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Are countries ready for the new meso revolution? Testing the waters for new industrial change in Korea

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ABSTRACT

Capitalism needs momentum and market for growth. Even without subscribing to a specific academic school, capitalism has felt the need for theories or mechanisms to overcome crises in the past. This research tries to shed light on the recent momentum of industry 4.0 with an expanded scope that includes this wave in a series of *meso* revolutions brought about by the spread of capitalism. After reviewing a lineage of theories that could shape meso revolutions in economic history, this research used Bank of Korea's data, including total capital efficiency and machinery investment efficiency, to check the recent status of the private sector of Korea. An institutional review of the preliminary budget analysis adopted in Korea was then conducted to draw some implications for the country's preparedness toward the so-called industry 4.0 with potential implications for other countries.

1. Introduction

Are we ready for the 4th industrial revolution? This term has been drawing attention in many societies, yet there remains a critical question whether we are really preparing for this wave (Schwab, 2016). This research tries to approach the issue from a somewhat different perspective in comparison to the conventional discussion being carried out in different circles. While many of the detailed dialogues on the 4th industrial revolution seemed to have succeeded in drawing public attention (Berger, 2014; Kelly, 2017; Schwab, 2016),[1] one needs to look back where to start so as to be better prepared for it. In this vein, this research tried to empirically review, citing the case of Korean economy, whether the current economic situation is sufficiently tuned for the arrival of the 4th industrial revolution. Accordingly, this research will first review theoretical arguments leading to the current stage to show that the 4th revolution could be a recurring phenomenon. The research will then empirically analyze the preparation on the part of the private and public sector in Korea in order to glean implications for other countries in similar contexts.

2. Literature review

2.1. Precedents for industry 4.0 and other meso revolutions

Of late, major economic journals and academic papers have been covering Industry 4.0 and related issues. The concept also features as a theme at major conferences. This shows that there is always a strong demand for such an idea that would draw people's attention, provided it is something that would help boost the economy (Brynjolfsson, 2016; Ross, 2017). This sets the momentum for an analytical diagnosis of this new term, considering not many debates and discussions have been held on its core elements (Berger, 2014; Duperrin, 2016).

2.1.1. Meso industrial revolution or a genuine revolution?

Since the first industrial revolution in which steam engines and large-scale manufacturing facilities replaced the traditional alternatives in major leading industrial countries back in the 18th century, history has seen continuous trends of industrial changes (Galbraith, 1987; Keynes, 1936; Koch, 2017; Robinson, 1962; Schumpeter, 1942). Furthermore, there have been theories arguing that the so-called mass production system did not have any technological merits vis-à-vis the old systems (Diebold, 1985; Piore & Sabel, 1984). This strong argument offers a prospect to indicate that any new industrial revolution would be merely a new *meso* revolution.

Capitalism has been described as an entity that thrives on ever-perpetuating new markets, (Galbraith, 1987; Keynes, 1936; Kurtulus, 2015; Polanyi, 1944). Even without referring to a specific school of thought, capitalism has required theories or mechanisms to come out of crises in the past (Kim, 2010; Minsky, 1986). After revolutionizing industries, it is now a matter of market size in deciding how many and

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[1] Public discussions on the 4th industrial revolution include the following forums.
https://www.weforum.org/focus/the-fourth-industrial-revolution
https://www.brookings.edu/blog/brown-center-chalkboard/2017/04/11/surfing-the-4th-industrial-revolution-artificial-intelligence-and-the-liberal-arts/

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much to produce (Hill, 2007; Kim, 2010; Minsky, 1986; Vernon, 1979). Scholars of the 'regulation school' have presented the similar view (Boyer, 1987; Boyer, 2000; Boyer, 2013; Lyu, 2016). Whether one subscribes to the modern management theories or the regulation school, it is evident that capitalism needs markets, because they are the only constraints in its expansion and continuance (Minsky & Whalen, 1996; Palley, 2012).

The pivotal issue here is where the momentum would come from for the ever-perpetuation. To be straightforward, there could be three strong candidates: technology, government, and market (Piketty, 2014). The government has been a powerful resolver not only in the real world but also in the theoretical arena (Friedman, 1962; Wade, 2003). Right from Keynes, regulation school, and other theorists in economics to economic historians and sociologists such as Polanyi, the government has been a moderator in maintaining the market (Minsky, 1986). Even in a more recent literature on economics, one can still find the role played by governments (North, 1990; Rosenberg, 1994).

Another candidate in resolving the market perpetuation has been 'technology'(Alchian, 1963; Nelson, 1981). Technology is a powerful and captivating concept, which can help explain the effect of change and growth (Antonelli, 1995; Nelson, 1996). Yet, there have been critical constraints with regard to this concept. In the mainstream economics, factors of production are expressed as either K or L, and it has not been easy to adjust technology into this frame. The consequence has been a series of mathematical advancements in the discipline to cope with the developments in capitalism (Baumol et al., 1994). In the real world, technology has aided business leaders as well as populaces to "explain" everything they virtually wanted to. Compared to both government and technology, relying just on markets has had insufficient appeal to the academic circles as well as business and government audiences (Rosenberg, 1994; Wade, 2003).

2.1.2. Preceding trends prior to industry 4.0

Succeeding the theories introduced in the previous section, theoretical trends that have been meaningful in understanding the advent of the industry 4.0 and other *meso* industrial revolutions originated from two streams: a series of natural developments in capitalism [6,15 (Galbraith, 1987; North, 1990; Rosenberg, 1994)], and more artificial efforts to sustain economic development. Of course, the first stream also includes institutional aspects, and one can still argue that it is not natural at all. However, as this section will review later, the first stream has waded through its development for a long and sustained period of time compared to the second one.

The first type of stream that has brought the preceding trends has a historical origin, especially the European setting. Researchers called this the "flexible specialization" (Piore & Sabel 1984), which offered powerful insights against the stronghold of mass production. A strong argument in this theory came not from its appeal as the alternative to mass production but its appeal wherein mass production became the industrial norm based on political reasons (Piore & Sabel, 1984). As one looks through industrial history since the 1980s when the flexible specialization theory surfaced, the mass production system began its efforts to survive in the market by becoming more flexible. The just-in-time production (JIT) can be a well-fitting example found in a different context (Womack et al., 1990). With regard to policy makers, the flexibility allowed them to focus on "industrial districts" where the flexible technology and institutional settings were prepared (Harris, 1997). As a growth engine, industrial district ideas too consequently drew attention, and could be regarded a meso-revolution from the mainstream mass production world and from different national and regional governments.

The second stream featured a more artificial nature. Since the 1960s, advanced economies began realizing the efficacy of science and technology in economic development and, at the same time, they realized that the causal link from research & development to actual economic growth has become more complex than it was decades before. In some ways, this argument could be understood as the weakening of the so-called linear model of science and technological development (Stine, 2009). Policy ideas that have sprung out of this line of thinking have led to the development of policies including science parks and techno parks in different countries. The most conspicuous relevant examples include the Sophia Antipolis in France, Tsukuba Science City in Japan, Cambridge Science Park in the UK, and Daeduk Complex in Korea (Kim & Woo, 2007).

All these policy efforts from the two different streams can be regarded as the previous trends of *meso* industrial and technology revolutions with which each nation or region attempted to boost science- and technology-based economic growth or, in a broader term, capitalism. These trends, in some sense, have worked as the "newness" to capitalism's ever perpetuating growth engine.

2.1.3. Key characteristics of the meso industrial revolution including industry 4.0

Having discussed the trends toward industry 4.0 as a meso industrial revolution, it is now reasonable enough to sum up several characteristics of the actual trend called industry 4.0. First, compared to the so-called first industrial divide or revolution, the industry 4.0 is much smaller in scale (Audretsch, 1997). The old industrial revolution featured several critically important features, which the recent *meso* industrial revolutions, including the industry 4.0, did not entail. History has seen the commodification of labor (Polanyi, 1944) and the advent of the capital market. More popular features included the change in energy sources from the previous stages of industrial production. Also important was the advent of the national market, which was set up by the government (Polanyi, 1944). The industry 4.0 argument does not feature these multi-façade natures of the "old" industrial divide.

Second, the industry 4.0 and other *meso* industrial revolutions are, in nature, parts of the ever-perpetuating mechanism of capitalism. Capitalism needs markets that are ever-growing and ever-changing (Reinhart & Rogoff, 2009). This agenda has been reinforced as a fate, since mass production-based production system had this as a precondition. This is why, with some irregular or regular cycles, history has observed the advent of different *meso* industrial revolutions.

Third, the trend and change that meso revolutions suggest have never predicted a complete watershed using the technology they have individually promoted. In fact, even the "original" Adam Smith-inspired mass production systems have never replaced manufacturing factories in a way to watershed everything (Brynjolfsson, 2016; Diebold, 1985; Piore & Sabel, 1984). Instead, one has observed a historical trend of "dual economy," in which traditional old sectors co-exist with the newer sectors that were introduced by the industrial revolutions.

Fourth, the direction that industry 4.0 has suggested features an amalgam of information technology with traditional sectors (Piore, 1980). As an observer of theories, one can find that this prescription would bring several merits. One such merit would be an easier acceptance by existing industries. The second merit would be potential for faster cost recovery, while the third and the most important one would be its appeal to maintain the existing orders of capitalism. In so far as these conditions are in existence, industry 4.0 can draw greater audience, revealing itself as one of the *meso* industrial revolutions.

2.1.4. Why meso revolutions are needed in capitalism

Ever since capitalism has become an engine for growth, it has needed markets at different stages. During the first period, there were new markets in geographical contexts. Sailing to other continents opened new markets. Since the 20th century on, technology markets have been the locomotive for growth, followed by the third new market source that came from financial contexts. Of course, the second and third sources of technology and financial markets continue to work. A newly observable phenomenon is a complex amalgam of the technology and financial market dynamics, which tends to be expressed as a new *meso* industrial revolution. Industry 4.0 is a typical case in this line of