Galatasaray Üniversitesi İleti-ş-im Dergisi / Galatasaray Üniversitesi Journal of Communication
Yıl / Year: 2022 – **Sayı / Issue:** 37 – **ss / pp.** 164-186 – **e-ISSN:** 2548-124X **DOI:**10.16878/gsuilet.1167144

Makale Başvuru Tarihi / Date Received: 26.08.2022
Makale Revizyon Tarihi / Date Revised: 06.11.2022
Makale Kabul Tarihi / Date Accepted: 12.12.2022

Araştırma Makalesi / Research Article / Article de Recherche

A Critical Debate on the Political Economy of Digital Memory

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Abstract

Digital technologies have transformed the conventions of preserving, recalling, and forgetting the past as they provide new digital tools and platforms to remember, to forget and to collect data for individuals, societies, and corporations. With the convergence of new media, memory gains a global aspect along with its personal and local characteristics and turns into the digitally mediated memory. These technologies enable digital memory to be indexed, archived, circulated, and processed infinitely in cyberspace. Therefore, the advancements in the Web and cloud computing technologies yield new dimensions for memory studies to be discussed from a political economy perspective since digitally mediated memory has some economic, political, societal, and cultural impacts on societies. This study conceptually scrutinizes the commodification processes of digital memory and analyzes its material and immaterial bases from a political economy perspective, and claims that they are fundamentally interwoven. The rare earths which are used to produce technological devices are considered as the material basis. Additionally, major technology corporations using these rare earths, and their data centers are taken as the extensions of its materiality. Digitally archived, managed, and retrieved memory is considered as data, which represent immaterial basis of digital memory. The materiality and immateriality of digital memory are not regarded as independent from the inherent power relations and ideologies of the current data economy. Thus, this study aims to discuss digital memory from a political economy perspective to reveal the flow between its materiality and immateriality and the inherent power relations in the data economy. It also poses the potential challenges, risks, and outcomes we may encounter in such an economic system.

keywords: *digital memory, data centers, the data economy, power relations, political economy.*

Résumé

Un débat critique sur l'économie politique de la mémoire numérique

Les technologies numériques ont transformé les conventions de préservation, de rappel et d'oubli du passé étant donné qu'elles fournissent de nouveaux outils et plateformes numériques pour se souvenir, oublier et collecter des données pour les individus, les sociétés et les entreprises. Avec la convergence des nouveaux médias, la mémoire gagne un aspect global avec ses caractéristiques personnelles et locales, et se transforme en mémoire numérique. Ces technologies permettent d'indexer, d'archiver, de circuler et de traiter à l'infini la mémoire numérique dans le cyberespace. Par conséquent, les progrès des technologies du Web et de l'informatique en nuage offrent aux études sur la mémoire de nouvelles dimensions à discuter dans une perspective d'économie politique, car la mémoire numérique a des impacts économiques, politiques, sociétaux et culturels sur les sociétés. Cette étude examine conceptuellement les processus de marchandisation de la mémoire numérique et analyse ses bases matérielles et immatérielles dans une perspective d'économie politique, et affirme qu'elles sont fondamentalement entrelacées. Les terres rares qui sont utilisées pour produire des dispositifs technologiques sont considérées comme la base matérielle de la mémoire digitale. Additionnellement, les grandes entreprises technologiques utilisant ces terres rares et leurs centres de données sont considérés comme des extensions de sa matérialité. La mémoire archivée, gérée et récupérée numériquement est considérée comme des données, qui représentent la base immatérielle de la mémoire numérique. La matérialité et l'immatérialité de la mémoire numérique ne sont pas considérées comme indépendantes des relations de pouvoir et des idéologies inhérentes à l'économie actuelle des données. En conséquence, cette étude vise à discuter de la mémoire numérique dans une perspective d'économie politique pour révéler le flux entre sa matérialité et son immatérialité et les relations de pouvoir inhérentes à l'économie des données. Elle présente également les défis potentiels, les risques et les résultats que nous pouvons rencontrer dans un tel système économique.

mots-clés: *mémoire numérique, centres de données, économie des données, relations de pouvoir, économie politique.*

Öz

Dijital Belleğin Ekonomi Politiği Üzerine Eleştirel Bir Tartışma

Dijital teknolojiler, bireylerin, toplumların ve şirketlerin veri toplama, hatırlama ve unutmalarına olanak veren yeni dijital araçlar ve platformlar sağladığı için, geçmişi saklama, hatırlama ve unutma teamüllerini dönüştürdü. Yeni medya yakınsamasıyla birlikte bellek, kişisel ve yerel özellikleri yanında küresel bir boyut da kazandı ve dijital olarak aracılanmış belleğe dönüştü. Bu teknolojiler dijital belleğin siber uzamda sonsuz defa indekslenmesine, arşivlenmesine, dolaşıma girmesine ve işlenmesine olanak sağlıyor. Bu nedenle, dijital olarak aracılanmış bellek toplumlar üzerinde bazı ekonomik, politik, sosyal ve kültürel etkiler yarattığı için, Web ve bulut teknolojilerindeki ilerlemeler, bellek çalışmalarının yeni boyutlarının ekonomi politik bir bakış açısıyla tartışılmasını mümkün kılıyor. Bu çalışma, dijital belleğin metalaşma süreçlerini kavramsal olarak inceler, dijital belleğin maddi ve gayri maddi temellerini ekonomi politik perspektiften analiz eder ve bu ikisinin temel olarak iç içe geçtiğini ileri sürer. Teknolojik araçların üretilmesinde kullanılan nadir elementler, dijital belleğin maddi temeli olarak ele alınır. Ayrıca, bu nadir elementleri kullanan büyük teknoloji şirketleri ve onların veri merkezleri bu maddi temelin uzantıları olarak incelenir. Dijital olarak arşivlenen, yönetilen ve erişilen bellek, veri olarak kabul edilir ki bu, dijital belleğin gayri maddi temelini oluşturur. Dijital belleğin maddi ve gayri maddiliği, mevcut veri ekonomisine içkin iktidar ilişkilerinden ve ideolojiden bağımsız değerlendirilemez. Bu nedenle, bu çalışma veri ekonomisine içkin iktidar ilişkilerinin ve ideolojinin maddiliği ve gayri maddiliği arasındaki akışı açığa çıkarmak için, dijital belleği ekonomi politik bir perspektiften tartışmayı hedefler. Ayrıca böyle bir ekonomik sistemde karşılaşılması muhtemel zorlukları, riskleri ve çıktıları da ortaya koyar.

anahtar kelimeler: *dijital bellek, veri merkezleri, veri ekonomisi, iktidar ilişkileri, ekonomi politik.*

Introduction

Memory studies encompasses psychology, sociology, history, politics, anthropology, communication, literature, art, architecture, and other disciplines. Due to its interdisciplinary characteristics, the scholars in diverse disciplines provide various definitions, functions, and conceptualizations for memory. For example, according to Tulving (2007) there are 256 types of memory mentioned in psychology journals (cited by Brown et al., 2009). A growing body of research in memory studies expanded around the concept of the "collective memory" in recent decades, although the term was first coined by Halbwachs in 1925. Halbwachs states (1992, p. 38) "It is in society that people normally acquire their memories. It is also in society that they recall, recognize, and localize their memories". Thence, memory has not been regarded as a reflection of subjective mind, but as a result of social and cultural relations and organizations. Simply, recalling particular events and forgetting others cannot be considered independent from society.

In accordance with the emergence of information and communication technologies, debating memory across disciplines has become more complicated as it offers new opportunities to understand the relationship between both individual and collective memories and the past. These advancements have led memory studies to benefit from not only digital media, but also other disciplines, since digital remembering and collecting data digitally have economic, political, societal, and cultural impacts on contemporary societies. The convergence of new media provoking new models of perception and behavior has added a global aspect to memory, along with its personal and local characteristics. Therefore, production of and access to memory and their protection and selection for future use need to be re-discussed from the perspective of digital humanities.

Digital memory studies investigate what has changed in traditional memory studies after digitalization in terms of representation of the past, mediation, archiving, national identity, and the new methodology of research (Maj & Riha, 2009). They also examine digital memory discourses, forms, and practices (Garde-Hansen, Hoskins & Reading, 2009). Some studies on collective memory in the era of new media, for example, Neiger et al. (2011) discuss the theories of media memory, their ethical and cultural aspects, and the operations of the media. Moreover, Gutman et al. (2010) highlight the relationship between transnational politics and memory, and Assmann & Conrad (2010) delve into global memory, global icons, and cultural symbols.

In addition to the aforementioned studies, an array of research focuses on the technological structure of digital memory. Casalegno (2004, p. 314) considers digital memory "as a living system […] within its mutual interactions with social, technological, and territorial environment", and alludes to an ecological

approach to the new kinds of communal memories, which are created by networked communication technologies. Likewise, Van Dijck (2010) discusses the socio-technical, performative infrastructures of social media that channel experiences and memory. On the other hand, Hoskins (2011, p. 271) reviews "ongoing dichotomous formulations of memory" from a different perspective and employs the term "connective memory" which is the result of the "connective turn" of digital technologies and media "shaping an ongoing recalibration of time, space (and place) and memory".

Hoskins (2011, p. 272) asserts, "memory is not in this way a product of individual or collective remembrances but instead is generated through the flux of contacts between people and digital technologies and media". Similarly, Reading (2009; 2011) coins the term "globital memory" to describe the blending of global memory and digital -byte- technologies. Reading & Notley (2015) further this avenue and discuss the materiality of globital memory, based on their own empirical research in Australia and Malaysia highlighting the production of the rare earth minerals used in making digital communication technologies. They also examine the political economy of globital memory and the frictions between labor and capital involved in the memory commodity chain. Reading (2014) claims that the materiality of globital memory leads to the exploitation of human labor and environmental destruction.

Given the dearth of research, meagre studies on the technological architectural aspect of digital memory and its inherent power relations to date, further research is required in the memory studies. Accordingly, this study aims to examine the materiality and immateriality of digital memory and to discuss how the transitivity between them works from a political economy perspective. Deploying Reading & Notley's (2015) and Reading's (2009; 2011; 2014) emphasis on the role of the rare earths industry, taken as a material ground of digital memory; we suggest that its materiality could be extended to include those who buy and consume these materials - that is, the major producers and consumers of digital communication technologies. Major technology corporations benefit from these rare materials to produce technological devices which are used to save the immaterial basis, i.e. data. In other words, since those digital technologies operate through the algorithmic processing of information, digital memory is considered as data in our study. As Sluis (2010, p. 229) asserts, "when the collection and distribution of media becomes the collection and distribution of data, our digital memories become subject to the economics of information production and knowledge management".

While the immaterial basis of digital memory is recognized as data; data centers, which preserve, save, and process users' data represent the materiality of digital memory. Regarding the flow and transitivity of materiality and immateriality of digital memory, the questions addressed in this study are: Taking memory as three different categories –individual, collective and corporate memory

- how has the digitalization of memory developed throughout the emergence of computer and the Internet technologies? Who are the actors in the economy of digital memory? How are the power relations in the economy of digital memory sustained and reproduced? Taking the uneven structure of digital memory into account, what are the challenges we may encounter in the future?

In sum, this study examines cloud servers and data centers as the extensions of personal, collective, and corporate digital memory, and attempts to reveal the flow of the material and immaterial bases of digital memory in the data economy. In the following sections, this study conceptually scrutinizes the commodification processes of digital memory from a political economy perspective. Additionally, it discusses the power relations in the economy of digital memory and concludes by indicating potential challenges, risks, and outcomes we may face in regard to the rise of the digitalization of memory.

Digitalization of Memory Throughout the Emergence of Computer and the Internet Technologies

People used to have analogue memory objects, such as photos, letters, artefacts, and monuments, to remember and to communicate with the past. However, digital technologies have changed the conventions of preserving, recalling, and even forgetting the past. These technologies help us externalize individual memory in a given format or medium, thus offering new rituals and ways of socializing and experiencing memories. These external devices and milieus provided by the technology corporations and the Web services such as Meta, Google, Apple, etc., offer new ways to preserve the individual memory of our everyday life and to shape and access to public resources, i.e., connect with collective memory. Namely, these communication technologies and networks have become tools and platforms for both individual and collective memory and turned memory into digitally mediated memories. Besides, corporate memory is also digitalized, as cloud servers and data centers help corporations preserve their digital assets and archives in the so-called "secure spaces".

Early efforts for digital documentation and creating links among these documents and digital archiving, simply, digital memory conceptualization dated back to 1945, when Bush (1945) introduced the concept of Memex (Memory Index). He asked readers to:

> Consider a future device for individual use, which is a sort of mechanized private file and library. It needs a name, and, to coin one at random, "memex" will do. A memex is a device in which an individual stores all his books, records, and communications, and which is mechanized so that it may be consulted with exceeding speed and flexibility. It is an enlarged intimate supplement to his memory.

Further, Nelson imagined a global information network in which nothing would be lost anymore - a kind of universal archive - in his Xanadu Project, which was created in 1960 and has not been completed yet.

> We need a way for people to store information not as individual "files" but as a connected literature. It must be possible to create, access and manipulate this literature of richly formatted and connected information cheaply, reliably and securely from anywhere in the world. Documents must remain accessible indefinitely, safe from any kind of loss, damage, modification, censorship or removal except by the owner. It must be impossible to falsify ownership or track individual readers of any document. This system of literature (the "Xanadu Docuverse") must allow people to create virtual copies ("transclusions") of any existing collection of information in the system regardless of ownership (What is Xanadu, n.d.).

Bush's concept of Memex and Nelson's Xanadu Project demonstrate early stages of intensification and acceleration in accessing to human knowledge. They imagine the possibility of a computer acting as individual and collective memory, in a sense, both enabling data selection and exchange between users. This imagination leads to today's networked computers. Moreover, in 1974 Nelson invented the idea of hypertext, and Berners-Lee added the use of multimedia to hypertext. All these advancements lead to the World Wide Web (Abbate, 2000, p. 215). Far from the military roots of the network - the ARPANET (The Advanced Research Projects Agency Network), Berners-Lee's World Wide Web was designed as "a pool of human knowledge" in his terms (Berners-Lee et al. 1994, p. 76). However, it seems we are receding from Berners-Lee's decentralized network in today's digital world. Referring to Foucault's emphasis (1972) on the power relations in the history of knowledge; studying on the structures, ownership, and the power relations of the Web since its emergence has potentials to provide new ways of thinking on memory. Initial and recent developments in these technologies and services - namely, digital indexing and archiving - lead us to digital memory. Therefore, the Web itself becomes a medium for infinite sets of personal, collective, and corporate digital memories requires analysing from a political economy perspective.

The Actors in the Economy of Digital Memory

Remarkably, the etymology of "money" has some foundations of memory in itself. Hart (2000, p. 18) indicates that the roots of money go back to the Greek goddess of memory.

> … the word "money" itself comes from the Roman mint at the temple of Juno Moneta. Moneta is the Latin equivalent of Mnemosyne, the Greek goddess of memory and mother of the Muses, custodians of the principal arts and sciences. … Thus, for

> the Romans and implicitly for all those European cultures which take their word for coinage from them, money was at first a store of collective memory linked to the reproduction of the arts as living tradition.

Accordingly, economy and memory are fundamentally interwoven. Money is still a store of collective memory and provides the material basis for both economy and collective memory. In this regard, for today's societies, the aforementioned Reading & Notley's (2015) and Reading's (2009; 2011; 2014) research, which discuss the material basis of digital memory highlighting the importance of raw materials in communication technologies are noteworthy.

Who owns or demands to own all these rare earth minerals and in what fields they are used and how they are traded are substantial to examine the actors of the economy of digital memory. According to UNCTAD (2014, p. 17), some rare earth minerals are used in three different industries in general: For green energy, for lifestyle and for defense. For the ownership of all these minerals, Seaman (2019, p. 3) remarks:

> For the last two decades China has produced between 80 and 95 percent of the world's rare earths – a group of 17 metals that have become key components of revolutionary technological progress in the fields ranging from energy to ICT, to medical devices, to defense. Despite their name, rare earths are not rare, and can be found across the globe.

A recent study shows that China accounted for 68 per cent of global rare-earth elements (REE) production in 2019, however it is assumed that this share is higher as there are some (almost 50-60 per cent of REE production) illegal mining and smuggling in China (Ferreira & Critelli, 2022, p. 61). Their reserves, their production processes, and their transportation are salient for the global trade of REE. Besides, China is not only a major producer but also a consumer of the rare earths. Canada, Brazil, India, Russia, Thailand, Malaysia, and Vietnam are some of the other countries that produce rare earths (King, n.d). However, the USA and Australia accelerated their investments in the rare earth mine production after China's "export control measures, including licenses, taxes and quotas, that would severely limit the supply of rare earths to industrial consumers abroad" in the 2010s (Seaman, 2019). Since China uses rare earths as an "economic weapon", (Seaman, 2019) especially during the trade war between China and the USA today, other countries are searching for resource supplies and solutions to replace them. Mills (2019) reviews the trade war between the USA and China and discusses its impacts on rare earths market. "More recently, the COVID-19 pandemic revealed the risks associated with the concentration of goods production in China and heightened concerns about China weaponizing supply chains for geopolitical purposes". These "tensions also revived US concerns about its reliance on China as a primary source of rare-earth elements" (Ferreira & Critelli,

2022, p. 57). Mills (2019) forecasts that Apple, Tesla, General Electric, Western Digital, Seagate and Cree Inc. would be badly hurt, either from export restrictions on rare earths or outright bans. Therefore, some communication technology corporations, like Apple, have invested in recycling methods to re-use rare earths collected from old phones to maintain a steady supply and to be less dependent on overseas suppliers and more environmentally friendly (Nellis, 2019). As technology corporations have high demands for rare earths, the struggle for the ownership of these materials and for obtaining a better position in their global trade pervade more in the future.

The rare earths are the crucial components for the materiality of digital memory. However, they are not the only factors which determine its economy. There is also the immaterial basis, which could be recognized as the algorithmic processing of information. Scilicet, digitally mediated data are considered as the immaterial ground of digital memory in this context. Accordingly, the economy of digital memory can be discussed within the terms of the data economy.

The production, distribution, and consumption of digital data shape the data economy. In addition, not only owning data but also having the right to access, control and use data matter in the data economy. The Data Economy report (Frontier Technology Quarterly, 2019, p. 1) explains how supply and demand work as follows:

> Distinctions between buyers and sellers or consumers and producers are blurred in the data economy. Supply and demand do not necessarily determine price, price is often indeterminate or implicit, and yet, enormous values are created in the data economy. Data is increasingly a critical factor of production, complementing labour and physical capital. But unlike capital or labour, data is non-depletable. The use of data by many does not diminish its quantity or value. On the contrary, the use of the data by many may increase its value.

According to the report (2019, p. 3), the dominant players in the data economy are Google (Alphabet Inc., parent company) (search engine); Facebook, WhatsApp and WeChat (social media/messaging); Uber and Airbnb (share economy platforms); Netflix, Venmo, and Expedia (content and service provider); Amazon, eBay, and Alibaba (retailers); Microsoft, Apple, and Google (operating systems); and Apple, Samsung, and Cisco (data hardware). However, COVID-19 pandemic had a drastic impact on the digital world which led to appear new actors or more powerful old actors in the data economy. Likewise, the Digital Economy Report (UNCTAD, 2021, p. xv) documents the two leading countries in the data-driven digital economy: The United States and China.

> Together, they account for half the world's hyperscale data centres, the highest rates of 5G adoption in the world, 94 per cent of all

> funding of AI start-ups in the past five years, 70 per cent of the world's top AI researchers, and almost 90 per cent of the market capitalization of the world's largest digital platforms.

The largest platforms are "Apple, Microsoft, Amazon, Alphabet (Google), Facebook, Tencent and Alibaba" (2021, p. xv). These corporations are the material and immaterial centers of digital memory, which can be acknowledged as the actors in the economy of digital memory too.

The material basis of digital memory is not limited with these, the data centers developed by these firms could also be scrutinized as an extension. Secure storage of data becomes an imperative factor in providing sustainable services for these corporations. Wherefore, these firms require cloud computing services to store and access to data over the Internet. According to the report (UNCTAD, 2021, p. 39):

> Co-location data centres are highly concentrated in developed countries. As of January 2021, within a total of 4,714 co-location data centres, almost 80 per cent were based in developed countries, mainly in North America and Europe. Only 897 were in developing countries, mainly in Asia, and 119 in transition economies. Africa and Latin America hosted, respectively, 69 and 153 of these data centres.

As of Q4 2020, the market share of cloud infrastructure service revenues by provider as follows: Amazon Web Services 32%, Microsoft Azure 20%, Google 9%, Alibaba 6%, IBM 5%, Salesforce 3%, Tencent 2%, Oracle 2% and the others are 21% (UNCTAD, 2021, p. 40). In addition, the largest platforms like Apple, Microsoft, etc. "are increasingly investing in all parts of the global data value chain: data collection through the user-facing platform services; data transmissions through submarine cables and satellites; data storage (data centres); and data analysis, processing and use, for instance through AI" (UNCTAD, 2021, p. xv). In this framework, it is conjectured that similar data firms also operate in cloud computing, resulting in a concentration of and monopolization over digital memory and the shaping of its materiality and immateriality.

The Power Relations in the Economy of Digital Memory

To peruse the power relations in the data economy, the value of the data market and its impact on Gross Domestic Product (GDP) in different regions are displayed below, which provides notable benefits to estimate its size and some of its positive impacts on societies.

> […] depending on the definition, estimates of the size of the digital economy range from 4.5 to 15.5 per cent of world GDP. Regarding value added in the information and communications technology (ICT)

sector, the United States and China together account for almost 40 per cent of the world total (UNCTAD, 2019, p. 4).

On the other hand, according to Cattaneo et al. (2020, p. 4-5) "The value of the Data Economy … exceeded the threshold of 400 Billion Euro in 2019 for the EU27 plus the United Kingdom, with a growth of 7.6% over the previous year". The report includes three different post-Covid-impact scenarios for those countries in the period 2020-2025 too. According to The Baseline Scenario, the data economy will reach "a value of 550 billion Euro in the EU27, with a steep increase of its incidence on EU from 2.8% in 2020 to 4% in 2025". The High Growth Scenario forecasts "a value of 827 billion Euro in the EU27, with an incidence on EU GDP of 5.9%." Finally, the Challenge Scenario estimates that the data economy will "reach a value of 432 billion Euro in the EU27 with an incidence on GDP of 3.3%" (Cattaneo et al., 2020: 6). Yet, the data market value of the United States has reached more than 200 million Euros in 2020 (UNCTAD, 2021, p. 18). The Data Economy report (Frontier Technology Quarterly, 2019, p. 3), appraises that the size of the data market in emerging and developing economies is much smaller.

Meanwhile, governments and some international organizations enact laws to regulate data processing, ensure data security, protect the lawful rights and interests of individuals and organizations and safeguard national sovereignty and security of data. Some examples are as follows: EU General Data Protection Regulation (GDPR) (Wolford, 2022); The Data Protection Act 2018 in the UK (Data protection, n.d.); the Federal Trade Commission Act and the California Consumer Privacy Act (CCPA) in the US (Data Guidance, n.d.); the Data Security Law (2021) and the Personal Information Protection Law (2021) in China; Personal Data Protection Law in Turkey (KVKK, n.d.). Furthermore, the United Nations (UN) act to augment the usage of data in a more positive, humane way. According to the report (Frontier Technology Quarterly, 2019, p. 2) "The United Nations has an important role in shaping how data will impact our future, ranging from facilitating negotiations on a multilateral framework on data to making sure data is a positive force for peace, development and human rights". The UN publishes reports[1] on how data can be used to support sustainable development and to prevent people from data-related abuses by filling data gaps and improving data quality. Furthermore, the UN organizes forums, such as the UN World Data Forum 2018, to leverage data for sustainable development and to improve migration policies. In addition, the UN tries to establish common principles to support the operational use of Big Data as a risk-management tool for human rights (Frontier Technology Quarterly, 2019, p. 2). All these steps may have some positive impacts on digital memory in the future.

Another example for affirmative impacts is "a series of public, arts-based participatory interventions called 'The Museum of Random Memory' (MoRM)".

1 UN Global Pulse, UN Data Revolution Report.

"Conducted between 2016 and 2018, MoRM was designed to encourage people to think about the future of their memories in the age of digitalization, automated preservation, and automated or datafied categorization of their personal legacy or larger cultural heritage" (Markham, 2021, p. 383). The baseline question of the performance was: "How do you imagine your memories will take material shape for future archeologists, who will dig through various data artifacts in 80 years to make historical sense of what happened back in 2017?" (Markham, 2021, p. 387). The author explains the strategy of the intervention as follows, "to invite critical discussions about issues related to digitalization, datafication, and the future of memory making, but very indirectly" (Markham, 2021, p. 387).

These activities and efforts of some international organizations and non-governmental organizations are constructive for both the materiality and immateriality of digital memory, as they set guidelines for how data should be collected, stored, processed, distributed, and used. Namely, these steps have auspicious impacts on both the future design and structure of these tools, media, and networks and on data archiving and processing, and thus, affecting the materiality and immateriality of digital memory in promising ways.

On the other hand, the data economy also has adverse impacts on societies. To manifest the reasons behind these, inherent power relations of the data economy are required to be scrutinized. This analysis also expounds how immateriality shapes the economy of data and digital memory. Referring to Stiegler (2010), the question of economics is the externalization and exploitation of forms of human memory, of libidinal economies and economies of attention.

Additionally, the Internet is not the entirety of the digital world. There are also the Deep Web and the Dark Web, both of which have some unfavorable aspects. The Deep Web is generally used as memory for corporations as they save their private archive, thus it is regarded as corporate memory in this study. These Web technologies are ubiquitous parts of cloud computing and the data economy. As Mosco (2014, p. 175) asserts,

> The growth of cloud computing continues a process of building a global informational capitalism by concentrating production, processing, storage, distribution, and electronic services in a handful of companies, and, in some cases, governments, that manage labour and consumption through the systems that the cloud enables.

Furthermore, providing data storage and developing new products are not the only economic outcomes of these cloud corporations; they also create more markets through their activities. At this point of our discussion, we have two key questions to be addressed: (1) how the emergence of cloud computing technologies and companies has turned human knowledge (i.e. memory and humans themselves) into commodities, and (2) once memory is produced, reproduced, archived in, and retrieved from these cloud computing technologies, how are its

use value, exchange value, and surplus value determined in informational capitalistic modes of production and consumption?

Unlike physical capital, the value of data in the data economy is manifold as different patterns of data are analyzed and processed with other relevant data. For example, tracking tools are used to determine which websites a user visits and the data collected from those visits are sold to the third parties. As Sluis (2010, p. 229) contends, once data is separated from its presentation (through algorithms), it "contributes to the modularity, speed and automation of contemporary memory. Increasingly, digital memories can be processed and circulated without human intervention; images and texts can be rapidly decontextualised and recontextualised onto different interfaces". As data are automated in the digital world, their values are estimated differently comparing to the traditional financial systems.

> The value of data can depend on it being private, determining who can use it and who cannot. Furthermore, data can be stored and transported at very low cost. Individuals, households, businesses are both often producers and consumers in the data economy, with firms extracting, analyzing and intermediating data (Frontier Technology Quarterly, 2019, p. 1).

In the value chain of the data economy, data are captured, stored, organized, and analyzed. "Machine learning algorithms use copious amounts of data to detect patterns and relationships in the data that are otherwise too difficult to detect" (Frontier Technology Quarterly, 2019, p. 2). Therefore, "an entirely new 'data value chain' has evolved, comprising firms that support data collection, the production of insights from data, data storage, analysis, and modelling. Value creation arises once the data are transformed into digital intelligence and monetized through commercial use" (UNCTAD, 2019, p. 1). In other words, (digital) memory is not fully controlled by humans or societies anymore. It is also shaped by algorithms, which are developed by major data firms. Therefore, the question here is that "who ultimately will come to shape what memory counts and what doesn't? And more importantly, what is forgotten?" (Hoskins and Halstead, 2021, p. 682). The global pandemic implied a new era of such a memory. "It was a memory that was pre-ordained or pre-mediated in the datafied infrastructures of our time" (Hoskins and Halstead, 2021, p. 682). All these demonstrate how the immateriality of digital memory is configured by its materiality and how the two are fundamentally interwoven.

Moreover, these giant data firms sell the data to the third parties, such as market researchers, advertisers, and politicians, thence they create new markets. All forms of documenting, indexing, and archiving human knowledge lead data firms to exploit users' data to make more profit. In this regard, not only the workers of these corporations but also the users of these platforms, along with their productive power and all user-generated content, are exploited via machine learning algorithms which mine the data to find useful correlations to

be sold to third parties. Fuchs and Mosco (2016a; 2016b) and Fuchs (2010; 2011; 2012) claim that selling prosumers'[2] data to the third parties results in an infinite exploitation of prosumers, which contributes to the capital accumulation in informational capitalism. This turns prosumers into both commodities and workers of these corporations. Eventually, prosumers' labor becomes unpaid immaterial labor in informational capitalism. Furthermore, as these corporations provide those milieus to produce content in a given format or medium, it can be assumed that contemporary digital memory has become more technologically biased than in the past. Therefore, the materiality and immateriality of digital memory cannot be regarded as independent from the inherent power relations and ideology of the current economic system.

Exploitation is related to excess and accumulation. As online users upload content constantly, they provide infinite sources (i.e., 'raw material'—or raw immaterial in a sense) for these data firms. Besides, not only the user-generated content, but also users' online activities and behaviors are valuable, since the data collected and processed from these activities and behaviors are sold to advertisers, politicians, and governments, who demand to keep their masses under surveillance. That recollects Marx and Engels' saying: "Capital is not a thing, but a social relation between persons which is mediated through things" (1996, p. 753). Moreover, those data firms will never be short on 'raw material/raw immaterial', unlike their predecessors. Additionally, the actual workers of data firms (software developers, engineers, data analysts, etc.) work to develop more advanced algorithms leading to the development of artificial intelligence (AI) and machine learning (ML). Their AI and ML algorithms constantly mine data (user-generated content and the activities and behaviors of users) to find new correlations, matches, and patterns for the potential use, resulting in sustainable data mining. Therefore, not only data are infinite, but so are data processing techniques. Briefly, this exploitative power of data firms via their excessive sources serves to provide new ways of production and consumption for the data economy leading to accumulation of 'immaterial capital.'

In capitalistic modes of production and consumption, "use value is dominated by the exchange value of products, which become commodities" (Fuchs and Mosco, 2012, p. 133). As Fuchs and Mosco (2012, p. 133) discuss:

> Media and technologies as concrete products represent the use value side of information and communication, whereas the monetary price of the media represents the exchange value side of information and communication. … Consumers are interested in the use value aspect of media and technology, whereas capitalists are interested in the exchange value aspect that helps them to accumulate money capital. By the time media and technology reach consumers, they have taken on commodity form and are therefore likely to have ideological characteristics.

2 Prosumer is a combination of producer and consumer and it refers to users of Web 2.0.

Smythe (1981) coined the term "audience commodity" in the 1980s to refer to the phenomenon in which audiences are exploited and sold as commodities to advertisers. Therefore, Smythe shifts the paradigm of media studies from media manipulation to exploitative power, which leads to generating a surplus value of media. Scholars studying on informational capitalism, such as Fuchs a& Mosco (2012) extend Smythe's idea of audience commodity to the commodification of user and digital labor in information networks. For Fuchs (2014, p. 276), "social media and the mobile Internet make the audience commodity ubiquitous and the factory not limited to your living room and your typical space wage labour—the factory and work place surveillance are omnipresent. The entire planet is today a capitalist factory[3]". As Fuchs depicts above, in contemporary informational capitalism, exploitation is neither limited by working time, as our leisure time is also abused by the Internet platforms whenever we use them, nor limited by space—unlike factories in the past—due to the mobile technologies accessible to anywhere we want. One of the functions of media in the past was to organize and fill in the leisure time of the masses to drive them to consume. However, digital media and data firms have turned the masses into prosumers. Simply, the leisure time of the Internet users is now valued for production of surplus value by these data firms, which alters users into digital laborers. Besides, their leisure time activities become digital labor. Since the user's activities and content produced in leisure time are recognized as an individual's memory in our study, it is our claim that an individual's digital memory production and consumption contribute to the surplus value of these data firms in an indirect way.

In addition, Prey (2012) affirms that network theories generally ignore the exploitative power of networks, even though they focus on inclusion–exclusion dimensions. As memory networks are also examined in our research, to discuss their exploitative power from Prey's perspective is beneficial to reveal the power relations in the economy of digital memory. Prey (2012) postulates that exclusion is a consequence of digital inequalities and exploitation, and disagrees (2012, p. 255) with Castells' argument that exclusion is "the predominant side effect of contemporary informational capitalism". In this sense, exclusion is the inherent consequence of capitalism. "All entities […] achieve their significance by being in relation to other entities" (Law cited in Prey 2012, p. 259). The network society in contemporary informational capitalism includes all who are online, while excluding the ones who do not yet have access to the Internet. However, this is valid for a limited period of time, as the excluded ones will be valued for future potential markets as well. Furthermore, the excluded ones are also useful to determine the use value and surplus value of digital commodities at a given point in time, or—as Marcuse puts it "whether the excluded are really excluded from the system, or whether they are in fact quite useful for it but simply excluded from its benefits" (Marcuse cited in Prey 2012, p. 257). Therefore, in capitalistic power relations, the excluded ones are already included ontologically and the ones who are also exploited.

3 The original emphasis in the cited source.

How inclusion and exclusion work in the transitivity between materiality and immateriality of digital memory can be illustrated with a simple example from today's social media platforms. Imagine that an African tribe, living in its original small community, was used as the object of a documentary recorded by a digital camera and that the content was then disseminated through a TV channel's official social media accounts. The African tribe would be included (online) in a way, despite actually being excluded (offline). The digital memory of the African tribe was produced and saved by the TV channel but was disseminated through the aforementioned data firms. Once the digital memory of the African tribe is uploaded to a database, then the algorithms mediate new connections to the memory, which result in the commodification of the digital memory. In other words, this study claims that contemporary informational capitalism embraces everyone and everything without excluding anyone or anything. Simply, digital memory includes all the inherent power relations in contemporary informational capitalism. The ones using these technologies for the sake of preserving memory also help the data firms to produce surplus value, and increase their accumulation of capital, since the data firms involve in embedded relationships. Therefore, the data firms reproduce all these given power relations as well.

Cloud computing technologies and data centers also add a new spatial dimension to digital memory. Before digitalization, the spatial dimension of collective memory was limited by national boundaries or the boundaries determined by international political contexts, such as commemoration day and monuments. However, some of these boundaries have faded away or turned into immaterial boundaries, and collective memory becomes global interactive memory and results in the flow of memory. Similarly, people have used cloud computing technologies to save, archive, and recall their memories since the emergence of these digital technologies. Therefore, one's personal memory, such as a photo album, is also mediated digitally, which is kept in and accessed by the remote servers of data firms. Likewise, a corporation's archive is not preserved in the basement of its building anymore; it could be kept in a data center in a remote part of the world. Therefore, digital technologies and data centers have also altered the spatial dimension of digital memory.

The Challenges We May Encounter

The power relations in the economy of digital memory create some challenges we may encounter in the future. While the data economy leads to the commercialization and commodification of memory, it has a potential to lead to the militarization of digital memory as well. Additionally, unequal power relations and digital divide are expanding across the globe, whereas privacy and security concerns are growing as data firms take increasing parts in our lives.

Even though the emergence of web technologies aimed to have an ideal "pool of human knowledge" (Berners-Lee et al. 1994, p. 76), it resulted in more

commercialized memory in today's world. Monopolization over production, distribution, and consumption of digital data leads to the centralization of the Web and make people be obliged to use the aforementioned major platforms and corporations for memory. Moreover, due to the web technologies, cloud computing, major platform providers and data firms, memory has been turned into "an algorithmic memory: an increasingly intelligent self-organising extensible memory which can circulate independently of human intervention" (Sluis, 2010, p. 231). In other words, as memory has become more technologically biased, human beings have less control over the immateriality of memory. It seems that there will be more machine intervention into memory through AI and ML technologies in the future, which may harm humans' decision-making processes. Furthermore, with the assertion of the "trade secret", these corporations are not transparent in sharing how their algorithms work, which results in losing control over data for the users. Besides, the management of data is another crucial issue. Predictive algorithms seeking to find correlations may use dirty or biased data and yield faulty predictions and these data corporations are reluctant to take responsibilities over faulty predictions. Additionally, machine intervention into memory leads to more surveillance and monitoring on data, i.e., on memory. Undisclosed surveillance power could violate privacy, reduce trust in public authorities, carry serious risks of creating prejudice and discrimination and reinforce the existing inequalities in societies. Hence, the commercialization of networks has some negative impacts on digital memory.

Trust, privacy, and security are the other critical concerns in the discussion of the materiality and immateriality of digital memory. Keeping digital memory in "secure" spaces of giant data firms may have some risks because of the monopolization on data. Moreover, while these data firms invest in finding solutions to establish data centers in secure places, their activities harm the environment, causing digital pollution, e-waste and climate change. According to the report (CBInsights, 2019), the electricity and water consumption of data centers are very high, compared to other industries. Their consumptions reveal that the materiality of digital memory has some adverse impacts on the environment. However, some small positive advancements of these energy-hungry data centers have been observed in the recent years. According to Oberhaus (2019), the three biggest cloud providers—Amazon, Microsoft, and Google—invest in renewable energy resources. But there are still some steps to be taken to have the greenest cloud. In addition, data centers are always in danger of being hacked, which direct these firms to seek some secure spaces for their centers, such as placing the centers under the ocean (Oberhaus, 2019). However, the locations of some data centers are not announced publicly for security reasons, therefore most of their locations are unknown. In this framework, it is concluded that with their material and immaterial nature, data centers threaten the environment.

From a materialistic perspective, when compared to the past, the economic value of digital memory has increased because of the market share of

the data and knowledge economy in GDP in many developed countries of the world. However, as documented in the aforementioned reports, there are conflicts and unequal power relations among the countries which are the major data producers and consumers, since there is a high level of concentration in the market. The conflict between the USA and China does not seem to end in the near future. The conflicts on data are not only economic, but they also encompass the defense industry, which results in the militarization of data economy and digital memory.

Moreover, because of the uneven structure of globital memory, developing countries are disadvantaged in this economic system. It is important to note that the data economy does not follow the traditional North-South divide, as some Asian countries play major roles. However, most developing countries do not have the funds to support the research on and development of digital technologies and thus are not the main actors and suppliers in data industry. On the other hand, low-income individuals in both developed and developing countries have less access to digital technologies and low media literacy skills. The unequal economic involvement of the developing countries in the data economy and the militaristic dimensions of the economy may result in the intensification of digital divide and therefore, some negative consequences on digital memory in the future.

Conclusion

Individuals and societies have used digital external devices and online milieus to preserve and archive their personal and collective memories since the emergence of the Web technologies. All these Web technologies, data centers and technology corporations not only serve as platforms or networks for the preservation of memory but also shape how we can archive and select what is to be remembered and forgotten through their algorithms. These new ways of remembering and forgetting have turned the 'mediated memory' of the past into the 'globital/connective memory' of today. In this framework, this study concludes that cloud computing technologies and data centers owned by the global technology corporations which are the main actors in the data economy are the new extensions of personal, collective, and corporate digital memory. These new digital reservoirs of memory have added new temporal and spatial dimensions to memory, which can be accessed to anytime and anywhere. However, the Internet users have become workers of these data firms, as the former always produce content for the latter. Not only the user-generated content but also users' online activities and behaviors are now "raw materials/raw immaterial" for these firms, because these data are sold to the third parties as commodities. Therefore, all the online content, activities, and behaviors to create one's digital memory contribute to feeding these corporations; and they serve as exchange value and surplus value to sustain the data economy. In this context, technologically biased digital memory reproduces the power relations of the data economy.

Digitally archived, managed, processed, and retrieved data are examined as the immaterial basis of digital memory. Besides, the rare earths and the suppliers and buyers of these rare earths, and cloud computing services and data centers which save and process data are considered as the material bases of digital memory in this study. Therefore, we conclude that there is a constant flow and transitivity between materiality and immateriality of digital memory and both parts are fundamentally interwoven.

Consequently, examining digital memory from the political economy perspective may contribute to understanding of the inherent power relations and the material and immaterial aspects of the economy of digital memory. Further discussion could be on whether there are any ways to emancipate from these unequal power relations. Our suggestions are that creating a de-centralized structure for networks and using free software can provide more freedom-respecting spaces for data, which may result in strengthened public privacy and less monopolization in the data economy. Effective policies to regulate data protection, ownership, and security, such as the General Data Protection Regulation (GDPR) in EU, are also positive steps. Moreover, government efforts to apply new tax rules to these data firms may contribute to limiting data monopolies. In addition, pressure placed by international and non-governmental organizations on these data firms and governments to use conflict-free materials and establish clear and ethical regulations and standards for data sharing and processing, as well as open-data policies and measures to prevent data abuse and digital pollution are all valuable efforts to have a better future.

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Ethics Committee Permission

Ethics Committee Permission is not required for this study.

Author Contribution Statement

The research was conducted by a single author.

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Declaration of Conflicting Interest

No potential conflict of interest was reported by the author(s).

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