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Bengt-Åke Lundvall

DEPARTMENT OF ECONOMIC HISTORY, LUND UNIVERSITY

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# Development strategies in a context of world system disorder

*Bengt-Åke Lundvall*

Professor Emeritus

Aalborg Business School, Aalborg University

Department of Economic History, Lund University

E-mail: bal@business.aau.dk

"I'm a pessimist because of intelligence, but an optimist because of will."

Antonio Gramsci in a Letter from Prison (December 1929)

## Abstract

The world has been through several major crises since the beginning of the new millennium and the old-world order, with the US as hegemonic power, is challenged by the rise of China. There has been a reversal of, as well as directional change in, the globalization trend. A weakening of international collaboration is taking place against a backdrop of global challenges such as climate change, digital revolution and global inequality, challenges calling for coordinated action. Starting from a knowledge-based world system perspective, the paper reflects on, what this means for innovation and development strategies in the South. Which are the main threats and opportunities in the current era? Which lessons can be drawn from the rise of China? What are the implications for research agendas?

**Keywords:** world system theory; development theory; Wallerstein; Freeman; knowledge; innovation systems

**JEL codes:** O19; O30; B52

## 1. Introduction

The world has been through several major crises since the beginning of the new millennium such as the financial crisis 2009 and the Covid crisis 2019, and currently it faces, a risk of military conflict between great powers. The old-world order, with the US as hegemonic power, is challenged by the rise of China and there has been a reversal of, as well as directional change in, the globalization trend. A weakening of international collaboration is taking place against a backdrop of global challenges such as climate change and global inequality, challenges calling for coordinated action and transnational governance. This paper reflects on, and invites to a broader discussion of, what this means for innovation and development strategies in the South. What are the main threats and opportunities in the current era? Which lessons can be drawn from the rise of China? What are the implications for research agendas?

This paper starts from the same assumptions as Lundvall (1992), where it was stated that we live in an era where knowledge has become the most important resource and learning the most important process. And it operates with the same broad definition of knowledge and learning as used in Lundvall and Johnson (1993) – knowledge is defined as including both explicit and tacit elements and learning as including searching/exploration as well as learning by doing, using, and interacting.<sup>1</sup> But, while Lundvall (1992) was focused on national systems of innovation in the North, this paper applies this perspective, first, to the world level and, second, to the challenges for countries in the South.

## 2. Combining Wallerstein's world system perspective with Freeman's development theory

The paper combines Wallerstein's world system perspective (Wallerstein 1979; Wallerstein 2003) with Freeman's theory of world economic development (Freeman 1982/2004; Freeman 1987; Freeman 1995/2004; Freeman 2004; Freeman 2008). Wallerstein's perspective has much in common with Christopher Freeman's. Both refer to long cycles of the Kondratieff-type and both

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<sup>1</sup> The focus on knowledge is grounded both in history and theory. First, attempts to measure intellectual and intangible capital as share of total capital indicate its growing importance and studies show that it is fundamental for growth and development (OECD 2008, WIPO 2017, Unctad 2019). Second, as resource, knowledge has unique characteristics. It can be shared without losing value and its value grows by use. It is not a scarce resource – it requires specific state interventions to transform it into private commodity. In a world characterized by absolute and irreversible scarcity (a world threatened by climate change, exhaustion of natural resources and accelerating extinction of species) this unique trait is of principle importance.

propose that social science/economics should be integrated with history. One major difference is that, while Wallerstein emphasizes the dependency of countries in the periphery, Freeman's analysis is focused on changes in the world pecking order and on how knowledge-based strategies make it possible for developing countries to rise. While the world system perspective defines the shackles blocking development, Freeman's analysis gives inspiration for developing countries attempting to throw off the shackles.

I see the two perspectives as complementary. The world system perspective demonstrates, how systemic relationships make it difficult for poor countries to industrialize and create jobs and well-being. Freeman's approach demonstrates that the world capitalist system is not frozen once and for all – history never ends! With a clear understanding of the dependency, developmental states can design and implement strategies that break up the dependencies and exploit opportunities.<sup>2</sup>

In modern times, the single most important example of a rise of a periphery country is China, now seen by the US government as challenging its hegemony (Rikap and Lundvall, 2021; Lundvall and Rikap 2022). China's move from the periphery to the semi-periphery has wide implications for the constitution of the world system and at the same time it offers important insights in the potentials and limitations of knowledge-based development strategies in the current era.

Wallerstein's specific interpretation of the capitalist world system is outdated in important respects – not least the idea that industrial activities are concentrated in the core countries while periphery countries are specialized in natural resources. Nonetheless, I find it useful to apply the world system perspective and to redefine it as constituted by national innovation systems in a context of learning economies and knowledge-based development. New applications of the world system perspective, where the focus is on ecological unequal exchange gives another reason for analyzing the world as a system constituted by nation states with different positions in the international division of labor (See Box 1 below). Finally, as argued in Lundvall (2022), transformative innovation policy addressing global challenges needs to go beyond the transformation of national innovation systems and aim at transforming the global innovation system.

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<sup>2</sup> The global value chain perspective gives an illustration of the dialectics between dependency and development. While there, under specific circumstances, is room for learning and upgrading for enterprises participating in global value chains, at a certain stage in the development process there is a need to 'break the chains' to avoid the poverty and the middle-income traps (Lee, Szapiro, and Zhuqing 2017).

### 3. The reversal of the globalization trend and the growing role of techno-nationalism

From the very beginning the conceptualization of national innovation systems, as developed by Freeman (1987), Lundvall (1992) and Nelson (1993) was challenged by alternative understandings raising doubts about the primacy of the national level (Niosi and Bellon 1994; Carlsson and Stankiewicz 1991). Is it meaningful to focus on national systems in a world with transnational enterprises and institutions? How to modify the concept so that it reflects that innovation processes involve interactions at the transnational level, some of them within multinational enterprises, others in transnational networks (Chaminade, Lundvall and Haneef, 2017, pp. 122-138)?<sup>3</sup>

These analytic discussions have counterparts in policy debates on development strategies. Liberal experts and international organizations propagating pro-market strategies presented the linking of domestic firms into global value chains as an alternative and more realistic strategy than one, where the state engages in building stronger national innovation system (Baldwin, 2013; World Bank 2020). This is in line with neoliberal ideas and the World Bank-view that ‘the private sector agents should be in the driving seat’.

In 2015, Globelics organized a seminar in Copenhagen that brought together scholars working on global value chain analysis with scholars working on national innovation systems (see <https://www.eurolics.org/activities/eurolics-workshops/activity-1/>). One outcome was a special issue of *European Journal of Development* (see Lema, Rabelotti, and Gehl Sampath, 2018). There was no simple conclusion in relation to the policy issues in the contributions. But together they indicated that the two perspectives could and should be combined – to benefit from participation in global value chains requires strengthening of the national knowledge infrastructure. Joining global value chains should *not* be seen as an alternative to building a stronger national innovation system. Strategic management of the interface between local/nation and international/global interface should be at the core of development strategies (Lee, forthcoming).

But already at that time, the trend toward a globalized capitalism had been both broken and modified. There was a slow-down in value chain trade in tangible products while international trade in services and especially in digital services accelerated (Unctad 2019). There were different factors at play behind the reversal. The 2008 financial crisis triggered a weakening of the element of global

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<sup>3</sup> A similar discussion can be found among scholars ascribing to the world system view. While Wallerstein regarded ‘globalization’ as nothing new, Robinson (2011) and others adhering to the world system perspective argued that it represented a new stage characterized by transnational corporations and institutions, with a weakening of nation states.



value chain trade. This reflected a shift in China's economic strategy enhancing the role of domestic demand relative to exports which reduced its dependence on global value chains – the share of value content of imports in its exports started to fall as early as 2010. (Garcia Herrero 2020). The 2019 Covid-crisis resulted in a further disruption of supply chains (Hayakawa and Mukunoki 2021) and gave rise to policies aiming at increased self-sufficiency. At the same time, US-based tech giants expanded world-wide and as a result trade in digital services, spanning from e-commerce and use of search machines to social media, exploded (Rikap and Lundvall 2022).

The factor with the most lasting impact may nonetheless be geo-political. The economic rise of China and the challenging of US-leadership in strategic technologies has led to a 'technology war' with boycotts and embargos leading to further disruption of supply chains (Rikap and Lundvall 2021). While the first initiatives in 2018 by the Trump-administration defined the US-problem as one of bilateral trade deficit, and took the form of trade quotas, there is now a clear focus on limiting China's access to technology and China's access to markets for high technology products (Ciuriak 2019). Recently, the war in Ukraine and the unwillingness of China to join the West in isolating Russia have sharpened the conflict and we see the contours of a new world order where the US with allies confront China and its allies, while the protagonists in the two camps make efforts to strengthen their position through recruiting new allies in the rest of the world.

The weakening of trade in commodities went hand in hand with a move toward techno-nationalism in the US.<sup>4</sup> While the US-administration has been among the most active in the world subsidizing science and technology (mainly through public programs related to the military and the health sector), the official doctrine has been neoliberal, anti-state and pro-market. This can be illustrated by the terminology used in the US, where the 'innovation eco-system' took the place of national innovation system (Jackson 2011). While the concept national innovation systems indicated an active role for the state, eco-systems are vague in this respect and the term indicates that the innovation system is the outcome of a 'natural' evolution. Over the last decade the illusion of the

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<sup>4</sup> Techno-nationalism is an ancient phenomenon and refers to attempts to protect technologies (silk worms) of economic importance as well as weapon technologies (iron cannons). The concept techno-nationalism became more widely used in connection with the Japan-US trade conflict and Europe's Airbus attempt to break the Boeing monopoly (Ostry and Nelson 1995). More recently it has been used to refer to China's technology policy and its strategy for independent innovation (Suttmeier and Yao 2004). Following Friedrich List's interpretation of international competition as based primarily on 'geistliches Kapital', any successful attempt to catch-up would involve element of techno-nationalism including protection of infant industries. What is new in recent developments is that the US as world economic leader explicitly engages in techno-nationalist initiatives across a wide spectrum of technologies.

passive state has evaporated and now there are no ideological constraints for what the US-administration is ready to do to make sure that the US stays abreast of China in strategic technologies.

This change is reflected in a change in the world economic order, where US has moved from policing a rule-based world economy to systematically breaking the rules that it formerly imposed on others. The US aggressive industrial and trade policy, as reflected in the US Inflation Reduction Act, a USD 391 billion package of subsidies and tax credits, is officially aimed at driving the country's transition to clean energy but the main purpose is to respond to the rise of China. The shift in the US approach from a rule-based international order toward techno-nationalism is illustrated by the fact that in 2010 the US raised issues in WTO with China's more modest support to Wind Power (<https://www.reuters.com/article/us-usa-china-windpower-idUSTRE6BL3EU20101222>).

#### 4. Wallerstein and the world system perspective

Current debates on global value chains have focused on, how participation might help development countries climb the ladder and secure a bigger share of value through upgrading. Earlier work by Prebisch (1950) and Marxist scholars saw them primarily as creating a dependency and structural relationships by which the rich countries exploited the poor countries.<sup>5</sup> They were thus seen as playing a key role in 'unequal exchange', where the rich countries harvest surplus value from international trade with countries in the South. They are important elements in Wallerstein's world system theory.

The world system perspective, as developed by Immanuel Wallerstein, categorizes national systems as belonging to either the core, the periphery, or the semi-periphery. According to Wallerstein, they have different roles to play in the international division of labor and they are characterized by different forms of work organization. The core countries are specialized in manufacturing and produce high value products for the world market, and they are characterized by wage labor. The periphery countries are specialized in low value products and especially in raw materials based on natural resources. Historically, the periphery was dominated by slave labor while serfdom and tenancy were common in the semi-periphery. According to Wallerstein, the capitalist

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<sup>5</sup> The early work of Gary Gereffi, one of the key contributors to the modern literature on global value chains, pioneered his work by a critical study in the dependency school tradition showing how multinational firms allied themselves with capitalists in Mexico to overtake its promising attempts to establish exports of steroid hormones (Gereffi, 1978).

world system began to take form around the 15<sup>th</sup> century through colonization and it led to the integration of all countries in world-wide markets.

According to Wallerstein, the capitalist world system is poly-centric kept together primarily by economic interdependence. Historically, it followed upon a world order characterized by empires such as the Roman empire, which were ruled primarily by military force with one single center. There is nonetheless a hierarchy among the core countries in the capitalist world system and shifting nation states have taken on the role of hegemon. The Portugal, Netherlands, England and, most recently, the United States have in different historical epochs been hegemonic powers. Hegemony requires economic and military strength as well as cultural dominance.

Late in his career, Wallerstein (2003) foresaw the demise of the US as the hegemon of the core. He recognized that it had by far the strongest military power in the world but saw a weakening of its economic power and its ideological dominance. The US debacle in Vietnam illustrated the limits of how far military dominance can be used to rule the rest of the world. Wallerstein refers to Japan as a rising economic power not mentioning China in this context.<sup>6</sup>

According to Wallerstein, one important mechanism reproducing the hierarchy in the world system and the distinction between core and periphery is unequal exchange. The exchange of commodities and services involves a premium to producers from the core countries while resource-based commodities are sold below their value. Recent attempts to estimate the aggregate transfer of value taking place at the world level end up with astronomical figures (Hickel et al, 2022).<sup>7</sup>

Our results show that in 2015 the North net appropriated from the South 12 billion tons of embodied raw material equivalents, 822 million hectares of embodied land, 21 exajoules of embodied energy, and 188 million person-years of embodied labour, worth \$10.8 trillion in Northern prices – enough to end extreme poverty 70 times over. Over the whole period, drain from the South totalled \$242 trillion (constant 2010 USD). This drain represents a significant windfall for the global North, equivalent to a quarter of Northern GDP. For comparison, we also report drain in global average prices. Using this method, we find that the South's losses due to unequal exchange outstrip their total aid receipts over the period by a factor of 30. Our analysis

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<sup>6</sup> One of the few who recognized early on the possibility that China might become a challenge for the US-hegemony was Arrighi and Silver (see Arrighi and Silver, 2001; Arrighi, Silver, and Brewer, 2003). Arrighi and Silver saw China as a market economy but not as capitalist.

<sup>7</sup> This is one example of a growing literature that apply the concept unequal exchange to the ecological dimension. See for instance Andersson (2006).

confirms that unequal exchange is a significant driver of global inequality, uneven development, and ecological breakdown.

The authors have little to say about the mechanisms that lie behind this gigantic value transfer, but they do refer to the role of global value chains, where lead firms in the North through their control of technology and market access seize most of the value created in the chain leaving little to enterprises and workers in the periphery.

Box 1:

Ecological unequal exchange

The quote from Hickel et al (2022) illustrates a new wave in the world system literature where the focus is on ecological unequal exchange (Hornborg 1998; Andersen 2006; Rice 2007. Jorgensen 2016). According to Jorgensen (2016), ecological unequal exchange refers to the environmentally damaging withdrawal of energy and other natural resource assets from and the externalization of environmentally damaging production and disposal activities within less-developed countries.

A new world order aiming at sustainable and equitable development should address both the value dimension and the ecological dimension of unequal exchange. Countries in the periphery should join forces to get better deals when they give core and semi-periphery countries access to their natural and human resources. In this paper we argue that deals that involve transfer of knowledge and technologies may have the most lasting effect in terms of development.

It is obvious that the world economy has gone through different important transformations since Wallerstein presented his world system analysis. The spread of manufacturing to the South has changed the patterns of the global division of labor. But according to the analysis of Basu and Vasudevan (2021), even within this new pattern, simultaneous productivity growth in the core and in the South may have a negative impact on employment and wages in the South.

This reflects the growing role of intangible capital and especially of intellectual capital. Market control and intellectual capital absorb a growing proportion of value. These activities are concentrated in the core countries, and it remains difficult for enterprises in the periphery to enter such activities. It is no longer enough for peripheral countries to industrialize; they need to establish market control through branding as well as build technological strongholds.

In the current era, unequal exchange reflects, more than anything else, uneven access to knowledge (explicit as well as tacit, embodied as well as disembodied, individual as well as collective) and therefore the strength and weakness of the national innovation systems (knowledge infrastructure, education system) constitute a decisive factor explaining unequal exchange. Global value chain (GVC) analysis studies what takes place at the enterprise level and considers, how lead firm may use monopoly power – both market control and control of technologies. To explain unequal exchange and transfer of surplus value, the GVC-perspective needs to be complemented by analysis at the level of national innovation systems.

As we shall see below, what constitutes a strong national innovation system might change from one historical era to the next reflecting the predominant techno-economic paradigm. In the current era, the acceleration of the development and application of artificial intelligence and digital services transforms the global order. At the same time, it calls for a critical reassessment of the value chain concept (Durand and Milberg 2019). While there has been a reversal in the global value chain trade in tangibles the tech giants have been main drivers in accelerating global trade in digital services. As argued in Rikap and Lundvall (2021), their mode of operation is not easily captured by the value chain figuration. Tech giants operate as spiders in a network where the most important flows are intangible (data, knowledge, algorithms). Rikap and Lundvall (2021) refer to these networks as Corporate Innovation Systems – defined as world-wide networks of subordinate suppliers and knowledge, data and ideas – both enterprises and knowledge institutions - led and controlled by one major enterprise.

We see the kind unequal exchange taking place in these networks as characteristic for the current era. The tech giants harvest knowledge both from the knowledge commons and from subordinate enterprises and public knowledge institutions. They transform these elements of knowledge to private property, exploiting the other participants in the corporate innovation system. While some elements of knowledge remain as ‘public goods’, tech giants’ transformation of knowledge into private capital is their most important source of intellectual rent and profit. Some, but far from all, of this intellectual capital is protected by intellectual property rights (See Rikap and Lundvall 2021).

The current world system remains hierarchical and characterized by unequal exchange. The developing countries are handicapped under intellectual monopoly capitalism by the privatization of

knowledge in the enterprise sector as well as by core states' techno-nationalist strategies (Pagano 2014; Rikap 2018). The world system is characterized by a hierarchy of national innovation systems and by hierarchical corporate innovation systems. The transformation of the world system reflects co-evolution of corporate and national innovation systems. Mostly the state protects the interests of its own intellectual monopolies, but conflicts may emerge as when tech giants intrude on fundamental state functions as control of money and finance. Tech giants' interests will not always coincide with their domestic state. But when world hegemony is at stake, we see a convergence where private actors join forces with the national state.<sup>8</sup>

Box 2:

A world system perspective on the production of social science

An interesting specific example of how the world system hierarchy is reflected in the production and evaluation of knowledge has been presented by Demeter (2019). Demeter explains the global skewness of publishing, citation patterns and academic recognition in social science resulting in a systematic devaluation of research pursued in the South. He demonstrates that it reflects the specific institutional set up, where core countries, and especially the US and the UK, have monopolized the knowledge infrastructure (publishers, journals etc.). It is interesting to note that China is an exceptional case, where scientific publications have become more visible over the last decades and that it reflects that China has acquired specific elements of the knowledge infrastructure from core countries.

'..China—through Baring Private Equity Asia—gained some control over the formally Thomson Reuters owned Web of Science, the most extensively used and most prestigious indexing service and scientific database. With this, the Chinese state and academy—at least theoretically—has some influence over citation indices, journal selection and assessing processes, which is an advantage one cannot overestimate.' (Op cit. p. 134)

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<sup>8</sup> Miller (2022) illustrates how the tech giants and the US state have joined forces to defend a US-lead in semi-conductors and it shows the important role of military in the promotion of the technology.

## 5. Freeman's theory of world development

At least since 1980 and until he passed away, Freeman pursued a research agenda with a double aim: to develop an alternative to neoclassical economic growth theory and to explain the evolution of the world order. Why do some countries catch-up while others fall behind? What is the basis of world hegemony and how to explain that latecomer countries can forge ahead and become world leaders?

To simplify, Freeman's theoretical framing is constituted by two basic elements, the uneven (but not completely irregular) development of technology and the national innovation system (NIS).<sup>9</sup> He uses the theory of shifting techno-economic paradigms, as developed by Carlota Perez, to establish the necessary link between the two concepts (Freeman & Pérez, 1988). In Freeman and Louçã (2002) and elsewhere, he combined historical analysis with attempts to quantify economic processes as characterized by long waves of growth and stagnation.<sup>10</sup>

The most coherent and ambitious presentations of his theory of economic development can be found in the newly published paper from 1995 (Freeman, 2019). Here Freeman argued that economic development will reflect the co-evolution of five semi-autonomous systems (science, technology, economics, politics, and culture). Societies where these systems match (systemic coherence) will prosper. In his 1995-paper, he does not assign a dominant role to any of the sub-systems but in much of his work he refers to shifts in technology as principal factor disturbing systemic coherence and leading to transitions in the world order.

Freeman linked technological revolutions to shifts in global leadership. He explained that in the 18<sup>th</sup> century, England's NIS had developed characteristics (and systemic coherence) contributing to explain, why it became the homestead for the industrial revolution based upon steam power and textiles. As new technological systems dominated by electricity and chemistry emerged, Germany and the United States (US) forged ahead and left England behind. Freeman's (1987) analysis of Japan's emergence as a potential technological leader in an era of information technology illustrated this general hypothesis.

Freeman's (1982/2004) paper on science, technology, and international competitiveness does not mention unequal exchange, but the criticism of mainstream theory of international trade and the

references to Friedrich List indicate a hierarchical world order, where some lead countries establish ‘absolute advantage’ based on technological leadership. Absolute advantage refers to situations where a country has taken a lead in general purpose technological systems with a wide set of applications across products and industries. This implies that a lead country simultaneously can harvest technological rents based on national technological monopolies from many industries. With the concept ‘absolute advantage’ Freeman gives a signpost for how to rethink unequal exchange in a knowledge-based world economy.

Rikap and Lundvall (2021) and Lundvall and Rikap (2022) use Freeman’s framing of world development to study the rise of China in the era of artificial intelligence and how this has resulted in a geopolitical confrontation, where the US defines China’s rise as a threat to its hegemony. According to Rikap and Lundvall, governments both in the US and China act *as if* technological leadership in specific strategic technologies such as artificial intelligence is a prerequisite for world dominance (Webster et al 2017). China gives priority to strengthening the national innovation system in general and specifically to build strong AI-competences, while the US-sanctions against China are directed specifically to areas of importance for AI such as super-computers and advanced semi-conductors.<sup>11</sup> Recently it has combined these forms of protectionism with an ambitious industrial policy specifically designed to keep abreast of China in strategic technologies.

## 6. China’s rise

The reforms initiated by Deng Hsiao Peng in the middle of the 1980s were crucial for the subsequent rapid economic development. Increasingly the success was built on investments in knowledge. China, like Japan 40 years earlier, invested heavily in knowledge through education and research.<sup>12</sup> but China was much more open to inward foreign direct investment than Japan. State owned enterprises engaged in joint ventures with some of the world’s most powerful multinational enterprises entering fields, where China was far behind in technological terms (Gu and Lundvall 2006a; Gu and Lundvall 2006b).

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<sup>11</sup> Miller (2022) gives a historical overview of what he refers to as the ‘Chip war’. The book takes a US-view on history, but it demonstrates how the US state and US big business join forces in protecting technology-based hegemony when the hegemony comes under threat.

<sup>12</sup> The literacy rate increased from 66% 1982 to 97% 2022 (<https://www.statista.com/statistics>). Between 1996 and 2020 the enrolment rate in higher education increased from 3.4% to 57.6%. The R&D expenditure as share of GNP increased from 0.2 to 2.5% between 1982 and 2023.



Some sectors, including telecommunication and automobiles, were attractive for the multinational enterprises because China offered a rapidly growing market. Others located activities in China primarily because of the abundance of cheap labor. Chinese leaders offered foreign firms access to markets and to cheap labor because China did not have the financial strength needed to import technology and with the openness Chinese leaders expected that there would be ‘spill-overs’ of knowledge from the multinationals to the state-owned enterprises.

Around 2005, the limitations of the strategy became obvious. Despite massive investments in education and research China’s performance in terms of technology and innovation remained weak. China only had a handful of triad patents and almost all its high-tech exports came from foreign owned enterprises. Economic growth remained based, primarily, on quantitative expansion of capital and labor rather than on technological progress. This gave rise to strategy change under the heading ‘independent innovation’.

A series of case and sector studies pursued by innovation scholars in the beginning of the new Millennium played an important role as inspiration for the new strategy. Lu Feng (2006) and his colleagues demonstrated that in sectors such as automobiles and telecommunication most of the state-owned enterprises engaged in joint ventures with multinational firms had not developed their own *technological capabilities* and one reason was that the multinationals blocked technology transfer. There were exceptions such as Geely in automobiles and Huawei in telecommunications and they were characterized by avoiding turn-key solutions and instead importing components and parts and taking on an active role in designing the final product. According to Feng (2019), the lack of success in building technological capabilities reflected the combination of unwillingness of foreign partners to share technology and the lack of incentives for SOEs management. Since there was no competition from indigenous producers, multinationals harvested huge profits from the Chinese market, often through the sales of products based upon outdated technologies.

The strategic shift from imitation to ‘independent’ (alternatively translated as indigenous) innovation was implemented with the 2006 – 2020 Plan for the Development of Science and Technology in the Medium and Long Term, where the term “indigenous innovation” became the keyword. A crucial ambition of this plan was to overcome the dependence of foreign firms in advanced technologies. This new direction towards indigenous innovation was confirmed in the Made in China 2025 (MiC) plan and again in China’s 13th Five-Year Science and Technology Plan

and in its most recent five-year plan (2021-2025). This strategy implied that the openness of the economy should be managed differently.

The strategy change meant new emphasis on applying science and engineering in the production system and forthwith joint venture agreements became explicit regarding technology transfer. Today China has taken the world lead in specific sectors and technologies such as in e-vehicles, green technologies (solar panels and wind power), and high-speed trains. This reflects a combination of state led initiatives at the central and province level and entrepreneurial initiatives. Huawei has become world leader in telecommunication. China has as the only country besides the US built its own tech giants such as Ali Baba, Tencent and Baidu. One factor behind the US struggle to arrest China's development is that China now aspires to become world leader in artificial intelligence (Webster et al 2017).

There is little doubt that the combination of ambitious investments in education, research and development, the focused industrial policy and the scale of the market have been important for some of the success stories. The relative progress in artificial intelligence had as one specific prerequisite The Great Firewall which limited foreign access to digital services. While the US tech giants (Google, Amazon, Facebook, Apple, and Microsoft) established dominant market positions in the rest of the world, they could not penetrate the Chinese market for digital services.

## 7. China's move from the periphery to the semi-periphery has transformed the world system

According to Wallerstein, most of the world population is living in the Periphery and Core with a minority in the semi-periphery. Given the size of China's population its rise has led to a change in this respect with a semi-periphery more populous than both the core and the periphery (Grell Brisk 2017). Wallerstein regards the semi-periphery as integrated part of the world capitalist system, and he assumes that it has a crucial role as a stabilizer of the world system. Those who subscribe to the world system perspective tend to regard China as participating in unequal exchange with countries in the periphery (Li 2019). According to this view, while China remains exploited through unequal exchange with the core countries its rise has reduced exploitation and it has opened for China's unequal exchange with countries from the periphery.

China has gradually strengthened its intellectual property regime and at the same time government has offered economic incentives linked to patenting. As a result, enterprises and knowledge

institutions have become active in transforming technical knowledge into intellectual property. 2022 Chinese enterprises led the world and applied for 695,400 international patents followed by the US (595,700) and Japan (502,600). This development confirms that Chinese enterprises now harvest intellectual rents online with, and at a scale corresponding to, what enterprises from the core countries do. Consequently, China has now got a strong stake in the current world regime of intellectual property.<sup>13</sup> According to a recent OECD study China is now number two, after the US, when it comes to harvesting intellectual rents from global value chains. India, the other major semi-periphery country on the rise, is number three (OECD 2008).

Another important change in the capitalist world system is the increasing role of geo-politics and geo-economics in organizing international relations. The capitalist world system has, according to Wallerstein, been kept together primarily by economic interdependence in contrast to earlier époques when empires were ruled primarily by military force. With the growing conflict between the US and China we see a movement back toward conflicting empires and to a world order where military power plays a major role.

The new trend toward geo-economics, where economic interests are subordinated to geo-politics, is reflected in the US weaponizing the dollar and the attempt by China and other semi-peripheral countries to establish an alternative world currency as well as in economic sanctions, including boycotts, embargos, and denial of market access. This politization of the economy impact all countries and the working of the capitalist world system.

## 8. Is de-coupling between China and the West a possible future scenario?

Western critiques of China have raised the issue of isolating China through economic de-coupling. Given current patterns of trade and logistics such a strategy would have enormous economic costs for both parties. The West would probably carry the biggest costs, since China has reduced its dependence on imports of components and semi-manufactured goods, while the West has become more dependent on such imports from China.

What we have witnessed so far is technology-specific de-coupling, where the US, together with some Western allies, try to weaken China's advance through blocking exports to China of what they assume are strategic goods, especially advanced semi-conductors (Ernst 2020) and the software and

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<sup>13</sup> Interestingly, 2020, most countries turned down a Chinese candidate for the Presidency of WIPO, the UN organisation in charge of intellectual property protection after diplomatic pressure from the US.

equipment necessary to manufacture them. At the same time the US has blocked access to the US-market for specific technologically advanced Chinese enterprises.

This limited form of decoupling may slow down technological progress in specific areas, but it might also have the opposite effect. The focused efforts on winning the technological race related to artificial intelligence where the great power states and their giant corporations combine efforts may accelerate the development and use of AI technologies in the US, in China and world-wide.

However, the race will, when combined with great power techno-nationalism, leave the rest of the world further behind the two protagonists.

Another field where the US and China are engaged in a technology race is in green technologies. Since 2008 China has successfully used industrial as well as science and technology policy to direct innovation toward developing solar, wind and e-vehicles and is now ahead of the US in these technologies. (<https://fairbank.fas.harvard.edu/research/blog/how-china-is-winning-the-race-for-clean-energy-technology%E2%82%AC>). China's success in these fields is a major factor explaining the more recent US drive to use federal funds to develop green technologies. Together, the CHIPS and Science Act, Infrastructure Deal, and Inflation Reduction Act have brought close to half a trillion dollars in fiscal incentives and investments into the growth of clean energy and low-carbon technologies in the US. One important element is the exclusion of Chinese enterprises from these programs. The US-China competition might (especially if was combined with a willingness to share knowledge and technologies with third countries) contribute to a more sustainable world but it is second best to a situation, where the superpowers joined forces and pooled their specific capabilities.

In the long run, the rivalry makes it more difficult to cope with global challenges such as financial instability, inequality, climate change and health issues. And the growing bitterness of the conflict undermines global security. Mutual suspicion is reinforced by propaganda on both sides. The US insists on the higher moral ground with reference to democracy. Chinese leaders regard the technology war as a systematic attempt to dwarf China's legitimate development ambitions. The mass media propaganda, combined with limited insights in the reality and culture of the adversaries, increases the risk for escalation and military conflict.

In the short term the lack of co-operation between China and Western countries has already worsened the situation for vulnerable countries risking sovereign default and now desperately in

need of debt restructuring. For restructuring to take place, all creditors must agree. As Kristalina Georgieva, the head of the IMF, explained in early April, geopolitical fragmentation "will make it harder to resolve sovereign debt crises, especially if key official creditors are divided along geopolitical lines." (<https://www.imf.org/en/Blogs/Articles/2023/01/16/Confronting-fragmentation-where-it-matters-most-trade-debt-and-climate-action>).

## 9. On the need to transform the world system

Most countries in Africa and Latin America are not directly involved in the great power conflict outlined above. They will nonetheless experience the consequences of the conflict and they need to develop strategies to cope with them.

1. The UN is a global forum for international co-operation where China and the US meet in the presence of the rest of the world. China has been investing in building a stronger presence in the organization, while the US has problems with recognizing the authority of the UN as framework for cooperation. In a more politicized world, the voice of ‘third world’ countries may be listened to, and together they could help establish the UN as a platform for conflict solution.
2. The case of China as outlined in this paper and the transformation of the world capitalist system in the direction of intellectual capital exploitation point to the crucial role of access to knowledge as a prerequisite for economic and social development. A critical review of institutions (such as WIPO) and rules (WTO, UNCTAD) determining access to scientific and technical knowledge should aim at a new global regime characterized by knowledge sharing. Such a review should consider a need for regulation of brain drains as well as flows of data from the periphery to the core. Current demographic trends with aging in Europe and high rates of population growth in Africa point to ‘selective opening’ for the best trained youth to join labor markets in the core countries.
3. Such a new regime could be combined with giving innovation clearer directions aiming explicitly at social and environmental sustainability. The UN institutions could establish new ways of channeling knowledge resources from the core and semi-peripheral countries to the third world countries. This kind of knowledge transfer and capacity building would reduce current gaps in income between the core and the periphery.
4. It would require building new capabilities to absorb and develop green technologies and health technologies in those countries.

While the conflict hampers coordinated international action necessary to cope with global challenges threatening the most vulnerable countries, it also offers new opportunities for countries in the periphery. In connection with geopolitical conflicts Great Powers will attempt to mobilize political support from countries in Africa, Asia, and Latin America. They will try to impose their own standards and norms as well as establish infrastructure for communication and transport that establish commercial links with third countries. This implies that they will have stronger incentives to listen to the voice of countries in the periphery.

In the 1970's peripheral countries called for a New International World Order and some of the Western countries responded to this call until the wave of neo-liberalism took the form of Washington Consensus which was, in its turn, undermined when its negative impact on development became obvious. Now voices are raised to initiate a similar initiative. On 27 January 2023, 50 delegates from twenty-six countries gathered in Havana with the aim of launching a New International Economic Order. The background for the conference was that in 2023 Cuba is in charge of the Presidency of G77.

A specific consequence when the West moves production out of China is that some peripheral countries will attract industries exploiting low wage labor. This process has already begun, because of the rise in Chinese wages and it might be re-enforced by the de-coupling process. These countries could learn from the China case that investing in knowledge is a prerequisite for upgrading production and for a move into more productive activities. But they could also learn from the China case that knowledge spill over and knowledge investments needs to be combined with industrial, technology and trade policy to lead to sustained development.

The move toward geo-politics in the world system reveals that it is no longer possible to regard economic exchange as separated from political power and the role of the state. For peripheral countries this implies that there is ample room for regulating the trade with natural resource-based products with the aim to usurp more of their value in exchange with the core countries. Individual countries, vulnerable to sanctions, might not have the political strength to do so but several countries may join forces. The OPEC coordination is an example of a co-operation forcing importers to pay a premium that can be used to build a more diverse and knowledge-based economy.

Moreira and Lee (2023) discuss how the leading producers of Coffee beans (Brasilia, Colombia and Vietnam together their export constitutes 60% of world total) could join forces to get a bigger share of value through forming a cartel. Currently Switzerland, the Netherlands and Germany dominate the exports of processed coffee and take most of the value. The long-term goal would be to refine the beans and to establish strong brands at the world level. This would require technology transfer from the core countries to the producers of coffee beans and producers of other crops.

Another field which is of special importance for Africa is minerals playing key roles of electrification (batteries, e-vehicles, solar panels etc.). Africa produces more than 70% of the world's cobalt (DRC-Zambia), 60% of manganese (Gabon, South Africa), 25% of bauxite (Guinea), nearly 15% of copper ("copper belt" of the DRC-Zambia), a significant portion of graphite (Mozambique, Madagascar, Guinea). The ideal for Africa would be to become able to master the end-to-end value chain – from battery construction to e-vehicles. China largely dominates the sector, from mining to end products. African countries should navigate the competition between the industrialized powers.<sup>14</sup>

The International Energy Agency (IEA) has produced a major report on the role of critical minerals in clean energy transitions and it shows that while the mining for most minerals takes place in Africa and Latin America, China is dominating the processing and the US and China are the major end users (IEA 2021). In another IEA report it is demonstrated that 23 African countries are highly dependent of mineral exports (more than 30% of total export). With its lead in process technology China has a key position in a possible transformation and upgrading of economic activities in some of these countries.

But single countries are weak and vulnerable when negotiating deals. There are several reasons why regional collaborations among peripheral countries may serve their interests better than going alone in the current era. The new expansion of data-driven digital services offers opportunities primarily for big scale enterprises that operate beyond national borders. The formation of coalitions or federations of countries also make it more realistic to counter neo-colonial exploitation of domestic and regional investments in education and knowledge.

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<sup>14</sup> The situation is, however, difficult for the African countries depending on exports of oil and gas. With the growing focus on net-zero emissions investments dwindle and, long-term, demand prospects are dim – see <https://www.unido.org/research-and-industrial-policy-advice/research-and-industrial-policy-advice-research-and-publications>.

One implication of the current world disorder is thus that countries in the periphery should join forces to mobilize the power necessary to change the current world system. One major aim should be to avoid war, and another would be to force core and semi-peripheral countries to share knowledge with and to transfer technologies to the South. China has engaged in belt road globally but seems to be reluctant to use it to share knowledge and promote learning. So far, the focus has been on creating markets and infrastructure for the benefit of Chinese enterprises.

What really matters for income gaps and unequal exchange is access to knowledge and China has become a major owner of intellectual property. Can Chinese leaders see the parallel to the successful US Marshall plan and let it inspire a ‘belt road for knowledge’ in this era of intellectual neo-colonialism?

Cuba is chairing G77+China this year (<https://www.commondreams.org/news/havana-declaration-just-world-economy>), Cuba’s president is chairing national innovation council and Cuba’s international focus is for G77 countries to aim at ‘innovation sovereignty’. The current global divide is dangerous and undermines necessary cooperation to cope with global challenges, but it might make the voice of third countries louder in the UN and elsewhere. Could G77, under Cuban leadership, inspire China to take the lead in the direction of a new world order with knowledge sharing in green technologies, health technologies and technologies to process natural resources?

But peripheral countries need to combine such efforts with building stronger innovation systems. Not to make efforts to do so would correspond to what Christopher Freeman has referred to as ‘voluntary underdevelopment’ (Galdos and Hanef 2022).

## 10. Building stronger national innovation systems in the periphery

To build stronger national innovation systems requires a combination of public and private investments in knowledge and infrastructure. Increasing the understanding of the importance of education and knowledge among citizens is crucial to mobilize the necessary resources through taxes and private initiative. It is equally important to train competent public servants who are accountable and respected among citizens. To formalize informal activities is a way to increase the tax base. This is important in countries and regions where most citizens work in the informal sector.

Often ‘knowledge’ is narrowly defined in the context of peripheral countries as codified scientific knowledge. There is more attention to universities and less to the training of skilled workers and technicians. Establishing technical institutes and professional training close to the sphere of



production – extraction of minerals, agriculture, manufacturing and services – is often more important for development than expanding universities.

Any innovation system strategy must take its point of departure in the current economic structure and the resources and infrastructures at hand. Establishing new industries might result in new jobs and incomes in a faraway future. In the short to medium term upgrading agriculture, services, and mining may give more direct results. Upgrading implies new methods as well as new products. Often infrastructural investments in relation to storage, transports and quality control will help. But the introduction of radically new technologies such as digital services combined with mobile communication may play an important role in the upgrading and in reaching new markets (Zhang and Wu 2016).

Historically, there are several examples of, how poor countries that were depending on natural resource exports could become rich. This is true for the US as well as for the Nordic countries. They have in common that they invested in human resources and imported technology from abroad. On this basis they developed upstream, and downstream industries related to their natural resource specialization. It included machinery for agriculture, forestry and mining as well as machinery for the process industries refining the resources. This is true for the Nordic countries which remained poor until the late 19<sup>th</sup> century (Bruland and Smith 2010)

Can countries in the periphery develop along a similar path today? Today the major barrier to development is the knowledge gap reflecting unequal access to knowledge. The combination of privatization of knowledge and techno-nationalism in core countries contributes to a new form of dependency and unequal exchange. There is a risk of a ‘reverse spill-over’ where core countries harvest the fruits of the modest investments in knowledge made in peripheral countries (import of skilled workers, harvesting data etc.). New digital technologies and services offer opportunities to modernize traditional sectors and to establish wider access to markets. But their development and use have increased the knowledge gap between core and periphery.

As indicated, there are several good reasons to develop the national innovation systems in the Global South with focus on green technologies. The ecological situation where the planet already is surpassing planetary boundaries and reaching critical tipping points force all global actors to promote the development and use of such technologies. For countries in the Global South the focus should be on enhancing the absorptive capacity in relation to such technologies and to develop

capabilities to apply them to the major sectors in the economy. Local and bottom-up initiatives may go hand in hand with nation-wide initiatives.

## 11. Implications for the research agenda

How to develop the research on innovation and development? One implication from our discussion is that it is crucial to understand on-going changes in the world system. National innovation systems should be seen as elements of an evolving world system. This requires a historical perspective where we regard 'the present as history'.

The analysis of the co-evolution of the world system and national systems could take inspiration from Christopher Freeman's distinction between sub-systems for science, technology, economy, politics, and culture and apply them to respectively the world system and the national system level. And we should add a planetary perspective and give attention to the interface between human activities and nature as an ecological system. (Freeman 1995/2020)

It has never been a good idea to assume that the economy can be understood without reference to politics and power. Recent developments, where it has become obvious that geo-politics tend to dominate over immediate economic benefits, requires that scholars working on innovation and development give more attention to the subsystem of politics, including the formation of international co-operations and alliances. Transformative innovation will require changes in global governance.

One specific issue is how the current tendencies toward de-coupling and techno-nationalism affect the global co-operation in science and what it means for future progress in science. The Covid crisis and the success of Pharma-giants to resist knowledge sharing of vaccines illustrated the problems with a divided world system of science. This issue is crucial in a world plagued by global warming and threats to planetary survival. Research should follow the on-going changes in the global knowledge landscape.

Another major issue raised in this paper is how the reproduction of global inequality reflects a world system where unequal exchange is rooted in private and state knowledge monopolies. This calls for research on the distribution of value in global value chains and in corporate innovation systems as well as on alternatives to current institutions regulating intellectual property right.

## 12. Conclusions

To capture the ongoing transformation of the global order we combined two quite different perspectives: Wallerstein's World System perspective and Freeman's theory of world development. We showed how the rise of China has changed the world system in fundamental respects and how the experience from the rise offers lessons for peripheral and semi-peripheral countries. The new world order is characterized by significant risks for war, and we pointed to the UN, as perhaps the only institutional framework that can bring the great power conflict under control. In the current era the most important mechanism reproducing dependence and unequal exchange is the knowledge divide. Knowledge sharing from core to periphery should therefore be at the very core of a New International Economic Order.

We proposed that peripheral countries may exploit a stronger negotiation position to make better deals when it comes to export natural resource-based products and scarce metals and that they need to establish alliances or regional federative collaboration to muster the necessary political clout. Finally, we pointed to a combination of massive investments in knowledge and directional innovation and trade policy as necessary elements in a strategy to reduce dependence and establish sustained development.

We ended with some preliminary ideas on how research on innovation and development might contribute to the understanding the co-evolution of the world system and the national innovation systems.

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