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(Article begins on next page)



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Nature and labour. Theoretical approaches and metaphors of wealth before Adam Smith

Stefano Fiori*

Abstract. In the seventeenth century and the early decades of the eighteenth, there occurred a conceptual reversal regarding the relationship between land and labour as agents of production of wealth. Authors of the seventeenth century attributed to labour – as “form” and “father” – a fundamental role in producing wealth, and they considered land as “matter” and “mother”, while Physiocrats attributed reproductive capacity only to land, and viewed labour as either mere support of nature or “sterile” transformative activity. These conceptions about the formation of wealth emerged not only from theoretical analyses but also from metaphors which had an important role in providing preliminary conceptual frameworks.

Keywords: Aristotle, Preclassical economic thought, matter, form.

JEL Classification: B11, B4

1. Introduction

Pre-classical economics comprised two alternative interpretations of formation of wealth. One, in the seventeenth century, attributed to labour a predominant role in the production of wealth with respect to land (see Perrotta 2004, pp. 166-7); the other, supported by the physiocrats, attributed to land a predominant role in the production of wealth with respect to labour. Both approaches mixed ‘visions’ and more composite analyses, metaphors and theoretical terms, and interpreted discourse on nature as an essential part of economic discourse.¹ This variety of tools denotes the problematic search for causal relations through which to explain formation of wealth. In considering land and labour as “agents of production”, in a sense these authors faced a problem of “imputation” in production, although they lacked the proper analytical framework to deal with it in rigorous terms. In both approaches the two inputs show different capacities in determining the final product. For the Mercantilists, labour prevails over nature; it changes the form of natural matter, multiplies products, and adds value to them, while nature, which exhibits different degrees of fertility, contributes to the formation of wealth, also with its spontaneous fruits. By contrast, for the physiocrats nature, with its generative powers, plays the fundamental role in production, while labour does not possess any reproductive capacity.

The origins of the close connection between discourse on nature and economic discourse are multiple and, at least partially, can be traced back to Aristotle’s work, where the notions of matter and form were used in analytical and metaphorical terms to illustrate both artisanal productive processes and processes of sexual reproduction.

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¹ Schabas (2005, p. 5) remarks that “until the mid-nineteenth century, economic theorists regarded the phenomena of their discourse as part of the same natural world studied by natural philosophers”.

In the seventeenth century, although alternative in many respects, Aristotelian approaches and theories which embodied the spirit of the Scientific Revolution provided arguments about the prevalence of labour over land in production of wealth. William Petty represented this concept in metaphorical terms as the prevalence of labour-father over land-mother.² Malynes and Misselden – by following Aristotle – adopted a similar view, and emphasised the prevalence of form over matter, two terms related to labour and land. Finally, Aristotelian and non-Aristotelian thinkers argued that art prevails over nature, because art multiplies and transforms natural products.

The idea of the prevalence of labour over land in production of wealth was reversed by Physiocracy, and this reversal was probably influenced by the fact that the concept of nature had changed in the first decades of the eighteenth century. Empirical approaches and more accurate observations suggested new interpretations of nature's vitality. From Linnaeus to Quesnay, the analogy between animal and plant sexuality was used to explain the continuous renewal of nature. And the idea of nature as a limited force which cyclically reproduces scarce resources was replaced by the idea of nature as a generous mother able to generate abundance. The conception that reproductive processes occur *only* in nature marginalised the view, developed during the seventeenth century, that formation of wealth was due to the union of labour and land respectively interpreted as form-father-male, and as matter-mother-female. Although characteristics attributed to land and labour drastically changed, the conceptual frame of reference continued to be based on a discourse on nature. The view of land as mother survived, but nature was now qualified as prolific and not as ungenerous. Labour was considered sterile, but its "sterility" evoked in opposite terms the same naturalistic framework that previously emphasized the figure of the "labour-father". However, other elements prevented consideration of labour as the father of wealth. Labour in Physiocracy was considered to be an external help to reproductive processes which occur in nature, because labour directs nature, but it is nature that produces.

Views on the causes of formation of wealth in the age of Mercantilism and Physiocracy gave rise to the analysis of formation and allocation of surplus (Brewer 1992a, p. 49), and consequently to the analysis of the income distribution, especially in Petty, Cantillon, and Quesnay.³ Therefore, these analyses (although often developed confusedly) were the result of the preliminary assumptions about the capacity of nature and labour to engender wealth.

2 According to a large body of literature, metaphors help to explore unknown phenomena by reusing through analogy terms and concepts borrowed from other fields of human experience and from other sciences, because they preliminarily organize our ideas about certain phenomena, especially when a comprehensive theory is not available. In this sense, they are not simple linguistic phenomena, but conceptual tools which coexist and interact with theoretical discourses. The literature on the cognitive nature of metaphors is huge. However, at least five authors should be mentioned: Max Black, Mary Hesse, Richard Boyd, and Lakoff and Johnson. Black (1962) explained that metaphors reorganize our ideas about a certain object. Hesse (1966) showed the relation between deductive models of scientific explanations and metaphors. Boyd (1993, p. 490) maintained that metaphors "represent one strategy for the accommodation of language to as yet undiscovered causal features of the world". Also Lakoff and Johnson (1980) argued that our conceptual system is largely metaphorical.

3 Although his analysis presents many deficiencies, Petty dealt with the "mysterious nature" of rents (Aspromourgos 1995, p. 24; see also Roncaglia 1977, ch. 7), and applied his theory of agricultural surplus to the analysis of the "social division of labour" (Aspromourgos 1995, p. 22). Cantillon, in the context of the surplus analysis, considered the allocation and distribution of the agricultural product as the relationship between city and country, and calculated that the labour of 25 persons provides subsistence to 100 persons (Cantillon 2015, ch. 16). In his view, wages are "determined independently of prices and outputs" (Aspromourgos 1995, p. 82) and, he was of the opinion that "Wages are ('probably') set by 'the custom of the place', but subject to the landowners choice" (Brewer 1992a, p. 53). Moreover, Cantillon considered "the determination of rents" as "a kind of conventional division of agricultural product" (Aspromourgos 1995, p. 83), while - like Petty - he "had any clear concept of capital" (Brewer 1992b, p. 717). Also in Quesnay the concept of surplus was relevant. He attributed to land the capacity to produce physical surplus, but he regarded wealth also in terms of value (Vaggi 1987, ch. 2) which is distributed especially to landlords as rent (*Ibidem*, p. 121), and it is used to sustain the effectual demand. Finally, Vaggi (*Ibidem*) points out that the physiocrats also considered the profit of farmers as part of the social surplus.

The article is structured as follows: Section 2 examines how Aristotle's notions of the earth and labour were respectively associated with terms such as 'female', 'mother', 'matter', 'potentiality', and with terms such as 'male', 'father', 'source of movement', 'form', 'actuality'. It also shows how in that approach labour performs a fundamental role with respect to the earth in (re)productive processes. Section 3 considers Petty's metaphor of land and labour as respectively mother and father of the wealth, where the labour-father prevails over land-mother in production of wealth. Section 4 analyses how Malynes and Misselden reused the Aristotelian categories, and how they argued that form prevails over matter. Section 5 shows that Aristotelian and non-Aristotelian thinkers shared the idea that art and nature are distinct, complementary forces which exhibit some similarities regarding processes of production of artificial and natural objects. Section 6 highlights that in the seventeenth century many authors argued that art improves nature. Section 7 shows that the argument "art prevails over nature" was part of the economic debate. Labour was considered the source of economic growth, and from this conviction derived proposals aimed at encouraging domestic manufactures, innovations, and the export of value-added commodities. Section 8 discusses Cantillon's view of land and labour as respectively the matter and form of wealth. Section 9 considers Mirabeau's work as representative of the change that occurred in the interpretation of relationships between nature and labour and it shows how he reused the notions of matter and form. Section 10 illustrates how, from Linnaeus to Quesnay, nature was increasingly seen as a privileged place in which reproductive processes occur, and how new arguments in favour of sexualisation of nature influenced the idea that nature expands and generates abundance. Section 11 discusses the impact of these ideas in the physiocratic approach, and it shows that labour was viewed as either a support for natural reproductive processes or a transformative activity unable to produce surplus. This reversal with respect to conceptions of the seventeenth century, however, occurred within the paradigm of naturalization of economics, that is, the approach which considered the economic sphere as dependent on the natural sphere (see note 1).⁴ Section 12 provides some concluding remarks.

2. Aristotle's conceptual couples: matter and form, female and male, earth and labour

The co-occurrence of matter and form, with which respectively the earth and labour are associated, dates back at least to Aristotle. Matter potentially includes the determinations of being, and it represents the possibility to receive a form, where giving form is the operation by which matter is shaped. The relationship between matter and form, which in Aristotle relates to the one between potentiality and actuality, is apparent in artisanal production, where the artisan shapes a matter which can potentially receive many forms. Aristotle maintained that these processes characterize also living beings, and that the conceptual couples 'matter/form' and 'potentiality/actuality' are associated with the couple 'mother/father'. In reproductive processes the male, as "source of movement", gives life and form to the matter provided by the female. This means that the father has an active role, while the mother as matter is simply characterized as potentiality.⁵ This perspective can be extended to "the universe as a whole" where "the earth's nature is thought of as female and mother" (*De Generatione Animalium*, henceforth GA, I, 2, 716 a, 14-17). Therefore, an association between two sets of terms is established: on the one hand, 'female', 'mother', 'matter', 'potentiality', and 'earth'; on the other, 'male', 'father', 'source of movement', 'form', 'actuality', and 'labour'. Labour pertains to the second set of terms because it possesses the capacity to transform matter, giving it an end which manifests itself in the final product. The relationship between transformative processes activated by labour and transformative processes of sexual reproduction

⁴ I prevalently consider debates which focused not on inanimate nature, but on living nature.

⁵ Among living beings, which are characterized by sexual reproduction, "the male provides both the form and the source of movement while the female provides the body, i.e. the matter" (GA, I (A), 20, 729 a, 9-12).

are illustrated by an analogy: as the male does not provide the matter for the offspring, so “nothing comes away from the carpenter to the matter of the timber”. The carpenter’s “hands move the tools, and the tools move the matter. Similarly the male’s nature [...] uses the seeds as a tool containing movement in actuality, just as in the productions of an art the tools are in movement” (GA I, 22, 730 b, 13-23, see also GA, II, 1, 734 a, 734 b, 735 a, and Balme 1972, p. 152).

Labour, and in particular artisanal labour, changes the form of matter and exhibits male features of creation and reproduction which distinguish it from the passivity of the matter.⁶ Production of a new entity, both as a useful good and as a new living being, coincides with the process of giving form, and this makes it possible to liken labour activity to biological processes. The only difference is that in labour activity the final cause is external, while in sexual reproduction it is internal to the final product. The process of creation needs the indispensable cooperation (a union, more precisely) between the labour-father and the earth-mother, although the prevalence of the father with respect to the mother in both creation and (re)production is evident.

3. Aristotelian heritage: land-mother and labour-father

Traces of the Aristotelian approach which interprets the relationship between earth and labour in terms of parental figures, whose union metaphorically illustrates *how* wealth is engendered, are present in the seventeenth century.⁷

Arguments of this kind – which are not exclusively attributable to the Aristotelian heritage - were not completely hackneyed, and contributed to conceptually framing a problem which was unresolved in analytical terms: the cause of wealth generation. Their role in preliminary organizing ideas about that phenomenon, while a theory was not yet available, might explain why Aristotelian commonplaces continued to be used, even though opposing systems of thought related to scientific revolution were imposing themselves in European culture (see sect. 6).⁸

Although the metaphors of the earth-matter-mother and labour-form-father rarely gave rise to structured investigations into the generation of wealth, they exerted a certain influence on some analyses of trade as a (sometimes tacit) pre-analytical assumption. Mercantilists did not confuse wealth with money (Perrotta 2004, pp. 164-5; Magnusson 2015, p. 103), and analyses of its rise, also with the help of metaphors, focused on the combination of labour and land. The majority of them would have agreed with Charles Davenant that

“Gold and Silver are indeed the Measure of Trade, but that the Spring and Original of it, in all nations is the Natural or Artificial Product of the Country; that is to say, what Land or what this Labour and Industry Produces” (Davenant 1699, p. 12, quoted in Magnusson 2015, p. 101).

“Land and Labour”, Petty (1662, pp. 44-45) maintains, are “two natural denominations” by means of which “all things ought to be valued”, although it is preferable “to finde out a natural Par” between them. Since production of wealth depends on land and labour, this can be described as the result of an organic relationship between these “two

⁶ Some scholars have criticized Aristotle’s reduction of female to inert matter (see Dean-Jones 1994, pp. 14–15 and p. 177). By contrast, others maintain that in Aristotle’s writings the female is not reducible to raw material, and performs a more active role in sexual reproduction (see Mayhew 2004 and Connell 2016).

⁷ These traces were not mere commonplaces. In general, Aristotelian biology continued to affect the sciences of life of the seventeenth century both in conceptual and metaphorical terms, for example in Harvey’s physiology.

⁸ As discussed in this section, for example, traces of Aristotle are in William Petty’s writings, although he was influenced by anti-Aristotelian philosophers like Bacon and by Hobbes (Aspromourgos 1996, chap. 4; Ullmer 2011).

natural denominations”: “Labour is the Father and active principle of Wealth, as Lands are the Mother” (*Ibid.*, p. 68). This famous expression metaphorically suggests that wealth is the offspring of labour and land, although the two parents do not contribute in the same way to its birth, given that only labour is viewed as the “active principle of Wealth”, a concept that in Aristotle refers to the creative “source of movement”.⁹ The prevalence of labour is also illustrated in another passage, where “the Wealth” is considered as “the effect of the former or past labour” which does not differ from “efficiencies in being” (Petty 1691b, p. 110). Here land is not mentioned, while the role of labour as active principle is emphasized. However, the biological and reproductive features of land and labour appear also when Petty (1676, p. 377) maintains: “Hands being the Father, as Lands are the Mother and Womb of Wealth”. The “Hands” evoke the creative process of labour, and since they are the “Father”, this creative capacity has male features. Also in this context, since land exhibits maternal features, wealth appears as an offspring which develops in the “womb” of the mother.¹⁰

4. Prevalence of form over matter: Malynes and Misselden

The relationship between matter and form is well illustrated by Botero in *Delle cause*, a work written in 1588 and soon translated in English: “nature giueth the matter and the subject, but the Art and cunning of man giueth an unspeakeable variety of forms and fashions” (Botero 1606, p. 49).¹¹ The notions of ‘matter’ and ‘form’ were widely used also in the seventeenth century. Bacon, Kepler, Harvey, Hobbes, Gassendi, Descartes, Boyle, Malebranche, Newton, and Leibniz used those concepts in a variety of forms, also when they provided theories alternative to Aristotle’s one (Manning 2012). Although interpreted in dissimilar way, these concepts were used also by Malynes and Misselden.

Malynes (1622, p. 500) suggested that there are reasons to consider “essence or existence of things” in terms of “matter and form and privation”, where “privation” is an Aristotelian concept (*Metaphysics* V, 1022 b 22 - 1023 a 7; XII, 1069 b 33; *Physics* 192a 3) which refers to becoming, and indicates the lack of form usually required by the nature of a thing.¹² Misselden (1623) accused Malynes of having misinterpreted Aristotle, because “privation” alludes not to the essence of things, but to properties that things do not possess.¹³ Moreover, although matter and form determine

⁹ The concept that labour prevails over matter was shared by many cultural traditions, and it appears also in the Bible. In *Genesis*, God works and his labour is creation (Gen. 1, 1 and 2, 3). He uses his hands to give form and life to inert matter (the “ground” from which man and animals are moulded (Gen. 2, 7 and 19)). And man, who similarly works, in some way through his labour is associated with Divinity.

¹⁰ This image can be compared to the non-metaphorical explanation of the rise of rent in terms of surplus: “Suppose a man could with his own hands plant a certain scope of Land with Corn [...] I say, that when this man hath subducted his seed out of the proceed of his Harvest, and also, what himself hath both eaten and given to others in exchange for Clothes, and other Natural necessaries; that the remainder of Corn is the natural and true Rent of the Land for that year” (Petty 1662, p. 43).

¹¹ “[L]a natura dà la materia e’l soggetto, ma sottigliezza e l’arte dell’uomo dà l’innarrabile varietà delle forme” (Botero 1588, p. 40).

¹² Privation is not simple negation, but the predisposition of matter to acquire a certain form. Some aspects of the debate on matter, form and privation in the seventeenth century are illustrated in Manning (2012, pp. 16-32).

¹³ Aristotle, Misselden (1623, p. 11) maintained, reduced “principles” of natural things to “matter, form and privation”, but he “excludeth Privation from the *Being* of natural things”. Therefore, “principles” and “essence” of things have to be distinguished. “Principles” of natural and artificial things depend on the fact that form appears in two ways, since a certain form that initially lacks (form absent as “terminus a quo”) can appear subsequently (form present as “terminus ad quem”) (*Ibid.* pp. 11-12). By contrast, “essence” of things is composed exclusively of “matter and form” (*Ibid.*, p. 9). In the course of time these themes were marginalised in consequence of the emergence of new traditions of thought. An

“essence”, it is the form which performs a fundamental role in qualifying the nature of things. In a house, the matter “is stone and timber”, and the form “is the fashion or proportion after which it is built” (*Ibid.*, p. 10), but it is the form which distinguishes a house from other artifacts also built with stone and timber. These analogies regard also commerce: “Commodities and Money, are the *Matter* of trade: the manner of buying and selling, is the *Forme* of trade” (*Ibid.* p. 7), but are not the “materials of trade” which determine commerce.¹⁴

This dispute, which took place in the same years in which Bacon and Galilei wrote their works, is an example of how the Aristotelian idea that form prevails over matter permeated some economic discourses. Although Malynes and Misselden disagreed about the role of “privation”, they shared the opinion that form qualifies things, because matter is imperfect (Malynes 1622, p. 500)¹⁵, and form “giueth perfection” to the matter (Misselden 1623, p. 10). This view was consistent with the metaphorical image – later developed by Petty - which represented the prevalence of the labour-father-active principle over the land-mother in production of wealth. And both, as next sections show, were consistent with the idea that art prevails over nature (see section 6).

5. Art and nature as distinct, complementary, agents

In the seventeenth century, the Aristotelian notions of form and matter were respectively associated with “art”, a term closely related to labour, and nature. But the art-nature dualism was used also in the cultural context of the Scientific Revolution. The outcome was an unusual alliance between Aristotelian and non-Aristotelian perspectives, which had in common the idea that art prevails over nature.

Although the view that art dominates a nature which weakly reproduces itself was pervasive, art and nature were considered complementary rather than opposed forces, as Petty’s metaphor of the union of the father and of the mother, and as the relationships between matter and form suggest.¹⁶ For this reason, reformulation is required of Johnson’s assumption that in the seventeenth century art was considered as opposed to nature (Johnson 1937, chap. 13). The boundaries between the natural and the artificial, originally configured by the Aristotelian and Scholastic approaches, were redefined in light of the “mechanical philosophy”, and this led to a weakening of the art/nature distinction, because experiments and mechanical devices showed that it was possible to replicate natural processes artificially (Dear 1995, p. 151; Shapin 1996 pp. 30-32; Wootton 2015, pp. 322-323). Some analogies between the ways of working of art and nature were emphasized, although this did not mean removing the idea that they are distinct agents. When Francis Bacon maintained that “the artificial does not differ from the natural in form or essence, but only in the efficient” (Bacon 1623, p. 294), he pointed out that art and nature are similar as regards their “form or essence”, but – as distinct agents - differ as efficient causes of processes of production and transformation (Newman 2004, p. 259-260).¹⁷ A similar position, but within an Aristotelian framework, was put forward by Misselden (1623, p. 9), when he maintained

example is Dudley North (1691, p. 11), who opposed Descartes’ method to hypothetical reasoning, where this latter includes the Aristotelian concepts of “matter, form and privation”.

¹⁴ As regards Aristotle’s influence on Malynes and Misselden see Finkelstein (2000, chaps 2 and 3), and Magnusson (2015, p. 151). According to Appleby (1978, p. 244), Misselden and Mun reasoned “in the spirit” of Francis Bacon, although on this point Magnusson (2015, p. 152) rightly is more cautious.

¹⁵ “Deprivation” is an “imperfection” of matter in the sense that only in our imperfect world things change form. By contrast, in the perfection of the Heaven neither “generation” nor “corruption” occur (Malynes 1622, p. 500).

¹⁶ The idea of an opposition between art and nature was prevalent in other periods. Dear (1995, p. 155) remarks that in Scholastic philosophy the opposition between art and nature rested on the idea that “The natural course of a process could be subverted by man-made, artificial causes, because art replaced nature’s purposes with human purposes”.

¹⁷ Also Rossi (1968, p. 26), although he maintains that Bacon departed from the traditional opposition between art and nature, emphasizes this point. Newman (2004, pp. 259-260) interprets Bacon’s view as coherent with the Scholastic tradition. He also maintains that even Boyle did not eradicate the distinction between art and nature (pp. 256-7).

that the essences of natural and artificial things do not differ, because both are explained in terms of matter and form. Like Misselden, Malynes viewed matter and form as distinct but coessential components of things, in both natural and artificial products, and pointed out that “artificiall riches” derive from “naturall riches” (Malynes 1601, p. 5). Others, like Barbon, emphasized that the “artificial” sphere, rather than being in opposition to the “natural” one, is an extension of it.

In short, art and nature were considered distinct, complementary, forces which give rise to processes of production and transformation analogous in some respects. The idea that they are distinct agents is apparent in the writings of Botero, Browne Malynes, Mun, Roberts, Davenant, Barbon¹⁸, and others, where the *empirical distinction* between natural and artificial commodities was at the centre of many conjectures.¹⁹ The idea that art and nature are complementary forces was included in analysis of wealth by both Hobbes (1651, p. 163) and Child (1694, p. 26), since, as Mun remarked, wealth depends on man’s capacity to “add *Art to Nature*, [and] our *labour to our natural means*” (1664, p. 193, emphasis in the original).

6. Prevalence of art over nature

Many arguments were put forward to explain why art prevails over nature. Botero maintained that wealth depends on “art and industry” and not on nature: “Industrie and Art exceedeth Nature far [...] At a word, such a wealth there is in Art and Industry, that neither the mynes of Siluer, nor the mynes of gold in Noua Hispania nor in Peru, can be compared with it” (Botero 1606, pp. 50-51, quoted in Keller 2012, p. 194). If wealth is a consequence of art, nature has limited powers. Nature, Hobbes pointed out, is weak and its resources are scarce, and only labour and industry have the capacity to exploit and multiply them.²⁰ After all, the “state of nature”, as a condition of conflict among men which must be governed by a social and political agreement, presupposes scarce resources, given that, if resources were unlimited, conflicts among men would be neutralized. By contrast, since natural resources are scarce, only the security and peace ensured by agreement among men can constitute a precondition for plenty (Hobbes 1651, chap. 13).

Aristotle in *Physics* identified two relatively contrasting features of the relationship between art and nature, i.e. *art as imitation of nature*, and *art as completion of nature*.²¹ The latter conception (art as completion of nature) considered art as “perfective” because it allows nature to achieve an end that would not be realizable otherwise (Newman 2004, p. 17). Many authors developed this view in the seventeenth century. Daniel Sennart (1572-1637), medical professor at the University of Wittenberg, conceived experimentation in laboratories as a direct application of the principle of perfective art (Newman 2004, pp. 250-255). Also Bacon spoke of “the Aristotelian language of perfective Arts” (*Ibid.*, p. 258),

¹⁸ Barbon’s re-use of the Aristotelian distinction between natural and artificial goods is discussed in Finkelstein (2000, pp. 210-11).

¹⁹ Malynes traced this distinction back to Aristotle (see *Physics* II, 192 b 8): “Aristotle saith, that riches is either naturall or artificiall. The naturall riches as lands, vines, forrests, meddowes, and such like. The artificiall, as money, gold, silver, wooles cloth, and all other moveables and houshold stuff. Nowe as this artificiall riches is proceeding of the naturall riches, and that both these doe receive their price and estimation by money [...] so reason requireth a certaine equalitie betweene the naturall riches of lands, and the artificiall riches of commodities proceeding of the same” (Malynes 1601, pp. 5-6).

²⁰ “[P]lenty dependeth (next to God’s favour) merely on the labour and industry of men” (Hobbes 1651, p. 163). Christensen (1989, pp. 704-5) remarks that Hobbes’ view on relationships between nature and labour echoes the pseudo-Aristotelian *Oeconomica*, and that this perspective reappears in Petty and Cantillon.

²¹ “Art partly completes and partly imitates the work of nature” (*Phys.*, II 8 199a, 15). The idea of art as imitation of nature suggests that art is subordinate to nature, because nature is the model for art (Close 1971). It was widespread in classical antiquity from Plato onwards and developed in manifold forms over the centuries, especially in the Renaissance (Close 1971).

and in general alchemy, chemistry and agriculture were viewed as arts that, by altering nature, improve it.²² Like Bacon, Botero emphasized “the centrality of perfective views of nature in his analysis of industry” (Keller 2012, p. 195). Art exceeds nature because of its perfective ability and, while nature provides “materia prima”, human perfective arts act as “second nature” (*Ibid.*, pp. 198 and 211). In turn, Thomas Browne (1605-1682) maintained that art and nature construct the world in alternative ways, but art is “perfection of nature” (quoted in Johnson 1937, p. 260). Art gives form, and for Misselden and Malynes “the forme giveth to the thing, the perfection of being” (Misselden 1623, p. 10. See also Malynes 1622, p. 500).

These topics were dealt from an economic point of view as well. Barbon, in *An Apology for the Builder*, maintained that “the earth by the arts of husbandry produceth ten times more food than it can naturally” (Barbon 1685, p. 11). “Natural wares” are multiplied by art, and “by Art [they] are Changed into another Form than Nature gave them” (Barbon 1690, p. 10). Therefore, art improves nature in both quantitative and qualitative terms, because it multiplies natural products and modifies their form. However, as the cause of such an improvement, the role of art can be further specified in relation to labour, since – as Petty maintained - art increases labour productivity by means of organization of labour and new inventions (Petty 1691a, p. 182, see sub-section 6.1).

However, nature has an infinite capacity to reproduce its “natural wares” through the perpetual cycle of seasons, from which limitlessness the “artificial wares” derive:

“The Native Staple of each Country is the Riches of Country, and is perpetual, and never to be consumed; Beasts of the Earth, Fowls of the Air, and Fishes of the Sea, Naturally Increase: There is Every Year a New Spring and Autumn, which produceth a New Stock of Plants and Fruits. And the Minerals of the Earth are Unexhaustable; and if the Natural Stock be Infinite, the Artificial Stock that is made of the Natural, must be Infinite” (Barbon 1690, pp. 10-11).

The idea that the “Natural Stock is Infinite” does not mean that “Every Year a New Spring and Autumn” produce an infinite amount of natural (and artificial) wares, but that nature endlessly reproduces itself over time. Therefore, the natural stock, considered in this temporal perspective, is “infinite” in the sense that it is “perpetual”, and consequently also the artificial stock is infinite in the same sense. Barbon knows that, since the banishment from the Garden of Eden, mankind has struggled against scarcity (Barbon 1690, p. 14), and that it is not unusual that “the Influence of Heaven [...] sometimes causes Murrains, Dearth, Famine” (Barbon 1690, p. 15). Living nature cyclically reproduces scarce resources and the earth is the deposit of incalculable resources like minerals, but scarce resources reproduced every year, and non-renewable resources (“Minerals of the Earth”) without transformative and multiplicative capacity of art remain only potential wealth.

Also for Locke, nature is weak, while labour multiplies the products of the earth: “For the provisions serving to the support of human life, produced by one acre of inclosed and cultivated land, are [...] ten times more, than those, which are yielded by an acre of land, of an equal richness, lying waste in common” (Locke 1690, § 27). Labour – as for Barbon – not only multiplies natural goods but also changes their form and improves their quality. As a concrete activity which produces use-value, it “puts the difference of value on everything” (*Ibid.*, § 39) because it provides “more useful commodities” (*Ibid.*, § 42, see §§ 40-43, cf. Vaughn 1978; Cohen, 1995, p. 175; Russell 2004, pp. 303-304), while “nature and the earth furnished only the almost worthless materials” (*Ibid.*, § 43).²³

²² Art prevails over nature, and “fundamentally alter[s] nature” (Bacon 1623, p. 294). Moreover, nature can be oriented, because its “secrets” can be revealed “under the vexations of art” (Bacon 1620, p. 95).

²³ The union of land and labour, however, reveals an antagonist process. Human labour denaturalizes matter: he who collects water from a fountain and puts it in a pitcher “hath taken it out of the hands of nature” (Locke 1690, § 29).

In conclusion, in the seventeenth century the idea that art prevails over nature was put forward by Aristotelian and non-Aristotelian approaches that variously mixed. The Aristotelian conception that art is the completion and perfection of nature interacted with the view of the Scientific Revolution that art dominates, alters, and improves nature. Moreover, laboratory experiments showed that it was possible to reproduce natural processes artificially. Also the development of art as technique contributed to reinforcing this conviction. New instruments like Galileo's telescope and the microscope were able to expand the natural capacities of sense organs, and made new experiences possible. These tools, in the service of knowledge, reinforced the Baconian conviction that "knowledge is [a] power" which can be employed to strengthen nature through artificial means. In turn, these arguments were coherent with the one, developed by Barbon and Locke among others, that art improves nature because it multiplies and shapes natural products. On this view, art and nature do not have a symmetrical role in the production of wealth, although both – as distinct forces – contribute to its rise, just as the father-form and the mother-matter contribute in different ways to reproductive processes.

7. Labour, added value, and innovations

The view on the prevalence of labour over nature, and the conception according to which labour has a special role in formation of wealth, took shape within a debate focused on the outflow of money, trade balance and the trade crisis of England of the 1620s. On the one hand, Malynes, Maddison, and Robinson viewed undervaluation of the currency and the low exchange rate as the causes of the crisis; on the other, Misselden and Mun interpreted the economic problems of England as a consequence of the fact that the flow of money depended on a negative balance of trade (Magnusson 2015, p. 162). Although the two positions involved practical problems, they helped to introduce, albeit vaguely, the conception that the economic sphere was ruled by its own laws. Labour was considered a fundamental cause of the growth of nations, and many proposals on economic policy mirrored this conviction. In the sixteenth century, Italian, French and Spanish authors anticipated the idea that a positive trade balance would favour employment by means of the exporting of goods whose value was increased by labour, and the importing of raw materials. Botero maintained that industry and art, rather than "fruitfulness of land" ("fertilità del terreno"), promote population growth and increase wealth both in quantitative terms, and in terms of added value.²⁴ Thomas Mun shared this view, and maintained that "we know that our own natural wares do not yield us so much profit as our industry" (Mun 1664, p. 134).²⁵ These arguments were part of the thesis that art prevails over nature. In addition, Botero clarified that the high price of manufactured goods determines the incomes of many people, while the price of natural products does not, because it results in low revenues:

"The reueneue gotten out of the Iron Mynes, is not the greatest. But of the proffit that is drawe out of the worke, and upon the trade and traffique thereof, a number of people live and are maintained; such I meane as digge it out of the Myne, frowre it, melt it, forge it, cast it, sell it by whole sale, or by retayle; Such as make Engines thereof for Warre,

Labour cooperates with, but at the same time opposes nature because the hands of man take something away from the hands of nature, and this subtraction constitutes the source of legitimacy of property rights.

²⁴ Things "wrought by the cunning hand of man, are of much more, and of far greater price and estimation, than such things as nature doth produce" (Botero 1606, p. 49) ("[L]e cose prodotte dall'artifitiosa mano dell'huomo sono molto più e di molto maggior prezzo, che le cose generate dalla natura" (Botero 1588, p. 39)).

²⁵ Mun wrote *England's Treasure by Forraign Trade* in circa 1630, but it was published posthumously in 1664.

Armor for defence and offence; And an innumerable kynde of Iron works and tooles besides for husbandrye [...]”²⁶
(Botero 1606, p. 50)

These words are echoed in Mun:

“Iron oar in the Mines is of no great worth, when it is compared with the employment and advantage it yields being digged, tried, transported, bought, sold, cast into Ordnance, Muskets, and many other instruments of war for offence and defence [...] and other instruments for Tillage” (Mun 1664, pp. 133-134).

Antonio Serra suggested promoting manufactures, and he stressed that foreign trade of domestic artisanal products increases wealth in countries where gold and silver mines are lacking. Manufacturing is preferable to farming, because artisans can indefinitely increase the volume of goods that they produce, while in agriculture this does not occur because a piece of land makes it possible to sow only a precise amount of wheat (Serra 1613, p. 120). In this perspective, labour possesses an enormous productive capacity which manifests in artisanal production, a capacity which in agriculture encounters some natural limits.

Also Bacon, who was influenced by Botero like Mun²⁷, considered labour as the cause of wealth for its capacity to add value to the matter, and proposed to developing manufactures because they increase employment.²⁸ In a letter written to George Villiers, Duke of Buckingham, he maintained:

“let us advance the native commodities of our own Kingdom, and employ our country-men before strangers, let us turn the wools of the land into cloaths and stuffs of our own growth, and the hemp and flax growing here into linen cloth, and cordage; it would set many thousand hands on work, and thereby one shilling worth of the materials, would by industry be multiplied to five, ten, and many times to twenty times more in the value being wrought.” (Bacon 1872, p. 23)

Development of manufactures would have achieved a “profitable Trade” if exported commodities were “more in value” (*Ibid.*, p. 22).

The view that manufacture had to be encouraged was shared by Child, Barbon, and Davenant in the late seventeenth century. These “authors stressed that a country should export products with as much value-added content as possible and import as little of such products as they could”, because in this way not only raw materials but also the work of labourers would have been paid (Magnusson 2015, pp. 218-219, see also Viner 1937 pp. 51-57). Finally, these themes were summarized by Defoe:

26 “[L]’entrate che si cavano dalle miniere del ferro non sono grandissime, ma dell’utilità che si traggono dal lavoro e dal traffico d’esso ferro vivono infiniti che lo cavano, che lo purgano, che lo colano, che lo vendono ingrosso, e a minuto, che ne fabricano machine da guerra, arme da difesa e offesa, ferramenti innumerevoli per l’uso dell’agricoltura [...]” (Botero 1588, p. 40)

27 Trace (2017) provides a large body of evidence showing that Bacon, Mun, Misselden, and other authors were influenced by Botero.

28 According to Bacon (1625, p. 84), “it cometh many times to passe, that *Materiam superabit opus* [the workmanship will surpass the material]; that the worke, and carriage is more worth than the material, and enricheth a State more”. These arguments were developed one century later by Cary, Janssen and the authors of *The British Merchant*, a publication edited by Defoe (Magnusson 2015, pp. 118-120).

“TRADE encourages Manufacture, prompts Invention, employs People, increases Labour, and pays Wages: As the People are employ'd, they are paid, and by that Pay are fed, cloathed, kept in Heart, and kept together; that is, kept at Home, [...]. [A]s [people] are kept together, they multiply together; and the Numbers, which by the Way is the Wealth and Strength of the Nation, increase.” (Defoe 1728, pp. 17-18)

The need to stimulate “inventions”, pointed out by Defoe, was a theme present in the seventeenth century, where – in the context of the Scientific Revolution – there took shape the idea that technique strengthens and orients nature (see sect. 6). However, the role of inventions was discussed also in the late sixteenth century by Botero, in relation to the capacity to expand the economic power of states. To increase the population of his city, the prince should introduce industry and art (“industria” and “artifizi”) by encouraging the immigration of qualified artisans from other countries, and by stimulating inventions (“inventionii”) (Botero 1588, p. 42), because labour and art play a strategic role in promoting economic growth. His advice to the prince that new inventions (“nuove invenzioni”) must stand the test of time and of experience²⁹ was in accordance with Bacon’s later view that innovations should be introduced gradually. On the one hand, innovations often do not integrate within the past order of things; on the other, “reverence” for “old times” and “retention of custom” engender many problems. Therefore, “It were good [...] that men in their innovations would follow the Example of Time it selfe; which indeed *innouateth* greatly, but quietly, by degrees, scarce to be perceiued.” (Bacon 1625 p. 140, emphasis in original). In a different context, William Petty seemed to take this view into account when he analyzed why innovations are gradually accepted. By complaining that “Right of Innovations” is not sufficiently protected, and that only a few “Inventions” are rewarded, he observed that “the generality of men will scarce be hired to make use of new practices, which themselves have not thoroughly tried, and which length of time hath not vindicated from latent inconveniences”. Original innovations have to be improved, but these improvements are gradually introduced by many artisans, with the consequence that “not any one man can pretend to the Invention of the whole, nor well agree about their respective shares in the parts” (Petty 1662, pp. 74-75).

As well known, William Petty in many circumstances analyzed how labour, art, and innovations generate surplus (Aspromourgos 1996, p. 37). Labour increases land productivity, and art, by means of “Inventions”, multiplies the productive capacity of labour (Petty 1691a, p. 182).³⁰ Therefore, he suggested calculating “a Par and Equation between Art and Simple Labour”, since a man by means of art produces as two men produce with their simple labour (Petty 1691a, p. 182). This calculation was apparently conceived as part of a larger, but not developed, project including “a Par and Equation between Art and Opinion”, and “between Lands and Labour” (Petty 1691a, p. 181-182).³¹ This latter concept, developed in more coherent terms by Cantillon (see Brewer 1992b, and Aspromourgos 1996, chap. 6), implied that agricultural surplus – which assumes the form of rent – was determined as the difference between produced corn and corn necessary for the labourer’s subsistence, and it was calculated in monetary terms by comparing that physical surplus with the surplus engendered by silver mining (Petty 1662, p. 43).³²

29 “[N]on si deve facilmente prestar fede a nuove invenzioni, se l’esperienza non le ha prima autorizzate” (Botero, 1589, p. 116).

30 A labourer by art “can do the Work of five men by one, effects the same as the begetting four adult Workmen” (Petty 1691b, p. 118).

31 He also considered “an Equation [...] between Labour, and Favour, Acquaintance, Interest, Friends, Eloquence, Reputation, Power and Authority” (Petty 1691a, p. 182).

32 Brewer (1992b, p. 718) remarks that the surplus theories of Petty and Cantillon are essentially similar. However, in *Political Anatomy of Ireland* Petty set out a different theory in which rent derives from the capacity of land to produce without labour input (Petty 1691a, p. 181).

8. Between continuity and change: Cantillon and the notions of matter and form

The view of the economic system that Cantillon presents in the *Essai sur la nature du commerce en général*³³ is generally considered to be an anticipation of the physiocratic approach, since it delineates a hierarchic model of society based on expenditure by the prince and landowners, where agricultural surplus is a concept better defined than in Petty's, Barbon's, and Locke's works. Many studies since Schumpeter's *History of Economic Analysis* have discussed the connection between Cantillon and Quesnay; and Aspromourgos (1996, p. 73) has defined Cantillon's work "the theoretical bridge between the seventeenth-century English economics and French Physiocracy". Thornton (2007) argued that Cantillon was an antimercantilist in many respects, and Benítez-Rochel and Robles-Teigeiro (2003) pointed out that Boisguilbert influenced Cantillon, and that both provided "the basic principles of the *Tableau Economique*" (*Ibid.*, p. 232). In particular, Boisguilbert, Cantillon and Quesnay shared the opinion that the earth occupies a dominant place in the economy (*Ibid.*, p. 235). This point is important because, in this line of thought, interpretation of relationships between land and labour began to change, and Physiocracy in particular considered land and not labour to be the main cause of production of wealth.

However, the opening words of Cantillon's *Essai* do not introduce new analytical propositions; rather, they reproduce Aristotelian topics:

"The Land is the Source or Matter from whence all Wealth is produced. The Labour of man is the Form which produces it: and Wealth in itself is nothing but the Maintenance, Conveniencies and Superfluities of Life" (Cantillon 2015, H3).

Land is defined as "source or matter", but the meaning of the term "source" is not explained, and this expression is used only in this circumstance, while elsewhere in the *Essai* land is qualified simply as "matter" (*Ibid.*, H75). However, for Cantillon, land is not simply inert matter, because it produces "overplus" (*surplus de produit*) (*Ibid.*, H13, E13), and exhibits different degrees of fertility which determine the quality of its produce (*Ibid.*, H68-H70).

Labour "gives form of wealth" to the products of the earth, and its main feature consists in transforming natural objects (*Ibid.*, H4), and in multiplying goods (*Ibid.*, H438). Moreover, it is characterized by different degrees of "skill": the farm labour of a young son of a husbandman requires "no art or skill" (*Ibid.*, H41), but if he learns a trade his labour changes qualitatively in consequence of the learned skill.

The quantity and quality of both land and labour enter into the explanation of "intrinsic value" as costs of labour and raw materials employed in production (Brewer 1992a, p. 63; Aspromourgos 1996, p. 81), and they are expressed in money (Cantillon 2015, H103). However, the reduction of intrinsic values to costs of production is the consequence of a long reasoning process. In particular, the intrinsic value of a commodity is "the measure of the quantity of Land and of Labour entering into its production, having regard to the fertility or produce of the land and to the quality of the Labour" (*Ibid.*, H70). It should be reckoned by considering the quantity and quality of both land and of labour, but this calculation can be simplified because: 1) quantity of labour – or more precisely subsistence of labourers – can be expressed in terms of quantity of land, 2) quality of land and labour can be not considered. As regards the first point, it is sufficient to calculate quantities of land and labour by reducing quantity of labour to a certain amount of land. This reduction is possible because the value of labour is equivalent to the subsistence engendered by land necessary to maintain a "labouring slave" and his son, that is, twice the amount of land necessary to maintain one labourer. As regards the second point, Cantillon considers not the different quality, but the "ordinary goodness" of land prevalent in

³³ The book was written in the early 1730s but not published until 1755.

a given country (*Ibid.*, pp. H88), while the quality of labour is not evaluated, because Cantillon takes into consideration not labour, but the ordinary subsistence of labourers, i.e., subsistence as socially, geographically, and historically determined, which in turn is calculated in terms of the land necessary to produce it. As a consequence, quality of land and quality of labour do not enter into his calculations. By means of this solution, Cantillon shifted the focus from labour, which as “form” is irreducible to “matter”, to the subsistence of the labourer, since only the latter is reducible to the amount of the land necessary for its production. In short, although Cantillon still conceived the rise of wealth as an Aristotelian relationship between matter and form, he discovered that wealth can be calculated by referring only to land. Land acquired centrality in economic theory in this way, and in consequence of the fact that growth of population depends on how land is used according to the will of the landowners, and on how it supports other activities (see chap. 15 of the *Essai*).

9. Mirabeau and the change of perspective

Mirabeau maintained that Cantillon’s *Essai* was not in contrast with the traditional approach. He well knew and was influenced by this book, which was in his possession for many years before it was published, and which initially he probably intended to plagiarize (Cantillon 2015, p. 7; Sabbagh 2016, p. 95, note 20). The influence of Cantillon’s *Essai* is evident in *L’ami des hommes* (1756), a work that Mirabeau wrote before meeting Quesnay, where he argued for the fundamental role of labour in producing wealth with respect to land: “the earth produces little or nothing which is ours, without the labour of man”³⁴ (Mirabeau 1756, p. 17).

The emphasis on the role of labour aids understanding of Mirabeau’s reformulation of the famous sentence which opens Cantillon’s *Essai*:

“Wealth is the food, conveniences, and pleasures of life. The earth produces it, and the labour of man gives it form. Landed property (*fonds*) and form are the earth and man. What is beyond? Everywhere, form is necessary for landed property (*fonds*) [...] If man is nil, so too is the earth” (*Ibidem*, p. 34)³⁵

Since, echoing Cantillon, “the earth is the matter and the labour is the form”³⁶ (*Ibid.*, p. 197), the central role of labour in producing wealth, and in giving form to matter, explains why the increase of the working population is so important for Mirabeau.

In July 1757 Quesnay invited Mirabeau to Versailles to discuss their ideas (Théré and Charles, 2008, p. 12), probably because he perceived some affinities with his own theory in Mirabeau’s view of agriculture as fundamental for increasing the population. This meeting marks Mirabeau’s conversion to Physiocracy and the beginning of the collaboration with Quesnay. It also brought about a sharp change in Mirabeau’s ideas about the rise of wealth. In reporting the interview to Rousseau, in a letter in 1767, Mirabeau emphasized two points. The first was the negative judgment on Cantillon, who adopted the erroneous opinion widespread in the seventeenth century that trade is the

34 “[L]a terre ne produit que peu ou rien qui nous soit propre, sans le travail de l’homme” (Mirabeau 1756, p. 17).

35 “La nourriture, les commodités & les douceurs de la vie sont la richesse. La terre la produit, & le travail de l’homme lui donne la forme. Le fonds & la forme sont la terre & l’homme. Qu’y a-t’il par-delà? Par-tout la forme est nécessaire au fonds [...] Si l’homme est nul, la terre l’est aussi” (*Ibidem*, p. 34).

36 “[L]a terre est la matière, & le travail est la forme” (*Ibid.*, p. 197).

“principle of wealth” (Rousseau 1932, p. 176). Before meeting Quesnay, Mirabeau shared Cantillon’s approach and, as he himself admitted, this implied that some mistakes in his ‘populationist’ thesis were due to the influence exerted by Cantillon’s book (Meek 1962, p. 16). The ‘populationist’ thesis was that “the labour of man alone possesses the capacity to increase wealth”, and consequently the only way to increase prosperity consists in increasing population and productive labour (Rousseau 1932, p. 176, partially translated in Meek 1962, pp. 17-18). The second point was that Quesnay reacted to this argument by reversing it and positing nature as the term from which any reasoning on production of wealth had to start (see also Mirabeau 1763, p. 103), since labour without nature could never begin (Banzhaf 2000, p. 520).³⁷

This change of perspective would appear clearly in *Philosophie Rurale* (1763), a book written in collaboration with Quesnay (Théré and Charles 2008), where land (*la terre*) is described not simply as the matter shaped by labour, but as the “source of production” (*source de la production*) (Mirabeau 1763, p. 6). This reversal regards also the relationship between matter and form: “In vain one has argued that [the sterile class] produces the form; to produce the form is to produce nothing” (*Ibid.*, p. 6, translated in Herlitz 1997, p. 173). The form in the strict sense cannot be produced because only nature produces, while artisanal labour simply gives shape to what has been engendered by nature. As a consequence, the roles of nature and labour in producing wealth have to be re-interpreted in this perspective.

10. Sexuality, vitality, and expansion of nature

Mirabeau’s change of perspective synthesizes the reversal that occurred within the approach that conceived the discourse on nature as a part of the economic discourse. This change precluded the definitive abandonment of the Aristotelian relationship between matter and form, also as a union of land-mother and labour-father, because the view of nature as a domain ruled by its own laws, in which reproductive processes occur independently from labour, acquired increasing salience. Labour does not participate in reproductive natural processes; rather, it is an external help to natural reproductive processes.

The idea that nature is the framework in which reproductive processes occur and have an impact on the economy was present also in Linnaeus. Although Linnaeus’ approach to economic issues was influenced by cameralism and Mercantilism (Koerner 1999, chap. 5), his theory is comparable to the physiocratic one in some respects. According to Rausing (2003, p. 177), the Swedish school of economics to which Linnaeus belonged “in its emphasis on farming, [...] foreshadowed, even if it did not influence, the French physiocrats of the 1750s”. And Müller-Wille (2003, pp. 166-7) maintains that similarly to Quesnay “Linnaeus was one of the first to have identified circulation as a form of biological reproduction”, and that it “seems probable that Quesnay knew the work of Linnaeus and other naturalists of his time”. In Linnaeus’ system, which was widely adopted after 1737, natural sciences and economics are components of the same theoretical framework that he named “Economy of nature” (Rausing 2003, p. 184). In nature, where cyclical processes of “propagation, preservation and destruction” occur, there are no scarcities because the Creator has “established the minimum and maximum rates of reproduction for every plant and animal” which guarantees “a full abundance to all” (Worster 1977, pp. 35-36). Economics was viewed “as the discipline of how to husband the natural world and, in doing so, order society on nature’s model” (Rausing 2003, p. 185).

³⁷ Cantillon (2015, part I, chap. 15) maintained that subsistence determines population; nonetheless, Mirabeau criticises Cantillon for neglecting the fact that wealth and subsistence depend on nature.

The idea of reproduction of living beings played an important role in Linnaeus' theory on the continuous renewal of nature, and it was shared by many studies of his time. Investigations into the sexuality of plants appeared late in the seventeenth century, although the analogy between animal and plant sexuality was fully developed in the first decades of the eighteenth century (Schiebinger 1993, pp. 11-39). Sébastien Vaillant in 1717, in France, on the basis of analogies drawn from human anatomy, proposed the idea, until then little known and accepted, that plants have sexual organs. But he was not alone in claiming this discovery. Also Claude Geoffroy claimed that honour, while Robert Thornton maintained that the discovery had been made by the English (Schiebinger 1996, p. 165; Williams 2001, pp. 9-18). Finally, the young Linnaeus, under the influence of Vaillant's work, since 1729 outlined the functions of stamen and pistils in pollination as sexual acts (Williams 2001, p. 19).³⁸ Although this kind of argument was not new, given that also in Aristotle (GA, I (A) 18 724b 10 and 23 731a 25) nature is ruled by male and female principles, it acquired importance in consequence of its inclusion within the conceptual framework of the economy of nature.³⁹

This approach was developed in France. Julien Offray de La Mettrie maintained that male and female plants sexually mate in "coitus", and described their sexual organs: "The *stylus* of the female [plant] is the vagina while the vulva and the mons Venus [...] correspond to the *stigma*. Thus the uterus, vagina, and vulva make up the *pistil* [...] The *stamen* is the penis, and the sperm is our fecundating power" (La Mettrie 1748, pp. 287-288, translated in Schiebinger 1996, p. 163). In the same years, like Linnaeus, La Mettrie, and others, also Quesnay - in *Essai physique sur l'économie animale* - adopted the view of the continuous renewal of nature as a consequence of the sexual reproduction of plants and animals: as "the prolific liquor of the Animals, is provided with animacules that fertilize eggs (*oeufs*)⁴⁰ so "the liquor of the powder (*liqueur de la pousse*) of the Stamens of the Flowers also contains the germs which fertilize the seeds (*semences*)"⁴¹ (Quesnay 1747, p. 156), where the "liqueur prolifique" and the "liqueur de la pousse" come from the male, while the substance of "oeufs" and "semences" come from the female.⁴²

11. Nature and labour in Quesnay's approach

Sexualisation of nature – as a conception developed in consequence of more accurate investigations – showed how nature increases its products on new bases. This meant considering nature as the privileged place in which male and

38 This conception characterized Linnaeus' system in subsequent years: "plants produce seeds, but they are entirely unfit for propagation, unless foecundation precedes, which is performed by an intercourse between different sexes, as experience testifies. *Plants* therefore must be provided with *organs* of generation, in which respect they hold an analogy with *animals*" (Linnaeus 1749, p. 59, emphasis in original).

39 In some way contrasting with the idea that abundance engendered by nature is always desirable (see sect. 10), but with reference to inanimate nature, Christopher Polhem, in Sweden, in the 1720s, remarked that abundance of iron and copper produces a fall in prices (Magnusson 1977, p. 258).

40 "[L]a liqueur prolifique des Animaux, est fournie d'animacules qui fécondent les oeufs" (Quesnay 1747, p. 156).

41 "[L]a liqueur de la pousse des Etamines des Fleurs contient aussi les germes qui fécondent les Semences" (*Ibid.*, p. 156).

42 From the 1740s onwards, in consequence of more accurate observations of animal generation, due also to the use of the microscope (Leeuwenhoek was the first to see single-celled organisms invisible to the naked eye in 1676), nature appeared to be characterized by distinctive vitality and creative capacity. Theories of pre-formation and pre-existence, which maintained that the embryo pre-exists and that nature is deprived of vital powers because all organisms were originally formed at the time of Creation, were rejected. Also mechanical philosophy, which reduced biological phenomena to mechanical-physical ones, declined. By contrast, epigenesis – the theory of gradual development of the embryo - reappeared along with vitalism. In these perspectives, life does not depend on inert matter reducible to mechanical and motion laws. However, the transition from theories of preformation, pre-existence and ovism (the view that life comes from an egg) to vitalism was gradual, and these approaches often coexisted and influenced each other (Bernardi 1980, pp. 14-21).

female principles interact and determine its renewal. The idea of expansion of nature as consequence of its cyclical renewal, from which abundance derives, influenced Quesnay's economic approach. "Fertility of the land" is at the basis of cyclical reproductive processes, both natural and economic (Quesnay 1766, p. 209), and the "produit net", as the physical surplus cyclically reproduced by nature, determines the surplus generated by the market as the difference between costs and revenues (Banzhaf 2000, pp. 518-523).

If nature embodies male and female principles of reproduction, labour exhibits two distinct features which place it outside the sphere of natural reproduction: 1) transformation of natural matter, 2) activity of direction of nature's forces. As regards the first point, labour, in artisanal production, transforms the matter provided by nature, but does not possess generative capacities. It is "sterile"; therefore, it cannot be considered as father. As regards the second point, and in reference to the agricultural sector, man is now a midwife (Tribe 1978, p. 96), that is, a help that from outside favours the rise of natural goods. Nature, and not labour, incorporates generative capacities, since "labour directs but nature produces" (Mirabeau 1763, p. 93, translated in Herlitz 1997, p. 173). Moreover, the guidance of nature does not depend only on direct labour, but involves a more complex activity of administration and management of rural property. It is an activity usually performed by the farmer, who decides how to exploit natural resources, and plans his investments (Quesnay 1757, pp. 479-484). These processes reduce the possibility to represent labour simply as a "father", not only because labour does not participate in natural reproductive processes, but also because renewal of nature depends on expenditures not directly related to labour, which increase the productivity of land, and because factors other than direct labour help nature to be more productive. Labour, as a complex activity of direction and management and as physical work, consists in combining material produced by nature, but "We have to distinguish an *adding together* of items of wealth which are combined with one another, from a *production* of wealth [that is] from a *generation* or creation of wealth, which constitutes a renewal and *real* increase of renascent wealth" (Quesnay 1766, p. 207, emphasis in the original), because the "generation" of wealth depends on nature. Finally, human labour is not the only force which favours nature's productivity, because other forces perform this function irrespective of man: "Independently of the direction given by the employing hand, draught-animals have within themselves a motive force which gets them going and duplicates our impulsion" (Mirabeau 1763, pp. 92-93, translated in Herlitz 1997, p. 173). This entails revision of the old idea that only labour possesses the capacity to multiply goods. Human labour alone is unable to produce increasing wealth without support: "If a man cultivates the land with his hands, he will derive from it only his subsistence and that of his family, and will indeed live very poorly" (Mirabeau 1763, p. 121). By contrast, "he must find a form of assistance which will furnish him with a larger product, and demand less from him by way of upkeep", where this "assistance consists of machines, livestock, wheat, manure" which require "the mass of the original advances [*avances primitives*]" (*Ibid.*, p. 121). In short, human labour is only one element among others which stimulates natural reproductive processes and favours the rise of wealth.⁴³

The story of the notions of land and labour can be narrated in reference to the emergence of the concept of capital. While Petty's and Cantillon's consideration of land and labour as exclusive agents of wealth production reflects the persistence of the concepts of matter and form, Quesnay's introduction of the notion of capital (related to terms like *avances primitives*, *avances annuelles*, and *avances foncières*), although little developed, reflects increasing abandonment of that view (Aspromourgos 1995, pp. 116-123, Magnusson 2015, pp. 103-106). Capital, as a further

⁴³ Physiocratic ideas were attacked after the mid-1760s. Among those who opposed certain tenets of Physiocracy were Galiani and Necker. Necker, in particular, argued against a rapid liberalization of the market, and was in favour of a slight regulation of the foreign grain trade. He also criticized from a pragmatic point of view (a perspective which also characterized Galiani) the abstract generalizations of economic behaviour of the Physiocrats. On these themes see Faccarello (1994).

element cited to explain the rise of wealth, crowded out the dualistic view of labour and land as father and mother, and as form and matter. Investments and expenditures did not fit with the biological representation of wealth as the offspring of land-mother and labour-father. Wealth was not defined in simple naturalistic terms; it depended on the market; it was not reducible to material goods, and it regarded commodities exchanged at the market prices (Vaggi 1987, pp. 34-40). Moreover, the notion of matter and form changed their meanings. In the physiocratic approach, nature was not matter with weak reproductive capacities as in seventeenth century, but a domain which expands in consequence of its generative capacities. Labour was not form in traditional sense. While for Aristotle giving form meant giving life to matter, and for Petty labour was an “active principle of Wealth”, for physiocrats artisanal labour shaped, but was sterile; therefore, it neither gave life to matter nor was an active principle. And labour which helps nature in agriculture was not form, but a force which stimulated nature.

Although some metaphors concerning the relationships between nature and labour decayed, and the appearance of a more complex conceptualization of the market came to undermine the naturalistic view of the relationships between land and labour, the metaphorical language of organic generation, in different forms with respect to the past, continued to characterize economic theory. Land was viewed as “the mother of all goods” (Mirabeau 1973, p. 120) which “gives birth” to surplus, thanks to its “fecundity” (or “fertility”). Labour in agriculture was described as (re)productive, in the sense that it facilitated the reproductive processes of nature, while in the industrial and artisanal sector it was defined as “sterile”. Similarly, money was considered as “sterile” wealth. In the seventeenth century and the early decades of the eighteenth, economic discourse and discourse of nature were closely related, and the metaphorical language highlights this relation. In this perspective, theories of the age of Mercantilism and Physiocracy, rather than being alternative paradigms, were alternative versions of the same naturalistic paradigm.

12. Conclusions

This article has examined two explanations about the formation of wealth developed in the seventeenth century and the early decades of the eighteenth, which reorganized and even reversed ideas that dated back at least to Aristotle: those of land as female, potentiality, mother, matter, and labour as male, actuality, father, source of movement, form. One explanation, in the age of Mercantilism, attributed to labour a prevalent role in the production of wealth and considered land as matter; the other – proposed by the physiocrats - attributed to land a prevalent role in producing wealth, and viewed labour as either mere support for natural reproductive processes or a useful, but sterile, capacity to transform natural products. These perspectives emerged not only from theoretical analyses but also from less structured conceptions which provided preliminary conceptual frameworks with which to explore economic phenomena, since an overall theory about the formation of wealth was not available.

In the seventeenth century, diverse arguments supported the view that labour prevails over land in the production of wealth. William Petty represented this concept by means of the metaphor of labour-father-‘active principle of Wealth’ and land as “Mother and Womb of Wealth”. A view related to that metaphor was put forward by Misselden and Malynes, who reused the Aristotelian idea that form prevails over, and confers distinctive traits on, matter. The conception that art prevails over nature in the production of wealth stemmed from a point of view in part analogous. It was the result of the unusual alliance between Aristotelian and non-Aristotelian perspectives that mixed in various ways. The former approach developed the Aristotelian idea that art is the “completion of nature”; the latter, in the spirit of the Scientific Revolution, maintained that art is “perfective” and, therefore, enhances nature. Barbon and Locke, in

their economic and philosophical writings, suggested that art improves nature in quantitative and qualitative terms, because art increases products spontaneously engendered by land and modifies their form. These and other authors pointed out that nature is weak and at most cyclically reproduces scarce resources, and that art as an *artificial* technique expands natural limitations. Reproduction of natural processes by means of experiments and mechanical devices entailed acceptance that the artificial and the natural were similar in some respects, but not removal of the idea that art and nature are distinct forces. Precisely because they are distinct forces they play different roles in production of wealth, and in general in reproductive (biological) processes. These topics developed within debates on political economy, where arguments in favour of a positive trade balance were based on the idea that labour is the main source of wealth, and that employment would be increased by exporting value-added commodities produced by manufactures, and by importing raw materials.

The seventeenth-century idea of the prevalence of labour over land was reversed by Physiocracy. That reversal, so well illustrated by Mirabeau's intellectual biography, was presumably related to the changes that occurred in the eighteenth century in the concepts of nature and labour. Empirical studies and more accurate investigations showed that plants, by embodying male and female features like animals, sexually reproduce. Nature was now seen as a prolific, rather than ungenerous, mother because it possesses internal forces which explain its own expansion. Linnaeus described the abundance of nature, and Quesnay connected "produit net" to nature's powers. They used expressions like "economy of nature" (Linnaeus) and "animal economy" (Quesnay) to synthesize the idea that economic discourse presupposes a discourse on nature. And Quesnay, in particular, pointed out that the reproductive capacities of land are at the basis of economic reasoning. These conceptions crowded out the seventeenth-century notion that the formation of wealth depends on the relation between labour and land, as agents that participate in reproductive processes as the father and mother of wealth, because generative capacities were attributed exclusively to nature, which renews itself. Corresponding to the redefinition of the concept of nature was redefinition of the concept of labour. Unlike mercantilists, physiocrats did not consider labour as possessing generative capacities, because it either favours from outside, along with other forces, nature's generative processes or it simply shapes what nature produces, and as such is sterile. Also the Aristotelian notions of matter and form changed their meanings, and indeed were increasingly marginalised. The seventeenth-century conception of nature as matter which exhibits scarce reproductive capacities was replaced by the view that nature is potentially the cause of abundance. If male features are internal to nature, labour is not "father"; rather, it is activity which helps natural reproductive processes from outside. Form, which from Aristotle to Petty was associated with the power to *give life* to matter by determining its "essence", was now more trivially the external shape of an object, linked to its function (not to its essence). And the acquisition of form, as shape, became the result of *sterile* labour in Physiocracy.

The alternative analyses of relationships between land and labour formulated during the seventeenth century and by physiocrats shared the idea that economic discourse is inseparable from discourse on nature. Economic discourse and discourse on nature had many conceptual terms in common, sometimes expressed in metaphorical form. The description of land as either ungenerous or prolific, and of labour as either father of wealth or sterile activity, denotes a continuity, in the sense that opposite terms were used alternatively to delineate the same framework, that of the naturalization of economy. Although it can be debated when economic theory was denaturalized (see Schabas 2005), elements, like Quesnay's notion of "avance", that would contribute to the formation of economic theory as an autonomous, non-naturalistic, discourse can be detected in the period examined in this paper. But the history of the notion of capital is another story.

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References

- Appleby Joyce Holdam (1978), *Economic Thought and Ideology in Seventeenth-Century England*, Princeton: Princeton University Press.
- Aristotle (1936), *Physics*, a revised text with introduction and commentary by W.D. Ross, Oxford: Clarendon Press.
- Aristotle (1972), *De Generatione Animalium I*, in *De Partibus Animalium I and De Generatione Animalium I* (with passages from II. 1-3), trans. by D.M. Balme, repr. in 2003, Oxford: Clarendon Press.
- Aristotle (2007), *The Metaphysics*, trans. by John H. McMahon, New York: Dover.
- Aspromourgos Tony (1996), *On the Origins of Classical Economics: Distribution and Value from William Petty to Adam Smith*, London and New York: Routledge.
- Bacon Francis (1620), *The New Organon*, in Bacon (1962).
- Bacon Francis (1623), *Of the Dignity and Advancement of Learning*, in Bacon (1962).
- Bacon Francis (1625), *The Essayes or Covnsels, Civill and Morall*, London: John Haviland.
- Bacon Francis (1962), *The works of Francis Bacon* (1860), vol. 4, James Spedding, Robert L. Ellis, and Douglas D. Heath (eds), repr., Stuttgart-Bad Cannstatt: Friedrich Fromann Verlag Günther Holzboog.
- Bacon Francis (1872), *A Letter of Advice Written by Sir Francis Bacon to the Duke of Buckingham* in James Spedding (ed.), *The Works of Francis Bacon: The Letters and the Life*, Vol. 6, London: Longmans.
- Balme David M. (1972), *Notes*, in *De Partibus Animalium I and De Generatione Animalium I* (with passages from II. 1-3), trans. by D.M. Balme, repr. in 2003, Oxford: Clarendon Press.
- Banzhaf Spencer H. (2000), *Productive Nature and the Net Product: Quesnay's Economies Animal and Political*, "History of Political Economy", 32, 3, pp. 517-551.
- Barbon Nicholas (1685), *An Apology for the Builder*, in John R. McCulloch (ed.), *A Select Collection of Scarce and Valuable Economical Tracts*, London: Printed for the Political Economy Club, 1859, pp. 3-26.
- Barbon Nicholas (1690), *A Discourse of Trade*, in Jacob H. Hollander (ed.), *A Reprint of Economic Tracts*, Baltimore: John Hopkins Press, 1905, pp. 9-43.
- Benítez-Rochel José J. and Robles-Teigeiro Luis (2003), *The foundations of the Tableau Économique in Boisguilbert and Cantillon*, "The European Journal of the History of Economic Thought", 10, 2, pp. 231-248.
- Bernardi Walter (1980), *Filosofia e scienze della vita. La generazione animale da Cartesio a Spallanzani*, Milano: Loescher.
- Black Max (1962), *Models and Metaphors*, Ithaca (N.Y.): Cornell University Press.
- Botero Giovanni (1588), *Delle cause della grandezza delle città*, Roma: Giovanni Martinelli.
- Botero Giovanni (1606), *A Treatise, concerning the Causes of the Magnificencie and Greatnes of Cities*, London: Richard Ockould and Henry Tomes.
- Botero Giovanni (1589), *Della ragion di Stato*, Torino: Utet, 1948.
- Boyd Richard (1993), *Metaphor and Theory Change: What is "Metaphor" a Metaphor for?*, in *Metaphor and Thought*, second edition, A. Ortony (ed.), Cambridge: Cambridge University Press, pp. 481-532.
- Brewer Anthony (1992a), *Richard Cantillon. Pioneer of Economic Theory*, London and New York: Routledge.

- Brewer Anthony (1992b) *Petty and Cantillon*, "History of Political Economy", 24, 3, pp. 711-728.
- Cantillon Richard (2015), *Richard Cantillon's Essay on the Nature of Trade in General. A variorum edition*, edited by Richard van den Berg, London and New York: Routledge.
- Child Josiah (1694), *A discourse of the nature, use and advantages of trade*, London.
- Christensen Paul P. (1989), *Hobbes and the physiological origins of economic science*, "History of Political Economy", 21, 4, pp. 689-709.
- Close Anthony J. (1969), *Commonplace Theories of Art and Nature in Classical Antiquity and in the Renaissance*, "Journal of the History of Ideas, 30, 4, pp. 467-486.
- Close Anthony J. (1971), *Philosophical Theories of Art and Nature in Classical Antiquity*, "Journal of the History of Ideas, 32, 2, pp. 163-184.
- Cohen Gerald A. (1995), *Marx and Locke on land and labour*, in *Self-ownership, freedom, and equality*, Cambridge: Cambridge University Press.
- Connell Sophia M. (2016), *Aristotle on Female Animals: A Study of the Generation of Animals*, New York: Cambridge University Press.
- Davenant Charles (1699), *An Essay Upon the Probable Methods of Making a People Gainers in the Ballance of Trade*, London: R. Horsfield.
- Dean-Jones Lesley A. (1994), *Women's Bodies in Classical Greek Science*, Oxford: Clarendon Press.
- Dear Peter (1995), *Discipline and Experience. The Mathematical Way in the Scientific Revolution*, Chicago: University of Chicago Press.
- Defoe Daniel (1728), *A Plan of the English Commerce*, London.
- Faccarello Gilbert (1994), 'Nil Repente!': *Galiani and Necker on economic reforms*, "The European Journal of the History of Economic Thought", 1,3, pp. 519-550
- Finkelstein Andrea (2000), *Harmony and the Balance: an Intellectual History of Seventeenth-Century English Economic Thought*, Ann Arbor: The University of Michigan Press.
- Herlitz Lars (1997), *Art and nature in pre-classical economics of the seventeenth and eighteenth centuries*, in M. Teich, R. Porter, and B. Gustafsson (eds), *Nature and Society in Historical Context*, Cambridge: Cambridge University Press.
- Hesse Mary B. (1966), *Models and Analogies in Science*, Indiana: University of Notre Dame Press.
- Hobbes Thomas (1651), *Leviathan*, edited by J.C.A. Gaskin, Oxford: Oxford University Press, 1998.
- Hull Charles H. (ed.) (1963-4), *The Economic Writings of Sir William Petty [1899]*, vols I-II, repr. in New York: A.M. Kelley.
- Johnson Edgar A.J. (1937), *Predecessors of Adam Smith*, New York: Augustus M. Kelley, 1960.
- Keller Vera (2012), *Mining Tacitus: secrets of empire, nature and art in the reason of state*, "British Journal of the History of Science", 45, 2, pp. 189-212.
- Koerner Lisbet (1999), *Linnaeus: Nature and Nation*, Cambridge (Mass.): Harvard University Press.
- Lakoff George and Johnson Mark (1980), *Metaphors We Live by*, Chicago and London: The University of Chicago Press.
- La Mettrie Julien Offray de (1748), *L'Homme-plante*, in *Œuvres Philosophiques*, tome I, Fayard 1987.
- Linnaeus Carl (1749), *The Economy of Nature in Miscellaneous Tracts Relating to Natural History, Husbandry and Physics*, trans. by Benjamin Stillingfleet, 3rd ed., London: J. Dodsley, 1775.

- Locke John (1690), *Second Treatise of Government*, edited by C. B. Macpherson, Indianapolis Cambridge: Hackett Publishing Company, 1980.
- Magnusson Lars (1977), *Economic Thought and Group Interests. Adam Smith, Christopher Polhem, Lars Salvius and classical political economy*, “Scandinavian Journal of History”, 2, pp. 243-264.
- Magnusson Lars (2015), *The Political Economy of Mercantilism*, London and New York: Routledge.
- Malynes Gerard (1601), *A Treatise on the Canker of Englands Common Wealth*, London.
- Malynes Gerard (1622), *Consuetudo, Vel Lex Mercatoria*, London: Adam Islip.
- Manning Gideon (2012), *Three biased Reminders about Hylomorphism in Early Modern Science and Philosophy*, in G. Manning (ed.), *Matter and Form in Early Modern Science and Philosophy*, Leiden-Boston: Brill, pp. 1-32.
- Mayhew Robert (2004), *The Female in Aristotle’s Biology: Reason or Rationalization*, Chicago: The University of Chicago Press.
- McCulloch John R. (1856) (ed.), *A Select Collection of Early English Tracts on Commerce from the Originals of Mun, Roberts, North, and Others*, London: Printed for the Political Economy Club.
- Meek Ronald L. (1962), *The Economics of Physiocracy. Essays and Translations*, repr. in 2003, London and New York: Routledge.
- Mirabeau (V. Riqueti, marquis de) (1756), *L’ami des hommes, ou traité de la population*, première partie: Avignon.
- Mirabeau (V. Riqueti, marquis de) (1763), *Philosophie rurale, ou économie générale et politique de l’agriculture réduite à l’ordre immuable des loix physiques et rurales, qui assurent la prospérité des empires*, Amsterdam: Libraires associés.
- Mirabeau (V. Riqueti, marquis de) (1973), *The Tableau Économique and its Explanation*, in Ronald L. Meek (ed.), *Precursors of Adam Smith*, London: Rowman and Littlefield, Totowa, N.J.
- Misselden Edward (1623), *The Circle Of Commerce*, London.
- Müller-Wille Staffan (2003), *Nature as a Marketplace: The Political Economy of Linnaean Botany*, “History of Political Economy”, Annual Supplement to volume 35, pp. 154-172.
- Mun Thomas (1664), *England’s Treasure by Forraign Trade or The Ballance of our Forraign Trade is the Rule of our Treasure*, in McCulloch J.R. (1856), pp. 115-209.
- Newman William R. (2004), *Promethean Ambitions. Alchemy and the Quest to Perfect Nature*, Chicago and London: University Of Chicago Press
- North Dudley (1691), *Discourses Upon Trade*, London, in *A Reprint of Economic Tracts*, J.H. Hollander (ed.), Baltimore: The Johns Hopkins Press, 1907.
- Perrotta Cosimo (2004), *Consumption as an Investment: I. The fear of goods from Hesiod to Adam Smith*, London and New York: Routledge.
- Petty William (1662), *Treatise of Taxes and Contributions*, in *The Economic Writings of Sir William Petty* [1899], in C.H. Hull (1963-4) (ed.), vol. I, 1963.
- Petty William (1676), *Natural and Political Observations upon the Bills of Mortality. By Capt. John Graunt*, in *The Economic Writings of Sir William Petty* [1899], in C.H. Hull (ed.), vol. II, 1964.
- Petty William (1691a), *The Political Anatomy of Ireland*, in *The Economic Writings of Sir William Petty* [1899], in C.H. Hull (1963-4) (ed.), vol. I, 1963.
- Petty William (1691b), *Verbum Sapienti*, in *The Economic Writings of Sir William Petty* [1899], in C.H. Hull (ed.), vol. I, 1963.

- Quesnay François (1747), *Essai physique sur l'æconomie animale*, seconde édition, tome III, Paris: Guillame Cavalier.
- Quesnay François (1757), *Grains*, in *François Quesnay et la Physiocratie*, L. Salleron (ed.), vol. II, Paris: I.N.E.D, pp. 459-510.
- Quesnay François (1766), *The 'Dialogue on the Work of Artisans' [Second Dialogue]*, reprinted and translated in Meek (1962), pp. 203-230.
- Rausing Lisbet (2003), *Underwriting the Oeconomy: Linnaeus on Nature and Mind*, in "History of Political Economy", Annual Supplement to volume 35, pp. 173-203.
- Roncaglia Alessandro (1977), *Petty, la nascita dell'economia politica*, Milano: Etas.
- Rousseau Jean-Jacques (1932), *Correspondance générale de J.-J. Rousseau*, Théophile Dufour (ed.), tome 17, Paris: Librairie Armand Colin.
- Russell Daniel (2004), *Locke on Land and Labor*, "Philosophical Studies", 117, pp. 303–325.
- Rossi Paolo (1968), *Francis Bacon: From Magic to Science*, trans. Sacha Rabinovich, London: Routledge and Kegan Paul.
- Sabbagh Gabriel (2016), *Cantillon in French and English. Two Editions by Richard van den Berg and Antoin E. Murphy: New Facts and Hypotheses*, "Contributions to Political Economy", pp. 91-125.
- Schabas Margaret (2005), *The Natural Origins of Economics*, Chicago: The University Chicago Press.
- Shapin Steven (1996), *The Scientific Revolution*, Chicago and London: The University Chicago Press.
- Schiebinger Londa L. (1993), *Nature's Body: Gender in the Making of Modern Science*, New Boston, Beacon Press.
- Schiebinger Londa L. (1996), *Gender and natural history*, in N. Jardine, J. A. Secord, and E.C. Spary (eds), *Cultures and natural history*, Cambridge: Cambridge University Press.
- Serra Antonio (1613), *A Short Treatise on the Wealth and Poverty of Nations (1613)*, edited by Sophus Reinert, London: Athem Press, 2011.
- The Bible* (1994), James Moffatt Translation, edited by James A.R Moffatt, San Francisco: Kregel Classics.
- Théré Christine and Charles Loïc (2008), *The Writing Workshop of François Quesnay and the Making of Physiocracy*, "History of Political Economy", 40, 1, pp. 1-42.
- Thornton Mark (2007), *Was Richard Cantillon a Mercantilist?*, "Journal of the History of Economic Thought", 29, 4, pp. 417-435.
- Trace Jamie R. (2017), *Giovanni Botero and English Political Thought*, Doctoral thesis, St. Catharine's College, University of Cambridge.
- Tribe Keith (1988), *Land, Labour and Economic Discourse*, London: Routledge and Kegan Paul.
- Ullmer James H. (2011), *The scientific method of Sir William Petty*, "Erasmus Journal for Philosophy and Economics", 4, 2, pp. 1-19.
- Vaggi Gianni (1987), *The Economics of François Quesnay*, London: Macmillan.
- Vaughn Karen I. (1978), *John Locke and the Labor Theory of Value*, "Journal of Libertarian Studies", 2, 4, pp. 311-326.
- Viner Jacob (1937), *Studies in the Theory of International Trade*, London and New York: Routledge, 2017.
- Williams Roger L. (2001), *Botanophilia in Eighteenth-Century France. The Spirit of the Enlightenment*, Dordrecht: Springer-Science+Business Media, B.V.
- Worster Donald (1977), *Nature's Economy: The Roots of Ecology*, San Francisco: Sierra Club.
- Wotton David (2015), *The Invention of Science: A New History of the Scientific Revolution*, New York: Harper.