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AGENT-BASED SIMULATION AS AN IMPLEMENTATION OF METHODOLOGICAL INDIVIDUALISM

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Agent-Based Simulation as an Implementation of Methodological Individualism

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Abstract: This paper investigates the relationship between methodological individualism (MI) and Agent-Based Simulation (ABS). We discuss and analyze a thesis defended by philosophers Caterina Marchionni and Petri Ylikoski (2013). The thesis maintains that, since MI is often considered to be a reductionist approach, it is confusing and meaningless to assume that ABS, which is a non-reductionist and emergentist explanatory model, is committed to MI. We reject this thesis arguing that, from a philosophical standpoint, addressing the problem of the consistency between MI and ABS from a strictly utilitarian perspective is unsatisfactory. We analyze this problem in more substantial terms, i.e. focusing on its more theoretical and conceptual aspects. Moreover, we maintain that ABS explanations must be regarded as individualist explanations and provide a set of logical and historical arguments against the widespread interpretation of MI in terms of reductionism.

Keywords: Agent-Based Simulation, Methodological Individualism, Emergence, Reductionism, Downward/Upward causation

JEL Codes: B10, B40, B41, B53, C60, C92

Agent-Based Simulation as an Implementation of Methodological Individualism

1.Introduction

This paper investigates the relationship between methodological individualism (MI) and Agent-Based Simulation (ABS). To achieve this goal, we use a stimulating article entitled “Generative Explanation and Individualism in Agent-Based Simulation” by Caterina Marchionni and Petri Ylikoski (2013) as starting point of our analysis. Marchionni and Ylikoski (p. 2) argue that it is “misleading” and confusing to regard ABS models as implementations of methodological individualism (MI). This is because, while ABS is a systemic and emergentist approach, MI, as highlighted by most contemporary social philosophers, is committed to reductionism. Marchionni and Ylikoski agree with the dominant interpretation of MI in terms of reductionism, but they do not clarify their reasons for doing so. They consider it irrelevant to clarify this point because, for their argument, what matters is only what is commonly understood as the content of MI. They support the inconsistency between MI and ABS because of practical and utilitarian reasons related to the fact that today MI is commonly understood as reductionism, while ABS is at odds with the latter. In our opinion, their uncritical

acceptance of the dominant interpretation of MI in terms of reductionism as a sufficient criterion for rejecting the consistency between MI and the ABS research strategy is a problematic stance. We regard Marchionni and Ylikoski's viewpoint as based on arguments that are, from a philosophical and methodological perspective, unconvincing and partly self-contradictory. Rejecting their perspective, we stress that philosophers of the social sciences cannot analyze the problem of the consistency between MI and ABS in strict utilitarian terms assuming the dominant interpretation of MI as the only relevant criterion to solve that problem. This is because the proper task of philosophy is investigating the substantial aspects of a problem of this type independently of dominant intellectual fashions. Moreover, we maintain that ABS explanations must be regarded as individualist explanations and provide a set of logical and historical arguments against the dominant interpretation of MI in terms of reductionism.

2. Generation, Mechanism and the Bottom-Up Explanation

According to Marchionni and Ylikoski (p.2), the ABS methodology represents a bottom-up research strategy and the ideas of "generation" and "mechanism" are sufficient to define that strategy. By "generation" they mean

the emergence of systemic macro-properties from agents' micro-properties (p.4). By "mechanism" they mean what is understood through "the systemic variation of the simulation's assumptions" (p. 4). That variation allows the simulator "to see how the assumptions make a difference to the outcome" (p. 4), i.e. to understand better the causal dependencies that characterize the simulated system. By using such an approach, the simulator can learn which "assumptions matter for the model results" (p. 5) and understand "the mechanism implemented in the simulation" (p.5).

In Marchionni and Ylikoski's opinion (p. 8), ABS methodology allows the simulator to understand the micro-macro causal mechanisms that produce social phenomena as well as the micro-macro causal circularity that is a typical feature of these phenomena: "It is crucial to show how macrostates affect individuals at a certain point in time and how the actions of those individuals produce new macrostates at a later time."¹ Marchionni and Ylikoski stress that ABS assumes that agents are immersed in a structure of interactions that affects their behavior and limits their freedom. For Marchionni and Ylikoski (pp. 8-9), the ABS bottom-up explanation presupposes assumptions about agents as well as systemic and

¹ In ABM, this circular causality is also known as downward and upward causation; see, for example, Squazzoni (2009) and Trajkovski and Collins (2009).

non-reductionist assumptions (e.g. structural constraints that produce social conditioning).

3. ABS Interpreted as a Non-individualistic Approach

According to Marchionni and Ylikoski, the view that ABS is an implementation of MI, which has been supported by many authors (e.g. Manzo 2014; Macy et al. 2011, p. 252; Neumann 2008; Sawyer 2004, p. 263; 2003, p. 340), must be rejected. Marchionni and Ylikoski regard this view as highly problematic and confusing because of the dominant interpretation of MI in terms of reductionism developed in analytic philosophy and some sectors of sociology. According to this interpretation, MI is inconsistent with any non-reductionist micro-macro explanatory approach that assumes that structural constraints affect the autonomy and freedom of the individual. In other words, this dominant interpretation argues that MI denies: (i) the existence of non-individual or systemic properties; and (ii) the causal power of those irreducible global properties, i.e. the influence of structural factors on individuals (see Kincaid; Udehn). Marchionni and Ylikoski regard the interpretation of MI in terms of

reductionism, so widespread today, as correct, but they do not clarify why they think so. They consider it irrelevant to clarify this point because, for their argument, what matters is only what is commonly understood as the content of MI. Their point is that, since MI is usually regarded as a reductionist approach, it is confusing and meaningless to assume that ABS, which is a non-reductionist explanatory strategy, is committed to MI. In their opinion, “the ideas of generation and mechanism are sufficient to define the bottom-up research strategy” of ABS (p. 2).

Marchionni and Ylikoski (p. 10) points out that there are two aspects to note about the reductionist interpretation of MI:

First, [MI] is a thesis about explanation, not about ontology. Therefore, arguments about the existence of social wholes, structures, and such entities vis-à-vis individuals do not directly bear on arguments about explanation of social phenomena. Second, [MI] qualifies as a strong version of methodological individualism in that it holds that explanation of social phenomena should appeal only to individuals, their properties, and interactions. The corollary of such a view is that non-individual properties are denied non-derivative explanatory status.

Marchionni and Ylikoski (p. 10) recognize that some advocates of MI endorse “weaker versions” of MI, according to which non-individual properties have a causal power and limit individual autonomy. Marchionni and Ylikoski do not develop and clarify this point. They stress several times that they do not want to get entangled in debates about the proper definition of MI and that the only thing that matters for their argument is the content of MI, as understood by the dominant interpretation of that doctrine: “the debate over the proper definition of methodological individualism is a distraction from the real methodological issues” (p. 9). However, somewhat contradictorily, they suggest to be wary of the non-reductionist interpretations of MI (p. 10):

It is legitimate to ask...in what sense these more liberal positions are individualistic and whether they represent the same position that many anti-individualists are trying to defend (see Udehn 2001).

To clarify their assumption that MI, as it is usually understood, and ABS are inconsistent perspectives, Marchionni and Ylikoski (pp. 10-11) consider a model of sociological explanation developed by Centola, Willer, and Macy (2005), three authors who suggest that there is a close relationship between ABS and MI. For

details about that model see Centola, Willer, and Macy (2005) and Marchionni and Ylikoski (2013, pp. 10-11). According to Marchionni and Ylikoski (ibid., p. 12), the explanation provided by these three authors is inconsistent with MI for two reasons. First, it is based on “a structural assumption about the macrostructure of the population”, i.e. on “structural” or “non-individual properties”. These properties “are attributed to larger scale entities than individuals” and cannot be otherwise (ibid., p. 12). Second, Centola, Willer, and Macy’s explanation refers to irreducible population-level attributes such as “the frequency and degree of clustering of true believers (and other agents)”. Like structural properties, the population-level attributes “cannot be applied to individuals.” (ibid., p. 12)

4. Marchionni and Ylikoski on the Necessity of Breaking Down the Association between ABS and MI

Marchionni and Ylikoski’s conclusion is that, given that “some of the crucial explanatory variables in ABS are structural” or “non-individualistic”, it is evident that the association of ABS with MI cannot be accepted:

The burden of proof then shifts to those who wish to make the association: they should show that those explanatory variables are either not explanatory, or that they can be credibly interpreted as individualistic. The discussion above makes clear that denying their explanatory relevance is not a viable strategy; reinterpreting them as individualistic properties does not look a very promising strategy either. (p.13)

To make their argument more compelling, Marchionni and Ylikoski offer: (i) two further substantial arguments against associating ABS with the stronger (i.e. more reductionistic) versions of MI and (ii) three points of caution against associating ABS with MI that apply to both the strong and weak (i.e. less reductionist) formulations of MI. Their first substantial argument is that, since the ABS methodology does not dictate how the agents are to be interpreted, agents can also be non-individualagents, i.e. households, groups, factories, organizations and so on (p. 13). Marchionni and Ylikoski stress that, as a consequence,

ABS is not by itself individualistic, and restricting its use to individualistically acceptable applications (i.e., applications in which agents are to be interpreted as

individuals) would require strong arguments. Whether such arguments can be provided is an open question in which advocates of methodological individualism carry the burden of proof. (p.13)

Marchionni and Ylikoski's second substantial argument is an objection to the claim that the structural assumptions used in ABS and doing explanatory work are consistent with MI because "structural properties can be shown to result from purely individualistic processes" (for example, it can be argued "that network structures are generated by certain kinds of individual preferences in interaction") (pp. 13-14). Marchionni and Ylikoski reject that claim for the following reasons: (i) the fact that the emergence of structural variables can be explained in terms of individualistic processes does not mean that these variables are reducible to individual properties and, most importantly, it does not mean that structural variables, understood as irreducible entities, do not have explanatory power; (ii) because of the devastating criticism levelled at reductionism in social sciences developed by Kincaid (1996) and others, a purely individualistic explanation of structural variables, i.e. an explanation that does not refer at all to irreducible properties and denies the causal power of those properties, seems impossible.

Marchionni and Ylikoski's first point of caution is that the usefulness of the debate around MI in resolving real micro–macro problems in the social sciences is controversial (p.14). As stressed above, they argue that such problems can be discussed more fruitfully without getting bogged down by issues related to the proper definition of MI. According to Marchionni and Ylikoski (ibid.), their notion of the bottom-up strategy of explanation “suffices to capture the idea of generation and the virtue of understanding mechanisms”. The second point of caution is that, since the reductionist and negative understanding of MI is dominant within the scientific community, the association of ABS with MI “can make some social scientists less receptive to the productive possibilities of ABS methodology” and “turn some potentially interested people away from ABS.” (p. 14). Finally, Marchionni and Ylikoski argue that there is the danger that a conceptualization of micro–macro problems in terms of MI may lead to biased strategies in ABS research:

For example, understanding the agents in ABS exclusively as individuals might make researchers blind to large-scale structural factors that have significant explanatory import and that can be effectively modeled with ABS methodology. Similarly, thinking of properties like network topologies as explanatorily inert may

lead to researchers systematically choosing to make simplifications and idealizations at this level rather than at the level of the individuals. In turn, this could lead to a situation in which more realistic accounts of the networks in which individuals are embedded are seldom tried out. Both kinds of bias would be unfortunate for the development of ABS research because one of its advantages is precisely that it allows social scientists to overcome (some of) the traditional limitations of social scientific model-building and theorizing.(pp. 14-15)

5. A Criticism of Marchionni and Ylikoski's Utilitarian Approach

Marchionni and Ylikoski develop a purely utilitarian argument as the main reason to support their idea that the relation between ABS and MI must be broken down. As stressed above they argue that, although they regard the dominant interpretation of MI in terms of reductionism as correct, they do not need to clarify why they think so because, for their argument, what matters is only what is commonly understood as MI. Their point is that, since MI is usually considered to be a reductionist approach, it is confusing and meaningless to assume that ABS, which is a non-reductionist and emergentist explanatory model, is committed to

MI. In their opinion, “the ideas of generation and mechanism are sufficient to define the bottom-up research strategy” of ABS (p. 2). Marchionni and Ylikoski assume that the debate over the proper definition of methodological individualism is irrelevant from their standpoint and regard it as a simple distraction from the real methodological issues.

The utilitarian approach used by Marchionni and Ylikoski to justify their view that the relation between ABS and MI must be broken down seems to us unsatisfactory from the standpoint of the philosophy of the social sciences. We believe that, within the frame of philosophical analysis, the problem of the consistency between MI and ABS cannot be decided following the majority rule and also that it cannot be analyzed assuming that the debate over the proper definition of MI is irrelevant. Since trying to solve abstract issues such as the problem of the consistency between MI and ABS is exactly the philosopher’s job, we fail to see the philosophical value of Marchionni and Ylikoski’s approach.

Moreover, Marchionni and Ylikoski’s view on the relation between MI and ABS seems to us partly contradictory. They stress many times that they do not want to get entangled in debates about the proper definition of MI because those debates are irrelevant from their utilitarian standpoint and because, for them,

what matters is only the dominant interpretation of MI, but in some parts of their article they also express wariness of the non-reductionist interpretations of MI (p. 10; p.13). Since they do not provide any reason for being wary of those interpretations and support agnosticism regarding the proper definition of MI, why do they suggest this?

6. Two Variants of MI

Marchionni and Ylikoski argue that we should break down the relationship between MI and ABS because, since the former is often interpreted as a reductionist approach, supporting that relationship is confusing and misleading. We disagree with this view for two reasons. The first is that, as pointed out above, it seems to us that, from the standpoint of philosophy and methodology, the consistency between MI and ABS cannot be decided following the majority rule. The second is that, in our opinion, despite its popularity, the opinion that MI

equals reductionism does not hold because reductionism is only the most simplistic variant of MI (see Tuomela 1990; Jarvie 2001, pp. 117 ff.; Demeulenaere 2011, p. 11). Both reductionist and non-reductionist variants of MI can actually be distinguished (see Di Iorio 2015, pp. 75 ff; 2016a; 2016b). Following the dominant interpretation of MI in terms of reductionism, Marchionni and Ylikoski (p. 10) suggest to reject that distinction and regard the entire individualist tradition as reductionist, i.e. as inconsistent with emergentist and systemic approaches that acknowledge various structural constraints limiting individual freedom (see also Kincaid 1986, Udehn 2011).

If one carefully considers the history of MI, which is quite complex, it is clear that two different variants of can be distinguished (and to these two variants can be related various subvariants). There is a version of MI, which is employed by social contract theory and large sectors of the economic sciences – namely so called conventional or orthodox economics – which neglects social conditioning and conceives the individual in atomistic terms (see Di Iorio 2015, pp. 75-115). This radically unrealistic variant of MI, which is rooted in the mechanistic philosophy of the eighteenth century, can be correctly regarded as reductionist (see O’Driscoll and Rizzo, 1992). By contrast, the non-reductionist variant of MI, which is rooted in the work of Bernard de Mandeville and Scottish Enlightenment

philosophers such as Adam Smith and David Hume and has been developed by most of the sociological individualists (the *Verstehen* tradition), the Austrian School of Economics, and Popper and his followers, conceives of society in an emergentist and systemic way and the agent as influenced by many structural and socio-cultural factors that limit his/her freedom (see Boudon 1971; 2013; Bouvier 2011; Demelenauere 2011; Di Iorio, 2015; 2016b; Di Nuoscio 2017; Hayek, 1948; Manzo 2014; Petitot 2016; Rainone 1990). As understood by this second variant, MI is consistent with the reference to irreducible concepts and explanations.

This is not the place to analyze in detail the differences between the two variants of MI. There are a number of works in which that difference has been clarified (see, for instance, Boudon 1971, Demelenauere 2011; Dupuy, and Dumouchel 1983; Di Iorio, 2015, 2016a, 2016b; Di Nuoscio 2017; Hayek 1948, Jarvie, 1972, 2001; Laurent 1994; Nadeau 2016; Popper 1957, 1966a, 1966b; Petitot 2016; Campagnolo 2016) and we refer the reader to this literature. In the next section we will focus on the non-reductionist variant of MI and clarify why this variant is at odds with reductionism. The point that we would like to stress here is related to what Marchionni and Ylikoski call the conceptual confusion that can be caused by arguing that MI and ABS are compatible because, while ABS is a non-reductionist approach, the dominant interpretation of MI assumes that MI is

reductionism. This possible confusion is the reason why Marchionni and Ylikoski support their utilitarian approach and suggest breaking down the association between ABS and MI. In our opinion, the risk of confusion can be easily avoided without breaking down that association by taking care to define ABS as non-reductionist MI rather than simply as MI. In other words, in arguing for the compatibility between MI and ABS, it must be carefully stressed that ABS is only consistent with one of the two variants of MI, while it is inconsistent with the other.

7. On the Non-reductionist Variant of MI

Regarding the view that the entire individualist tradition is reductionist, Marchionni and Ylikoski refer the reader to the work of some famous critics of MI such as Kinkaid (1986; 1996), Pettit (1993) and Udehn (2001). Those critics of MI assume that the entire individualist tradition denies the systemic and irreducible nature of social phenomena and the structural socio-cultural constraints that limit individual freedom. Their view, which has been highly influential in some sectors of philosophy and the social sciences, seems to us historically incorrect and clearly

inapplicable to what we have called above the non-reductionist variant of MI. Kinkaid and Pettit's interpretation of MI is similar to Udehn's, but not identical. Kinkaid and Pettit, as well as many other analytic philosophers (e.g. Lukes 1968; 1973; Sawyer 2002; 2003), theorized an interpretation of the individualist tradition in terms of *semantic reductionism*, while Udehn and others (e.g. Archer, 1995 and Baskhar, 1979) supported an interpretation of that tradition in terms of *idealistic reductionism* (see Di Iorio, 2015, 2016a: 2016b).

According to the interpretation of MI in terms of semantic reductionism defended by analytic philosophers such as Kinkaid (1986; 1996) and Pettit (1993), explanations in terms of MI are based on the principle that social properties are semantically reducible to individual ones (for more details on this see Di Iorio 2015, p. xx). On this interpretation, MI is mistaken because:

- (i) the semantic reducibility of social proprieties, which are systemic and non-strictly individual, is impossible as showed by various arguments provided by philosophers and systems theory. One of the most famous argument against this reducibility is the multiple realization problem (see Kincaid 1986);

- (ii) supporting semantic reducibility means denying the obvious truth that social properties causally influence action in the sense that they limit human freedom (see Di Iorio 2016, p. 105).

The interpretation of MI in terms of semantic reductionism is historically and logically questionable. This interpretation cannot be applied to what we have called above the non-reductionist variant of MI because of at least three reasons. First, because of the central relevance that this variant attaches to the notion of unintended consequences of human action. Explanations in terms of unintended consequences cannot be regarded as reductionist explanations because they refer to emergent properties semantically irreducible to the individuals' mental and behavioral properties (see Di Iorio 2015, 2016; Hayek 1952). Second, advocates of that variant of individualism such as Hayek, Popper and Boudon openly rejected semantic reductionism and regarded the assumption that a society is semantically more than the sum of its parts as trivially true (for more details about this see Di Iorio 2015, p. 94; 2016a; see also Boudon 1971; Hayek 1967, 60; Popper 1957, p.82). Third, non-reductionist MI acknowledged the existence of emergent properties that causally influence individuals and create systemic constraints that

limit their freedom. The history of MI and of the empirical explanations provided by its advocates offers countless examples of this (see Boudon 1971; Bouvier 2011). The study of this history has been unfortunately neglected in the works on analytic philosophers who criticized MI. They developed refined arguments against MI understood as semantic reductionism, but neglected that the equation between MI and this kind of reductionism does not hold from an historical standpoint. Since reductionism has been supported only by the most simplistic variant of MI, arguments against reductionism do not undermine MI. One example of the wrongness of the assumption that MI equals semantic reductionism is Mises and Hayek's analysis of the price system as a cybernetic system (see Hayek 1948, 1973; Mises 1922). According to these two famous methodological individualists, who challenged conventional economics and its unrealistic and atomistic presuppositions, market prices are semantically irreducible to psychological or individual properties because those prices are systemic effects that unintentionally emerge from the aggregation of different individual evaluations. For Mises and Hayek, market prices, which reflect distributed information and presuppose a set of legal constraints related to private law and private property, allow the coordination of economic activities insofar as they limit the freedom of choice of individuals, who need to consider

price variations because of their budget limitations. In Mises' and Hayek's opinion, economic coordination is made possible by a spontaneous mechanism or self-organizing process centered on the fact that market prices, which are emergent effects unintentionally created by human choices and allow the use of distributed information, in turn affect these choices. According to Mises and Hayek, because of the price mechanism the whole economic system causally influences its parts, and vice versa, and via this circular causality there is a spontaneous adaptation of the local to the global and the global to the local (cf. Bouvier 2011; Di Iorio 2016a; Petitot 2016).

Mises and Hayek's analysis of market prices is based on the approach of another famous non-reductionist methodological individualist, Carl Menger, who was the originator of the Austrian School of Economics, to which Mises and Hayek belong. As understood by Menger (1985, p. 142), MI assumes that human actions must be considered to be parts of a global structure or system (see Campagnolo 2013: 2016) and that "social structures ... in respect to their parts are higher units". According to Menger, these structures are endowed with "functions" that "are vital expressions of these structures in their totality" (ibid., p. 139). From his standpoint, society is a structure or system because each part of it – each individual or each social subsystem (say a firm) – "serves the normal function of

the whole, conditions and influences it, and in turn is conditioned and influenced by it in its normal nature and its normal function” (ibid., p. 147).

The interpretation of MI in terms of idealist reductionism supported by Udhen (2001) and others -- namely critical realists such as Archer (1995), Baskhar (1979) and Lawson (1997) -- is based on different assumptions from the interpretation of MI in terms of semantic reductionism, but shares with the latter similar conclusions. This is because it argues similarly that MI is a non-systemic approach that denies the structural constraints on agents. According to the interpretation of MI in terms of idealist reductionism, since MI, especially in its sociological versions, is based on an interpretative approach (*Verstehen*), i.e. on the study of the subjective meaning the individuals attach to their actions, MI cannot grasp the objectivity of social reality and social constraints. The reason for this is that this reality and those constraints exist independently of the individuals' subjective views and cannot be accounted for focusing on the understanding of those views. According to the interpretation of MI in terms of semantic reductionism, MI assumes that socio-cultural constraints are pure opinions, i.e. subjective mental constructs, to which no objective limitations correspond (see Di Iorio 2015, pp. 103-105; 2016; King 2004). On this interpretation, MI is flawed because of the following two reasons: (i) it is a form of idealism that denies that

socio-cultural constraints exist independently of the individual's opinion about what he or she is free or not free to do; and (ii) the individual is embedded in a social structure which is characterized by a set of rules, sanctions, and social positions that are objective and real because they exist independently of the subjective opinions of the agents about the social world and its constraints. The objectivity of social constraints on action is shown, for example, by the fact that if a French tourist who visits New York City does not know that drinking alcoholic beverages on the street is forbidden in New York City, this does not alter the fact that if this tourist drinks alcoholic beverages on the street in New York City and the police see him/her, the police will stop him/her.

The interpretation of MI in terms of idealist reductionism cannot be applied to the non-reductionist variant of MI because, contrary to what Udehn and critical realists argue, that variant assumes that strictly subjective opinions "are not the basis of social life" (King 2004, 190). As largely stressed by authors such as Weber, Hayek and Boudon, non-reductionist MI "explains the social world and the constraints that this world imposes on individuals in terms of shared meanings and of unintended consequences related to these shared meanings" (Di Iorio 2016, p 368). In explaining the foundations of the social world, that variant of MI does not apply its hermeneutical approach (*Verstehen*), to strictly subjective

opinions, but rather to common meanings; and it explains social constraints and social sanctions as objective (and sometimes brutal) consequences of these common meanings, i.e. of a set of “collective beliefs” (Boudon 2001). As highlighted by Hayek (1952, p. 34), social systems must be regarded as “the implications of many people holding certain views,” that is, as “the consequences of the fact that people perceive the world and each other through sensations and concepts which are organized in a mental structure common to all of them”. For example, Max Weber (1946, pp. 396-415) explained the caste system in India as a largely unintentional consequence of common or shared magical and religious beliefs – beliefs that are understandable through an interpretative method and impose strict ritual constraints on individuals.

8. MI, Bottom Up Strategy and Ontological individualism

The non-reductionist variant of MI is neither semantic reductionism, nor idealist reductionism, but a bottom-up strategy that assumes: (i) the (unintentional) emergence of systemic macro-properties from agents’ micro-properties; (ii) the existence of a micro-macro causal circularity (such as the one

described by Mises and Hayek in their analysis of market prices); and (iii) the fact that agents are immersed in a structure of interactions that limits their freedom (see Petitot 2016). As a consequence, we consider the dominant interpretation of the individualist tradition as a whole in terms of reductionism as mistaken. It seems to us that the dominant interpretation misunderstands the nature of the individualist explanations as understood by what we have called above the non-reductionist variant of MI. This is because that variant aims at developing neither reductionist explanations (i.e. explanations that reduce social properties to strictly individual or mental ones), nor at denying the causal relevance of irreducible social factors on the individual action and freedom. Moreover, it also seems to us that the dominant interpretation misunderstands the relationship between ontological individualism and explicative individualism.

Many non-reductionist individualists such as Menger, Weber, Simmel, Spencer, Mises, Hayek and Popper argued that MI is based on ontological individualism (see Antiseri 2007; Di Nuoscio 2017). Ontological individualism, which is also called nominalism, is a metaphysical theory about the nature of the social world, namely about the nature of social wholes expressed by collective nouns such as “state”, “market”, “army”, “class”, “society” and “bureaucracy”. According to ontological individualism, collective nouns do not correspond to

effective or concrete realities (substances) because they are only synthetic ways to describe conveniently a set of individuals (whose interaction produces emergent and systemic properties). In other words, ontological individualism assumes that collective nouns do not refer to things that really “exist independently of the individuals which compose them” (Hayek, 1948, p. 6). According to ontological individualism, while the word “individual” does correspond to a real entity, collective nouns such as “capitalism” or “society” do not because they refer to individuals and systemic effects related to individual interactions rather than to an independent substance or concrete entity. As stressed by Hayek (1952, p. 54), in dealing with collective nouns which describe social wholes one should avoid committing “the mistake...of treating as facts what are no more than vague popular theories”, i.e. commonsense views that naively hypostatize social wholes. This mistake is called by Hayek “the fallacy of ‘conceptual realism’ or, by using a term made famous by A. N. Whitehead, “the fallacy of misplaced concreteness” (ibid.).

Methodological individualists, or at least many of them, consider holism, which is the approach that historically contrasted with MI, as based on a different ontology than ontological individualism, i.e. on a mistaken theory about the nature of collective nouns. According to this different ontology, which is called

ontological holism or realism, collective nouns such as “society”, “culture”, “class” or “capitalist system” do refer to real substances that exist independently of individuals such as, for example, a flower or a stone (see Antiseri 2007; Di nuoscio 2017). Holism, understood as a method based on realism, assumes: (i) that individuals are irrelevant from an ontological and explicative standpoint because they are derivatives of social wholes understood as concrete entities; and (ii) that what matters is ultimately the study of how those social wholes determine human thoughts and actions. An example of holism understood in these terms is the deterministic relationship between the economic structure and the individual consciousness in the work of the holist Marxist thinker Louis Althusser (see Boudon and Bourricaud, p. 1990). As stressed by Popper (1957; 1966a, 1966b) and Hayek (1952), holism is the theory that social sciences should explain social wholes (understood as concrete supra-individual entities) own laws of functioning and evolution to unveil the hidden determinants of consciousness and action. According to this theory, the method of the social science cannot be described in terms of a bottom-up strategy of explanation. The problem here is not explaining emergent social phenomena in terms of unintentional consequences of human intentions because human intentions are regarded as irrelevant and social phenomena are considered to be produced by hidden deterministic social

mechanisms that control the individuals and their minds (see Di Iorio 2015). According to this holistic view, the ultimate causes of social phenomena are located in social wholes understood as concrete entities. This stance is at odds with emergentism. Only an approach based on an individualist ontology, which denies the existence of supra-individual entities that control the agents, can locate the ultimate causes of social phenomena in the individuals and support a bottom-up strategy of explanation.

As stressed by Marchionni and Ylikoski (p. 10), according to Lukes and other supporters of the dominant interpretation of MI, this approach “is a thesis about explanation, not about ontology”. However, because of the reasons stressed above, this view is questionable. It is actually historically false. As understood by many of its advocates, MI directly stems from a criticism of ontological holism, i.e. of the view, which is rooted in Platonism, that collective nouns refer to real substances and that the individuals, their thoughts and actions are derivative of those substances (see Di Iorio 2015: 2016a: 2016b).

Non-reductionist methodological individualists such as Weber, Simmel, Spencer, Menger, Mises, Hayek and Popper assume that the acceptance of their individualist approach and its bottom up and emergentist explicative strategy is a

corollary of the rejection of ontological holism in the name of ontological individualism (see Antiseri 2007; Di Iorio 2015; Di Nuscio 2016, 2017). Obviously, if the ontological and causal relevance of individuals is denied and individuals are regarded as remote-controlled by holistic social entities, no bottom up strategy is possible and social phenomena cannot be explained in terms of circular causality between micro and macro factors (see Petitot 2016). As understood by MI, ontological holism entails the necessity to focus on the hidden socio-cultural factors that unconsciously control individuals, i.e. the necessity to support sociological determinism. On the contrary, according to non-reductionist MI, which is logically and historically linked to a nominalist ontology, individuals must be regarded as the ultimate engine of history and social processes and the social wholes must be explained in terms of emergent properties and micro-macro processes produced by the interaction of self-determined individuals (Hayek 1952; Bulle and Phan 2017; Di Iorio 2015; Di Iorio and Herfeld 2017).

9. Defending the Connection Between ABS and MI

Marchionni and Ylikoski offer: (i) two substantial arguments against associating ABS with the stronger (i.e. more reductionistic) versions of MI and (ii) three points of caution against associating ABS with MI that apply to both its strong and weak (i.e. less reductionist) formulations. Their first substantial argument is that, according to ABS, agents can also be non-individual agents, i.e. households, groups, factories, organizations and so on (Marchionni and Ylikoski 2013, p. 13). Marchionni and Ylikoski stress that, as a consequence, “ABS is not by itself individualistic” (ibid.). Their view stems from the interpretation of MI in terms of semantic reductionism that we rejected above. According to that interpretation, explanations that refer to non-individual agents are inconsistent with MI because this approach aims at developing explanations that solely refer to strictly individual psychological and behavioral properties and laws. We rejected the interpretation of MI in terms of semantic reductionism because of the reasons highlighted above. It seems to us that explanations that refer to non-individual agents must not necessarily be regarded as non-individualistic. Those explanations are consistent with the non-reductionist variant of MI insofar as they do not conceive non-individual agents in holistic terms, i.e. as supra-individual substances (concrete entities) that ontologically exist independently of the individuals and control their thoughts and actions (see Di Nuoscio 2017; Nadeau

2016). The central point that we would like to stress here is that non-individual agents as conceived by ABS are not holistic entities and that, as a consequence, it is untrue that ABS, because of its consistency with the analysis in terms of non-individual agents is anti-MI². Non-reductionist methodological individualists have provided many examples of explanations in terms of non-individual agents (understood in non-holistic terms). Consider, for example, Coleman's concept of "corporate agents" (Coleman 1990, 325 ff), Spencer and Hayek's analyses of cultural evolution in terms of "group selection" (see Di Nuoscio 2016) and Kirzner's concept of "corporate firm" (Kirzner 1978, 63ff) that is similar to the concept of firms extensively used in agent-based computational economics (Arifovic, 1994; Chen and Ni, 2000). The reference to non-individual agents is simply indispensable in the analysis of many social phenomena. As stressed by Bulle and Phan (2017, p.3), following Boudon (2007),

methodological individualism does not exclude that under certain conditions, a collective entity might be legitimately treated as an individual, for example, a group, such as a government or a

² In fact, this point can be driven away. 'Individual' per se is not independent of the level or granulation chosen in our analysis; for example, to analyze the stock market bubbles, should we start from neurons or from decision makers? This issue has been well pointed out since the influential paper by Herbert Simon (Simon, 1962), but its relevancy to agent-based modeling was first addressed by Davis (2013) and further by Chen (2016). Nonetheless, despite its diverging points, once the level or the granulation is fixed, the 'bottom' is determined, and then the bottom-up mechanism is operated and demonstrated from there, through agent-based modeling (Tsfatsion, 2001).

political party, equipped with procedures allowing it to transform the individual opinions of its members into collective decisions issued in their name.

Marchionni and Ylikoski's second substantial argument is an objection to the claim that the structural assumptions used in ABS and doing an explanatory work are consistent with MI because "structural properties can be shown to result from purely individualistic processes" (for example, it can be argued "that network structures are generated by certain kinds of individual preferences in interaction") (Marchionni and Ylikoski 2013, pp. 13-14). Marchionni and Ylikoski (ibid.) reject that claim because of the following reasons: (i) the fact that the emergence of structural variables can be explained in terms of individualistic processes does not mean that these variables are reducible to individual properties and, most importantly, it does not mean that structural variables, understood as irreducible entities, do not have explanatory power; and (ii) because of the devastating criticism levelled at reductionism in social sciences developed by Kincaid (1996) and others, a purely individualistic explanation of structural variables, i.e. an explanation that does not refer at all to irreducible properties and denies the causal power of those properties, seems impossible.

Because of the reasons stressed in the previous pages, criticisms of MI based on the impossibility of reductionism and the necessity to refer to structural variables and their causal power in the social sciences fail. MI, or at least the variant we defend, is consistent with anti-reductionism and systemic approaches. The tendency to equate MI with reductionism seems to us undermined by a careful analysis of the history of MI and the empirical explanations provided by the practitioners of the social sciences committed to MI. Such a careful historical analysis is lacking in the works of analytic philosophers such as Kincaid who criticized MI by demonstrating the impossibility of reductionism (see Di Iorio 2015, 2016a; Di Nuoscio 2016; Nadeau 2016; Petitot 2016). Since there is no equivalence between MI and reductionism, the fallacy of MI cannot be derived from the failures of reductionism. Non-reductionist methodological individualists provided analyses in systemic or structural terms that match well the ABS methodology. Consider, for example, the similarities between what Dupuy and Dumouchel (1983; see also Di Iorio 2016b; Petitot 2016) call Hayek's "complex methodological individualism", i.e. Hayek's interpretation of the market in terms of a complex self-organizing system based on the use of distributed knowledge and ABS models. Those similarities have been carefully analyzed by Caldwell (2004, 361-369) and Vriend (2002). As stressed by Caldwell (2004, 363), "anyone

who has read...[Hayek] will be startled on encountering recent work in agent-based computational economics or ‘artificial society modeling,’ for it all seems so familiar”. Caldwell (ibid., 363-366) showed, in particular, the similarities between the approach developed by Epstein and Axtell (1996) in their book *Growing Artificial Societies: Social Science from the Bottom Up* and the theory of market supported by Hayek and the other members of the Austrian school of economics committed to the non-reductionist variant of MI. For a detailed analysis of those similarities, we suggest the reader refer to Caldwell (ibid., 362-366 and 367-368).

Marchionni and Ylikoski’s first point of caution is that the usefulness of the debate around MI in resolving real micro–macro problems in the social sciences is controversial (p.14). As stressed above, they argue that such problems can be discussed more fruitfully without getting bogged down by issues related to the proper definition of MI. According to Marchionni and Ylikoski, their notion of a bottom-up strategy of explanation “suffices to capture the idea of generation and the virtue of understanding mechanisms” (p. 14). We disagree with Marchionni and Ylikoski’s position for four reasons.

First, they do not explain why the usefulness of the debate around MI in resolving real micro–macro problems in the social sciences is controversial. We

consider the analyses of the concept of unintended consequences developed by supporters of MI such as Menger, Weber, Spencer, Hayek, Popper, Merton, Coleman, Boudon and Elster as highly useful to resolve micro-macro problems (see Bouvier 2011). Second, as stressed above, agnosticism about the real nature of a very important intellectual tradition such as MI does not seem to us a valid option for philosophers, while we consider it a reasonable option only for practitioners of the social sciences disinterested in strictly methodological issues. Third, if it is true that we can see further only by standing on the shoulders of giants and if it is also true that MI cannot be equated to reductionism, breaking down the connection between ABS and MI would lead theorists of ABS to neglect the profound and rich methodological and scientific contributions provided by the most eminent non-reductionist methodological individualists. It seems to us that those contributions are still very useful to understand social mechanisms, the structural nature of social phenomena and their bottom-up (emergent) properties and can contribute to the reflections on the methodological presuppositions of ABS (see Manzo 2014). Four, the origins of the concept of “social mechanism”, which Marchionni and Ylikoski consider to be useful to understand the nature of ABS explanations must be traced back to the works of two non-reductionist methodological individualists: Elster (1989) and Boudon (1998). The fact that the

concept of “social mechanism” developed within the framework of MI and is historically linked to the explanative approach of MI is another proof of the consistency between ABS methodology and MI as well as of the fact that Marchionni and Ylikoski’s proposal to break down the connection between ABS and MI is questionable.

The second point of caution highlighted by Marchionni and Ylikoski is that, since the reductionist and negative understanding of MI is dominant within the scientific community, the association of ABS with MI “can make some social scientists less receptive to the productive possibilities of ABS methodology” and “turn some potentially interested people away from ABS.” (p. 14). As we stressed above, this risk can be avoided without breaking down the connection between ABS and MI by simply clarifying that ABS is exemplificative of the non-reductionist variant of MI. Moreover, although it is true that the definition of MI in terms of reductionism is widespread, especially among analytic philosophers, and can make those who are familiar with those philosophers’ works suspicious of MI, it is also true that this definition is less popular among continental philosophers, sociologists and ABS scientists. It is significant that, as highlighted by Marchionni and Ylikoski, many ABS scientists consider themselves committed to MI (see Manzo 2014). Some of them, like Epstein and Axtell (1996, pp. 16-17), are aware

of the confusions linked to the concept of MI and have carefully clarified that they defend a variant of MI which is non-reductionist.

Finally, Marchionni and Ylikoski argue that there is the danger that a conceptualization of micro–macro problems in terms of MI may lead to biased strategies in ABS research:

For example, understanding the agents in ABS exclusively as individuals might make researchers blind to large-scale structural factors that have significant explanatory import and that can be effectively modeled with ABS methodology. Similarly, thinking of properties like network topologies as explanatorily inert may lead to researchers systematically choosing to make simplifications and idealizations at this level rather than at the level of the individuals. In turn, this could lead to a situation in which more realistic accounts of the networks in which individuals are embedded are seldom tried out. Both kinds of bias would be unfortunate for the development of ABS research because one of its advantages is precisely that it allows social scientists to overcome (some of) the traditional limitations of social scientific model-building and theorizing. (pp. 14-15)

The objections levelled at Marchionni and Ylikoski above can also be applied to their last point of caution. Since the non-reductionist variant of MI does not

neglect structural factors and their explanatory relevance, it is questionable that a conceptualization of micro–macro problems in terms of MI may lead to biased strategies in ABS research. As stated earlier, what seems important to us is clarifying that there are two variants of MI and that ABS is committed to the non-reductionist one.

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