

# The Stack as an Integrative Model of Global Capitalism

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**Abstract:** This article investigates recent transformations in global capitalism's political economy as it relates to the evolution of globally integrated production and exchange apparatuses, such as platforms, enabled through technological advances in computational infrastructures. These infrastructures are explicable in terms of the model of the Stack, understood as an accidental mega-structure of the contemporary platform economy that is integrating previously detached circulation and accumulation structures. The Stack is introduced as an integrative model of a multi-layered political economic system that allows us to understand and explain recent developments in global capitalism. Focus is thereby given to intensified real abstraction of labour induced by the capitalist appropriation of planetary-scale computation, and the associated rise of platform sovereignty in opposition to the traditional sovereignties of states and markets. Building on the model of the Stack, we set in relation different perspectives on recent capitalist development in terms of planetary-scale computation: transnational informational capitalism, cognitive capitalism, intellectual monopoly capitalism and techno-feudalism. Thereby we highlight aspects of value creation as well as rent-seeking through the model of the Stack.

**Keywords:** global capitalism; the Stack; planetary-scale computation; systemic cycles of accumulation; real abstraction; rent vs profit

## 1. Introduction

One of the accompanying effects of the consolidation of global capitalism is the emergence and successive evolution of planetary-scale computation. This term has recently been used to describe the shifting nature of cloud computation, which is no longer fixed to one location or piece of machinery. Instead, it is realised as a flow of computational procedures within distributed global infrastructure. The organisational affordances of planetary-scale computation have made capitalist production and exchange more integrated on a global scale. Moreover, they have also complicated political economic interdependencies of production and exchange within capitalism.

The complexity of planetary-scale computation can be understood in terms of its multi-layered structure, captured in the vertical model of “the Stack” introduced by Benjamin Bratton (2015). The aim of the article is to insert planetary-scale computation into a *longue durée* perspective of capitalist evolution, and to introduce the concept of the Stack as an integrative model of global capitalism. In our reading, this model is capable of assessing, complementing and synthesising current perspectives on capitalist evolution, such as transnational informational capitalism (Fuchs 2014), cognitive capitalism (Vercellone 2007), intellectual monopoly capitalism (Pagano 2014) and

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techno-feudalism (Durand 2020). However, such a reading requires us to go beyond Bratton's original intentions. The Stack has its origins in design and media theory, and its political-economic consequences remain implicit in the model. The motivation of this article is to close this research gap.

To achieve our aim, we first take a world system perspective in Section 2. This allows us to extend Bratton's generic model of the Stack in long-run political economic terms. The world system perspective stresses the evolution of current mutations of capitalism on a global scale. In particular, we highlight "evolutionary patterns of world capitalism" along "systemic cycles of accumulation" (Arrighi and Moore 2001). These systemic cycles are shaped by two different phases of expansion in time and space: material and financial expansion. In Section 3, focus is given to the model of the Stack itself. Alongside the introduction of its fundamental assumptions, we note its complex dynamics with respect to global production networks and the sovereignty of state and non-state actors. We observe how the reproduction of infrastructure of and for planetary-scale computation depends on Fordist accumulation and exploitation in the Global South, as well as on the role of China as the Stack's most central production and trading hub of semiconductor-based infrastructure and interfaces. It is noted in this respect that surpluses made on behalf of planetary-scale computation, e.g. by cloud services or platform providers, rely on the material expansion of Chinese industry.

With respect to sovereignty, we indicate that global capitalism is influenced by a novel kind of platform sovereignty that is regulating hegemony in cyberspace. Silicon-Valley-based platforms in particular have gained an intellectual monopoly that is subsuming the general intellect with the acquisition of user-based data. Platforms intensify the real abstraction of labour (e.g. via platform-mediated labour; see Gruszka and Böhm 2020) and therefore produce "dividualized subjectivities" (Lazzarato 2014). This makes users dependent on platforms by pushing novel social norms. This dependency can be regarded as an exploitation of the general intellect, but in political-economic terms, it needs a careful assessment as to whether it contributes to capital accumulation or to rent-seeking. As we highlight in Section 4, the latter is more probable. We present our conclusion in Section 5.

## 2. Planetary-Scale Computation and Capitalist Evolution

The evolution of capitalism rests upon a complex path-dependent process of endogenous transformations. Major qualitative changes depend on social development, marked by breaks in the established institutional structure. Such a perspective yields a picture of phases of capitalist development shaped by periods of continuous quantitative growth and discrete structural metamorphosis (Hanappi and Scholz-Wäckerle 2017).<sup>2</sup> Hence, capitalist evolution rests on a sequential and complex dynamic between the politics of social development and economic variation – a process mutually shaped by structure and embedded agents. Structural hegemonies of nation states are then associated with the continuity of a given developmental phase. In a similar vein, Fuchs (2014) has argued for a dialectical methodology concerning the (dis)continuity of capitalist evolution:

If one applies a dialectical methodology, the rise of transnational informational capitalism is neither only a subjective nor only an objective transformation, but is based on a subject-object dialectic [...] Informational capitalism is based on

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<sup>2</sup> Continuity is thereby represented by the capacities of a regime of accumulation to stabilize its reproduction (Lipietz 1992).

the dialectical interconnection of subjective knowledge and knowledge objectified in information technologies (141-142).

Fuchs (2014) has identified and described the current transformational tendency of capitalist evolution as “transnational informational capitalism”. The aim of the present article is to complement and substantiate this perspective via the model of the Stack (Bratton 2015). The advantage of this model is its ‘metastable’ perspective. While it identifies a generic structure of planetary-scale computation, it leaves the question of hegemony and therefore of any crucial political economic implications intentionally unresolved, since the digital infrastructure is subject to competing forms of sovereignty. It is thereby prone to different kinds of appropriations (Srnicek and Williams 2015; Lika-včan and Scholz-Wäckerle 2018). Although capitalist evolution is shaped by co-existing varieties of capitalism (as well as non-capitalist agencies and structures), there is always a dominating regime, a global hegemon serving as an attractor in terms of accumulation and exchange. Fuchs (2014) highlights this notion very clearly by referring to an international division of labour for the reproduction of global capitalism. This division is based on a global production network built on the mining of major metals (2014, 171) and cheap labour in China (2014, 183ff.) for assembling the world’s semiconductor-based hardware.

How do these observations fit into the *longue durée* of the world system perspective? Following the previous remarks, world capitalism (of which global capitalism is a historical permutation) is not just a geographical phenomenon. It is a historical system with changing global powers and world hegemonies in core regions and with established dependencies in periphery regions (Kvangraven 2020). Following Arrighi and Moore (2001), one can identify “evolutionary patterns of world capitalism” which describe very basic regularities of material and financial expansion via “systemic cycles of accumulation”.<sup>3</sup> Arrighi and Moore argue that each systemic cycle is characterised through an alternation of material and financial expansion. We are particularly interested in the latest US hegemonic systemic cycle of accumulation, whose material expansion relates to the period of “Fordism” (Gramsci 1971, 277ff.). In geographical terms, this expansion has been associated with the spread of American productive methods around the world and in particular in Europe after WWI.

Before the US hegemonic systemic cycle of accumulation took off, the previous uneven development in Europe and the US (shaped by the extensive class struggle in the 19th century) led to a development of an “integrated capitalism”. Due to high growth rates, such an integrated capitalism became achievable (Hanappi 2020a), allowing the bourgeois ruling class to strengthen their power and to stabilise the capitalist nation state. It is important to highlight that this material expansion phase, although highly dependent on international trade, had strong national dynamics. However, the financial expansion of the US cycle surpassed national dynamics – since the 1970s especially, this cycle of accumulation revealed the contradictions of the modern world system on a truly global scale. This latter phase has been often called “Post-Fordism” (Jessop 1995; Lipietz 1992). In this phase, the US and the European industrial nation states experienced global wage pressure, as well as increasing global financial dominance (shareholder capitalism). These changes have been made on behalf of increasing flexibilisation, leading the integration of global production networks into highly uneven international development. The financial expansion phase of the US cycle has been

<sup>3</sup> Arrighi and Moore (2001) identify four systemic cycles of accumulation: (1) Genoese cycle in the long 15th-16th century, (2) Dutch cycle in the long 17th century, (3) British cycle in the long 19th century and (4) US cycle in the long 20th century.

paralleled, therefore, by a material expansion of other economies, most notably that of China. This perspective suggests that China may play a role of a potential world hegemon, capable of initialising the next systemic cycle of accumulation (Malkin 2022). While real growth in China has certainly not only been subject to its role in the production of semiconductor-based hardware, it is evident that this sector is of high strategic geopolitical importance.<sup>4</sup>

Post-Fordism also heralds the era of digital transformation. This transformation comes with significant uncertainties related to the large-scale restructuring of industries, value chains and markets. Global capitalism delivers “a new time-space equation” and compression of both time and space (Liagouras 2005, 22). Elsewhere, Manuel Castells explains that its novelty stems from a transformation of world economy into global economy.

A world economy, that is an economy in which capital accumulation proceeds throughout the world, has existed in the West at least since the sixteenth [century], as Fernand Braudel and Immanuel Wallerstein have taught us. A global economy is something different: it is an economy with the capacity to work as a unit in real time on a planetary scale (Castells 2000, 92).

What is underscored here is the transnational character of the current evolution of capitalism, in contrast to Fordism. Global production networks “work as a unit in real time on a planetary scale” through the existence of planetary-scale computation. “Planetary-scale computation” describes the shifting nature of cloud computation by the use of distributed systems. Production is no longer fixed to one location or to single pieces of machinery. Instead, it is realised through a flow of computational procedures within a distributed global infrastructure. Thus, planetary-scale computation represents a historically novel ‘skin’ enveloping the planet, aimed at recording, measuring, and facilitating human and non-human processes in the form of data. Data become the central means of mediation and coordination in economies worldwide, leading to a transformation of their institutional forms and their agents’ patterns of behaviour and practices.

From a political-economic perspective, planetary-scale computation represents a complex economic phenomenon. It involves a modular global production structure concerning interdependent feedback between software (knowledge as means of production) and hardware (material accumulation). The (re)production of platform infrastructure, and hardware more generally, depends strictly on integrated global production networks and the exploitation of environment and labour on behalf of unequal exchange (Suwandi 2019; Ricci 2019; Patel and Moore 2017; Hickel et al. 2022). Post-Fordism, far from representing a ‘postindustrial society’, thus appears as the period in which all branches of the economy are fully industrialised for the first time, to which one could further add the increasing automation of the sphere of circulation. This mirrors Ernest Mandel’s earlier projections tied to his analysis of “late capitalism” (*Spät-kapitalismus*), where he expected automation to disrupt the structure and continuity of the capitalist economy similarly as machinery did during the first and second industrial revolutions:

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<sup>4</sup> Compare also Bown (2020) and Moriahra (2020) for the role of the semiconductor industry in the trade war between the US and China. This is an international conflict about specific means of production (microchips) that are largely produced in Taiwan and South Korea.

The automatic production of automatic machines would hence be a new qualitative turning point, equal in significance to the appearance of the machine-production of machines in the mid-19th century (Mandel 1975/1998, 191; 206).

### 3. The Model of the Stack and Its Complex Dynamics

While planetary-scale computation has a distributed and heterogeneous character, it still comes with a coherent structure.

Planetary-scale computation takes different forms at different scales – energy and mineral sourcing and grids; subterranean cloud infrastructure; urban software and public service privatisation; massive universal addressing systems; interfaces drawn by the augmentation of the hand, of the eye, or dissolved into objects; users both over-outlined by self-quantification and also exploded by the arrival of legions of sensors, algorithms, and robots. Instead of seeing all of these as a hodgepodge of different species of computing, spinning out on their own at different scales and tempos, we should see them as forming a coherent and interdependent whole (Bratton 2015, 4-5).

Bratton proposes treating the structure of planetary-scale computation through the vertical topological model of “the Stack”. He describes the Stack as a complex system, an “accidental megastructure, a platform of platforms” comprised of six layers: Earth, Cloud, City, Address, Interface and User. These layers allow us to distinguish different dimensions and aspects of planetary-scale computation. For example, the interplay of User, Cloud and Earth layers emphasises the material-energetic needs of planetary-scale computation, thus situating it within global production networks. Additionally, the advantage of such a vertical topology lies in its capacity to capture the interplay between centralising and decentralising tendencies. On the one hand, the systemic dynamics of centralisation are integrated in platform protocols or corporate ownership of computational infrastructures, while on the other the dynamics of decentralisation are largely found in individual users’ interaction with peripheral interfaces.

With respect to political economy, the main novelty of the Stack is the introduction of platforms as autonomous forms of organisation. A platform is defined as “a standards-based technical-economic system that simultaneously distributes interfaces through their remote coordination and centralizes their integrated control through that same coordination” (Bratton 2015, 42; see also Srnicek 2016; Langley and Leyshon 2017). Such a definition allows Bratton to claim that alongside states (as traditionally centralising organisational forms) and markets (as traditionally decentralising organisational forms), platforms represent new institutional economic forms of resource, commodity, and service allocation (2015, 41-42). In this regard, the Stack architecture undermines and overrules territorial jurisdictions of nation states. It allows for a sort of cosmopolitan mobility of elements within the planetary network, be it matter, energy, labour, capital, or information. The platforms’ novel institutional form enables a new kind of sovereignty: *platform sovereignty* (Bratton 2015, 21-22). Platforms are capable of drawing frontiers, creating their own sovereign territories and dividing the space of “deep address” into parcels of private property. In political economic terms, these trends are enforced by capitalist actors operating in and through the Stack, including,

for example, legislators and patenting institutions.<sup>5</sup> As a result, the traditional hegemony of national capital accumulation is, at minimum, weakened.

Our assessment of Bratton's model of the Stack organises it into two components. First, we acknowledge its theoretical value as a generic model of planetary-scale computation in media-theoretical terms. Second, we argue that the model must be extended in political economic terms in order to yield insights into the nature of contemporary capitalist evolution. Its design is promising in mirroring actual contradictions in the world economy, such as the aforementioned (de)centralising tendencies. An interesting example for such a contradiction, highlighted by Bratton (2015, 131-134), concerns the organisational structure of platforms such as Amazon: a company that presents itself as a 'marketplace' – a medium for free market exchange – while in fact it is meticulously planning exchange and coordination patterns between suppliers and demanders. This leads to a comparison of platforms such as Amazon with socialist planned economies, which is both intuitive and highlighted in the literature (e.g. Morozov 2019). However, the disadvantage of Bratton's account lies in the lack of connection between his insightful platform-specific interpretations and the long-run evolution of capitalist development, since his account does not engage with the historical mapping of global power relations between owners of the means of production and productive forces. That said, the relations of production and their evolution is not discussed via the media-theoretical perspective native to the model. Therefore, we propose to complement the generic model of the Stack with an additional level of political economic analysis, preparing it for further uses in terms of the analysis of capitalist development. Such an analysis needs to account explicitly not just for forms of political sovereignty, but also for power dynamics that play out within the structure of the Stack. This involves articulating implications regarding the scope of agency and types of interplay between various actors in the economy and its reflexive social structures.

Regarding power structures, the first thing to note is that hegemony over hardware manufacturing, mineral extraction and energy production still intervenes in the picture of platform sovereignty and limits the scope of its applicability. In fact, material realities of planetary-scale computation are controlled by the standard-setting mechanisms of "transnational hybrid authorities" (Graz 2019). These are still linked to particular nation-state hegemonies,<sup>6</sup> which compete for their place in global production networks to absorb surpluses. Global production networks in the semiconductor industry developed through the absorption of surpluses of capital and labour and have established new "spatio-temporal fixes" (Harvey 2014). In the context of the Stack, we may refer to the fixation of Silicon Valley in the US or the Guangzhou-Shenzhen region around the Pearl River Delta in China. According to Harvey (2014), a spatio-temporal movement involves contractions and expansions of capitalist assemblages throughout the planet as well as a literal fix of the overaccumulation of the previous cycle of accumulation (compare with Arrighi and Moore 2001). We argue, therefore, that the materialisation of the Stack is carried mainly through the most recent capitalist crises, through "phases of intense rationalization in geographical transformation and expansion" (Harvey 2001, 302). This process is clearly linked to the terms of primitive accumulation via *extractivism* – "a capitalist-dominated economic and growth model oriented toward the extraction and export of raw materials" (Brand et al. 2016, 129) – and unequal exchange (Ricci 2019; Hickel et al. 2022). The competition for global power between states and

<sup>5</sup> Compare Pagano (2014) on the role of "Trade-Related Aspects of Intellectual Property Rights" (TRIPS) for the development of intellectual monopolies.

<sup>6</sup> As previously mentioned alongside Pagano's (2014) assessment of intellectual monopoly capitalism.

non-states is dependent on the strategic occupation of resource repositories such as fossil fuels and rare minerals in order to keep up the global value chains as the lifeline of the Stack. This aspect of integrated economic reproduction in global capitalism depends strongly on the sovereignty of transnational hybrid authorities, allowing for continuous exploitation of the Global South (Adunbi 2022).

Acknowledgement of the material realities of planetary-scale computation is central to Bratton's notion of the Stack: "There is no planetary-scale computation without a planet, and no computational infrastructure without the transformation of matter into energy and energy into information" (2015, 75). Computation is therefore unthinkable without its mineral-energetic "terrestrial substrate" (76), summed up in Bratton's discussion of the Earth layer as the basal stratum of the Stack. Yet the power dynamics of extractive capitalism are secondary to Bratton's analysis – due to its integral ambiguity, the model of the Stack tends to relativise the dependency of planetary-scale computation on particular sites of spatio-temporal fixation. Fixation leads to a "production of space" and is only maintained through means of financialisation and long-term investments traditionally made by national hegemonies, as Harvey (2014, 147) notes. Regarding the latter, Bratton notes a dialectic relationship between platform and state sovereignties (2015, 119-124). On the one hand, platforms take over functions of service provision traditionally realised by state institutions and infrastructures. These include services as diverse as information and communication networks, transportation, healthcare, and payment systems. By making themselves non-substitutable, platforms also drain financial means from previous state investment to their corporate business model. On the other hand, some states harvest the functionalities of platforms, thus 'platformizing' themselves. This includes a spectrum of states ranging from Estonia (where platformisation takes the form of e-governance or digital citizenship) to China (where platformisation materialises in state-corporate hybrid business models or surveillance apparatuses; see Huang 2022). Nation states deploy a series of strategies to adapt to the emerging landscape of platform sovereignty, leading to the institutionalisation of new models of sovereign agency. These two aspects of platform-state interaction<sup>7</sup> have further global political economic implications concerning the hegemony over global production networks, as previously discussed.

Another crucial political economic issue implied by the model of the Stack is the interplay between political subjectivities generated by platforms and economic subjectivities. This theme relates primarily to the novelties in the labour process under conditions of planetary-scale computation. The Stack's native form of subjectivity is that of a *user*, understood as an addressable position (node) within the computational network. The user is caught in a cybernetic recursion of the observer and the observed; it is biopolitically tracked and controlled. Bratton (2015, 260-265) argues that we are currently dealing with two types of users: the overindividuated user and the hive user. The overindividuated user stands directly in the heritage of the *homo oeconomicus* in terms of quantification of the self. It is strictly performing the laws of bourgeois accounting on itself. The hive user is a modern offspring of the *homo economicus*, as it is following the laws of herding behaviour. This holds for many kinds of collective behaviour in social media as well as algorithmic trading. Furthermore, artificial intelligences (non-human users) acquire the same kind of behaviour, since their existence develops out of machine learning, fed by the big data produced by human users. Therefore, any progressive institutional change concerning the labour process and the alienation of

<sup>7</sup> See further Montalban et al. (2019, 815) for "The 'silicolonisation' of public policies: the final pillar in the edifice of the Schumpeterian Workfare State".

workers around the globe is crippled by reproducing fragile and vulnerable subjectivities of a fragmented and/or overdetermined self. Subjectivities made dependent in such a manner by capitalist platform apparatuses are ideologically attracted to authoritarian capitalism (Fuchs 2018).

Seen from the vantage point of global capitalism, the politics of usership allow for the continuation of the subsumption of labour under capital. Planetary-scale computation entails a specific mode of economic subjectivisation that builds upon the three different forms of subsumption, i.e. formal and real subsumption as well as subsumption of the general intellect (Marx 1864; 1858/1993). Historically, formal subsumption has shaped the hegemony of the Genoese and the Dutch cycle, real subsumption that of the British and the US cycle. Fuchs (2014, 198) summarises that the former “[...] entails quantitative changes in the mode of production, in the productive forces, whereas the real subsumption changes the productive forces qualitatively”, associating the former with the production of absolute surplus-value and the latter with the production of relative surplus-value (see also Marx 1885/1992, 432). The notion of the general intellect relates to a section in Notebook VI in *Grundrisse* (Marx 1858/1993, 690-695). Marx discusses particularly the question “to what extent fixed capital (machine) creates value”. All in all, these three stages of subsumption remind us of the different topologies of power and knowledge (which are influential for the reproduction of subjectivities) in a given phase of capitalist development.

The relation of capital to labour is marked by the hegemony of knowledges, by a diffuse intellectuality, and by the driving role of the production of knowledges by means of knowledges connected to the increasingly immaterial and cognitive character of labour (Vercellone 2007, 16).

We compare the subsumption via general intellect with the concept of “machinic enslavement” developed by Deleuze and Guattari (1987, 456-458). Lazzarato (2014, 25-26) characterises machinic enslavement as *dividualization*, where human life is turned into fragmented quanta of abstract labour. The more fragmented and abstracted these units are, the less contextualised in space and history they become. The resulting dividualized subjects can be broken down into series of data, archives of properties, and volumes of masses, thus becoming computable entities in the deep address ontology of planetary-scale computation.

#### 4. Understanding Recent Perspectives of Capitalist Evolution

While the micro-macro linkages discussed in the previous section clearly increase the structural pressure on workers’ emancipation by establishing additional inertia in the transformation of the labour process, emancipatory endeavours are anything else than doomed, as we are going to outline at the end of this section. Before this, we analyse the current capitalist appropriation of the Stack and its role in the continuing abstraction of labour. The political-economic unfolding of this concrete abstraction sets the default conditions for any emancipatory pursuit. In Marx’s terms, the abstraction of labour is given by the metamorphosis of the commodity form, from use-value into value, thereby from the general commodity form to the money form via exchange: the societal making of a monetary production economy (Bellofiore 1989). As a result, objects are detached from their concrete place and use. This vector of increasing abstraction demonstrates the movement from world to global capitalism, as a force of abstracted homogenisation of nature. These abstractions appear not only in territories and infrastructures of the Stack (via the Earth, City and Cloud layers), but also in the dividualization and control

of subjectivities by the capitalist appropriation of the Stack (via the Address, Interface and User layers). Global capitalism makes it very difficult to escape from this concrete abstraction. Quantitative comparison and aggregation through global competition is omnipresent. Our main question is thus: Who is actually profiting from this transformational tendency?

First, there is a hypothesis of *cognitive capitalism*, which conceives that the law of labour value loses weight and may even sublimate itself to “life value” (Morini and Fumagalli 2010). This notion, however, falls short in its interpretations of value creation and capital accumulation, since it misses the global scale of capitalist production. It is true that the general intellect and life itself becomes ever more subordinated to capital, but this is essentially not a novel phenomenon. Different reproductive spheres of work have been suppressed by waged labour over the course of capitalist evolution.<sup>8</sup> According to our previous analysis, which emphasises the multiple layers of the Stack, their complex dynamics and its global reproduction, we cannot confirm any sign of a possible sublation of the theory of labour value itself. Production and exchange still build on classical capitalist mechanisms, but at different geographical sites. The increase in the US economy’s cognitive (immaterial or even digital) labour supply and demand affirms the transition from material to financial expansion in the current systemic cycle of accumulation of the US. The greatest share of surplus is still accumulated via material labour in global capitalism, via Fordist exploitation on assembly lines in Southeast Asia and extractivism in regions of the Global South.

Where surplus value is generated in labour-mediating platforms such as Uber, courier services or Amazon Mechanical Turk, the situation is of course more complicated with advertising platforms such as Google or Facebook. First, there is no labour value created where users update their profile data and interlink with each other around the world. Value originates in this context only where employed data analysts collect, structure and aggregate these user inputs into databases and then sell information packages to advertising companies. Rotta (2022) shows that the commodification of knowledge and information has only led indirectly to productivity growth in the US. Second, one production level below, there is value generated where the software of those platforms is programmed, maintained and supported, where algorithms are tested and improved (Fuchs 2014, 203-211). Third, another production level lower, as highlighted in the previous section, there is value added originally stemming from the cheap labour behind the Stack’s global production networks where primary resources are extracted and later assembled into hardware (Fuchs 2014, 174-180; 185-194). This labour ranges from the micro-level production of interfaces allowing users to make inputs to platforms, to the macro-level establishment of cloud infrastructures and data centres, as well as the maintenance and expansion of the physical infrastructure of the Internet itself. Without this surplus labour there is no platform after all.

But how can we understand the enormous profit gains of platforms such as Google, Amazon, Microsoft, Apple or Facebook if they generate hardly any real value via accumulation? It seems intuitive to understand the origination of these gains from an intellectual monopoly perspective. In general, intellectual monopoly capitalism concerns the establishment of corporate market power through the protection of intellectual property for the production of intangible assets (Pagano 2014). The overarching commonality with cognitive capitalism is given by the emphasis on open vs. closed

<sup>8</sup> This includes work for the “reproduction of the self”, “reproduction of household and family”, and “reproduction of the community”. Fischer-Kowalski and Haas (2016) show that the latter forms of work grew more and more dominated by work for the “reproduction of the economy at large” over the course of history, but especially since the rise of fossil capital.

knowledge. Vercellone (2007) argues that there is a global historical trend in opening up knowledge via increasing public education on the one hand and open access to knowledge archives on the other hand, spreading the general intellect widely (as with Wikipedia). This makes labour less material and less vulnerable, therefore enabling workers' emancipation. Pagano (2014) argues otherwise, that the more important global historical trend lies in the appropriation of knowledge by the increased protection of intellectual property through the patenting activities of multinational corporations such as Big Pharma or Big Tech.<sup>9</sup> Durand and Milberg (2020) extend the framework by introducing the term "information rents"<sup>10</sup>, which allow multinationals to capture rents originating at different levels within global production networks. The authors differentiate between (1) "legal monopoly rents", which "arise from patents, copyrights, and trademarks", (2) "vertical natural monopoly rents", which arise from network externalities<sup>11</sup>, (3) "intangibles-differential rents accruing from an uneven distribution of intangibles intensity between participants in a given GVC" and (4) "data-driven innovation rents accruing from the enhancement of innovation capabilities derived from data centralization"<sup>12</sup> (Durand and Milberg 2020, 420-421). The bottom line that we would like to highlight here suggests that through the infrastructures of planetary-scale computation, platforms accrue profit through information rent-seeking rather than through capital accumulation. This insight supports the hypothesis that the Stack represents an intensification of the vertical integration of global capitalism, but neither through the emergence of a new form of capital, nor through a new mutation in its mode of production<sup>13</sup>, nor from the sublation of the law of labour-value.<sup>14</sup> Instead, this intensification is realised by establishing a sort of hegemonic mix through intellectual monopoly capitalism and "techno-feudalism" (Durand 2020)<sup>15</sup> where differential information rents are accrued in similar terms as Ricardian differential land rents.<sup>16</sup> Techno-feudalism then guarantees terms of platform sovereignty for different *hemispherical stacks*: Silicon Valley's GAF A (Google, Amazon, Facebook, Apple), Chinese BAT (Baidu, Alibaba, Tencent), the Russian stack (dominated by Yandex) and so on (Bratton 2019, 17).

However, as recently highlighted by Morozov (2022), there is no evidence that capitalism – in particular accumulation by innovation (extended ladder) – has come to a halt. In Morozov's opinion, it is misleading to infer a transformation from some sort of capitalism to some sort of feudalism. Our analysis shall clarify that these techno-feudalist tendencies refer to information rents and are subject to platform sovereignty (Bratton 2015). It is important to take a world system perspective here, as also highlighted by Morozov (2022, 102-105), to understand the mixed and varied nature of

<sup>9</sup> See Rikap (2021) for an introduction, overview and detailed discussion about the political economic mechanisms of intellectual monopoly capitalism and corresponding empirical evidence.

<sup>10</sup> As originally developed in Foley (2013).

<sup>11</sup> "...when the investment supporting the network exhibits return to scale and sunk costs, which is the case for information system and supply chain management know-how" (Durand and Milberg 2020, 421).

<sup>12</sup> As the authors highlight, this kind of data concentration relies on oligopolistic regimes of Schumpeter Mark II innovation.

<sup>13</sup> See also Montalban et al. (2019).

<sup>14</sup> As argued by proponents of cognitive capitalism (Dyer-Witthford 2005; Vercellone 2007; Morini and Fumagalli 2010).

<sup>15</sup> See also Yannis Varoufakis' recent comment on "techno-feudalism" (2021) at Project Syndicate.

<sup>16</sup> A similar argument is made by Montalban et al. (2019).

global capitalism. China's production of semiconductor-based interfaces and infrastructure needs to be associated with accumulation by innovation, whereas extractivist infrastructures clearly operate in a mix of accumulation by innovation as well as dispossession. On a global scale, this notion indicates the critical dependency of Silicon Valley on China, a power armature composed of platform and state sovereignties. Global capitalism is therefore confronted with a clash between two sovereignties, only one of them of the platform kind, broadly speaking. The Chinese semiconductor industry remains in this respect integrated within the traditional state sovereignty, as far as it is one of the central contributing sectors to China's current material expansion in its competition for world hegemony (Malkin 2022). In the case of the US, intellectual monopoly and techno-feudalism fuels US financial expansion via asset price inflation by redistributing profits within the different capitalist class fractions.<sup>17</sup> These two aspects make the US economy very vulnerable, since it firstly has no alternative to relying on semiconductor-based hardware from China and, secondly, is running straight into the next big financial crisis.

We may expect that the emergent techno-feudalist structure of rent-seeking in global capitalism will eventually lead to a consolidation of political economic structures, operating on a planetary scale. However, the techno-feudal structure may potentially transcend the earlier established conditions of global capitalism from which it emerged. Bratton's (2015, 328-331) argument suggests that even if platforms are organisational forms developed within global capitalism, their dual capacity for centralisation and decentralisation allows for the emergence of apparatuses that can be equally used for dispossession and for universal provision of value to users through technology appropriation and social provisioning (Srnicsek and Williams 2015; Likavčan and Scholz-Wäckerle 2018). For instance, the Stack seems to offer a versatile ontology for the description of seemingly hybrid political economies such as the present Chinese model, and it can be similarly applied to the description not just of geographically specified political economic forms, but also their transitory historical forms.

As for the possibility of counter-hegemonic alternatives, one avenue of exploration focuses on commons-based appropriation of the Stack that aims at negating money-based exchange mechanisms (Project Society after Money 2019). As far as "communication power" is a central means of coordination and control, it is significant to "re-program communication networks" (Castells 2009, 299ff.) by building a "communication society as a society of the commons" (Fuchs 2020, 293), as similarly argued by Hanappi (2020b) and Gruszka et al. (2020). The development of emancipatory commons-based platforms would, on the one hand, diminish the increasing dividualization of subjectivities and could enhance the reproduction of critically reflective subjects along the lines of the "multitude", understood as an aggregate, leaderless and non-governable political subjectivity (Hardt and Negri 2000). On the other hand, it could sequentially replace the corporate appropriation of institutions and infrastructures within the global production network. While reflecting on the meaning of this double transformation induced by commons-based appropriation of the Stack, one can identify here a recuperation of a key value of *autonomy* as a practice of self-governance via planetary-scale computation (or *self-legislation*, following the Greek etymology of the term) (Likavčan 2019). In this respect, Schneider (2022a) discusses decolonial tactics of establishing *governable stacks* as a means of resisting those ideological appropriations of planetary-scale computation that tend to serve as means of "extension of whiteness" and of the neoliberal politics of dividualization.

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<sup>17</sup> Compare Zukerfeld and Yansen (2016).

The idea of governable stacks acquires critical relevance particularly in relationship to another political category – sovereignty – widely discussed by both Bratton (2015) and Schneider (2022a). As far as platform sovereignty represents a historical drift away from state-based and market-based sovereignties, the potential for a variety of heterodox stacks with emancipatory goals emerges, ranging from red stacks (Terranova 2014) to anarchist/libertarian networks facilitated by Web 3.0 blockchain technologies in the form of decentralised autonomous organisations (DAOs). Schneider's examples indeed cover the wide range of the technological and political spectrum of emancipatory activities, ranging from community platforms such as Catalanian Guifi.net (Schneider 2022a, 26), to commons-based technologies such as Sovereign Cloud Stack or NextCloud (2022a, 28), to blockchain projects such as Democracy Earth (2022a, 29). Self-help platform economies in South Africa or Kenya serve as other such examples (Rodima-Taylor 2022). This demonstrates how the model of the Stack works thanks to its metastable nature not just as an integrative model of global capitalism, but also as a map of possible futures and nodes of interventions – capitalist stacks are just as possible to imagine as communist, anarchist or any other emancipatory form of appropriation. Their key differing features would be their position on the spectrum between the centralising and decentralising tendencies of platforms, as well as their respective interlocking between state and platform sovereignties.

The discussion of alternative appropriations of the Stack (both as a model and as an existing infrastructure of planetary-scale computation) relates directly to our final remark. The model's strategic ambiguity (i.e. its metastable nature) can be treated as an initial condition, but once it bends under the pressure of realities of capitalist political economy, this ambiguity collapses. Insisting on its ambiguity may lead to the model's misuse as a tool for neutralising political analysis of capitalism's intertwinement with planetary-scale computation. For that reason, we highlight the need for further investigation of political economic aspects of planetary-scale computation, to rework and extend the model of the Stack. Moreover, we believe that it is possible to mobilise the model to understand what kind of correctives and regulations are appropriate to steer the Stack's future into post-capitalism proper. In this respect, the more recent essay by Schneider (2022b) points at such reconstructive appropriations with respect to blockchain technologies, especially in terms of encoding user rights.

## 5. Concluding Remarks

The expressive capacity of the model of the Stack hints at a yet-to-be-mapped space of future political economies after global capitalism. As we aimed to highlight in this article, the contours of this space can be preliminarily distinguished by observing emergent forms of rent-seeking that seem to overwhelm potential mutations of value in capitalism. We opened our analysis with the observation of capitalist evolution from world to global terms. The observation is given on the one hand by the financial expansion of the latest US hegemonic cycle of accumulation and on the other hand by the rise of material expansion in China, which is competing for world hegemony in a potentially novel systemic cycle of accumulation. We have shown complementarities and similarities between existing literature and a novel model of global capitalism called 'the Stack'. In our reading, the emergence of the Stack as an accidental megastructure reflects the tendency towards an integrated global capitalism. This form of capitalism means an intensification of labour and environmental exploitation on a planetary scale, coupled with the emergence of new forms of sovereignty (i.e. platform sovereignty). The Stack's complex evolution over six layers reflects the transnational nature of plan-

etary-scale computation. The ubiquity of the latter depends on the geopolitics of effective global production networks, reproducing mixes of old models of political economy: extractivism, Fordist exploitation as well as rent-seeking, monopolisation, and financialisation. This high dependency on global production networks makes the Stack vulnerable to its long-term economic reproduction, as demonstrated by the trade war between the US and China. The Stack serves otherwise as a theoretical model of planetary-scale computation that contributes to a richer understanding of the subjectivities reproduced by global capitalism. As abstract labour gains new momentum of exploitation with platform-mediated labour, economic subjects become dividualized. This notion makes political emancipation from capital ever more difficult, given the increased fragmentation of the working class that is paralleled with the corporate protection of knowledge. Technology appropriation and the establishment of commons-based platforms for social provisioning seem to be a potential counter-hegemonic response.

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