

# COMPARISON OF TRANSITIONAL THEORIES TO POST-SCARCITY IN SCIENCE-FICTION LITERATURE

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## ABSTRACT

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Scarcity, or limited resources, is the fundamental economic problem the humanity faces continuously. Without it, economics would be meaningless. Science-fiction literature depicts societies where abundance is becoming persistent feature. Humans no longer participate in the production process itself, machines become sentient thanks to artificial intelligence and everyone has access to all goods and services desired. Scarcity as a multiple-born phenomenon, namely originating with labour and land, has been eradicated. Everyone is fully satisfied, exchange is non-existing, the medium of exchange – money – is no longer required. This paper compares some of the most representative economic thoughts in science – fiction genre since 1910s. Main purpose is to identify whether the societies have really achieved post-scarcity or they are only transitional theories, suffocating from still-present scarcity. Results of the paper suggest that even though the societies look like and are presented as they achieved post-scarcity, they are still experiencing scarcity in certain forms and use a medium of exchange to redistribute resources. This implies that these theories rather depict a socialistic utopia than a fully emerged post-scarcity society, even in the most progressive novels scarcity still occurs. Only the Culture series indicate signs of fully developed post-scarcity era.

## KEY WORDS

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post-scarcity, abundance, science-fiction, scarcity, artificial intelligence, utopia, socialism

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# 1 INTRODUCTION

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We are living in an era of immersive breakthroughs. Robotics became so flexible that they can deliver packages and not trip over during the journey (O’Kane, 2018); autonomous cars can take over control on highways or even park (Armstrong, 2018); and machine learning is able to learn and create well-constructed responses better than some of us can (Gesso, 2017). The implications of such advances provide a rather optimistic view towards the development of economy as well the structure of societies but rises questions of the purpose of an individual as an economic unit (Garrett, 2015). You see, automation is taking a good part of our jobs and is hungry for even more (Cunningham, 1957), causing disruptive forces not only in the low-performing jobs, but also in a combination with artificial intelligence it is taking over positions of doctors, financial brokers, transportation (Goos et al., 2014). Such progress causes disruptions on labour markets as well as transmit the decision-making power to machine and artificial intelligence (McGarrah, 1985). With the exponential growth of such technological progress, we may sooner or later face the question of how to secure those who cannot possibly employ themselves anymore under a current capitalist system (Shanahan, 2015). Will a new system of allocation of goods produced by machines alone occur (Eberly and Stock, 2018)? A question posed by Torry (2013) on the other hand reveals concerns whenever consumers will be still able to consume even if they no longer participate on markets. Such questions were tried to be answered and prediction made on how a such society shall function. Karl Marx pointed out that not only tools and machines were coexisting together to form a singular sociological structure, where the human

mind remained the decision-making body of this socio-economic entity (Marx, 1973). John Maynard Keynes dreamt in his famous speech Economic Possibilities for our Grandchildren (Madrid, June 1930) about a society, where the leisure time would be not the privilege of the upper class – industrialists but enjoyed by proletariat class thanks to the massive technological progress. Is this dream achievable thanks to the Artificial intelligence (Folgeri, 2016)? Author of *The Age of Spiritual Machines* (2001) and *The Singularity is Near* (2006), Ray Kurzweil, believes so. Basing his research on exponential growth enabled by high robotics and artificial intelligence, he predicts that artificial intelligence will be on par with those of humans within 21<sup>st</sup> century (Kurzweil, 2001). He refers to it as Technological Singularity, a point, where the machines will be able to replicate on their own and AI keeps writing and improving its own lines of code (Kurzweil, 2006).

The scientific and economic theories are prophesying possible outcomes based on the current socio-economic paradigms, however, this paper is not about them. Search for answers takes place in the most imaginative and progressive literature of today: science-fiction. The aim of the paper is thus to identify within science-fiction literature transformation theories of societies from capitalistic systems into post-scarcity. How are the natural scarcities, labour and resources, dealt with in order to achieve such a transmission? Is the money eliminated in the process as well or do they persist? Not only we will answer these questions, we will reveal how easily socialism utopia can be falsely labelled as a post-scarcity society.

## 2 ECONOMIC ORIGIN OF SCARCITY

Scarcity is commonly defined between people as a *'lack of something'* thanks to a highly perceived demand and it can be subjectively eliminated by perception of *'having consistently full shopping shelves'*. From the economic point of view, scarcity is recognized as a higher demand for free goods rather than the ability to supply those goods for free (Bronfenbrenner, 1962). Scarcity can be perceived as absolute, where the inability to find additional unit of resource is impossible due to its physical limits and non-existent substitute; or relative, in which shortage of supply in one or several areas is imbalanced, or even disrupted by external or internal forces (Daoud, 2010; Wagner and Newman, 2013). Though these two rises from a natural development, a third one is created by rigidities on markets (e.g. slow implementation of new technology), but especially by restricting the amount of produced output to induce scarcity in consumption, leading to an increase of price of a given product. This is known as artificial scarcity (Bronfenbrenner, 1962).

The nature of scarcity can be derived from multiple sources. One of the fundamental limits is identified in the non-renewable resource, respectively in the land itself (Mackellar and Vining, 1989). Effectiveness is being compromised by such theories as Hotteling's law, suggesting that producing goods as homogeneously as possible leads to minimalization of inputs (Krautkraemer, 1998), or by annexation of the land (Barbier, 2012). Labour is identified by Fang and Wang (2006) as another factor playing a significant role in the production of scarcity. Not only positive net immigration seems to be a very intuitive short-run solution of this problem (Jenkins, 1978), but it triggers the initiative to innovate if technology is strongly labour saving inclined (Acemoglu, 2010) as well. Therefore, upon these limitations is successfully thriving capitalism (Panayotakis, 2011) and failed pure socialism (Machaj, 2018).

As is suggested by Schwab (2017), the Industry 4.0 is already right behind the corner, bringing substantial changes. Artificial intelligence (AI), the core leader of this change, is significantly shaping the possibilities of computing power and starts making visible impact in the markets (Skilton and Hovsepian, 2018). Moreover, its advancement can greatly benefit collective intelligence and impact it on a brand-new level (Mulgan, 2018). Moreover, it helps to develop Internet of Things (IoT), agents with specific purpose within electronic wireframe, together creating a complex nature of an artificial organism capable of perceiving various variables autonomously (Manu, 2015). With AI and IoT expanding, robotics is becoming much cheaper and intelligent, replacing not only blue-collar workers (Ford, 2018). Is the Universal Basic Income the right reciprocal action (Downes and Lansley, 2018)? How can the education positively affect the way fourth industrial revolution will keep developing and eventually transmit itself beyond (Gleason, 2018)?

Thanks to scarcity as the main capitalistic constrain, inputs inevitably relocate limits to every output regardless whenever it is a good or a service. Overcoming these restrictions could mean a rise to a new economy, an economic agent and even a structure of society, which would have been gifted not only by a limitless consumption, but also by eliminating the medium of exchange – money. Such scarcities do not imply only on eliminating the physical, natural obstacles, but imply changes in the management (Carter and Jackson, 1987) and is perceived as an aspect stimulating violence (Käkönen, 1986). An escape from scarcity is observed by inclining towards the undergoing of a natural revolution (Best, 1998), but does it truly represent a post-scarcity society we would like to achieve?

### 3 CRITERIA FOR SELECTING REPRESENTATIVE SCI-FI LITERATURE

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The context of scarcity therefore sticks to the physical, fundamental reasons for it to occur in labour and land, which implies elimination of money (or similar commodity) as a medium of exchange in the process. The criteria are summarized and compared between scarcity and post-scarcity economy in the Tab. 1.

People are scarce input in the production process, continuous employment would imprint transform scarcity into final output. This can be effectively solved only by substituting labour by a ‘perfect entity’ (artificial intelligence) or by not requiring labour in the production process at all. Scarcity born from limited resources will keep prevailing as long the economy depends on the discovery of new deposits of the raw materials. Exponential growth in technology is required to achieve production that will eliminate exploitation of raw materials and will enable production even if they are gone. If scarcity is gone, no longer is required to allocate these inputs to be effectively employed. Medium of exchange no longer matters – it has lost power in deciding what a customer chooses to consume. These are our primary targets to identify in the book. One more concept will help to select appropriate novels. The dynamic nature of society is continually captured and clear progress from society A to society B is established will. If author depicts only the transformed society (already in point B), there is a chance that the drivers behind the change will not be explained exhaustingly enough. Contemporary economy without a deeper economic background is meaningless to resolve. Therefore, the nature of the selected literature has to showcase not only sociological change within societies, but economic transformation as well.

The historical development of sci-fi literature is astounding; however, we will focus on the review of novels from 20<sup>th</sup> to 21<sup>st</sup> century. With

the birth of a *robot* in *R.U.R.* by Karel Čapek, the authors started shifting more focus on how such artificial entity can change not only the world of technology, but what impact could it bring in relation to humanity and economics. More importance was put on showcasing the socio-economic world than before. However, not every author of that era wrote to that desirable extend to draw a comprehensible conclusion. For example, Isaac Asimov in his book series *Foundation* depicts the galactic conflicts between worlds as well as their technological development within framework of the contemporary society. On the other hand, the series *The Space Odyssey* written by Arthur C. Clark, pinpoints technological progress in the society within few decades, omitting any representation of how the economy works at all. Popular novels of the last decade within science-fiction genre, such as *The Hunger Games* or *Divergent* trilogies, depict post-apocalyptic world, reconstructed into dystopian societies lead by ‘chosen ones’, living in prosperity and abundance while others are outcasts or servants. Similar dystopian world is also showcased in *The Maze Runner* series; however, the world here is still in its apocalyptic setting, unable to make a transition to neither utopia nor dystopia. Due to the lack of economic approach and static attitude, these books do not fulfil necessary standards to be considered in the paper standards. Comparison of socio-economic aspects of selected novels is made in a Tab. 2.

Based upon the criteria, the selected literature novels for the purpose of the review are: *Moving the Mountain* by Charlotte Perkins Gilman, *Riders of the Purple Wage* by Philip José Farmer, *Mars* trilogy by Kim Stanley Robinson, *The Culture* series by Iain M. Banks and *Down and Out in the Magic Kingdom* by Cory Doctorow.

Tab. 1: Comparison of scarcity society with post-scarcity society in regard to identified conditions

| Criteria                   | Scarcity society  | Post-scarcity society   |
|----------------------------|---|---|
| Labour scarcity            | Prevailing;<br>scarcity decreased through migration,<br>distribution of labour and<br>specialization          | Eliminated;<br>labour no longer desired in production<br>process  |
| Land/resources<br>scarcity | Prevailing;<br>technological progress improves<br>production capabilities; new mineral<br>deposits discovered | Eliminated;<br>ability to multiply products without a<br>need of additional input; enough inputs<br>to produce unlimited output |
| Medium of exchange         | Present;<br>monetary medium to re-allocate inputs<br>to satisfy most desired wants and needs                  | No longer relevant as output is<br>sufficient for all the wants and needs to<br>be satisfied                                    |
| Decision making body       | Management  | Artificial Intelligence   |

Tab. 2: Socio-economic aspects of sci-fi literature

| Novel (series)                 | Sociological<br>aspect | Economic<br>aspect | Dynamic<br>development |
|--------------------------------|------------------------|--------------------|------------------------|
| Hunger Games (trilogy)         | Yes                    | No                 | No                     |
| The Divergent (trilogy)        | Yes                    | No                 | No                     |
| The Maze Runner (series)       | Yes                    | No                 | No                     |
| The Space Odyssey (series)     | Yes                    | No                 | No                     |
| Foundation (series)            | Yes                    | No                 | Yes                    |
| The Culture (series)           | Yes                    | Yes                | Yes                    |
| Down and Out the Magic Kingdom | Yes                    | Yes                | No                     |
| The Mars trilogy               | Yes                    | Yes                | Yes                    |
| Riders of the Purple Wage      | Yes                    | Yes                | No                     |
| Moving the Mountain            | Yes                    | Yes                | Yes                    |

## 4 COMPARISON OF TRANSITIONAL THEORIES IN SCIENCE-FICTION LITERATURE

### 4.1 Labour Scarcity

Journey in identifying post-scarcity starts with the factor which Classical Political Economists considered to be the cause of the growth for the contemporary economies of the 18<sup>th</sup> century – labour.

Let us begin with the oldest novel on our list, *Moving the Mountain*. It is important to notice that the contemporary societies of the late 19<sup>th</sup> and early 20<sup>th</sup> century, in which the Charlotte Perkins Gilman lived, were strongly influenced by the movement of feminism to regain rights for women. This should be kept in mind, as lot of the initiative is done thanks to the strong women movement in the novel.

*Moving the Mountain* recognizes the status of women in the society as a trigger for changes. Arguably enough, strong feminine movement invoked that ‘*He [a man] has no right to her “services” anymore.*’ This is very consistent with the institute of marriage in 19<sup>th</sup> century, as women indeed were deemed as second-class citizens, serving the household and raising the children. The argument for marriage weakened in the novel after the equalization of women, allowing them to do what a man could do for centuries. Owning capital and conducting business even enforced these movements: ‘*She does not “belong” to anyone in that old sense*’ and ‘*a woman who is in a business [...] does not give it up when she marries*’, revealing that

independency has become on par with men's level. (Gilman, 1911, p. 102–103)

The liberalization kickstarted the change of view on society, economy and government after women flowed into these important institutions. The first trigger in the process of scarcity elimination is recognized in the 3<sup>rd</sup> chapter, revealing a significant movement within the food industry, which was initiated by the success of 'some women with a real business sense, and enough capital'. (Gilman, 1911, p. 84)

What the business model looked like? Simply put, these women overtook a block of abandoned apartments and redefined them to serve a new purpose. A visionary social hub interconnecting various activities was created, putting emphasis on the link of various activity institutions: from work to culture, education to health care provision and child caring centres connected to others through playgrounds and parks. A very similar to Gilman's idea was introduced by Viktor Gruen, a father of shopping mall, described by Trufelman (2015) in the podcast *99% Invisible*, episode 163. His initial vision of a shopping mall did not encompass only shops, it was rather a mixed-use facility: 'See image of people living closer communication with other people, see image of having the possibility to walk from one place to another.'

Gilman (1911, p. 88) continues to explain how the population of such facility started once a centralized food service for the community was introduced, giving birth to 'high wages, first-class houseworkers, and the residents paid for them by the hour.' Kitchens were considered as manufacturing units, hugely dispersed, causing inefficient redistribution of labour, wasting a significant part in the process of gross domestic product. The idea was that by centralizing these units and eliminating them from households, costs will be pushed down, making the food much cheaper. Considering the prediction that such unification occurs through the whole US within several years, the price of the food will decline even more rapidly thanks to a perfect competition reciprocates eliminating any sign of profitability whatsoever. This centralization affected other industries as well, creating benefits

in substantial reduction of the work time 'that no one needs to work over two hours a day and most people work four.' (Gilman, 1911, p. 48)

We can conclude that movement from scarcity to abundance of products occurred not due to the technology, but rather by incorporating previously ineffectively used workforce (= women) and by substantial improvement in the specialization of labour and skills which happened in the centralisation of production. To support this theory, Gilman (1911, p. 54) furthermore denotes importance of the future generations '[...] we train them to higher efficiency, especially the children' carried through by 'best and wisest of us are proud to serve [them]' as the core of the development of future abundance, still triggered by highly skilled labour. Unifying argument upon which Gilman (1911, p. 131) builds the theory is a fact that 'All these people work' and are willing to work for 'true social economics, not the dismal science.' However, this concept would sooner or later crumble, as we know that the labour is not as productive as capital (i.e. machinery, tools) in the long run and its scarcity will always be present due to the nature of labour to be limited in any given time.

The novel *Riders of the Purple Wage* recognizes the need for people to work, as the main character still creates art not for pleasure, but for a sell. However, the contemporary need of society for labour is not depicted; the author rather focuses on how a man has to change to achieve post-scarcity society thanks to the labour itself.

A rather deep depiction of what society should look like and behave like to reach full post-scarcity is initiated by comparing interaction within societies based on the Chaos theory (mockingly transposed Butterfly effect): 'Confucius once said that a bear could not fart at the North Pole without causing a big wind in Chicago' to a self-made 'Theory of electrical circuit' (name of the theory is not fully proposed, rather derived from text). For the sake of the simplification of the argument in comparison, let us imagine a simple society as a unit composed of many variables. Under chaos theory the author predicts 'human society

is a daisy chain', an indeterministic system of unsure (but not unknown) outcomes. Let us interpret it on an example, where a small change in the increase of traffic jams induced an increase demand for cigarettes. Now, let assume position under *Theory of electrical circuit*, where one variable has a well-known impact on others, just like in electrical circuit each component acts based on his role and influences results of others seamlessly through its action. Under this theory we can develop the example a little further: a small change in the increase of traffic jams *has impacted the stress levels of individuals* and induced an increase in the demand for cigarettes. A rather small change but with a significant impact of the missing variable in Chaos theory, which would not make an electrical circuit function properly. The author depicts the world under this theory as '*Age of Complete Interconnection*', where each variable within the system is inevitably important for its functioning '*No wires can hang loose; otherwise we all short-circuit.*' (Farmer, 1992, p. 54–55)

However, the system works only under the assumption of perception of individualistic nature; a sort of a '*hapax legomenon*'<sup>1</sup> entity. The man under a current system is too rigid, bearing the burden of past norms depicting what a man should be, look like and perform. The author gives a birth to a highly-individual entity named '*The Totipotent Man*'. In biological terms, totipotent describes an immature or incomplete cell capable of transforming itself to any cell type and thus able to create any body organ imaginable. This concept applied in economic terms creates a being capable of limitless flexibility (flexibility symbolizing the ability of the immature cell to grow to anything desirable); a well-balanced structure which 'grows' and reflects the current society's desires. Such entity, strong individual is according to an author a condition for achieving post-scarcity, '*Golden world*' society: '*He must come into being before the Golden World can be realized. How can you have a Utopia without Utopians?*' (Farmer, 1992, p. 55)

This idea confirms that the author recognizes that his world isn't really the one he envisioned to be and suggests how to improve it. '*The Totipotent Man*' seems to be born from the concept of beauty and freedom, just like art, where art is the high expression of individualism. That's why the most profitable activities occur in the art, even though the competition is fierce. This may imply a possible metaphor that the individuality starts to be reflected in many people, getting them closer to the mythical '*The Totipotent Man*', who can eliminate labour scarcity in process.

Author of Mars trilogy, Kim Stanley Robinson, on the other hand relies heavily on the skilful and intelligent workforce. Through the series, definition of '*who is a scientist*' comes from various members of the crew going to Mars. One describes a scientist to be: '*[an] apolitical, supposedly, like civil servants – empiricists*', who would like to persuade '*rational scientific style, the greatest good for the greatest number, which ought to be fairly simple to arrange.*' The premise here is clear: the scientist is acknowledged as a perfect being bound not by economical rationality, but cognitive rationality, a sort of segregate '*pure*' thinking impossible to be achieved (unless the argument bestows on artificial intelligence). Robinson (1996, p. 85–86) advocates that such thinking lacks any '*emotions, religions, governments, and other mass delusional systems of that sort*' to secure that the system is based solely on high-scientism. Robinson (1996, p. 129) furthermore keeps denying the efficiency of economic rationality in creating wealth in the third book, *Blue Mars*, claiming that '*Economic rationality is simply not the highest value. It is a tool to calculate costs and benefits, only one part of a larger equation concerning human welfare.*' Similar preposition, even though more archaic in the core, is declared by a third scientist, who identifies the research facility as '*a little model of prehistoric utopia*', operated by '*clever primates*' integrated in satisfying their utility through self-sustainability (even though it could be argued that the scientist here is depicted as a rational economic entity). This argument

<sup>1</sup>A word or phrase that appears only once in a manuscript, document, or particular area of literature.

showcases the benefits of rather enclosed, self-sufficient community, providing one for another is prevailing notion for a society structure on Mars. (Robinson, 1993, p. 337)

It seems that the author seeks that the change comes from the most skilful and educated group of people, especially scientists and engineers etc.; through holding assumption that they are perfect entities capable of mastering self-management. The preposition involves a high level of decentralization of government creating interconnected communities capable of surviving on their own. The refusal of leadership or any kind of hierarchy is constantly supported and followed: ‘[...] and for all that time we have had no leaders, really. [...] the group decides what needs doing most. It’s been a very communal society, a democratic group.’ (Robinson, 1993, p. 165)

On the other hand, there is not a significant demand for blue-collar workforce. This argument is supported later in the first novel, where the machines work with ‘very little supervision, like most of the project, in both manufacture and operation’, showcasing that their high autonomous performance eliminates the need for physical labour. Newcomers arriving to these newly formed apartments are mostly another engineers and scientists who ‘[...] had to see [only] to programming, deployment, maintenance, and troubleshooting of these machines.’ Enumerated responsibilities create a demand for jobs that are not interfering with the production process itself; their purpose is to set up and ‘accommodate’ this machinery. Robinson (1993, p. 234) this way implies a desire for skilled workers devoted to employing such machines, as they cannot replicate. Even though later in the third novel, *Blue Mars*, the author showcases that people cultivate potatoes in the Mars soil, or even hunters and gatherers are present, their ‘labour’ is not conditioned by the requirement of conducting the physical work. They serve for scientific research and/or as a source of fun.

Doctorow (2003, p. 12) depicts in *Down and Out in the Magic Kingdom* a post-capitalistic ‘Bitchun Society’, a cultural phenomenon developed all around the world based on ‘benef-

icent ways: introducing Free Energy to their greenhouses, then an engineered crop or two, then curing a couple deaths [...]’. The author unfortunately uses static approach in describing the society; the vague explanation of what initiated the changes does not hold up and is vastly insufficient in regard to evaluated criteria.

Given the development, two new fundamental benefits of such society were introduced, that being transhumanism ‘the death of death’ and post-scarcity ‘the death of scarcity’, evaluating them as obsolete concepts which were accepted for too long and prolonging the time of economic/society change. The society was successful in eliminating as well ‘any sort of dull, repetitious labor [...]’ which Doctorow (2003, p. 59–66) owes to the unconscious state of mind thanks to their advanced transhumanist bodies. This implies that bodies are overtaken by the artificial intelligence for a while and then switched back to the owner of the body once the task is completed, however, these actions is performed only in tasks which are recognized as unpleasant.

Labour is a long-forgotten concept in the Culture series. Everything is done thanks to the highly developed artificial intelligence called Mind, which exercise extraordinary power and is fully autonomous, developing itself for the pleasure of its inhabitants. They not only manage the whole orbital system but manifest themselves as ‘the silver-skinned avatar is under the direct control of the god [the Mind] which holds the power of life or death over the Orbital and everybody on it’ and provide life to androids (which are self-conscious as the Mind itself). (Banks, 2010, p. 148)

## 4.2 Resource Scarcity

In the previous chapter we have identified the novel *Moving the Mountain* as being strongly dependent on the exploitation of labour from multiple points of view – integration of women in the production process (a wasted resource) and enabling a significant specialization to occur in every possible field. However, the author remains very limited regarding the identifica-

tion of how the resource scarcity was lifted up and eliminated. We are aware of the fact the primary sector is the one which benefited the most, as the significant improvements in agriculture were conducted. However, there is not a clear answer for other sectors. The author derives the benefits to occur in vertically aligned industries, such as those in transportation and improved agriculture *'the soil improved; the output growing in quantity and quality'*, but others are not mentioned or just very briefly (improvement in electrical industry, especially batteries).

*Riders of the Purple Wage* depict rather progressive production methods, yet they seem to be greatly compromised. Stating that imported *'inorganic chemicals are converted into energy and then into the matter of food, drink, medicines, and artefacts'*, production is presented so advanced that the cheapest output comes directly from laboratories and only literal chemicals are imported, supported by the claim that they produce *'Artificial but exact duplication of organic stuff.'* Interestingly, the author proposes that *'little agriculture or animal husbandry outside the city walls'* still occurs. Extraordinarily presented common agriculture production when *'there is superabundance for all'* provides base for Farmer (1992, p. 73) to express that markets might not be perfectly competitive and are likely to be affected by marketing, where *'goodies'*/premium products are sold at a higher price, even if their quality might be the same – similarly to the market of common agriculture products and premium products, e.g. Bio products. Resources, even though that a significant progress in production has been established, are still scarce, meaning that market stimulates its allocation and affects the prices. We will come back to this when discussing the requirement of owning a medium of exchange – money.

Unlike the first two novels, where the extend of scarcity in the primary resources wasn't clear, the *Mars* trilogy clearly showcases the importance of raw materials, especially heavy metallurgy. Not only that the primary aim of the newcomers on Mars is focused on the mining of the raw materials, but the conflict between the Earth and Mars on who has the right

for the Mars' natural resources has escalated to a war with scalable results. As the author suggests, these heavy metals become the core attribute for the expansion of production. Moreover, the importance of machinery is clearly shown, creating them from resources found on Mars. The signs of certain abundance start to emerge once the machines become responsible for the construction of shelters autonomously. Later on, a further revelation about machines showcases that they had advanced and are even possible of reproduction, self-construction to the extend they are possible to construct even larger structures: *'[...] month these three components together would have conjured obedient beasts out of the sand: first the factories, then the assembly plants, then the construction robots themselves, vehicles as big and articulated as a city block.'* This implies that machines are ready to produce a vast number of products, at costs driven to non-existence and establish post-scarcity in the production industry. (Robinson, 1993, p. 483)

In the case the novel *Down and Out in the Magic Kingdom*, we can get a better insight on how the resources are scarce by showcasing it on a rather indirect example. At one stage, a protagonist of the novel gets to the point where his Wuffies (a so called medium of exchange, elaborated in next chapter) becomes significantly low. A person with this status is not subjected to a direct threat of crisis survival: *'the number of low-esteem individuals at large was significant'*, and can still carry on living *'just fine, hanging out in parks, arguing, reading, staging plays, playing music.'* He himself regards at this point as being richer than *'99.99999 per cent of all the people who'd ever lived, I had a life of unparalleled luxury'* and elaborates what actually being *'low on Whuffies'* means in regards to obtaining goods and services in a simple comparison: *'While I couldn't get a table in a restaurant, I was free to queue up at any of the makers around town and get myself whatever I wanted to eat and drink, whenever I wanted it.'* (Doctorow, 2003, p. 104)

We can conclude that there is a certain recognized minimum regardless of the position

of your personal Whuffie, a sort of guaranteed basic product. This is however not caused by the abundance generated on the markets, but represents a re-definition, per se, of how social securities in the society are defined. In our contemporary society, these securities take especially the form of money; however, in the case of this novel's *'Bitchun society'* the social benefit represents an access to basic commodities, seamlessly abundant. Thus, even though necessities can be relatively fulfilled limitlessly, other services and products can be accessed only once you raise your reputation score.

The Culture series is the one which defines itself as the *'true abundant'* society. Inhabitants of the planet no more work, they have been substituted by physical representatives of the Hub (a place storing the Mind, basically the hardware dome), governed by the Mind (Artificial intelligence occupying the Hub): *'millions of human-form representative entities called avatars'*, which are capable to *'deal(s) on a one-to-one basis with its inhabitants.'* Argument could be applied that a scarce labour has been replaced by scarce *Avatars*, not eliminating the scarcity, only changing a scarce variable for another one. This argument could hold if the Mind would not exercise inhuman capabilities thanks to the computational raw power of the Hub: *'It is theoretically capable of running each of those and every other system on the Orbital directly while communicating individually with every human and drone present on the world, plus a number of other ships and Minds.'* (Banks, 2010, p. 276)

Only the idea of having produced landscape to one's desires means that the inhabitants of the Culture were not only granted ability to consume limitlessly, but the AI has been able to transform non-economic goods to economic ones through the Artificial Intelligence as well, increasing the boundaries of what the consumer can consume. However, how this artificial intelligence exercises such a magnitude of tasks is unknown.

### 4.3 Presence of a Medium of Exchange

If we recapitulate the knowledge we have received from the previous two chapters, we can identify that most of the authors do not fulfil the conditions for elimination of scarcity either from labour or natural resources/land, except from the Culture series by I. Banks. This means that if scarcity is still prevailing in these novels, the presence of medium of exchange is inevitable.

In *Moving the Mountain* and *Riders of the Purple Wage*, both authors use money to identify what should be produced from the scarce resources. Even though that goods you are paying for seem to be in these novels as relatively cheap, scarcity implies that certain products need to be more expensive than the others due to their properties. The importance of money is proposed in the following sentence: *'It's as big a place as being head of Harvard College,'* she said, *'and better paid than that used to be'*, applying that diversity on markets is still there and highly-paid people can live wealthier than the others. (Gilman, 1911, p. 198)

*Riders of the Purple Wage* provides a more elaborated insight into the problematic. The author implies that the government redistributes a certain amount of money to everyone, a certain guaranteed income: *'[...] those on the purple wage get their goods and those with extra income get their goodies'*. This basic income (= purple wage) can be used only for obtaining certain commodities, possibly basic needs (food, shelter, water, etc.), while an additional income covers utility gained from wants. The limitation of what can one buy supports the fact the world has not achieved a full post-scarcity production, therefore, there is still limitation in the production capabilities and it requires working to obtain more from society. Scarcity is perfectly depicted on the inability to obtain what is desired: *'Trouble is, he's short of units and coupons and can't buy the materials'*, applying that through negatively perceived actions the purple wage can be reduced as well: *'But Mama spends far too much and also is addicted to gambling, a vice which deprives her*

of her full guaranteed income.' This forces the main character to work 'by selling or trading his paintings', implying that the money still has to be earned in order to gain access to more services and goods. (Farmer, 1992, p. 83)

According to the author, creating the purple wage was the direct answer to the problem which economies face: overpopulation and automation. The term overpopulation bears Malthusian's feeling and unfortunately is not the best one to be used; as it has been proved that overpopulation as a theory doesn't hold up (Longman, 2004). Author doesn't identify any other variation which would be more beneficial and would solve both problems at the same time, otherwise forcing us in an indecisive loop of which problem to support: 'Buridan's ass, dying of hunger because it can't make up its mind which of two equal amounts of food to eat.' (Farmer, 1992, p. 82)

When money becomes obsolete, to what kind of medium can we derive scarcity in society? Later in the first novel *Red Mars* a full-scale 'eco-economics' is proposed; a distribution system reflecting the arising post-scarcity. It is structured on a system of complex mathematical equations deriving 'how many calories we create by our efforts or send on to future generations [...]' The system is 'very indirect, naturally, and it involves a lot of speculation and subjective judgment', but due to the author's immersive notion towards high scientism, he assumes 'to simply assign certain calorie-equivalent numerical values to all kinds of activities' to stabilize the system. Such complexity arises from the notion of non-physical contribution to society in the form of services and culture, whose output cannot be physically measured and thus the energy output derived is highly unlikely to be identified. However, author identifies the main driver of the change of caloric outcome is located within its 'ecological efficiency by efforts to reduce how many kilocalories they use.' This performance evaluated structure can be asserted to each and every job and rank them were bottom-lined, most inefficient ones are 'parasitical jobs that add nothing to the system by an ecologic accounting.' This happens as

they 'predate on the system without having any predators, in other words, produce meaningless outcome (energy) willing to consume by no-one.' The author furthermore suggests that 'The entire [...] executive class does nothing a computer couldn't do,' giving out the notion that computer systems and presumably artificial intelligence applied in these places would significantly improve ecological efficiency of the system. (Robinson, 1993, p. 292–294)

How such evaluation of the system can be elevated to a 'cognitive' rationality level? Presented is a data set of what economic rational Martians considered as the most impactful on their living: 'that our best to calculate what they contribute back to the system in terms of well-being, and for transfiguring this economic rationality to be measured as a physical thing'. The common physical thing is considered to be economic necessity 'What does the activity equal in terms of food, or water, or shelter, or clothing', even though a relevancy is found as well in 'medical aid, or education, or free time.' (Robinson, 1993, p. 295)

A different concept is proposed in the novel *Down and Out the Magic Kingdom*. The author creates a so called 'Whuffie', a reputation-based currency. It works on the premise of actions people undertake continuously, then evaluated by others based on how favourable or unfavourable the action is perceived. Simultaneously, this alternates the Whuffie score. Doctorow (2003, p. 15) however claims that even if you were 'broke but respected, you wouldn't starve; contrariwise, if you were rich and hated, no sum could buy you security and peace.' Human behaviour, or rather self-esteem, becomes a direct source of your 'price' in the society. Such implication strongly supports the doing of what a man likes to do, not where he is paid the most, as no longer post-scarcity (in most of the cases) does reflect itself on wages and salaries (the scarcer the skill, the higher the payment). As long as they are happy doing what they do, the Whuffie will stay relatively favourable.

Whuffies act more like a scale, a meter: the higher your respect is the more commodities and services you are allowed to consume, and

vice-versa. This can be rather confusing at the beginning as the main character says that he *'pissed away most of my Whuffie – all the savings from the symphonies and the first three theses [...], until I'd expended all the respect anyone had ever afforded me'*, suggesting the possibility that he had to pay by his earned score in order to receive services and goods. Luckily, the author clarifies the statement right away by saying *'I'd pretty much—drinking myself stupid at the Gazoo, hogging library terminals, pestering profs'*, elaborating on the idea that the main character *'misbehaved'* and his actions were deemed as unfavourable ones, lowering his Whuffie in process. Not spending, but countervailing measures in form of negative scores are a reason for someone's decline of Whuffies. (Doctorow, 2003, p. 14)

Even though this concept looks very favourable, it still suffers: your actions may receive you positive reputation if you are acting on the behalf of a popular opinion at the expense of public discourse. At the same time, it does not offer a weight of importance/difficulty to the given action evaluation (even though this could be justified by the perceived utility for the action; the same cup of coffee could be worth for someone 2 Whuffies and for someone 10 Whuffie). Unlike to money, the Whuffies' history of *'transaction'* is publicly available on a network to review with access for everyone, securing a publicly, peer-to-peer controlled system.

Moreover, the rule *'the death of scarcity'* is in conflict with the idea that people, even though voluntary, still undertake jobs in order to increase their prestige and thus wealth.

Iain M. Banks (2017, p. 7) perceives medium of exchange, money, as *'a sign of poverty'* and tool that *'implies poverty'* throughout his first novel *The State of the Art* from the *Culture* series. Medium of exchange is irrelevant to discuss once the Artificial Intelligence becomes present and eradicates scarcity both in labour (artificial intelligence and machines) as well as in resource scarcity (large uninitiated landscapes, produced by Artificial Intelligence on command). A well

proposed argument occurs in the novel *Look to Windward*, where a character discusses what a word *'holiday'* in scarcity economy represented: *'People had to do all the work and create wealth for themselves and society and so they couldn't afford to take very much time off. So they worked for, say, half the day, most days of the year and then had an allocation of days they could take off, having saved up enough exchange collateral.'* But the Culture does not live in *'Age of Scarcity'* anymore, eliminating the primitive stuff, money at process. (Banks, 2010, p. 12)

However, I. Banks still admits that artificial scarcities can occur from time to time, breaking the established cycle and retracting the temporary need for a medium of exchange into the system. A perfect example of such scarcity is provided in the novel *Look to Windward*. A famous composer creates a symphonic orchestra masterpiece, which takes place at the largest possible stadium at The Culture's orbital at the specific time to commemorate anniversary of a great galactic war. Due to the one-time occurrence and restricted amount of capacity of the facility (producing scarcity), the Avatar (representation of The Mind, artificial intelligence) proclaims that the inhabitants are *'reinventing money'* by forcing themselves to obtain tickets by doing favours to please the others in order to receive one: *'People who can't stand other people are inviting them to dinner, booking deep-space cruises together – good grief – even agreeing to go camping with them [...], have traded sexual favours, they've agreed to pregnancies, they've altered their appearance to accommodate a partner's desires, they've begun to change gender to please lovers; all just to get tickets.'* The Avatar concludes that *'Suddenly everybody's a live symphonic music fan.'* applying how rarity of an event or product alters the taste and impacts the demand of the consumer for it. Otherwise overlooked product becomes perceived differently due to the change in perception, alternating emotional attachment towards consuming, increasing or decreasing the demand for it. (Banks, 2010, p. 349)

## 5 THEORETICAL INSIGHTS AND OBJECTIVE JUDGMENT OF CLAIMS

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Even though that the representative novels suggested that post-scarcity occurred, it isn't true. For the post-scarcity to truly be reached, the labour and land scarcity has to be fully wiped out, alongside with the eradication of medium of exchange. All three of these conditions are not fully satisfied in most of the theories. In *Moving the Mountain*, the theory heavily draws from the success of its labour, implying the importance of education and immersive distribution of labour. If such model is run in the long-run, the society will keep facing the labour scarcity and thus will not be able to elevate itself to a next step in reaching post-scarcity. Moreover, the society hasn't achieved similar benefits like in agriculture; therefore, scarcity is still prevailing and requires money as a medium of exchange to resolve it. Similar problems occur in the novel *Riders of the Purple Wage*. To enjoy more commodities, you are required to work to get money. Wants (and as the author suggests, partially even needs) cannot be fully satisfied by universal basic income. Dependency on the labour is no longer perceived as the most useful stimuli for abundance to occur. Scarce resources are still prevailing, even though the processing of them has progressed substantially.

In the Mars trilogy, we take a step further. The society developed on Mars no longer pursues a capitalist market; money is not present but substituted by ideological redistribution of commodities and services upon amount energy transformed into the society due to your doings. This means that work is still prevalent and required for the people to conduct in order to enjoy wider range of commodities. Even though

the machines have been able to build themselves as well as to conduct most of the physical work on behalf of the people, scarcity is still prevailing.

A similar scenario is in *Down and Out Magic Kingdom*, where output is redistributed upon your social score – the higher the score, the wealthier you are. However, this novel eradicates the concept of death, where immortality gives you the chance to regain the social perception. The arising question is whether such principle cannot be abused easily? Will there be enough output to satisfy the demand once many inhabitants will become significantly rich due to the fact that they defined each other as respectable? If not, would it lead to a devaluation of 'Whuffie'? At the same time, the concept of 'death of scarcity' doesn't hold due to the prevailing use of medium of exchange.

These four theories cannot be labelled as one which transformed themselves into post-scarcity; however, can be perfectly sorted into a category of socialism utopia theories. They enwrap themselves in a peaceful world full of benefits, which are mostly driven by recognition of a contribution to a common wealth.

The only example from this is the I. Banks *Culture* series. The society is developed to such extent that no one has to work in order to consume and can consume whatever they demand. If those attributes are resolved as fulfilled, medium of exchange no longer persists. It is true that artificially created scarcities can occur from time to time as was shown, whilst reinventing an undefined medium of exchange, which greatly diversifies from individual to individual.

## 6 DISCUSSION AND SUGGESTION FOR FURTHER RESEARCH

As the outcome of the literature suggests, the nature of the theories lie in the paradigm shifts in socio-economic factors. Transformation of these factors is triggered by industrial revolutions (Nochteff, 1988) and is clearly perceived within the reviewed literature. From a rise of international trade of manually constructed goodies known as proto-industrialization (Ogilvie and Cerman, 1996) exploited to a first industrial revolution, breaking any commonly established economic theories (Clark, 2014). Massive mechanization took place as a response, making the Great Britain a leader in agriculture and textile production (Allen, 2011), enveloping further to labour distribution and its specialization (Smith, 2007).

The second industrial revolution exploited these factors even further thanks to the utilization of gas and petrol for chemical synthesis and automotive industry (Jevons, 1931). However, negative consequences of this industrial revolution had emerged as well. The labour force was formed by people of all categories (Berg and Hudson, 1992), where children were no exception (Humphries, 2013); unsatisfactory working conditions and unsustainable working hours present (Clark, 2005). Environment was affected as well to the extent that it reciprocated and requested regulations to reduce not only natural damage (Foster, 1999), but as well health issues due to the incorporation of chemical processes and the lack of their safety regulation (Le Roux, 2018).

These negative outcomes gave birth to two economic ways of thought in 19th century: utopian socialism, which desire was to create a harmony in small society structures, where everyone played certain part (Miller, 2008); and scientific socialism, represented by a strong class ideology, common wealth and subjecting capitalism to a self-destructing, unsustainable concept (Leontiev, 1946).

As most of the reviewed science-fiction literature built heavily upon first and second industrial revolution, mostly upon its failures; and was being written during the boom of

computing power and a possible birth of artificial intelligence (Folliet and Cunneen, 1957), it tends to strongly depict socialistic-utopian world transcended after third industrial revolution. How far these theories predict the development and how correct are they?

Further research shall be focused on comparison of the current economic theories trying to predict the inevitable socio-economic paradigms thanks to the upcoming fourth industrial revolution and contrast them with the science fiction literature. Industry 4.0 built itself on the success of robotics, artificial intelligence and cheaper production (Schwab, 2017), but rises a question whether the labour markets are flexible enough to accommodate these changes (Ford, 2018). Would the solution be based in the basic income distributed equally to everyone as a social security to help them leverage the negative consequences of the Industry 4.0 (Downes and Lansley, 2018), a payment similar to the one in the *Riders of the Purple Wage* (Farmer, 1992)? Or do the theories go beyond Industry 4.0, into socio-economic paradigms such as those presented in Technological Singularity theory (Raulerson, 2013), where the artificial intelligence will be on par of humans (Shanahan, 2015), extensively prolonging our life-spans (Thompson, 2012) and starts with terraforming (Neyrat, 2019), just like in *The Mars* series (Robinson, 1993) or in *Down and out of the Magic Kingdom* (Doctorow, 2003)? How well do these theories reflect (if at all) the sublimation of human and artificial into a singular seamless society, where the human consciousness remains on top and keep control over all the process just like predicted in Marx's *Fragments on the Machines* (Marx, 1973) – or is the other way around? I believe such pluralities within real economic theories and science fiction literature can be identified, moreover, economic theories can be positively influenced by recognizing and implementing possible details of economic outcomes which they have not thought about yet.

## 7 CONCLUSIONS

Even though the limitless conceptual factor provides the authors with the power to create scarcity unbound societies, they do not do so. However, we can still draw conclusions from this paper and suggest possible outcomes.

Firstly, it is a common denominator that the post-scarcity-like (= almost abundant) state always occurs and/or originates in a certain economic sector; meaning it cannot be triggered by multiple sectors at same time. This could imply that the world economies shall look for the signs of abundance in one sector, focus on its continuous stimulation to the point it starts to lower the prices in response even in other sectors. Such trigger-sector would transpose itself to the point it would no longer be deemed profitable and exploitable from a capitalistic point of view (= generate a profit).

Secondly, the theories suggest that it is easier to eradicate scarcity within the resources than from the labour itself. This means that we can obtain products cheaper by focusing on imprinting technological innovation into the production process, lowering the overall costs instead of trying to eliminate the human impact from the production process, which seems to be rather impossible. Every novel besides the

Culture series perceives the work as a still necessary variable, especially for the accumulation of more wealth (*Moving the Mountain, Riders of the Purple Wage, Down and Out of the Magic Kingdom, Mars* trilogy).

Thirdly, there seems to be a certain impact of freedom of markets and liberty towards eradication of scarcity. The more liberal the environment seems to be in socio-economic terms, the more likely signs of output abundance starts to occur in technologically strongly dedicated economic sector (especially quaternary industry). On the other hand, authoritative approach and centralisation indicates that abundance will appear in less technologically depending sector (primary sector).

To sum it up, the theories due to their utopian movement rather than post-scarcity notion still bear interesting ideas of the socio-economic structures, where abundance is the main building structure to follow. A further research could be conducted in the identification of how these theories perceive utility maximization as a process eventually leading to the bliss point or how institution of religion impacts the development of the socio-economic variables.

## 8 REFERENCES

- ACEMOGLU, D. 2010. When Does Labor Scarcity Encourage Innovation? *Journal of Political Economy*, 118 (6), 1037–1078.
- ALLEN, R. C. 2011. Why the Industrial Revolution Was British: Commerce, Induced Invention, and the Scientific Revolution. *The Economic History Review*, 64 (2), 357–384.
- ARMSTRONG, J. 2018. How Do Driverless Cars Work? *The Telegraph*, November 2, 2018. Available at: [www.telegraph.co.uk/cars/features/how-do-driverless-cars-work/](http://www.telegraph.co.uk/cars/features/how-do-driverless-cars-work/).
- BANKS, I. M. 2007. *The State of the Art*. 1st ed. Night Shade Books.
- BANKS, I. M. 2010. *Look to Windward*. 1st ed. Pocket Books.
- BARBIER, E. B. 2012. Scarcity, Frontiers and Development. *The Geographical Journal*, 178 (2), 110–122.
- BERG, M. and HUDSON, P. 1992. Rehabilitating the Industrial Revolution. *The Economic History Review*, 45 (1), 24–50.
- BEST, S. 1998. Murray Bookchin's Theory of Social Ecology: An Appraisal of 'The Ecology of Freedom'. *Organization & Environment*, 11 (3), 334–353.
- BRONFENBRENNER, M. 1962. The Scarcity Hypothesis in Modern Economics. *The American Journal of Economics and Sociology*, 21 (3), 265–270.
- CARTER, P. and JACKSON, N. 1987. Management, Myth, and Metatheory – From Scarcity to Postscarcity. *International Studies of Management & Organization*, 17 (3), 64–89.

- CLARK, G. 2005. The Condition of the Working Class in England, 1209–2004. *Journal of Political Economy*, 113 (6), 1307–1340.
- CLARK, G. 2014. The Industrial Revolution. In AGION, P. and DURLAUF, S. N. (eds.). *Handbook of Economic Growth*. Volume 2, Chapter 5, pp. 217–262.
- CUNNINGHAM, W. J. 1957. Automation. *American Scientist*, 45 (1), 74–78.
- DAOUD, A. 2010. Robbins and Malthus on Scarcity, Abundance, and Sufficiency: The Missing Sociocultural Element. *The American Journal of Economics and Sociology*, 69 (4), 1206–1229.
- DOCTOROW, C. 2003. *Down and Out in the Magic Kingdom*. 1st ed. Tor Books.
- DOWNES, A. and LANSLEY, S. (eds.). 2018. *It's Basic Income: The Global Debate*. 1st ed. Bristol University Press.
- EBERLY, J. C. and STOCK, J. H. (eds.). 2018. *Brookings Papers on Economic Activity: Spring 2018*. Brookings Institution Press.
- FANG, C. and WANG, D. 2006. Employment Growth, Labour Scarcity and the Nature of China's Trade Expansion. In GARNAUT, R. and SONG, L. (eds.). *The Turning Point in China's Economic Development*, pp. 143–171. ANU Press, Canberra.
- FARMER, P. J. 1992. *Riders of the Purple Wage*. 1st ed. Tor Books.
- FOLGIERI, R. 2016. Technology, Artificial Intelligence and Keynes' Utopia: A Realized Prediction? In BAIT, M., BRAMBILLA, M. and CRESTANI, V. (eds.). *Utopian Discourses Across Cultures: Scenarios in Effective Communication to Citizens and Corporations*, pp. 73–86. Peter Lang AG, Frankfurt Am Main.
- FOLLIET, J. and CUNNEEN, J. E. 1957. The Third Revolution. *CrossCurrents*, 7 (2), 97–108.
- FORD, M. 2018. The Rise of the Robots: Impact on Unemployment and Inequality. In PAUS, E. (ed.). *Confronting Dystopia: The New Technological Revolution and the Future of Work*, pp. 27–45. Cornell University Press.
- FOSTER, J. B. 1999. *The Vulnerable Planet: A Short Economic History of the Environment*. NYU Press.
- GARRETT, B. 2015. *Technology Will Keep Changing Everything – and Will Do It Faster*. Atlantic Council.
- GESSO, J. 2017. *The Machine Learning Technology Behind Gmail Smart Reply* [online]. Available at: [betsoil.com/2017/11/the-machine-learning-technology-behind-gmail-smart-reply/](https://betsoil.com/2017/11/the-machine-learning-technology-behind-gmail-smart-reply/).
- GILMAN, C. P. 1911. *Moving the Mountain*. Charlton Company.
- GLEASON, N. W. (ed.). 2018. *Higher Education in the Era of the Fourth Industrial Revolution*. Palgrave Macmillan.
- GOOS, M., MANNING, A. and SALOMONS, A. 2014. Explaining Job Polarization: Routine-Biased Technological Change and Offshoring. *The American Economic Review*, 104 (8), 2509–2526.
- HUMPHRIES, J. 2013. Childhood and Child Labour in the British Industrial Revolution. *The Economic History Review*, 66 (2), 395–418.
- JENKINS, J. C. 1978. The Demand for Immigrant Workers: Labor Scarcity or Social Control? *The International Migration Review*, 12 (4), 514–535.
- JEVONS, H. S. 1931. The Second Industrial Revolution. *The Economic Journal*, 41 (161), 1–18.
- KÄKÖNEN, J. 1986. Scarcity and Violence. *Current Research on Peace and Violence*, 9 (3), 110–118.
- KRAUTKRAEMER, J. A. 1998. Nonrenewable Resource Scarcity. *Journal of Economic Literature*, 36 (4), 2065–2107.
- KURZWEIL, R. 2001. *The Age of Spiritual Machines: How We Will Live, Work and Think in the New Age of Intelligent Machines*. Texere Publishing.
- KURZWEIL, R. 2006. *The Singularity Is near: When Humans Transcend Biology*. Penguin Books.
- LE ROUX, T. 2018. Between Industry and the Environment: Chemical Governance in France, 1770–1830. In ROBERTS, L. L. and WERRETT, S. (eds.). *Compound Histories: Materials, Governance and Production, 1760–1840*, pp. 184–204. Cultural Dynamics of Science, Vol. 2. Brill.
- LEONTIEV, A. 1946. *Marx's Capital*. International Publishers.
- LONGMAN, P. 2004. *The Empty Cradle: How Falling Birthrates Threaten World Prosperity and What to Do about It*. 1st ed. Basic Books.
- MACKELLAR, F. L. and VINING, D. R. 1989. Measuring Natural Resource Scarcity. *Social Indicators Research*, 21 (5), 517–530.
- MACHAJ, M. 2018. *Capitalism, Socialism and Property Rights: Why Market Socialism Cannot Substitute the Market*. Agenda Publishing.
- MANU, A. 2015. *Value Creation and the Internet of Things: How the Behavior Economy Will Shape the 4th Industrial Revolution*. 1st ed. Routledge.
- MARX, K. 1973. *Grundrisse: Foundations of the Critique of Political Economy*. Vintage.
- MCGARRAH, R. E. 1985. Do Computerized Intelligence Systems Cause Artificial Management? *Challenge*, 28 (5), 38–43.
- MILLER, T. (ed.). 2008. *Given World and Time: Temporalities in Context*. 1st ed. Central European University Press.

- MULGAN, G. 2018. The Functional Elements of Collective Intelligence. In MULGAN, G. *Big Mind: How Collective Intelligence Can Change Our World*, pp. 35–47. Princeton University Press.
- NEYRAT, F. 2019. *The Unconstructable Earth: An Ecology of Separation*. 1st ed. Fordham University.
- NOCHTEFF, H. J. 1988. Industrial Revolution, Technological Paradigm and Regional Alternatives. *CEPAL Review*, 36, 25–32.
- O'KANE, S. 2018. *Starship's Robots Can Now Deliver Packages, Too* [online]. Available at: [www.theverge.com/2018/10/31/18044738/starship-technologies-robot-package-delivery-price](http://www.theverge.com/2018/10/31/18044738/starship-technologies-robot-package-delivery-price).
- OGILVIE, S. C. and CERMAN, M. (eds.). 1996. *European Proto-Industrialization: An Introductory Handbook*. 2nd ed. Cambridge University Press.
- PANAYOTAKIS, C. 2011. *Remaking Scarcity: From Capitalist Inefficiency to Economic Democracy*. Pluto Press.
- ROBINSON, K. S. 1993. *Red Mars*. 1st ed. Bantam Books.
- ROBINSON, K. S. 1996. *Blue Mars*. 1st ed. Bantam Books.
- RAULERSON, J. 2013. *Singularities: Technoculture, Transhumanism, and Science Fiction in the 21st Century*. 1st ed. Liverpool University Press.
- SCHWAB, K. 2017. *The Fourth Industrial Revolution*. Currency.
- SHANAHAN, M. 2015. *The Technological Singularity*. MIT Press.
- SKILTON, M. and HOVSEPIAN, F. 2018. *The 4th Industrial Revolution: Responding to the Impact of Artificial Intelligence on Business*. Palgrave Macmillan.
- SMITH, A. 2007. *An Inquiry into the Nature and Causes of the Wealth of Nations: Volume I*. Cosimo Classics.
- THOMPSON, P. M. 2012. *Returning to Reality: Thomas Merton's Wisdom for a Technological Age*. Lutterworth Press.
- TORRY, M. 2013. *Money for Everyone: Why We Need a Citizen's Income*. 1st ed. Bristol University Press.
- TRUFELMAN, A. 2015. The Gruen Effect. *99% Invisible*, Episode 163 [online]. Available at: [99percentinvisible.org/episode/the-gruen-effect/](http://99percentinvisible.org/episode/the-gruen-effect/).
- WAGNER, J. E. and NEWMAN, D. H. 2013. The Simon-Ehrlich Bet: Teaching Relative vs. Absolute Scarcity. *The American Economist*, 58 (1), 16–26.

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