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DOUBLE PARADIGM CHANGE AND NEW ECONOMICS RULES: INDUSTRY 4.0 PERSPECTIVE

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ABSTRACT

Industry 4.0 along with unconventional economic policies inspired by the Great Recession of 2008 represents two major forces impacting the socio-economic system in which we have recently entered. From one side, Industry 4.0 offers huge and vigorous opportunities for growth, as well as annulment of structural problems from the past. From the other side, the unconventional anti-recession economic policy measures, despite intentions, have failed to perform the intended role. Other forces of impact holistically interact with two main forces in formation of the so-called New Normal. This chapter investigates the impact of the New Normal on paradigm change, both in microeconomics and economics. The studies on the relationship between Industry 4.0 and paradigm change in economics are scarce (Schröder 2016; Devasez and Sarygulov 2017; Garcia-Muiña et al. 2018, Maresova et al. 2018). In response to this literature gap, the aim of this chapter is twofold: to promote contemporary concepts - stakeholder capitalism (instead of shareholder capitalism) and circular (instead of linear) model of growth, and to discuss with explanatory details the emerging contours of the related economic policy platform called "heterodox". A fundamentally transformed landscape requires paradigm change in economics theory, both micro and macro. Universal mobility and combinatorial innovations, synthesizing breakthroughs from the virtual and physical (and/or biological) worlds, are hallmarks of Industry 4.0. So too, paradigm change was born in microeconomics. Reconsidering paradigm change in macroeconomics is a consequence of the growing consciousness about ongoing structural imbalances, in particular income inequality, and urgent need for technological solutions to pollutant gas emissions. What theory really needs, after more than two and a half centuries of industrialization and more than a 40-year-old experiment with shareholder capitalism as the neoliberal version of free market capitalism, is a double paradigm change. Solutions to perplexing problems of a modern socio-economic system did not come only from core macro policies, but from industrial (structural, intentional) policies, of course, in harmony with core policies (monetary, fiscal and competition).

Key words: Industry 4.0, orthodox approach, structural bubbles, climate crisis, heterodox approach, industrial policies, automatic stabilizers.

1. INTRODUCTION

After the fourth industrial revolution was identified as a relevant phenomenon, the construct "Industry 4.0" has been introduced in the beginning of the last decade. K. Schwab (2017) eloquently explained the role of combinatorial innovations as a hallmark of the fourth industrial revolution. He continues to cast light on opportunities and/or perils related with Industry 4.0 (Schwab 2018), confronting the zero-sum-game thinking of linear industrial model with the circular model supporting regeneration and preservation of nature, rather than creating negative externalities.

The last stage of industrial revolution can be considered as a result of lateral expansion of breakthroughs from the cyber to physical (and/or biological) world and related symbiosis. Consequently, Industry 4.0 sets a number of challenges (Kagermann et al 2013, Fitzgerald et al. 2014, Arnold et al. 2016) for rules and rulers. Along with technical potentials and social accessibility of rules being used, success also depends on sustainability and inclusivity of their consequences.

Today, a complex nexus of forces is evolving with extraordinary rapidity and impact on the socio-economic system and behavior (business model and strategy) of economic actors. Opportunities and perils for economic development are indicative. Industry 4.0 challenges many of the economics rules that underpin conventional wisdom. Premises of the linear model of growth and mainstream policy platform are not providing an adequate context for Industry 4.0 anymore, at least for two reasons. First, they are related with conceptual lines of reasoning ill-suited to deal with a sustainable and inclusive growth pattern. Second, they cannot support transformative power of Industry 4.0.

In the time of the greatest popularity of market fundamentalism and before the Great Recession of 2008 has erupted, D. Rodrik (2004) emphasized the role of industrial policies for the economic development. The same author (Rodrik 2011) brilliantly explained how conventional economic policies have forced developed economy into profound viability, directly through real economy and indirectly through financialization. R. Rajan (2010) emphasized that jobless recovery and human resource paradox[1] related with implementation of the new technology combined with monetary and fiscal easing have effect of increasing risk appetite toward automatization and inflating asset price bubbles. He particularly stressed out incompatibility of such line of

[1] Too many people of the wrong skills set and not enough people with STEM expertise, algorithm thinking and soft skills.

reasoning with aspirations of developing economies for catching up and income convergence with developed world. Export-managed growth based on import technologies does not lead to sustainable macro balances in developing economies. Technology transfer as a way of industrialization contributes to current account deficit and deficit in capital balance due to financing of this purchase. Deficits increase debt, reduce the speed of growth, and a developing economy easily enters the "middle-income trap". Escaping this trap means reduction of technology purchase and related debt financing. The feasible way for transition toward inside technological development was manifestation of industrial policies as complementary measures to marketization. The emerging model of capitalism is known as "managed capitalism or pro-growth state". The related policy platform was later defined as "heterodox".

In contemporary economics there are many luminaries which followed the similar line of reasoning. In the wake of the Great Recession of 2008, J. Stiglitz (2010a) urged radical reform of monetary and financial system. The reason was the freefall of global economy (Stiglitz 2010b). In addition, D. Rodrick (2015) emphasized that economics has become hyper-politicized and also discussed how in an environment of high ignorance of negative external effects and country-specific paths, the pressure of mainstream economists to persist with conventional policies makes changes in economics rules very difficult. One group of highly influential experts from international financial institutions (Blanchard et al. 2010), along with other group of experts of the same impact factor (Blanchard at al. 2016), claimed that real economic potentials have been underutilized due to ignorance of structural policies and new policy instruments like automatic stabilizers. J. Stiglitz (2018) has reflected on the growing recognition that a prevailing academic orthodoxies are inadequate, because market fundamentalism and financialization combined with denial of the impact of negative external effects on economic development exacerbate two major contingencies of the modern world, income concentration and climate crisis. Using vast data sets B. Milanovic (2016) explained the impact of disruptive innovations and income concentration on long-term income inequality, both within and among nations.

A call for rewriting the rules in a changing macroeconomic, digital, demographic, and social landscape has been inspired by many pressing challenges, in particular climate crisis. M. Mazzucato et al. (2015) explained the role of industrial policies for annulment of structural imbalances, particularly anthropogenic climate change. Some researchers (Costanza et al. 2016) emphasized intention to measure quality of growth in connection with the UN 17 sustainable development goals (UN 2015). The consensus about a new consensus on the principles for policy making has emerged (Alkire et al. 2016). By the end of 2019, all over the world, particularly in the EU, the climate crisis has deserved mainstream discussions[2].

[2] The European Green Deal includes measures of the EU Parliament, EU Council, and European Central Bank.

Paradigm change is not an unusual endeavor. In social science it has occurred innumerable times. However, research on this topic is still in its infancy.

A new paradigm in economic thinking needs to be founded in a systemic and integrated manner considering the planet Earth as a system dynamics in which the socio-economic system is only one layer. Paradigm shift should generate solutions for annulment of structural imbalances from the previous system, unleash business actors' potentials in accordance with frontier technologies implementation, and, by doing the previous, safeguard the planet Earth for future generations.

In the changing context, microeconomics first experienced the call for paradigm change. On the business actor level, the cloud computing and business management tools coupled with mixed reality, are going to be central for digital transformation. Actually, it is the impact of combinatorial innovations on organizational structure and the way of functioning of business actors. The emerging new economy of big data that empowers artificial intelligence and robotics is transforming production and other stages of the value chain toward more simple and linear system (Canals and Heukamp 2020). The impact of change is visible in macroeconomics, too. In addition to annuling structural imbalances from the past, development and implementation of combinatorial innovations in a coordinated way aimed at restoring economic growth amplify the request for a paradigm change in macroeconomics (Djuricin and Vuksanovic Herceg 2018, 2019a).

The aim of our research is to understand the complexity of paradigm change, both from the micro and macro perspective. Research methods are in correlation with our intention to present a conceptual paper. The paper presents a comprehensive coalescence of relevant literature and knowledge about the the Industry 4.0 and its constitutional forces impacting both macro and micro economics. We carried out a qualitative exploratory research of mainstream economics rules, ill-suited to deal with contemporary problems. Extraction of fertile ideas and generalization are related with authors' long-term experience in professional services and corporate governance.

The chapter proceeds in seven steps. After Introduction, the second part discusses the main forces which triggered double paradigm change. The third part reviews what we think to know about Industry 4.0 as a key force of change. The fourth part analyzes causes of failure, or where we were wrong in conceptualization of growth based on the orthodox economic premises, particularly the set of premises related with the neoliberal version of free market capitalism. The following two, and probably the most important parts, concentrate on paradigm change broken down into paradigm change in microeconomics (and business management) and paradigm change in macroeconomics (and macro management), respectively. The reversibility principle (or feedback loop) is the prevailing idea for double paradigm change. The seventh part discusses the heterodox approach as feasible and viable alternative for restoring sustainable and inclusive economic growth. The last part presents concluding remarks.

2. A CALL FOR DOUBLE PARADIGM CHANGE

In every science, paradigm is a set of rules with the power to explain the behavior of the system being analyzed. The socio-economic system is a man-made system. It is highly non-linear closed loop system (Forrester 2003, 330). In social systems, a set of rules is continuously under the impact of the changing reality. Performance of the socio-economic system indicates adequacy of economics rules. False rules provoke volatility, imbalances, and regression.

In the new millennium dawning, anthropogenic climate crisis and income concentration are main sources of vulnerability. The "double trouble" has roots in premises related to market fundamentalism. Consciousness that the model of growth and related economic policy platform are failing to perform the intended role is growing. This chapter intends to address fundamental truths about the modern world's maybe most tentative social inventions, the shareholder capitalism and related economic policy platform, sometimes called the Washington Consensus.

Attribution studies of the natural world paint an alarming picture (Pasini et al. 2017). Along with rapid depletion of natural resources, there are three negative environmental consequences of current economic order: global warming represented by CO2 emission, acid rains and related damages represented by SO2 emissions, and water/air quality destruction represented by NOx emissions. The role of anthropogenic forces is a primary driver of the global warming of 1.5 degrees above preindustrial level.

According to (Rockström et al. 2017), if current trends in global warming continue unabated, by the end of the century the average temperature could rise to 4-5 degrees. This level of warming will follow the glaciers retreat, a significant sea level rise, and drying up of a great majority of fertile soil. The global economy must aim at rapidly scaling-up CO2 removal by technical means from zero to at least 0.5 GtCO2/year by 2030, 2.5 by 2040, and 5.0 by 2050. All sectors of the economy need compatible transformation pathways.

Halving gross anthropogenic carbon emissions every decade until 2050 will enable reaching of "2 degrees Paris Agreement warming limit". The previous requires huge investments in new climate economy. Such investments could help implement non-linear disruptive technologies toward carbon neutral world.

Besides ignorance of negative external effects, particularly global warming, the current economic framework also triggered another structural imbalance, income (and wealth) concentration. According to (Alvaredo et al. 2018), on a global level, distribution of wealth looks like a champagne glass. Namely, one-fifth of the rich participates in more than four-fifths of the income. By 2017, top 1 percent captured 27 percent of total growth. Income concentration has an extremely dangerous social impact in bust stage of the business cycle. Anyway, bad times are bad for many and good for few.

The New Normal is a generator of change, a double flying wheel with two major forces moving in different directions*:* Industry 4.0 and market fundamentalism.

From 1784, when introduction of the steam machine marked the beginning of the industrial revolution, technological change used to be the key driving force of economic progress and social prosperity.

In every stage of industrial revolution, the diffusion curve of the new technology vintage can be adequately described by a logistic (symmetrical or asymmetrical) curve (Davis 1979). Since this curve approaches the asymptote, the impact of the new technology vintage on output and productivity decreases progressively after a turning point of diffusion curve. So, we have a quantum leap in performance in the first stage of diffusion curve, and, after that, we have a diminishing return.

In contrast to the logistic shape of diffusion curve, during the industrial revolution the world population has followed an exponential curve. From the start of the industrial revolution until 2015, the human population skyrocketed. More precisely, it increased from 0.8 billion to more than 7.3 billion. According to (Kohli and Agarwala 2016, 12), the projection for 2050 is that the world population will reach 9.7 billion. The forecast shows continuity of exponential growth of population during the last wave of the industrial revolution.

Incompatibility between economic performance growth and population growth during the stages of industrial revolution could be a source of conundrum, particularly when it exacerbates another incompatibility related to climate crisis that the nature is dying and population expanding.

Increasing complexity of the economic system due to digitalization is another source of conundrum. In a complex dynamic system, the possible interconnections (or flows) grow with the square of the number of players (or nodes). Namely, the complexity of the system grows faster than the system itself. As a consequence, ability to find, classify, summarize, communicate, and analyze transaction data grows faster than that of using it as actionable information. The previous is a significant threat for continuity of business actors because noises from the market will grow faster than the signals, and in fact, the former easily drowns the latter. So, the fight for actionable information (instead of for market share) is the core rule in contemporary microeconomics.

Also, there are reasons for paradigm change in macroeconomics, too. One reason comes from consciousness about structural imbalances from the past. The opportunity for sustainable solutions emerges from the last wave of industrial revolution. So, inflection point in terms of double paradigm change, both in microeconomics and macroeconomics, is emerging.

The situation is further complicated by the fact that additional forces holistically impacted the two key forces of the New Normal amplifying and/or dampening the impact of the main forces (see Figure 1). So, we must also consider other forces of change driven by demography, geopolitics, profound impact of the 17 social

development goals of the UN Agenda 2030 and unconventional anti-recession policies. All forces of the New Normal are impacting the economic system and its future design and way of functioning. Net effect is not easy to predict because some forces are impacting the situation in a constructive, some forces in a disruptive way. For example, in case of anti-recession macroeconomic policies, negative impact is quite visible. Anti-recession policy is moving beyond the conventional set of policy rules. At least three examples portrayed the previous point. First, in quantitative easing policy inspired by the "too-big-to-fail" rule, the central bank actually bailed out creditors instead of debtors. Second, ultra-easy money policy rate decoupled risk-reward relationship. Third, negative interest rate policy destroyed the time value of money concept. By destroying fundamental economic rules, anti-recession, and mainly unconventional, economic policies actually destroy fundamentals of free market capitalism.

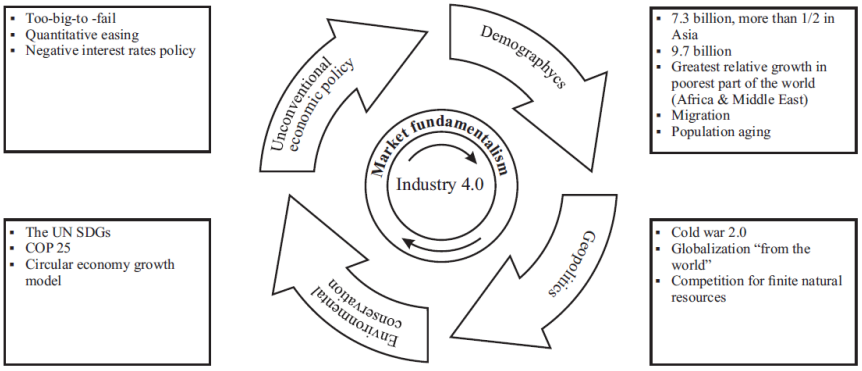

FIGURE 1. THE NEW NORMAL

Under the impact of the last wave of industrial revolution, paradigm change begins on a microeconomic level. But, technological *deus ex machina* does not work without an adequate economic context. The last wave of technological change has ambivalent meaning, it is related with opportunities and perils at the same time. Hence, the assurance of a new paradigm in macroeconomics (and macro management) has never been more essential. The paradigm shift in macroeconomics refers to how to transform amalgams from the cyber and physical (and/or biological) worlds into a sustainable and inclusive growth, both toward the people (full employment and decent work) and nature (conservation of nature) by using various transmission channels.

The transition from old to new economy is not a trivial endeavor. Contemporary socio-economic system is extremely vulnerable, socially unaffordable, and with a barbaric impact on the physical system and on the biosphere. If such layer of system dynamics continues to grow in this way, it can do nothing more than make the whole system increasingly unsustainable. Can anyone have serious doubts that redirecting economy from financial speculations to investment in carbon neutral technologies could enhance well-being in an environmentally sustainable manner?

3. INDUSTRY 4.0 AS AN ENABLER OF CHANGE

Each stage of the industrial revolution begins with non-evolutionary technological change. It includes serial trade-offs between factors of production and their transformation into new products/services. There are four stages of this cumulative process. In the last two stages of evolution, information substitutes capital in contrast to two previous stages when capital replaced the workforce. When it comes to the ultimate free good, in the fourth stage connectivity plays this role, instead of planetary resources like land, water and air.

In the last wave of industrial revolution there is no aspect of the economy and society that is shielded from transformative power of universal connectivity. It is a prerequisite for proliferation of combinatorial innovations.

The universal connectivity has transformed industrial economy into a shared economy, or a network for the platform economy, simultaneously broadening the growth model and economic policy platform. The automation based on integration of information and communication technologies (ICT) in the third industrial revolution tightens market linkages. The universal connectivity in the fourth industrial revolution enables continuation of integration, this time based on synthesis of cyber (ICT) and physical (and/or biological) innovations. By doing that, connectivity has capability to blur industry boundaries and create the network of networks (or business platforms) as emerging ecosystem of business actors. Consequently, the relative contribution of real economy and services has been radically altered. Also, the concept of property has evolved from material asset to intangibles, reflecting the growing role of information and knowledge in value creation. In a new setting, service-oriented business actors are going to use online platforms to connect distributed stakeholders. By doing this, they share access to their material assets, intangibles, key resources, and time on a scale that was not possible before[3].

[3] Facebook, as the largest media company, did not create content, Alibaba, as the largest trading company, has no stock, UBER as the largest passenger transport company, does not have fleets, and Airbnb, as the largest accommodation company, has no real estate.

Information age begins with the third industrial revolution. There are two conceptual roots in microeconomics in this stage of development. The article of M. Porter and V. Millar (1985) traced the role of actionable information in new circumstances. It is a complementary idea with previously developed M. Porter's groundwork, the concept of the value chain (1980). Almost every single message from these sources resonates in Industry 4.0 that is taking place today. The behavior of business organizations in the new setting discovers the role of the reversibility principle (or feedback loop) as a key rule of the new paradigm.

The universal connectivity impacted almost endless stream of combinatorial innovations with greater efficiency and superior value proposition due to the greater managerial visibility of the component costs structure, and it deepened insights into the client needs (data analytics). Cognitive technologies have capacity to transform traditional business models based on relatively known demand pattern and functional hierarchy into a new decentralized model based on networking within a business platform.

Creative convergence of different technologies is just a necessary condition for competitive advancing. Without a prevailing driving idea for product/service development it just leads business actors to refocus from the embedded to cyber-physical (and/or biological) systems. However, when combinatorial technologies dominate the market arena, connectivity of factors of production (including information, of course), in fact, is going to be the real source of competitive advantage.

In Industry 4.0 in contrast to the view that technological change leads to ephemeralization of everything, from replacement of fossil fuel with renewables to replacement of fiat money with cryptocurrency as digital gold, the opposite is true. Combinatorial innovations have made the economy more virtual, but they also vastly increased the need for intelligent consumption of material objects and energy sources. Actually, combinatorial innovations exemplify complexification in design and construction and sophistication in production and energy supply respecting circular economy requirements.

Technological change should never stop improving opportunities for economic development. But, strategy, not technology, as a way of behavior and impact, makes improvements. Climate change will influence the climate of change. Better rules and industrial policies contribute to the possibility that some combinatorial innovations could arrest climate change.

Following the new economics rules, the Industry 4.0 will drive the industrial model toward greater reuse of material elements and energy sources. The previous also means favoring natural elements in construction and design that are most adaptable. Carbon, which can be as soft as graphite or as hard as diamond, may be the commodity of the future. With the reuse of carbon, various handicaps of CO2 emissions will be transformed into an advantage. Unfortunately, related changes are not only healthy, but also disruptive (Christensen 2013).

4. LIMITS OF GROWTH IN NEOLIBERAL GROWTH PATTERN

Despite intention, neoliberalism (or market fundamentalism) has been continuously creating hidden costs in the form of negative externalities and bubbles. Behind such structural imbalances are premises of the model being implemented.

Key elements of the neoliberal line of reasoning are as follows:

i. Economic agents are rational, selfish and with constant preferences
ii. Common welfare measured by GDP as the first derivative of egoism
iii. Market as efficient and a self-regulating mechanism
iv. Competition as an exclusive driving force of prosperity of the economic system
v. No rationale for the state involvement in the economy

The related growth model is linear as depicted in Figure 2. The neoliberal line of reasoning is based on implicit assumptions that the supply of free goods is practically infinite and that there is no need to regulate the negative external effects (Djuricin and Vuksanovic Herceg 2019b).

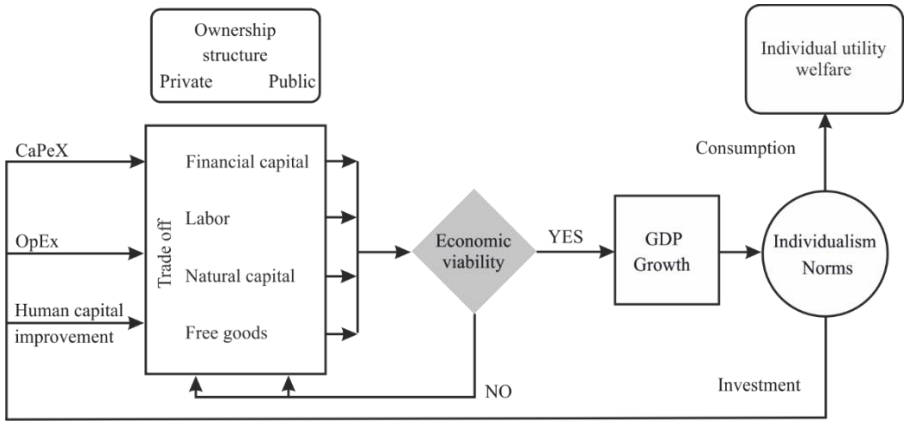

FIGURE 2. NEOLIBERAL MODEL OF GROWTH

Source: Partially modified in accordance with idea in (Constanza et al. 2016)

In the related economic policy platform there are "1+2" policy goals. The ultimate goal is inflation (low and stable). Additional (and related) goals are full employment

and sustainable growth. In such context, the main policy tool is inflation targeting, almost exclusively based on monetary policy measures. In neoliberal narrative, when the economy is fully liberalized, deregulated, and privatized, the price stability is going to be a prerequisite for the full employment and sustainable growth. The previous is followed by internal (fiscal) and external (current account and capital) balances. Also, in this line of reasoning, policy makers, by holding fiscal balance and external balances in check, actually leave to the market forces to do the rest in accordance with resource allocation, factors' pricing, and factors' incomes effects (Djuricin and Vuksanovic Herceg 2019b).

What was wrong with the previous set of premises? As for the first premise, it is self-evident that people are not fully rational, that their tastes are not consistent as well as that they are not completely selfish. Also, GDP is not a valid approximation of well-being. But more important fault line of the neoliberal narrative is the explicit assumption that the increase of market efficiency through deregulation, liberalization, and privatization automatically encourages the sustainability of growth. Unfortunately, in the real world, previous policies sometimes cause just the opposite effect. Namely, typical policy measures, at maximum, can enhance static efficiency and the short-term growth, paying no attention to frontier technologies, learning by learning, learning by doing, lifelong education, and thus to structural transformation as the indicator of dynamic efficiency.

Moreover, assumptions such as ex ante inferiority of state ownership, do not have steady confirmation in reality. There are many areas, even in developed economies, from network technologies and natural monopolies to education and research and innovation, in which the private sector is likely to fail to meet growth sustainability proposal. What neoliberals intend to do is to romanticize the role of private companies in fast-growing industries, ignoring their dependence on the fundamental inventions coming from the public sector in cutting-edge technologies. Examples of B. Gates from Microsoft and D. Musk from Tesla colorfully explain the previous point.

So, the impact of ignorance of negative external effects on industrialization has been reduced to unavoidable collateral damage. Under such premise, inclusivity gap toward the nature is going to be the grand divorce between economy and ecology. On the other hand, if we put into the growth equation objective finiteness of natural resources, we see that in the absence of any action based on negative feedbacks, including those from the market, the increase of output cannot be enough to reach sustainability proposal effects (Djuricin and Vuksanovic Herceg 2019b).

No doubt, climate crisis is a relevant economic factor. How to situate the climate issue into the economy? Following the view of J. Forrester (2003), the planet Earth could be explained as the system dynamics, namely a plurality of elements interconnected together by exchange relations (or flows). In extreme synthesis, the planet Earth includes three layers: the physical system, the biosphere, and the socio-economic system. In the physical system, the conservation law is a fundamental law of

functioning. Namely, there is negligible exchange of the material elements and energy. This layer is closed, but not isolated, which means that exchange is possible. The biosphere is something in between the socio-economic system and the physical system. In this case the adaptive evolution is the law of functioning. Dynamic equilibrium between previous two layers is a precondition for circulation of material elements and energy flows.

The socio-economic system is a man-made layer. It is a complex, integrated and dynamic system with the roots in the physical system and biosphere. Basically, it is a non-linear system. Any conceptual framework in economics should respect this premise. Viability of the socio-economic system is the indicator of satisfaction and cohesion. In orthodox economic framework, particularly in its neoliberal version of shareholder capitalism, the prevailing mechanism of coordination of confronting interests of different players is market mechanism. In such a system, price is a proxy for fair value.

Economics rules, primarily impacting taxes, cost of capital and competition, are changeable. They depend on distribution of power between economic actors. The more equitable the distribution, the greater the motivation for value creation.

The socio-economic system does not exist separately from the physical system and biosphere. The laws that govern the main processes in the physical system and biosphere are not negotiable. If the economic system's rules violate the biosphere and physical system, they violate the planet Earth as system dynamics. Also, any socio-economic system, as an intellectual intention for reaching universal values like sustainability and inclusivity, could not be a barrier for fair and equitable distribution of income and wealth.

After a long period of industrialization and particularly after long domination of market fundamentalism, there are many fractures inside the layers, as well as between the layers of the system dynamics. The reason for that is related to structural imbalances (or bubbles) in the economic system. The exponential economic growth is burdened with different sorts of bubbles, from income concentration to pollutant gas bubble. Unfortunately, fractures in the economic system have triggered the fractures of the other layers of the system dynamics threatening the planet Earth, as a whole. For example, fossil fuels have enabled remarkable economic growth. But pollutant gas emissions have strengthened the global warming.

In the context of finite material elements and energy resources, the ignorance of negative external effects could not respect sustainability and inclusivity proposals. Not respecting the laws of nature, linear model of production follows only short-term interests of the few (shareholders). When economic growth is uncontrollable, it incorporates material elements and energy resources into itself. Such a growth is regularly based on artificial obsolescence of products along with more consumption of material elements and energy. From the other side, ignorance of sustainability proposal

means less free goods, actually, less nature. The economy will be at an uncontrollable risk if situation with climate crisis worsens.

5. PARADIGM CHANGE IN MICROECONOMICS

Industry 4.0 has emerged at the level of business actors, actually in operations (or production) stage of the value chain, merging digital technologies with physical and cognitive technologies and, by doing this, shifting existing paradigm in new direction. Paradigm shift in microeconomics constitutes a reversal of the production logic based on artificial intelligence and robotics. Machinery no longer processes the product, but the innovative product (or embodied client's needs) communicates, *via* digital twin, with the machinery to tell it what to do.

Hard as it is to imagine today, much of the theoretical platform of microeconomics is based on the behavior of a representative company. Mainstream framework assumes that every player in a competitive game is, more or less, the same. In the age of dynamic and radical changes, concerns about behavior of any player in the competitive game in aggregate makes this wisdom too mechanistic and somewhat irrelevant. Moreover, framework improvement which rules out heterogeneity within an industry can offer a partial explanation, at best. Holistic approach in strategy formulation based on behavioral economics wisdom (Kahneman) is more suitable for the new circumstances.

In Industry 4.0, operations and products/services they create are not simply connected, driving physical objects into the digital realm. They are also related in accordance with transactional data which are classified, summarized, communicated, and analyzed continually across the value chain. In Industry 4.0, the way of functioning, as well as the competitive game, have changed and so have the rules. The reversibility principle (or feedback loop) is a key rule.

The concept of the Information Value Loop (Raynor and Cotteleer 2015) explains how the reversibility principle functions in transformation of transaction data into actionable information across the value chain. Or, how information creates the value by enabling the loop from physical back to digital, from digital back to physical, and from digital back to digital technologies. Each stage from the loop is enabled by specific ICT breakthroughs (sensors, network, artificial intelligence, big data, cloud, broadband, etc.).

The value of actionable information depends on its magnitude (scope, scale, scalability, and frequency), time (timeliness and latency), and risk exposure (security, reliability, and accuracy). The new paradigm incorporates physical-to-digital-to-physical loop (or PDP loop), particularly at the nexus of Act-Create sequences of the link that is specific to production stage (see Figure 3).

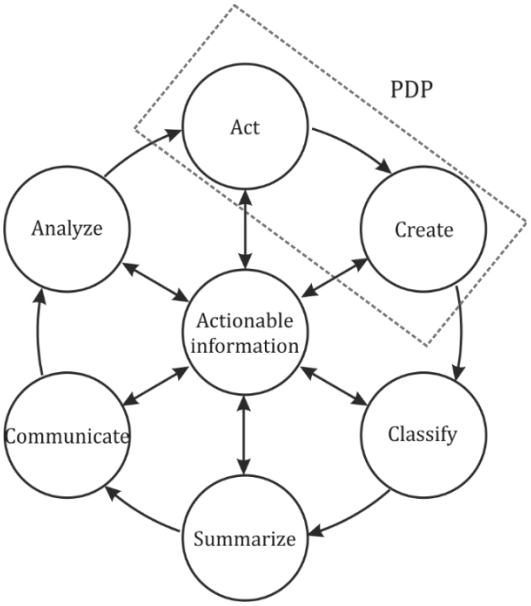

FIGURE 3. THE INFORMATION VALUE LOOP

Source: Partially modified in accordance with source (Raynor and Cotteleer 2015, 53)

The reversibility principle offers advantages, both from the supply and demand side. From the supply-side perspective, economies of scale and other size-related advantages are becoming a bigger advantage than ever before, allowing the huge investment in new technology platforms, artificial intelligence and cognitive technologies to take place. From the demand-side perspective, for personalized high value added products market niche becomes the norm. Universal connectivity enables that business strategy can integrate economy of scale along with differentiation *via* agglomeration effect.

The unstoppable forces of combinatorial innovations based on universal connectivity and reversible processes make structural changes in the economy, as a whole. Also, they are reshaping the world of human work, particularly redefining the relationship between people and robots toward augmented workforce.

Paradigm change in microeconomics is happening at the production stage of the value chain and spreading up across the value chain, business platform, industry, and economy as a whole simultaneously changing the paradigm change in macroeconomics. Vision and coordination are two key words.

6. PARADIGM CHANGE IN MACROECONOMICS

Proactivity along with coordination of technological development, as well as respect toward environmental sustainability, at both micro and macro level, are the ways to diminish the threat of regression when "the future is behind us". And, eventually, to transform threats inspired by disruptive innovations into opportunities when the "future doesn't exist"[4]. The previous imperative is based on the new set of economic rules with the transformative power:

i. Economic actors are not always rational, selfish, and with constant preference
ii. The market needs a corrective mechanism to deliver on its premise of efficient resource allocation and reasonable and sustainable balance between factors' prices and factors' incomes.
iii. The state should play a pivotal role as strategic, long-term and purpose-oriented investor. The so-called "pro-growth state" has a role to play in shaping industrial policies in coordination with core macroeconomics policies.
iv. Also, the state should provide macroeconomic stability and financial stability. A subtle balance between fiscal and monetary policy is needed to provide this role. To make the growth sustainable, expansionary policies should be carefully managed through automatic stabilizers.
v. Private ownership is not exclusive leverage of economic development. State-owned companies and public private partnership also have a role to play, particularly in industries with higher positive external effects (infrastructure, frontier technologies, environmental conservation, renewable energy, etc.), and where the benefits are too far stretched into the future, meaning not attractive for private investment.
vi. In the transformation process, social norms and mind-sets are important, but mind-setting is critical. Architects of the new system should know that the unregulated market is not sacred to the economic system. Humans are sacred to humans. Market forces do have propensity to deliver on inclusiveness, particularly when natural resources are put up for sale to the highest bidder and human beings are priced like other factors of production and easily replaced by robots. Sustainable growth and inclusivity both toward the people and nature are complementary tenets rather than substitutes. Both tenets are the principal contributors of stakeholder capitalism.

[4] After losing the position in the mobile telephone market, Nokia has developed the 5G network.

A changed world demands a changed management (both micro and macro). What macro management really needs is a shift from the linear model of production to a circular one. For example, in manufacturing, the circular economy includes eco-design, production reprocessing, eco-logistics, eco-consumption, repair-reuse, and recycling. Actually, the circular model provides decoupling of economic growth from negative external effects. The aim of decoupling is twofold: material and resource decoupling, as well as impact decoupling.

The circular economy is a closed system of interactions of information, resources, and cash (or fund) flows between economy and environment. Decoupling of economic growth from negative external effects depends primarily on growing material and energy resources productivity[5]. The corresponding model of growth enables proliferation of combinatorial innovations based on a deepened insight in well-being and with the intention to match entrepreneurial habit with carbon neutral proposal in new investments (see Figure 4).

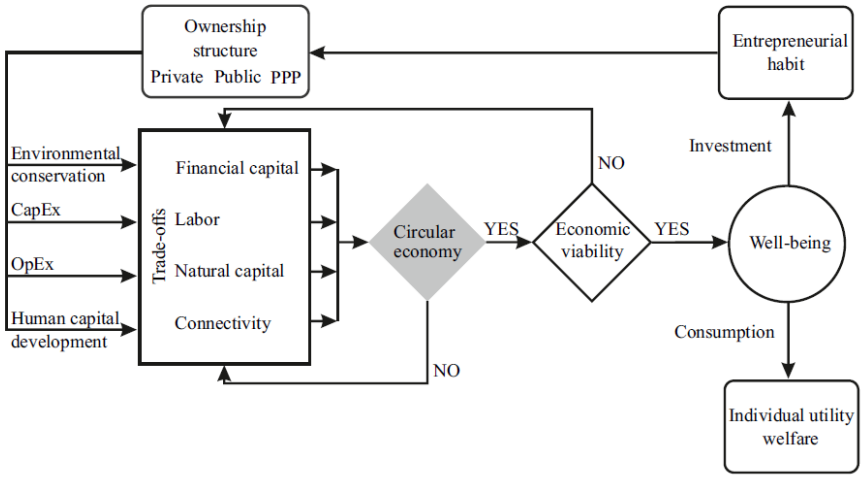

Figure 4. Circular Economy Model of Growth
Source: (Djuricin and Vuksanovic Herceg 2019, 104)

The Great Recession of 2008, in fact, made clear that macroeconomic policy must follow more than one policy target (Blanchard et al. 2010, 10). Sustainable and inclusive

[5] According to stylized EUROSTAT database for 2018, in the EU, the champion in material and energy resources productivity is the Netherlands producing value of 4.17 EUR per 1 kg of material and energy resources. In the EU-28, average resource productivity is 2.04 EUR per kg.

growth requires macroeconomic stability, but this does not mean just exclusive focus on inflation. The extended list of policy targets begins with the output gap (low and stable).

Besides the extended list of policy targets, the new policy platform is also characterized by making more policy instruments, from transformational policies, including industrial policies (both horizontal and vertical) to a hard macro policy regime nexus (monetary, fiscal, and competition). It is one of the reasons why this policy platform is called "heterodox". The great challenge is to learn how to coordinate these policy instruments. The combination of conventional core policy instruments and design of automatic stabilizers as new policy instruments are two promising paths.

The industrial policies are at the center of the heterodox economic policy platform. There are three types of industrial policies: vertical, horizontal, and environmental. Vertical (or sector-based) industrial policies refer to the tradable sector (export and/or anti-import industries). The tradable sector consists of industries with the dynamic advantage (comparative, competitive, and sustainable competitive). Horizontal (or sector neutral) industrial policies relate to big science, research and innovation, education, infrastructure development, start-ups and scaling-up, etc. Environmental policies refer to the circular economy proposals and carbon neutral investments. The second set of policies represents hard macroeconomic policy regime. By simplifying the scheme to the extreme, this policy platform refers to the use of automatic stabilizers for the core macro policies (monetary and fiscal). The third set of policies provides the platform for infrastructure development, both physical and conceptual. All policies in interaction can help to define priority sectors as a base for main strategic initiatives.

If automatic stabilizers are to play an important role in the future economic policy platform, a central issue is going to be the match between policy targets and policy instruments. For example, tax exemption for research and innovation costs in the tradable sectors and renewables plays the role of a fiscal automatic stabilizer supporting carbon neutral development priority. Also, ecologically motivated taxes and fees can give an effective incentive to take into account external effects, both positive and negative, connected with energy sources. The mix of the energy taxes and fees is a subtle problem (energy taxes have positive while environmental taxes have negative impact on renewable energy expansion). The mix of taxes and fees could encourage significant investment in the renewable energy solutions and could incentivize divestment in fossil fuels. Or, financial incentives (for example, green bonds) encourage renewable investments. In monetary sphere, a neutral interest rate and competitive FX rate play the role of automatic stabilizers encouraging investments in the circular economy.

7. TOWARD THE HETERODOX APPROACH

Besides the waning of confidence in economic neoliberalism and growing consciousness about its terrifying consequences[6], the situation regarding double paradigm change is ambivalent. From one side, there is a blind spot of denial of neoliberal fault lines. From the other side, the new conceptual platform with solid theoretical backing (Rodrik 2004, Stiglitz et al. 2013, Mazzucato et al. 2015, and Stiglitz 2018) has already been developed.

An alternative framework to market fundamentalism is backed by inspiring experience in economic development from some Asian economies during confrontation with "middle-income trap" in the 1960s. These alternatives are "managed capitalism" and "pro-growth state". Two development pillars of this wisdom were marketization and export-based industrialization based on imported technologies. This strategy was unsustainable because technology transfer was a primary cause of growing indebtedness and "middle-income trap". The new policy platform was based on two institutional choices: the "invisible hand of the market" and "visible hand" of the state. In our previous work we have already expressed the interest for implementation of an alternative approach in peripheral economies with delay in economic development (Djuricin and Vuksanovic 2014). We strongly believe that, along with the growth acceleration and catching up, this approach is able to cause annulment of structural imbalances from the past, particularly a pollutant gas bubble.

Indeed, the viability of any economic system depends on its ability to respond positively to fundamental rules and constructively to the negative forces of the change. In the socio-economic system, the greatest of all challenges are not those posed by outside forces, but those which arise from inside premises that can't be lasting.

Similarity of economics as liner system and natural sciences has no foundation. Economics is about the rules people create, not about the laws of a purely quantitative science. So, economic reality is not governed by models with mathematical precision, particularly when that can be simplified in econometric modeling by *ceteris paribus* premise. Economic reality depends as much or more on subjective, sometimes irrational, and inconsistent choices. The purpose of economic theory is to formulate rules that are founded on universal values which represent prosperity as the human destiny. One of the fundamental values of humankind is balance with the nature. If an economic system violates the nature, everything will be violated.

For economic development, short-term output growth is not an end in itself. Individual well-being (or utility welfare) is not just income, it is a multidimensional phenomenon. Besides consumption, the growth delivers the funds needed to reach social tenets like education, employment, reskilling, health care, science, technological development, etc. Sustainable growth is the aim for improvement in all dimensions of the well-being. When a model of growth is not adequate, the output growth may come

[6] Recently, the Declaration of World Scientists' Warning of a Climate Emergency was signed by 11,258 scientists from 153 countries.

at the expense of some dimensions of well-being, particularly environmental degradation.

Macro management based on inflation targeting is not fully reliable. In this line of reasoning, natural (or planetary) capital, as well as human capital are not included. Policy makers can't navigate non-linear economic system with a simple tool like inflation targeting, particularly when it is based almost exclusively on monetary measures ("we can't manage what we do not measure").

Under the impact of combinatorial innovations as a hallmark of Industry 4.0, the production engineering which has been traditionally viewed as relatively linear and well managed, is reaching the level of dynamism and complexity typical for non-linear systems like the economic system. Managing non-linear systems requires binding physical objects with digital realm. In conversion of transactional data into actionable information, the reversibility principle plays a critical role.

Implementation of the reversibility principle and feedback loop in macroeconomics, in fact, means broadening the concept of macroeconomics (and macro management) with pro-growth industrial policies which respect environmental sustainability, as well as implementation of new industrial policies with the aim to encourage innovative activities of economic actors. The "pro-growth state" as a platform based on industrial policy centric model of growth provides a better balance between the market, the state, and the nature. The new concept is resilient and respects national economies specifics. According to (Alkire et al. 2016, 2), there are context-specific policies based on heterodox policy principles.

In the spotlight of the new approach are reindustrialization based on carbon neutral technologies and export, as well. Annulment of anthropogenic pollutant gas emissions could help develop non-linear disruptive technologies enabling transition of linear manufacturing models toward circular economy. Annulment of the causes of global warming is crucial not only regarding new industrialization, but also with respect to the related investment multiplier effect. One job in carbon-free eco-friendly manufacturing technologies creates more than one job across the economy, as a whole. Indeed, export based on this production provides enough foreign exchange necessary for sustainability of macro balances.

8. CONCLUSION

When a man-made socio-economic system grows with frequent speculative bubbles episodes, the winner-takes-all drawback, explosion of inequality (income, wealth, access to opportunities, right to work, etc.), stagnation trap, environmental degradation and climate crisis, it means that something is fundamentally wrong with its premises.

If we do not focus on the problems, but on the system which creates problems, we are on the track to find solutions. The world we are living in is system dynamics, or an interactive system composed of disparate, non-linearly interacting elements. It is a complex and dynamic system. In such a system which is hard to understand, predict and manage, a context-free proposition (position of an economic actor relates to the way of behavior) is prevailing, instead of contingency proposition according to context matters (anything goes, everything's relative).

As we have implicitly said many times, the subject of this chapter is related to the systemic nature of the nexus of relationships that bind people, *via* an economic system, with the physical system and biosphere in a sustainable and inclusive way. This context that we called the New Normal reflects seismic changes in the economy. The new context is ambivalent, holds out both promises and perils. Whatever skeptics of a double paradigm change in microeconomics and macroeconomics may say, today's work of economists is getting done in networks of stakeholders with growing consciousness about limits of growth. Also, they are familiar with new constructs like industrial policies and automatic stabilizers. Consequently, this chapter reveals how the new macroeconomics paradigm is pushing toward development of the empowered networks of technological platforms and government institutions inspired by human capital development and preservation of nature, and how a corresponding double paradigm change keeps up with the accelerating pace of change.

The simultaneous waning of confidence in neoliberalism and climate crisis alert is no coincidence. The shareholder version of capitalism can be changed by a more progressive alternative without change of the three fundamental pillars of capitalism, market, private ownership and democracy. The economic system that emphasizes sustainable and inclusive growth should pay attention to compatibility, instead of balance, to collective interest instead of individuality. If the emerging system intends to be sustainable and inclusive, it must be based on the reversibility principle (or circular processes) and industrial instead of reactive policies. There are problems that cannot be left to the market mechanism to solve.

Stakeholder capitalism as a context, the circular economy as a vision of the growth model, and related heterodox economic policy platform are able to translate technological breakthroughs into progress in well-being and shared prosperity. While recognizing the limits of market mechanism the state by itself needs to operate intelligently and efficiently. Some sort of a new Renaissance, maybe new Enlightenment, in social norms and mind-set is needed if we expect that key institutional choices work together in complementary ways and with impact. The political class which in the previous period sanctioned and preserved extreme disequilibrium in power by making the distance from intellectual elite advice, has to play a new role. When politicians speak, everyone listens. When politicians listen, everyone benefits.

In the nature reversibility is a fundamental law of functioning. In the socio-economic system reversibility exists from both micro and macro perspectives, between stages in the value chain, as well as between policy targets and automatic stabilizers in macroeconomic policy regime. They should be exploited in a systemic and constructive way. It is an approach towards a new consensus on the economic rules, maybe.

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