Circular Economy in the Third industrial Revolution

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Introduction

This paper looks at the need to transition from a Linear Economy to a Circular Economy in the era of the Third Industrial Revolution and what in general terms the impact of a declining working population will be. The aim of this paper is to highlight some important issues in the economy and to form a basis for further discussion about these subjects.

The current economic system that we are part of is called the Linear Economy (LE) for the following reasons. It is a linear economy, because raw materials get collected, manufactured into a product which get sold to a consumer who dumps it after use. By some called "take, make, dispose". In other words natural resources are used for just for temporary [1] benefits in the meantime creating waste and depleting the resources.

A Circular Economy (CE) is an economic system where the waste from production to final consumption stages of disposal, is minimised and becomes a resource. This resource can then be used as input for the same or different products. So inherently the CE is more environmentally friendly; and has the ultimate goal of zero waste.

The 1st Industrial Revolution starting in the 18th Century was based on coal and steam. Followed by the 2nd Industrial Revolution starting late 19th Century based on oil & gas. The Third Industrial Revolution (TiR) is described by activist economist thinker Jeremy Rifkin (2011) as follows. "*The co-joining of Internet communication technology and renewable energies is giving the rise of a Third Industrial Revolution. In the 21st century, hundreds of millions of human beings will be generating their own energy in their homes, offices and factories and sharing it with one other across intelligent distributed networks – an intergrid – just like people now create their own information and share it on the internet*".

Need for Change

The opening sentence of this paper states a transition from LE to CE, so why is there a need for transition? There are many reasons, to name one, it is doubtful that anyone wishes to runout of resources, but currently we are extracting and using them at such an alarming rate that they cannot be replenished so we will run out. In the process we destroy and

1 That could be 5 minutes to 100s years

pollute the environment. The neo-liberals [2] probably refer to the latter as a little collateral damage we need to have in the name of economic growth.

What would be the forecast be in the status quo scenario. As mentioned before, we will run out of resources; land and sea and air get polluted in such a way that many areas will become unliveable and unusable for safe food production, resulting in mass movements of climate refugees (Boogaerdt, 2017b). Status quo thinking is easy, there is no disruption; business as usual and do not have to deal with the uncertainties of a new system. People do not like change, however these same people that advocate the status quo, are likely very happy to indulge themselves with the latest gadgets which change their life enormously, for example the smartphone, so here some paradoxical behaviour.

We have to acknowledge that the LE has served us well to get where we are now. Let's reflect on how we got there. In this paper "we" is defined as the Western Developed World, originally only Europe, then adding USA and later Japan, Singapore and Korea. We created that wealth initially by pillaging the Americas done by the Spanish and Portuguese, followed by pillaging of Asian subcontinent and south east Asia by the Dutch and British. After that it was Africa's turn to be pillaged. The first major example of LE and its environmental impact is deforestation of the island of Madeira by the Portuguese (Patel & Moore, 2018) [3]. Even now we continue to pillage, e.g. the Amazon.

Depletion of resources is often not so visible, but pollution is. Just look at all the plastic waste worldwide. The latter has been well documented visually in the ABC's "War on Waste" series which show that a lot of waste is of single use products (ABC, 2018). Another good summary is the special report in The Economist "A load of rubbish" (Economist, 2018b). In contrast atmospheric pollution is not visible most of the times. With clear skies in Australia we do not think much about air pollution. That is quite different in places like Beijing and New Delhi where the air pollution is obvious. Pollution by CO_2 or CH_4 is nowhere visible, that does not mean that we can keep on polluting the atmosphere with them.

A definition of the CE is an economic system where the original natural resource embedded in a product is used as a resource for the next new product. If renewable energy (RE) is used there is only minimal loss of cheap clean energy, RE has its in efficiency and internal and embedded energy losses. The use of RE in the TiR means that energy costs could be very low and form a "*zero marginal cost*" (ZMC) (Rifkin, 2014). There are some researchers that see CE as a refocussing of capitalism, a sort of "capitalism 2.0", "co-operative capitalism", "reboot capitalism" or "naturalised capitalism" to name a few (Hobson & Lynch,

2 Neo-Liberal = Neoliberalism or neo-liberalism refers primarily to the 20th-century resurgence of 19th-century ideas associated with laissez-faire economic liberalism. Those ideas include economic liberalization policies such as privatization, austerity, deregulation, free trade and reductions in government spending in order to increase the role of the private sector in the economy and society. More at Wikipedia

3 Madeira means wood in Portuguese. So "Ilha de Madeira" means island of wood(s).

2016). These approaches are "not [about] the end of capitalism as an ideology, but the issue of how capitalism's technical components – which have come off the rails – can be reformed" according to Schwab (Hobson & Lynch, 2016). But that would not create a sustainable economy since the fundamental tenet of capitalism is "growth", which is not possible anymore in a finite world. The concept of CE philosophy is too different from LE which is still based on pillaging and banking (Patel & Moore, 2018). There is no doubt that there needs to be a reward for saving, or for being prepared to take a risk. To be clear the CE is not against private business and not necessarily in favour of state owned enterprises. In both LE and CE state owned enterprises are better than privately owned ones only in the case when monopolies are involved. The Economist (2018c) writes about the need to breakup or to modify many of the oligopolies and modernise the unions. The Ellen MacArthur Foundation (EMF), which has links with multinationals like Cisco, Philips and Google, was established with the aim to help with the to transition to a CE. There is nothing compulsory about this, but to quote Hobson & Lynch (2016) "enable organisations to develop new opportunities and realise their circular economy ambitions faster". Besides some EU legislation about CE, China has also created its own rules for closed loop policies at various levels (Hobson & Lynch, 2016). In the USA quite a bit of CE research is carried out, but no action at government level. Much same in Australia, with no real discussion in the political sphere. This shows that CE is not some weird leftist scheme or that CE is not just pie in the sky by some researches.

CE is also more environmentally friendly, because it reuses and recycles more, however it does not necessarily accounts for externalities. Adding the accounting of externalities to LE would make it easier to transition to CE. But, many politicians appear to believe that major problems we face can be fixed with technology, originating in the free-market economy and adding some externality costing (Gare, 2017). Stahel (2016) states that the LE focuses on "bigger-better-faster-safer" — in other words, fashion, emotion and progress. LE is good in providing goods, but also wastes resources in saturated markets. Companies make money by selling huge amounts of fashionable and cheap goods (Stahel, 2016) or as Kyosaki (2000) would say they focus on selling "dodads" (unnecessary items). This process is described by Oberhuber (Rau & Oberhuber, 2017) as "Products are made today to quickly break (designed to fail), to be outdated (designed to be outdated) or to be out of fashion (designed to be out fashioned). The producer wants to sell as many products as possible, that keeps his business running. If you provide a service instead of a product, you get a very different incentive. The producer then not only gains control over the product, but also bears the responsibility for it. He suddenly has every interest in ensuring that products function as long as possible and that the customer is fully satisfied with it." This all leads to enormous use of resources and creating vast amounts of waste.

One of the main problems with the LE does not account for externalities. From a neo-liberal perspective externalities should not be part of the economic model because it interferes simply with the profitability model of opportunistic short term gain. It will be difficult for neo-liberals to accept that their model will come to a crashing halt, when resources run-out

or when pollution becomes so bad that health costs become so exorbitant that only a few afford it and as result people are dropping off like flies. The essence of the matter is according to Rau & Oberhuber (2017b) that "power and responsibility are too far apart. The producer has the power, but not the responsibility for the consequences of his actions. He passes it on to the consumer. Where power and responsibility come together, things are going well". In CE this changes because the producer takes more responsibility of the product. This were part of the externalities get internalised. Transitioning from LE to CE is changing from an open system that does not account for externalities to a nearly closed looped system (we actually are already living in a closed system, namely the earth). There will be business opportunities in CE. Business leaders have to start thinking more innovative.

Part of the TiR will be occupied by services like Uber, Airbnb and the like, which are just a different forms of LE based economy. Are these types of services suitable for CE? Yes, because they are based on optimising the use of assets which have an impact on the environment. However there are projections that when autonomously driving Ubers and share cars fewer people will be using public transport which will lead to traffic congestion. The TiR will find a solution for this possible problem. Also, the TiR will make progress in CE possible, because it will create new ways of zero marginal costs and the Internet of Things. The blockchain technology will likely become part of TiR, enabling amongst others compliance to transactions and improving the move towards a zero marginal cost society (Casey).

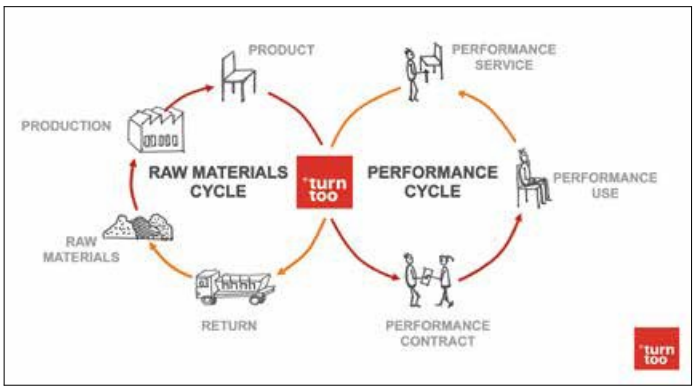
In history we have seen already a move from agricultural society to an industrialised society and further to a service oriented society in the 1970s. The gig-economy is an extension of that. Because of the move away from low-wage production, it will be harder for less educated people to find work. To avoid marginalisation othere solutions have to be found. All issues raised lead to the notion of more cooperation that we have to start operating in the "commons" as Rifkin (2014) has pointed out. This is already happening in open source software development as described by Rifkin. However, the "commons" are not a sort of utopian societal form without any need of any regulation. The "commons" cannot be left on their own as history shown. So, if we like it or not the "commons" need to be regulated otherwise it will morph into an unequal feudal state (Hardin, 1968).

As indirectly indicated the standard CE approach may not be enough to make the economic system truly circular. CE has a bit of following in Europe and China, but till now what has been shown is in essence a modification of the LE into CE, like connecting the two endpoints of LE and so forming a circle. There need for more radically different thinking in the sense of implementing more novel ways to do business. One of them is the concept of "**as a Service** (**aaS**)" created by Rau (Rau & Oberhuber, 2017). This concept described below in a transcription from a book by Rau & Oberhuber (2017, pp 88-89, pp100-101; Turntoo, 2018). The authors suggest that in order for the world to become sustainable we have to move from the current linear economy to Circular Economy. Part of the rethinking is to

have goods as a service. At Amsterdam Schiphol airport one of the passenger halls during an overhaul the lighting has been changed. At an airport many lights are turned on 24/7. It is also common to refurbish commercial buildings after 15 years which equate to about 130,000 hours. Normally LED lights last about 50,000 hours. That means during this 15 year period the lights have to be changed twice, with still 20,000 hours left when the next refurbishment starts. For this hall Philips was contracted to supply "*Light as a Service*" which means all costs of equipment, maintenance and the cost of electricity are borne by Philips and at the end of the contract Philips takes back the lamps that they then can use as a resource. So it is in Philips best interest that the lights are free of problems for 15 years and the energy consumption is as low as possible. Guess what, Philips has now developed a LED light that last 130,000 hours that is the whole contract period. During the contract period the airport pays Philips a fixed amount monthly to cover the cost. When Philips improves it efficiency it increases its profits.

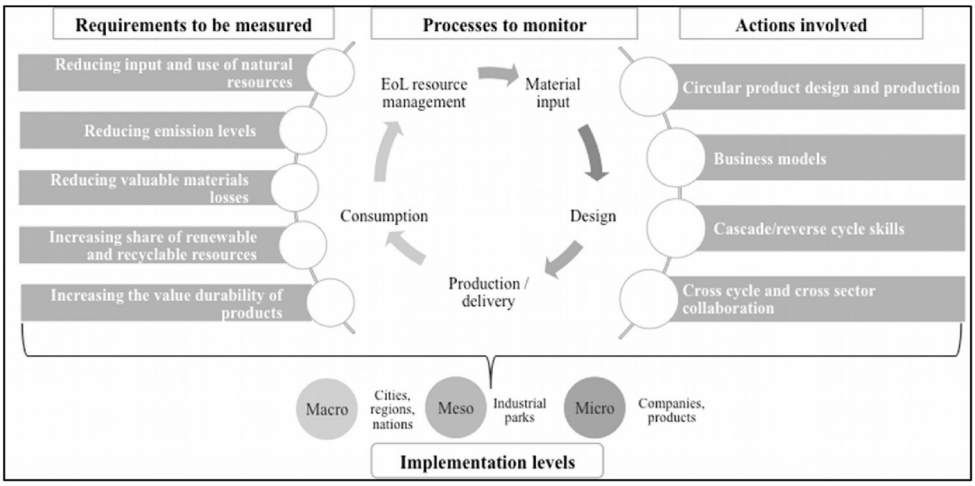
In the CE when there is an economic incentive to recycle it could easily be that some organisations will cut corners. By moving towards something "as a Service" (aaS) economy there will be an incentive to recycle properly because the provider of the service is responsible for the "final waste" (Rau & Oberhuber, 2017). The before mentioned gap between power and responsibility can be narrowed by initiatives under the name of "Extended Producer Responsibility (EPR)" (Economist, 2018b; Wagner, 2013). The OECD has put outcome policies for EPR to be implemented for many products (Johnson & McCarthy, 2014). The "Material Circularity Indicator" proposed by the Ellen MacArthur Foundation (Ellen MacArthur Foundation, 2015a) shows an attempt to include in the analysis the loss of materials and the product durability. This last requirement, in particular, is not considered in any other of the studies analysed, despite its importance in a CE strategy: planned obsolescence represents one of the main obstacles on the way to product durability, especially in electronics (Guiltinan, 2009). Part of the EPR is as Beemster (2015) says "Companies must take total responsibility for their products", as is also suggested by Rau & Oberhuber (2017).

To have environmentally effective waste collection and recycling there are always the determinants if individuals will properly recycle, that is to separate properly its waste (Wagner, 2013). This problem could be partially solved by instead of buying an item, is to have it as an aaS. Even further goes the concept of keeping a ledger for materials used in a building as proposed by Rau & Oberhuber (2017) in the form of the "Madaster" (≈ Materials Cadastre). In this Madaster one can track where the material was and now is. A blockchain technology maybe useful for this; however at the moment the physical overheads would be too large. So far the Madaster is owned by a not-for-profit organisation.



from Rau (2011) in Beemster, 2015

The diagrams from Rau and Elia capture the major issues of the CE. There would be many variations of CE which also depend on the product and circumstances. It would be a multidimensional structure where some parts can be aaS while others can only be part of a more generic CE.



from Elia etal, 2016

Until now waste management has been part of the LE endpoint. Due to lack of dumping sites recycling has become a bigger part of waste management over the last decades. There are still many paradoxes in the waste collection systems we observe (Boogaerdt, 2017a). In a wasteless society where everything gets reused, does it than matter that products are "designed to fail" or "designed to be outdated"? In a circular economy, the objective is to maximize value at each point in a product's life. New jobs will be created and systems are needed at each step (Stahel, 2016). As Rau & Oberhuber (2017) say "***waste is just material without an identity***". But, if we recognize waste as a resource like identifying this is "lead", this "gold" it becomes a resource with value.

As seen waste management forms an integral part of CE by aiming to zero waste where the "old" waste becomes a resource. The Economist (2018b) quotes that McKinsey consultants worked out that a tonne of dumped rubbish in Asia's waterways cost the economy US$375 because pollution and disease compared with US$ 50 - 100 to correctly dispose of this same

rubbish. This is a clear example that when externalities are taken into account current LE models and business practices do not stack up financially.

From Taiwan to USA to Europe, food waste in the developed world is enormous. There are companies starting up to reprocess some of this waste as part of the move towards CE. An interesting example is one that creates a pasta from beer brewing waste (Economist, 2018b). It will help to have near zero marginal cost of electricity, produced by RE.

Shipping a piece of equipment that is broken or at the end of the aaS contract back to the country it was manufactured could be a costly challenge for a small company. So maybe multinational companies that do well currently in the globalised world have an advantage also in the CE. However it is possible a totally new industry could emerge that repairs, on-sells or recycles aaS products that could be contracted out by the manufacturer to take care of that equipment in that country. To keep track of the material "smart contracts" could be created using blockchain technology (Casey, 2018; Rifkin, 2014). Then there is always the problem what happens to the obligations towards a piece of equipment when the aaS provider goes broke? Can it be solved by a new style of insurance policy?

Quoting Rau (Rau & Oberhuber, 2017) "In the whole issue of the circular economy, the political preconditions are very important. The regulations still cause too many problems today, for example when reusing or repairing materials. If a large company exports medical equipment or IT equipment outside the European Union, they cannot retrieve it for repair. After all, you cannot export electronic waste across national borders. So there are urgently new legal frameworks that politicians need to define." To that Oberhuber adds :" On the other hand, companies and by extension the general public also have a big role to play in the transformation. We need to feel stewards of everything we have in our hands. Although we may use the materials for our daily needs, we must ensure that future generations can do the same. Careless discarding of things is untenable." There may be a need for some regulation or policy to ensure the transition to CE, many will think "Oh no! More red-tape". However, it has to be kept in mind that if people and organisations would do the right things in relation to society, one would not need so many regulations. There will also be a concern that this will cost jobs. Research indicates that if product lifetimes are doubled and the amount of fresh resources is halved it will create in Spain alone 200,000 jobs (Economist, 2018b).

This is all good and well, but how can an economy survive without growth and business will say "can we grow with CE". Growth for organisations is seen and used as a survival mechanism. Money as an incentive seems to be more related to existing large organisations, especially the financial industries with related problems (Canberra, 2018; Patel & Moore, 2018). So with CE can we have growth? Before answering this question maybe we have to define what economic growth is. Is growth just an increase in GDP, a flawed measure which include for example clean-up costs after an environmental disaster, or is it an increase in society's well-being? Should it mean profitability of companies, or

average wage increase? Or should we abolish all reference to growth? A better economic measure could be to report on social well-being and amount of inequality, which could include general health of the population and level of poverty. If we measure an economy along these lines measuring growth could be abolished since it measure just GDP (Boogaerdt, 2017c). In a CE it may be possible that according to classic-economics-models there is negative growth while in the new CE-standard there is a positive improvement.

With disruptions in the economy due to technological change and with before mentioned demise of low-wage jobs, there will be a need to look at "inclusive growth measures". Otherwise that group of citizens will be marginalised (Agrawal, 2018; Domokos & Ostrihoň, 2015; Herdiana etal., 2014; Suryanarayana, 2015). To avoid marginalisation, government will need to implement a Universal Basic Income (Boogaerdt, 2017b). Or, maybe use more modern monetary theory policies and get governments to fund minimum wage jobs which will stimulate the economy (Connors, & Mitchel, 2017; Heilbronner, 1990; Juniper etal, 2014; Kelton, 2012; The Conversation, 2016). The latter would also reduce welfare payments and mental health issues.

To speed up the transition to a CE there needs to be also a bottom up approach movement by the consumers. Many of the proponents of the LE will continue to promote the status quo and will only change if there is a financial incentive, e.g. losing customers when your product is not manufactured according to CE principles. There is no doubt that CE requires more collaboration and cooperation. Often voluntary collaboration is difficult, so some regulations may be needed. The journal Nature reports on a study in 2011 which shows that after cooperative activities 3 year olds share food more equitable than when they are just involved individual activities (Johnson, 2016), this gives hope. Moral issues also arise when there is a need for collaboration (Ostrom, 2010; Schwenkenbecher, 2013 & 2014). As Rau & Oberhuber (2017) say "Knowledge is no incentive for change. Financial incentives are that. No one turns around his business plan because they think their grandchildren will be better off". This observation is important; showing there has to be some sort of legislation to ensure there will be a financial incentive. In part to enable the transition is for business is to hire graduates who have knowledge of the model changes in both economic and technical levels. This also means that economic, engineering and other courses at universities have to provide for this. The graduates have to persuade their (prospective) employers that society is changing so much that they need people that can help them and should hire them because they have been taught how the transition works. This cooperation leads also to more ZMC services and products which are an integral part of the TiR.

Externalities

Many accountants would like to argue against costing of externalities, because they are too expensive to implement. I challenge independent researchers and governments to crunch

the numbers and publish them. In general in a budget there is never a breakdown of costs that relate to externalities, e.g. do we see a ledger that shows all the real costs of rehabilitation of mines and all abandoned mines, costs of spills paid for by the tax payer? It will not be easy to exactly account for the costs of externalities and how to put them in to the accounts. In addition if all externalities get costed and paid for by the initial user/producer that will have price and tax implications. No doubt the costs for products will go up; but consumers will have more disposable income since the government will tax them less because it does not have to pay for the externalities.

Triodos Bank (Netherlands) goes one step further by no longer writing the building down to zero, but taking into account the permanent value of the materials (Rau & Oberhuber, 2017; Urgenda, 2018). If externalities are incorporated in balance sheets they may show increases in assets and/or liabilities (Boogaerdt & Brown, 2019). That is important because many of the externalities do not impact now, but only in years to come. They should be listed on the balance sheet as liabilities. It may seem as a marketing exercise, but nevertheless RENFE (Spanish Railways) says in its 2010 annual report that it saved €2 Billion in external costs due to reduction in air pollution etc (Bebbington & Larringa, 2014).

Renewable Energy installations can be controlled in local communities while fossil fuel extraction distributions etc require large-scale investments; and nuclear power needs even larger investments. The control of these types of operations has to be centralised (Johnson, 2016; Rifkin, 2011). From all the arguments till now it becomes apparent that fossil fuels do not have a place in the CE because they are not and never will be a renewable resource [4].

"We are not machines. We are spiritual beings, on a human journey. We are extremely sensitive to everything, including what the space looks like. You certainly should not underestimate the impact of the built environment on people. But then I would rather be treated in a kind of neutral machine than in a formal, forced building" says Rau (2017). With declining and aging populations resulting in fewer people paying tax it is important that both the tax paying and non-tax paying part of the population are healthier. So our built environment is important. Following on from this it is very important that buildings become more liveable. Take for example of Council House 2 (CH2) in Melbourne where the extra cost of creating the "greening" of the building was paid back very quickly due to decline in sickness, so increase in productivity (Paevere & Brown, 2008). The build environment when established in a CE will reduce the externalities for people living or working in them, as is shown in the report about CH2. "Most healthcare institutions are too big. They take care of the revenue models. We have to turn the roles around. You do not have to make a hospital but a health center. Look at Japan. A general practitioner is paid on

4 As said even though fossil fuel does not have a place in a CE, the "fossil fuel" companies will continue to have one. The reason is that in order to get to the 1.5°C temperature target by 2100, work has to be done on negative emissions. That means taking out CO_2 out of the atmosphere and sequestering it in amongst others old oil/gas wells. The "fossil fuel" companies have the expertise about reservoirs, pipe lines, wells etc, so they are ideally placed to provide this service to society. For example, the Pilbara (WA) is an ideal place with ample sun and wind to provide cheap RE to perform this task and is near exiting oil/gas infrastruture.

the basis of the number of healthy people, not on the basis of the number of sick people" observes Rau (2017), which suggests a total rethink of the healthcare system, and have the externalities of this sector are included in the model.

In the status quo scenario we keep on living the "high life" which will be paid for by the next generations. So it becomes essential that we start paying for these externalities now; even though the costs may be incurred well in the future. It is like an insurance scheme. Hopefully with the emphasis on costing externalities our societal way of thinking will change from short-term to long-term. The worst attitudes are shown by the Trump's Administration and partially by Australia's Liberal Government which know that there is anthropogenic climates change, but cannot be bothered to do anything about it; they rather focus on the short term. In other words they tell the next generations "*they can get stuffed, because we do not give a shit about you*".

Population Issues

The success of a LE is based on growth, which will be problematic with a declining working age population. The question becomes, is any other economic system more suited for a declining population? Bearing in mind whatever economic system an ageing and declining population means fewer people generating taxes to support an increasing proportion of the population.

In the move from Agricultural Society to a Service Oriented Society there has been an increase in life expectancy. Without an ever increasing population, having a proportionally older population will increase the burden of the working population. Unless there will a spectacular improvement in productivity and an increase in wages the result will be a lowering of living standards since more taxes will have to be collected from less people.

Along the development path of economic growth fertility drops and people have fewer children, who in general have a better life is the conclusion from literature (Hobson & Lynch, 2016). From literature about declining populations and its economic impact there are no alternatives given for "economic growth" (Ebertadt, 2010; Vincent, 1946). No literature search has been found about the circular economy and impact of a declining population. With a declining population the age distribution will shift. Resulting that at a given moment there will be more people older than 65 year than under. As a rough scenario add to that all the children under the age of 18 and we get a society where at max only third could be productive from a taxation viewpoint. Not taking into account the people in the 18-65 group that for whatever reason are not able to generate tax. The working poor probably do not pay very much tax at all. This is another reason to improve efficiency and start paying superannuation contributions now when young, because in years to come these burdens become prohibitive (Boogaerdt, 2017c).

Impacts with this scenario are decline of fertility rates in the developed world which means even fewer people that provide the necessary tax base [5]. Another large impact will the move towards the gig-economy where fewer people have permanent jobs and so affect the tax base that is needed to pay the old part of population. Without use of further automation and robotics it will be impossible to increase the productivity enough that we can survive comfortably with a declining population. Not only is automation economic it will be a necessity, it is also a major factor in making goods and services cheaper and so should improve productivity, approaching ZMC.

There is a need for more studies about the effects of a declining and aging population in a CE. In this paper the issue was raised to highlight the necessity of further investigations in this phenomenon. The declining populations have also societal implications, like the China's one child policy, where the offspring of these children will have no cousins (Fong, 2017).

Conclusion

There is wide range evidence that the current economic system of LE is not suitable to create a liveable sustainable and fairer future. The transition in moving to the alternative CE is on its way. The evidence and alternatives presented are across the political spectrum. There will be incumbents who will lose out if they do not adapt in time or may not wish to adapt for whatever reason, they will fight against change

Environmental pressure will make CE acceptable for economic and political reasons in order to survive as a society. At its core the CE is an economically and politically palatable response to aspirations for sustainable growth in the context of mounting pressures on global resources (Hobson & Lynch, 2016).

A declining population will put strain on both the LE and CE; and on a cursory observation CE should be in itself not be an impediment to handle population decline, there is no guarantee the CE can handle declining populations well. However there is no doubt that UBI has to be seriously looked at in order to deal with the gig-economy and declining population.

5 There is a need for a decline in global population since the planet will not be able to sustain an ever increase in numbers, especially in light of climate change.

But with all innovative systems developed in the transition to CE in the TiR the change may result in a better future. But nevertheless the transition to CE is extremely important in order to survive in a non-chaotic way. Transition is also exiting because all of the innovations. So in CE we do not have to focus on growth but service contracts and so the decline in population may not affect its profitability so much.

The main reason there needs to be a transition to CE is the long-term survival of the human race in an acceptable way.

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