	Share of board members in national Olympic sports organisations (%, women and men)
Sub-domain	**Attainment and participation**		**Segregation**	**Political**			**Economic**		**Social**		
Domain	**Knowledge**			**Power**							

di Bella et al. (2021). However, the task seems very complex for a complete comparison across the 27 EU countries.

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Comparative Analysis of Regional Gender Disparities

Sandra Fachelli and Pedro López-Roldán

1 Introduction

The analysis of gender equality at the country level is a key information tool for assessing the impact of gender policies as well as the trends of change over time regarding this social reality. The European Institute for Gender Equality (EIGE) has been conducting this function since 2013, producing several interesting results (see Chapters "Gender Equality, Equity, and Equal Opportunities", "The Main Indicators of Gender (in)Equality", and "Gender Equality as EU Strategy" in this book). In the context of the ReGEM project, we would like to deepen this type of analysis by investigating at the regional level (NUTS2) the extent to which differentiated behaviour can be observed within each country. We chose Italy, Spain, and France as case studies, covering a total of 62 regions, to analyse gender equality with the different indicators proposed in the GEI and to observe what particularities emerge from a disaggregated territorial analysis, essential for the development of local gender policies. We constructed a disaggregated measure as close as possible to the national-level indicator produced by EIGE: Regional Gender Equality Index (RGEI) obtained from Eurostat in the form of micro-data.

Chapter "Gender Equality, Equity, and Equal Opportunities" conceptualises the phenomenon of gender (in)equality, while Chapter "The Main Indicators of Gender (in)Equality" presents the main proposals on its measurement, particularly the GEI. Chapter "Sub-national Level Data to Measure Gender (in)Equality in the EU: Opportunities and Limitations of Official Datasets" shows the need to work at the

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subnational level and the limitations encountered in doing so. Considering these different reflections, this chapter presents the results of a comparative analysis of the indicators available at the regional level according to the NUTS2 division in the four countries chosen in this study. We carried out two types of analysis: construction of the index and analysis of the six main domains that define the measure, work, money, time, power, knowledge, and health, with the aim of typifying the regions analysed. The analysis will also provide relevant insights into the role of national boundaries in gender equality when physical separators determine them (in particular, Spain, France, Italy, and France). Internal disparities are also relevant, such as the north/south division in each country.

The European Union (EU) is considered to be one of the world's most advanced political systems with regard to the promotion of gender equality. In 1957, the construction of an initiative at the European level in the field of gender equality was not self-evident, and continuous work for 40 years led the EU to impose a series of norms and values on gender equality on member states. The policies were then developed through successive treaties and the gradual extension of community competence within the Council and the Commission, and the driving role played by women, such as Jacqueline Nonon, Éliane Vogel-Polsky, Barbara Helfferich, and Eryl McNally (Jacquot, 2014).

Until 1997, Article 119 (today, Article 157 of the Treaty on the Functioning of the European Union) was the sole foundation for European activity in the area of gender equality; we can say that a substantial policy for combatting inequality and promoting gender equality was built on this single basis. In general, the policy was based on different instruments (treaties, directives, jurisprudence) to guarantee a variety of rights and was the central pillar during 1975 and 2010.

In 2006, the Parliament and Council established an important body, the European Institute for Gender Equality, thought regulation number 1922, which became fully operational in 2010. The objective was to contribute to and strengthen the promotion of gender equality, including gender mainstreaming in all community policies and the resulting national policies, and the fight against discrimination based on sex, and to raise EU citizens' awareness of gender equality by providing technical assistance to community institutions, in particular, the Commission and the authorities of the Member States.

A report on progress on equality in all areas, specifically in business leadership in 2010, stated that the progress was not so good 'despite a general trend towards more equality in society and on the labour market, progress in eliminating gender inequalities remains slow' (European Commission, 2011a: 17).

Actions that will give an important boost to gender equality were established in 2010. In that sense the European Commission boosts three strategic plans to promote the advancement of women and objectives for strategic engagement for gender equality: Strategy for Equality between Women and Men 2010–2015[1]; Strategic

[1] European Commission (2011b).

Engagement for Gender Equality 2016–2019[2]; and Gender Equality Strategy 2020–2025.[3]

Particularly in research and innovations, the Vademecum on Gender Equality in Horizon 2020 (2014) was very important, promoting gender equality at each stage of the research cycle: measures before the call, during the process of selection, and in the execution action of research.

The European Regional Development Fund (ERDF) has certainly been a key body in promoting gender equality at the regional level. All programs funded between 2000 and 2006 had specific requirements in this regard (European Commission, 2010).

Among the main requirements concerning the integration of these actions in the ERDF were a clear reference to the intention to ensure the contribution to the elimination of inequalities and promote equality between men and women; to promote community policies and operations concerning equality between men and women; the quantification of global objectives for the reduction of inequalities; a clear demonstration of consistency in planning and strategising about equal opportunities of the relevant national employment plan; how the balanced participation of women and men would be achieved within the monitoring committees; to construct key monitoring indicators broken down by sex; to perform ex-ante evaluations of the situation in terms of equality between men and women; to detailed objectives and quantify targets on equal opportunities between women and men for those priorities, and to measure them; and to adopt measures and an outline of how equal opportunities would be considered in the management and control arrangements for selecting and monitoring operations.

An evaluation carried out in 2010 by the European Commission has shown significant gender equality effects of such policies, especially on childcare and elderly care services, which were more effective than specific measures in both creating employment opportunities for women and improving work-life balance. The impact of social infrastructure and regeneration projects in areas experiencing depopulation or deprived urban areas has also been shown to be indirectly beneficial for women's employment and quality of life, with potential positive effects on fertility rates. The smallest impact has been on demographic changes, which takes a long time to observe. Among the lessons learned, it can be underlined that: (a) the local dimension is relevant to demographic change and gender equality, but, while necessary, it is not sufficient; (b) to address the multiple dimensions of demographic change and gender equality, it is necessary to adopt integrated and multi-level policy solutions; (c) to deliver positive effects on gender equality, it is not enough to set this as a horizontal principle but to complement it with sound implementing measures; and (d) to improve the effectiveness and sustainability of ERDF interventions, appropriate management capacities are necessary at the regional and local levels (European Commission, 2010).

[2] European Commission (2016).

[3] Gender Equality Strategy 2020–2025 (2020).

More recent reports on ERDF have shown its important role in the promotion of gender equality principles in several intervention areas (European Commission, 2018). This investment has been particularly relevant, considering that these services faced cuts in public funding at the national, regional, and local levels. Approximately EUR 1.25 billion was programmed for investment in childcare infrastructure during the 2014–2020 period. The ERDF has also supported the mainstreaming of gender equality with specific measures and contributed to the reduction of gender segregation in occupations and sectors (González Gago, 2019: 46). However, as the same author notes, mainstreaming equal opportunities and gender equality principles into all ERDF intervention areas is still perceived as very difficult by almost 30% of managing authorities; as a result, little attention has been paid to the specific needs of women in the intervention design, and this lack of focus reduces the effectiveness of ERDF-funded actions with respect to gender equality.

In a more general framework, we examine the performance of regional disparities. In this regard we can summarise four stages: (1) Before the Great Recession, the regional disparities were in a decline between EU member states, to the extent that the EU was nicknamed a 'convergence machine', as Monfort (2009) showed. (2) A second stage shows a negative impact with great effect at the regional level, as a consequence of the neoliberal model and its policies, as noted by Perrons and Dunford (2013). (3) A sudden stop in the convergence process during the Great Recession, a crisis that also had a deep impact on economic and social cohesion in the EU, was frequently cited as one of the main causes for the lack of popular support for the project to build the European Union (Montfort, 2020). (4) The COVID-19 crisis in 2020 demonstrated that a shock of such magnitude, even if temporary, can have permanent or at least long-lasting effects on regional convergence (Montfort, 2020), which also generates a significant delay in the catching-up process.

In the course of this overall process, the other convergence ('gender equality') had its own vicissitudes. Without any doubt, 'gender mainstreaming' played a fundamental role in the policy transformations in the 1990s and marked the so-called exception model by Jacquot (2015). This model was followed by the 'anti-discrimination model' until the mid-2000, where the emblematic image is a female victim of discrimination in the public sphere, and, finally, the 'rights model', which ran from the 2000s to the 2010s, wherein the image is a woman whose fundamental right to equality is not respected (Jacquot, 2015: 176).

Currently, the result according to the evaluation report of the 2016–2019 strategic plan shows rather moderate progress with a score of 2.6 on a scale ranging from 1 to 5, when considering all thematic areas across all member states (González Gago, 2019: 40).

It is thus evident that the significance of regional disparity, and in particular, the pending effort to be made in terms of gender, is a long work still in progress, and that external vicissitudes play a key role in the reduction or widening of differences. Some efforts, such as those of the European Commission (2021: 17), analyse the indicator of how women perform in relation to the best-performing women (FemAI), and a second index reveals whether women are at a disadvantage compared to men in the same region (FemDI). Four out of five residents of less-developed regions live in

a region with below-average female achievement and above-average female disadvantage. Nevertheless, only one in five residents living in a transition or more developed region faces below-average female achievement and above-average female disadvantage.

These approximations are fine, but without regional gender equality indicators, we are blind to the changes that have taken place and cannot assess their progress. Monitoring these regional gender differences is essential for identifying the processes of convergence (or divergence) that are urgently needed. The evidence of increased inequality in regional development with the 2009 and COVID crises highlights the importance of regional development issues and the urgent need to analyse them with reliable information.

Finally, we would like to highlight that, according to recent trends in regional disparities (Montfort, 2020), Europe is a territory with significant internal inequalities that cannot be improved if they are only addressed at the national level. Therefore, the implementation and monitoring of regional policies is imperative, in the same way that gender policies at the national level are insufficient. Consequently, adequate information is required for the implementation, monitoring, and evaluation of policies at the regional level.

2 Methodology for Regional Comparative Analysis

In the following sections, we present a descriptive and typological analysis of the equality measure conceptualised and operationalised by the EGEI both at the country level, comparing the 27 European countries as a whole, and at the regional level, taking into account the NUTS2 division for the territories of Spain, France, and Italy. The results also include information on changes over time, especially between the reference years of 2010 and 2019.

The data presented refer to the overall calculation of the GEI and its decomposition into six domains: work, money, knowledge, time, power, and health. In the disaggregated analysis of the domains, we follow a typological construction methodology called structural and articulated typology (López-Roldán, 1996; López-Roldán & Fachelli, 2015) to complement the analysis of the index with the structuring of the main dimensions that make it up, look for possible specific patterns by country, and compare the different regions with each other to configure general types of gender equality according to the similarities observed. Figure 1 shows a schematic of this process.

The final objective was to elaborate a typology of both countries and regions according to the levels of gender equality synthesised in the six GEI domains. To do so, we followed a general four-step procedure. First, we take as a model of analysis the theoretical conceptualisation developed by the EIGE, which is expressed operationally in the six domains of the GEI index (see Chapter “Sub-national Level Data to Measure Gender (in)Equality in the EU: Opportunities and Limitations of Official Datasets”). We then applied a combination of two multivariate data analysis

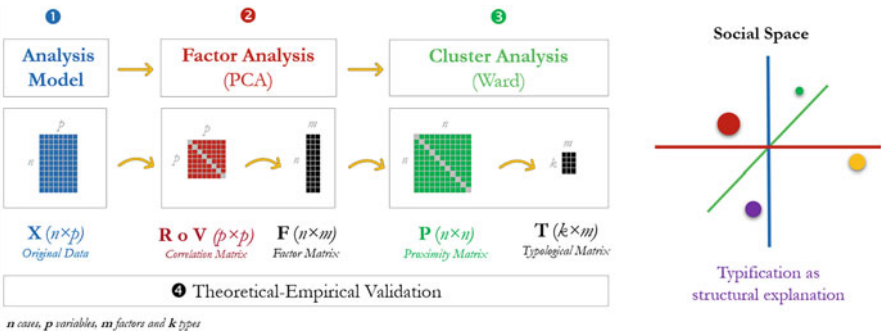

Fig. 1 Structural and articulated typology

techniques. First, by means of principal component factor analysis, we synthesised a set of six gender equality domain variables into two main factors of differentiation of the units of analysis (countries or regions) based on their intercorrelations and by creating a social space (Bourdieu, 1979; Blasius et al., 2019) to allocate these units. The six variables were expressed as two main factors. Based on these factors, which are small in size, we proceeded to apply the second technique: a cluster analysis using an ascending hierarchical method called Ward, or minimum loss of inertia, with the aim of grouping the countries or regions that are most similar to each other and are differentiated from the others according to a number of groups or types, which are considered suitable for typologically expressing the patterns of behaviour of the indicators used to account for gender equality and according to theoretical empirical validation criteria.

Table 1 presents the data for the 27 European countries for the six domains used in the gender index, as developed by the EGEI for the benchmark years 2010 and 2019. With this information, we perform a typological analysis at the country level, comparing the two reference years 2010 and 2019. Table 2 includes the same variables referring to the NUTS2 territories of Italy, Spain, and France (a total of 62 territories) but from the calculation with the indicators that were collected for the regional analysis in this study (see Chapter "Sub-national Level Data to Measure Gender (in)Equality in the EU: Opportunities and Limitations of Official Datasets"). We also analyse the three countries as a whole and within each country, with the 2019 data, to show the comparative diversity of regional behaviour.

3 Gender Equality in European Countries

First, we present the results of an analysis of the 27 countries considered in the EIGE gender equality index. We will provide an account of the main results obtained in 2010–2019 according to the values of the index constructed and will be

Table 1 Mean, standard deviation, and coefficient of variation (%) of the RGEI and six domains, 2019—regions of Spain, France, and Italy

Index	Statistic	Overall	Spain	France	Italy
RGEI	Mean	73.6	74.7	73.9	72.4
	Std. deviation	4.6	4.6	3.4	5.5
	CV	**6.2**	**6.2**	**4.5**	**7.6**
Work	Mean	69.7	75.9	73.2	60.6
	Std. deviation	9.4	6.2	3.6	9.3
	CV	**13.5**	**8.1**	**5.0**	**15.4**
Money	Mean	85.5	82.6	86.0	87.4
	Std. deviation	5.2	6.1	2.4	5.5
	CV	**6.1**	**7.4**	**2.8**	**6.3**
Knowledge	Mean	62.4	64.7	61.3	61.5
	Std. deviation	7.0	5.9	8.8	5.3
	CV	**11.2**	**9.1**	**14.4**	**8.7**
Time	Mean	82.7	83.6	82.2	82.5
	Std. deviation	4.4	4.4	3.4	5.3
	CV	**5.3**	**5.2**	**4.1**	**6.5**
Power	Mean	69.8	68.0	68.5	72.8
	Std. deviation	8.7	9.2	9.0	7.6
	CV	**12.5**	**13.5**	**13.2**	**10.4**
Health	Mean	90.5	87.9	91.6	91.6
	Std. deviation	4.3	5.4	1.5	4.3
	CV	**4.8**	**6.2**	**1.7**	**4.7**

Source: Own elaboration with EUROSTAT data

Table 2 Mean of the variables by the typology, 2019—regions of Spain, France, and Italy

Typology	*n*	Work	Money	Knowledge	Time	Power	Health	Factor 1	Factor 2
Type 1	27	750.5	860.7	650.9	840.0	650.3	910.0	0.4	−0.7
Type 2	21	70.0	880.2	620.3	840.6	780.1	930.0	0.5	0.9
Type 3	7	660.9	770.0	560.3	790.0	590.7	850.0	−10.4	−10.2
Type 4	7	490.5	80.6	550.4	760.1	720.5	860.4	−10.7	10.0
Total	**62**	**690.7**	**850.5**	**620.4**	**820.7**	**690.8**	**90.5**	**0.0**	**0.0**

Source: Own elaboration with EUROSTAT data

complemented with a typological analysis based on the six domains of the equality measure.

The analyses carried out by EIGE since 2013, with the series of data available between 2010 and 2020 (EIGE, 2022), show, in global terms, an improvement in the equality index, albeit relatively moderate, 5.5 points since 2010. As highlighted in the 2021 report 'it will take nearly three generations to achieve gender parity at the current pace', which could mean some 60–70 years at that rate get the equality between men and women. The future will tell us what the more or less accelerated rate of growth of the indicator will be, but in the short term, the immediate effects of

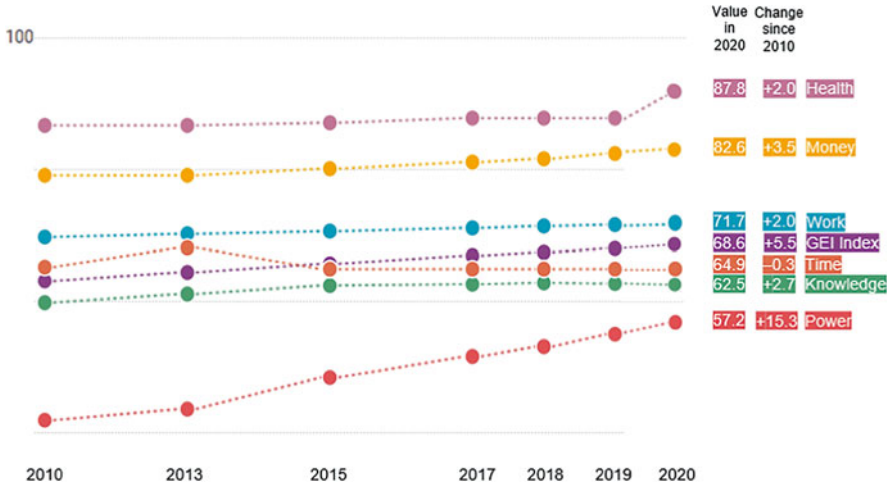

Fig. 2 Evolution of the GEI index and domains from 2010 to 2020. Source: EIGE (2022)

the COVID-19 pandemic augurs a certain slowdown in the trend, although in 2020, the increase in the level of equality has remained the same as the previous year—that is, a pace of two points per year since 2010 (EIGE, 2022).

The analysis of this period through the six domains of the index (Fig. 2)–work, money, knowledge, time, power, and health–shows the different levels achieved and the different growth rates in each of them (EIGE, 2021, 2022). Thus, the domains of health and money had the highest scores, but health with minimal progress since 2010, except last year, which rose significantly. In the case of money, progress is more important, but with a decelerating trend. The domain of work remained more or less constant over time, and no relevant changes were observed in the aggregate indicator. The contribution to the time domain index score is negative in the long term, and the COVID crisis is expected to increase unpaid care and reproduce more inequalities for women. Knowledge has experienced a moderate increase at the beginning of the decade but has remained static in recent years; in 2020, it has decreased for the second consecutive year. Finally, power is the area of the greatest gender inequality; nevertheless, the overall progress in gender equality is mainly generated by advances in this area.

The 27 countries considered were situated in this particular context. In summary, four main situations and trends that classify countries can be distinguished (EIGE, 2021: 29). Figure 3 shows four patterns: (1) countries that are above the European average in the index value and have slow growth; (2) countries that are also above the average but with a higher rate of change over time than the average for all countries; (3) countries below the European average but with a fast growth rate; and (4) countries with a relatively lower index and a slower trend.

The three countries that we analyse in a territorially disaggregated manner are located in two of these profiles: France and Spain in Pattern 2, and Italy in Pattern 3.

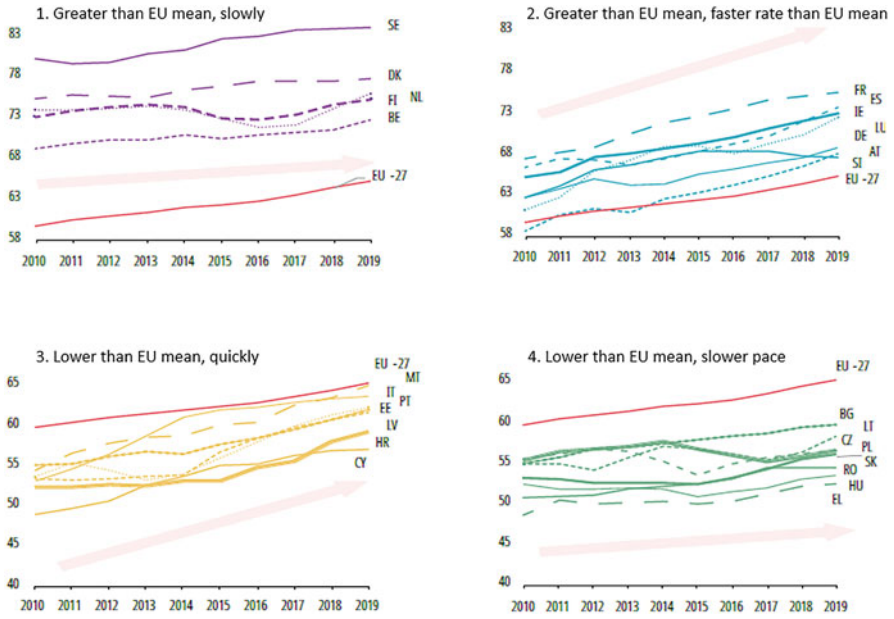

Fig. 3 Evolution patterns of the GEI Index by countries from 2010 to 2019. Source: EIGE (2021)

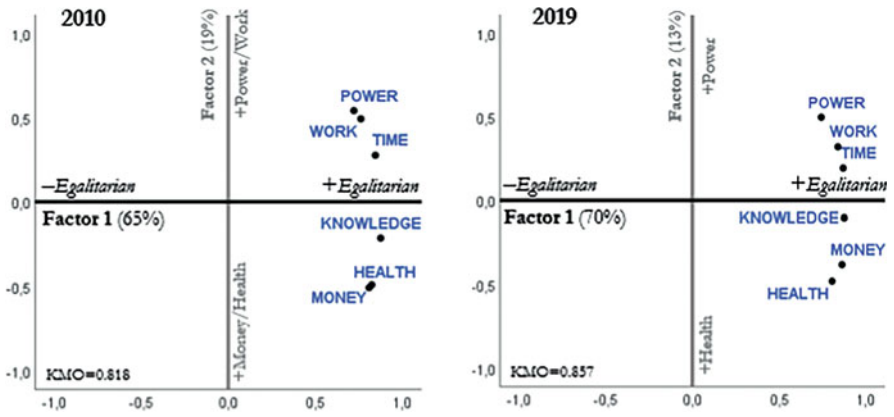

Fig. 4 Principal component analysis. Factor Plot, 2010 and 2019. European countries. Source: Own elaboration with EIGE data

To complement these results, we applied a combined analysis of dimensionalisation and classification to establish a typology of countries according to the six domains considered in the equality measure. We have done so with the data that takes 2010 as a reference year, comparing them with the most recent data from 2019 (see Table 1 in the Annex).

The principal component analysis yielded two dimensions or factors that accounted for 84% of the variance explained in 2010 and 83% in 2019 (Fig. 4). In

both cases, a fairly similar social space is drawn in which the first main factor is configured (with 65% of the variance in 2010, rising to 70% in 2019), which expresses a dimension that contrasts countries with high levels of equality in all domains with countries with low levels. It is a dimension of a lower or higher degree of gender equality that corresponds to the measure expressed by the GEI index, as the correlation between the two variables is 0.938 in 2010 and 0.954 in 2019.

The second factor has less importance (19% in 2010, which was reduced to 13% in 2019) and introduced a second differentiation profile of the countries, showing a small change between the two periods. In the first year under consideration, countries where the money and health domains stand out are contrasted with countries with greater equality in power and work. In 2019, the differences between these domains tended to be reduced, with the health domain standing out at the extremes compared to the power domain.

If we place the 27 European countries in these social spaces of gender equality after applying cluster analysis, we obtain a typology with three significant groups in the 2 years studied (Figs. 5, 6, and 7).

The typology obtained in 2019 shows, on the one hand, Group 1, which is characterised by having the highest levels of equality in the different synthetic indicators of dominance (running from north to south of Western Europe, in order of the first factor: Sweden, Denmark, the Netherlands, Luxembourg, Ireland, Finland, Belgium, France, Spain, Austria, Malta, Germany, and Slovenia).

Groups 2 and 3 had lower levels of equality. The difference between these two groups was attributed to the second factor. Group 2 is characterised by higher values in the domains of power and work and includes mainly Eastern countries (Estonia, Latvia, Lithuania, Croatia, Bulgaria, Romania) together with Portugal. Group 3 was identified by higher values in health and money, including countries in Southeast Europe (Italy, Cyprus, Czechia, Slovakia, Hungary, Poland, and Greece).

This distribution coincides to a large extent with that obtained in 2010, when three countries moved: Malta and Luxembourg were in Group 3 and are now in Group 1, and Poland was in Group 2 and moved to Group 3. Group 1 also shows similar internal differences that tend to attenuate somewhat over time due to the loss of importance of the second factor.

4 Regional Typological Analysis

Country-level analysis provides a basic and fundamental overview of gender equality behaviour that summarises the dynamics of the aggregate whole territory, as well as the expression of the results of action by national, regional, and local governments. Although its informative value is essential, the measurement of a country's gender equality does not cease to be an average indicator of internal realities that may be notably different, implying specific diagnoses and their own needs for action. To show the internal differences, we chose three countries—Spain, France, and Italy—breaking down the gender equality indicators at the NUTS2 level, as

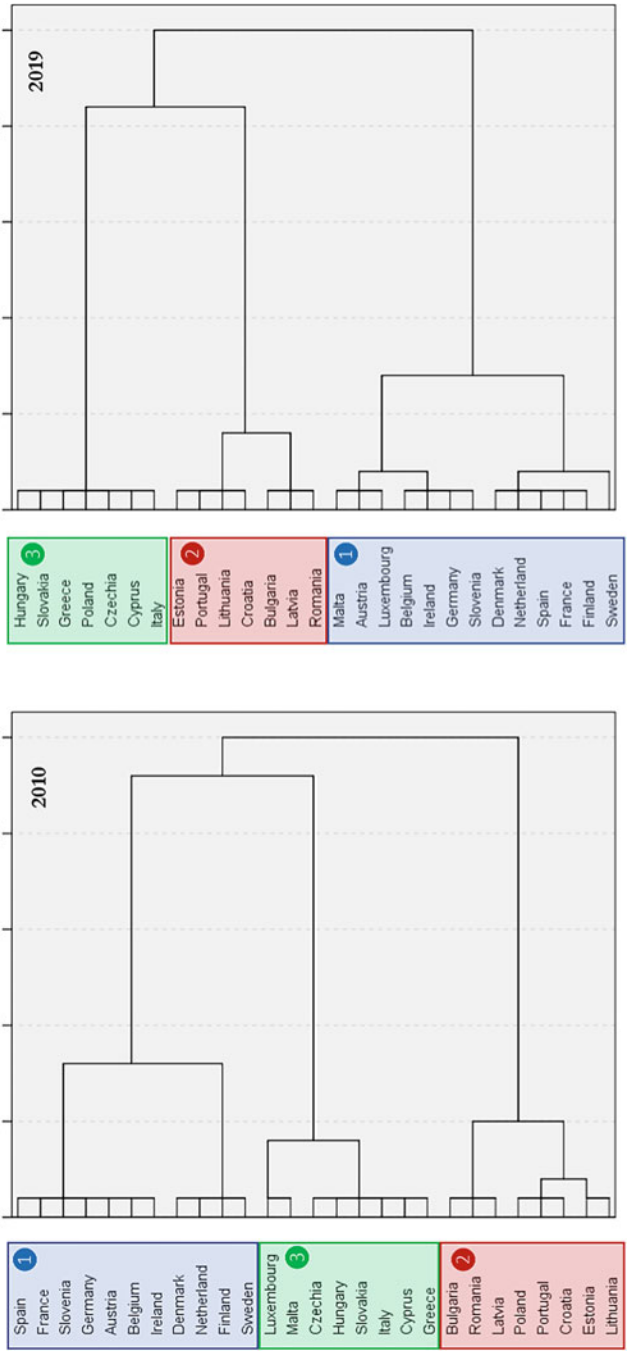

Fig. 5 Cluster analysis: Dendrogram, 2010 and 2019. Source: Own elaboration with EIGE data

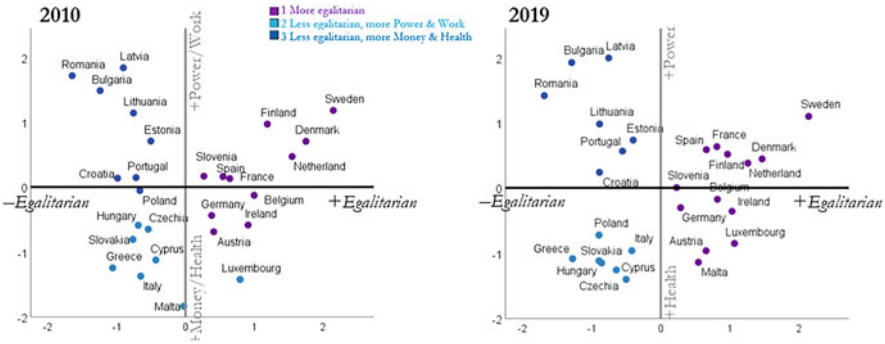

Fig. 6 Cluster analysis: Typology in factor plot, 2010 and 2019—27 European countries. Source: Own elaboration with EIGE data

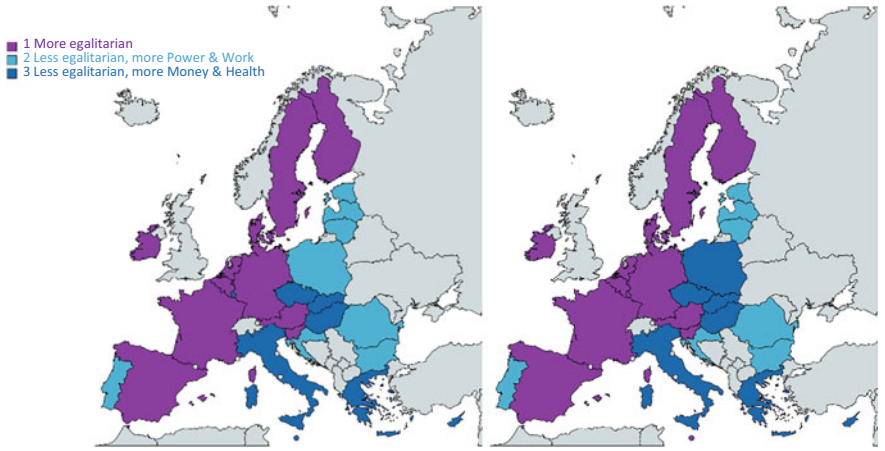

Fig. 7 Country map by the typology, 2010 and 2019. Source: Own elaboration with EIGE data

explained in detail in Chapter "Sub-national Level Data to Measure Gender (in)-Equality in the EU: Opportunities and Limitations of Official Datasets".

With the available information for 22 individual variables that configure the domains and sub-domains of the NUTS2 territories, we have the resulting values that show territorial diversity in detail. We wanted to analyse these results in a complementary way by relating the aggregation in the six domains to the 62 regions that it sets the three chosen countries (see Table 2 in the Annex). To do so, we followed the procedure described in the previous section.

First, we establish the main differentiation factors and then apply cluster analysis to elaborate the typology of regions. We approached this descriptive analytical exercise in two different ways: first, by looking at all regions simultaneously, with the aim of positioning them in relative terms from a joint vision between the three countries, and second, we analyse the internal reality of each country separately.

We conclude the analysis by relating the measure of gender equality at the regional level to various variables of interest for which information is available: gross domestic product per capita, the regional competitiveness index, the social progress index and the quality of government index, and population density.

4.1 Overall Intercountry Analysis

We first present the mapped results of the regional gender equality index by grouping territories into quartiles (Fig. 8). Italy shows the clearest internal division of its territory between the north, above Lazio, with high levels of equality (especially in Trentino-Alto, Emilia-Romagna, Valle d'Aosta, Veneto, Friuli-Venezia Giulia, and Adige-Sudtirol), and the south with low values, coinciding to a large extent with the results obtained in Salvatore Alaimo et al. (2019) and di Bella et al. (2021). This territorial pattern is unclear for Spain and France. In the Spanish case, it tends to be centre-north, which shows greater equality (highlighting Navarre,

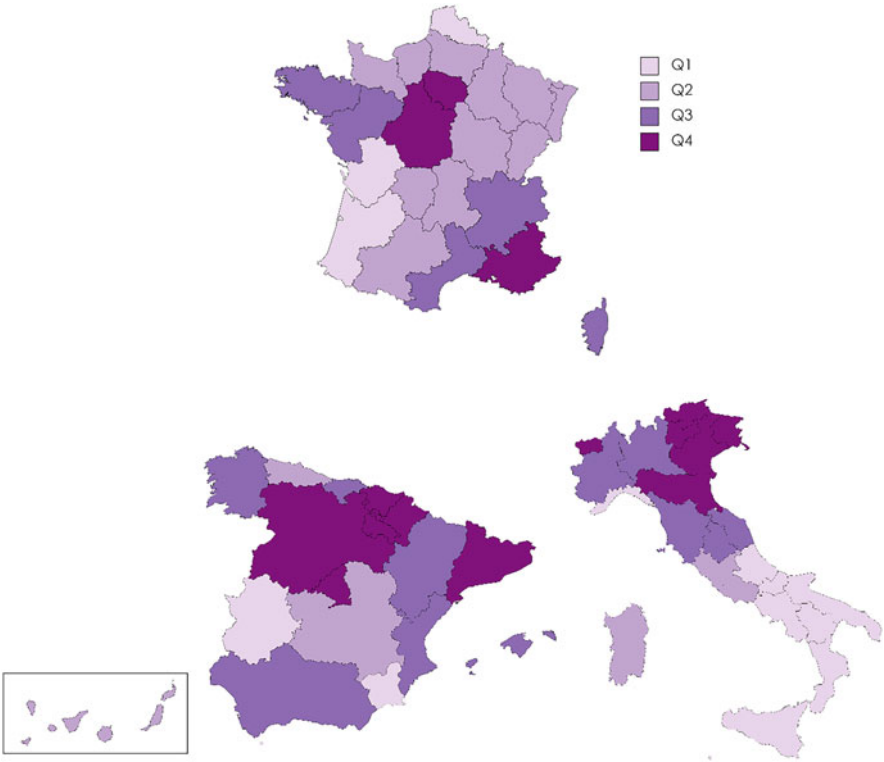

Fig. 8 Regional map of the RGEI in quartiles in Spain, France, and Italy, 2019. Source: Own elaboration with EUROSTAT data

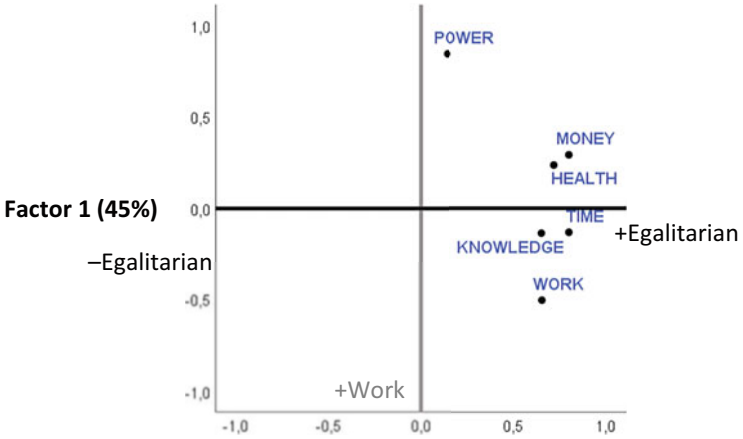

Fig. 9 Principal component analysis: Factor plot, 2019—regions of Spain, France, and Italy. Source: Own elaboration with EUROSTAT data

Basque Community, La Rioja, Castile-Leon, Madrid, and Catalonia), but Andalusia is close to the highest levels and Asturias is farther away. In the French case, the highest equality values were located in the northwest (Île-de-France, Centre-Val de Loire, Pays de la Loire, and Britany) and southeast (Provence-Alpes Côte d'Azur, Corsica, Languedoc-Roussillon, and Rhône-Alpes).

Italy shows the greatest internal disparities in the RGEI, with a coefficient of variation of 7.6, compared to Spain's 6.2, and France's lower dispersion of 4.5 (see Table 1). If we analyse the six domains that conform to the global measure, work, power, and knowledge show the greatest differences between regions, with the work domain standing out in Italy, knowledge in France, and power in Spain.

Considering the six domains in which the gender equality indicators are aggregated (work, money, knowledge, time, power, and health), we conducted a factor analysis to synthesise the six characteristic variables of the 62 regions (see data in Table 2 in the Appendix) in terms of two main factors of variation that explain 64% of the variance. To some extent, these factors coincide with those previously obtained in the country-level analysis. Above all, because the same main factor is configured to express the dimension of low to high levels of gender equality, the second dimension, unlike the previous analysis, mainly contrasts the domains of power versus work as a second factor of differentiation of the regions. This structure is shown in Fig. 9, on which we proceed to locate and group different regions.

The first factor also correlated highly with the regional gender equality index (RGEI) developed in this study, with a value of 0.885. Figure 10 shows the linear relationship between the two measures graphically, differentiating the regions of each country.

If we analyse gender equality by considering these two factors, not only can the regions be differentiated by the degree of overall equality achieved, but also by the predominance of one of the domains established by the second factor. To this end,

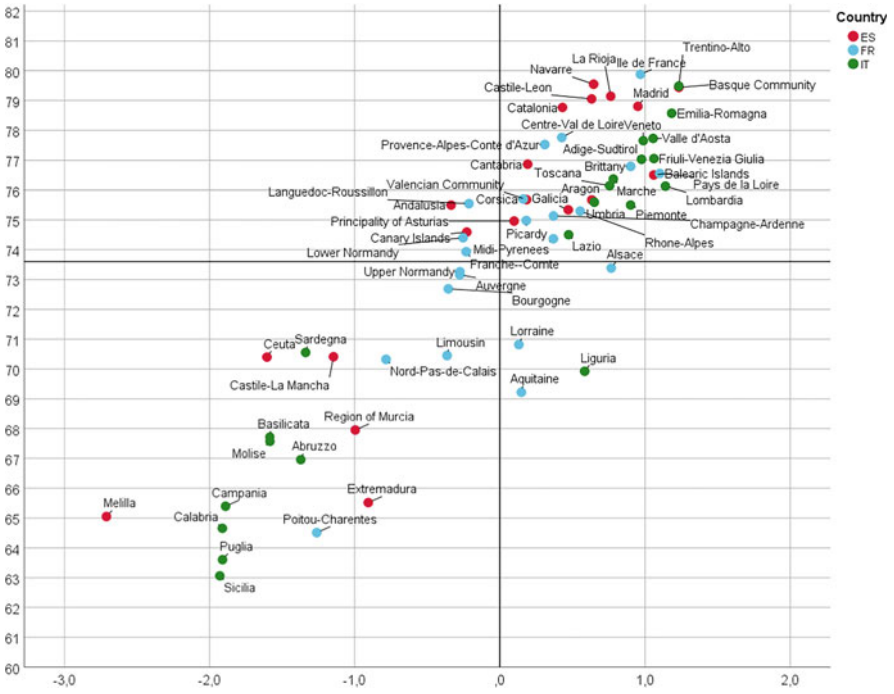

Fig. 10 Correlation between RGEI and first factor, 2019—regions of Spain, France, and Italy. Source: Own elaboration with EUROSTAT data

we classified the regions and obtained a typology of four types. The results are presented in Table 1 and Fig. 11.

The four types correspond to a large extent to the four quadrants that arise from dividing the scatter plot by the factorial axes. The two on the right, Types 1 and 2, show medium and high levels in the equality index. They are differentiated by the contrast between the work and power domains; the first type stands out for its high values in the work domain, whereas Type 2 stands out for its high values in the power domain. The remaining indicators showed similar values. Types 3 and 4 identify the regions with the lowest gender equality values, separated, as in the previous case, by the differentiated values in work, higher in Type 3, and higher in Type 4.

Which regions are a part of each type? In Fig. 11, the regions have been identified by the type and country to which they belong, and in Fig. 12 on the physical map. The case of Italy, again, is the one that most clearly expresses the differences observed between its regions, dividing its territory fundamentally into two parts: the north and the south of the country, with high and low levels of equality, respectively. This classification is consistent with the previous result, in which we considered only the RGEI value. On the one hand, there is a set of regions with medium and high values of gender equality on the right side of the factorial graph with two differentiated identities. Most of them are part of Type 2 and have high

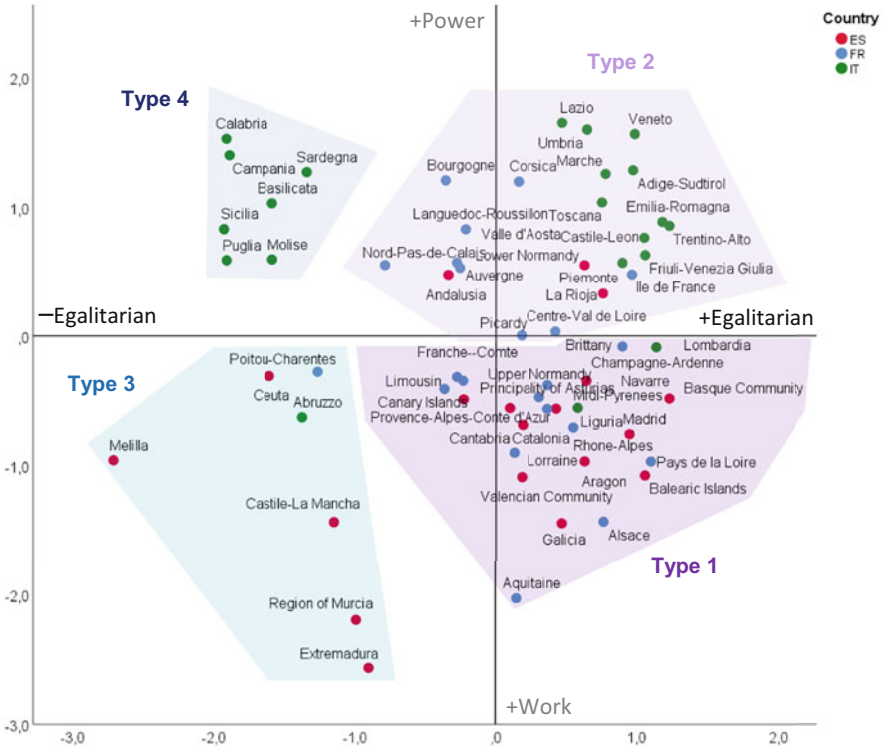

Fig. 11 Cluster analysis: Typology in factor plot, 2010 and 2019—regions of Spain, France, and Italy. Source: Own elaboration with EUROSTAT data

values in the power domain, and two regions, Lombardy and Liguria, are separated as part of Type 1, as they share lower values in the power domain, but higher values in the work domain. On the other hand, there are less equal regions in the south, with the exception of the Abruzzo region which has better indicators in the work domain and joins Type 3. The rest of the regions form an exclusive group of Italian territories, Type 4, positioned on the axis of less equality but whose best indicators are reached in the power domain.

Spain and France share higher levels of equality with the majority of their regions, both in Type 1 (higher values in the work domain) and Type 2 (higher values in the power domain). Type 3 includes regions in Spain with lower gender equality and higher values in the work domain (Extremadura, Castile–La Mancha, Region of Murcia, Ceuta, and Melilla). France is a profile that identifies only the region of the Poitou-Charentes.

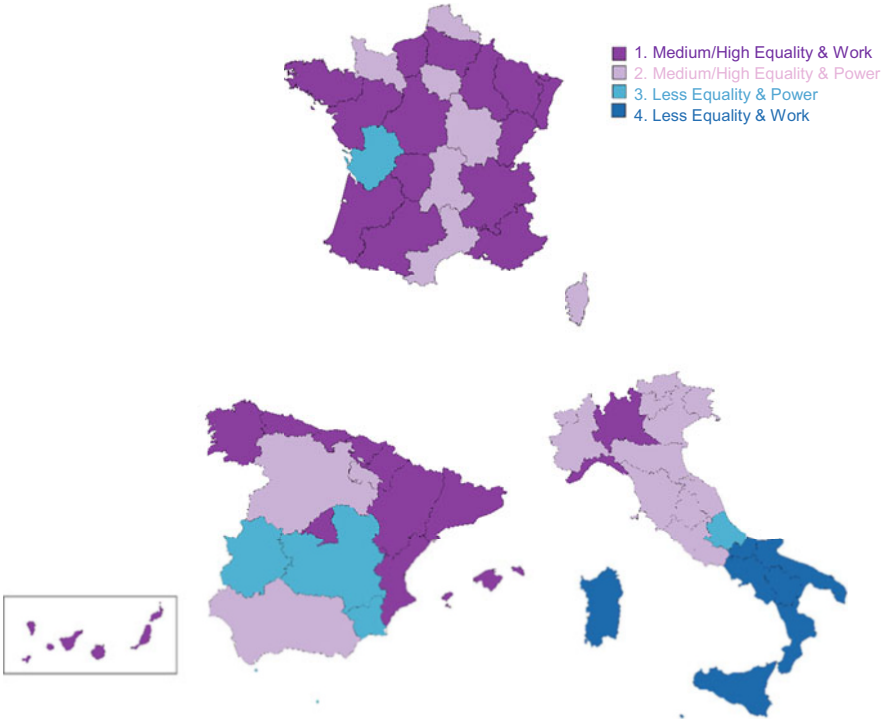

Fig. 12 RGEI typological map, 2019—regions of Spain, France, and Italy. Source: Own elaboration with EUROSTAT data

4.2 Intracountry Analysis

The comparative results, we have just seen, reveal the relative positions of the regions in relation to the others, considering the overall performance of the three countries. However, the picture of the internal reality of each country is conditioned by this general context and does not reveal the diversity of each country in the same way, although some characteristics are apparent. Therefore, we will present the results separately.

Figure 13 presents, first, the factor analyses for each country. The interrelationships of the six domains are expressed partially differently among the three countries and in relation to the previous joint analysis. Spain and Italy retain the characteristics of the first factor as a general dimension of equality, but France contrasts the power domain with the rest. The weight of the first factor is also of unequal importance: in Italy (74%) it is greater than in Spain (51%) and France (39%), showing, to a greater extent, the significant inequality that exists among the territories in all the indicators in Italy. The domain of power in this country is the one that appears different and configures the second factor.

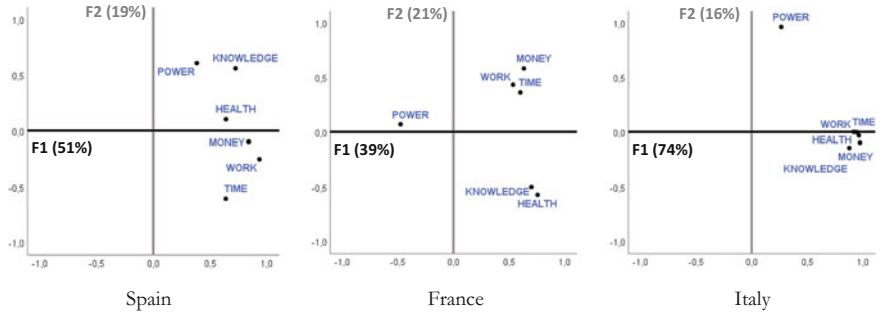

Fig. 13 Separated principal component analysis: Factor plot, 2019—regions of Spain, France, and Italy. Source: Own elaboration with EUROSTAT data

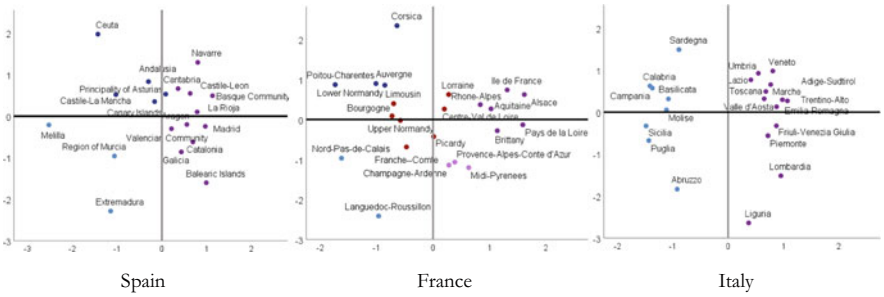

Fig. 14 Separated typological analysis: Factor plot, 2019—regions of Spain, France, and Italy. Source: Own elaboration with EUROSTAT data

Spain maintains the same general pattern as Italy in the first factor, but in the second, it contrasts the domains of power and knowledge with the domain of time. France, on the other hand, together with the variation in the first factor, needs two more factors to achieve a sufficient level of explained variance, showing a greater diversity of profiles. Second, there is an opposition between the regions where money, work, and time stand out as opposed to knowledge and health. Third factor, with a weight of 18%, introduces a differentiation between the regions with a better score in power, work, and knowledge domains versus time domain.

These differentiated patterns among the three countries are consequently expressed in some variations in the distribution of regions (see Figs. 14 and 15). Italy shows the least change and maintains the fundamental division between north and south in two main groups, with the extreme behaviour of Abruzzo and Liguria for the second factor characterised by less equality in the power domain. In the case of Spain, there are small movements in the relocation of the regions according to the two new factors that partly modify the classification obtained in the joint analysis, revealing more clearly the division between the more egalitarian in the north (Type 1), with the exception of Asturias, and the less egalitarian in the south: either with better values in the domains of power and knowledge (Type 2) or in the domain of

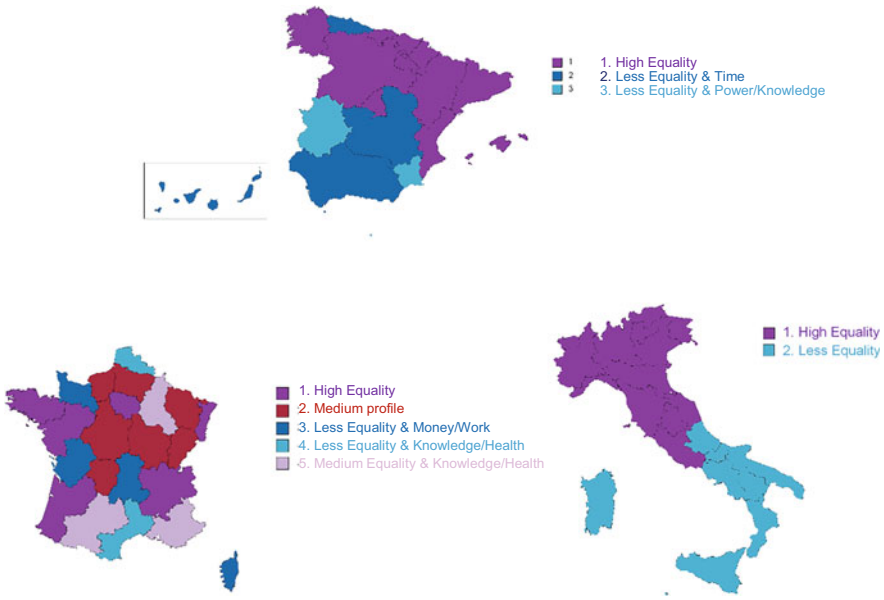

Fig. 15 Separated typological map, 2019—regions of Spain, France, and Italy. Source: Own elaboration with EUROSTAT data

time (Type 3). Finally, France shows the most changing distribution as a result of the loss of importance of the first factor and diversification of the differentiating profiles of its territories. Type 1 is the most egalitarian. Type 5 was more moderated, with high scores in knowledge and health. Type 2 includes regions around the mean for all the factors. Types 3 and 4 are those with a lower level in the equality index, differentiated by the division of the second factor: three with higher values for money, work, and time, and four for knowledge and health.

4.3 Relationship with Other Indicators at the Regional Level

In this section, we analyse the relationship between gender equality and various measures available at the regional level (NUTS2). The following indicators were considered:

1. The Gross Domestic Product (GDP) per capita in the purchasing power standard in 2019 shows regional disparities related to the standard of living and economic development. The original and natural log-transformed variables were presented.
2. The European Regional Competitiveness Index (ERCI) measures the main competitiveness factors for NUTS-2 level regions across the European Union. The index measures more than 70 comparable indicators related to governance; infrastructure, including digital networks, health, human capital, labour market,

and innovation; and the ability of a region to provide an attractive and sustainable environment for businesses and residents to live and work (European Commission, 2022a).
3. The EU Social Progress Index (EU SPI) is a measure of social development and quality of life at the regional level that goes beyond Gross Domestic Product. The Index measures social progress in European regions at the NUTS2 level, using 12 components described by a total number of 55 comparable social and environmental indicators, deliberately excluding economic aspects. Its components are further aggregated into three broader dimensions describing the basic, intermediate, and more sophisticated aspects of social progress (European Commission, 2022b).
4. The European Quality of Government Index (EQGI) measures the average citizens' perceptions and experiences of corruption, quality, and fairness of three essential public services—health, education, and police—in their region of residence (European Commission, 2022c).
5. Tertiary education is an indicator of cultural or educational factors and is defined as educational Levels 5–8 in the International Standard Classification of Education (ISCED).
6. Population density as an indicator of the degree of urbanisation of a region.

Table 3 presents the correlations between these variables. GDP per capita, or its logarithmic transformation, is the variable that shows the highest correlation with gender equality at the regional level and a certain tendency in that the higher the economic level of the region, the higher the level of gender equality achieved.

For the remaining indicators, the correlations were moderate. For the regional competitiveness index, the social progress index, the quality of government index, and tertiary education, correlations were positive between 0.40 and 0.57. Thus, the linear trend is somewhat blurred. In the case of population density, virtually no correlation was observed.

The relationship between RGEI and GDP can be seen graphically in Fig. 16, where the regions are distinguished by country.

Again, this joint description reveals specific behaviours when distinguishing between individual countries (Table 4). In relation to previous results, Italy notably increases the levels of correlation between the gender equality index and all indicators, except population density. France, on the contrary, reduced them, maintaining moderate or low levels only in GPD per capita. Spain, for its part, also increases its correlation with all the variables except EQI, although it reaches the values of the Italian case, except in tertiary education.

5 Conclusions

In this chapter, we have sought to show how disaggregated analysis at the regional level enriches research and shows diverse realities in the behaviour of gender equality indicators, thus providing valuable information to inform and monitor

Table 3 Pearson's correlation between gender equality and several indicators—regions of Spain, France, and Italy

	RGEI	Factor 1	GDP per capita	ln (GDPper capita)	ERCI	EUSPI	EQGI	Tertiary education	Density
RGEI	1	**0.885**	**0.606**	**0.664**	**0.565**	**0.436**	**0.400**	**0.471**	**0.236**
Factor 1	0.885	1	0.697	0.771	0.662	0.422	0.435	0.371	0.238
GDP per capita	0.606	0.697	1	0.979	0.729	0.306	0.257	0.267	0.537
ln(GDP per capita)	0.664	0.771	0.979	1	0.786	0.378	0.336	0.284	0.448
ERCI	0.565	0.662	0.729	0.786	1	0.699	0.637	0.542	0.360
EUSPI	0.436	0.422	0.306	0.378	0.699	1	0.904	0.779	−0.065
EQI	0.400	0.435	0.257	0.336	0.637	0.904	1	0.646	−0.134
Tertiary education	0.471	0.371	0.267	0.284	0.542	0.779	0.646	1	0.236
Density	0.236	0.238	0.537	0.448	0.360	−0.065	−0.134	0.236	1

Source: Own elaboration with EUROSTAT data

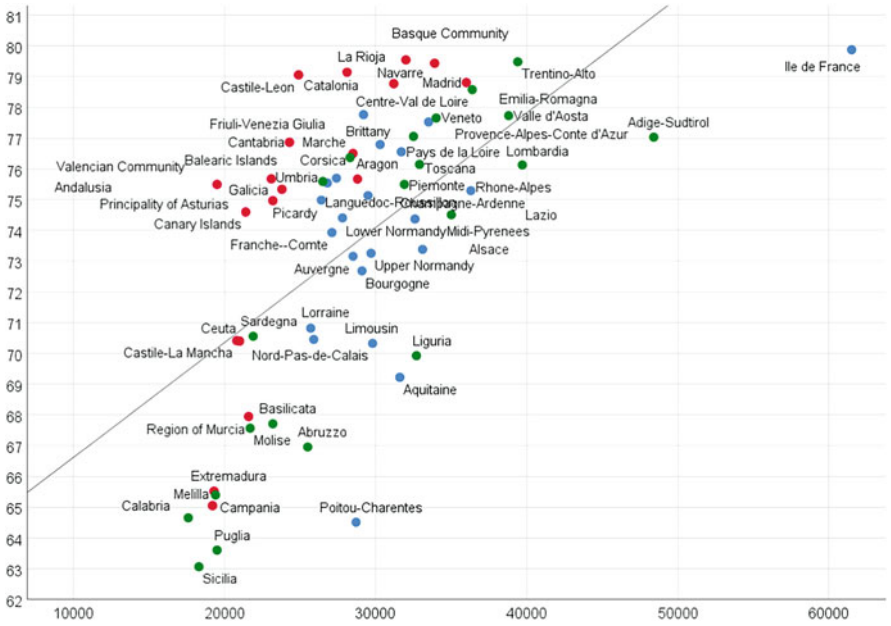

Fig. 16 Scatterplot between RGEI and GDP per capita—regions of Spain, France, and Italy. Source: Own elaboration with EUROSTAT data

policies aimed at reducing gender gaps at both the local and national levels. Through the construction of the regional gender index (RGEI) in Spain, France, and Italy, we contrasted the detailed data with a more general overview, which is also necessary at the country level in Europe as a whole.

The relevance of this analysis lies in the importance of the persistent regional disparities observed in Europe, which have been well recorded by several productions. In particular, conforms to a line of European political action whose most important program has been the ERDF as a European structural and investment fund allocated by the European Union, which aims to transfer money from richer regions and invest it in the infrastructure and services of underdeveloped regions.

The analyses carried out in Europe have justified the importance of joint action due to the finding of significant regional socioeconomic disparities. Political action has been implemented with a strong orientation towards the convergence of different regions, a process that has been achieved over time, but the crises tend to slow down and/or reverse (Montfort, 2020).

The ERDF program has had a great influence on gender issues by including gender mainstreaming among the requirements for receiving funds; thus, it has been an important instrument for regional and local governments to be directly involved in the issue and has had to take measures in this regard to implement all types of work.

To map gender differences, we begin by analysing the differences between European countries. According to the EIGE data, we start by noting that a relative

Table 4 Pearson's correlation between gender equality and several indicators by Region (Spain, France, and Italy)

Country	Index	RGEI	Factor 1	GDP per capita	ln(GDP per capita)	ERCI	EUSPI	EQGI	Tertiary education	Density
ES	RGEI	1	**0.895**	**0.754**	**0.782**	**0.811**	**0.727**	**0.030**	**0.755**	**0.310**
	Factor 1	0.895	1	0.772	0.801	0.839	0.760	0.166	0.731	0.375
	GDP per capita	0.754	0.772	1	0.996	0.891	0.741	0.186	0.819	0.572
	ln(GDP per capita)	0.782	0.801	0.996	1	0.895	0.765	0.191	0.821	0.530
	ERCI	0.811	0.839	0.891	0.895	1	0.774	0.171	0.907	0.636
	EUSPI	0.727	0.760	0.741	0.765	0.774	1	0.464	0.862	0.146
	EQI	0.030	0.166	0.186	0.191	0.171	0.464	1	0.261	−0.195
	Tertiary education	0.755	0.731	0.819	0.821	0.907	0.862	0.261	1	0.451
	Density	0.310	0.375	0.572	0.530	0.636	0.146	−0.195	0.451	1
FR	RGEI	1	**0.752**	**0.447**	**0.449**	**0.388**	**−0.276**	**−0.263**	**0.358**	**0.367**
	Factor 1	0.752	1	0.474	0.508	0.550	0.108	0.101	0.509	0.325
	GDP per capita	0.447	0.474	1	0.990	0.855	0.035	−0.380	0.797	0.928
	ln(GDP per capita)	0.449	0.508	0.990	1	0.872	0.078	−0.312	0.821	0.888
	ERCI	0.388	0.550	0.855	0.872	1	0.337	−0.119	0.876	0.775
	EUSPI	−0.276	0.108	0.035	0.078	0.337	1	0.726	0.376	−0.114
	EQI	−0.263	0.101	−0.380	−0.312	−0.119	0.726	1	−0.121	−0.511
	Tertiary education	0.358	0.509	0.797	0.821	0.876	0.376	−0.121	1	0.674
	Density	0.367	0.325	0.928	0.888	0.775	−0.114	−0.511	0.674	1
IT	RGEI	1	**0.954**	**0.846**	**0.883**	**0.866**	**0.869**	**0.850**	**0.621**	**0.151**
	Factor 1	0.954	1	0.877	0.916	0.927	0.813	0.873	0.676	0.214
	GDP per capita	0.846	0.877	1	0.990	0.845	0.816	0.820	0.600	0.152
	ln(GDP per capita)	0.883	0.916	0.990	1	0.893	0.834	0.849	0.659	0.155
	ERCI	0.866	0.927	0.845	0.893	1	0.757	0.796	0.755	0.277
	EUSPI	0.869	0.813	0.816	0.834	0.757	1	0.859	0.625	−0.072
	EQI	0.850	0.873	0.820	0.849	0.796	0.859	1	0.499	0.106

(continued)

Table 4 (continued)

Country	Index	RGEI	Factor 1	GDP per capita	ln(GDP per capita)	ERCI	EUSPI	EQGI	Tertiary education	Density
	Tertiary education	0.621	0.676	0.600	0.659	0.755	0.625	0.499	1	−0.054
	Density	0.151	0.214	0.152	0.155	0.277	−0.072	0.106	−0.054	1

Source: Own elaboration with EUROSTAT data

Table 5 GEI and RGEI comparisons

Country	GEI	RGEI
Spain	73.7	74.1
France	75.5	78.0
Italy	63.8	68.0

Source: Own elaboration over EUROSTAT

global improvement of almost five points in the GEI was achieved between 2010 and 2019, with different patterns of evolution between countries.

To deepen these results, we performed a typological analysis in 2010 and 2019 to dimensionalise the main factors based on six domains that make up the index and observe whether the structure of between countries changes or remains constant. The conclusions of this analysis, in accordance with the same results obtained by the European Institute for Gender Equality, are that the structure has remained basically the same in this period, that there have been moderate advances in the value achieved in the gender equality index, but that the levels and rhythms of different countries differ from one another. We show these differing levels in our typological analysis by differentiating the three groups of countries in both periods. There is a fundamental distinction between egalitarians and egalitarians. The latter are differentiated into two: those that score better in the power and work domains, and those that score higher in the money and health domains.

Our main objective is to show how information at the subnational level nuances aggregate analyses by showing specific structures and dynamics that allow us to enrich the conclusions of the analyses and provide us with a very important tool for designing national and local policies on gender equality. On the other hand, disaggregated analyses present shades when the regions of a country are compared to the regions of other countries or when they are compared internally. Both types of logic are of interest: the first approach relativises and compares the situation of a country's territory with the territories of the rest of the countries considered; the second approach is limited to the sociopolitical reality of the country and is of particular interest for the design and evaluation of national and local public policies.

In the countries chosen for this study and the 62 regions they comprise, the data obtained from the RGEI allow us to conclude, first, that, on an aggregate basis, the highest levels of gender equality are found in France, followed by Spain and Italy. The final values of the index establish the same order as the data elaborated by the EIGE, with certain variations in magnitude given the adaptation made in the construction of the measure (Table 5).

However, internal regional realities are quite diverse. Thus, a greater number of regions in Italy than in the rest of the countries are in the fourth quartile, while others are in the first quartile, showing significant polarisation of the territory. Many regions in France are in the second quartile, while Spain shows a dispersed distribution of regions in the different quartiles. Therefore, important disparities need to be considered in the analysis and policy.

The complementary typological analysis that we have carried out deepens these disparities and shows the diversity of the regions of each country with particular patterns of territorial structuring. When the 62 regions were treated together, the

similarity of the first main factor of less or more gender equality in the six regions was reiterated. However, differences appear in relation to the behaviour of the domains in the second factor; in this case, polarising the regions where equality stands out in the domain of power compared to that of work. This dimensionalisation into two principal components determines the typology of the four types of regions that we obtain by grouping them according to the profiles of the four quadrants: medium-high equality/power, medium-high equality/work, low equality/power, and low equality/work.

Regional disparities by sex are also nuanced when a separate analysis is conducted by country. Three distinct patterns were found, one for each country. Italy and Spain maintained the identity of the first factor of less or greater equality, but France changed it by opposing power to the rest in this first dimension, in addition to needing two additional factors to express the diversity of profiles in its territory. Italy and Spain only need a second factor but with differentiated profiles. This shows a territorial distribution marked by the dualisation between northern and southern Italy, the greater diversity of profiles in France, and Spain's intermediate position between the two above.

Finally, we wanted to relate the RGEI results to elements linked to other indicators of economic, social, cultural, political, and demographic development. Here again, the disparities between countries are shown. Overall, the highest correlation is observed with GDP per capita, but when we separate the countries, the reality is more accentuated for Italy, not very relevant in France, and moderate in Spain. In the case of the cultural indicator, the relationship between tertiary education and gender equality is relatively weak; however, when we separate the countries, it is shown to be an important factor in the Spanish case, somewhat less so in the Italian case, and not very relevant in the French case. The association between the social indicators also shows a weak relationship at the general level, increasing in the case of Italy and Spain and disappearing in the case of France. The weak relationship with political indicators at the general level is important only in Italy and disappears in Spain and France. Finally, there was no strong correlation with the level of urbanisation in the region.

These results demonstrate the importance of working at different territorial levels in research and the design of public policies. Moreover, this requires sufficiently disaggregated sources of information that allow us to measure gender equality at the regional level. With this richer and more detailed information, we can better observe the complex social realities of our societies, and that of gender equality/inequality in particular. This will make it easier for us to formulate better diagnoses and implement better policies, both at the state level, to direct policies to compensate territories and distribute resources more efficiently and to enable political and social action to fight for equality at the local level.

Annex (Tables 6 and 7)

Table 6 Gender equality index by country. Global index and domains—2010 and 2019

Country		Index year: 2013 | Reference year: 2010							Index year: 2021 | Reference year: 2019						
		GEI	Domain						GEI	Domain					
			Work	Money	Knowledge	Time	Power	Health		Work	Money	Knowledge	Time	Power	Health
EU	Europe 27	63.1	69.7	79.1	59.8	65.2	41.9	87.8	68.0	71.6	82.4	62.7	64.9	55.0	87.8
BE	Belgium	69.3	72.7	85.5	70.6	70.3	47.9	86.3	72.7	74.9	89.9	70.8	65.3	61.0	86.3
BG	Bulgaria	55.0	67.9	60.8	50.4	43.9	45.8	77.2	59.9	69.6	64.5	55.2	42.7	60.2	77.2
CZ	Czechia	55.6	64.9	73.8	55.4	53.8	31.0	86.3	56.7	67.4	78.9	58.5	57.3	28.1	86.3
DK	Denmark	75.2	79.8	83.6	73.2	80.4	58.0	89.5	77.8	79.4	89.1	71.0	83.1	66.8	89.5
DE	Germany	62.6	70.0	83.2	56.3	69.8	38.3	90.7	68.6	72.4	86.0	54.7	65.0	62.8	90.7
EE	Estonia	53.4	71.2	65.5	51.6	73.7	21.9	82.2	61.6	72.5	73.2	57.3	74.7	36.6	82.2
IE	Ireland	65.4	73.5	85.5	65.3	70.8	37.2	91.3	73.1	76.5	87.8	67.4	74.2	58.4	91.3
EL	Greece	48.6	63.6	75.3	53.4	35.6	22.3	84.3	52.5	65.3	73.7	54.9	44.7	27.0	84.3
ES	Spain	66.4	71.8	77.1	63.5	60.8	52.6	90.3	73.7	73.7	78.4	67.9	64.0	76.9	90.3
FR	France	67.5	71.5	83.5	62.0	66.6	52.4	87.4	75.5	73.2	86.3	67.0	67.3	81.4	87.4
HR	Croatia	52.3	67.2	68.6	49.9	49.8	28.4	83.8	59.2	70.1	74.0	51.8	51.0	45.3	83.8
IT	Italy	53.3	61.3	78.9	53.8	55.1	25.2	88.4	63.8	63.7	79.4	59.0	59.3	52.2	88.4
CY	Cyprus	49.0	70.5	80.7	55.5	45.9	15.4	87.9	57.0	70.6	82.6	56.0	51.3	30.0	87.9
LV	Latvia	55.2	72.6	58.9	49.2	62.0	34.8	79.3	62.1	74.3	68.7	50.9	65.8	50.4	79.3
LT	Lithuania	54.9	72.6	60.8	54.3	52.2	32.9	80.3	58.4	74.2	69.9	56.1	50.6	39.3	80.3
LU	Luxembourg	61.2	70.9	91.8	66.3	70.2	25.6	89.9	72.4	76.3	92.4	70.8	69.1	53.4	89.9
HU	Hungary	52.4	66.0	70.8	54.5	54.1	23.5	86.7	53.4	68.0	73.3	57.2	54.3	22.9	86.7
MT	Malta	54.4	65.1	79.2	65.4	54.3	20.9	92.3	65.0	76.8	84.2	65.2	64.2	37.5	92.3
NL	Netherlands	74.0	76.3	86.6	66.9	85.9	56.9	90.2	75.9	78.3	87.0	67.4	83.9	64.0	90.2
AT	Austria	58.7	75.3	82.8	58.9	56.0	28.4	91.9	68.0	76.8	87.7	64.3	61.2	48.2	91.9
PL	Poland	55.5	66.3	69.5	57.8	54.2	30.6	83.3	56.6	67.2	76.7	57.6	52.5	31.5	83.3

(continued)

Table 6 (continued)

Country		Index year: 2013 | Reference year: 2010							Index year: 2021 | Reference year: 2019						
		GEI	Domain						GEI	Domain					
			Work	Money	Knowledge	Time	Power	Health		Work	Money	Knowledge	Time	Power	Health
PT	Portugal	53.7	71.4	71.8	50.1	38.7	34.9	84.8	62.2	73.2	73.6	56.5	47.5	53.6	84.8
RO	Romania	50.8	67.9	59.8	47.2	50.6	30.8	71.3	54.5	67.5	69.1	52.8	50.3	34.7	71.3
SI	Slovenia	62.7	71.9	80.3	55.0	68.3	41.1	87.8	67.6	73.0	83.7	56.6	72.9	53.0	87.8
SK	Slovakia	53.0	64.8	70.2	59.5	39.9	29.5	85.5	56.0	66.8	75.1	61.6	46.3	30.7	85.5
FI	Finland	73.1	74.5	84.1	58.6	80.1	69.1	89.5	75.3	75.5	87.9	61.9	77.4	74.3	89.5
SE	Sweden	80.1	80.4	85.3	70.7	84.5	77.8	94.6	83.9	83.1	85.4	75.2	90.1	84.5	94.6

Table 7 Gender equality index by region (NUTS2) global index and domains 2019

		Index year: 2021 | Reference year: 2019						
			Domain					
NUTS2		RGEI	Work	Money	Knowledge	Time	Power	Health
ES11	Galicia	75.3	79.6	87.7	89.0	83.7	65.9	62.3
ES12	Principality of Asturias	75.0	74.8	80.0	89.7	86.7	67.0	65.8
ES13	Cantabria	76.9	78.7	80.4	86.4	87.6	69.9	68.5
ES21	Basque Community	79.4	78.4	85.5	92.7	90.1	74.5	68.2
ES22	Navarre	79.5	79.0	81.8	89.5	86.3	75.5	73.2
ES23	La Rioja	79.1	80.1	87.5	92.2	84.4	64.0	80.8
ES24	Aragon	75.7	79.8	82.6	93.2	87.5	66.5	62.0
ES30	Madrid	78.8	81.7	87.8	90.1	86.9	69.3	69.8
ES41	Castile-Leon	79.1	77.0	87.1	92.1	83.0	65.6	82.8
ES42	Castile-La Mancha	70.4	71.4	78.4	87.4	73.0	64.1	61.7
ES43	Extremadura	65.5	72.1	86.2	88.1	75.3	52.8	47.2
ES51	Catalonia	78.8	82.6	89.1	79.6	89.2	64.9	76.6
ES52	Valencian Community	75.7	77.3	87.1	88.0	80.4	66.7	67.7
ES53	Balearic Islands	76.5	85.3	87.8	89.8	93.3	60.8	62.7
ES61	Andalusia	75.5	70.5	84.5	88.3	78.0	62.9	82.1
ES62	Region of Murcia	67.9	72.0	82.5	87.4	74.4	59.3	52.6
ES63	Ceuta	70.4	66.0	72.2	87.2	73.9	64.7	69.9
ES64	Melilla	65.1	59.7	78.9	69.2	77.1	52.1	66.6
ES70	Canary Islands	74.6	75.7	82.0	90.2	79.3	63.3	71.0
FR10	Ile de France	79.9	78.4	81.4	92.9	91.7	70.5	76.5
FRB0	Centre-Val de Loire	77.8	75.1	79.6	90.5	88.2	71.7	72.4
FRC1	Bourgogne	72.7	69.8	78.1	91.9	88.2	52.7	78.3
FRC2	Franche-Comte	73.9	74.0	77.1	91.1	84.4	64.7	67.1
FRD1	Lower Normandy	74.4	74.5	79.1	89.4	86.7	57.5	76.5
FRD2	Upper Normandy	73.3	76.1	80.2	90.7	83.3	58.1	69.0
FRE1	Nord-Pas-de-Calais	70.3	66.0	79.9	90.8	82.2	52.6	73.1
FRE2	Picardy	75.0	73.1	83.2	92.2	84.6	62.4	71.4
FRF1	Alsace	73.4	77.5	87.1	93.3	88.4	62.7	55.3
FRF2	Champagne-Ardenne	75.1	69.7	83.3	92.5	84.9	69.9	66.2
FRF3	Lorraine	70.8	71.3	86.4	91.3	86.9	56.0	58.6
FRG0	Pays de la Loire	76.6	73.5	88.6	93.2	87.8	72.5	61.4
FRH0	Brittany	76.8	70.9	86.9	93.4	88.5	69.2	68.7
FRI1	Aquitaine	69.2	76.9	82.8	92.7	87.1	58.6	46.8
FRI2	Limousin	70.5	69.9	82.1	89.9	85.8	54.6	63.4
FRI3	Poitou-Charentes	64.5	70.3	79.0	89.2	84.4	38.3	62.2
FRJ1	Languedoc-Roussillon	75.5	67.4	78.7	92.8	81.0	67.5	79.4

(continued)

Table 7 (continued)

NUTS2		Index year: 2021 | Reference year: 2019						
		RGEI	Domain					
			Work	Money	Knowledge	Time	Power	Health
FRJ2	Midi-Pyrenees	74.4	71.4	82.5	93.7	85.5	67.6	63.2
FRK1	Auvergne	73.2	71.9	82.7	89.4	85.6	53.7	76.5
FRK2	Rhone-Alpes	75.3	76.4	84.6	92.1	87.2	64.9	64.3
FRL0	Provence-Alpes-Conte d'Azur	77.5	79.5	78.3	92.7	83.4	72.0	70.1
FRM0	Corsica	75.7	77.0	87.1	88.9	86.9	50.6	86.9
ITC1	Piemonte	75.5	67.1	86.4	94.8	92.5	63.9	70.0
ITC2	Valle d'Aosta	77.7	72.4	86.1	94.6	92.5	64.2	75.3
ITC3	Liguria	69.9	62.6	86.8	94.8	92.5	60.2	53.6
ITC4	Lombardia	76.1	68.4	86.5	94.9	92.5	70.4	64.2
ITF1	Abruzzo	67.0	56.8	75.8	86.5	80.9	62.9	58.1
ITF2	Molise	67.6	56.2	75.5	86.4	80.9	55.8	70.8
ITF3	Campania	65.4	46.3	75.0	86.3	80.9	54.8	74.5
ITF4	Puglia	63.6	46.3	75.8	86.5	80.9	53.9	64.9
ITF5	Basilicata	67.7	50.7	75.3	86.4	80.9	59.8	73.6
ITF6	Calabria	64.7	43.8	76.0	86.4	80.9	53.9	74.7
ITG1	Sicilia	63.1	43.6	78.0	86.4	80.0	52.6	67.2
ITG2	Sardegna	70.6	59.4	77.3	86.4	80.0	56.7	81.8
ITH1	Trentino-Alto	79.5	70.9	86.9	93.5	92.4	70.5	77.7
ITH2	Adige-Sudtirol	77.0	66.1	88.6	93.5	92.4	63.1	79.1
ITH3	Veneto	77.7	64.8	88.2	93.5	92.4	64.9	81.9
ITH4	Friuli-Venezia Giulia	77.1	67.0	87.8	93.4	92.4	67.7	72.7
ITH5	Emilia-Romagna	78.6	69.9	88.2	93.5	92.4	67.3	77.3
ITI1	Toscana	76.1	68.2	84.6	96.7	89.6	62.7	75.9
ITI2	Umbria	75.6	64.2	85.2	96.7	89.6	60.7	80.1
ITI3	Marche	76.4	65.8	84.9	96.7	89.6	64.2	77.6
ITI4	Lazio	74.5	61.5	83.9	96.6	89.6	60.5	78.8

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Gender-Responsive Regional Policies: Gender Budgeting

Leda Maria Bonazzi

1 Introduction

Achieving gender equality and empowering all women and girls has been identified by the United Nations as one of the 17 Sustainable Development Goals (SDGs) "to achieve a better and more sustainable future for all" by 2030. The importance of this topic is related to the fact that gender gaps are responsible for significant losses in economic growth, human development, and more generally, sustainable development (Kabeer & Natali, 2013; Moorhouse, 2017; Profeta, 2017, 2020). In fact, eliminating gender inequalities can not only increase female economic participation and boost economic growth but also improve health outcomes for women and children.

Despite the increase in female labour force participation over the past three decades, and the actions that various governments have undertaken at different levels, women still do not have the same opportunities as men to participate in economic activities in most countries (Fruttero et al., 2020). According to the World Economic Forum (2020), the world as a whole has closed only 58% of the gender gap in economic participation and opportunities; the corresponding number for political empowerment is 25% (Casarico & Profeta, 2020). Moreover, at the current rate of progress, the World Economic Forums also estimates that it will take 170 years to close the global gender gap in economic participation and opportunities.

In what follows, we explore various policies implemented by countries to promote gender equality with a focus on gender budgeting. First, we explain the main policies adopted, and show why they are effective. Second, we present some of the main experiences in major European countries, both at the national and regional levels, when available.

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2 Gender Budgeting

Since the mid-1980s, many countries have adopted fiscal policy measures to promote gender equality. The results up to 2015 were certainly positive: gender gaps in primary school enrolment have largely closed across all regions of the globe; progress has been made in reducing gaps in secondary school enrolment; and women's access to healthcare has improved. However, gender gaps in labour force participation rates in most regions of the world are still sizable (Kolovich, 2018).

There are several policies that can help achieve gender equality: childcare initiatives, using fiscal policies to promote female labour force participation, allowing for more flexible work hours and improved labour mobility. Many countries have invested in education and training for women. In doing so, they have improved access to financial services and have reduced legal barriers to women's economic activity.

Among these policies, in advanced economies, there are three main examples of gender-responsive fiscal policies widely used to tackle gender inequality: childcare subsidies, paid parental leave, and a shift from household to individual tax filing.

In the first example, the goal is to reduce the cost of childcare for all middle-class working mothers of preschool children, which increases female labour force participation particularly among low-income families. Moreover, returning to work gives women the chance to gain experience, which increases their wages and boosts overall economic activity. The second is maternity leave: if it is well-designed, it improves inclusion as it benefits women at the bottom of the income distribution who face a relatively larger cost of child-rearing in the absence of parental leave. Finally, changing from household to individual tax filing generates a decline in the marginal income tax of the secondary earner (typically women) and increases the return of participating in the labour force (extensive margin). Furthermore, among women who already participate in the labour market, the shift from household to individual tax filing, generates a large increase in the number of hours worked. See Chapter "Gender-Responsive Regional Fiscal Policies: The Labour Market" for an overview of the gender gaps in the labour market.

One of the most widely implemented policies worldwide is 'gender budgeting'. It originated in Australia in the mid-1980s and spread to Canada, South Africa, and the United Kingdom in the 1990s: as of 2018, more than 80 countries have adopted gender budgeting with varying levels of intensity (Kolovich, 2018). By definition, gender budgeting allows fiscal authorities to ensure that tax and spending policies and public financial management instruments address gender inequality and the advancement of women in areas such as education, health, and economic empowerment. As explained by Kolovich (2018), if well designed, gender budgeting can improve the efficiency and equity of the overall budget process. Fiscal authorities at any level of government can assess the needs of boys and girls and men and women; identify key outcomes or goals; plan, allocate, and distribute public funds; and monitor and evaluate achievements.

In this chapter, we focus on initiatives that have been undertaken in Europe, where gender budgeting has focused almost exclusively on addressing gender-

related goals through the expenditure side of the budget (Elson, 1998). However, other European countries have incorporated gender-related goals into their revenue and welfare policies which are important areas for women's economic empowerment.

There are various approaches, as illustrated in Kolovich (2018). In some instances, national and regional governments have legislated for gender budgeting (such as Austria, Belgium, and Andalucía); others have initiated changes to the institutions of the budget (such as Albania, Belgium, and Iceland), while others have recommended the fundamental concept of marrying equality policy with economic policy (such as Finland, Iceland, and Sweden).

3 Cases Studies: European Countries

Gender analysis has increased debate on fiscal policy by demonstrating that gender budgeting contributes to good budgeting, which accounts for the social and economic benefits of women's equality and economic empowerment (Kolovich, 2018). In addition, gender budgeting across Europe is almost exclusively associated with the expenditure side of the budget, particularly expenditures related to the delivery of public services. The introduction of gender budgeting in the European Union has had, on aggregate, a positive influence on the development of gender equality policy, not only in the Member States but in the rest of Europe as well. Recent austerity measures have not considered gender equality sufficiently, placing women at a heightened risk of poverty. Indeed, there is a need to consider gender when budgeting in the face of continued austerity. Finally, the following steps should include a greater coordination between gender equality goals and gender budgeting, and the introduction of gender budgeting at regional and local levels of government (with respect to this point, Sect. 3.5 of this chapter presents an overview of some initiatives).

3.1 Spain

Focusing on Spain, the autonomous region of Andalucía offers an interesting and advanced implementation of gender budgeting, which started in 2003 and has been reinforced over the years by other primary legislation and regulations. The 2003 law established two gender budget provisions: first, the regional budget presented to parliament must contain a Gender Impact Report and, second, a Gender Impact Commission (an interdepartmental coordinating body composed equally of women and men) was created within the Ministry of Finance to oversee the execution and approval of the Gender Impact Report (Kolovich, 2018). The Gender Impact Report, a document on the status of gender equality which includes all the developments that have taken place in the year being reported, but it does not record the degree to which

gender equality objectives attached to budgetary programmes meet their goals. Since 2007, this report has to be published for the draft of the Finance bill in order to prioritise budget programmes that are most relevant to and capable of improving gender equality.

The government has also made significant efforts in the collection and management of sex-disaggregated and gender-relevant data, to the extent that in 2015, 50% of those in charge of budgets were trained in the use of sex-disaggregated data. It is especially on the data collection that country has achieved outstanding results: of 282 statistical activities undertaken through the Statistics and Cartography Programme for 2012, 129 were disaggregated by sex; almost 75% of budget staff incorporated sex-disaggregated data into their reporting. The use of gender-relevant indicators has increased year by year, with an increase of more than 22% in the number of indicators used for the 2015 budget compared to the 2014 budget (Kolovich, 2018).

3.2 France

France has a long tradition of gender quality legislation in terms of employment and professional life. One of the greatest innovations in 2019 was the launch by the Ministry of Labour of a Gender Equality Index to measure and fight the gender pay gap and other gender-related inequalities at work.

The first explicit reference to gender mainstreaming in national policy documents emerged only in 2000, and in 2012, methodology and tools for gender mainstreaming were developed by the Ministry of Women's Rights. All ministries were required to have a roadmap, with high-level officials in central administrations required to take responsibility for its monitoring, and results presented at annual gender equality conferences. This methodology was implemented between 2013 and 2016. Despite its legal basis, gender mainstreaming increasingly relies on goodwill and inter-ministerial cooperation (https://eige.europa.eu/gender-mainstreaming/countries/france).

As far as gender budgeting is concerned, in the early 2000s, two documents foreshadowed a budget dedicated to gender equality policy: the annexes to the Finance Acts containing documents related to gender equality policy, and the gender mainstreaming policy document that deals with inter-ministerial gender equality policy and gathers all programmes with direct or indirect responsibility to gender equality. However, a real gender budgeting procedure will be piloted in several programmes in 2020 before being gradually extended to other programmes.

Unlike Andalucía in Spain, the production of sex-disaggregated data is institutionalised to a limited extent and remains poor. However, in 2013, following the publication of a report that pointed out this aspect, a webpage dedicated to gender statistics was created for the National Institute of Statistics and Economic Studies (Insee) website. Another webpage focusing on women and men in the workplace was created for the Ministry of Labour's DARES (Direction de l'animation de la

recherche, des études et des statistiques) website, while the Ministry of Education's DEPP (Directorate of Evaluation, Forecasting and Performance Monitoring) website dedicated a webpage to girls and boys from school to higher education. There is also a dedicated page on the website of the Secretary of State of Gender Equality, but not on the website of the Ministry of Solidarity and Health (EIGE Europe). Nevertheless, the production of sex-disaggregated data remains unsystematic, and significant sex-disaggregated economic data to support gender budgeting are missing. Notwithstanding the long tradition that France has of gender equality legislation in employment and professional life, gender budgeting falls behind other European countries. However, additional measures to tackle gender inequality, such as gender training, have been implemented in this country. For example, in 2016, the HCE issued a guide to support public communication free from gender stereotypes, and in 2018, the CSEP produced a kit for promoting gender equality in occupational classifications (EIGE, Europe 2022).

3.3 Italy

In Italy, Article 3 of the Italian Constitution enshrines the general principle of equality between women and men. Even so, the progress achieved in gender equality has been mainly driven by the need to adopt the directives of the European Union and to use European funds. Despite progress in legislation since the 2000s, Italy still falls short of achieving satisfactory policy results, mainly due to both the financial crisis and continuing austerity policies that threaten previous achievements in gender equality, and the lack of measures to ensure the implementation of gender mainstreaming (EIGE, Europe 2022).

Gender-responsive budgeting has been promoted by many local governments since the 2000s; indeed, it has been implemented first at a sub-national level, and from 2016 to 2018 also at a national level. The first pilot attempt was made in 2016 to assess the different impacts of budgetary policies on women and men in terms of money, services, time, and unpaid work. A second trial was carried out in 2017 with the aim of achieving a more complete set of indicators on gender gaps and to obtain a clearer picture of the relevant expenditure and activities of each administration from a gender perspective. From the perspective of data gathering, a national directive of 2007 called for the collection of gender-sensitive statistics within public administrations. Since 2008, ISTAT began to integrate the gender dimension into many of its surveys, and many of these surveys, especially those in the social statistics sector, have been conducted on specific gender issues. More recently, surveys on sexual harassment against women in 2007–2009, on maternity and female participation in the labour market, and on women's safety have been conducted to disseminate relevant statistical information on gender issues. Nevertheless, many efforts have been made to improve data collection in a variety of fields, some of which have not yet been explored, such as economics, business, transport, and agriculture, because the gender perspective is perceived as less relevant, even though this is not always the case.

3.4 Germany

In Germany, gender budgeting has been in operation since 2003 as a tool for gender mainstreaming, following a decision by the Berlin House of Representatives in 2002 Kolovich (2018). The reason behind its introduction was related to the aim of supporting and promoting female participation in active civil society initiatives. Since 2003, the process of gender budgeting has evolved significantly in Germany, and the most recent version demonstrates a very well-designed integration of the gender-related information used in the budgetary process. The main feature of this approach is the use of a new 'steering' tool. As explained by Kolovich (2018), 'Each chapter of the budget begins with a sex-disaggregated breakdown of public officials employed by the division of the department in which the chapter is concerned. In addition, the mean monthly salary is disaggregated by sex and gives an indication of the gender gap in salary'. Moreover, the budget shows the number of beneficiaries disaggregated by sex, indicating a trend over a three-year period, and projected targets for the following two years.

As already pointed out, the amount and accuracy of gender information incorporated in the budget has evolved and increased year by year, showing the government's commitment to this topic.

3.5 Regional

Women's lower wages constitute a highly political and societal issue that persists not only between countries (OECD, 2017), but also between smaller regional units. However, only a few studies have investigated this topic; examples include Murillo Huertas et al. (2017) for Spain, Fuchs et al. (2021) for Germany and Alaimo et al. (2019) for Italy.

In the work about Germany, the authors find that the drivers of gender-specific wage differences can be identified in the structure of human capital and firm-specific factors varying across regions, the different social norms across regions, and the fact that regions differ in sectoral and establishment composition. All of these aspects generate different regional opportunities for both men and women. Their results showed that gender differences in job-related characteristics are important drivers in regions with a high gender pay gap, while individual characteristics come into effect in regions with a low and negative gap.

Additional studies on regional disparities in the gender wage gap, such as Nisic (2017) and Hirsch et al. (2013), have shown that mobility restrictions imposed by partnership ties can be reduced by the size of the labour market. Living in a metropolitan area characterised by large and diverse labour markets may significantly weaken the negative impact of spatial limitations on partnered women. Gender differences in mobility gradually shrank over time, but the reduction was lower in rural areas, which determines a different competitive environment between

urban and rural areas. Finally, regional disparities in the gender wage gap may also arise from differences in the industrial, occupational, and firm composition of regions which contribute to occupational sex segregation like in England and Wales as documented by Perales & Vidal (2015).

Among the countries described above, only Italy and Spain present some degree of gender budgeting at the regional and local levels. This aspect represents, of course, something that should be improved since implementing gender budgeting at the sub-national level—either regional or municipal—plays a crucial role in the effective implementation of gender budgeting: first, because of their informative advantage towards the respective local community; and second, because of their ability to monitor, report, and eventually exchange information with the national office.

In Italy, for example, despite there being a sizeable/substantial heterogeneity in regional territories, several Italian municipalities and provinces have developed 'gender audits' (gender budget documents) to support the implementation of local and regional gender equality policies (EIGE, Europe 2022). Moreover, many local authorities have appointed specific political mandates on equal opportunities and equality boards or commissions (with primarily consultative powers) to encourage the implementation of gender strategies.

It is also worth pointing out that Italy is divided over the main economic and social indicators for gender, with the south and the islands on one side and the north and centre on the other. Furthermore, the gender gap indicators show that a limited number of regions (led by Piedmont and Emilia Romagna) are approximately halfway towards the goal, while a larger group is positioned around the Italian average, at one-third of the way towards the goal. All the southern regions (except Sardinia) lagged considerably behind (EIGE, Europe 2022).

In Spain, gender equality and mainstream gender are extremely relevant topics, not only at the national level but also at a local level, since some competences on gender equality policy are shared with the central state, and public authorities and local administrations should cooperate with public authorities to achieve effective gender equality. In detail, each region approves its statute (which is then approved by the Spanish parliament), and local gender equality bodies thus have different structures. Some autonomous communities have created autonomous administrative bodies responsible for gender equality policies, while others have designated a specific department or office; the more committed on gender mainstreaming are Bilbao, Madrid, and Barcelona City Councils, which have incorporated key instruments to implement gender mainstreaming, such as data disaggregated by sex, gender impact assessments, or gender budgets (EIGE, Europe).

4 Conclusions

Throughout this chapter, we have outlined one of the most widely used gender-responsive policies, gender budgeting. It can be defined as the application of gender mainstreaming in all stages of budgeting and planning processes, meaning that all budgetary processes are conducted by adopting a gender perspective with the long-term aim of promoting gender equality goals (EIGE, Europe 2022). We have also described how it has been implemented in some European countries at both the national and local levels.

An additional element that it is relevant to point out is that for how it has been conceptualised, gender budgeting has two aims: to include the lived realities of women's and men's lives in budgets, and to make existing inequalities visible in budgeting (EIGE, Europe 2022). It is also true that it is only a starting point for the wider aim of achieving gender equality. Gender budgeting, in fact, is fundamental to identifying gender gaps and challenges, which are used to formulate objectives to tackle gender inequalities and define appropriate indicators for measuring progress. However, achieving gender equality requires a policy mix with interventions on various aspects. The report of the International Labour Office "Closing the gender pay gap: A review of the issues, policy mechanisms and international evidence" by Rubery & Koukiadaki (2018) identifies four main issues. "First of all, action in the labour market sphere needs to be complemented by support for social reproduction and those taking care of social reproduction. Second. . .it is necessary to combine gender equity with the overall objective of more inclusive labour markets and to consider intersectional effects of policies within each gender, not only changes in aggregate or average indices. Third, action should be targeted on remedying the particular form of gender pay inequality that dominates in a particular institutional environment. Changes to the policy mix, therefore, need to be targeted to fit the country context and determine at which end of the wage distribution action is most needed. Fourth, achievement of gender pay equity is not a fixed but a constantly moving target".

To conclude, it is possible to state that gender budgeting by helping achieve the broader aim of gender equality also leads to economic gains by contributing to the EU's objectives of growth, employment, and social cohesion.

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Gender-Responsive Regional Fiscal Policies: The Labour Market

Fabrizio Culotta

1 Introduction

The labour market allows individuals to earn a living throughout their lifetime. When it comes to gendered issues, the labour market is also an environment where different outcomes between female and male workers emerge. Differences between women and men naturally exist because of the biological characteristics related to sex differences. The possibilities of maternity and longevity are the most notable examples. Compared with men, women also have less physical power. In fact, the origin of the gender gap in the labour market goes back to the 'male breadwinner' model, typical of an industrial economy, in which women's role was traditionally limited to homemaking activities (Fortin, 2005; Lewis et al., 2008).[1] Physical skills are relevant to the labour supply for an industrial economy.

Since the late 1960s, instead, the transition towards a service economy has been accompanied by an increasing demand for nonphysical skills. Thus, the rise of a service economy has sustained the increasing participation of women in the labour market. Olivetti and Petrongolo (2016) show that for the period 1850–2008, the growth of the service economy explains at least half of the overall variation in working hours among females across high-income countries over the decades. This new trend was followed by a reduction in the gender gap in the accumulation of human capital. Since the 1980s, women have surpassed men in their degrees of

[1] Another accepted hypothesis on the origin of gender division of labour, put forward by Boserup (2007), focuses on agricultural practices that influenced the historical division of labour and gender norms. Along this line, Alesina et al. (2013) find that descendants of societies that traditionally practiced plow agriculture, which requires more physical strength, have less equal gender norms than those who practiced agriculture with digging sticks and hoes.

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attainment. The cohort born between 1955 and 1965 was the first to demonstrate this feature (McDaniel, 2013). But higher women's employment rates were not followed by men's increasing responsibilities for domestic chores and care, a social outcome known as 'stalled revolution' (Hochschild & Machung, 1990; Friedman, 2015).

Since the late 1990s, the changing role of women in the labour market has then been reinforced by public interventions promoting, from one side, anti-discrimination legislation aimed at removing entry barriers in male-dominated occupations. However, family-friendly policies tried to ensure a higher work–family balance for both female and male workers. Structural changes in the labour market were subject to the instauration of a 'flexicurity' system characterised by the spread of part-time and temporary contracts and, not always by the introduction of income security (Wilthagen & Tros, 2004).

Despite decades of progress, gender gaps in labour market outcomes remain substantial (Petrongolo & Ronchi, 2020). This situation also concerns the developed Western world, even though it varies across countries according to the welfare regime, family and employment policies, tax and benefit system, and social norms (Kushi & McManus, 2018). The persistent gender gap has gained attention from policymakers and researchers, leading to the implementation of equal remuneration policies and employment opportunities in many countries, as advocated by international and European institutions (Kolovich, 2018; Hartlapp et al., 2021). In 1999, the Amsterdam Treaty brought new insights into gendered issues at the EU level by introducing the concept of gender mainstreaming within the community (Hurtado, 2017). See Chapter "Gender-Responsive Regional Policies: Gender Budgeting" for a discussion on gender budgeting initiatives. Public intervention becomes necessary when inefficient behaviours and market friction lead to lower activity, higher unemployment, lower wages, and gender segregation in some types of employment contracts and occupations. Private initiatives are not sufficient to reduce the gender gap observed in labour markets. Accordingly, corrective fiscal policies are justified by market failures.

To narrow the gender differences in labour market outcomes, different labour market policies have been implemented in different countries at different points in time. The experience of labour market policies across European countries, notably from Scandinavian countries, delivers two conclusions. First, since the reduction in gender gaps should be supported by cultural change, which is a slow-moving process, public intervention needs to be carried out over time to produce long-lasting effects. Of course, the effectiveness and time profile of impacts depend on the type of program and participants' characteristics (e.g. gender, age, education, unemployment duration) as well as on the local availability of jobs (Card et al., 2018). Second, implementation at the national level of labour market policies cannot be fully effective if territorial differences are not explicitly considered or if local governors are not actively involved during the conception, implementation, and monitoring phases. Gender-responsive fiscal policies should be fully integrated into the policy agenda of subnational governments (Rönnblom, 2005). The ability of local governments to attract and manage economic resources, such as European funds, as well as the ability to promote innovation in their territories of lower

economic growth, is a crucial factor in the effectiveness of the policy itself. The quality of local governments is likely to be a link in the chain between national initiatives and local firms and workers.

Gender gaps may also be the result of women's preferences, and not solely due to differences in human capital, labour market experience, and discrimination (Altonji & Blank, 1999). Recent developments in the economic literature on gender gaps have noted the role of commuting preferences in the formulation of labour supply decisions (Petrongolo & Ronchi, 2020; Le Barbanchon et al., 2020). Empirical evidence shows that women are less willing to commute because they have a larger share of home responsibilities (Perales & Vidal, 2015; Gimenez-Nadal & Molina, 2016). Hence, they are constrained by the distance they can travel to work or look for a job. Unemployed women restrict their search to smaller areas, which is often associated with lower job opportunities. This hinders them from obtaining better jobs and higher wages in other regions. Compared with men, women living in both rural and peripheral regions are more willing to accept compensating penalties for commuting less (Fuchs et al., 2021). The labour market behaviour of single women does not seem to be characterised by spatial limitations (Nisic, 2017).

Following this line of reasoning, the differences in commuting attitudes between women and men can represent a structural factor that reduces the effectiveness of gendered policies set at the national level. An example of this clarifies this point. Suppose a labour market policy aims to reduce employment among women. To do so, a fiscal incentive was introduced for firms hiring female workers. Firms and workers are distributed throughout the national territory, albeit unevenly. Hence, there is a stable geography for jobs and skills. It is further assumed that women have a higher cost of commuting, especially if they are more involved than men in housing chores. Under these assumptions, the higher female labour demand will not be compensated for by an adequate flow of women from where they live to different regions. Women living in peripheral regions are likely to offer labour only as local employment opportunities, which has huge implications for women's career prospects. If the assumption of perfect inter-regional mobility is violated among women, then regional labour market policies are more effective in reducing gender disparities because of their greater adaptability to the structure of the local economy. Labour market policies settled at the national level, instead, by implying a 'one-size-fits-all' labour market strategy, disregard construction regional specificities in terms of economic and demographic structure (Altavilla & Caroleo, 2013). Economic theory suggests that regional disparities in labour market dynamics may reflect market rigidities or frictions that hinder the adjustment process to asymmetric shocks (Blanchard et al., 1992; Pissaridēs, 2000). Given that the adjustment process could be fast or slow, regional differences in sex gaps can persist for a long time. However, in the long run, they generally disappear through migration flows and other factor mobility across regions (Niebuhr et al., 2012; Riekhoff & Järnefelt, 2017). Unfortunately, this does not seem to be the case when one deals with gendered issues (European Commission, 2022).

The topic of gender-responsive fiscal policies is gaining momentum in the European political agenda as set by the Gender Equality Strategy 2020–2025. The

persistence of gender gaps in the labour market has led policymakers to implement policies aimed at realising women's potential by reducing discrimination in the workplace and ensuring fewer family constrained career developments. Indeed, constraints often also concern the geographical mobility of women, which calls for greater attention to local labour market conditions as well as greater involvement by local institutions (Nisic, 2017).

This chapter first provides an overview of the main gender gaps observed in labour markets using a life-cycle perspective is embraced. This is justified by the consideration that age is an important variable for both sides of the labour market because it is considered by firms during their hiring and firing decisions, and by workers when they search for or change jobs. From a policy perspective, the experience collected across countries allows us to distinguish among policies that sustain young women at the onset of their careers. This is the case with policies that ease early schoolwork transition and skill formation. Instead, wage and occupational policies intervene at a later stage, focusing on the removal of gender differences in paid wages, occupational segregation, and the impact of maternity. Finally, specific labour market policies focus on older workers during their training activities for skill updating, retirement, and pension provisions. Particular attention has been paid to the role of regional governments. Politically, local decision-makers are of strategic importance because they have more accurate knowledge of the administrated territory and society than their national counterparts. Their greater proximity is an advantage to be exploited at different phases of a policy, from conception to monitoring its implementation. From an economic standpoint, labour markets are local entities, each characterised by a specific distribution of firms by sector and the size and distribution of workers by skills and age. The persistence of regional specificities in the labour market calls for local intervention tailored to the economic needs, forces, and potential of that territory. From a social point of view, acting locally allows decision-makers to adapt the general labour market policy to the demographic and cultural context of that geographic area. The adherence of a gender-responsive labour market policy to the characteristics of a specific territory is a fundamental prerequisite for the effectiveness of that policy. A labour market policy promulgated at the national level does not necessarily operate homogeneously throughout the national territory. The presence of economic, demographic, and cultural differences with respect to the national context can undermine the full implementation of a policy, reduce its effectiveness, and deliver unexpected outcomes.

2 The Gender Gap and Fiscal Policies: Collected Evidence

With the support of empirical evidence, this section describes the various forms of gender gaps observed in the labour market. The discussion is divided into three parts. The first part focuses on stylised facts characterising the gender gap at the onset of women's working careers—that is, from the school–work transition until their first

employment experiences. At this stage, the apprenticeship and vocational training policies were examined. The second part deals with gender gaps characterising the middle phase of women's careers across employment outcomes, such as wages, contracts, occupational segregation, and mobility. Corrective policies in this case aim to prevent women's discrimination in the workplace, increase the matching between women and jobs through active labour market policies (ALMPs), and reduce career interruptions during maternity periods. Finally, the third part focuses on gender gaps observed later in women's careers. This life cycle includes employed workers whose human capital is depreciating and unemployed women who reduce their search intensity for a job. It also regards women as widows and women dropping out of the labour force. Women at this age are usually targeted by training policies for skill updating, or, if older, are involved in early retirement schemes. Pension policies are also considered to influence the gender gap.

2.1 Early Career

Despite women having already surpassed men in terms of tertiary educational attainment at the beginning of this century (McDaniel, 2013; De Hauw et al., 2017), divergent patterns emerge in terms of paid wages and sectorial occupations. The field of study seems to be a candidate factor explaining most of the observed gender differences in this case (Francesconi & Parey, 2018; Fuchs et al., 2021). Traditionally, female-dominated fields of study include the Arts and Humanities, including Foreign Languages. An increase in female graduates has also been observed in health-related studies such as Medicine, Pharmacy, and Nursing. In contrast, STEM disciplines (Science, Technology, Engineering, and Mathematics) tend to be male-dominated. Workers who graduate in STEM disciplines are usually needed by large firms that offer more profitable contractual arrangements, with higher wages and steeper career profiles. On the contrary, women who graduated from non-STEM disciplines were characterised by lower salaries and flatter wage profiles.

If differences in the field of study can explain much of the observed gender gaps throughout the active life cycle, an effective corrective policy should intervene before choosing the field of study. Decision-makers should incentivise young women to enrol in male-dominated disciplines if the goal is to close the gender gap in STEM disciplines. Similarly, public interventions could, in principle, incentivise the hiring of inexperienced women in traditionally male-dominated sectors by offering them training for adequate skill formation. A more equal distribution of skills between women and men operating at the beginning of the life cycle would be able to reduce employment barriers towards large firms and innovative sectors. As shown by Dilli and Westerhuis (2018), for European countries, a lower gender gap in STEM is associated with higher female entrepreneurial activity in knowledge-intensive sectors. Hence, closing the gender gap in STEM education can benefit a country by stimulating innovative economic activities. Female

entrepreneurship also exerts a positive externality on post-secondary enrolment. As Casarico et al. (2016) show, in European countries, increasing the share of women in managerial occupations and self-employment affects the probability of enrolling in higher education. Moreover, the integration of women and men in the same labour field can help mitigate cultural reluctance inherited from the past male-breadwinner social model. Interventions at an early stage are likely to have a positive impact on the formation of gender-related stereotypes. Indeed, the results from a natural experiment involving Norwegian militaries show that cultural barriers are permeable (Dahl et al., 2021).[2] All of these considerations are valid at both the national and regional levels. Decision-makers should ensure smoothness in the transition from the educational system towards existing employment opportunities at the local level. The procedure of matching available employment opportunities with individual skills is of utmost importance, especially in territories where jobs are scarce or concentrated in a few economic sectors. In this scenario, it is likely that a misaligned educational system will lead to subsequent mismatches between workers and jobs from the perspective of offered and required skills at the regional level. This structural distortion, operating at the beginning of women's careers, affects their future employment prospects. For example, Francesconi and Parey (2018) document that Germany has had smoother transitions towards employment for university degrees in male-dominated fields. By contrast, during the first years of post-graduation experience in the labour market, women experience more fragmented paths. The share of young women in secure employment trajectories is systematically lower than that of men when the comparison is restricted to the same marital status (Brzinsky-Fay & Solga, 2016; Berloffa et al., 2019a, 2019b). Overall, a higher level of educational attainment facilitates the entry phase of women into the labour market, but it does not ensure a smooth transition towards secure employment positions.

From a policy perspective, measures such as Employment Protection Legislation (EPL) play a relevant role in the distribution of the risk of an initial mismatch between jobs and workers. The gender gap in the secure employment trajectory is found to be larger in countries where EPL is stricter, that is, in countries where firing workers is more costly (Berloffa et al., 2020). A more stringent regulation on the dismissal of regular employment is likely to be reduced by congestion and the probability of reaching permanent employment. On the contrary, a relaxation of rules governing the protection of jobs may help to facilitate firing, and through this channel, a higher churning rate increases the matching quality between young women and entry-level jobs. Women are likely to benefit from gender-specific EPL, especially at the beginning of their careers, when the probability of leaving for maternity is still low. On this side, the flexibility of contractual arrangements may induce employers to offer contracts of limited duration as an initial screening device

[2] Unfortunately, results also suggest that without continuing intensive exposure, effects are unlikely to persist. Precisely, 6 months later, treatment responses were converging to those of the control group.

for more stable positions (Faccini, 2014). Of course, temporary contracts can also represent dead-ends for women trapped in repeated mismatches (Booth et al., 2002), which would lead to frequent career interruptions and the accumulation of non-employment spells.

The geographical dispersion of firms and jobs has implications for the dynamics of the gender gap in training policies. Training policies are expected to be beneficial at this stage because they are instrumental in career progression and catch-up after employment interruptions. Acquiring new skills, or complementing those already acquired, may prevent women from falling directly into a precarious employment trap or intermittent careers just after their school-work transition (Brzinsky-Fay & Solga, 2016). Since training activities are often offered by large and innovative firms, the territorial distribution of these firms influences the effectiveness of the training policy in that region. Regions characterised by a higher rate of firms offering training and a higher female participation rate are likely to produce positive effects (Nisic, 2017). In contrast, the gender training gap is expected to be higher in regions characterised by a higher presence of small and medium firms. Another critical aspect of gendered training policies is the content of programmes. If intended to be beneficial, it should allow women to acquire stable employment, focusing on the acquisition of skills required by the local economic system in which they reside. Neglecting the local nature of labour demand is likely to reduce the scope of the training policy itself, that is, improve women's employability, at least in the short run.

Unfortunately, empirical evidence shows that, despite being beneficial for prolonging careers, participation in training is far lower among female employees than among their male counterparts (Fitzenberger & Muehler, 2015; Lössbroek & Radl, 2019; Fuchs et al., 2021). Like men, women receive less training during their early careers, which in turn undermines the professional basis for future career development. Additionally, empirical findings reveal that the distribution of the gender training gap by age is inverted-U-shaped. The seminal work of Fitzenberger and Muehler (2015) shows that the gender training gap is close to zero at the age of 25, increases thereafter, peaks at the age of 35, and finally reduces at the age of 50. There is no catch-up in the gender gap after childbirth. Divergences in training participation can be mainly attributed to differences in employees' characteristics, such as wages, working time, and position within the firm. Investment in training is also based on the expected time workers spend within the provider firm. Accordingly, marginal workers, such as part-time and temporary workers, would be less involved in training activities because the shorter the expected residual employment duration of women, the less inclined firms will be in providing them with training (Lössbroek & Radl, 2019). Such penalisations affect women's productivity and, thus, their future career prospects.

2.2 Middle-Aged Careers

Gender differences in labour market outcomes do not exhaust in the early phase of workers' careers but continue to be observed under different forms throughout the entire life cycle. Gender gaps became more pronounced in the middle phase of the life cycle. The middle-aged group includes women who already had their first job experience and those who participated in training courses for general and firm-specific skill formation. It also concerns long-term unemployed women and inactive women. More importantly, this age group includes women in their maternity years.

A few years after college completion, women experience more unsecure employment trajectories characterised by longer unemployment spells, lower wage profiles, and accumulated experience (Berloffa et al., 2020). Women also experience lower wage returns to occupational mobility, which reduces the steepness of their wage profile as well as their occupational prospects due to job changes (Reshid, 2019). Differences in human capital endowments do not exhaustively explain the differences observed in the labour market between women and men. Compared to men, middle-aged women exhibit stronger geographical restrictions in their job search (Eriksson & Lagerström, 2012; Petrongolo & Ronchi, 2020), thus do not apply to employment positions offering higher wages and better occupational prospects than those at the local level (Fuchs et al., 2021). The gender gap in commuting distance was particularly pronounced among mothers. Their greater share in family responsibility makes them reluctant to accept or look for a job that is far located, even at the cost of lower wages. The effects of a restricted job search area are likely to result in lower wages and longer unemployment spells, especially for women living in the peripheral regions. This exacerbates the gender pay and employment gaps among middle-aged workers.

The wage differential is the most studied outcome through which to look at gender differences in the labour market. The gender-based pay gap varies across countries, regions, sectors, and wages. Different countries are characterised by different economic institutions, national legislation, and sociodemographic and cultural factors that affect the labour income received by employed women. Different childcare provisions and wage-setting institutions are likely to account for variations by country (Arulampalam et al., 2007; Francesconi & Parey, 2018; Kuitto et al., 2019). Moreover, the general gaps in labour earnings are wider in countries where part-time and temporary jobs are more widespread (Berloffa et al., 2020). The fact that women are more often employed under these types of contracts increases the gender pay gap at the bottom of the wage distribution, the so-called sticky floor effect. The gender pay gap also increases at the other extreme of wage support, the so-called glass-ceiling effect. This is explained by the lower intra-firm mobility among female workers, resulting in fewer supervisory and top positions offering greater remuneration (Fuchs et al., 2021). Women are less inclined to negotiate aggressively (Casarico & Lattanzio, 2023). Differences in return to mobility also explain the divergent pattern at the end of the gender-based pay distribution. Del Bono and Vuri (2011) provide evidence of Italian workers during the first 10 years of

labour market experience. The estimated returns of job mobility account for 30% and 8% of the wage growth for men and women, respectively.

One dimension of the gender pay gap that has received little attention is territorial dispersion. Fuchs et al. (2021) showed that wage differences by gender vary considerably for Germany at the NUTS-3 level, ranging from negative values to beyond 40%. Focusing on the determinants of the gender pay gap across regions, the findings reveal that job characteristics and the presence of large firms are relevant for regions with a high gender pay gap. Individual characteristics are more important in areas with a low gender-based pay gap. Differences were also observed between urban and rural areas in the same region. Estimates for full-time workers in Germany reveal that the gender pay gap in rural areas is around 10% and has remained stable for over three decades (Hirsch et al., 2013). A similar conclusion is reached with reference to Spanish regions, which show substantial heterogeneity in the size of the gender gap, roughly comparable to cross-country differences in Europe (Murillo Huertas et al., 2017). The geographical distribution of industries, interacting with the lower mobility of women constrained by family-related reasons, substantially contributes to the persistence of regional dispersion of the gender pay gap (Iammarino et al., 2019).

Another relevant dimension on which gender differences have been studied is labour supply. Estimates of different labour supply elasticities and, more recently, of reservation wages confirm that women and men behave differently in the labour market. Job preferences are shown to be relevant in explaining gender differences in employed wages, not only at the top of the wage distribution (Casarico & Lattanzio, 2023; Redmond & McGuinness, 2019). According to the empirical literature, women have higher labour supply elasticity than men (Bergemann & Den Berg, 2008; Evers et al., 2008). A simple explanation relies on the 'Le Chatelier principle': individuals with more options have a more elastic supply function (Bergemann & Den Berg, 2008). In fact, in the labour market, family and house management represent an exit strategy for women's decision-making problems. Additionally, Alesina et al. (2011) show that higher bargaining power for the family, higher wages, and lower home productivity are sufficient conditions to reproduce gender differences in labour supply elasticities. Males are often family members committed to a career with longer working hours and fewer home duties. Indeed, what matters in the household is the economic organisation as primary and secondary earners within the partnership. On this point, the recent work of Bartels and Shupe (2022) shows, for the first time, that gender differences in the extensive margin responses of labour supply dissipate among individuals with the same earner's role, that is, within primary and secondary, within the household. The results also show a high degree of heterogeneity across countries in the EU, with Italy, Germany, and Spain among the countries with the highest labour supply elasticity of secondary earners.

Regarding the extensive margin of labour supply, reservation wage (a monetary measure for job preferences) is a crucial factor in explaining gender differences in labour market outcomes (Brown et al., 2011). Interestingly, Caliendo et al., (2017) found that in Germany, controlling for reservation wages in an otherwise standard Blinder–Oaxaca decomposition halves the magnitude of the gender gap in realised

wage. Women have lower reservation wages than men because of both personal (e.g. age and labour experience) and job characteristics (e.g. wage and geographical location). Preferences for nonwage job characteristics may affect the reservation wage gap between females and males. The presence of children, particularly pre-age schoolchildren, is relevant in explaining the gender gap in reservation wages (Brown et al., 2011). Focusing on Italy, Brown et al. (2022) further estimated the gender reservation wage gap along the entire support of the reservation wage distribution and across regions. Women and men have similar reservation wages at the bottom of the distribution, but they differ for larger values. From a geographical perspective, the gender reservation wage gap is higher in the south than in the more industrialised north of Italy. Remarkable differences at the regional level once again highlight the role of policy differentiation in reducing gender gaps in the labour market. The same policy intervention implemented across different regions is likely to produce heterogeneous effects because the responsiveness of women to policy incentives is different.

Having children has the greatest impact on women's labour careers. Repeated spells of non-employment, that is, unemployment and inactivity, are often related to periods of childbearing and/or housing chores which reduce the possibility of successfully re-entering the labour market. In this respect, women are more penalised than men. Empirical evidence from more than two decades shows that career quality never returns to a level prior to non-employment spells (Manzoni & Mooi-Reci, 2020). Of course, the effect of maternity on female employment outcomes depends on country-specific and historically dependent economic, political, and cultural factors (Alesina et al., 2013). In most European countries, where the male breadwinner social model is still culturally vigorous (e.g. Southern European countries), the gender gaps in employment and wages are larger than in countries where anti-egalitarian views are weaker (e.g. Scandinavian countries) (Fortin, 2005). Episodes of motherhood are known to penalise women also compared to childless women, i.e. the so-called motherhood gap (Budig & England, 2001). Compared to childless women, mothers are likely to earn less because being engaged in childcare leads to losing job experience, being less productive at work, and trading-off higher wages for mother-friendly jobs located closer to the area where they live. According to a survey by Cukrowska-Torzewska and Lovasz (2020), several mechanisms are in place. While the gap associated with one child is driven by the mother's preference for jobs that pay less, the gap for mothers with at least two children is mainly due to human capital depreciation. The motherhood gap is small in Nordic countries, Belgium, and France, where public policies actively support gender equality. In contrast, Central and Eastern European countries have the largest motherhood gap. The motherhood gap in Southern European countries is small, mainly due to low female employment rates.

The reconciliation of work and family is fundamental in this sense, as it ensures equal treatment between women and men in the division of housing chores and, consequently, in the labour market. Cross-country empirical literature on the use of time confirms that women employ more time in housing chores than men. Kuitto et al. (2019) show that, in Finland, the duration of parental leave for women is more

than ten times greater than that of men. Similarly, Anxo et al. (2011) and Gimenez-Nadal and Alberto (2022) found that women in Europe spend more time on unpaid work and childcare. Greater responsibility for housing chores and childcare also affects women's attitudes towards commuting. In the Netherlands, the effect of homemaking on commuting is twice as difficult for women as compared to men, whereas childcare time only affects women's commuting time (Gimenez-Nadal & Molina, 2016). Commuting entails monetary and non-monetary costs, such as the cost (time, physical) of travelling and the cost of delegating childcare activities to third parties (e.g. nannies or parents) or institutions (nursery, kindergarten, school). Accordingly, the distance from employment opportunities and the cost of reaching them affects the cost opportunity to work. This result can be associated with the fact that women are employed more in sectors such as service, teaching, and personal care which are less geographically concentrated compared to other economic sectors.

The weak spatial mobility of productive factors hinders not only the process of regional convergence but also the closing of the gender gap at the national level. Indeed, as expected from neoclassical economic theory (Blanchard et al., 1992), geographical labour mobility acts as an adjustment mechanism to macroeconomic shocks and territorial imbalances. This argument is also supported at the empirical level, for example, Niebuhr et al. (2012) for Germany 1995–2005. Unfortunately, the national labour markets of most European countries are still characterised by persistent regional disparities. The peripheral regions (e.g. southern Italy and Spain) have continued to be more exposed to a long-term decline in employment and competitiveness. However, the core areas of some metropolitan regions (e.g. northern Italy, southern Germany, Benelux, and Austria) have attracted a higher share of high-job and innovative employment initiatives. The function of market forces has not led to regional convergence in economic performance, but rather to the concentration of income and employment in high-growth regions. Economic and financial crises in the last two decades, as well as the COVID-19 experience, have weakened the convergence power, typically of a period of prosperity (Iammarino et al., 2019). Policy interventions are thus necessary to restore economic growth in depressed areas and to sustain improvements in terms of gender equity.

Women continue to experience different treatment in the labour market in the middle of their life cycle. Initial differences in the field of study, as summarised by the substantial gender gap in STEM disciplines, can only partially explain the segregation of women into part-time and temporary jobs in the service sector. Additional factors, both from the supply and demand sides, enter into play when women transition to the intermediate phase of their active life. Women of these ages show lower labour market attachment than young female workers, mainly because of the experience of motherhood. Family ties also impose restrictions on geographical preferences in job search. The overall situation in the labour market for middle-aged women, compared to men, is of larger amplitude. Longer nonemployment spells and human capital depreciation hinder the possibility of closing gender differences in employed wages and occupations. Furthermore, the presence of children constrains mothers' ability to find or maintain employment within a reduced search radius,

since the commuting attitude reaches a minimum during motherhood. This ties the development of women's employment to local economic dynamics.

Gender wage, occupational, and mobility gaps in middle-aged workers' careers were more pronounced than in the extreme part of the life cycle. Different policies should intervene at different points in the wage distribution to close the gender pay gap in labour earnings. Minimum wage policies reduce wage inequality at the bottom of the wage distribution. The same effect is exerted on the distribution of the gender pay gap by increasing the remuneration level of workers employed at less than the minimum wage. Since a large proportion of women is employed at the bottom part of the wage distribution, often associated with non-standard contractual arrangements, raising the lower boundary of the employed wage reduces the gender difference in the employed wage at the national level. Regional studies also confirmed the beneficial impact of raising the minimum wage. Robinson (2005) documents for the United Kingdom that the largest beneficial effect is expected in low-wage regions; that is, in those regions where the share of low-paid female workers is the highest. Bargain et al. (2019) document that the implementation of minimum wage policies in 1999 can close the gender gap at the bottom of the wage distribution. See Caliendo and Wittbrodt (2022) for a recent contribution to German data. In the upper part of the distribution, gender employment quotas on company boards and other top positions may contribute to reducing the wage distance between males and females. Bertrand et al. (2018) studied the effect of a reform in Norway by introducing a gender quota of 40% on the boards of publicly limited companies. The reform was successful in reducing the occupational gap, especially for top positions, and the wage gap, particularly for higher values of support.

Different other policies have been adopted to counteract the negative effects of labour market forces on women's labour market outcomes. Bergemann and Den Berg (2008) were seminal in surveying the literature on ALMPs. Focusing on European women aged 25+, which are often the target of ALMPs policies, it emerges that the employment effect of training is positive, especially in those territories where women's participation is lower. More recently, Card et al. (2018) reviewed approximately 200 articles on ALMPs and confirmed that training policies are beneficial for women's employability. In general, programmes that favour human capital accumulation are associated with the largest gains for women. The findings also reveal that the programme becomes effective only for a couple of years after completion of the programme. By contrast, the effects are almost nil in the short run, whereas women find fewer opportunities through job search assistance programmes, such as job consulting and interviews. Of course, the success of ALMPs depends on the local labour market conditions. As shown by Altavilla and Caroleo (2013), ALMPs are more effective in Italian regions with high employment and vacancy rates. In contrast, they are less effective in regions characterised by high unemployment rates, lower vacancy rates, and lower wages. It also results that the richer North uses more training programmes compared to the South, where employment incentives are preferred as ALMP instead. Regarding training policies, evidence across European countries confirms that middle-aged women participate less. Focusing on German workers aged 25–50, Fitzenberger and Muehler (2015)

provided the first estimates of the gender training gap. Under these conditions, it is likely that gendered fiscal policies target low-skilled individuals, secondary earners, and other workers with weak labour market attachment. Another successful ALPM experience is the introduction of a hiring incentive through a reduction in the payroll tax rate. Under this gender-differentiated regime (Alesina et al., 2011), firms are expected to hire cheaper female workers. Rubolino (2022) analyses the change in the female payroll tax rate introduced in Italy in 2013. The tax cut generated long-lasting growth in female employment and reduced the time spent under income assistance programmes. Taxing women less because of their higher labour supply elasticity is theoretically optimal (Alesina et al., 2011). Gender-differentiated taxation allows the realisation of large welfare gains, since the aggregate social loss from distortionary gender-neutral labour income tax is reduced. See also OECD (2022) for consideration of the role of gendered taxation. Additionally, start-up subsidy programmes, as an alternative form of incentive for female employability, may be effective in reducing gender gaps. The case of a start-up subsidy programme for Swedish job-seekers, as documented by Månsson and Delander (2011), reveals that women participating in the program had higher success in running a business than non-participating individuals, but lower success rates than participating men.

Another possible policy channel through which to reduce gender gaps in the labour market is to increase the geographical mobility of employed women (Le Barbanchon et al., 2020). This could also be beneficial from the perspective of reducing gender wage and occupational gaps. In this sense, gender-responsive policies in the labour market are extended to the sphere of urban planning and transportation. These interventions may reduce the time and monetary costs of reaching core areas from the peripheral regions. A successful policy experience in this sense is that of Germany, as examined by Caliendo, Künn, and Mahlstedt (2017). In this case, the results reveal that jobseekers participating in the subsidy programme and moving to a distant region received higher wages and found more stable jobs compared to non-participants. The availability of benefits successfully increased the quality of job matches by increasing the geographical mobility of female job-seekers, as predicted by economic theory (Blanchard et al., 1992).

The role of maternity remains predominant in determining the different wages and employment patterns between women and men. Women, when they come to mothers, start to prioritise family affairs over their own labour careers, which are strictly influenced by local economic and employment dynamics. The success of a given ALMP strictly depends on the local labour market conditions; therefore, nationwide labour market programmes may not guarantee to produce improvements homogeneously across all regions. Certainly, if not effective, corrective policies may exacerbate gender differences in the labour market in older age groups. In contrast, if risk factors for wage and occupational differences are correctly targeted, then the initial gender-related disparities may not accumulate in the middle phase of women's life–work cycle.

2.3 *Late Careers*

Thus, analysing gender gaps in the late phase of a working career becomes a politically relevant issue. In fact, the share of older workers in the labour market is increasing in the context of population aging and increasing women's participation. If one also considers that the mortality patterns of women are lower than those of men, then a higher number of women are expected. When workers approach the end of their life cycles, gender disparities are likely to widen. Women continue to be discriminated against as compared to men because of their aging. See Duncan and Loretto (2004) and, more recently, Lössbroek and Radl (2019) for a discussion of gendered ageism. Indeed, in terms of perceived discrimination, age places before gender and ethnic discrimination in the workplace. See Ayalon (2014) for a study on European countries using the European Social Survey.

Women in their late careers behave differently from women in their middle ages. Older women are likely to have experienced episodes of motherhood, being long-term unemployed or inactive, working under non-standard contractual arrangements, and being stuck in flat career profiles (Fuchs et al., 2021). The employment conditions of older female workers are expected to increase the gender pay gap at both extremes of wage support. Women with low labour market experience, often employed in marginal jobs, and women with low work intensity, employed in part-time contracts, would increase the gender differences at the bottom (Robinson, 2005; Bertrand et al., 2018; Redmond & McGuinness, 2019). On the top side of wage distribution, occupational segregation in non-technological sectors and flatter career progressions contribute to increasing the wage difference between women and men (Del Bono & Vuri, 2011; Casarico & Lattanzio, 2023; Fuchs et al., 2021). The lower geographical mobility of women, which already affects the perspective of careers in the middle phase, ties further the wage and employment profiles of women to the economic dynamics of the area in which they live with their families (Gimenez-Nadal & Molina, 2014; Perales & Vidal, 2015; Gimenez-Nadal & Molina, 2016; Iammarino et al., 2019; Fuchs et al., 2021). This effect is stronger at older ages since it is less likely that women will change jobs and locations when the search effort is higher for a higher cost of commuting (Chéron et al., 2013). Search costs may also increase because of the deterioration of health conditions. Cross-country analyses of the gender gap in self-rated health and longstanding illness reveal that women report worse health conditions than men, especially in Southern Europe where female unemployment and inactivity rates are higher compared to other parts (Dahlin & Härkönen, 2013; Palència et al., 2014). Some stylised facts also operate on the labour demand side. In general, older workers experience longer spells of unemployment because of their approaching retirement age. Considering the age distance to retirement as a proxy for the residual employability of workers, employers are less likely to hire older workers. The so-called time-horizon effect (Chéron et al., 2013; Hairault et al., 2015), when related to gendered issues, further hinders the possibility of women successfully re-entering the labour market after a period of inactivity or long unemployment spells in their later careers.

In this respect, training policies can be conceived as a part of a lifelong learning strategy. Older workers, especially women, can profit from opportunities to update their skills after a period of depreciation in human capital. This step is particularly important in the era of continuous technological processes. One would expect increasing participation of women and men in training courses once obsolescence affects their working performance and reduces the possibility of prolonging their working career. Unfortunately, the empirical evidence contradicts this conclusion. As documented by Lössbroek and Radl (2019) for nine European countries in 2015–2016, participation in both educational and on-the-job training activities is far lower among employees aged 50+ than among younger workers. Moreover, women continue to participate less than men do in their training activities. On the one hand, low work intensity and accumulated experience disincentivised women from undertaking training courses. However, employers can be reluctant to offer training courses. This is the case for part-time and temporary workers and women working in small firms (Lössbroek & Radl, 2019).

Women in their late life cycle also face a higher risk of widowhood than their male counterparts (Ahn, 2005; Werding, 2008; Sánchez-Marcos & Bethencourt, 2018; Nicholas & Baum, 2020; Peña-Longobardo et al., 2021). The widowhood risk increases with age, and the mortality profiles of men are higher at 50+ years than those of females (Nicholas & Baum, 2020). Widows remain responsible for household care during widowhood (Vara, 2013). Peña-Longobardo et al. (2021) further distinguish between the short-term and long-term consequences of widowhood. In the short run, financial and mental health are mainly affected. In the long run, the rearrangement of formal and informal provision of care has been settled. In economic terms, the risk of widowhood represents a huge income shock for a household as an entity. In fact, the survivorship pension is an important redistributive policy instrument that alleviates the risk of poverty among older women (Ahn, 2005; van der Vaart et al., 2020). Depending on the generosity of the welfare system, the magnitude of the survivor pension can trigger an opposite effect on the widow's labour supply. If an income effect prevails, widows can be drawn from the labour market; if the opportunity cost of not working shrinks, then widows enter out of inactivity or remain active in the labour market (Kim & Rizzi, 2020). Indeed, of the two, more often the first occurs since the provision of a survivor pension reduces labour supply (Werding, 2008; Sánchez-Marcos & Bethencourt, 2018).

Given the different employment patterns throughout their entire activity period, women and men do not exhibit the same retirement behaviours. Women usually retire earlier than men do for several reasons (König, 2017; Riekhoff & Järnefelt, 2017; De Luigi et al., 2021). First, retirement schemes maintain a lower retirement age among female workers. However, conformation to European directives calls for the homogenisation of retirement ages between women and men. Second, as noted by Dahlin and Härkönen (2013) and Palència et al. (2014), women may end up their careers with health-related problems more than men due to their longer employment in labour-intensive industries, such as manufacturing and personal care. Health deterioration may also be a consequence of widowhood (Peña-Longobardo et al., 2021). Third, in the role of secondary earners and care providers within the

household (Bartels & Shupe, 2022), women may withdraw from the labour force as soon as the eligibility requirements are satisfied independently of the level of their pension entitlement. It has also been found that women retire later than the statutory retirement age if they are less educated (De Luigi et al., 2021) and those who need to compensate for lower lifelong earnings (Riekhoff & Järnefelt, 2017; Kim & Rizzi, 2020). In contrast, highly educated women and public employees retire earlier than their male counterparts (Riekhoff & Järnefelt, 2017; De Luigi et al., 2021). Women's retirement choices are also somehow linked to those of the primary earner partner (Michaud et al., 2018). Finally, women's decisions to retire also depend on the institutional setting of the public pension system–that is, on the pension formula of the pension regime. Defined-benefit types usually incentivise early retirement because pension benefits are less elastic to a few years of additional contribution if they do not alter the reference wage. In contrast, defined-contribution pension systems incentivise workers to prolong their working careers because of the direct link between pensions and accumulated contributions.

Labour market differences are the main drivers of the resulting gender gap in pension income (Lis & Lis, 2019). Bonnet et al. (2022) provide the first estimates of the gender gap along the pension distribution for France. The findings reveal that these differences are mainly due to differences in career length. Moving along the distribution, the gender pension gap increases, and the role of wages gradually becomes more important. In the upper decile, the gender pension gap is more pronounced and depends entirely on the wage differences. The gender pension gap is wider in the private sector than among civil servants since public careers are traditionally less fragmented and not characterised by long periods of inactivity.

On average, women are entitled to smaller pensions but experience a longer retirement period than men. Due to biological differences, women outlive men. The differences in total pension wealth, defined as the product of pension income and expected payment duration, are lower than the gender gap in pension income. Moreover, systematic gender differences in longevity are responsible for the implicit transfer of resources from short- to long-living pensioners (Ayuso et al., 2016). The adoption of population-wide pension parameters in the calculation of annuity triggers a transfer mechanism of public resources penalising men for living shorter but favouring women for living longer than imputed at the national level. As shown by Culotta (2021), for Italy, the implicit tax/subsidy mechanism is more intense in regions where gender gaps in the labour market are higher. Regional dispersion in implicit subsidy is higher among females than males, reflecting a higher dispersion in longevity at retirement among women.

A policy that is found to have an impact on the gender pension gap is the provision of a minimum level of pension. This mechanism is similar to increases in minimum wage (Robinson, 2005; Bargain et al., 2019; Caliendo & Wittbrodt, 2022). Aimed at reducing poverty among retirees, increases in the minimum pension reduce the gender pension gap in the lower part of support. As empirically shown by Bonnet et al. (2022), a positive effect mainly occurs in the first decile among private workers. The gender pension gap in the first decile is even larger in the absence of this safety measure. Instead, the minimum pension is insignificant for explaining the

gender pension gap among retired civil servants. The relative advantages of women in the public sector would provide an additional explanation for their over-representation in public administration (Bonnet et al., 2022). Pension reforms proceed along with increases in retirement age, often automatically linked to continuous longevity gains. Shifts towards defined contribution pension regimes increase the elasticity of pension annuity to the whole career dynamics. Hence, in principle, the elasticity of the gender pension gap to variations in gender pay and employment gap increases. In general, pension policies aim to alleviate poverty among retirees, as with the institution of pension minimums, and they act as income-maintenance devices, as in the case of old-age pensions. Gender-differentiated pension policies could improve the well-being of retired women but could not close the gender gaps in the labour market. When women approach retirement, policy intervention aimed at reducing gender differences in labour market outcomes can easily vanish because of their interaction with pension policies which, instead, influence withdrawal from the labour market.

3 Gender Gaps and Fiscal Policies: A Regional Perspective

So far, we have seen that women in the labour market are generally penalised compared to men in a variety of ways throughout their life cycle. As widely documented in the empirical literature, gender gaps are almost insignificant at the time of entry into the labour market. The only relevant difference that emerges from studies focusing on the early school-work transition is the role of the field of study. Women are enrolled more in non-STEM disciplines than men, giving rise to the so-called gender STEM gap (Casarico et al., 2016; Dilli & Westerhuis, 2018; Francesconi & Parey, 2018; Fuchs et al., 2021). This gender difference then results in the self-selection of young women in economic sectors, such as healthcare, teaching, and manufacturing. In contrast, men are employed more in the industrial, technological, and innovative sectors. Compared to female-dominated jobs, male-dominated jobs offer a more stable employment career with higher wages and growth profiles. A few years after their entry into the labour market, women and men have already exhibited persistent differing dynamics in further labour market outcomes (Del Bono & Vuri, 2011; Fitzenberger & Muehler, 2015; Brzinsky-Fay & Solga, 2016; Acosta-Ballesteros et al., 2017; Berloffa et al., 2019a, 2019b; Reshid, 2019; Berloffa et al., 2020). Typically, women are associated with a lower accumulation of labour market experience, human capital, and longer spells of unemployment and inactivity. Women are also more concentrated among part-time and temporary workers (Booth et al., 2002; Faccini, 2014; Lössbroek & Radl, 2019; Berloffa et al., 2020). Lower returns in occupational mobility, together with flatter wage profiles of female-dominated sectors compared to male-dominated sectors, represent additional factors feeding the distance in labour earnings between female and male workers. The gender pay gap is persistent across the entire wage distribution, and across countries. The differences are more pronounced at the bottom

(Robinson, 2005; Bargain et al., 2019; Caliendo & Wittbrodt, 2022) and top of the wage distribution (Bertrand et al., 2018; Casarico & Lattanzio, 2023; Fuchs et al., 2021).

A common factor in all of these gender gaps is the role of maternity. Becoming a mother is associated with a further wage penalty compared with childless women, that is, the so-called motherhood gap (Budig & England, 2001; Cukrowska-Torzewska & Lovasz, 2020). Episodes of maternity, often leading to long inactivity spells, substantially contribute not only to human capital depreciation but also to undermining their future career prospects (Manzoni & Mooi-Reci, 2020). Gender differences in the labour market have been linked to lower geographical mobility. Family ties restrict mothers' job searches to local vacancies, which in turn limits their career prospects to economic dynamics at the local level (Perales & Vidal, 2015; Gimenez-Nadal & Molina, 2014, 2016; Nisic, 2017; Petrongolo & Ronchi, 2020; Fuchs et al., 2021; Le Barbanchon et al., 2020). Women select jobs paying lower salaries but are more compatible with family care. Women also invest less effort in work and are less oriented towards occupational careers (Cukrowska-Torzewska & Lovasz, 2020). These differences are more pronounced for women living in peripheral regions than for those living in more densely populated areas, such as metropolitan cities (Nisic, 2017). Gender occupational segregation is contingent on the local industrial context (Perales & Vidal, 2015). Core economic areas are more dynamic and competitive. Thus, gender-related discrimination is lower in these areas (Fuchs et al., 2021). In contrast, gender gaps are larger in regions characterised by a lack of large and innovative firms, poor-performing local labour markets, depressed economic areas, and a more aged population. As geographical mobility is expected to continue to decrease with age, the possibility of recovering maternity employment patterns at the end of the life cycle is very low. The closer one is to retirement, the higher the probability of non-employment (Chéron et al., 2013; Hairault et al., 2015). Overall, these considerations deliver two messages for policymakers who want to embrace a gendered perspective in the design of labour market policies. First, the older the targeted women, the less effective the policy because the possibility of retirement may undermine the validity of the intervention. Second, policy interventions should be addressed by local authorities since they understand the local economic reality better than national decision-makers. The resulting decentralisation calls for coordination between national and regional governance and the quality of the latter. There is a role for both national and regional economic policies in mitigating the regional dispersion of gender gaps in the labour market. In contrast, the implementation of nationwide labour market policies may generate asymmetric effects in countries characterised by a marked regional dispersion in labour market performance (Altavilla & Caroleo, 2013).

For example, training policies aim to counteract possible mismatches in the labour market and, in general, increase the employability of targeted participants. If combined with other ALMPs, such as job assistance programmes, skills assessment, and job counselling, they increase their effectiveness (Bergemann & Den Berg, 2008). However, the adoption of a nationwide perspective does not necessarily match the industrial characteristics and needs of some regions. The uneven

geographical distribution of firms providing training exacerbates the regional disparities in gender gaps. Likewise, training policies targeting specific groups of women may produce negative collateral effects in the presence of uneven geographical distribution of participants. The implementation of other types of ALMPs is also affected by regional disparities in national labour markets. Employment subsidies, ranging from job creation in the public sector to hiring subsidies and start-up grants in the private sector, would be effective if not aligned with local economic and demographic conditions. ALMPs helping female job seekers should be tailored to the effective employment opportunities available in that region if the final goal is to improve the matching process between women and jobs. On this point, Wapler et al. (2018) and Wapler et al. (2022), who examine the effect of different labour market policies across German regions, stress the distinction between low and high-unemployment regions, since many effects of ALMPs could vary with respect to local labour market conditions. Wage subsidy programmes work better in low-unemployment regions, while vocational and in-firm training are more beneficial in high-unemployment regions. In addition, Altavilla and Caroleo (2013) find that northern Italy, the richest part of the country, uses more training programmes compared to the south, where employment incentives are preferred. However, what matters for the effectiveness of ALMPs across regions depends on the number (and type) of vacancies. Wapler et al. (2022) found that if there are a high number of vacancies per unemployed in low-unemployed regions, the potential for participants might be relatively high, as improvements in their employability more easily lead to employment. The opposite situation occurs in regions with high unemployment rates, where labour markets are slack and the bargaining power of firms in relation to jobseekers and public employment services is higher.

Another prominent policy for reducing the gender gap in employment is the introduction of gender quotas. The imposition of a larger share of women leads to a reduction in the gender employment gap and the wage pay gap along the entire wage distribution. In particular, Bertrand et al. (2018) document positive effects in the upper part of the wage distribution from the introduction of gender quotas on the administrative boards of public limited companies in Norway. Instead, raising the minimum wage reduces the gender pay gap at the bottom part of the wage distribution. However, when regional peculiarities are considered, the policy's effectiveness cannot be guaranteed homogenously across all regions. For example, in the case of minimum wage policies, the effect is larger in regions where women are highly concentrated in low-paid jobs (Bargain et al., 2019; Caliendo & Wittbrodt, 2022). The effectiveness of the introduction of gender quotas on the administrative boards of private firms strictly depends on the presence of large firms in that territory. In regions where large firms are scarce or even missing, the effect of gender quotas on women's employment and wages is likely to be lower, simply because fewer firms in that region will change their board composition. Cuts in female payroll tax can also reduce the gender pay and employment gap (Alesina et al., 2011; Rubolino, 2022). Under this programme, the lower cost of hiring women incentivises employees to balance their staff. Clearly, the level of employment incentive will drive the magnitude of the tax cut as well as the skills of women

entering employment. From a regional perspective, it is likely that areas with small and medium firms will not make larger use of this subsidy compared with more developed and dynamic regions. To increase policy effectiveness in the context of persistent regional differences, it is necessary to know the causes of unemployment and inactivity among women at the local level. Demand-deficient unemployment in a region requires the creation of more jobs in that territory. Structural unemployment due to a persistent mismatch between labour supply and demand should be challenged with ad hoc interventions in terms of educational policies and mobility programmes (van Dijk & Edzes, 2016). These programmes, if aligned with the economic characteristics of a region, can reduce the mismatch both vertically, owing to the overeducation of women (Robst, 2007; Acosta-Ballesteros et al., 2017), and horizontally, as implied by different fields of study (Francesconi & Parey, 2018; Fuchs et al., 2021). Mobility programmes can counteract the lower mobility of women and, through this channel, reduce the geographical mismatch between women and job characteristics (Caliendo, Künn, & Mahlstedt, 2017).

National policies should embrace the goal of achieving development in all types of regions and should not be based on an abstract notion of convergence and redistribution. The lower geographical mobility of women compared to men, which can be assumed to increase with age, at least after maternity, imposes greater attention on the regional dimension of gender-responsive policies promulgated at the national level. A one-size-fits-all approach may be asymmetrically effective in this respect. In several countries, since the 1990s, there has been a tendency to decentralise labour market policies (van Dijk & Edzes, 2016). Since then, national policymakers have acquired greater awareness of the local dimensions of the economies in their policy formulation. Two types of decentralisation policy can be distinguished: programmes that are designed at the national level and implemented at the regional level, and those where the power to design and implement is assigned at the regional level. In the first case, space-neutral policies of the labour market assume that labour is highly mobile. In contrast, place-based theories emphasise the localness of possible labour market failures and economic institutions. Hence, gender-responsive fiscal policies should be tailored to the specificities of all regions, particularly in Europe, to increase their effectiveness at the national level. Instead, space-neutral policies can be effective in more developed regions and mask failures in others (Iammarino et al., 2019). Gender-differentiated regional labour market policies can provide better adherence to the local nature of economies and reduce the various forms of the gender gap.

Unfortunately, the implementation of gendered policies at a regional level does not seem to produce definitive results in many European countries. Scandinavian countries have a long tradition of gendered regional policies in the labour market. For example, in Norway and Sweden, gendered regional policies were already operationalised in the late 1970s with the goal of increasing female employment

and entrepreneurship in rural areas (Rönnblom, 2005).[3] In the rest of Europe, the integration of the gender perspective into the content of regional policies was later conceived as a policy paradigm. Over the past two decades, cohesion policies have been successful in reducing regional disparities by bridging the gap between high- and low-income regions in the EU (Arbolino et al., 2020; European Commission, 2022). However, the effects of European cohesion policies on women's performance in the labour market are conditional on the quality of the institutions in the respective regions (Cerciello et al., 2019; Arbolino et al., 2020). As Cerciello et al. (2019) show, for Italy over the years 2007–2013, the absorption of European funds is strongly associated with the quality of institutions. Arbolino et al. (2020) further stressed that improving the quality of regional institutions is not a short-term goal, but it implies removing those factors that impede the exploitation of the potential of employed women (Arbolino et al., 2020). Poor institutions constitute a crucial obstacle to the development of growth-promoting factors, such as competitiveness, entrepreneurship, and the capacity to innovate and create jobs (van Dijk & Edzes, 2016; Iammarino et al., 2019). Similarly, weak coordination between national and regional actors can harm the correct understanding of policy content and, to a greater extent, compliance with what was originally designed. Spain and Sweden's experience in the management of European social funds from 2007 to 2013 is indicative in this respect. National and regional actors who were interviewed claimed that there was no organic collaboration between them (Carlsson, 2020).

Instead, more fluid coordination between national and local governors is essential to guarantee correct comprehension, implementation, and monitoring of gender-responsive labour market policy across regional decision-makers. Obviously, some regions are more capable than others of managing external funds and coordinating with other institutional actors. In these regions, it is likely that the gendered labour market policy will have a higher chance of being more effective than regions lacking a sound and qualified institutional organisation (van Dijk & Edzes, 2016; European Commission, 2022).

4 Concluding Remarks

Reducing gender differences in labour market outcomes remains one of the most pressing challenges for developed economies. One of the tasks of the Gender Equality Strategy 2020–2025 is closing gender gaps in the labour market (Rubery & Tavora, 2021). While the gender gap in education is being closed, gender gaps in employment, pay, family care, power, and pensions persist in most European countries. Differences in labour market outcomes between women and men have been increasing since the 2008 financial crisis and the subsequent turbulent periods

[3] Norway launched in 1985 the initiative of promoting seven projects aiming to improve opportunities for women's employment in rural areas as employees and entrepreneurs.

(European Commission, 2022). They did so during these years of COVID-19 (Queisser, 2021). The impact of an economic crisis propagates along the national territory but at different intensities. Some areas recover faster than others and are supported by a more resilient economic environment. Instead, labour market dynamics in peripheral regions recover slowly. This feature also affects the effectiveness of labour market policies aimed at reducing gender-related differences across regions. The presence of persistent territorial differences within a national territory highlights the importance of cohesive policies. The European Commission has actively considered regional convergence through regional cohesion policies. EU regional policy is one of the world's largest public policies in terms of budget size, accounting for approximately one-third of the EU's total budget (Carlsson, 2020). It is a comprehensive macroeconomic redistribution policy aimed at reducing territorial, economic, and social disparities within the EU by promoting and financing projects. Following the contraction of national public investment owing to financial and economic crises, cohesion policies have become a more important source of public investment. European cohesion policies remain the main policy channel to reduce gender gaps at the local level and increase regional convergence in this respect.

There is a growing consensus in the literature about the importance of acting locally to reduce gender gaps at the national level. Regional characteristics, including the quality of local institutions, become important strategic variables when considering the implementation of a given policy along the national territory. Failures in understanding the sources of regional imbalances as well as policy content are likely to weaken the potential effects of the implemented policy. Likewise, coordination between central and local decision-makers is crucial in determining the adherence of a policy to local regions. Unlike in developed regions, labour market forces operating in developing regions are not sufficient to increase employment opportunities for women. Furthermore, the lower geographical mobility of women stresses the role of local decision-makers from conception to the monitoring of gender-responsive policies in labour markets. Actions tailored to the specific economic and sociodemographic conditions of the territory are instrumental for inclusive growth (European Commission, 2022).

The 2030 Sustainable Development Goals set by the European Commission explicitly consider gender equality as one of the most urgent issues for future sustainability-oriented policies. The possibility of reducing gender gaps is known to boost economic growth by increasing employment and competitiveness, and reducing poverty (Morais Maceira, 2017). Apart from concrete measures, changes in gendered values and the social role of women substantially contribute to the equalisation of labour market conditions between women and men (Fuchs et al., 2021). Of course, if effectiveness is also desired at the cultural level, gender-responsive policies in the labour markets should be prolonged to reduce barriers between female- and male-dominated sectors and occupations (Dahl et al., 2021). The distinctive historical and institutional characteristics of each (local) economic system are influenced by strong cultural underpinnings (Kushi & McManus, 2018). The duration of the intervention is thus expected to last longer, particularly in developing regions, than in more developed subnational areas. Skill endowments

are still unevenly distributed and concentrated in more developed regions, especially the capital regions. Entrepreneurship, which is critical for economic growth, tends to be concentrated in large cities. Large and dynamic firms create jobs in low-growth regions. Investments in technological infrastructure, skills, innovation, and governance will drive regional convergence in the coming years. Smart specialisation strategies, introduced in *Cohesion Policies 2014–2020*, can help address this divide, but they need to focus on regional potential. The removal of barriers will increase the ability of women to exploit new opportunities driven by green and digital transitions. The goal of making Europe the world's leading innovation economy is to go through a more inclusive role for women in productive processes. Thus, a gender-differentiated design of labour market policies at the regional level is necessary to achieve satisfactory outcomes when discussing women's conditions in the labour market. Benefits also arise from an efficiency viewpoint, especially when compared to gender- and space-neutral policies (Alesina et al., 2011; Iammarino et al., 2019). It is a long way to close gender gaps in the labour market, but the direction is at least clear. Empirical evidence on regional disparities is still emerging, and is mainly constrained by data availability. The development of spatial regression methodologies and greater data availability will permit a deeper geographical analysis of the effect of fiscal policies on gender gaps. Further research should explore the multiple intersections between geography and gender gaps in the labour market.

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