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JUST ANOTHER NICHE IN THE WALL? HOW SPECIALIZATION IS CHANGING THE FACE OF MAINSTREAM ECONOMICS

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JUST ANOTHER NICHE IN THE WALL? HOW SPECIALIZATION IS CHANGING THE FACE OF MAINSTREAM ECONOMICS*

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Abstract

There is considerable discussion on so-called 'mainstream pluralism', that is, on the co-presence of a variety of research programmes in today's mainstream economics that: 1. significantly deviate from the neoclassical core; 2. are pursued by different, often separate communities of researchers; 3. have their origins outside economics. The literature tends to regard mainstream pluralism as a transitory state towards a new, post-neoclassical, mainstream. This paper advances a new interpretation: it suggests that the changing and fragmented state of mainstream economics is likely to persist over time under the impact of specialization (as a self-reinforcing mechanism) and the creation of new specialties and approaches, also through collaboration with researchers from other disciplines.

Keywords: Mainstream pluralism; Mainstream economics; Specialization; Burden of knowledge; Economics in relation to other disciplines

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Introduction

There is considerable discussion on the future scenarios of economics as a discipline. Historians of economics and economic methodologists are debating on so-called 'mainstream pluralism' (Davis 2006), that is, on the co-presence of a variety of research programmes in today's mainstream and which significantly deviate from the neoclassical core. Connoted by the use of distinct theories and methods, such programmes are pursued by different, often separate communities of researchers. A non-exhaustive list includes evolutionary game theory, behavioural, cognitive and experimental economics, neuroeconomics, agent-based complexity economics, new institutional economics, and the capability approach. Economics has never been an entirely cohesive discipline. Nonetheless, the contrast between the fragmentation of today's 'mainstream pluralism' and the decades when many leading mainstream economists extolled the virtue of the 'imperial' attitude of their discipline (built upon the relative strength of the neoclassical core) could not be starker. In recent decades, not only have other disciplines had a profound impact on economics, but they are also at the origins of virtually all the research programmes that currently populate the mainstream.

Analysis of the current and future state of the discipline is an extremely complicated undertaking. Theoretical speculations in this regard involve questions that range from the nature and desirability of pluralism as opposed to the monolithism of dominant approaches, through the relationships among mainstream, orthodoxy and heterodoxy, the (sociological) analysis of individuals' research careers, to economics as a discipline in a *milieu* of social sciences. Also in an attempt to have these various perspectives converse with each other, this paper contributes to the discussion by suggesting that the fragmented nature of mainstream economics may persist over time under the impact of the self-reinforcing mechanism of specialization and the resulting creation of new specialties and approaches. In view of the huge literature on, and soaring interest in, pluralism, Section 1 elaborates on the ambiguities inherent in the term 'pluralism' in order to describe the current state of the mainstream. Then presented is a widely shared perspective on the future of mainstream economics whereby pluralism is a transitory phase in a Kuhnian-Lakatosian cycle of scientific development bound to re-establish the dominance of a single approach. As an alternative to this view, Section 2 discusses the recent evolution of economics as an ongoing process of growth in size and diversity induced by – and at the same time producing – patterns of radical specialization. To explain the necessity of specialization in economics

and the heights that it has reached, we employ Heiner's (1983) notion of the competence-difficulty gap that induces individuals to opt for behavioural rules and routines in contexts of uncertainty. Narrowing one's expertise is seen as a viable strategy with which to reduce the competence-difficulty gap that 'innovators' in economics suffer from because of the discipline's continuously growing corpus. After providing evidence on the impact of the 'burden' of previously accumulated knowledge on innovative research, we discuss specialization as a solution for this state of affairs, citing in support an unduly neglected theoretical framework in which to analyse the importance of specialization. The reference is here to Thomas Kuhn's later (evolutionary) work on scientific development, where specialization, not paradigm shifts, is considered as the key driver of progress. From this perspective, mainstream pluralism results from the discipline's growth in size and diversity. Because specialization increases, at the aggregate level, the burden of knowledge that it is otherwise intended to reduce for individual researchers, it aggravates the problem. By creating its own necessity, specialization continuously causes new niches to open in the mainstream wall.

The 'from within' character of the suggested explanation for mainstream pluralism should not divert attention from the changing pattern of the (historically troubled) relationships between economics and contiguous disciplines which have generated many of today's mainstream research programmes. Section 3 tries to merge into a coherent narrative – wherein specialization plays a fundamental role – the tradition of economics imperialism, the novelty of 'reverse imperialisms' by other disciplines, and current proposals to reunify the social sciences by adopting a transdisciplinary paradigm. Such proposals are interpreted as reactions to, and certifications of, the fragmentation of mainstream economics. In light of the later Kuhnian framework, we instead suggest that the desired transformative effects of one discipline upon another can occur at the (much lower) level of niches produced by specialization: 'local' rather than 'global' knowledge is thus the driver of scientific development.

Section 4 offers suggestions for future research. Specifically, it suggests that the 'cycle theory' of alternation between periods of dominance and periods of pluralism in economics should be integrated with analysis of the long-term trend of increasing specialization. It then highlights the importance of the later Kuhnian framework for the debate, in heterodox economics, on the usefulness of integrating different schools of thought into a unifying perspective. Finally, it speculates on a possible new, fundamental role that the history of

economic thought could play – if mainstream pluralism proves to be the onset of a phase of disunity – in a post-foundational economics.

1. '**Mainstream pluralism**'

The economic crisis and the subsequent crisis of economics[1] have made pluralism a hotly debated issue. It is common to refer to Hodgson, Mäki and McCloskey's 1992 "plea for a pluralistic and rigorous economics" in the *American Economic Review* (*AER*) as the first initiative of a series that culminated in the creation of a variegated international movement in favour of pluralism involving academics and, more recently, young economists and students.[2] Pluralism has been defined in a variety of ways, and the multiple issues debated further complicate the search for clarity on its meaning. Pluralism is, first, an ethical principle (Garnett, Olsen and Starr 2010). The epistemological dimension of pluralism is based on the idea that there exists no superior standard, but only competing standards for truth and knowledge. This may imply advocacy of pluralism not only as methodology (pluralism of method; see Samuels 1998; Boumans and Davis 2010) but also as meta-methodology, rejecting the reductionism of monism on ontological bases (the 'open' character of the system under consideration: see Dow 2004, 1997). Pluralism also has normative and prescriptive dimensions (see Dutt 2014).

On a more general level, pluralism is not simply plurality; rather, it "involves arguments or reasons for plurality" (Mäki 1997, 39). Whence derives the difference between the "first-wave" pluralism (Garnett, Olsen and Starr 2010, 2) of Post Keynesians, Institutionalists, Sraffians, Marxians, and other dissenting schools of thought, who were monist "in their pursuit of stand-alone alternatives to mainstream theory" but nevertheless "sought to make truth and method contestable in economic enquiry" (ibid.), and the "second-wave pluralism" inaugurated by the *AER* petition calling for a "critical conversation and tolerant communication between different approaches" (Hodgson, Mäki and McCloskey 1992). By directing attention to the importance of (second-wave) pluralism for heterodoxy[3], Dobusch and Kapeller (2012) have introduced a distinction between an "interested" variety of pluralism (whereby heterodox economists should actively engage in constructing a pluralist conception of economics and in practising pluralism, rather than contenting themselves with tolerance for "a pluralism of paradigms", 1045) and a "disinterested" one. This latter variant tolerates a plurality of approaches and allows the coexistence of different schools of thought, without true concern for pluralism itself: that is, (in Mäki's 1997 abovementioned

terms) without a theory that prescribes a plurality of approaches.

Pleas for pluralism thus signal that economics is not pluralist (Sent 2006), and there is little doubt that mainstream economics disregards pluralism as an issue (Davis 2008b; see also Holcombe 2008). Yet the literature on today's 'mainstream pluralism' as opposed to the compactness of yesterday's neoclassical dominance may induce the belief that the coexistence of a plurality of research programmes in today's mainstream is a kind of disinterested pluralism. *Faute de mieux*, 'mainstream pluralism' therefore appears to be an acceptable label. There are three main reasons supporting its use. First, 'neoclassical economics', as Colander (2000) already observed fifteen years ago, has become an obsolete and useless label for modern economics. Second, such plurality is perceived and recognized as legitimate by mainstream economists themselves (Davis 2008b). Although the latter are generally indifferent to the ideal of impressing a pluralist turn on economics, Dani Rodrik (2015) has recently used the 'plurality' argument to defend economics against accusations (by Fourcade, Ollion, Algan 2015) of 'insularity' and reductionism. "Economics is a collection of models that admits a wide variety of possibilities", he writes (Rodrik 2015, 178), while pointing to the heterogeneity of mainstream economics (and explicitly agreeing with Colander, Holt and Rosser 2004). Third, the newness of today's plurality of mainstream research programmes is due also, and significantly, to the contribution of other disciplines (see Davis 2006)[4], which "have taken economics in novel directions" (Rodrik 2015, 207).

Davis's (2008b) account of the alternative positions concerning the recent evolution of mainstream economics includes two opposed radical views: the one whereby mainstream economics is a synonym of neoclassical economics (1); and the one which holds that neoclassical economics is dead, and not just as a label (4). Intermediate positions are the one according to which other approaches coexist with dominant neoclassical economics (2), and the one which maintains that the mainstream is already a pluralistic environment which includes neoclassical economics as the formerly dominant, but now declining, research programme (3). In regard to mainstream pluralism, we here adopt a median position between views (2) and (3). Today's mainstream economics shows at least some signs of neoclassical dominance, but at the same time its "changing face" (Colander, Holt and Rosser 2004, Hodgson 2007) is likely to be towards pluralism. The aim of this paper is to provide reasons to believe that today's mainstream pluralism may mark the inception of a future of pluralism.

Much depends on the definition of 'mainstream'. Colander tends to use a sociological

concept (Dequech 2007-8) of 'mainstream economics' which emphasizes the ideas that leading economists "find acceptable" (Colander, Holt and Rosser 2004, 490). Dequech's definition is based on prestige and influence in terms of approaches taught at the most prestigious universities, published in the top journals, and receiving financial support from the most important foundations. Adopters of this definition focus less on internal consistency and speak of 'diversity', somehow moderating enthusiasms for the 'changing face' of the mainstream. After all, the neoclassical subset of the mainstream still dominates pedagogy (Davis 2008a), and the search for commonalities in the mainstream likely reveals the continuing relevance of mathematical formalization and narrowness of 'method' (see Dequech 2007-8).[5]

More in general, it is widely believed that, despite being "everywhere evident" (Caldwell 2013, 758) in the practice of economics, this 'diversity' in research will not last long. It might simply represent one of the two (necessarily transitory) phases of a cycle shaped by the succession of periods of dominance of single approaches and periods of pluralism. Davis (2008a, 350-351) identifies five "pluralistic environments" in the history of the discipline that later gave way to dominance: first, "the transition from classical to neoclassical economics in nineteenth-century Britain"; second, "the *Methodenstreit* between the German Historical school and the early Austrians"; third, "the multiple approaches to labour and monetary economics in post-Marshall Cambridge"; fourth, "the interwar competition in the USA between institutional and neoclassical economics"; fifth, and finally, "the 1970s debate between proponents of monetary and fiscal policy in the ISLM framework".

Despite the general heterogeneity of the landscape, concerns and fields of inquiry shared by competing research programmes in mainstream economics would increase the likelihood of a return to monism in the form of a "new general research programme for economics that would abandon much of neoclassicism" (Davis 2008a, 350). Colander, Holt and Rosser (2004, 496) Suggest that complexity, the "defining factor of the new work at the edge of economics", could act as a sort of attractor. The various research programmes would be changing both mainstream economics and how it sees itself, while complexity as a "different framework for economic thought" is "moving steadily to the centre" of the discipline (Arthur 2014, 25). This would pave the way for the triumph of the "broader vision" of complexity as a "new orthodoxy" (Colander, Holt and Rosser 2004, 497). Institutional economists (see Hodgson 2007) explore the possibility that today's pluralism may result in

the advent of "an alternative evolutionary paradigm" (Hodgson and Stoelhorst 2014, 532) providing economics with the "system view" required to realize Veblen's dream of economics as an evolutionary science (Winter 2014, 638).

Despite widespread dissatisfaction with both approaches when applied to economics, economists involved in the debate continue to employ, explicitly or tacitly, a post-Popperian philosophy of science inspired by Thomas Kuhn and Imre Lakatos (see Sterman and Wittemberg 1999). When Kuhn published *The Theory of Scientific Revolutions* (1962), logical positivism was by far the dominant philosophy utilized to explain scientific progress in economics. As early as 1971, however, Kunin and Weaver argued that economics was the social science most suitable for application of Kuhn's theory, mainly because of the strength of the neoclassical paradigm.

Kuhn maintained that the development of science proceeds by 'paradigm shifts', where 'paradigm' is the model defining how to conduct research (indicating both puzzles to solve and tools for solution) in periods of 'normal science'. A revolution requires a legitimacy crisis: the accumulation of anomalies that cannot be explained without breaking the rules of the guiding paradigm produces a "proliferation of divergent articulations" or "ad hoc adjustments" (Kuhn 1970[1962], 83). Researchers will gradually come to regard such puzzles as anomalies until they experience a sort of 'gestalt' switch: when an alternative paradigm? has attracted a sufficient number of leading researchers from other approaches, a revolution occurs, and the new incompatible paradigm replaces the previous one.

It may be tempting to refer to neoclassicism as the once leading 'paradigm' which has now ceased to govern research in economics owing to the accumulation of 'anomalies'. One could observe, for instance, that the axiomatic approach has erected insurmountable walls around the object of research of the neoclassical paradigm: consequently, with the discovery of fundamental flaws in general equilibrium theory, the paradigm has lost much of its external credibility. Or it has been argued that the survival of neoclassical economics depends on its ability to encompass criticisms emanating from competing approaches, but also that the resulting elastic paradigm, like an oil spot, is condemned to lose depth while growing in extension (Fontana 2010; see also Bronk 2011, Palley 2013, and for a criticism, Elsner 2013).

Competition between alternative paradigms is *de facto* impossible in periods of normal science. Paradigm implies maturity, whereas pluralism is but science in a pre-paradigmatic, and necessarily transitory, phase. Orthodox economics has always been internally

challenged by a number of alternative research programmes. The 'paradigmism' of the orthodoxy – the dismissal of heterodoxy, and the denial of its legitimacy – simultaneously serves the purposes of defending the discipline's autonomy from neighbouring sciences and of strengthening its 'scientific' character. It defends the discipline, especially in the transition from theory to policy, from the potentially destructive effects that open recognition of the plurality of views and values inspiring research in economics might trigger (Davis 2008a). But 'paradigmism' may affect heterodox economics as well, when it aspires to become the "single correct alternative", "the new 'general theory', to which other theories would be subsumed as special cases" (Garnett 2006, 526, 524); an ambition, the case of complexity economics seems to confirm, which continues to inspire current edge-research programmes in today's economics.[6]

An increasing number of (heterodox) competing approaches can therefore be taken as symptomatic of paradigm crisis. Pre-paradigmatic periods are marked by "frequent and deep debates over legitimate methods problems and standard of solutions, though these serve rather to define schools than to produce agreement" (Kuhn 1970[1962], 48). If these alternative approaches are gradually accepted into the mainstream, the chances of revolution are positively affected. As Colander, Holt and Rosser (2004, 487) maintain: "a large variance in acceptable views, such as emerged in the profession over recent decades, signals that changes are likely in the future".

Often purely speculative in character, the discussion seems to tolerate a certain degree of inaccuracy in the use of one or another philosophy of scientific development.[7] Kuhn's own remarks about social (as opposed to natural) disciplines lacking a unifying paradigm (see Boumans and Davis 2010) added to economic methodologists' criticisms of the rigidity of Kuhn's theory for economics (see Drakapoulos and Karayiannis 2005). The literature on mainstream pluralism admittedly tends to employ, therefore, a Lakatosian view of scientific progress. In Lakatos's (1970) perspective, each research programme consists of an indispensable 'core' of irrefutable assumptions, and a 'protective belt' made of (dispensable) assumptions, procedures, and testable theories, ensuring that it is possible to apply the 'core' to specific problems even in the presence of anomalies. Pluralistic competition – contrariwise, Lakatos (1970, 142; see Walker 2010) assumes that "peaceful coexistence" cannot last indefinitely – between different research programmes is possible even in the case of dominance: research programmes can in fact experience 'progressive' shifts – when predicting or leading to the discovery of new facts – and, conversely, 'degenerative' ones.

"The dominant approach to economic methodology" in the 1980s (Backhouse 2004, 181), Lakatos's "methodology of scientific research programmes" (MSRP), lost attractiveness (see De Marchi and Blaug 1991) after it became clear that Lakatos had restrictively identified the 'research programme' with its invariant core, and that MSRP made measurement of theoretical and empirical scientific progress a virtually impossible endeavour (see Backhouse 2004, Boumans and Davis 2010). This did not prevent Colander, Holt and Rosser (2004, 488) from directly invoking Lakatos in support of their 'gradualist' argument about changes within today's mainstream:

> When certain members of the existing elite become open to new ideas, that openness allows new ideas to expand, develop, and integrate into the profession. In this case change within the profession can be accepted gradually, being introduced 'data set by data set' and 'new technique by new technique' as well as 'funeral by funeral'. In some cases these new ideas will originate from outside the mainstream, from those who consider themselves heterodox, even if the acceptance of such ideas leads to their 'normalization' and removal from being identified as heterodox. These alternative channels allow the mainstream to expand, and to evolve to include a wider range of approaches and understandings. Eventually, sufficient change is made so that future historians of thought will consider the orthodoxy of the period changed. This, we believe, is already occurring in economics (ibid.).

Changes would occur "in a way that is not apparent to the mainstream. These changes do not lead to sudden paradigm shifts, but instead lead to cumulative evolutionary changes that ultimately will be recognized as a revolutionary change" (489).

But the literature on 'recent economics' is Lakatosian as well. More importantly, it is so in distinguishing between a subset of 'core' research programmes and ones that represent the discipline's 'periphery', although these latter are not to be understood as a 'protective belt' but rather as occupying a marginal position. "They pursue questions and issues removed from core concerns and often at odds with core assumptions" (Davis 2012, 213). Until the 1980s, taken together, such programmes represented the 'heterodoxy'. And it was in the periphery that economics encountered other disciplines, sharing with them assumptions and theoretical frameworks, and creating new research fields that would eventually result in transformation of the discipline as a whole (Davis 2008a). But Lakatosian gradualism does not necessarily discourage adoption of a cyclical model to explain the evolution of economics: Davis (2008a) plainly contrasts his reading of the history of economics as an alternation of dominance and pluralism with the possibility that economics might "simply become more pluralistic for the indefinite future". Not dissimilarly from Kuhn's theory (see

Mäki 1997, Weinberg 2001), the pattern remains cyclical: mainstream pluralism is the 'pre-paradigmatic' state of contemporary economics.

2. Fragmentation, specialization, and the recent evolution of mainstream economics

As Coats has recently pointed out, economics is a "large and heterogeneous discipline" held together by "formalization and mathematization" but populated by "a number of dissenting or deviant doctrinal schools, rival methodological approaches, and innovative developments designed to remedy its defects and/or overcome its limitations" (Coats 2014, 383). Some "prominent economists with impeccable professional credentials" in this dissenting area would even "threaten the discipline's foundations" (ibid.). Only a few scholars, however, have insisted on fragmentation as the distinctive feature of recent economics. The most important reference in this regard is still the 1991 'philosophical' symposium of the *Economic Journal* on "The Next Hundred Years" of the discipline.

In his contribution to the symposium, Pencavel (1991) emphasized the continuing growth of economics in both size and diversity. On the one hand, economists had fully demonstrated their usefulness and necessity in (modern) societies that rely closely upon the competencies and authority of expert systems; the discipline will therefore grow in size in the future, he argued. Yet the possibility for economics to express its arguments mathematically, a key factor supporting its forays into territories traditionally pertaining to other disciplines, will not have much influence in the future. Pencavel wrote that "rival" sciences will acquire the skills to compete, and economists will learn how to use methods, and modes of thought from other sciences. "Economists will be an increasingly heterogeneous assortment of scholars. Indeed, it will become difficult to identify exactly what common elements bind us all" (85). In a "bigger", "more varied", and "more competitive" economics, "a rough pyramidal hierarchy will persist, but there will be a much wider base with many minarets representing local confluences of authority" (81). Economics will in fact become "a fragmented world of specialization" (ibid.), with the resulting problem for its practitioners of keeping abreast of developments "in more than a few narrow fields of the subject" (ibid.).

Economists, wrote Turnovsky (1991, 143) in his contribution to the symposium, will literally ignore, and be "happy to ignore, other areas of the discipline" (ibid.). Specialization, he observed, is mainly "an inevitable consequence of the maturing of economics" (ibid.): "as

progress is made into understanding the various branches and processes of economics, more detailed knowledge and expertise is required. This involves investment on the part of the individual in certain analytical techniques, necessitating his specialization to that subarea" (ibid.). But then, when no one is any longer "well versed in ongoing research" outside that subarea, "the profession will assume a more pluralistic character", Pencavel (1991, 86) remarked. The then editor of the *Journal of Economic Literature* felt that his "knowledge of Economics was becoming increasingly specialised. I knew more and more about a narrower scope of Economics" (Pencavel 2008, 6). His editorship of *JEL*, launched in 1969 "to help practicing economists keep abreast of the vast flow of the literature" (Perlman 1969, iii), represented "an opportunity to counter this professional imperative towards specialization" (ibid.); that is, to "step back from the research frontier and to take stock of a significant intellectual enterprise and to pass judgment on it" (ibid.).

Specialization may provide an important access point to the highly fragmented landscape of 'mainstream pluralism' [8]. Pencavel's and Turnovski's idea of the 'necessity' of specialisation for increasingly sophisticated economic analysis may find a possible theoretical grounding in Ronald Heiner's (1983) study on *The Origin of Predictable Behavior*. Heiner suggested that rules and institutions evolve in contexts characterized by uncertainty, which prevents agents from complying with the standard neoclassical assumption of maximizing behaviour. Contrary to the received view, he argued, it is "uncertainty in distinguishing preferred from less-preferred behavior" that induces agents to resort to rule-based behaviours, that is, to mechanisms inhibiting the flexibility to choose potential actions. The standard theory assumes that there is no mismatch between one's 'competence' (C) and the 'difficulty' (D) of selecting the most preferred alternatives. Conversely, in Heiner's framework, uncertainty generates and widens the 'C-D gap'. In so doing, it also lowers the tolerance limit of the 'reliability condition' that determines when the selection of a new action is sufficiently reliable for an agent to benefit from enhanced flexibility and the possibility itself to select that action. By lowering the probability of selecting the right action at the right time, uncertainty causes the agent to reduce the repertoire of possible actions, favouring the adoption of (more predictable) behavioural rules. Remarkably, Heiner refers to the dynamics of scientific inquiry as an illustration of this reasoning.

> The work of Thomas Kuhn (1962) (see also Popper, 1969; Lakatos and Musgrave, 1970) has emphasized a systematic pattern of resistance in the behavior of scientists to quick and sensitive reaction to new ideas and theories. Yet, when sufficient anomalies and awkwardly interpreted

> evidence about a previous theory build up, a major shift in ideas (a "scientific revolution") will relatively quickly occur. ... The Reliability Condition also implies other features in the behavior of scientists, such as: (a) resistance to accepting or using several competing theories unless there also exist easy to decipher (and reliable) criteria of when to switch between them; (b) similar resistance to incorporating new concepts or variables into accepted theories unless reliable criteria on how to use them are available (consider an economist's reaction to incorporating sociological variables into economic models); (c) differences in accepting and rewarding (salary, promotion, etc.) theoretical vs. empirical research in different fields depending on the reliability of observable data studied in those fields (for example, see Leijonhufvud's 1973 parody about "Life Among the Econ") (Heiner 1983, 575-576).

Heiner (1983: 566) is suggesting that the uncertainty arising from the "potentially complex set of relationships" between researchers' 'repertoires' and the 'structure of the environment' of scientific research induces scientists to resist exploring the possibilities opened up by the introduction of new ideas and theories within the walls of an established paradigm. Scientists will consider breaking the rules of normal science – "that limit both the nature of acceptable solutions and the steps taken to obtain them" (Boumans and Davis 2010, 98) – only when the accumulation of anomalies has recreated the conditions for consensus on a new paradigm. But there is more that one can infer by using Heiner's own reasoning: in general terms, difficulties in incorporating new concepts or variables into accepted theories may have to do with the maturing of a discipline. The growing need for more detailed knowledge and substantial involvement generally amplifies the difficulty of innovating while keeping control over developments in the entire discipline or field. In fact, economics participates in the enormous growth of scientific disciplines documented by a number of studies (see for instance Larsen and Ins 2010): while around a thousand economic articles (indexed in Thomson Reuter's Web of Science) were published annually in the 1950s, researchers currently publish some 20,000 works per annum (Claveau and Gingras 2015). When the *Journal of Economic Literature* was launched, some 5,000 major articles were published every year in about 250 economic journals.[9]

In Heiner's (1983: 566) framework, uncertainty arises because either an agent is less confident about its perceptual abilities or the complexity of the environment increases. Growing uncertainty about the research strategy to implement in times of expansion (in both size and diversity) economics widens the 'competence-difficulty' gap, in particular for

researchers at the outset of their careers. Therefore scientists are not only generally unwilling to accept new concepts or competing theories: owing to the gap between the competencies that they can put to use in trying to innovate and the difficulty of managing an ever-growing disciplinary literature, researchers reduce the repertoire of possible research paths by narrowing their expertise to extremely specialized fields.

Specialization is not only an almost inevitable by-product of the increasing sophistication of core economic theory (Turnovski 1991); it is also, as the apparently quite distant literature on innovation, creativity and entrepreneurship can demonstrate, an active, pragmatic and essentially individual response to the widening of the competence-difficulty gap. As a leading scholar in this field observes on introducing an investigation into the effects of knowledge accumulation on technological progress, researchers face the so-called problem of the "burden of knowledge"[10]: "if one is to stand on the shoulders of giants, one must first climb up their backs, and the greater the body of knowledge, the harder this climb becomes" (Jones 2009, 284). The 'burden of knowledge' corresponds to the difficulty that 'technological' innovators face in trying to reach the 'frontier of knowledge' (283) and achieve new breakthroughs.

Innovators in sciences are confronted with similar difficulties. Focusing in particular on post-doctoral and graduate students' contributions to academic knowledge, recent studies on the frontier of knowledge provide evidence of longer educational periods, longer time to publish, and lower productivity for late trainee cohorts (Conti and Liu 2015). The literature on life-cycle creativity shows, in general, that "age at great achievement" (a proxy for educational attainment) has significantly risen among scientists over the past century (see Tilghman et al. 1998; Jones, Reedy and Weinberg 2014). This result is consistent with the longer duration of doctoral programmes, the growing frequency of post-doctorates in the life sciences since the 1960s, and increasing age at doctorate for Nobel Prize winners over the twentieth century (Jones 2010[11]). Since any innovation increases the burden of knowledge, researchers must resolve, in Heiner's terms, a competence-difficulty gap, and only two strategies are available: either they learn more by attaining broader education at greater costs; or they narrow their field of expertise by specialising. The two effects are two sides of the same coin, the 'burden of knowledge': "if the distance to the frontier were not increasing, then increasing education should be associated with broader individual knowledge, not narrowing expertise" (Jones 2009, 310).

It is not difficult to document growing specialization in economics. Suggestive evidence

comes from the general and rapid increase in the overall number of academic journals, and in particular of specialised journals – "the specialization of journals", wrote Stigler, Stigler and Friedland (1995, 334), "will follow that of the scholars or professional practitioners". The decreasing importance of generalist journals further corroborates the hypothesis: among top journals, only the *American Economic Review*, the *Journal of Political Economy* and *Econometrica* have held top-ranking positions over the past three decades, while other prestigious journals such as the *Review of Economics and Statistics*, *Economica* and the *Economic Journal* have lost positions (Goel and Faria 2005, 538). Indirect evidence is provided by the spread and growing importance of the rankings of professional economics journals used to evaluate the research performances of universities, departments, and individual economists, and therefore to assign funds and make hiring decisions (see Ritzberger 2008).[12]

Economics associations, which have multiplied since the dawn of the discipline, have closely followed the dynamics of economic journals' growth (see Buccola 2006). Whilst general-interest associations have grown relatively slowly, field-level associations have expanded rapidly, in particular during the 1970s, and hyper-subfield groups have exploded since the following decade. The history of the JEL codes (see Cherrier 2015) offers another way to tell the same story: their revision in 1991 made evident the process of radical specialization and fragmentation accompanying the explosion of economics since the 1960s. Economists wanted more detailed JEL codes that could be used as "a map with which to navigate a growing and rapidly changing discipline" (37). Pencavel's leadership ensured attainment of this end. Also to be noted is that increasing exchanges between economics and other disciplines do not necessarily contribute to mitigating fragmentation by means of new interdisciplinary syntheses: newly born journals are often interdisciplinary in character, but extremely specialized (Jacobs 2014).[13]

Specialization can also be measured, albeit roughly, by team size: specialised scientists feel an incentive to work in teams. Results obtained by Jones's (2009) study on a rich patent data set, which furnishes robust evidence on increasing specialization and team size, hold for academic research as well. The body of research articles (19.9 million) included in the Institute for Scientific Information Web of Science database clearly reveal a rapid increase in co-authorship, and a spectacular rise, within social sciences, in economics (Wuchty, Jones and Uzzi 2007). In truth, Jones (2010) and co-authors (Jones, Reedy and Weinberg 2014) find that the incidence of co-authorship in economics has been constantly lower than

in biology throughout the twentieth century. However, in economics, co-authorship was almost non-existent before the 1930s, while there has rather been a sharp increase since the early 1950s (Laband and Tollison 2000). As pointed out by McDowell and Melvin (1983), the growing size of economics has substantially expanded the gains from specialization, which in turn accounts for the rise in co-authorship. And the gap between economics and biology has greatly diminished since the 1980s, when formal intellectual collaboration soared in economics while declining in biology. Laband and Tollison demonstrate also that 'informal collaboration' – and therefore the 'social construction' of knowledge, measured by collegial commentaries on papers published in a leading journal in the discipline – is much higher in economics than in biology.

Interestingly, when implicitly replying to criticisms of his early account of scientific revolutions[14], Kuhn (2000) himself emphasized in his late, neglected works the importance of specialization as a driver of scientific progress. "What replaces the one big mind-independent world about which scientists were once said to discover the truth is the variety of niches within which the practitioners of the various specialties practice their trade" (120), he observed. While in *The Structure of Scientific Revolutions*, the demise of the (once) dominant paradigm dramatically reduces the burden of knowledge, the later Kuhn sees scientific change as the "gradual and piecemeal communitarian evolution" (Kuukkanen 2012, 135) produced mainly by processes of speciation of scientific disciplines that cause the proliferation of specialties and result in further specialization. Whenever the prevailing theories and methods fail to explain a given phenomenon, Kuhn argued, scientists concentrate on that specific anomaly, thereby exploring a narrower sub-set of their problem of interest and possibly developing models and methods that aim at solving the particular puzzle under consideration. Often too particular to be relevant to the entire field, the resulting theory or approach creates a new (sub)field or specialty: branches split off from parent fields, and specialties are offsprings of two pre-existing disciplines that overlap. Focusing on the "epistemic dimension of scientific specialization" (Wray 2011, 97), Kuhn stated that each specialty develops its own lexicon or taxonomy, one that is incompatible ("incommensurable") with the established tradition: specialization implies isolation. Revolutions are therefore "local": they occur in specific research communities, and since the new specialties have a narrower focus with respect to parent fields, these latter can continue to exist. A large collection of (new) specialties can gravitate around the same set of scientific puzzles, but at the same time, due to fragmentation, a kind of topic-incommensurability

(Wray 2011) is likely to emerge, making a rational resolution of the disputes *de facto* impossible.

The later Kuhn therefore sees science as a "process underway" (Wray 2011, 204), wherein new specialties and their intrinsic, "fruitful" (Kuukkanen 2012, 139) incommensurability create the conditions for greater accuracy. The literature on the 'burden of knowledge' explicitly points out that both learning more and narrowing expertise produce negative effects on innovation. To learn more, it is argued (Jones 2009), future scholars will necessarily have less time available in the life cycle for innovation, while the self-reinforcing nature of specialization aggravates the problem for future researchers. By contrast, a Kuhnian revolution would "simplify the knowledge space" (Jones 2009, 310). This position is compatible with the traditional belief that unifying theories can yield the greatest achievements in science. The later Kuhn moved in the opposite direction: lexical diversity and the resulting impossibility to communicate are "the essential precondition[s] for what is known as progress in … the development of knowledge" (Kuhn 2000, 99). The proliferation of niches and the condition of relative isolation that follows, 'closing' scientists within protected areas, allow these latter to develop instruments that are functional to advancing local goals; "concepts that are suited to modeling the phenomena [that research communities] study without too much interference from scientists in neighboring disciplines" (Wray 2011, 135). Moreover, specialization reduces the impinging influence of dominant thoughts, thus opening research to innovative thinking. Incommensurability "serves a constructive epistemic function" (ibid., 127). Thus, whilst conceptual innovations create barriers between specialties, they also "require barriers between specialties if they are to develop" (ibid.). Inter-specialty communication breakdowns become the norm.

The later Kuhn can offer useful insights into today's mainstream economics. Fragmentation is due not only to a general variety of approaches but also to the irreducible heterogeneity produced by the many, potentially incompatible manners in which each approach deviates from neoclassicism despite adherence to the "rationality-individualism-equilibrium nexus" that characterizes neoclassical economics itself (Davis 2008b, 58). In Davis's view, in fact, there are synchronic and diachronic approaches that focus, respectively, on outcomes generated by short-run interactions (i.e. game theory, experimental economics), and on long-run interactions and their transformational effects on the phenomenon under study (e.g. complexity agent-based models economics, evolutionary economics). Taking a different perspective, Davis also distinguishes between approaches that try to grasp the

actual functioning of decision making (experimental, cognitive and neuro-economics), and others that, while still focusing on the individual, are more concerned to represent intra-individual interactions through the stylized behaviour of ideal, textbook situations (game theory). Diachronic approaches end up by adopting a system-wide perspective rather than focusing on real-world individual behaviour.

While heterodoxy has arguably played a minor role in the evolution of the mainstream towards fragmentation, other disciplines have had an active part in stimulating such changes. Kuhn's later thoughts on scientific development may explain why this should not come as a surprise. In the above-illustrated theoretical framework, on the one hand, specialization is the result of interaction between pre-existing disciplines overlapping on specific topics or in their methodological orientation; and, on the other, it forces disciplines to interact by making scientists increasingly dependent upon the findings of researchers working in other areas.

3. Social sciences, specialization and mainstream pluralism

Many research programmes of today's 'mainstream pluralism' have their origins outside economics in other social sciences. Yet, for decades, these latter have arguably been victims of economics imperialism, a form of 'economics expansionism' to new classes of phenomena that are "located in territories that are occupied by disciplines other than economics" (Mäki 2009, 360). In a famous article in the *Quarterly Journal of Economics*, Edward Lazear (2000, 99-100) illustrated the success of economics imperialism by praising the virtues, in particular, of economists' "rigorous language that allows complicated concepts to be written in relatively simple, abstract terms", so that they can "strip away complexity". This is a story of success, writes Lazear, if we are to judge by the extent to which other disciplines have adopted the economic (methodological and analytical) approach to the analysis of issues traditionally of interest in their fields. Lazear fails to notice, however, that with the passing of time, economics imperialism began to show diminishing marginal returns (Hirshleifer 1985, Frey and Benz 2005, Fine and Milonakis 2009, Cedrini and Marchionatti 2017). The accumulation of 'anomalies' produced by the expansion of economics in its imperial era caused neoclassicism to become more elastic (instead of declaring insignificant any fact or concept that questioned its assumptions, see Mirowski 2001) so that it could absorb? criticisms coming from alternative approaches.

Acceptance of the rights but also of the duties pertaining to the imperial status of

economics, so to speak, may have been at the origins of the 'reverse imperialisms' (from other social sciences to economics) that characterize the recent evolution of the discipline. The turning point in this process of "social-scienciation" (Bögenhold 2010, 1585) of economics has been not so much the establishment of "limited intellectual 'colonies'", like behavioural economics (Mäki 2013, 336), as their acceptance within the citadel of mainstream economics (Frey and Benz 2004). Contrary to economics imperialism (see Stigler 1984), reverse imperialisms have somehow been invited. Growing awareness of "how constraining has been their tunnel vision about the nature of man and social interactions" (Hirshleifer's 1985, 54) and the effort itself "to reduce other fields to microeconomics" (Sent 2006, 84) through the microfoundations project (failures producing moderate acceptance of pluralism in theories, ibid.) removed obstacles to such invasions.

The literature on mainstream pluralism invokes collaboration with other disciplines as the means to achieve a radically different and desirable new mainstream (Hodgson 2007), or sees it as the *fait accompli* producing a new era in economics (Holt, Rosser and Colander 2011). Due to the recent incursions by social sciences into economics, it has become difficult to ascribe economics imperialism to the entire discipline (see Davis 2012): social sciences are actively fostering the fragmentation that characterizes today's mainstream pluralism. It is likely that specialization is playing a role in this evolution. Heiner's reasoning on resistance (however temporary) to paradigm shifts as (also) caused by the intrinsic difficulties of interdisciplinary adventures does not consider scientific specialization. For a variety of reasons, specialization requires *external* expertise deriving from other disciplines: in a later Kuhnian perspective, economists who have narrowed their expertise to reduce their C-D gap (or the burden of knowledge) and work in 'local' settings are likely to find themselves more dependent on the skills and knowledge of specialists in other fields. In a historical perspective, specialization with greater reliance on the contributions of other disciplines makes it possible to cope effectively with the C-D gap widened by the progressive removal of the 'futility theses' of economics imperialism by reducing the burden of knowledge of 'mature' economic science.

Interestingly, the recent literature on scientific innovation and creativity finds that the burden of knowledge is comparatively heavier in the age of mainstream pluralism. Studies on age and scientific 'genius' distinguish between the abstract and theoretical work of 'conceptual' economists, who solve precise problems deductively, and the concrete and empirical work of 'experimental' economists, who address broader questions inductively.

While conceptual work (innovations typically consisting in significant departures from the received paradigm) is done mostly at the outset of a career, great achievements in experimental work come much later, due to a heavier 'burden' of accumulated knowledge and experience, and the fact that the increase in 'training' (as opposed to 'creative') time 'truncates' early life-cycle innovative capacity (see Jones, Reedy and Weinberg 2014, Weinberg and Galenson 2005).

The transition from economics imperialism to mainstream pluralism and 'reverse imperialisms' is also, to a certain extent, one from theoretical and conceptual to concrete and experimental work. In the past there was widespread consensus on the primacy of economic theory ("centered on mathematical modeling of maximizing agents", Backhouse and Cherrier 2014, 10) over empirical work, and the idea "was strengthened by … economics imperialism" (ibid.). From the early 1970s onwards, dissatisfaction with both methodological monism and the scant relevance of such models were at the origins of the 'empirical revolution' of the 1990s. Representing "a significant departure from the now disparaged over-theoretical orientations of the 1970s and 1980s" (Fourcade, Ollion, Algan 2015, 92), the turn was favoured by the shift from theoretical towards applied economics, the resulting continuous creation and institutionalization of new fields lying at the origins of "a process of fragmentation of the discipline" (Backhouse and Cherrier 2014, 13).

The focus on specialization can add new elements to the discussion on the features that mainstream economics may assume in the near future. Davis (2008a) believes that a new orthodoxy can result from a combination of the research programmes currently coexisting in the mainstream. On this view, the new orthodoxy emerging from a 'conservative' rather than 'transformational' pathway will emphasize individuals' social embeddedness and the mutual influence exercised by individuals and social structures; but it will only mildly adopt an evolutionary rather than mechanical perspective on processes. In this regard, it is highly significant that Davis cites (without, however, discussing it) Gintis's (2007) proposal of a "framework for the unification of the behavioral sciences" as a serious candidate to become the post-neoclassical mainstream arising out of the current pluralism.

Gintis has stressed on various occasions the need to construct a new theoretical framework integrating natural and social sciences. A "strong current of unification, based on both mathematical models and common methodological principles for gathering empirical data on human behavior and human nature" (Gintis 2007, 15) would make it possible to render "coherent the areas of overlap of the various behavioral disciplines" (1), putting an end to a

"scandalous" but hitherto "tolerated" (15) situation of latent or concrete conflict. Gintis's transdisciplinary (to employ Alvargonzález's 2011 definition) approach uses the 'canonical model' of individual choice behaviour as reformed by recent laboratory and field behavioral research (see, respectively, Fehr and G***ä***chter 2000, Henrich *et al.* 2005; in general, see Camerer 2001, and Gintis, Bowles, Boyd and Fehr 2005). The new 'framework' rests on five "conceptual units". The general "gene-culture coevolution" perspective – "the application of sociobiology" (Gintis 2009: 224) – incorporates both "the most important analytical construct in the behavioral sciences operating at the level of the individual" (Gintis 2009, 222), that is, a rational actor model based on choice consistency rather than maximization, and a "sociopsychological theory of norms" (233) making the sociological and economic models of social cooperation compatible. (Evolutionary) game theory is raised to the status of "universal lexicon of life" (Gintis 2007: 8). Complexity theory concludes the list.

De facto reviving (Getty 2007) Edward O. Wilson's ambition to include the "last branches of biology" – that is, the recalcitrant social disciplines – in the "Modern Synthesis" of sociobiology (Wilson 1975, 1998, Hirshleifer 1985; in general, see Cedrini and Marchionatti 2017), Gintis assigns to biology in particular, in conjunction with the 'new' economics that he himself has contributed to developing, the task of leading the desired revolution in behavioural sciences. More importantly for our purposes here, in his endeavour? to "repair" (Gintis 2007, 1) the "fragmentation" (1) of behavioural sciences, Gintis conveys a crucial message about the revolutionary changes ongoing in mainstream economics under the influence of interdisciplinary work with biologists, anthropologists and sociologists. The unifying framework is configured as a collage of many, if not all, mainstream research programmes: from behavioral economics to evolutionary game theory, from new institutional economics to complexity economics, plus a revised version of the canonical rational actor model. Implicit in Gintis's proposal seems to be the idea that economics will inaugurate a new, post-neoclassical era of 'dominance' only with the advent of a unified, 'transdisciplinary social science' able to reconcile the autonomous streams of today's mainstream pluralism with one another within a much larger general framework. According to philosopher Steve Clarke (2007: 22), Gintis's "unified behavioral science could be expected to have many of the characteristics of a Kuhnian paradigm", and discourage researchers from further investigating the plausibility of the unified framework's assumptions. The problems of specialization, heterogeneity and incompatibility are simply projected at a higher level: to get rid of pluralism in social sciences, Gintis appeals to the

formerly imperialist disciplines, (socio)biology and economics, and asks them to drive the reunification.[15] The proposal targets behavioural disciplines (either the origins of reverse imperialisms or in any case involved in the development of new mainstream research programmes). But it also has the non-secondary aim of inducing economists working in the various programmes of mainstream economics to perceive unity in diversity, and uses (other) social sciences as sources of legitimacy for the principle of *e pluribus unum*.[16]

Gintis's work can thus be considered (also) as a reaction to the 'disintegration' of mainstream economics, with the concomitant attempt to reorganize it by exploiting the contribution that other social sciences can offer in this regard. The hypothesis receives indirect confirmation from exponents of other research programmes in today's mainstream. Colander, for instance, suggests treating the problem of pluralism in economics "from the perspective of all the social sciences" (Colander 2014, 516), whose pluralism ("each social science follows a relatively narrow methodological approach, and there is little conversation and cross fertilization of methods and approaches from one social science to another", 517) is "dysfunctional" (ibid.). Colander emphasises the lack of a common "scientific foundation for all social sciences" (Colander, Kupers, Lux, and Rothschild 2010, 3) and favours reintegration of the contributions of all social sciences into the core of all social science training through development of a framework that exploits "advances in theory, analytical and computation techniques … and advances in statistical analysis" (ibid.).

A recent special issue of the *Journal of Institutional Economics* (*JIE*) discusses the possibility of a theoretical and strategic alliance between institutional and evolutionary economics. Remarkably, the issue is almost entirely framed in terms of a possible paradigmatic (Kuhnian) shift whereby the two approaches could aspire to become the new mainstream. In general, this scenario is regarded as highly unlikely because of the "radical transformation of the academic values and culture within economics" that it would require (Hodgson and Stoelhorst 2014, 528). Yet it is argued that the *zeitgeist* in social sciences would be favourable, in general, to the institutional/evolutionary perspective, and might even produce a "gestalt shift" (ibid.) supposed to benefit, *in primis*, exactly institutional and evolutionary economics. A possible solution of this frustrating state of affairs is detected, once again, in moving towards the more "comfortable home" (529) of social sciences. In Winter's (2014, among others) words, evolutionary economics must "work outside the usual beachhead" (639). Today's mainstream economics is in fact the "scientific cacophony" of a "pre-paradigmatic discussion" (638), and not the "system view" that economics could offer

while participating in the "meta-project" of a "large-scale evolutionary framework developed by natural science and increasingly accepted by social disciplines" (ibid.). Only a "paradigmatic evolutionary social science", writes Stoelhorst (2014, 680), will then produce the desired revolution in economics: "the likelihood of a substantial impact [of institutionalist and evolutionary economics] on this mainstream would be increased if evolutionary economists are willing to cast themselves as evolutionary social scientists first, and as economists only second" (679).

Important non-core approaches (complexity economics, institutional economics), in sum, manifest scepticism regarding the possibility that a pluralistic mainstream can exert pressure for change and favour the launch of a truly post-neoclassical economics. Hopes are instead placed in the transformative effect that a transdisciplinary perspective, or 'unity-of-science' framework, can have on economics, while contributors to the *JEI* special issue even seem to outline a political strategy – surrounding the mainstream with the combined force of social sciences and thereby obliging it to reform.

This adds an important factor to the analysis of mainstream pluralism with a focus on specialization as the engine of progress in science. Specific fields like behavioural economics result from the overlap between two pre-existing disciplines: economics and psychology. In such cases, parent disciplines retain their autonomy by selectively appropriating contents from the other discipline so as to avoid importing contents that would conflict with the theoretical and methodological core of economics itself (Davis 2013). 'Selection biases' of this kind are fully justified, in a later Kuhnian evolutionary approach, since they facilitate the development of "concepts that are suited to modeling the phenomena [research communities] study without too much interference from scientists in neighboring disciplines" (Wray 2011, 135). The limited influence that dominant approaches can exert on developing niches would in fact enhance the possibility of conceptual innovations. At the same time, Kuhn implicitly confirmed that transformative influences of one science on another are possible, and indeed drive progress itself. Innovations occur at the frontier: here a continuous process of emergence, differentiation and integration of new specialties takes place, incessantly modifying the relationships between disciplines themselves. In other words, the idea of maintaining autonomy may be self-defeating: or, in any case, the problem itself of interdisciplinarity (as well as of imperialism) must be addressed, as Davis (2012, 212; see also 2016) remarks, "at a lower level of aggregation than entire fields or sciences".

The hope for a unified science is the main reason why philosophers have traditionally neglected the relevance of specialization, generally considered as an impediment to reunification (Wray 2011, 117). But the later Kuhn would not support criticisms of the 'scandalous' pluralism of social sciences. Rather, it is the variety and proliferation of niches, the resulting incommensurability, and the (necessarily) 'local' knowledge produced, that allows scientific progress.[17] A later Kuhnian approach would therefore postulate the existence of a specialization trade-off: while economics grows in size and diversity, it fragments under the 'burden of knowledge', which makes innovation more difficult to attain. Nevertheless, in an age of reverse imperialisms and (necessary) diffusion of interdisciplinary research, specialization may enhance the capacity itself to innovate by creating niches wherein specialists are free and able to reach the frontier of knowledge.

4. Conclusions

If Axel Leijonhufvud were to write a new report upon returning from the territory of the Econ tribe, some forty years after his 1973 journey, he would probably tell of a myriad of castes and totems.[18] He would describe the Econ social structure as far more complicated, with a persisting but looser pyramidal hierarchy, and a wider base, with many local authorities. He would also have difficulties in describing the manufacture of 'modls' in one's 'field' in general terms, due to the heterogeneity of 'modls' made by the various castes of the Econ. This paper has focused on two established, highly debated facts, about the current state of economics. First, mainstream economics shows a more pluralistic outlook with respect to the past; second, the amount of knowledge that the new generations of scholars have to master in order to reach the frontier of research has steadily increased over the years. Put in the appropriate perspective, these seemingly unrelated facts provide interesting insights on the present and future of economics as a science. The literature referred to in this article can be divided into two (heterodox) streams, roughly reflecting the usual descriptive/normative divide. One stream discusses the evolution of 'recent' mainstream economics, welcoming the end of neoclassical dominance and the emergence of mainstream pluralism. Sceptical about developments in recent economics, scholars of the other stream focus on pluralism itself and seek to foster it. Specialization provides a particular key to understanding the fragmented character of recent economics that might also be used in exploring the possibility of a truly pluralistic future. Nurtured by economics' growth in size and diversity, specialization results from, and at the same time fosters, a

decline in the binding power of the neoclassical paradigm and an increase in the 'burden of knowledge' required to innovate in economics. The widening gap between researchers' competencies and the difficulty of reaching the frontier encourages narrow expertise operating in niches that allow increasing autonomy in solving scientific puzzles. The process is self-reinforcing: by specialising, scholars end up by creating new specialties and approaches, enhancing variety and possibly sowing the seeds of pluralism.

The much heavier burden of knowledge marks a substantial difference between the current scenario and the past 'pre-paradigmatic' periods in economics. With a growing competence-difficulty gap, specialised scholars may unintentionally favour both topic-incommensurability (impeding the 'rational' resolution of disputes between competing theories) and incommensurability between neighbouring disciplines (see Wray 2011). The preceding sections dealt with the effects that this process can have on creativity and innovation in the discipline, as well as on the relationships (and boundaries) between economics and social sciences. One might add that the 'variety of scenarios' produced by increasingly specialised economic theory in an age of mainstream pluralism can likely prefigure the advent of a more "humble" economics that would make economists "better citizens in the broader academic community of social science" (Rodrik 2015, 209).

There are other noteworthy consequences, however. First, and most importantly, specialization attenuates the need for (global) Kuhnian shifts. A Kuhnian revolution would simplify the knowledge space, while specialization contributes to aggravating, at the aggregate level, the selfsame problem that individual researchers attempt to solve. But specialization is progress in Kuhn's (later) view: revolutions have a local character, and a single approach is unlikely to gain traction and become *the* paradigm of the discipline. Mainstream pluralism, therefore, may be here to stay. Hahn (1991) once prophesized the decline of pure theory, suggesting that economics would have less and less to do with deducing implications from axioms. The "uncertain embrace" (50) of history, sociology and biology will shape a new phase in the history of the discipline, he claimed, "our successors" being "far less concerned with the general … than we have been". "They will have to bring to the particular problems they will study particular histories and methods capable of dealing with the complexity of the particular, such as computer simulation" (ibid.). While even Hahn considered this "specialization cum interdisciplinarity" phase as temporary, this paper has cast doubts on the alleged imminent dismissal of mainstream pluralism and its replacement with a new orthodoxy. Rather, the story of mainstream economics might be

one of relatively short-run downward and upward movements – where 'downward' means towards dominance, and 'upward' implies towards pluralism, to use Davis's 'cycle theory' – around a stable long-term trend of increasing specialization. We may have entered a non-transitory phase of *mainstreaming*: one in which mainstream economics assumes the uncertain, fragmented and changing shape that specialized scholars will give it in the course of time by exploring and *de facto* creating their niches in collaboration with specialists from other disciplines. A continuously renewed mainstream environment can resist the temptation to return to the monism of an orthodoxy even without generating the pluralistic conception of economics for which heterodox economists are currently campaigning. But it might nevertheless be functional to the project; exactly as 'second-wave' anti-paradigmatic pluralism has evidently benefited from the fragmented state of the discipline, and perhaps used this latter as a *raison d'être*.

Second, and in normative terms, the later Kuhnian framework may be of a certain utility to heterodox scholars, like Dow (2008), who have defended "Kuhnian school-of-thought-ism" (as its critics call it; Garnett, Olsen and Starr 2009, 2) from the criticism that heterodox economists should move "further away from traditional groupings … and engag[e] in much more open interchange" (Dow 2008, 9). Dow's argument draws on the open-system ontology (see Lawson 1997, 2003), which, however, requires an equally open-system epistemology (methodological pluralism or "the advocacy of a plurality of methodologies", 14). She thus proposes a "structured" form of pluralism founded on a plurality of heterodox schools of thought which segment the heterodox system of thought along lines chosen to understand reality differently or throw light on specific different aspects of reality. Such closures, however, must be provisional, in line with an open-system approach, so as to allow cross-fertilization (Dow 2008b). Interestingly, Dow's defence of schools of thought rests on Kuhn's (earlier) framework, with its emphasis on language and the notions of incommensurability as difficulty, rather than absence, of communication (implying that "awareness of paradigm change and an effort to understand the language of another paradigm … can reveal meaning and thus understanding", Dow 2004, 279). It seems sufficiently clear that the later Kuhnian framework as outlined here adds new intriguing dimensions to the concept of incommensurability. It can thus provide reasons to revalue Kuhnian incommensurability as a "good basis for pluralism in economics" (contrary to what Marqués and Weisman 2010 argue).

Finally, the adoption of a later Kuhnian framework to analyse today's mainstream pluralism

has shown that the economic discipline is probably undergoing a major transformation. This 'from within' explanation of economics fragmentation, starting from the mainstream, provides reasons to predict that the discipline's future can be one of disunity. The prevalence of forms of 'local' knowledge, under the impact of specialization, may turn into a distinctive feature of economics in the near future, possibly leaving the discipline without shared theoretical foundations. This may prove to be an unhoped-for advantage for historians of economic thought and economic methodologists. By shifting the focus from how different the foundations of economics could have been to how different the local foundations of the research programs of today's mainstream pluralism are (see Lodewijks 2003), historic-methodological studies would provide the theoretical 'glue' for the analysis of economics in a post-foundational phase, helping the history of economic thought and economic methodology regaining a non-peripheral position in the discipline. By recovering the past[19], the "Econ" would restore "confidence in the present and … purpose and direction for the future" (Leijonhufvud 1973, 336).

Notes

[1] See Kirman (2010).

[2] The International Confederation of Associations for Pluralism in Economics was established in 1993. Then came the Post-Autistic Economics movement. This stemmed from a petition by French economics students, circulated in summer 2000, for broadband approaches to economics teaching. The issue was raised again in 2001 by the "Cambridge 27" group of 27 PhD candidates at Cambridge UK ("Opening Up Economics" was the title of their manifesto), and, in that same year, by students from 17 countries, who released an "International Open Letter" calling for reform of economics education. Finally, an International Student Initiative for Pluralist Economics was established in early 2014 by various groups of students from different countries. Pluralism has recently become the topic of many academic conferences.

[3] We here follow Dequech's (2007-8) 'negative' characterization of heterodoxy as the academic opposition to the mainstream.

[4] "Game theory arose out of mathematics originally via John von Neumann and was subsequently developed in its classical phase by Robert Aumann and Reinhard Selten; experimental economics draws on a long history of experimental practice in natural and physical science almost entirely absent from economics; evolutionary economics reflects Darwinian biology (despite Classical/Malthusian economics and Schumpeterian antecedents); behavioral economics receives its impetus from recent psychology; and complexity economics arises out of computer and mathematical methods applied in many natural and social sciences well in advance of their recent appearance in economics" (Davis 2006, 9).

[5] See Colander (2000, 137) on the "modelling approach to problems" as a unifying methodological feature of mainstream economics. Dow (2008a, 77) observes that the plurality currently shaping the mainstream landscape "is being unified by the shared purpose of a general systematization of

agents' rational behavior under certainty and uncertainty conditions, including interactive behavior". According to Davis (2008b), mainstream economics is in any case quite anchored to the triptych of far-sighted rationality, methodological individualism, and method of general equilibrium (while heterodox economics "is rather built upon the institutions-history-social structure nexus", p. 58). There are, however, important exceptions to the presumed methodological monism of mainstream economics. Complexity economics, for instance, cannot be subsumed under the abovementioned characterizations. Following Dutt's (2014) taxonomy of the dimensions of economic analysis, the epistemology of complexity is not that of optimizing agents; its ontology sees economies as out-of-equilibrium systems that evade the reductionist approach of methodological individualism; finally, its methods are far less mathematical and much more computational than those of the neoclassical core and its satellite approaches (see Fontana 2010).

[6] According to Arthur (2014, 25), "complexity economics is not a special case of neoclassical economics. On the contrary, equilibrium economics is a special case of nonequilibrium and hence complexity economics". Initially meant by K. Arrow (1988) as a way to fix some shortcomings of the general equilibrium theory, complexity economics soon began to be perceived, following the lead of B. Arthur, J. Holland and D. Lane, as irreconcilable with neoclassical economics. Mainstream economists reacted by underplaying contrasts (Blume and Durlauf 2006, 2) while applying the techniques of complexity economics (agent-based models and machine learning) to "orthodox" contexts (see Fontana 2010). In spite of this partial incorporation, however, complexity economics has kept its autonomy and grown considerably in the last fifteen years, gradually entering the mainstream itself (Fontana and Corsatea 2013).

[7] "We have no strong views on the Lakatos vs Kuhn debate and it should be clear that, for the purposes of our paper, there would be no significant loss in meaning from the substitution of 'paradigm' for 'hard core'" (Skouras and Kitromilides 2014, 71, n6). "My own limited appreciation of that post-Kuhn discussion includes, in particular, the sense that the Lakatos (1970) account of the methodology of research programs offers durable insights into the situation in economics. The present essay is not, however, about the philosophy of science – and Kuhn's framework better serves its purposes" (Winter 2014, 614).

[8] To our knowledge, only Dow (2008) has mentioned the 1991 *EJ* special issue in discussing the recent evolution of mainstream economics.

[9] For a significant illustration of the 'explosion' of economic research, see Margo's 2011 work on "The Economic History of the *American Economic Review*".

[10] In truth, the intuition dates back to de Solla Price's (1963) classic study on the growth of scientific publications as the main driver of specialization. One of the theoretical fathers of scientometrics, De Solla Price pragmatically insisted that limited cognitive capacities (in terms of how much of the ever-growing scientific literature a researcher can read) make it impossible to keep abreast of ongoing progress in the literature.
[11] See Weinberg and Galenson 2005 for a study of the life cycles of Nobel laureates in economics.

[12] "While half a century ago a well-trained economist may have comprehended all key developments in economics at large, today it is difficult to follow even the pace of subfields. Thus, the judgment by an individual academic is accurate only in so far as it concerns her or his own field of specialization" (Ritzberger 2008, 402).

[13] As a rule, "newly emerging interdisciplinarity projects quickly develop their own forms of segmentation" (Jacobs 2014, 8).

[14] Consider for instance Mulkay's (1975) "branching" model of scientific development.

[15] Gintis and Helbing (2015) have recently developed "an analytical core for sociology" resting upon

the same principles (rational choice theory, evolutionary theory, game theory and complexity theory) that inspire the proposal for the reunification of behavioral science. The model innovates by explicitly combining the "Walrasian general equilibrium model" with elements from classical sociological theory. Criticisms of the proposal have focused on the "imperialist" character of the model (Witt 2015), and the use of an "all-embracing mantra of rationality" (Hodgson 2015, 108) that amounts to liquidating sociologists' concerns for morality and other values.

[16] In commenting on Gintis and Helbing's (2015) analytical core for sociology, Hechter (2015, 89) argues that the two authors "are principally interested in convincing economists to take at least some aspects of sociological theory seriously. That it is published in a behavioral economics journal is proof of the pudding".

[17] On the conflict between the "unity of science" perspective and the idea of "local" science and knowledge, see the symposium "The Disunity of Science" published in *Perspectives on Science*, 3(7), 1999.

[18] While his 1973 report de facto only included the Micro and Macro, with their D-S and IS-LM totems.

[19] "Contrary to the normal case in primitive societies, the Econ priesthood does not maintain and teach the history of the tribe"; "few of the adults or grads … care to listen to [the] rumbling fairytales" of long-gone heroes of the tribe and associated legends (Leijonhufvud 1973, 336).

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