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Measuring the future: The youth HDI in Spain

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ABSTRACT

The paper provides three key contributions to examine how youth development can be used to approach the future: first, it introduces a new age-disaggregated human development indicator focused on the youth, named 'Youth HDI'. It centres on educational, living standard and health issues. Secondly, it shows how partial ranking analysis (posets) can be used to unfold incomparabilities in ordering regions, overcoming traditional limitations associated with the use of composite indicators. Finally, it employs Phillips and Sul (2009) convergence test and clustering algorithms to assess the evolution of the Youth HDI for different regions. These contributions are quintessentially methodological about evidence for 'perspective of futures'. This illustration shows how youth's vulnerability and marginalisation are not an exclusivity of developing countries. It unlocks the debate about the consequences of current youth's human development to sustainability and how this kind of disaggregated indicator is essential for fulfilling 2030 Agenda's transformative promise of "leaving no one behind"

1. Introduction

Our future depends on what happens to the youth today. The 2030 Agenda for Sustainable Development targets the youth as among the most vulnerable groups that must be empowered (UN A/RES/70/1, 2015). This is not simply because almost 90 % of the youth live in developing countries but also because those who live in developed countries are also subject to adverse circumstances such as higher poverty, unemployment, violence, marginalisation, disillusionment and lack of aspirations, to mention just a few. In addition, harsh historical economic, environmental and cultural circumstances are shaping the future of the youth not merely as a transitional phase in life but as a generational challenge (Corrales-Herrero & Rodriguez-Prado, 2021). These circumstances might impact throughout young people's life courses, undermining efforts toward SDGs (Sustainable Development Goals) (Sheehan et al., 2017). On the other hand, the youth are clear agents of change, with the potential to inspire, mobilise and drive sustainable development (World Economic Forum, 2021). Thus, the same youth that is commonly ignored by development policies holds the key to a better future for the planet. For this reason, it is important that we consider how we can assess the state of the youth based on human development evidence.

It is remarkable, however, despite its importance, how little attention the measurement of youth human development has received from the literature (Molnár & Vass, 2013). Few institutional attempts can be counted, such as the Global Youth Wellbeing Index

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(International Youth Foundation, 2017) or the Global Youth Development Index (Commonwealth Secretariat, 2021). As much as they explore a rich array of dimensions, including safety and security, civic participation, digital access and equality, among others, it must be noted that their very high number of variables (35 and 27, respectively) imposes high costs on the use of the indicators. One of them is that each particular indicator ends up explaining very little of the composite indicator. For instance, in the Global Youth Wellbeing Index, 'youth perceptions of violence' explains only 1.15 % of the final index, and 'youth expectations for future standard of living' explains even less, only 0.85 %. Furthermore, these big composite indicators lump together too many incommensurable features of youth's human development into a single representation that may hide too many trade-offs and arbitrary choices.[1]

Alternative academic measurements, such as the Weak and Strong Indicators of Youth Living Conditions (Corrales-Herrero & Rodriguez-Prado, 2021), the 'Youth HDI' (Saikia et al., 2018), the Index of Youth Investment (Hess, 2010), the Youth Welfare Index and the Youth Welfare Improvement Index (Chaaban, 2009) are often misleading in their denominations because they end up measuring features not associated with the youth.[2] For instance, the Index of Youth Investment is, in fact, more about children's health and education than about youth human development challenges. On its turn, the Youth Welfare Index has important data limitations that imply that the index cannot be constructed on a yearly basis and ultimately, what it provides is only an account of governments' general performance in health and education spending. The Weak and Strong Indicators of Youth Living Conditions explore a multi-objective double reference point method (based on 18 indicators) that is very interesting but that seriously under-represents health dimensions. Finally, the 'Youth HDI' solves all the issues above, using the same dimensions of the HDI (Human Development Index) but filling them with too many arbitrary assumptions. To illustrate, we could mention that in calculating a 'decent standard of living' for the youth, Saikia et al. (2018) assume that the proportion of youth who is employed earns the GNI_{pc} (Gross National Income per capita) and that the unemployed earn a subsistence income. In fact, they do not calculate the evolution of the income of the youth but simply estimate its value based on aggregates that refer to other economic groups rather than to the youth. This provides a misleading picture of the situation of the youth. Similarly, when it comes to the health dimension, they simply take the average of the number of 'years expected to be lived' between 15 and 35 years, ignoring the years in-between these max-min posts and confounding 'years expected to be lived' with 'life expectancy at birth' for the different ages. And finally, we should also mention that they include children and young people from 3- to 18-year-olds but calculate the expected years of schooling by normalising ages for full 18 years of schooling (rather than 15). In summary, these indexes do not seem to be doing a good job in directly characterising the lives of young people, biasing any analyses or inferences about how we can approach the future.

Given this context, the main objective of this paper is to suggest a reliable indicator of Youth HDI (YHDI) that overcomes most of the technical limitations of previous youth indicators by adhering as much as possible to the HDI standard methodology due to some of its valuable features (Anand & Sen, 1993; Sen, 2003; Klugman et al., 2011) such as: i) simplicity, grounded on a composite indicator with three dimensions focused on the lives of the youth, ii) communicability and broad outreach, based on three popular elements of human development, namely, health, knowledge and living standards, iii) transparency, built on clear methodological principles, such as normalisation or equal weights, iv) regularity, achieved by the use of a standard source of information produced on an ordinary basis, and v) reliability, built on secondary data produced by reputable agencies. The elaboration of the new Youth HDI proposed here entails an age-disaggregated adaptation of the HDI dimensions plus a restructuring of the living standard dimension to reflect better the precarious nature of jobs available to the youth.

In addition, this paper applies the new indicator to two key development analyses related to the principles of 'leaving no one behind' (LNOB) and 'equality' (UNDP, 2017; UNSDG, 2022). The first comprises the use of partial ranking analysis (poset) and Hasse diagrams to investigate the incomparabilities entailed in ranking different YHDI values. This provides a clearer picture of those left behind by the development processes. Similarly, state-of-the-art convergence techniques to investigate the development paths of different YHDIs can offer a useful benchmark for discussing equality issues. Taking everything into account, the main contribution of this paper is not merely the development of a youth human development indicator but its analytical use within a human development perspective so that we can engage with issues about 'the future of our future'. This is because the YHDI can provide an objective anchor that can be used to explore how the youth think subjectively about the future (Eckersley, 1997), grounding their beliefs and attitudes on their concrete realities (Alm, 2011; Kantenbacher et al., 2022). In addition, it is relevant for addressing the problem of a 'lost generation of youth' affected by diverse crises that can be even more damaging for the future of developing regions (Hilson & Osei, 2014).

The lives of the youth today can impact on the future through many different mechanisms. For instance, the youth who struggle with economic uncertainty are more likely to delay parenthood, what can affect their fertility and ability to have children in the future (Fahlen & Oláh, 2018). This might shape not only long-term demographic trends but impose a greater risk on the reproductive health of individuals, eroding family planning. Similarly, the youth who have difficulties in completing their education can be more limited in their future job opportunities and earning potential influencing future economic trends (Bruno et al., 2016). What happens to the youth

[1] Composite indicators with many sub-indicators amalgamate different variables without making explicit their tensions and conflicts. This becomes a serious problem whenever the number of sub-indicators is very high, such as 20–30 that can be found in different youth development indicators.

[2] Our research has identified other youth indices, such as the The Prince's Trust Tesco Youth Index (by Tesco and YouGov UK), the ASEAN Youth Development Index (by the ASEAN Union), the Australian Youth Development Index (by the Australian Youth Affairs Coalition) and the Youth Progress Index (by the European Youth Forum). It is noticeable how each of these indicators is limited by a particular shortcoming, either because it overemphasises some specific variables (such as mental health) at the expense of others or due to lack of consistency among different age groups or because they include a very large number of variables, making hard to understand the meaning of the final composite indicator.

can also affect social mobility and housing transitions in the future (Minguez, 2016) as well as how future generations will see their moral obligations towards aspirational and future problems (Goring et al., 2023). Grounding these debates on objective bases, such as those provided by the YHDI, might provide invaluable scenarios to examine how young people might shape the future of our societies.

Rather than developing a superficial Youth HDI for a selection of countries, we opted for calculating it in-depth for one country, Spain, disaggregating by regions (autonomous communities). The reasons for choosing Spain are three: first, Spain offers a paradigmatic case, given that it has several youth statistics that are among the worst of developed countries, such as high youth unemployment, high job temporality and high school dropouts. (Escalonilla et al., 2021; Puente & Regil, 2020; Tudela, 2021); secondly, the choice of a European country illustrates how youth's vulnerability and marginalisation are not an exclusivity of developing countries, and finally, Spain is a country that is already seeing a decline in its population (-0.02 % in 2021, −0.06 % in 2022) that should decrease even further during all this century, meaning that the implications of a poor youth human development can be much more impactful and lasting. Most importantly, perhaps, the YHDI built on Spanish data[3] might provide a methodological roadmap for similar indicators tailored to other countries in the future. The Youth HDI put forward here aims to overcome the existing gap between these two opposing alternatives (dashboards vis-à-vis the use of highly aggregated composite indicators) by providing a methodology inspired by the human development paradigm. It is true that other studies, such as Herrero et al. (2013) carried out by the Valencian Institute of Economic Investigations, have produced HDI estimations for the different regions in Spain but without disaggregating by age, making impossible whatever inferences about the youth.

The article is structured as follows. Section two introduces the conceptual foundations of the Youth HDI, relating it to the human development and the capability perspectives. Then, section three constructs the index, explains its methodology, and presents the data used. Section four describes the main results along with some statistical analyses. Section five introduces a poset (partial ordering) analysis of the main results to tackle the issue of incomparabilities in human development indicators. Section six shows the main convergence trends among different regions. Finally, section seven offers key analytical and concluding remarks that conceive youth's human development within a 'perspective of futures'.

2. Conceptual foundations

The proposal of a Youth HDI, as formulated here, sits well within the conceptual structure of the HDI. First, because the Youth HDI follows the HDI in privileging simplicity and practical reason: the utilisation of a composite indicator based on fewer dimensions and variables makes this kind of indicator 'easily usable', as argued by Sen, (2020a),(2020b). Secondly, because the HDI is, in fact, a family of simple human development indicators, and for this reason, it can easily accommodate an indicator such as the Youth HDI (Hirai, 2017). Indeed, the family of HDI indicators already contains indices such as the Inequality-adjusted Human Development Index (IHDI), the Gender Development Index (GDI), the Gender Inequality Index (GII) and the recently introduced Planetary pressures-adjusted Human Development Index (PHDI). Each of these indicators follows the same conceptual structure of the HDI, advancing its analytical configuration according to the question at hand (inequality, gender discrimination, planetary pressures). Similarly, this applies to the Youth HDI, which addresses a key stage of human development that is so far completely ignored by the family of HDI indicators.

Thirdly, because the Youth HDI can also be read, as the HDI, as an index that focuses on basic capabilities that expand people's (in this case, the youth's) future opportunities (UNDP, 2020). In fact, we can argue that the Youth HDI does a better job than the HDI in capturing basic capabilities once it expands the dimension of living standards to include job temporality and partiality as capabilities of critical importance for future opportunities (beyond the mere records of resources, as done by the HDI). Fourthly, because the objective of the Youth HDI, as the HDI's, is to promote public reasoning and public discussion, incentivising people to talk about indicators that they can understand and engage with (Sen, 2017). This might not happen with composite indicators that are made of 20–30 different variables and that are more difficult to have a stronger impact on the mind and draw public attention (Streeten, 1994). Finally, the Youth HDI does not use a threshold, but it is grounded on an assessment of the relative performance of participants, just as it happens with the HDI.

The road to the capability approach's informational pluralism is paved with partial rankings (when total comparability between the alternatives is not secured) because the sheer complexity and practical difficulty of defining what is best impose limitations that should be acknowledged (Sen, 2000, 2009 and 2017). Partial rankings are at the centre of Sen's conceptual framework because they articulate the informational pluralism required for comparative analysis and reasoned scrutiny (Qizilbash, 2007; Comim, 2018). They offer a conceptual tool to face the difficulties and challenges in trying to achieve consensus about normative evaluations. When full agreement cannot be achieved in a composite indicator because one sub-indicator suggests that a given alternative is good whereas another sub-indicator shows that it is bad, partial rankings can be very useful for highlighting the different sources of disagreement.

Another key conceptual issue related to the application of the capability approach to the Youth HDI refers to the centrality of the notion of agency in characterising people's advantage (Robeyns, 2017). While the agency aspect seems more diffuse and less obvious when applied to all population cohorts in the HDI (in particular to those populations with a large proportion of small children), it appears more focused and justified when used as part of the Youth HDI, given that current aspects of life expectancy, knowledge and

[3] It is true that Spain has two youth reports regularly published, the first, named *Injuve*, from the Spanish Ministry of Social Rights (Injuve, 2020), and the second, the Synthetic Index of Compared Youth Development (*ISDJC* in Spanish), from *Centro Reina Sofia for Adolescence and Youth* (Tudela, 2021; Megías et al., 2021). Whereas the first provides merely a dashboard of lists of disparate indicators, the second lumps together an excessive number of dimensions, hiding all kinds of incomparabilities and trade-offs amond fifferent variables, scales and weigths.

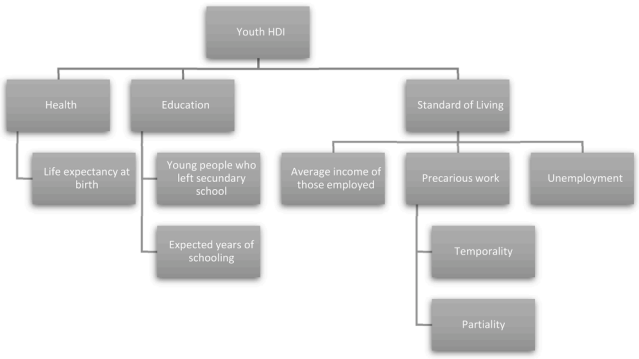

Fig. 1. – Schematic representation of the Youth HDI.
Source: Created by authors

living standards of the youth have clear and more immediate implications to predict their future trajectory (Sen, 1992). For instance, it is well-documented that youth unemployment has short-term impacts on human capital formation and long-term impacts on persistent unemployment and lower earnings (Mroz & Savage, 2006). Similarly, there is robust scientific evidence that health events during the youth are associated with late-life disease in single organs and the pace of ageing (Jagust, 2021). Finally, there are multiple and diverse future impacts derived from young people's education, going from traditional advances in labour market outcomes, crime reduction and improvements in health results (Dursun et al., 2018; Lochner, 2020) to enhancements in women's intra-household decision-making in financial and non-financial domains and reductions in their exposure to psychological abuse (Le & Nguyen, 2020). A common feature resulting from the three selected dimensions of the Youth HDI is that they refer to elements that are not necessarily very volatile in the short term and that might register their impacts more in the long term. For this reason, they can be considered good proxies for understanding 'the future of the future'. Taking stock of all the evidence above, it is not an exaggeration to suggest that an estimation of the youth's human development today is an approximate measure of the possibilities for their (and societies') future human development.

3. Methodology and data

The Youth HDI follows in the methodological footsteps of the HDI. First, it grounds the composite index on the same dimensions, namely, a long and healthy life, access to knowledge and a decent standard of living. It uses similar variables to populate these dimensions, with one noticeable exception: a decent standard of living (see Fig. 1). The justification for this change is straightforward: the issue of precariousness. The situation of the youth is so diverse and unequal that it would not be accurate to proxy this dimension by using the gross national income per capita, as done by the HDI. Instead, it structures the youth's standard of living on three sub-dimensions, corresponding to three labour market possibilities: employed, employed with a precarious job and unemployed. These categories reflect key debates about labour trends (ILO, 2011; La Porta & Shleifer, 2014; Muñoz-Comet & Steinmetz, 2020, to mention just a few). As such, they constitute a possible improvement on the use of a single measure of income, once they capture different categories of functionings and capabilities associated with distinct labour market conditions.

Secondly, the Youth HDI employs the same transformation and standardisation protocols used by the HDI, but with different results. We do not cap the income of the youth, as the HDI does, because it does not get even closer to its USD 75,000 threshold (Kahneman & Deaton, 2014). Similarly, we do not apply the natural logarithm of the income because the low values of wages paid to the youth do not appear to suggest a concave transformation function at these levels. But we follow the methodology of choosing minimum and maximum values (goalposts) in order to transform the indicators expressed in different units into sub-indices and indices that could be displayed between 0 and 1. This process of standardisation provides a direct way of handling informational pluralism in the elaboration of composite indices. It follows the latest guidelines of using fixed goalposts for comparability.

Thirdly, the Youth HDI gives equal and fixed weights to all dimensions, as done by the HDI. Given that all dimensions have a different number of subdimensions and corresponding variables, this means in practice that individual variables receive unequal weights (Drewnowski, 1974). For instance, the health dimension with a single variable gives 1/3 of weight to life expectancy at birth, whereas the standard of living dimension with three variables gives 1/9 of weight to each of them, as would be the case of the youth unemployment rate. The final index was calculated using arithmetic and geometric averages for all dimensions and the aggregates. In view of their very close results (with Pearson coefficient correlation rates within the range of 0.9–0.99), we decided to stick to the arithmetic average for all aggregations for simplicity's sake (a key ingredient in a human development perspective).

What is quintessentially distinctive about the Youth HDI is that *all data used is age-specific*, representing the population between 16 and 34 years old. There is no international consensus about how to categorise and classify young people according to their age. For instance, UNESCO and ILO work with the 15–24-year-old range, whereas the Commonwealth focuses on the 15–29-year-old. In Spain, for instance, INJUVE considers the range between 15 and 29 years old. We chose to work with a broader age range for two major reasons. First, because it provides an inclusive perspective of other data ranges and secondly, because it matched data availability from the Spanish National Statistics Institute. Table 1 describes all data sources used. For the Spanish Labour Force Survey, we analysed

Table 1
The Calculation of the Youth HDI.

Dimensions and indicators of the Youth HDI		Goalposts	Age group	Data source	Description
A long and healthy life	**Life expectancy**	MIN= 74,60 / MAX= 79,36*	16–34	INE demographic indicators	Measured as life expectancy in years for an individual at the time of her birth.
Access to education	**Education progress index (as proxy to MYS)**	MIN= 0/MAX= 1¶	25–34	MEVTS Statistic yearbook	Percentage of those who have completed only secondary mandatory education or less in general educated population.
	Expected duration of studies index (as proxy to EYS)	MIN= 0 / MAX= 8†	16–24	MEVTS Statistic yearbook and INE demographic indicators	Expected duration of studies in years, after completing secondary obligatory education.
Decent standard of living	**Income index**	MIN= 8.001,16 /MAX= 24.242,67§	16–34	INE microdata from the survey of life conditions	Average monetary or quasi-monetary net income of those employed.
	Partiality index	MIN= 0/MAX= 1¶	16–34	INE microdata from the labor force survey	Percentage of those working under part-time contract in the salaried working population
	Temporality index	MIN= 0/MAX= 1¶	16–34	INE microdata from the survey of life conditions	Percentage of those working under temporary contract in the salaried working population
	Unemployment index	MIN= 0/MAX= 1¶	16–34	INE microdata from the survey of life conditions	The ratio of unemployed in the active population.

* Posts represent the minimum and maximum life expectancy values from the international environment during the same period (between 1975 and 2004). The maximum value was recorded in 2004 in Monaco, and the minimum value was recorded in 1977 in Cambodia.
† The maximum schooling period is set to 8 years, and the minimum to 0 years.
§ Posts represent the minimum and maximum life expectancy values from Spanish autonomous communities during the period between 2009 and 2020. The maximum value was recorded in 2012 in Basque Country, and the minimum value was recorded in Extremadura in 2018.
¶ The maximum value of 1 means that the ratio of the indicator was 0, while the minimum value of 0 means that the ratio of the indicator was 1.
Source: Created by authors using Stata.

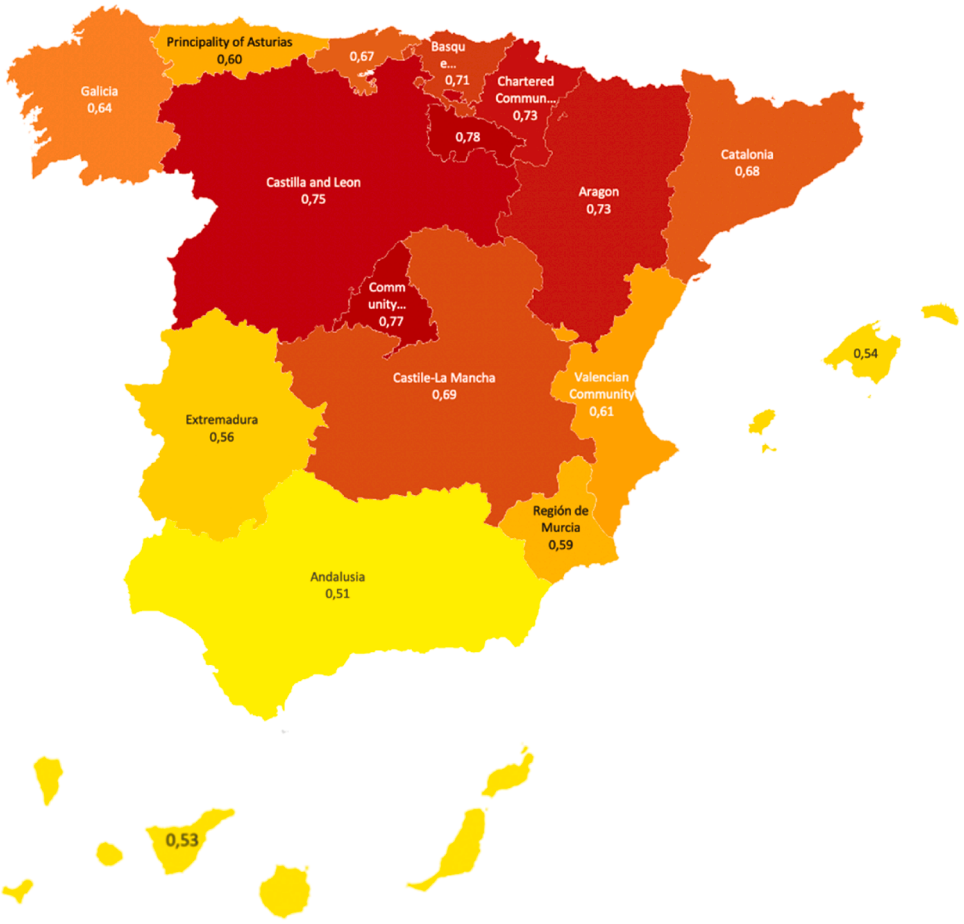

Fig. 2. – Map Youth HDI (2020).
Source: Created by authors using INE (2009–2020)

1.544.330 observations and for the Spanish Survey of Living Conditions of 87.172 observations for a period of 12 years.

INE, the Spanish National Statistics Institute, facilitates information about 'the life expectancy of a person of age *x* today who will continue to live". This measure corresponds to what Herrero et al. (2019) called 'life potential'. However, using this measure as the weighted average of life expectancy for the 16–34-year-old range would merge two different concepts, 'years lived' and 'life expectancy at a certain age', in a problematic way because it would carry a survivor bias. This explains why older age groups (people who survived certain ages) would always have higher life expectancies. In order to overcome this possible bias, we calculated the life expectancy at birth for each annual cohort and then produced the average life expectancy at birth of youth as the weighted average of life expectancy at birth for each age group. Considering LE = life expectancy; PL = population total; n = specific age group; i = specific autonomous community and j = specific year, we can calculate it as:

$$LE_{ij} = \sum_{n=16}^{n=34} \left(PL_{ij}^{n} \cdot PL_{ij}^{-1} \right) \cdot LE_{ij}^{n} \quad (1)$$

INE calculates life expectancy at birth measurements since 1975. That allowed us to estimate the life expectancy of youth beginning by the year 2009, with the first cohort of 34 years. The goalposts were established based on the maximum and minimum values found in the series for the 17 Spanish regions (named *autonomous communities* in Spain) for the 12 years considered (from 2009 to 2020). National values were used instead of international values for harmonising the health dimension with other dimensions, given that the overall index was based on national thresholds. Following this methodology minimises the survivor bias mentioned above at the cost of being influenced by child mortality. However, evidence about determinants of life expectancy suggests the relevance of a wide range of factors (e.g. pollutions, smoking, gender inequality, etc) that are specifically relevant for the youth (Wirayuda & Chan, 2021).

In its turn, the calculation of the education index is based on the HDI's methodological classification between those individuals who are most likely still studying (a flow measure, assessed by expected years of schooling, ESY) and those who are presumably not studying anymore (for convention, those above 25 years of age, representing a stock measure, assessed by mean years of schooling, MYS) (Saisana, 2014). Considering CR = percentage of those finishing only compulsory education; m = rate of enrolment of pupils and x = specific age group, we have:

Table 2
The Youth HDI (2009–2020).

Regions	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
AN	0,35	0,37	0,38	0,41	0,41	0,41	0,40	0,44	0,45	0,45	0,47	0,51
AR	0,57	0,57	0,59	0,60	0,61	0,63	0,66	0,67	0,67	0,69	0,71	0,73
AS	0,43	0,45	0,46	0,47	0,50	0,51	0,51	0,54	0,55	0,58	0,57	0,60
CB	0,46	0,48	0,50	0,51	0,53	0,53	0,57	0,60	0,62	0,64	0,63	0,67
CL	0,55	0,57	0,59	0,62	0,62	0,63	0,65	0,68	0,68	0,72	0,72	0,75
CM	0,48	0,50	0,52	0,54	0,54	0,57	0,59	0,61	0,60	0,62	0,66	0,69
CN	0,35	0,37	0,38	0,40	0,40	0,42	0,39	0,44	0,44	0,43	0,52	0,53
CT	0,51	0,54	0,56	0,57	0,57	0,58	0,60	0,61	0,63	0,64	0,65	0,68
EX	0,41	0,42	0,42	0,45	0,43	0,43	0,45	0,42	0,44	0,39	0,46	0,56
GA	0,44	0,46	0,47	0,49	0,50	0,53	0,51	0,54	0,56	0,58	0,61	0,64
IB	0,39	0,40	0,42	0,43	0,44	0,44	0,46	0,49	0,49	0,49	0,52	0,54
MC	0,42	0,45	0,44	0,45	0,47	0,47	0,48	0,52	0,53	0,52	0,55	0,59
MD	0,58	0,60	0,60	0,63	0,64	0,66	0,68	0,70	0,71	0,72	0,74	0,77
NC	0,51	0,54	0,54	0,56	0,58	0,59	0,61	0,64	0,67	0,71	0,72	0,73
PV	0,53	0,55	0,57	0,59	0,59	0,60	0,62	0,64	0,66	0,67	0,69	0,71
RI	0,47	0,52	0,53	0,55	0,58	0,59	0,61	0,64	0,67	0,69	0,71	0,78
VC	0,42	0,43	0,46	0,47	0,48	0,51	0,50	0,52	0,53	0,55	0,59	0,61

Source: Created by authors using INE (2009–2020)

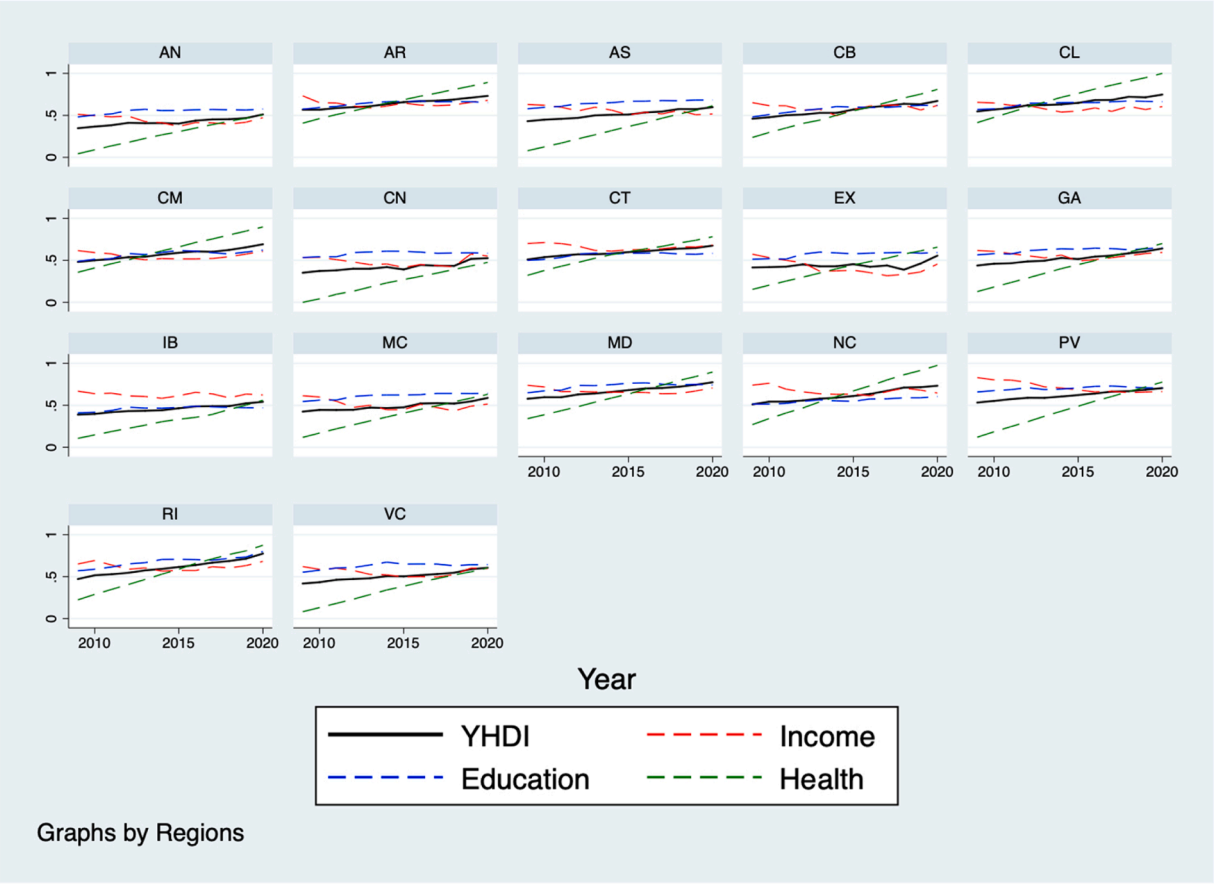

Fig. 3. – Main YHDI trends per region.
Source: Created by authors using INE (2009–2020)

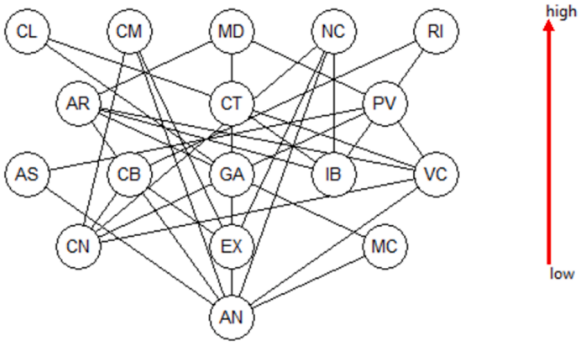

Fig. 4. – Hasse diagram of 2020 YHDI.
Source: Created by authors using INE (2009–2020)

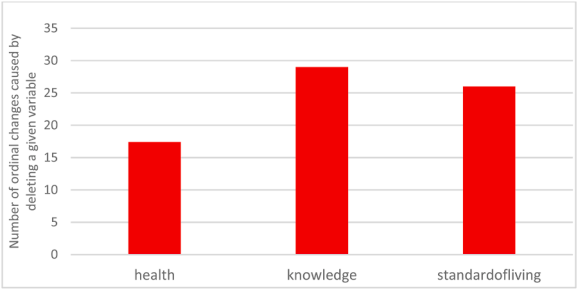

Fig. 5. – Sensitivity analysis of YHDI dimensions.
Source: Created by authors using INE (2009–2020

$$pMYS_{ij} = 1 - CR_{ij} \tag{2}$$

$$EYS_{ij} = \sum_{16}^{24} n \cdot m_{ij}^{x} \tag{3}$$

The proxy for MYS, named here pMYS, is provided by the Spanish Ministry of Education, Vocational Training and Sports (MEVTS), which asks individuals about their highest achieved level of education.[4] As a minimum measure of the stock of education for the youth, they consider the achievement of the first cycle of secondary education (called ESO in Spain). Data reported consisted of the proportion of young people who achieved this secondary level of education at most. For instance, this number was 35 % in Andalusia in 2020. Once this figure was produced, data was reversed (1−0,35) to generate a result harmonised with the Youth HDI (so that the higher the number, the higher the achievement). For the EYS proxy, we calculated how many years a young person (16–24-year-old) is expected to study based on enrolment ratios for every age (assuming that all enrolled would last till the end of the academic year). The calculation was processed for all ages. Then, the results were summed up to get the expected duration of study (Rigotti et al., 2013). For instance, for Andalusia, the expected years of study for someone aged 16 was 4.5 years.[5]

Finally, the standard of living dimension is calculated based on three sub-indicators: income index, precariousness index and unemployment index. But the precariousness index is made of two key indicators that explore the dimensions of temporality and partiality. They are all aggregated using arithmetic averages. First, the income index (I) describes the annual net income per capita for those who report earning some income from work. The income figures are all calculated at 2020 prices (INE, 2022), disaggregated by the 17 regions of Spain. In other words, regional inflation was taken into account when updating past income values.[6] The temporality index (TM) is calculated based on the proportion of young people working under temporary contracts in relation to all contracted workers. This information is derived from an INE survey that includes questions about the types of work contracts that people have.

[4] In Spain, 88 % of female and 80 % of male students finish compulsory education (INE, 2020). Because CR represents the percentage of those completing compulsory education, the proposed indicator is not strictly a MYS but a proxy for MYS, represented by the notation pMYS.

[5] For the 8 years of possible education between 17 and 24 years. the result for Andalusia would be produced by the following additions of progressive enrolment: $0.8934646 \times 1 + 0.7693899 \times 1 + 0.6765513 \times 1 + 0.5998519 \times 1 + 0.5350965 \times 1 + 0.4227605 \times 1 + 0.3368392 \times 1 + 0.25657058 \times 1 = 4.49052448$.

[6] A common challenge in income statistics is about those incomes informed as zero. The usual protocol is to try to identify those incomes by correlating them with other income or wealth variables. However, in this case we could not use the data provided by Spain's National Statistics Institute to disentangle rich from poor individuals. In addition, we did not have access to extra information to verify whether these individuals were living or not with their parents -a widely spread phenomenon in Spain.

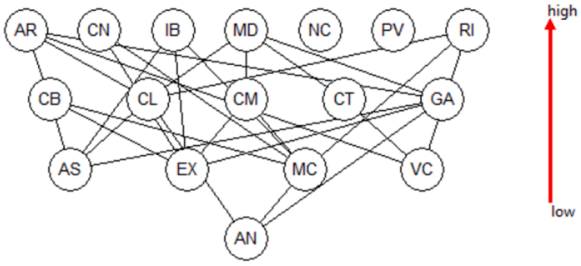

Fig. 6. – Hasse diagram of 2020 Standard of Living dimension.
Source: Created by authors using INE (2009–2020)

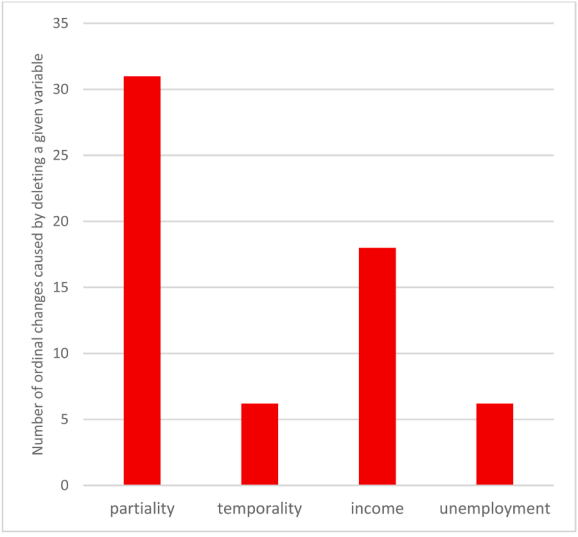

Fig. 7. – Sensitivity analysis of Standard of Living dimension.
Source: Created by authors using INE (2009–2020)

Because this is a negative feature of the standard of living dimension, the ratio is inversed by subtracting the result from one. For instance, for Andalusia in 2020, there were 72 % of youngsters between 16- and 34-year-old that worked under temporary contracts. Reversing the ratio means just to subtract 1 – 0.72 = 0.28. Considering I = income; EM = employed; PR = ratio part parttime workers; PT = number of part-time workers; FT = number of full-time workers; TM = ratio of temporary workers; CT = number of temporary contract workers; CF = number of full contract workers; UN = unemployment rate; UP = number of unemployed population and AP = number of active population, we have:

$$I_{ij} = \left(\sum_{n=16}^{n=(34)} I_{ij}^{n}\right) \cdot \left(\sum_{n=16}^{n=(34)} EM_{ij}^{n}\right)^{-1} \tag{4}$$

$$TM_{ij} = 1 - \left(\sum_{n=16}^{n=(34)} CT_{nij}\right) \cdot \left(\sum_{n=16}^{n=(34)} \left(CT_{ij}^{n} + CF_{ij}^{n}\right)\right)^{-1} \tag{5}$$

$$PR_{ij} = 1 - \left(\sum_{n=16}^{n=(34)} PT_{ij}^{n}\right) \cdot \left(\sum_{n=16}^{n=(34)} \left(PT_{ij}^{n} + FT_{ij}^{n}\right)\right)^{-1} \tag{6}$$

$$UN_{ij} = 1 - \left(\sum_{n=16}^{n=(34)} UP_{ij}^{n}\right) \cdot \left(\sum_{n=16}^{n=(34)} AP_{ij}^{n}\right)^{-1} \tag{7}$$

The partiality index (PR) follows a similar logic. It describes the proportion of young people who work under part-time contracts in relation to all contracts. This information comes from INE's Labour Force Survey that registers those who report working under a part-

Table 3
YHDI Convergence club classification results$A = \pi r^2$.

Clubs	Regions	Speed of convergence $\widehat{\alpha}$
Full sample	No overall convergence	−0923
Club 1	CL, MD, NC, RI	0105
Club 2	CB, CM, CT	1,02
Club 3	AS, VC	0579
Club 4	AN, CN, EX	0448
Diverging	AR, GA, IB, MC, PV	————

Source: Authors' calculations using INE (2009–2020)

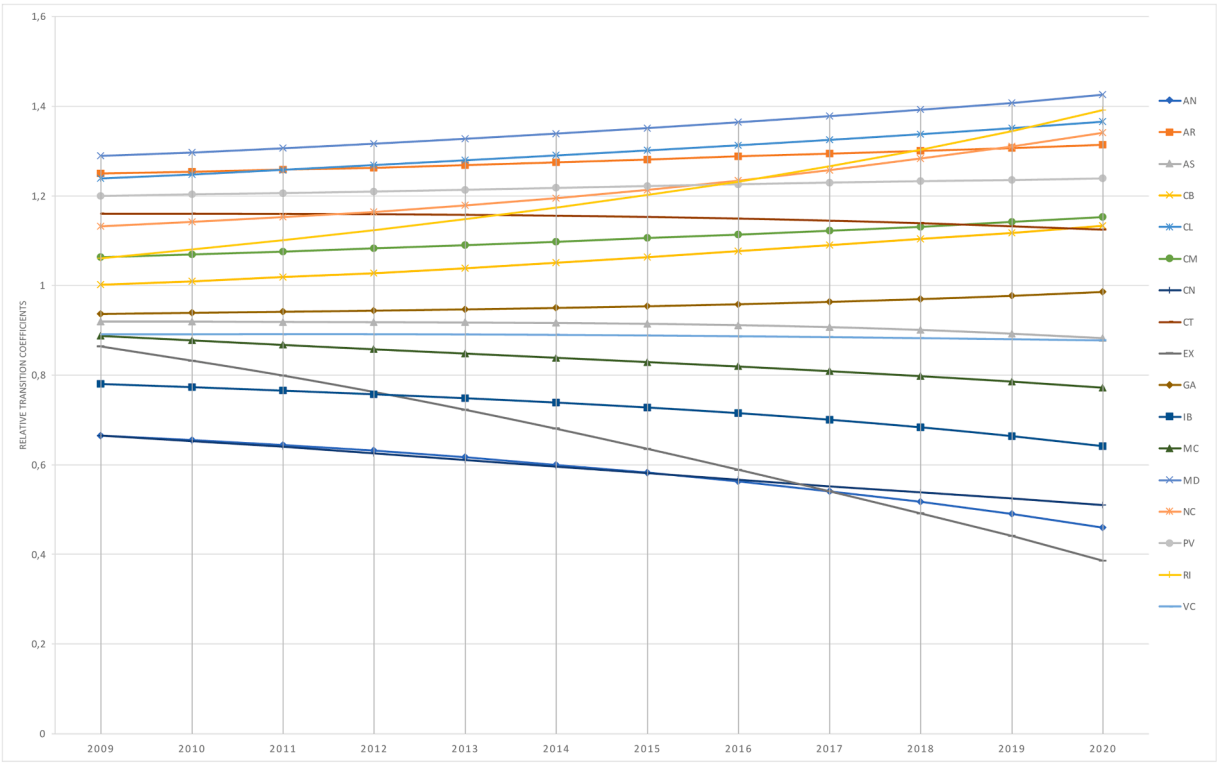

Fig. 8. – YHDI Regional Transition paths.
Source: Created by authors using INE (2009–2020

time contract. After calculating the proportion of temporary workers, the indicator is reversed as before. Finally, it is calculated the proportion of unemployed (UN) within the 16–34-age-range, in relation to all those who are considered active (waged full-time workers, waged part-time workers, self-employed full-time workers, self-employed part-time workers and unemployed). As before, the sub-indicator is adjusted by reverting its direction (subtracting it from one and expressing the information as a % of those who are not unemployed).

Including all formulae into a single representation would produce a general picture of the YHDI, as described by Eq. (8):

$$YHDI_{ij} = \frac{LE_{ij} + \frac{MYS_{ij}+EYS_{ij}}{2} + \frac{I_{ij}+\frac{TM_{ij}+PR_{ij}}{2}+UN_{ij}}{3}}{3} \tag{8}$$

The use of microdata allows some conceptual and practical improvements that are not normally possible in the elaboration of the global HDI that should dedicate considerable energy and effort towards the harmonisation of different national criteria.

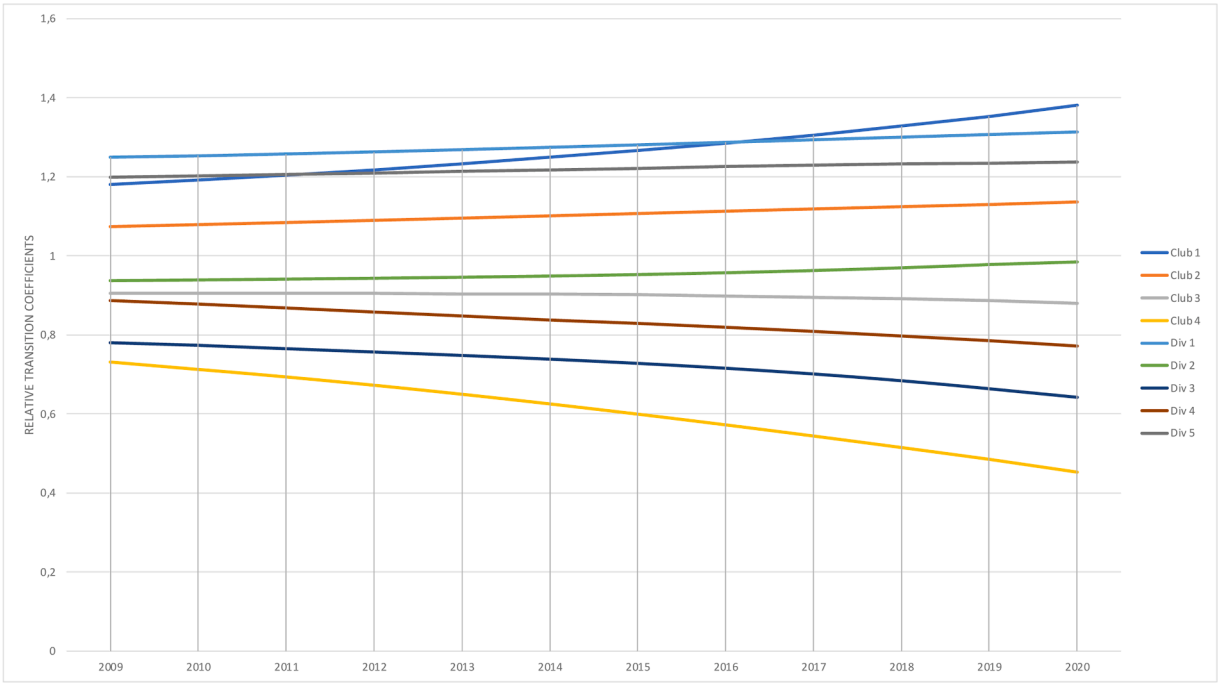

Fig. 9. – YHDI Club Transition paths. No colours are strictly necessary for the figures. It would be however convenient if we could use colours for Figs. 8 and 9.
Source: Created by authors using INE (2009–2020)

4. Results

The Youth HDI presented here focuses on the 17 regions of Spain[7] as the main units of analysis. By comparing their relative positions on key human development dimensions, these regions can potentially scrutinise their policy initiatives and develop future mechanisms to address the challenges identified by the Youth HDI. A brief look at Fig. 2 shows how the darker regions of Madrid and La Rioja display the best human development conditions for their youth (0.77 and 0.78, respectively) in 2020. Most of the northern regions present values above 0.7, a situation that changes as we move towards the south, with Extremadura and Andalucía exhibiting values in the range of 0.51–0.56.

Most interestingly however is to analyse the paths defined by the distinct YHDIs (Table 2). As much as past trends cannot predict future ones, *they shape future possibilities*. In this context, there is a considerable high level of heterogeneity of life expectancy at birth for the Spanish youth living in different regions. They correspond to an average life expectancy of 78,14 years for the youth in Spain. Indeed, the difference between the highest region (Castilla and Leon) and the lowest (Canary Islands) is 2.5 years. This is a meaningful difference that might take decades to be bridged. There is a remarkable stability between the highest and lowest values during the 12 years these data have been calculated. A different perspective is provided by the expected years of schooling for those between 16 and 24 (a measure of flow) and the proportion of youth that did not achieve the first cycle of secondary education for those between 24 and 34 (a measure of stock). The first thing that calls one's attention is the much larger disparity between the highest (La Rioja) and the lowest (Balearic Islands) values. There is also a lower level of stability at the top level, with the highest historical values being also achieved by the Basque Country and Madrid. By 2020, almost 40 % of all youth in the Balearic Islands did not complete the first cycle of secondary education, with less than 3 years of expected years of schooling (less than half than displayed by La Rioja).

The third component of the YHDI, the standard of living, is based on a compilation of labour market features for 16–34-year-olds. There is considerable inequality between the regions of Andalusia & Extremadura vis-à-vis Madrid, La Rioja and Catalonia. Looking separately at all sub-dimensions, it is possible to see that *prima facie* partiality does not seem to discriminate much between these groups (all around 20 % for all regions), but youth unemployment (above 40 % for the youth of Andalusia and Extremadura but around 20 % for Catalonia and Madrid and even a lower 13 % for La Rioja's youth) and temporality (76 % for Extremadura, 72 % for Andalusia versus 55 % for La Rioja, 52 % for Catalonia and 47 % for Madrid) seem to be crucial to explain their differences. However,

[7] We use the following abbreviations: AN: Andalusia, AR: Aragón, AS: Asturias, CB: Cantabria, CL: Castilla and León, CM: Castilla La Mancha, CN: Canary Islands, CT: Catalonia, EX: Extremadura, GA: Galicia, IB: Balearic Islands, MC: Murcia, MD: Madrid, NC: Navarra, PV: Basque Country, RI: La Rioja, VC: Valencia. The autonomous cities of Ceuta and Melilla were not included because of their lower number of inhabitants and smaller sample sizes.

these differences cannot be settled by visual inspection of descriptive statistics and for this reason, it is important to use more precise methods, such as the poset carried out in the sequence.

Fig. 3 provides a systematic account of the main Youth HDI trends. This evidence suggests notable improvements at the level of the health dimension, with a relative stability for many regions of the education dimension and more fluctuation within the standard of living (income) components. One of the serious limitations of this kind of analysis is that a composite indicator such as the Youth HDI lumps together dimensions that might hide incomparabilities within and between themselves.

For instance, within the standard of living dimension, the variables of income and unemployment might suggest that a certain group of individuals within a region enjoys a higher level of human development, whereas the variables of temporality and partiality can convey a different story. Therefore, it is important that we are able to assess how incomparable are the different data that we put together in a composite index, such as the Youth HDI.

An interesting point to mention is how our results suggest an increase in the YHDI in the midst of the COVID-19 pandemic -the most significant human development shock in generations. Indeed, when we look at the aggregate HDI, Spain dropped from 0.904 to 0.894. More specifically, from 2019 to 2020, Spain's LE felt from 83.6 to 82.3 years and GNI from 40.975 to 36.075 US dollars. On the other hand, MYS actually increased from 10.3 to 10.6 years and EYS had a small reduction of 17.5–17.47 years. Overall, it seems that the youth was less affected by the pandemic vis-à-vis other groups. For instance, calculations on excess mortality by the Spanish Ministry of Health, suggest that it took place foremost among the 75 + year-olds, followed by the groups of 74–65 and 64–55, with little impact on the youth. Similarly, the Spanish government introduced a series of measures by its Royal Decree-Law 8/2020 such as ERTES (Furlough Scheme) that maintain workers' wages and jobs during the pandemic. Overall, 756 thousand workers were directly benefited from this scheme. Other measures, such as the extension of unemployment benefits were also introduced minimizing the impact of the pandemic particularly on the youth population.[8]

5. YHDI: a poset analysis

Let's start with an example. The regions of Madrid and La Rioja are two of the best for young people, according to the YDHI. If one would look at the income that the youth made in 2020, one would rank Madrid (with an average income of 15.869 euros) higher than La Rioja (with an average income of 14.435 euros). However, if one would consider the unemployment statistics (20 % of unemployed youth in Madrid vis-à-vis 13 % for La Rioja), the conclusion would be the opposite. In addition, in case one wanted to emphasise the variable of life expectancy at birth for the youth, Madrid (with 78.9 years) would again rank higher than La Rioja (with 78.3 years). However, should one emphasise the expected years of schooling, La Rioja would rank higher than Madrid (with 6.2 and 5.8 years, respectively).

The use of partial ranking analysis (posets) can assist us in making sense of this and other embarrassing comparisons that are hidden when we transform different attributes into common metrics to aggregate them into composite indicators. Partial rankings do not collapse all different dimensions into a common metric. Instead, they highlight their incomparabilities by suggesting that when they exist, the alternatives are properly labelled as incomparable. Thus, comparability is only possible when a certain profile is better than another in all different dimensions. The core concept of a poset would be of a *chain*, that is, when profiles that are above in the ranking are those that have better values for all attributes than those of the subsequent profiles (Fattore & Bruggemann, 2017). These chains can be aggregated in represented in graphs called Hasse diagrams (Bruggemann & Patil, 2011). In simple words, a Hasse diagram is a visual representation of all combinations of partial rankings, with their comparabilities and incomparabilities (Caperna & Boccuzzo, 2018). Regions with better YHDI are at the top of the figure; those with lower YHDI are at the bottom, and those on the same line (side-by-side) are incomparable. The analyses were produced using the PyHasse software, developed by Professor Rainer Bruggemann, in its 'pro' version (more specifically, we used the modules mHDC17_3.py and sensitivity24_5.py). Fig. 4 reports the aggregate results for 2020 YHDI.

This diagram suggests that instead of a continuum ranking between the 17 regions, we have five levels of youth human development in Spain. The first (top) level is characterised by five regions that have incommensurable evaluations of their different dimensions. The lines explain the direct rankings that are possible to establish among those regions that are comparable. Overall, the poset analysis identifies 72 incomparabilities and 62 comparabilities within this group of regions. A sensitivity analysis (Fig. 5) unveils that the dimension that exerts the strongest influence in configuring this particular ranking is knowledge (code 1), followed by standard of living (code 2) and health (code 3).

In its turn, the standard of living is the most heterogeneous dimension, containing four different variables. The inspection of its Hasse diagram (Fig. 6) shows how regions are grouped into four different levels. At the bottom, the ranking of Andalusia, Extremadura, Valencia and Murcia overlaps with the two bottom lines of the YHDI ranking, taking into account the particularities of the Canary Islands (that is better in this dimension) and Asturias (that is worse here). This information should assist policy-makers in defining areas of priority within the country.

The sensitivity analysis of the Standard of Living dimension (Fig. 7) displays the importance of the different constituent variables in ranking the regions. It highlights the strongest influence of partiality of job contracts as the dominant variable in shaping the ranking, followed by income. This evidence puts forward some possible policy strategies for improving the lives of the youth in these regions that will be discussed in the final part of this paper.

[8] For further information please check https://www.sanidad.gob.es/estadEstudios/estadisticas/estadisticas/estMinisterio/mortalidad/docs/Defun2020_10112021_NOTA_TEC.pdf

A similar exercise was carried out for the knowledge dimension, but there the influences of the flow and stock variables were practically the same, and therefore the corresponding Hasse diagram is not reported here. On the whole, when we take into account the incomparabilities between the different YHDI variables, we can see that the overall partial ranking is most influenced by knowledge and standard of living dimensions, in which partiality plays the most decisive influence. We explore the emerging narratives in the last part of the paper, but it is important that before doing that, we investigate the dynamic aspects of YHDI with a convergence analysis.

6. YHDI: convergence analysis

Convergence tests are particularly relevant and useful because they encapsulate and materialise public-policy concerns about equality and possibilities of futures. Although HDI convergence has been previously studied (Jorda & Sarabia, 2015; Mayer-Foulkes, 2010; Konya & Guisan, 2008; Noorbakhsh, 2006), often the tests that are employed are restrictively demanding, such as β-convergence, conditional β-convergence and σ-convergence. Indeed, β-convergence tests imply that worse-off regions will grow faster in absolute terms than better-off regions, which is not always the case. Similarly, conditional β-convergence, which considers the steady-state growth path of the regions, demands the same higher rates of growth from the worse-off regions, given extra conditional variables. Finally, σ-convergence focuses on a reduction of the regions' income dispersion over time, which could also be very restrictive. On the other hand, the convergence test and clustering algorithm used here, developed by Phillips and Sul (2007) and Phillips and Sul (2009), provides a more general structure based on a nonlinear time-varying factor model that offers greater flexibility. More concretely, the variable of interest is decomposed into a non-observable common trend component and a time-varying idiosyncratic loading coefficient, which captures region-specific differences within the panel. This means that any departure of a given regional YHDI from the common trend depends on its individual characteristics and how these specific differences evolve over time. The main advantage of this representation is that it allows for testing convergence without imposing any limiting stationarity assumptions.[9] In addition, one does not have to assume any *a priori* convergence patterns.

The null hypothesis implies overall convergence in YHDI between all regions in the panel, whereas the alternative encompasses two possible outcomes, namely, club convergence (when subgroups of regions, i.e., clubs converge to different equilibria, with possibly one or more diverging units) and full divergence (divergence of all regional YHDI within the panel). We avoid unnecessary technical details here and concentrate on the key results and relative transition path of the YHDI, tracing out the individual trajectories for each region.[10] Table 3 displays the club classification outcomes of the Philips and Sul convergence test. Two results are worth highlighting. First, there is no evidence of overall convergence among the 17 regional YHDIs. Secondly, there are four clubs identified here that converge to different levels at multiple speeds (indicated by the estimated speed of convergence parameter $\widehat{\alpha}$ and a group of 5 regions that diverge. Consistent with what one would expect from the previously presented YHDI results, the autonomous communities of Castilla and León, Madrid, Navarra, and Rioja occupy the club with the highest YHDI, whereas Andalusia, the Canary Islands, and Extremadura comprise the least performing subgroup.

We have also calculated the individual transition paths for the youth living in the 17 regions considered in this study to provide further insights on the different types of transition behaviour exhibited by each. Fig. 8 shows how, apart from some particular cases, the general rule is a certain transition path stability over time. More specifically, this implies that certain transitions in the future are less likely given this stable patterns. Thus, curve points above the threshold of 1 suggest that the YHDI for that region is above the cross-section average at a certain point in time. Thus, the more consistent regions are those that have higher values. Most notably, the visual evidence presented here reveals that with the exception of Catalonia and Galicia, regions with transition parameters above (below) the panel mean in 2009 have further improved (worsened) their YHDI relative to the panel average over the sample period. Catalonia's slightly decreasing path shows that it could not maintain its position in terms of YHDI over the twelve years studied. Galicia is the only autonomous community that exhibits a catching-up behaviour towards better-performing regions, clearly moving away from those below the cross-section mean.

The same interpretation can be offered to the average transition curves for each club displayed in Fig. 9. It indicates that the transition paths are dominated by diverging paths and a global state of no overall convergence among the 17 regions in Spain. Given the previous results put forward by the poset, this stable lack of convergence and even increasing YHDI gap suggests that this problem might not be trivial to address.

It is not the objective of this paper to examine how particular characteristics of these regions (in terms of demographics, public spending patterns, migration flows, etc.) condition the different YHDI transition paths with the subsequent lack of YHDI convergence. But this could be the object of attention of future papers.

7. Concluding remarks: the future of the future

This paper provides three key contributions to examine how youth development can be used to approach the future: a new age-disaggregated human development indicator focused on the youth, an empirical analysis showing how posets can provide a clear

[9] Phillips and Sul (2007) explain that their method does not require the time series studied to be cointegrated, allowing a wider spectrum of transition dynamics, including transitional divergence between regions even when it is the case that they end up converging. Despite some similarities with the σ-convergence test, Phillips and Sul methodology is less restrictive and much more practical, offering a visual inspection of individual transition paths.

[10] The reader is referred to Phillips and Sul (2007) and Phillips and Sul (2009) for an exhaustive description of the methodology employed here.

identification strategy of incomparabilities involved in ranking regions and a club convergence test highlighting the comparative evolution of regional YHDIs. Together, posets and convergence tests can be used to tackle one of the fundamental points of the 2030 Agenda for Sustainable Development, namely, the issue of *leaving no one behind* (LNOB) by development processes (UNDP, 2017). While there is constant argumentation that the youth, as a group, has been left behind by development policies (UNSDG, 2022), there are no age-disaggregated statistics that can be used to comparatively assess the level of youth development vis-à-vis overall countries' development. The Youth HDI proposed here can potentially advance this agenda by addressing different levels (or degrees) of intersectionality in the human development of the youth. For instance, one could consider youth x regions, as in this paper, or extend it to youth x regions x gender or even go further as to examine youth x regions x gender x race x migration status x disability. Of course, the major problem in moving into finer disaggregation levels is the statistical reliability of the samples generated. But the main point is that on methodological terms, the introduction of the Youth HDI can be a breakthrough in advancing the LNOB 2030 Agenda for Sustainable Development.

The new Youth HDI proposed here focuses on youth's health, education and standards of living. This does not mean that other issues are irrelevant or less important for characterising the human development of the youth. Indeed, recent statistics by the Spanish Statistical Office (INE, 2022) show that the category of suicides is the number one cause of death among the youth in Spain, a problem that cannot be ignored. As much as suicide numbers can be reflected in youth's life expectancy or be related to youth's harsh standard of living conditions, a deep dive on this issue that transcends the search for structural human development parameters examined by the YHDI is necessary. Nevertheless, it is precisely this quintessential focus on few key elements of human development that is the mark of the HDI family of indicators.

The YHDI proposed here can give rise to youth specific policies related to key areas of human development. Given that we have followed a regional approach in this paper, its results can be used to identify particular human development gaps and target specific policies to youth populations in determined regions. The youth living in a region such as Andalusia finds itself living under lower life expectancy and lower standards of living. Indeed, the use of a poset analysis confirms this evidence from a static point of view, suggesting that the youth in Andalusia is being left behind. Policy making should be integrated to address all the key development areas at the expense of being inefficient, given the scale of the youth problem in this region. In addition, a dynamic analysis, focusing on convergence patterns shows that the youth in Extremadura live with levels of precariousness and temporality well above the acceptable, indicating that these regions should focus on inclusive growth as a key strategy for improving the living standards of their youth. On its turn, education policies in Spain have been successful in very few regions, such as those of Madrid, Basque Country and Rioja, with clear shortcomings in other regions. The extent of these regional inequalities is considerable and national scale policies should be considered in order to address these shortcomings in a more comprehensive fashion. Much more can be said about how the YHDI can inform public policy by helping with tools for identifying specific youth human development gaps and targeting regional policies.

If what happens to the youth today can provide any guidance about what will happen to society in the future, then starting by properly assessing youth's development today, based on actual evidence, is a necessary step for understanding and preparing for what can happen to our societies in the future. This is not about extrapolating current into future trends based on sophisticated statistical models but about scrutinising underlying structural elements that shape the conditions that will affect the decision-makers of the future. Moreover, if this future world is to be fair, we must start building fairness today by focusing on those young who are left behind (the ones who live less, are less educated and struggle to get a decent living). Future work should contemplate the formulation of youth policies that can integrate and target the key development areas examined here.

CRediT authorship contribution statement

Flavio Comim: Conceptualization, Methodology, Project administration, Resources, Writing – original draft, Writing – review & editing. **Oliver Raab:** Data curation, Visualization. **Octasiano Miguel Valerio Mendoza:** Data curation, Formal analysis, Software, Validation, Visualization. **Mihály Tamás Borsi:** Conceptualization, Formal analysis, Methodology, Visualization, Writing – original draft.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper

Appendix

Table A1
Life Expectancy of 16–34 year old, Index normalized using MAX and MIN of CCAA

Autonomous Communities	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
AN	0.043	0.090	0.138	0.179	0.227	0.269	0.306	0.350	0.390	0.430	0.466	0.507
AR	0.407	0.462	0.509	0.554	0.600	0.648	0.686	0.729	0.767	0.809	0.849	0.892
AS	0.079	0.125	0.170	0.221	0.269	0.319	0.368	0.414	0.467	0.515	0.561	0.615
CB	0.237	0.297	0.350	0.404	0.444	0.502	0.555	0.602	0.654	0.707	0.753	0.809
CL	0.414	0.477	0.538	0.600	0.658	0.715	0.762	0.814	0.860	0.905	0.950	1.000
CM	0.358	0.409	0.459	0.506	0.560	0.613	0.659	0.713	0.754	0.802	0.849	0.898
CN	0.000	0.042	0.096	0.132	0.182	0.232	0.271	0.310	0.349	0.392	0.434	0.476
CT	0.321	0.379	0.430	0.476	0.525	0.569	0.602	0.636	0.666	0.706	0.739	0.782
EX	0.154	0.204	0.253	0.300	0.349	0.400	0.443	0.487	0.525	0.575	0.613	0.657
GA	0.128	0.183	0.236	0.290	0.345	0.401	0.449	0.498	0.548	0.599	0.645	0.701
IB	0.106	0.147	0.187	0.226	0.264	0.305	0.334	0.356	0.392	0.451	0.503	0.560
MC	0.118	0.170	0.220	0.267	0.315	0.361	0.407	0.452	0.495	0.543	0.585	0.631
MD	0.341	0.388	0.436	0.484	0.537	0.587	0.634	0.692	0.740	0.796	0.843	0.895
NC	0.270	0.342	0.408	0.468	0.541	0.605	0.672	0.732	0.801	0.863	0.915	0.975
PV	0.120	0.185	0.246	0.305	0.370	0.430	0.490	0.550	0.605	0.663	0.718	0.777
RI	0.223	0.289	0.348	0.407	0.467	0.530	0.589	0.659	0.712	0.764	0.808	0.874
VC	0.082	0.131	0.181	0.231	0.286	0.342	0.386	0.434	0.478	0.521	0.558	0.606
MEAN	**0.200**	**0.254**	**0.306**	**0.356**	**0.408**	**0.460**	**0.507**	**0.555**	**0.600**	**0.650**	**0.693**	**0.744**
Std. Dev.	**0.132**	**0.136**	**0.138**	**0.141**	**0.144**	**0.147**	**0.150**	**0.156**	**0.158**	**0.160**	**0.161**	**0.164**
MIN	**0.000**	**0.042**	**0.096**	**0.132**	**0.182**	**0.232**	**0.271**	**0.310**	**0.349**	**0.392**	**0.434**	**0.476**
MAX	**0.414**	**0.477**	**0.538**	**0.600**	**0.658**	**0.715**	**0.762**	**0.814**	**0.860**	**0.905**	**0.950**	**1.000**

Source: Created by authors using INE (2009–2020).

Table A2
Geometric mean of pMYS and EYS

Autonomous Communities	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
AN	0.476	0.500	0.514	0.560	0.573	0.557	0.560	0.567	0.571	0.567	0.564	0.575
AR	0.555	0.578	0.597	0.628	0.647	0.659	0.664	0.668	0.660	0.661	0.660	0.651
AS	0.570	0.589	0.602	0.636	0.641	0.650	0.667	0.667	0.673	0.671	0.678	0.678
CB	0.479	0.504	0.531	0.560	0.576	0.605	0.599	0.595	0.596	0.608	0.619	0.618
CL	0.569	0.578	0.599	0.645	0.644	0.649	0.652	0.651	0.660	0.671	0.667	0.663
CM	0.452	0.479	0.493	0.569	0.562	0.585	0.603	0.595	0.579	0.564	0.581	0.598
CN	0.508	0.523	0.526	0.587	0.592	0.604	0.604	0.593	0.579	0.580	0.579	0.574
CT	0.495	0.509	0.532	0.573	0.586	0.577	0.585	0.585	0.589	0.576	0.573	0.583
EX	0.491	0.501	0.501	0.571	0.595	0.585	0.575	0.581	0.585	0.590	0.578	0.585
GA	0.558	0.574	0.574	0.615	0.627	0.636	0.633	0.645	0.640	0.627	0.637	0.653
IB	0.382	0.395	0.421	0.467	0.457	0.458	0.469	0.477	0.468	0.465	0.460	0.460
MC	0.526	0.548	0.554	0.603	0.616	0.621	0.622	0.625	0.640	0.639	0.637	0.639
MD	0.639	0.665	0.677	0.735	0.733	0.746	0.763	0.767	0.752	0.742	0.750	0.742
NC	0.513	0.514	0.523	0.547	0.565	0.551	0.547	0.575	0.577	0.589	0.589	0.604
PV	0.649	0.667	0.679	0.708	0.688	0.694	0.707	0.724	0.729	0.717	0.707	0.704
RI	0.522	0.548	0.582	0.633	0.652	0.695	0.698	0.697	0.690	0.715	0.731	0.800
VC	0.536	0.564	0.593	0.607	0.637	0.670	0.648	0.649	0.648	0.629	0.640	0.641
MEAN	0.525	0.543	0.559	0.603	0.611	0.620	0.623	0.627	0.626	0.624	0.626	0.633
Std. Dev.	0.065	0.066	0.065	0.062	0.061	0.067	0.069	0.068	0.068	0.069	0.071	0.076
MIN	0.382	0.395	0.421	0.467	0.457	0.458	0.469	0.477	0.468	0.465	0.460	0.460
MAX	0.649	0.667	0.679	0.735	0.733	0.746	0.763	0.767	0.752	0.742	0.750	0.800

Source: Created by authors using INE (2009–2020).

Table A3
Arithmetic mean of pMYS and EYS

Autonomous Communities	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
AN	0.482	0.505	0.517	0.560	0.573	0.557	0.560	0.567	0.571	0.567	0.564	0.576
AR	0.574	0.593	0.608	0.633	0.652	0.662	0.665	0.670	0.661	0.663	0.662	0.653
AS	0.579	0.595	0.608	0.638	0.642	0.652	0.668	0.669	0.677	0.674	0.682	0.683
CB	0.483	0.509	0.534	0.560	0.577	0.605	0.599	0.595	0.596	0.608	0.620	0.619
CL	0.570	0.578	0.600	0.645	0.645	0.652	0.654	0.652	0.661	0.672	0.667	0.663
CM	0.488	0.513	0.518	0.581	0.570	0.595	0.617	0.610	0.591	0.575	0.599	0.622
CN	0.533	0.543	0.542	0.593	0.600	0.609	0.608	0.598	0.584	0.587	0.589	0.585
CT	0.500	0.511	0.533	0.573	0.586	0.577	0.585	0.585	0.589	0.576	0.573	0.583
EX	0.514	0.520	0.515	0.575	0.598	0.588	0.578	0.585	0.590	0.595	0.584	0.593
GA	0.566	0.580	0.576	0.616	0.627	0.637	0.633	0.645	0.640	0.627	0.637	0.653
IB	0.410	0.417	0.438	0.479	0.466	0.465	0.475	0.488	0.481	0.476	0.472	0.471
MC	0.545	0.562	0.563	0.606	0.619	0.623	0.623	0.626	0.642	0.642	0.641	0.644
MD	0.648	0.673	0.681	0.736	0.734	0.746	0.763	0.768	0.752	0.742	0.750	0.742
NC	0.514	0.514	0.523	0.548	0.565	0.552	0.548	0.576	0.577	0.589	0.589	0.605
PV	0.659	0.675	0.687	0.710	0.688	0.694	0.707	0.725	0.730	0.718	0.707	0.706
RI	0.570	0.589	0.615	0.652	0.667	0.705	0.707	0.704	0.696	0.718	0.735	0.801
VC	0.554	0.577	0.604	0.610	0.639	0.673	0.649	0.651	0.649	0.630	0.642	0.644
MEAN	**0.540**	**0.556**	**0.568**	**0.607**	**0.614**	**0.623**	**0.626**	**0.630**	**0.629**	**0.627**	**0.630**	**0.638**
Std. Dev.	**0.061**	**0.063**	**0.063**	**0.061**	**0.060**	**0.067**	**0.069**	**0.067**	**0.066**	**0.067**	**0.069**	**0.074**
MIN	**0.410**	**0.417**	**0.438**	**0.479**	**0.466**	**0.465**	**0.475**	**0.488**	**0.481**	**0.476**	**0.472**	**0.471**
MAX	**0.659**	**0.675**	**0.687**	**0.736**	**0.734**	**0.746**	**0.763**	**0.768**	**0.752**	**0.742**	**0.750**	**0.801**

Source: Created by authors using INE (2009–2020).

Table A4
Geometric mean of Precariousness/Income/Unemployment

Autonomous Communities	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
AN	0.524	0.510	0.496	0.494	0.422	0.399	0.341	0.397	0.395	0.367	0.375	0.451
AR	0.743	0.663	0.654	0.612	0.580	0.594	0.625	0.611	0.599	0.598	0.625	0.652
AS	0.644	0.634	0.606	0.553	0.591	0.552	0.495	0.525	0.500	0.540	0.484	0.499
CB	0.666	0.633	0.624	0.566	0.569	0.483	0.555	0.597	0.596	0.597	0.526	0.587
CL	0.660	0.655	0.624	0.616	0.568	0.529	0.532	0.583	0.531	0.588	0.529	0.581
CM	0.636	0.614	0.593	0.538	0.506	0.512	0.507	0.512	0.472	0.506	0.536	0.578
CN	0.550	0.556	0.521	0.482	0.425	0.423	0.300	0.432	0.381	0.330	0.538	0.528
CT	0.713	0.726	0.708	0.667	0.608	0.596	0.609	0.602	0.622	0.635	0.629	0.662
EX	0.599	0.552	0.521	0.484	0.343	0.304	0.344	0.202	0.207	0.000	0.196	0.426
GA	0.628	0.623	0.587	0.556	0.514	0.549	0.464	0.490	0.484	0.525	0.538	0.570
IB	0.679	0.651	0.646	0.600	0.585	0.560	0.590	0.627	0.608	0.556	0.607	0.603
MC	0.630	0.618	0.559	0.470	0.489	0.419	0.401	0.487	0.441	0.380	0.417	0.494
MD	0.754	0.736	0.675	0.666	0.652	0.646	0.644	0.641	0.628	0.624	0.641	0.686
NC	0.749	0.773	0.699	0.657	0.630	0.615	0.614	0.597	0.636	0.679	0.641	0.618
PV	0.830	0.803	0.795	0.756	0.708	0.690	0.668	0.646	0.653	0.625	0.631	0.634
RI	0.672	0.713	0.656	0.597	0.606	0.554	0.558	0.559	0.599	0.580	0.605	0.651
VC	0.637	0.605	0.614	0.578	0.519	0.509	0.479	0.469	0.469	0.489	0.571	0.571
MEAN	0.666	0.651	0.622	0.582	0.548	0.526	0.513	0.528	0.519	0.507	0.535	0.576
Std. Dev.	0.076	0.079	0.076	0.077	0.092	0.097	0.113	0.112	0.119	0.164	0.117	0.075
MIN	0.524	0.510	0.496	0.470	0.343	0.304	0.300	0.202	0.207	0.000	0.196	0.426
MAX	0.830	0.803	0.795	0.756	0.708	0.690	0.668	0.646	0.653	0.679	0.641	0.686

Source: Created by authors using INE (2009–2020).

Table A5
Arithmetic mean of Precariousness/Income/Unemployment

Autonomous Communities	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
AN	0.532	0.517	0.498	0.496	0.426	0.409	0.368	0.414	0.411	0.391	0.409	0.460
AR	0.748	0.669	0.660	0.616	0.585	0.603	0.640	0.617	0.612	0.616	0.643	0.663
AS	0.647	0.641	0.611	0.555	0.592	0.553	0.499	0.532	0.514	0.550	0.494	0.502
CB	0.673	0.638	0.632	0.571	0.575	0.495	0.567	0.610	0.620	0.612	0.553	0.604
CL	0.665	0.660	0.629	0.620	0.573	0.534	0.548	0.586	0.548	0.599	0.560	0.590
CM	0.637	0.615	0.595	0.539	0.507	0.515	0.512	0.514	0.524	0.537	0.564	0.592
CN	0.556	0.559	0.527	0.490	0.450	0.453	0.416	0.450	0.441	0.423	0.564	0.538
CT	0.715	0.728	0.712	0.670	0.614	0.601	0.619	0.625	0.635	0.651	0.644	0.667
EX	0.603	0.563	0.525	0.487	0.381	0.380	0.386	0.360	0.323	0.333	0.356	0.444
GA	0.635	0.625	0.595	0.561	0.528	0.557	0.490	0.506	0.533	0.549	0.568	0.579
IB	0.683	0.655	0.657	0.615	0.601	0.575	0.607	0.651	0.633	0.581	0.619	0.608
MC	0.633	0.620	0.566	0.484	0.501	0.446	0.447	0.512	0.474	0.429	0.481	0.502
MD	0.755	0.737	0.677	0.670	0.656	0.650	0.649	0.648	0.636	0.632	0.658	0.690
NC	0.752	0.777	0.703	0.660	0.631	0.619	0.624	0.607	0.656	0.693	0.665	0.629
PV	0.840	0.815	0.807	0.771	0.712	0.695	0.673	0.654	0.661	0.641	0.643	0.646
RI	0.675	0.715	0.657	0.597	0.607	0.565	0.574	0.572	0.618	0.597	0.620	0.666
VC	0.639	0.608	0.617	0.580	0.526	0.517	0.495	0.500	0.497	0.518	0.590	0.581
MEAN	**0.670**	**0.655**	**0.627**	**0.587**	**0.557**	**0.539**	**0.536**	**0.551**	**0.549**	**0.550**	**0.566**	**0.586**
Std. Dev.	**0.076**	**0.079**	**0.077**	**0.078**	**0.085**	**0.085**	**0.095**	**0.087**	**0.097**	**0.101**	**0.088**	**0.074**
MIN	**0.532**	**0.517**	**0.498**	**0.484**	**0.381**	**0.380**	**0.368**	**0.360**	**0.323**	**0.333**	**0.356**	**0.444**
MAX	**0.840**	**0.815**	**0.807**	**0.771**	**0.712**	**0.695**	**0.673**	**0.654**	**0.661**	**0.693**	**0.665**	**0.690**

Source: Created by authors using INE (2009–2020).

Figure A1. Scatterplot Matrix of categories of Standard of Living in 2009 and 2020.
Source: Created by authors using INE (2009–2020).

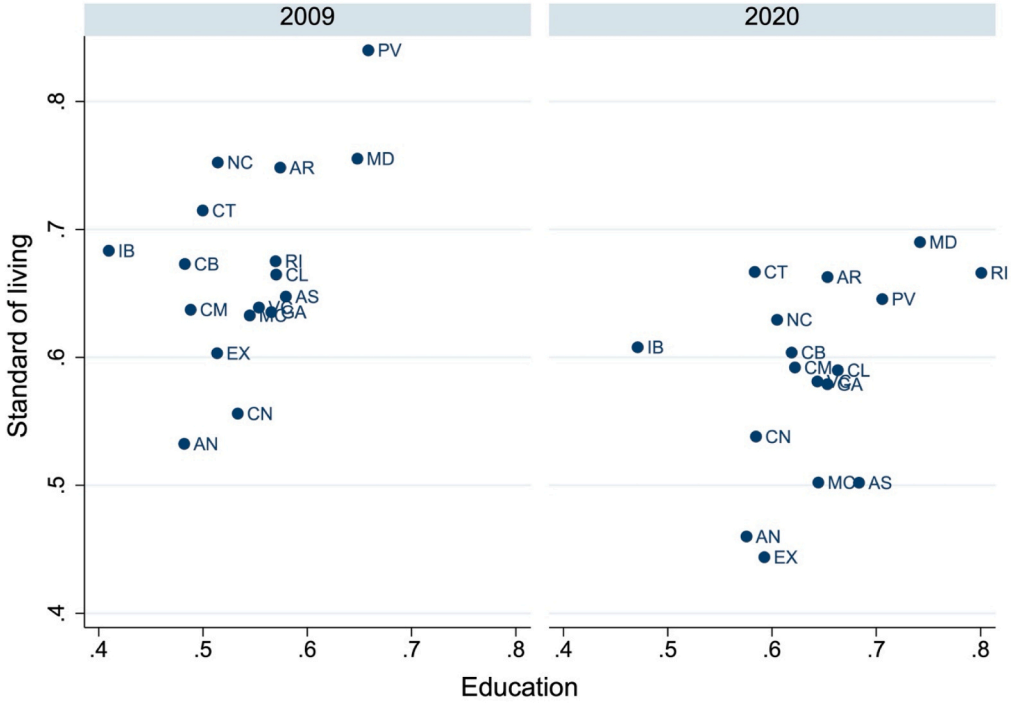

Figure A2. *: Scatterplot of Standard of Living and Education in 2009 and 2020.*
Source: Created by authors using INE (2009–2020).

Figure A3. *: Standard of Living and NEETs (Not in Education, Employment, or Training), Ages 15–34 in 2009 and 2020.*
Source: Created by authors using The Ministry of Education, Vocational Training and Sports and INE (2009–2020).

Data availability

Data will be made available on request.

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