Review Article

Economics Research in the Twenty-First Century — 25 Years of Scientific Breakthroughs

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This study offers a systematic and comprehensive overview of the research in economics published throughout the first quarter of the twenty-first century (from the year 2000 to the end of 2024). To undertake the endeavor, every article published in each of seven selected top journals in the field has been classified according to a pre-specified list of one hundred keywords. Three keywords selected from the list were assigned to each article, given the subjects they cover and the methods of analysis they employ. The proposed exercise reveals a widely diversified science, which touches every aspect of human decision-making and human interaction, at every imaginable scale and regardless of geography. It is also a science that looks at the past to understand the future, and a body of knowledge capable of reinventing itself in the face of the evolution of society. Much more than before, economics deals today with such themes as income inequality, climate change, healthcare, education, and gender and race issues; while maintaining a close look at traditional micro and macro topics, such as market competition or business fluctuations. Methodologically, a gradual revolution has taken place, with natural experiments progressively becoming a fundamental tool of economic inquiry.

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1. Introduction

When entering the first class of an introductory economics course, the typical student cannot help wondering what this field of knowledge is truly about: will I study the wealth and prosperity of nations, the patterns of international trade, the organization of market transactions, the preferences and choices of individuals? And what about money and finance, the role of the government, or the challenges posed

by climate change? Any experienced academic economist would be able to assure the student that economics covers all the mentioned concerns and many more. She would be able to tell, as well, that an active and fruitful body of research currently supports this scientific discipline: every year, an uncountable number of scientific studies are published, covering all relevant subjects that somehow are associated with decision-making and human interaction at any conceivable scale.

What the economist might find harder, in the context of such an explanation, is to provide a detailed and compelling answer on what, nowadays, are the subjects most insistently debated within the discipline and what are the perspectives under which they are approached. To acquire this perception, an overarching analysis of the published research is welcomed, and this is precisely the endeavor the current study pursues. In this essay, a comprehensive look at economic science, its object, the challenges it faces, and the methods of analysis it employs, is undertaken. This is done through a detailed assessment of the literature published in the first quarter of the twenty-first century, in seven of the most prestigious general-interest economics journals.

The selected journals are those commonly known as the top-5 journals in economics – *American Economic Review* (AER), *Econometrica* (Econ), *Journal of Political Economy* (JPE), *Quarterly Journal of Economics* (QJE), and *Review of Economic Studies* (RES) - plus two others, the *Journal of Economic Literature* (JEL) and the *Journal of Economic Perspectives* (JEP). After excluding comments, replies, errata, corrigenda, reports, and recommendations for further reading, all the articles published in the seven journals from the year 2000 to the end of 2024 were subject to a classification process by attributing to each one of them three from a series of one hundred pre-selected keywords. The list of keywords is comprehensive, encompassing references to most of the themes that belong to the domain of economic science.

The counting exercise unveils a broad-spectrum science, with published studies covering without exception all the traditional topics of economics research (e.g., economic growth, business cycles, employment, market competition and efficiency, public policies, the organization of the firm, household behavior, utility and preferences). Other topics are also progressively entering the mainstream of economic analysis, such as income inequality, the environment, healthcare, education, gender and racial discrimination and integration. The analysis also reveals that economics is not an isolated science, with strong ties connecting it to politics, psychology, or mathematics and statistics. Notwithstanding, it is a science with a strong degree of autonomy, capable of generating its own tools for the measurement and evaluation of economic phenomena and performance, and capable of conducting its own experiments (with a progressively increasing emphasis on natural experiments).

The remainder of the study is organized as follows. Section 2 explains how the information for the study was compiled, organized, and processed, highlighting, as well, some relevant general results. The sections that follow make, then, a brief assessment of the issues that stand out the most from the inspection of the data. Coordinates of space and time are considered in sections 3 and 4; the first of these sections deals with the geography of economic studies and the second one with historical contexts. Section 5 is concerned with globalization, and section 6 with environmental issues. Growth and trade theories are dealt with in section 7, while section 8 is dedicated to a brief note on macroeconomics. Section 9 is about inequality, section 10 highlights the interplay between politics and economics, and section 11 emphasizes the multiple perspectives in which the role of the government is subject to analysis.

Sections 12 to 14 concentrate on markets, labor, and the digital economy. Section 15 highlights the generous attention given by economics to healthcare and education, in contrast to the parsimonious degree of attention attributed to other economically relevant issues (section 16). Section 17 offers examples of the sensitivity of economics research to real-world events, and section 18 remarks how gender and race have become unavoidable themes in the economics debate. Section 19 focuses on human behavior, and section 20 reports that, although promising, the idea of approaching the economy as a complex evolving system has not yet made its way through economics. Sections 21 to 23 discuss the tools and methods that economics creates, develops, and employs, and sections 24 and 25 mention how economists envisage their own science. Section 26 concludes.

2. Collected Data and the General Picture

A grand total of 11,356 articles, from the seven journals mentioned in the introduction, were subject to scrutiny. To each of them, three keywords were attributed, from the list of one hundred keywords presented in Appendix 1, given the underlying subjects of analysis, and employed methods and techniques.

The way in which each keyword was interpreted for matters of classifying the articles was as broad as possible. For instance, keyword 1, *ECO*, contemplates all the studies in which the geographical location (country or region) substantially matters; keyword 28, *PIN*, collects references dealing both with the formation of prices of individual goods and with price changes at the macro level; keyword 68, *DEM*, gathers research associated with every aspect of population growth and change. The same broad logic is

applied to the interpretation of any other keyword. In each case, the criterion was to attach to each paper the set of three keywords most adequate to characterize the study.

The aggregate results emerging from the data collection and processing exercise are those displayed in Fig.1. The keyword with most assigned references is keyword 1, *ECO* (857), while the keyword with a lower number of attached references is keyword 49, *TOU* (5). Despite the differences in the number of articles per keyword, the most salient feature coming from the observation of Fig.1 is the relatively balanced distribution of articles by themes. Considering groups of keywords associated, e.g., with the international economy, macroeconomics, microeconomics, firms and management, individual behavior, mathematical techniques, and economic thought, one realizes that all of them receive a fair amount of attention from economics research.

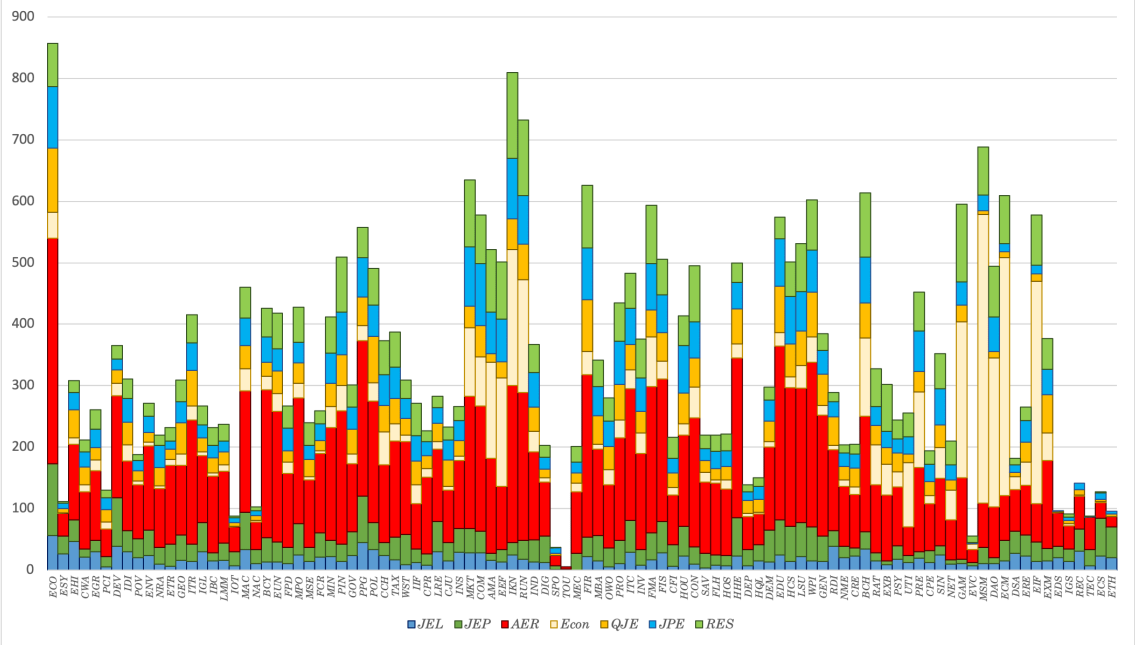

Figure 1. Number of articles per keyword

Besides displaying the article count by keyword, Fig.1 also highlights the relative weight of each of the seven journals. A glance through the columns of the figure reveals important differences across journals. First, the number of articles per journal varies significantly. The *American Economic Review* is the journal with the largest number of articles published in the considered period (4,372) and the *Journal of Economic Literature* is the journal with the lowest article count (605). The graphic in Fig.2 illustrates the distribution of papers per journal, for each of the years in the sample.

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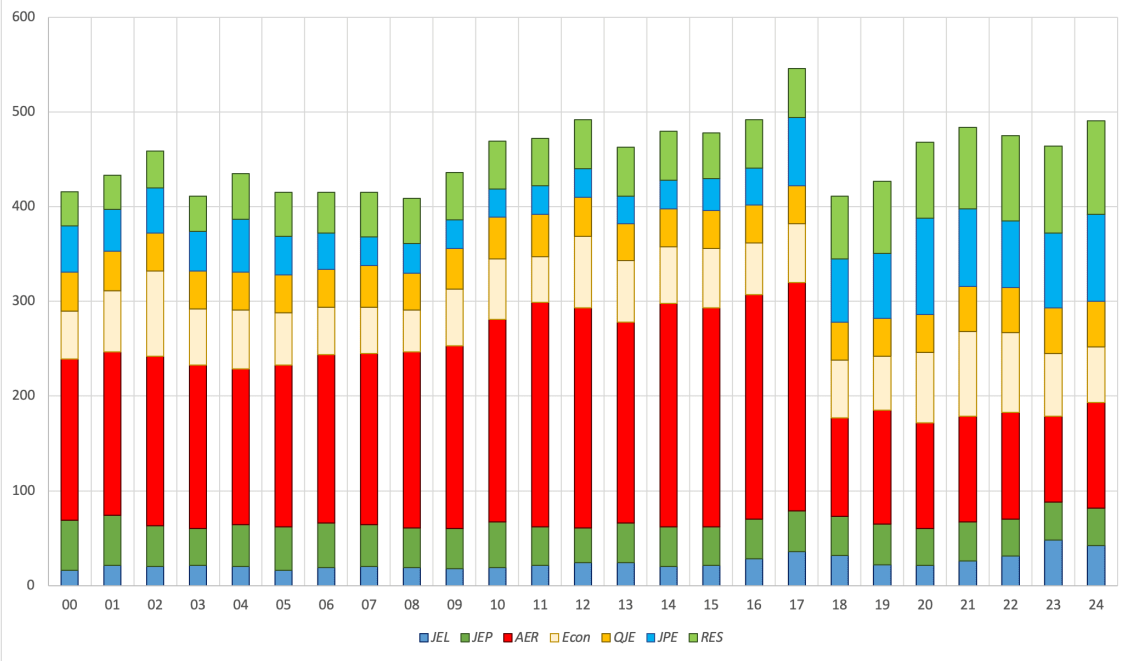

Figure 2. Number of articles per journal, per year

Second, although all being general-interest journals, they differ in the approached topics and the extent to which they cover more or less equitably the whole range of the selected keywords. Computing a simple concentration index, C_i,[1] one obtains the results in Table 1.

Values in Table 1 unveil that the *American Economic Review* is the journal with the lowest concentration index, i.e., with the greatest dispersion of references by keyword; while *Econometrica* is by far the less generalist journal, with the largest associated concentration index (almost 37 per cent of the references to papers published in *Econometrica* are allocated to a group of only five keywords: *GAM*, *MSM*, *DAO*, *ECM*, and *EIF*).

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Journal	C_i
Journal of Economic Literature	1.313
Journal of Economic Perspectives	1.302
American Economic Review	1.289
Econometrica	3.987
Quarterly Journal of Economics	1.398
Journal of Political Economy	1.414
Review of Economic Studies	1.550

Table 1. Concentration index for the distribution of references to keywords, per journal

In the sections that follow, some of the most prominent facts arising from the analysis of the published literature are highlighted, offering an overview of what economics research is about, and which are the topics that currently most concern economists.

3. Is There a North American Bias in Economics Research?

There are obvious reasons why the doubt raised in the title of this section is pertinent. First, the seven journals that constitute the base for the analysis fall in one of three categories: they are published by the American Economic Association, they are edited by some of the most prestigious North American universities, or they are published by societies with strong ties to the North American academic community. Second, the most influent economics departments in the world are based in universities of the United States. Third, a large percentage of the authors publishing in top journals are affiliated with such economics departments.[2]

In light of the above arguments, it is reasonable to conjecture that it might exist a North American bias in economics research. To answer the question and clear the doubts, the collected data associated with keyword 1, *ECO*, is subject to detailed analysis. Under this keyword, all the articles highlighting a

geographical location as a central piece of the underlying study were collected. These comprise studies on the macroeconomic performance of the considered countries or regions, research on specific sectors of the economies, and also studies that pursue experiments where the subject is some institution, group of people or event of that geographical location.

Employing the above criteria, the keyword *ECO* is the one with the most mentions of all the 100 keywords: 857 articles were classified under this item. To uncover the weight of the US economy in academic studies, the articles were then classified by country or region. When more than one country or region are contemplated in the article, the corresponding decimal points have been attributed to each of them (every article is valued in 1 point). In some cases, it was not possible to single out specific countries and, therefore, the articles were classified by wider regions (e.g., Middle East or European Union) or entire continents (e.g., Africa or Latin America).

Table 2 presents the top 10 countries under the adopted classification. One observes that the US economy receives by far the largest number of mentions, followed by China and India (these three countries together account for approximately half of the total observations).

	Country	***Mentions***	%
1	United States	239.50	27.95
2	China	101.50	11.84
3	India	90.50	10.56
4	Mexico	33.50	3.91
5	Germany	21.20	2.47
6	United Kingdom	20.20	2.36
7	Kenya	20.00	2.33
8	Russia (Soviet Union)	16.75	1.95
9	Japan	15.20	1.77
10	France	15.00	1.75

Table 2. Number of articles per country

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The inspection of Table 2 points to the confirmation of the North American bias, what is certainly associated with the earlier advanced reasons. However, one should also keep in mind that the American economy is the largest economy in the world, and this explains as well, at least partially, the attention that it receives. The more than 239 articles in which North America occupies center stage deal with a wide spectrum of relevant topics regarding its economy and society, from immigration trends or the origins of racial inequality, to issues pertaining to the dynamism of US businesses and the growth of the US economy. The bias towards the US economy is also evident from the large number of articles on its close neighbor, Mexico.

Germany, the United Kingdom, Japan, and France are also part of the top 10, what suggests a tendency for the most influential and wealthy economies in the world to be also the most studied. Notwithstanding, a few developing countries emerge as well in prominent places in the ranking. India, given its dimension, population level, and the many challenges its economy poses, is one of the countries under the spotlight of top economics research. In the spotlight is also Kenya, which has been a laboratory for important economic experiments regarding development experiences. Kenya is the only African country in the top 10, but many others are included in the long list of nations that caught the attention of top economics research.

One of the economies that received more attention from the academy in this first quarter of century is China. China ranks second in the list presented in Table 2, and the reasons for such are numerous. The influence of China in the world economy, the forces that boosted China's growth, the peculiar political context of the country, the role of innovation in the Chinese economy, and the clash between autocracy and innovation[1], have been exhaustively explored in the literature.

The systematized data on the geography of economic research can also be used for a brief analysis of the representativeness of each continent. The aggregate values are condensed in Table 3.

Continent	*Mentions*	%	Number of countries
Africa	107.50	12.54	22
America	325.00	37.92	11
Asia	272.70	31.82	18
Europe	150.80	17.60	21
Oceania	1.0	0.12	1

Table 3. Number of articles per continent

The numbers in Table 3 make it clear the preponderance of the American and Asian continents (together, they represent around 70 percent of all observations). Given its economic relevance, the European continent is clearly under-represented, with less than 18 percent of the mentions in this accounting exercise; moreover, the studies on European countries are more dispersed across countries, since this is one of the continents in the table for which one finds a larger number of mentioned economies.

4. Facts from History: Which Ones Economists Value the Most?

Building robust economic theories, correctly interpreting current events, and soundly forecasting the future, are all tasks that require a solid knowledge about the past. Hence, economic history is certainly an important component of the research in economics. The compiled data indicates the existence of 308 published articles deserving classification under keyword 3, *EHI*. These articles contain a very diffuse collection of studies, comprehending reflections about many different periods and facts of history. Nevertheless, it is possible to systematize information; specifically, one may highlight eight general themes that concentrate a large share of the research undertaken by economic historians.

The eight themes comprise 46.15 per cent of the papers collected under the mentioned keyword, and they are the following: (*i*) Pre-history and ancient civilizations (12 articles); (*ii*) Medieval Europe and preindustrial world (24 articles); (*iii*) Renaissance and the Enlightenment Era (8 articles); (*iv*) Industrial Revolution and the advent of capitalism (17 articles); (*v*) Colonialism (12 articles); (*vi*) Great Depression

and the New Deal (19 articles); (*vii*) Nazism and World War II (21 articles); (*viii*) Communism and the Cold War (13 articles).

In the first topic, pre-history and ancient civilizations, one encounters studies that cover the organization of the economy in such remote times as the Neolithic, the bronze age, or the Roman empire[2]. More systematic attention is given to the pre-industrial Europe, with various studies focusing on the economies of medieval ages and early modern Europe. For obvious reasons, the modern period is the era receiving the most attention from economic historians; this is the period when fundamental scientific and technological progress took place, leading to the beginning of the era of sustained economic growth. Articles associated with these two themes - Renaissance and the Enlightenment Era, and Industrial Revolution and the advent of capitalism – essentially assess the supremacy of European institutions and socioeconomic organization in triggering the Industrial Revolution and the transition to a capitalist market economy.

Colonialism is also at the core of the concerns of economists, namely as a tool to understand development processes and the worldwide inequalities of current days. In studies such as those by Acemoglu *et al.* [3] and Nunn[4], the consequences of the colonial legacy in developing countries are evaluated. The authors are unanimous in recognizing that the colonial heritage, although with positive points regarding the consolidation of various institutions, has contributed, with some of the imposed practices (e.g., slave trading), for a long-lasting blockade to economic development.

The three last highlighted themes are associated with the history of the twentieth century and they mark, precisely, three of the most important events of this century: the Great Depression of the early 1930s, which is the most significant macroeconomic episode of this one-hundred years period; the most devastating conflict humanity has experienced, the second world war, that followed the rise of the Third Reich in Nazi Germany; and the Cold War that emerged in the context of two conflicting political views about the organization of society and of the economy, namely communism and capitalism.

Studies on the Great Depression focused on the economic impacts of the recession and on the policies to mitigate them and their consequences over the lives of people in America and worldwide[5]. Nazism and the second world war are fundamental landmarks in the history of humankind, and they had strong economic repercussions for the entire world. The rise of the Nazi party, the Jewish exodus, and the emergence of female labor supply during World War II, are some of the topics explored in this context (see Doepke *et al.*[6], on the demographic and economic implications of the war). The communist centrally

planned economies in Soviet Union and East European countries over a long period of the twentieth century, and the repercussions that followed, continues to be an important topic of research for economists[7].

5. Assessing Global Economic Challenges

In the words of Fischer[8], "Globalization, the ongoing process of greater interdependence among countries and their citizens, is complex and multifaceted. Many of the problems that the critics of globalization point to are real. Some of them relate to economics. (...) As far as economics is concerned, the big challenge is poverty, and the surest route to sustained poverty reduction is economic growth." This remark is helpful in clarifying what globalization is - an ongoing process of increasing interdependence - and which is its most relevant challenge and ultimate goal: to mitigate poverty at a worldwide scale. Thus, it is not a surprise that part of the economics research in the last few years concentrates on approaching the issue of global inequality[9].

Associated with the discussion about universal poverty alleviation, development and growth, a generous amount of literature addresses particular parts of the process of globalization, as is the case of international migrations. Typically, at this level, the discussion has two fundamental components. On one hand, it is debated the migration of high-skilled workers and its benefits for scientific and technological progress, and consequent economic growth. On the other hand, it is assessed why the mobility of this input is treated in a radically different way from the mobility of capital or technology: migration of workers is most of the time perceived as a political issue and a matter of national sovereignties.

Besides the mobility of human capital, globalization is also about changes in the patterns of international trade, and how these changes rearrange the correlation of forces in our world[10]. Additionally, one cannot discuss globalization challenges without mentioning the global financial architecture: guaranteeing financial stability and reducing financial risks in global markets is a difficult and delicate task that, naturally, occupies the mind of economists (e.g., Stiglitz[11]). Despite the progressively stronger ties and interdependencies, one should note that the systematic and continuous intensification of the process of globalization is not an inevitability. The world economic system stands upon a relatively fragile political equilibrium that can be broken at any instant. Less enlightened political leaders may easily revert the process of globalization, making their economies turn inwards[12].

All of the above issues are discussed and formalized in a series of papers gathered under keyword 15, *IGL*. The number of papers associated with this keyword amounts to 267 (2.35 per cent of the total). Another keyword important for the evaluation of globalization and integration is keyword 18, *IOT*, for which 88 articles were counted. Regarding international organizations of paramount interest for economics, these are mainly three, namely the ones that followed or are the heirs of the global economic architecture designed with the end of World War II: the International Monetary Fund (9 papers directly dealing with its structure, mission, and role); the World Bank (8 papers), and the World Trade Organization (14 papers).

6. Changing Economics in the Era of Climate Change

Environmental and economic concerns are intertwined, and the increasing worry with environmental degradation and preservation encounters reflection on economic thought. To keyword 10, *ENV*, are attached 271 articles (2.39 per cent of the total). A suggestive form of emphasizing the pertinence of the economic discussion about environmental issues is to follow Tol[13] in remarking that climate change is the mother of all externalities; it is the largest, the most complex, and the most uncertain externality faced by humankind.

Economists are used to dealing with externalities; the profession knows that, regardless of their dimension and complexity, the management of externalities poses a challenge and requires creative and flexible solutions. These solutions often demand a mix of private negotiation and public intervention. In what concerns the environment, approaching the underlying external effects is particularly challenging on its two dimensions: the spatial dimension (given the transnational and global scope of the external effects) and the temporal dimension (given the intergenerational repercussions of such effects).

How to mitigate the social cost of carbon and other aggressions to the ecological balance is a widely debated topic. Economists have proposed various policies to tackle with the issue, from emission caps to policies incentivizing the transition to clean technologies or imposing the mandatory use of renewable energies. More imaginative solutions have been offered as well. For instance, Nordhaus[14] acknowledges the existence of an international free-riding problem associated with environmental degradation and suggests the following tentative remedy: the creation of climate clubs, i.e., agreements or treaties in which participating countries take responsibility and act to harmonize the reduction of greenhouse gas emissions from the combustion of fossil fuels; failing in complying may have, for the participating countries, the risk of incurring in penalties of various natures (e.g., political or commercial penalties).

Regarding the temporal or intergenerational perspective, environmental policies are equally hard to design and implement. Uncertainty about the future and the estimation of adequate time discounting rates to address environmental issues constitute serious obstacles for a rigorous assessment of the true implications of environmental degradation and climate change. Furthermore, there is a fundamental additional point to make: economists should account for the risk of a catastrophic climate outcome, that is, they should ponder how much effort and resources society should allocate to mitigate the probability of an apocalyptic end that may result from systematic environmental aggression[15].

The most pressing environmental problem the world currently faces is climate change. Climate change significantly increases the risk of catastrophic environmental disasters, thus requiring, from economists and scientists in other fields, the design and implementation of effective adaptation strategies. Cruz and Rossi-Hansberg[16] propose a dynamic model to evaluate the effects of local temperature changes; such changes trigger migrations, new trade patterns, and modifications on the profile of innovation; they also impact on natality and mortality rates. In the model, global warming has heterogeneous effects across locations but, on the aggregate, there might be significant welfare losses. Furthermore, global warming increases spatial inequality in income and wealth. Results are not static, though; as the climate changes, migration and innovation eventually become relevant adaptation mechanisms.

7. What's New in Trade and Growth Theories?

International trade and economic growth theories have always been two fundamental pillars of economic research. These theories have devised some of the most meaningful and powerful concepts and ideas that the economic science has to offer, as it is the case of the notion of comparative advantage or the mechanism of capital accumulation underlying the neoclassical growth model. Hence, it is surely relevant to account for the advances these theories have gone through in recent years. This can be done by examining the contents of the list of articles associated with keywords 5, *EGR*, and 14, *ITR*.

Economic growth literature has witnessed a consolidation of the ideas underlying the endogenous growth theory, reemphasizing the role of innovation and human capital accumulation as drivers of sustained growth. On the innovation side, the notion of creative destruction has been further explored, in settings that allow for integrating growth, technical progress, firm dynamics, labor market dynamics, and the organization of industries (e.g., Aghion *et al.*[17]). Concerning human capital accumulation, the work by Lucas and Moll[18] is an example of the emphasis placed on the relevance of human interaction in

fostering the propagation of ideas and how this constitutes a fundamental externality in enhancing the productivity of people.

Recent advances on the theory of economic growth highlight the need for a refined approach to the behavior of economic agents, namely through the recognition that agents (both households and firms) are heterogeneous at multiple levels[19]. Other studies approach the challenges for growth emanating from a world with declining fertility rates (what Jones[20] designates as the 'empty planet' problem), and the threats associated with the impact of automation and artificial intelligence in what concerns the reorganization of production processes and labor market dynamics[21].

Regarding international trade theory, Bernard *et al.*[22] remark that this body of knowledge has gone through a dramatic change since the beginning of the century. Although the notions of comparative advantage, preference for variety and economies of scale continue to be important to justify patterns of trade across countries, a new interpretation for the (evolving) observed patterns has emerged. This interpretation gained momentum with the influential dynamic industry model with heterogeneous firms proposed by Melitz[23].

The new interpretation is based on the idea that the exposure to international trade triggers a survival of the fittest effect: only the most productive firms will enter the export market and thrive, leading to aggregate productivity growth, which potentially contributes to a global welfare gain. Therefore, in this view, the focus is no longer on countries or industries, but on the small share of firms that become global firms because of their disproportionate dimension and high productivity, something that is further fed by the gains promoted by the participation in international markets.

Beyond the relevance of the heterogeneous firm productivity approach to international trade, trade theory has also benefited from other contributions. These include a revival of the analysis of the Ricardian concept of comparative advantage[24]; the study of global supply chains, offshoring, and task trade[25]; and the new approach to production and trade networks[26].

8. Macroeconomics: New Lessons for Old Problems

Macroeconomics is a fundamental part of economic thought. As expected, this is reflected on the undertaken counting exercise. Under keyword 19, *MAC*, we have allocated 460 articles (4.05 per cent of the total). Other keywords are also eminently associated with macroeconomics, namely keywords 20, *NAC* (103 articles), 21, *BCY* (426 articles), 22, *EUN* (418 articles), 23, *FPD* (267 articles), and 24, *MPO* (428

articles), among others that also put together studies that, at least partially, deal with issues pertaining to the aggregate economy.

Topics approached by macroeconomic literature are the same as always, most prominently those attached to the above-mentioned keywords. These themes have benefited from some new reflections over the course of the last twenty-five years. Most noticeably, the discourse has changed over this period: the Great Recession has introduced modifications on how macroeconomic phenomena are managed and discussed, with a significant change of tone. Before the Great Recession, authors argued emphatically in favor of the important contribution of the research in this area. Economists claimed that macroeconomics changed for the better, becoming firmly grounded in the principles of economic theory and being capable of offering important guidance for the formulation and implementation of economic policies, especially monetary policy[27].

After the recession, a much more careful perspective was adopted, with academics engaging in an effort to justify why the dominant macro frameworks – the dynamic stochastic general equilibrium model and the new Keynesian macro model – are still useful both to understand and explain how the economy works and to be used as a reference tool for policy design and implementation[28].

Even though the mainstream models of the neoclassical / new Keynesian consensus still prevail in macroeconomic analysis, it is nowadays widely accepted that new paths must be followed to deepen our understanding of macro phenomena. These new paths might constitute a significant departure relative to the methods and approaches currently accepted or they can be less radical proposals, consisting in additions to already existing frameworks.

A relevant avenue is the one launched by Akerlof[29], who proposed approaching macroeconomics from a behavioral perspective (thus recovering to macroeconomics the Keynesian notion of animal spirits). Behavioral elements in macro analysis can still be found in many contemporaneous studies, as is the case of Bianchi *et al*.[30], who propose a novel notion of expectations, the diagnostic expectations, which are formed on the basis of an overreaction to recent news.

As in the past, economists continue to search and to speculate about the sources of rigidity in the economy that can justify the observation of short-term aggregate fluctuations. Complementing the idea of price and wage stickiness, a group of authors have insisted on the role of sluggish information diffusion as a preponderant source of the inertia observed in the adjustment of real variables in reaction to monetary shocks or any other type of perturbation over the economy[31][32]. Issues of information

dissemination are, in the context of business cycles, also associated with the sentiments of agents and with how agents form expectations[33]. Relaxing the draconian rational expectations assumption might be the solution for more effectively addressing some of the observed macroeconomic puzzles and incongruences between theory and observable phenomena.

As in other areas of economics, like growth theory or international trade, short-term macroeconomics and the analysis of business cycles have much to gain in incorporating heterogeneous agents' settings, rather than keeping the analysis confined to the conventional notion of representative agent. It is in this perspective that a new strand of theoretical literature has gained life: the HANK (heterogeneous agent new Keynesian) model[34] emerged from the observation that agents are different from one another. For instance, they have different propensities to consume (e.g., due to different endowments or preferences) and, therefore, one needs to analyze how different shocks over the economic system might affect differently distinct types of agents (e.g., intertemporal optimizers, poor hand-to-mouth, and wealthy hand-to-mouth). Unlike the representative agent that populates most of the typical macro models, each agent in the HANK model will suffer different effects from different types of shocks, conducting the economy to aggregate outcomes that one cannot discern in the single agent standard setting.

9. Inequality under the Spotlight

An outstanding economic fact, observed over the past few decades, has triggered a voluminous and impactful strand of economic literature. The fact is the rising income inequality in the developed countries, most prominently in the United States. The literature tried to characterize the phenomenon, by systematizing the available empirical data and by discussing and theorizing about the evolution of income distribution. The salience of this theme is evident from the article counting: from the whole sample, 311 articles are directly associated with income distribution and income inequality topics (keyword 8).

The evidence is well known and its interpretation consensual: income inequality started rising at the end of the twentieth century, and this movement has intensified in the first quarter of the twenty-first century (e.g., Piketty and Zucman[35]). Top incomes suffered the strongest change, with a small share of the population concentrating a very significant share of the income of the respective economies. Following Alvaredo *et al.*[36], the top 1 percent of the population more than doubled the corresponding income share in the United States in the three decades that preceded their study. This movement is common across developed economies, but especially intense in North America.

The reasons underlying the observed increase in inequality have been assessed. Piketty[37] emphasizes the role of the dynamics of input returns in generating widening inequality, with a tendency for capital gains to increase, over time, faster than labor returns. But there are other factors that the literature highlights as well, as it is the case of the quality of institutions, the progressivity of the tax system, tax evasion on the higher-income classes, and the differences and widening gap in labor returns between qualified and non-qualified workers. In Acemoglu and Restrepo[38], technical progress, and automation in particular, is highlighted as a relevant source of increasing wage inequality.

The impact of innovation over inequality is a controversial theme. While many authors point to a negative correlation, Aghion *et al.*[39] do not find clear evidence that innovation promotes inequality; on the contrary, it might give rise to social mobility that, in some circumstances, may attenuate income gaps. And, one should note, rising inequality is not necessarily harmful for the average individual; as Mankiw[40] remarks, a completely egalitarian society is a dangerous utopia that may inhibit individual initiative and constrain growth. Instead, a dynamic economy capable of generating wealth might benefit all, even though some profit much more than others.

10. Politics and Economics: Close Cousins?

One of the most surprising results of the undertaken article count is the identification of a large number of papers dealing with political systems, electoral processes, and politics in general, even when the discussion is apparently dissociated from the core of economics. Top journals in economics, with no significant exception in the considered sample, consider the discussion of politics to be relevant and address it both from empirical and theoretical perspectives. Overall, 491 articles were identified as being connected with keyword 32, *POL*; this value represents 4.32 per cent of the total number of examined published articles.

What are the political issues that mostly concern economists? These cover a wide array of themes that range from the analysis of the political organization that best serves economic prosperity to the evaluation of electoral systems and electoral behavior.

On the macro side of the spectrum, we find relevant discussions on the relationship between political organization and economic growth. Acemoglu *et al.*[41] empirically evaluate the interplay between democracy and growth; their findings reveal that democratization typically increases the value of GDP. A possible explanation is that democracy exerts pressure on public institutions to invest more in education,

health, and other services that are beneficial for long-term growth. In the same vein, Besley *et al.* [42] establish a negative correlation between lack of political competition and material prosperity; where political competition is missing, governments tend to pursue policies that hinder growth (e.g., higher taxes, lower public investment).

Despite their merits, democratic systems have flaws and may not be able to promote, in every circumstance, the most desirable economic outcome. Various studies highlight that consolidated democracies are often the cradle for massive and persistent inequality. Democratic systems frequently have to manage and balance the goals of an equitable society and of free-market enterprise, in societies that are far from being exempt from lobbies and vested interests. It is in this context that economists look at the best ways to promote a better democracy, for instance, through direct participation of citizens in lawmaking and public budget choices.

The other major point of interest for economists in politics relates to electoral processes and the selection of politicians. This subject has been approached from both theoretical and empirical perspectives. Most of the empirical work is directed to the analysis of the US political system. The divisions in American politics are addressed, as well as the reasons underlying the increase of the populist vote (e.g., Funke *et al*. [43]). The gender gap in American politics is also debated; namely, the evidence that more women than men vote in the democratic party[44]. From a theoretical point of view, there is an extensive literature dealing with strategic voting, given a wide array of incentives and constraints that voters might be subject to (e.g., Alesina *et al*.[45]).

11. The Ubiquitous State: More Relevant Than Ever?

Studies on the role of the government, on the organization of state institutions, and on the implementation of public policies, are pervasive in economics research. They spread over a wide variety of themes, which, in the adopted list, are mainly associated with keywords 29 to 39. These keywords cover topics ranging from the provision of public goods to collective choice, taxation, the welfare state, the protection of property rights, and the regulation of markets. All these topics receive a strong degree of attention, with every one of the mentioned keywords having more than 200 associated articles. Some illustrative examples of the influential work on the role of the government, public policies, and institutions, are remarked in the paragraphs that follow.

To implement a wide array of public policies, governments need revenue. The most relevant part of this revenue comes from taxes. Studying the efficiency and equity of the tax system is a fundamental task for economists. It is important to evaluate how progressive a tax system should be[46], and how efficient the state is in avoiding tax evasion and in promoting voluntary compliance (e.g., Neve *et al.*,[47]).

It is also relevant to understand countries' differences in the capacity to collect taxes and how this impacts the wellbeing of populations. On one extreme, low-income countries exhibit a poor capacity to enforce the payment of taxes, creating a vicious cycle of underdevelopment and state weakness and inefficiency. On the other extreme, one finds some developed countries, e.g., the Scandinavian states, which are capable of raising large amounts of tax revenues and, thus, to implement massive redistributive policies, which in turn promote labor force participation and a sense of involvement in society that create a favorable environment to ensure low levels of tax avoidance and tax evasion. These issues have been extensively debated in the collection of papers to which the first paragraph of this section mentions.

Available public resources serve various collective goals. One of them is the provision of public goods. Market economies tend to underprovide goods with characteristics of non-rivalry and non-excludability, such as knowledge goods and innovation, and therefore public policies are essential to complement or replace the market in their provision. This, again, is a central research topic in economics, including a large collection of papers published in top journals in the last quarter of century. Another fundamental mission of the government is to promote equity and social justice through redistributive policies. How the welfare state and social insurance should work to balance in the best way possible the efficient use of resources and the criteria of social justice is also a central concern for economics (e.g., Golosov and Iovino[48]).

Furthermore, the government has responsibilities in the regulation of the private economy. Markets fail in many circumstances and generate negative externalities that often are difficult to internalize. Therefore, the regulation of businesses is an essential function of governments. Regulation may prevent and avoid litigation, and it contributes to the public wellbeing[49].

Finally, policy tools can work in other, less orthodox, ways, namely by acting with the goal of influencing the behavior of people. The literature on libertarian paternalism and nudging[50] constitutes a relevant new approach to the functions of the government, suggesting that policies may act upon peoples' choices

(e.g., on consumption, savings, or environmental preservation), generating results that are socially preferable, and thus outcomes that the government should promote.

12. Markets: Still a Fascinating Decentralized Coordination Device

Relations between economic agents take place in markets. Thus, the discussion on the design, organization, operation, and outcomes of markets is an unavoidable theme of discussion and analysis in economics. Four keywords in the proposed list deal directly with markets and their underlying forces, namely keywords 40, *MKT*; 41, *COM*; 42, *AMA*; and 43, *EEF*. Every one of these topics encompasses more than 500 references under the adopted classification.

A possible definition of market is the Hayekian notion of information-processing system within which spontaneous orders are likely to emerge[51]. Under such an interpretation, agents participating in market transactions are endowed with limited and local knowledge; their independent, uncoordinated, and decentralized actions generate a process of competition that typically directs the economy to an invisible hand outcome, i.e., to an efficient aggregate equilibrium. The efficiency of decentralized markets is a powerful result that economists have emphasized and preserved over time. However, markets are also complex entities that fail, have deficiencies, and benefit more some participants in transactions than others. The observed anomalies have been subject to profound analysis by economists over the last few years.

Although markets are resilient and thrive even in the most difficult circumstances, the own existence of some of them can be problematic. Unwanted markets exist (e.g., for illegal drugs), and even though it may be socially desirable to promote their extinction, this becomes hard when demand is inelastic[52]. In other cases, there are evident social gains in promoting the existence of markets, but repugnance works as a constraint for the transaction of the good, and for the creation of incentives for such; a widely studied example of a market with such features is the one involving the buying and selling of organs for transplantation[53].

For most goods and services issues of legality or repugnance are not relevant, and therefore conditions exist for markets to function. In this case, the attention then focuses on whether competition can be promoted, and pernicious concentration can be avoided. At this level, information is a key variable. For instance, informational advantages might be used by firms to segment markets and discriminate prices. Fighting information asymmetries increases transparency and has important consequences over prices,

consumer satisfaction, the structure of the industry, and the goods that are offered. Advances in communication technologies enhance the flows of information and contribute to healthier competition. All these topics are insistently discussed, analyzed, and modeled in the published research.

Despite the informational gains that new communication technologies have brought, there are still important obstacles that prevent markets from being virtuous entities capable of offering everyone the opportunity to thrive. McFadden[54] alerts for the exclusion of part of the consumers from the benefits of wider and more efficient markets. In many markets, a *phishing for fools* effect emerges; this effect reflects a startling contrast between hyper-rational agents that search for maximum profit at any cost, and emotionally vulnerable agents (often consumers of final goods and services), who are susceptible to manipulation, and are frequently phished as fools.

13. Labor: a Multidimensional Theme

Going through the list of selected keywords, subjects associated with employment and labor appear recurrently. The keywords with a straighter connection with labor issues are: 17, *LMM* (237 mentions); 22, *EUN* (418 mentions); 53, *OWO* (280 mentions); 54, *PRO* (435 mentions); 71, *LSU* (531 mentions); and 72, *WPI* (602 mentions).

In explaining aggregate employment dynamics, search and matching models are still a widely accepted tool. Their popularity stems from the logical coherence of the theoretical explanation and from the capacity these models exhibit to account for key business cycle regularities, mainly those associated with employment and wages. Differently from other macro models, namely the new Keynesian models, in search and matching settings wage inertia emerges endogenously through wage bargaining. Much of the theoretical research on labor markets and employment has been supported, over the last 25 years, on the search and matching paradigm.

Wage setting and wage rigidity, and the corresponding impact on business fluctuations and welfare, are central issues in macroeconomic analysis. Wages are also insistently approached from the perspective of the life-cycle choices of individual agents. Individuals have a series of choices to make over the life cycle regarding labor participation, education, and professional career. The evolution of earnings along the life cycle is influenced by human capital accumulation, job seniority, and job mobility. Individual choices determine, then, aggregate results. The careful scrutiny of such micro decisions and their macro impact are the subject of a generous amount of literature (e.g., Altonji *et al.*,[55]).

Another important point when analyzing wages has to do with the consequences of immigration over the wages of native workers. The published literature remarks that immigration tends to depress wages in low paying jobs but to increase wages in the upper levels of the wage distribution; it also highlights that selective immigration policies might actually lead to welfare gains for the low skill workers. Overall, wages are inseparable from incentives and productivity, and labor productivity depends, obviously, on factors that are not under the direct control of the worker, namely the way businesses are managed[56]. Central to the discussion on the interplay between employment and wages are public policies, particularly those that deal with the fixation and updating of minimum wages and of unemployment insurances, a widely studied set of subjects which are pervasively found in the published work throughout the first quarter of this century.

Another unavoidable theme on the economic discussion of labor is the loss of jobs that emerges from the automation of many activities. Although economics traditionally teaches that labor and capital are complements in production, technological progress in the last few years has introduced changes in this logic: in most cases, capital arises as a substitute for labor, with important economic implications for the entire society and for each one of us. Automation has implied a polarization of the labor market, with the disappearance of the job opportunities in the middle of the skill distribution and their concentration at the top and at the bottom of such distribution. Therefore, there is no doubt that technology has been changing the profile of the available jobs and that some win while others lose.

Overall, automation brings efficiency and productivity gains, but induces benefits essentially for those workers capable of supplying skills that are adaptive, creative, and capable of solving problems. Declining labor shares are a problem that developed societies must handle, namely through public interventions capable of containing the concentration of the new factor of production – robots and automated processes – in the hands of too few[57].

14. Economics on the Verge of the Digital Transition

The last quarter of century has witnessed a structural pervasive change in the organization of the economy and of the society. Many of the activities that demanded physical contact among people were dematerialized and now they take place online. Such a significant change in our way of living certainly encounters reflection in economics research. Keyword 47, *DIG*, provides a count of the published studies in themes connected with virtual markets, online social interactions, and services potentially provided in remote mode, such as education or health. Furthermore, included in this topic are also studies that

directly deal with the new data economy, the role of data as an input in production, and the processing of data through machine learning and artificial intelligence algorithms (e.g., Veldkamp and Chung[58]). The articles discussing such issues amount to 1.79 per cent (203 articles) of the full database.

Fig.3 depicts the evolution of the references to articles associated with keyword *DIG*; a trend line is added to the graphic. Following an initial hype at the turn of the century, certainly associated with the advent of internet and electronic commerce, the topic lost, in the following years, some of its topicality. The relevance of the subject has been regained in the most recent years, due to the new technological wonders attached to artificial intelligence that are starting to emerge.

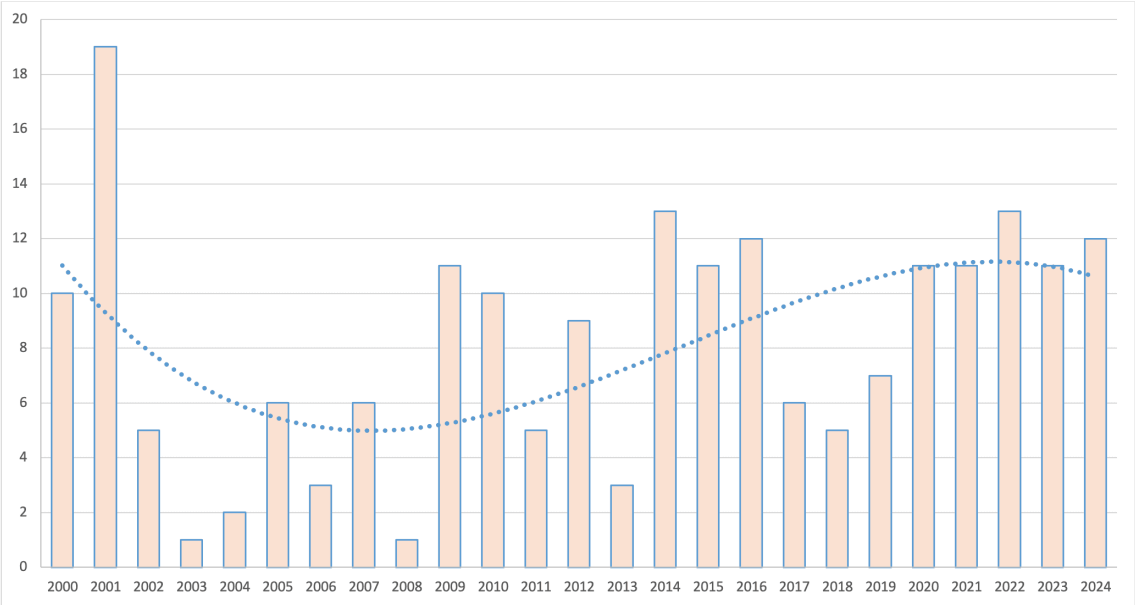

Figure 3. Number of articles under keyword 47, *DIG*, per year

A first phase in the approach to the digital economy mainly dealt with the potential gains of online trading. The Internet emerged as a powerful information system, capable of reducing search costs by enabling fast and simple price comparisons[59]. It did not take much time, though, for economists to realize that the new online vehicles were not the panacea for all the problems. Some of the literature highlighted that electronic ways of doing business and to trade goods and services did not bring frictionless markets and flawless transactions. Many economic activities remained stuck with their traditional channels and economists understood that most of the processes of this allegedly new economy could be discussed and explained in the context of traditional economic thinking.

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Successive and systematic improvements in information and communication technologies have helped in mitigating the initial criticism, and online markets continue, nowadays, to be the subject of influential research. Current studies on the thematic of digital markets investigate the anomalies, behavioral and organizational, that contribute to price dispersion, information asymmetries, and market power concentration in environments that, by their nature, were supposed to be the prototype of perfect competition. Understanding how people behave online is an important topic of research, in the sense that it can help in designing digital markets that are more efficient and that can generate additional gains for agents in both the demand and the supply sides of the market.

Currently, the digital economy goes much beyond the design and organization of market transactions. It is a pervasive presence in our everyday lives, and economic theory and analysis are increasingly reflecting this reality. For instance, recent studies highlight the impact of online social media on economic decisions and on political and ideological preferences of individuals. Online education is another example of a digital transition topic receiving much attention in economics' top journals. A fascinating new field of study is the one attached to generative artificial intelligence and how this can impact every economic and social activity. The possibilities are incommensurable, and a sensible use of the new technological potentialities can boost productivity at every level, including scientific progress[60].

15. Two Favorites: Healthcare and Education

Health and healthcare (keyword 65) and education (keyword 69) are two topics to which current economic research attributes a huge amount of importance. They are truly two favorite themes embraced by economic researchers. The undertaken accounting exercise identifies 500 articles associated with the first of these keywords and 574 articles attached to the second keyword. These figures correspond to 4.40 per cent and 5.05 per cent of the total articles, respectively.

Regarding healthcare, such an extensive literature covers a wide array of themes. Some authors focus on the link between health, inequality, development and growth at a global scale. Others tackle with the issue of rising health spending, associated with the technological sophistication of the sector. Others yet address important issues related to public health policies, as the taxation of unhealthy consumption goods, or, in a broader perspective, the role of government in financing healthcare.

One of the most insistently approached topics is health insurance. Differently from other locations, in the United States a significant part of the health sector is privately financed, and most of the analysis of

healthcare financing in economics research focuses on this peculiar organization of the health sector in North America. Studies concentrate on how competitive private insurance markets are and on how these might compete with a partial public coverage of medical expenses. Health insurance is also a fertile terrain to address incomplete information issues, namely concerning moral hazard. The analysis of health by economic scientists also approaches issues of efficiency and inefficiency in healthcare markets as a whole, and specific market segments, as the one associated with organ exchange.

Education is the second subject to which economists have attributed a generous amount of attention over the last few years. Education is pervasive in economics for several reasons: because it allows for human capital accumulation and, thus, fosters growth; because formal education is fundamental for individual professional success; and because education generates multiple social externalities, e.g. at the level of crime prevention.

Studies in education are pervasive, covering every imaginable subject and education level. Studies go from the analysis of preschool programs to secondary school and higher education. The subjects covered include, among many others, student achievement, school choice, online education, and teacher quality.

Unquestionably, by their nature, health and education are two themes with enormous repercussions in the organization of economic activity. The externalities associated with them, the appeal of the particular features of their markets' organization, their financing, and their pervasiveness in society, justify the relevance that in the last few decades economics has attributed to these subjects.

16. Two Outcasts: Sports and Tourism

While some issues are highly regarded, others, of equally paramount importance for economics, are, to a great extent, overlooked or modestly approached. Sports and tourism are two of such cases.

Keyword 49, *TOU,* has been attached to only five articles (less than 0.05 percent of the universe of published papers) and, from these, only one study can truly be interpreted as a systematic reflection on the economic impact of touristic activities over national and local economies. Although focused on a specific touristic region (Mexico's coastline), the work by Faber and Gaubert[61] pursues a comprehensive discussion on the most fundamental economic implications of tourism: tourism promotes market integration, contributes directly and positively to the current account and to GDP growth, assists in developing local economies, triggers singular urban and regional dynamics, and it is a powerful tool in the promotion of globalization, sharing of cultural experiences and values, and human development.

Investigating how touristic activities impact local, national, and global economies should, thus, be an important component of the work of academic economists, something that is far from what the collected data reveals.

Although less extreme, the case of sports is also paradigmatic. Less than 0.33 percent of the total number of articles (37 published articles) is somehow associated with the interplay between sports and economics. The subjects of these studies range from the evaluation of the pros and cons of hosting major worldwide events, like the summer Olympics[62] to the formal inspection of strategic behavior in specific game scenarios, as the shootout of penalty kicks in soccer[63].

Overall, the identified articles, although small in number, are comprehensive in dealing with many of the relevant topics in the crossroad between sports and economics. These topics comprise: the behavior, incentives, and performance of athletes; the operation of sports' labor markets; the management of teams and leagues; the organization of events; the design of betting markets; and, among others, the discussion of issues of accessibility, inclusiveness and discrimination. The diverse nature of the identified studies also reflects on the covered sports, which include both individual modalities (golf, tennis, chess, or sumo wrestling) and team sports (baseball, basketball, football, or soccer).

Sports and tourism involve the allocation and management of massive economic, financial, and human resources; they generate multiple important market transactions and externalities; and they create huge and diversified networks of interaction among economic agents. As such, they surely deserve a careful look from economic science, a look much deeper than the one currently provided by the incipient economic literature on these themes.

17. Sensitivity to Major Worldwide Events: the Great Recession and the COVID Pandemic

Two major worldwide events with devastating economic repercussions have marked the first quarter of the twenty-first century: the subprime financial crisis of 2007-2008 and the economic recession that followed, and the COVID-19 pandemic, which has strongly conditioned economic activity in the early years of the 2020s decade. To assess how these two events have shaped economic research and in order to evaluate how sensitive economics is, as a science, to current events, two particular keywords were introduced in the selected list: keyword 26, *FCR*, and keyword 66, *DEP*.

One may expect these two keywords to have gained relevance in the years that followed the events. If this indeed happened, it is a sign that research evolves and reacts to explain and present solutions for pressing issues that concern humanity. Thus, it is relevant to inquire the extent to which such topics became the center of attention for economists as they were affecting the lives of millions of people throughout the world.

Fig.4 displays, for each of the two keywords, a series of columns representing the difference between the number of articles on the subjects in each year and the corresponding average. Columns above zero indicate years in which the issues have received more attention than on the average of the twenty-five years, while columns represented below zero indicate the opposite. A visualization of the graphic clearly reveals that there are many more articles on financial crises in the years following 2008, and much more articles on epidemics and diseases following 2020. Thus, the conclusion is that economics is, in fact, sensitive to current events, namely events with worldwide pervasive impact.

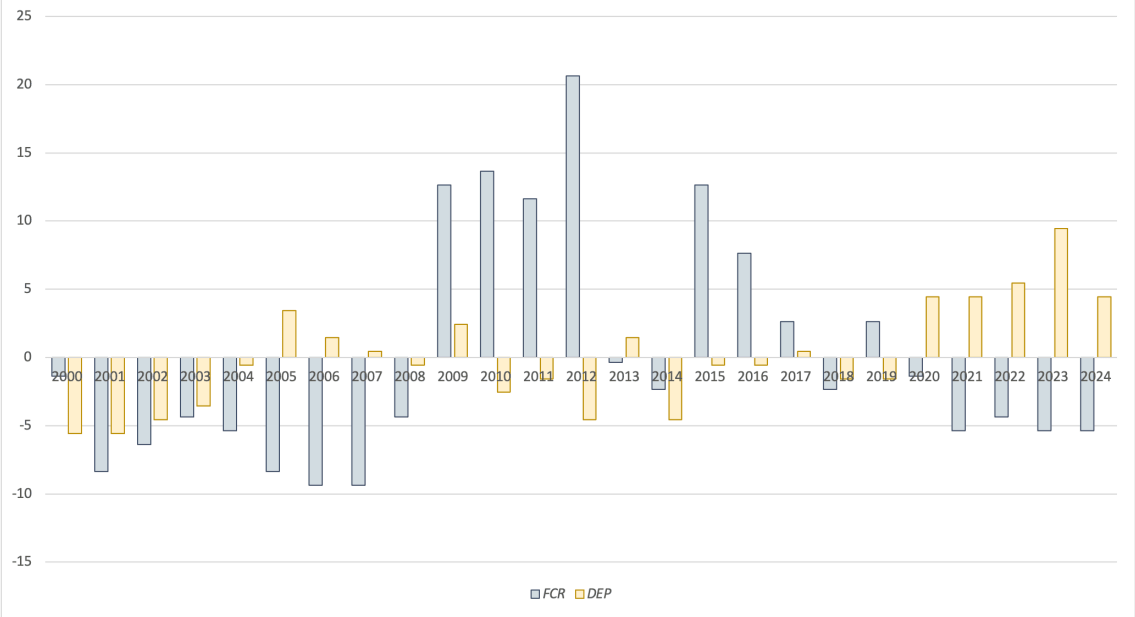

Figure 4. Number of articles under keywords 26, *FCR*, and 66, *DEP*, per year (difference to the mean)

The observation of Fig.4 makes it evident that the attention given to financial crises in the economics literature increased significantly after 2008, and that it remained particularly high in the four years that followed. Most of these articles dealt, in fact, with causes and consequences of the subprime crisis and of the great recession[64].

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Although pervasively devastating, the economic impact of the COVID-19 pandemic is much more recent and, therefore, harder to evaluate by looking at the corresponding trajectory in the figure. Nevertheless, it is visible that this topic has emerged as a relevant subject of analysis in the economic literature from 2020 onwards. The broad-spectrum impact of this health, social and economic crisis simply could not be ignored by economists. The impact of the pandemic affected all sectors of the economy and most of the individual decisions of economic agents (see, e.g., Albanesi and Kim[65]).

18. Gender and Race: Bringing Diversity and Discrimination to the Forefront of Economic Thought

The first decades of the twenty-first century have witnessed a growing interest of economic research in topics related with diversity and discrimination, specifically regarding gender and race. This justifies including in the selected list of keywords the items 73, *GEN*, and 74, *RDI*. These two keywords account for, respectively, 385 and 289 mentions (3.39 and 2.54 per cent of the universe of published articles).

On an economics perspective, gender issues are addressed mostly taking into account two interrelated subjects: wage gaps and career opportunities, on one hand, and women empowerment and development and growth, on the other. Women empowerment is essential to promote development, and this is a two-way relation: typically, economic growth and development helps in lowering inequality between men and women; and the stronger role of women in society and in the economy is an essential step to foster development and growth[66].

An important part of the involvement of women in the economy is associated with labor market participation. The increasing female employment is one of the most dramatic changes taking place in the economy of almost every country during the last century. This is due to equal access to education and a significant change in mentalities and awareness of how the society should work. Some of these changes occur naturally in society, others are imposed by political reforms. Despite the mentioned convergence, there are still differences, which are most prominently felt in terms of the wage gap and the career opportunities gap, which continue to be large, in disfavor of women, as documented in multiple studies (e.g., Bertrand *et al.*[67]). Advanced justifications for these gaps are of various natures including childbearing and the perpetuation of stereotypes[68].

The topics of interest for economists regarding racial discrimination are somehow similar to those mentioned above for gender. First, there is an obvious positive relationship between racial integration

and economic growth and development. Hsieh *et al.*[69] highlight that between 1960 and 2010, a figure around 20 to 40 per cent of the growth in aggregate productivity in the United States of America might be associated with an improved allocation of talent. Such an improved allocation is clearly attached to increased opportunities available to racial groups that in the past could not access qualified jobs.

Second, racial discrimination in the labor market is also addressed from the point of view of individual job positions and individual earnings. There is evidence of job opportunities discrimination and wage discrimination that although declining over time still subsist and still are a matter of concern for economists and other researchers. Discrimination is pervasive and still subsists in other areas of society, e.g., criminal justice. These issues are subject to analysis and discussion in current economics, namely when addressed from the perspective of the North American society.

19. The Next Frontier: the Human Mind

A group of the selected list of keywords is directly linked with human choices and behavior and with their underlying psychological drivers: these range from keyword 77, *BCH*, to keyword 83, *CPE*. The number of articles attached to each of these keywords is highly significant, suggesting that studying the preferences of people, how they select between different options, and how they behave and act, are central subjects of study for contemporaneous economics. Much of the studies dealing with choices go beyond the analysis of strict rationality and revealed preferences, and focus on the investigation of the mental and psychological processes that support decision-making.

Behavioral economics acquired, over the last couple of decades, a consolidated central place in economic thinking[70][71]. The behavioral approach brings back, to the study of economics, the psychological elements that govern human choices and that were largely neglected by the orthodoxy of neoclassical economics. Under the behavioral perspective, one is able to discuss ideas that clearly encounter correspondence in the way people choose and act, but that economists avoided, for a long time, to include in their models and theories, since they constitute deviations relative to the rationality paradigm. Procrastination and self-control, projection biases, wishful rationalizations, present biases, and anchoring, are a few examples of such deviating ideas that have been thoroughly investigated over the last few years.

To better understand how individuals, in economic contexts, choose to act and behave in certain ways, economics has gone beyond the analysis of preferences and observable actions and started to explore the

mental processes underlying the functioning of the human brain. Several authors have stressed the contribution that neuroscience might make to the understanding of decision-making processes. The basic idea is to open the black box of the brain and, therefore, to associate measurable neuron activity with the choices (seldom fully rational) made by economic agents.

Neuroeconomics emerges as a prominent sub-discipline of economics, allowing for the design of decision-making theories where the brain is interpreted as a structured and hierarchical organization. Under this view, mental resources are allocated by a central coordination device to the concretization of different tasks, which differ in length, effort, and other features. Such theories emphasize the idea that cognitive resources are limited and, therefore, need to be efficiently allocated. People plan decisions and make thought experiments in an effort to optimize their neurobiological capabilities and maximize the success of their deliberative processes.

The exploration of the human mind is one of the most fascinating endeavors of science. Economics is making important progress at this level, with the objective of better understanding human decisions and the most significant biases relatively to the rationality benchmark.

20. A Failure to Launch: Evolutionary and Complexity Economics

Mainstream economic theory is grounded on a few well-known concepts and ideas: rationality, optimization, efficiency, and equilibrium. Over the last few decades, these concepts and ideas have been convenient to assemble a robust and indisputable body of knowledge. However, by assuming them, much is eventually lost in the analysis of relevant economic phenomena. With this in mind, a progressively larger number of researchers has started to look at alternative and / or complementary approaches, and the notions of evolution and complexity have gained some visibility.

The novel approach is based on the notion that the economy is a complex and evolving system, where phenomena are emergent, out-of-equilibrium dynamics dominate, and there is path-dependence. While the orthodox view takes a simple world where sophisticated agents make rational decisions, under a top-down perspective, the complexity view recognizes that we live in a world that no isolated individual has the capacity to fully understand, i.e., the agents are simple, and the aggregate economy is overwhelmingly complex. In such an environment, the only way to explain and understand how the economy works is through a less mechanical and more organic approach, an approach that is eminently bottom-up.

Although compelling, the complexity view has not acquired the status one could imagine it would rapidly gain in economics. Research published in top journals continues to be dominated by the mainstream approach and, in fact, it is notoriously exiguous the sample of published articles that apply the notions, ideas, and methods of complexity and evolutionary economics. To keyword 87, *EVC*, only 55 published articles were associated, what corresponds to 0.48 per cent of the total. Therefore, one can state, without much room for error, that, at least for now, the bottom-up approach to economics is far from being accepted as a viable replacement for conventional and consolidated approaches. This is, in fact, a symptom that the economic science might be interpreted as a conservative scientific field.

Furthermore, not all of the 55 collected references are openly associated with the complexity view as characterized above (e.g., some approach the complexity of products traded in financial markets, while others look at evolutionary behavior in the context of standard strategic games). In fact, the research advocating the bottom-up approach is restricted to a very short list of papers (e.g., LeBaron and Tesfatsion[72]).

21. A Science that Creates Its Own Tools: Econometrics and Mathematical Methods

Contemporaneous economics relies heavily on mathematical and statistical tools. Most of these tools are not imported from other areas of knowledge, but they are rather a fundamental part of the research pursued within the boundaries of economics. At this level, the seven journals under scrutiny are in fact different, with *Econometrica* concentrating much of the research about econometric and statistical instruments, and about inference and estimation methods and techniques.

Specifically, six keywords are appropriate to characterize the relevance attributed to tools for empirical analysis; these are keywords 88, *MSM*; 89, *DAO*; 90, *ECM*; 91, *DSA*; 92, *ERE*; and 93, *EIF*. Some of these keywords are the ones with the highest number of associated articles in the entire list of selected keywords, what is a clear indicator of the importance that building and discussing methods of analysis has in this science. Together, the remarked six keywords concentrate 2.816 mentions to published articles; from these, 1.520 (53.98 per cent) have been published in a single journal; as remarked, in *Econometrica.*

Such voluminous literature is difficult to classify in categories or to exemplify with just a few references. Some of this work includes, in a far from exhaustive list, research on the following topics: vector

autoregression; panel data estimation and quantile regression; inference on counterfactual distributions; estimation with instrumental variables; non-parametric inference; regression discontinuity design; and machine learning. Authoritative surveys about econometrics and its applications include Imbens and Wooldridge[73] and Athey and Imbens[74]. These works discuss how important it is for economics to build its own tools to address its most important scientific challenges.

22. Let the Games Begin

One of the most powerful mathematical tools available to economists is game theory. Games allow for the analysis of strategic interaction situations and can be applied to almost every area of knowledge within economics. They are a fundamental instrument used in this research area, as the volume of publications associated with keyword 86, *GAM*, clearly indicates. A total of 595 papers (5.24 per cent of the considered universe) has, as central element of the study, game theoretic tools and game theoretic analyses. The considered sample of journals resort to game theory unevenly, with three of the journals (*Econometrica, Review of Economic Studies,* and *American Economic Review*), concentrating 86.05 of the references.

In Samuelson[75], an overall assessment of the emphasis given by economics to tools of game theory is undertaken. The author remarks that game theory is nowadays a standard tool, but it was not always like this: in the 1960s and 1970s it was a relatively isolated and independent niche receiving contributions from a relatively small number of mathematical economists. Today, almost every field of interest, in microeconomics, macroeconomics, international trade, labor market dynamics, and many others, resort to instruments, concepts and ideas of game theory to represent important strategic interactions. Game theory became a familiar and standard tool, which economists absorb since their early student years.

One might say that the adaptation of game theory techniques to economics has been a success, allowing for important progress in many research areas. The evolution has been significant, with the traditional separation between non-cooperative games and cooperative games no longer making sense. In a more general perspective, games must be interpreted in a much more flexible way, recognizing that the environment is complex and that there are many unobservable aspects in every established interaction. Learning, persuasion, and communication became important features in the discussion of game theoretical mechanisms.

The applications of game theory in economics are multiple and varied. Some illustrative examples include the modeling of coordination, communication, and cooperation in relationships, the analysis of

complementarities in scenarios of incomplete information, the study of how beliefs influence action, and the evaluation of interaction in dynamic network settings. Game theory is also important in the context of empirical and experimental work. Game experiments allow to evaluate strategic thinking, selection of courses of action, and consistency and compatibility of beliefs and choices. This experimental work is capital to better explain observable behavior and to predict new regularities.

23. The Triumph of Experiments

Generally speaking, economists can undertake two broad types of experiments: laboratory experiments and field experiments. The second are much more than less controlled variants of the first; they are an opportunity to scrutinize how people actually choose and behave, in natural rather than artificial environments. This is the reason why field or natural experiments have gained supremacy over laboratory experiments, and the reason why they have also gained a place of great relevance in economics in the last few decades (e.g., Banerjee[76]).

Among field experiments, a particular type of experiment became particularly notorious: randomized control trials. This type of experiment takes a treatment group and a control group and compares results, underlying a given event or process, across the two groups (e.g., Banerjee *et al*.[77]). Randomized control experiments have been used to address a multiplicity of issues, including development and poverty alleviation, healthcare, education provision, and individual behavior in social contexts.

Despite their growing use as a tool for economic analysis, field experiments are not consensual among economists. Sims[78] argued that economics is not an experimental science. Experiments can be useful in increasing our understanding of given events, but they do not replace careful and thorough statistical analyses of the available data. Results from experiments are, most of the time, not generalizable and, thus, their conclusions are confined to the specific problem being handled. For instance, it is frequent to identify in experiments a scaling problem: experimental studies are often pursued at a relatively small scale, while policy interventions are required at larger scales; in these cases, scalability might not be possible.

Another issue is that experiments must have some sort of theoretical support. Economic theory should be used to design and implement experiments; the results of these can also help in building more robust theories. The relationship between theory and experiments is bi-univocal and should be nurtured.

Regardless of the controversy associated with their place in economics, it is uncontestable that experiments, and essentially field experiments, have triumphed in economics and that they probably represent the most important revolution in economics research in the last quarter of century. They became a fundamental tool of analysis, as the figures in our counting exercise reveal. To keyword 94, *EXM*, were associated 377 references, what represents 3.32 per cent of the total of the collected articles. By undertaking experiments, economists are able to understand the reality and to simulate scenarios in a way that is essential to implement and monitor public policies.

24. Economists Looking in the Mirror: a Modestly Vain Profession

Does it make sense to assert that economics is an inward oriented science? Does economics devote a significant part of its intellectual effort to the discussion of its own meaning as a science and to the debate about its teaching and research activities? Five of the elected keywords reveal that economics does not spend too much time and effort looking at itself. These keywords, associated with economics concept, teaching, research and thought, are some of those with a lower article count. Namely keyword 95, *EDS* – 97 articles; keyword 97, *REC* – 141 articles; keyword 98, *TEC* - 88 articles; keyword 99, *ECS* – 127 articles; and keyword 100, ETH, 96 articles.

Economists discuss their views, assessments, expectations and anxieties about economics at various levels, namely in what concerns both teaching and research. About teaching, a few studies point to a gradual change in the way economics is being taught. Over the years, the teaching of economics has become more empirical and more focused on logical reasoning and less mathematical and theoretically oriented. This shift is also somehow reflected on economics textbooks[79].

Bowles and Carlin[80] point the way ahead, arguing that new themes should occupy the center stage of the teaching of economics. Within these themes, the authors highlight income inequality, climate change, the future of work, and financial instability. The change in the way economics is taught, the authors argue, must concentrate not only on the approached topics but also on methodology: the new economic teaching paradigm should be less focused on equilibrium and efficiency, and more centered on strategic interaction, behavioral foundations, and limited information scenarios.

Concerning research, one should first mention how economists look at the knowledge they create. Economics is a relatively insular science and, at least from the point of view of economists, there is a dominant position of economics within social sciences. This self-proclaimed supremacy of economics

and of economists has a series of ramifications that are worth discussing. First, it is built on the idea that economics must employ the same type of methods as exact sciences and life sciences do; but many of the issues dealt by economics are in fact of a social nature and probably need other types of approaches, softer than the ones typically used[81].

Second, what economists do, or should do, leads to an interesting discussion about how to classify economists. Roth[82] has initiated this discussion by claiming that economists should do more than analyze markets; they must also design them. In this sense, economists are essentially a kind of engineers. Focusing on macroeconomics, Mankiw[83] reinforces the idea that economists need to be much more than scientists who conceive logical models; they need to be engineers, capable of addressing the concerns of people in their everyday life (e.g., finding practical and effective solutions for unemployment). Duflo[84] contributes to this discussion by supporting the view that economists are more than engineers. They are required not only to design good policies or other solutions, but also engage with the details of policy implementation. In this sense, economists are not just scientists and engineers; they can also be seen as plumbers, with a strong emphasis on detailed field implementation of the designed policy guidelines.

In recent years, economists have remarked, in various ways, why their theories and empirical studies are important and useful. Regarding theory, Rubinstein[85] raises important questions about the true nature of theory, stressing the need for it to be a mix between a logical exercise and a powerful tool to explain observed regularities. Romer[86], in a comment about the direction taken by growth theory, alerts for the need to attribute substance to formal modelling; otherwise, economic theory incurs in the risk of becoming an irrelevant set of mathematical expressions that look like science but are not true science (what Paul Romer designates by *mathiness*).

On the empirical side, Angrist *et al.*[87] highlight the progressive supremacy of empirical work over theory in economics. Christensen and Miguel[88], in turn, emphasize the need for transparency and reproducibility in the development of empirical work, following the good practices already common in other scientific fields, in order to turn economics into a more credible science at the eyes of the academy and the general public.

Some remarks on the history of economic thought are also found in the top economics literature, with insightful reflections on the work of prominent classical economists, such as David Hume, Adam Smith,

Thomas Malthus, David Ricardo, Irving Fisher, John Maynard Keynes, and Friedrich von Hayek, among others.

A last note on the way economists perceive the work of economists goes to the work of Heckman and Moktan[89]. These authors have analyzed the relevance of publishing in the top 5 economics journals for academic careers. They find a strong correlation between publishing in the top 5 and the opportunity of developing a career in an influential North American university. This correlation may have some harmful impact on the creativity of research, because academics become potentially more concerned with pleasing their peers – the editors of the journals - than in offering a truly innovative and revolutionary scientific contribution.

25. A Proudly Isolated Science?

The insertion of keyword 96, *IGS*, in the suggested list has the purpose of assessing the extent in which economics relies on knowledge generated in other fields or in collaboration with such fields. To this keyword, we have assigned a relatively small number of published papers: 91out of 11,356. This does not necessarily mean that economics exists in a scientific bubble. Excluded from this list is a large number of articles that have been associated with other keywords, which, in fact, represent autonomous bodies of scientific knowledge. This is the case, for instance, of keywords 31, *POL*, 80, *PSY*, and 88, *MSM*. Each one of these is of great relevance in our counting exercise and, therefore, they reveal a strong connection between economics and politics, economics and psychology, and economics and mathematics. Therefore, the answer to the question in the title of the section is a clear no, economics is not an isolated science.

Despite the interconnections highlighted above, the direct link between economics and many social sciences and life sciences is relatively scarce. Taking a detailed look at the 91 papers associated with keyword 96, it is possible to emphasize the effort various authors have made to associate economics with other social sciences, namely sociology and anthropology (e.g., Small and Pager[90]). As a social science, economics should, in this perspective, cooperate with scientific fields that also study collective action, and assimilate some of their methods and approaches.

Some other authors claim, instead, a certain kind of superiority of economics over other social sciences. Economics has its own methods and tools of analysis, and therefore it does not need to build on insights from disciplines with similar subjects but distinct ways of approaching social phenomena. In an extreme view, Lazear[91] claims for a distinctive preponderance of economics against other social sciences, given

its methodological robustness and soundness which, according to the author, one can only find in physical sciences.

Sporadic mentions to other, not so common, associations of economics with other sciences can be found as well. These associations range from the links one can establish between economics and genetics to the close connection between economics, ecological systems and even biodiversity. Recall, also, that the relationship between economy and ecology is strongly present in most of the papers one has accounted for through keyword 10, *ENV*.

A last remark goes to the work of Shiller and Shiller[92], who regret seeing economics transformed essentially into a technical field. To aspire to a broader vision, economics must recover its early classical nature, which is inseparable from philosophy and other humanities. Interdisciplinarity is crucial for economics and no scientific knowledge, regardless of its origin, should be discarded when assessing the numerous interrogations that economic analysis poses.

26. Conclusion

Contemporaneous economics research pervasively covers all areas of human action and interaction. Microeconomic and macroeconomic topics equally receive strong attention from the journals that publish top research. There are also other themes of interest, with growing importance in economics, which emerged from the observed changes in society over the last few decades. The detailed exploration of published research and, thus, of how the economic science has progressed, allowed to arrive to some meaningful conclusions:

i. For various understandable reasons, empirical research is primarily focused on the North American economy, but this does not mean that other geographical regions are neglected. Most parts of the globe, both developed and developing regions, receive a fair share of attention from economists. Economists also look at history and at a wide variety of past events to support their arguments on how the economy works and to predict how it will evolve.
ii. Recent phenomena, and phenomena that gained a special relevance in recent years, such as globalization, climate change, or the digital transition, are, definitively and with strength in the agenda of researchers. Gender and race became important in studying economics at various levels, namely concerning inefficiencies provoked by discrimination.

iii. Important progress has been made regarding growth, trade and macro theories. In addition, inequality turned into a central topic of analysis in economics.

iv. A perhaps surprisingly strong relation between economics and politics was uncovered by the examination of the published research. Government intervention, market design and organization, and labor market dynamics are, as well, some of the currently most widely discussed topics.

v. There are some subjects that appear to receive disproportionate attention (as healthcare and education), in detriment of others (e.g., tourism and sports). Moreover, economics is sensitive to real-life events, namely those that have mostly disturbed the economy on a global scale since the beginning of the century, i.e., the great recession that followed the 2007-2008 financial crisis, and the COVID pandemic.

vi. Behavioral economics and complexity economics appear to be important pathways for the future of economic research, but they have not yet penetrated fully in mainstream economics.

vii. Economics is a science capable of creating its own tools and of adapting mathematical tools to study many of the observable phenomena. Especially, empirical research has acquired a new impetus with the generalization of field experiments, namely those associated with randomized control trials.

viii. Economists also reflect on their own role, although with containment and parsimony.

Although the above themes will certainly continue to be the ones deserving the most in-depth reflection from economists, one expects economics to evolve with society and to be able to respond to the new challenges that are posed every day. This is a science with a strong vitality that offers important, powerful, and useful contributions that are crucial for the progress of scientific knowledge, for the understanding of society, and also for the implementation of public policies.

Appendix 1. List of keywords

#	*Keywords*	*Acronym*	#	*Keywords*	*Acronym*
1	Economies	*ECO*	51	Firms	*FIR*
2	Economic systems	*ESY*	52	Management and business administration	*MBA*
3	Economic history	*EHI*	53	Organization of work	*OWO*
4	Conflict and war	*CWA*	54	Productivity	*PRO*
5	Economic growth	*EGR*	55	Innovation and technology	*ITC*
6	Physical capital and infrastructures	*PCI*	56	Investment	*INV*
7	Development	*DEV*	57	Financial markets	*FMA*
8	Income distribution and inequality	*IDI*	58	Financial institutions and services	*FIS*
9	Poverty	*POV*	59	Corporate finance	*CFI*
10	Environment	*ENV*	60	Households	*HOU*
11	Natural resources and agriculture	*NRA*	61	Consumption	*CON*
12	Energy and transportation	*ETR*	62	Savings	*SAV*
13	Geography and location	*GEO*	63	Financial literacy and household finance	*FLH*
14	International trade	*ITR*	64	Housing	*HOS*
15	Integration and Globalization	*IGL*	65	Health and healthcare	*HHE*
16	International business and capital flows	*IBC*	66	Diseases and epidemics	*DEP*
17	Labor mobility and migrations	*LMM*	67	Happiness and quality of life	*HQL*
18	International organizations and treaties	*IOT*	68	Demographics	*DEM*
19	Macroeconomics	*MAC*	69	Education	*EDU*
20	National accounts	*NAC*	70	Human capital and skills	*HCS*
21	Business cycles	*BCY*	71	Labor supply	*LSU*
22	Employment and unemployment	*EUN*	72	Wages and personal income	*WPI*

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23	Fiscal policy, deficits and debt	*FPD*	73	Gender	*GEN*
24	Monetary policy	*MPO*	74	Racial discrimination and integration	*RDI*
25	Monetary systems and exchange rates	*MSE*	75	Norms, moral and ethics	*NME*
26	Financial crises	*FCR*	76	Culture, religion and ethnicity	*CRE*
27	Money and interest	*MIN*	77	Behavior and choice	*BCH*
28	Prices and inflation	*PIN*	78	Rationality	*RAT*
29	Government	*GOV*	79	Expectations and beliefs	*EXB*
30	Public policies and public goods	*PPG*	80	Psychology and emotions	*PSY*
31	Politics	*POL*	81	Utility	*UTI*
32	Collective choice	*CCH*	82	Preferences	*PRE*
33	Taxation	*TAX*	83	Cognition and personality	*CPE*
34	Welfare state	*WST*	84	Social interaction	*SIN*
35	Incentives and individual freedom	*IIF*	85	Networks	*NET*
36	Contracts and property rights	*CPR*	86	Games	*GAM*
37	Law and regulation	*LRE*	87	Evolution and complexity	*EVC*
38	Crime and justice	*CJU*	88	Mathematical and statistical methods	*MSM*
39	Institutions	*INS*	89	Dynamic analysis and optimization	*DAO*
40	Markets	*MKT*	90	Econometrics	*ECM*
41	Competition	*COM*	91	Data sets and data analysis	*DSA*
42	Auctions and matching	*AMA*	92	Empirical research	*ERE*
43	Equilibrium and efficiency	*EEF*	93	Estimation, inference and forecasting	*EIF*
44	Information and knowledge	*IKN*	94	Experiments	*EXM*
45	Risk and uncertainty	*RUN*	95	Economics: definition and scope	*EDS*
46	Industries	*IND*	96	Interdisciplinarity and general science	*IGS*
47	Digital economy	*DIG*	97	Research in economics	*REC*
48	Sports	*SPO*	98	Teaching of economics	*TEC*

49	Tourism	*TOU*	99	Economists	*ECS*
50	Media, entertainment, and communication	*MEC*	100	Economic thought	*ETH*

Footnotes

[1] $C_i = \sum_{j=1}^{100} \left(\frac{c_{ij}}{\sum_{l=1}^{100} c_{il}} \right)^2 \times 100, c_{ij}$: number of articles of journal i allocated to keyword j.

[2] See Heckman and Moktan[89], who pursue a detailed analysis of the correlation between publishing in top economics journals and academic success in the main economics departments of universities located in the United States.

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