MCC
MATHIAS CORVINUS COLLEGIUM

MCC CIE
Conference Papers

I.

The Economic Impact of Emerging Technologies

MCC Center for International Economy

MCC CIE Book Series I.

The Economic Impact of Emerging Technologies

Editor: Jiandong Shi

This book and its conclusions reflect solely the private opinion of the authors and cannot be regarded as the official position of the Mathias Corvinus Collegium Foundation.

ISBN: 978-615-6221-26-1
DOI: 10.69960/CIE_CPII_EconomicImpactEmergingTech.2025

Publisher:
MCC Center for International Economy

Budapest 2024.

Contents

About The Authors

Bruno Perez Almansi PhD: Professor, National University of General San Martín

Feifei Zhu: Xi'an Jiaotong-Liverpool University

Mariana Nicolae PhD: Professor, Emerita, Bucharest University of Economic Studies

Martin Schroeder PhD: Associate Professor, Ritsumeikan University

Ngo Di Lan PhD: Researcher, Institute for Foreign Policy and Strategic Studies, Diplomatic Academy of Vietnam

Tianjiao Jiang PhD: Associate Professor, Fudan Development Institute, Fudan University

Xu Peng PhD: Associate Professor, East China University of Political Science and Law

Xu Yao PhD: Associate Professor, Fudan Development Institute, Fudan University

Yuehong Xu PhD: Professor, School of Management, Minzu University of China, Beijing

Youmin Xi PhD: Executive President and Professor, Xi'an Jiaotong-Liverpool University, Pro-Vice-Chancellor, University of Liverpool

Yubin Qin: Doctoral student, Fudan Development Institute, Fudan Universi

Foreword

The topics dealt with in this book reflect our times. From the seismic changes in the automotive industry triggered by the advent of electric vehicles and the resulting global reorientation of EV battery production, to the rise of Asian companies and the strategic responses of Central European countries, the discourse reflects the current technological zeitgeist. The authors, experts in their field, address the impact of these technologies on the global economy, regional development, policy formulation, investment strategies and geopolitical dynamics.

At the centre of the discussion is the realisation that technological progress is not just a question of economic progress, but a complex interplay of geopolitical interests, capital diversification and the strategic positioning of nations in the global competition for technological supremacy. The prescience of Joseph Schumpeter, who equated economic progress with social upheaval, resonates throughout the pages, reminding us that the march of technology is unstoppable, its benefits uneven and its challenges profound.

This book aims to provide policy makers, industry leaders and academics with the insights they need to navigate the turbulent waters of technological change. It emphasises the urgency for Central European countries, indeed for all nations, to adapt to this new technological and economic landscape, where access to new technologies is not only an economic necessity, but a critical factor for their political and economic future.

"The Economic Impact of Emerging Technologies – An MCC Conference" is not just a compilation of academic papers, but a roadmap for understanding and acting in the face of the technological revolution that is defining our age. As the world grapples with the economic, social, and political implications of these new technologies, the discussions summarised in this volume provide a beacon of understanding and direction.

The Mathias Corvinus Collegium, with its commitment to promoting dialogue on international economic issues, has once again proven to be a central platform for debate and discovery. In reading this volume, readers are invited to engage with the ideas that

will shape the future of our global economy in the face of unstoppable technological progress.

I.Electrical cars: a global outlook

The recent evolution of the Argentinian automotive industry and its attempt to develop the electric vehicle value chain

Bruno Perez Almansi

1.Abstract

The aim of this chapter is to analyse the main characteristics and performance of the Argentine automotive sector during the first half of the 21st century. The chapter begins by describing the sector's evolution in subsequent stages, including the post-convertibility phase (2002-2015), the Cambiemos' government (2015-2019), and the Covid-19 pandemic (2020-2022). Two main trends are highlighted in this trajectory. Firstly, the constant trade deficit of the sector in the context of economic crises. Secondly, the productive specialisation of the Argentinian automotive industry in medium pick-up trucks in the second decade of the century. The peculiarity of the latter is that this process was driven by the market, differentiating this case from the Thai productive specialisation through its "product champion" policy. The research is based on technical literature and various statistical sources.

2.Introduction

Argentina is one of the three largest vehicle manufacturers in Latin America with a *peripheral integration* in the automotive global value chain (GVC). In 2022, the sector included 10 foreign automakers that produced passenger and commercial vehicles, and approximately 350 auto parts suppliers. The Argentinian automotive industry has an important economic and social role in the country due to its participation in the industrial employment (6% in 2022), in the industrial sector value added (8% in 2022), in the total exports (10% in 2022), among other contributions.[i] The main trade automotive partner of Argentina is Brazil, with which they are connected through the Southern Common Market (Mercosur) trade agreement.

After the Argentine economic crisis of 2001-2002, the automotive sector experienced increasing growth until 2013, when the Latin American commodity boom ended, and Brazil entered a period of stagnation. During that stage, vehicle production growth was accompanied by a deep foreign trade deficit in the sector that accentuated the macroeconomic problems of the country. Moreover, after the arrival of Mauricio Macri in Argentina and Jair Bolsonaro in Brazil, the economic policies of these countries turned to an opening and liberalising orientation that led to the contraction of their domestic markets and deepened the automotive crisis.

Nonetheless, the evolution of these years was not homogeneous in all industry because, while the production of passenger cars was dropping, the light commercial vehicles manufacturing was increasing. This trend generated a productive specialisation of the Argentine automotive industry in medium pick-up trucks in the second decade of the 21st century. The peculiarity of this trajectory is that this process was driven by the market, with a limited intervention of the state, differentiating this case with the Thai productive specialisation through its "product champion" policy.

In 2019, a new government came to power and had to face the Covid-19 pandemic crisis that implied a sharp contraction of the sector. The years of the post Covid maintained the productive profile of medium pick-up trucks oriented to foreign markets, but also, some new passenger car models started to be produced. Furthermore, the new government initiated some attempts to promote the Electric Vehicle (EV) market and opened a small lithium-ion batteries (LIB) plant, trying to take advantage of the large lithium reserves in the north of Argentina. But these last attempts are still in an initial state, and their future is still uncertain.

Therefore, the chapter aims to describe the Argentinian automotive trajectory in the last decades, highlighting its main changes and problems. For this goal, in the following sections, the different stages of this evolution will be developed: 2) growth with external problems (2002-2015), 3) trade opening and productive specialisation (2016-2019), and 4) the Covid-19 pandemic and its effects. The study is conducted based on the survey of specialised References and the analysis of different databases through descriptive statistics methodologies. Among the sources used are: ADEFA, AFAC, ACARA, INDEC, OEDE, COMTRADE, companies' balance sheets, among others.

3.Period of automotive growth with external problems (2002-2015)

In South America, the regional organization of the automotive value chain was expressed in the Common Automotive Policy (PAC) between Argentina and Brazil in the 1990s. These modifications implied a trade openness in the auto parts tariff lines resulting in a significant foreign competition. This was combined with the appreciation of the Argentinian peso under the Convertibility regime, causing the increase in auto parts imports and serious consequences to local suppliers. Thus, while vehicle production has almost doubled during the 1990s, the volume of imports of parts per vehicle also doubled in this period (Morero, 2013: 21)[ii]. Furthermore, another important change of that decade was the strong regionalization of trade in the sector, concentrating the exports of vehicles in Brazil (Perez Almansi, 2021).

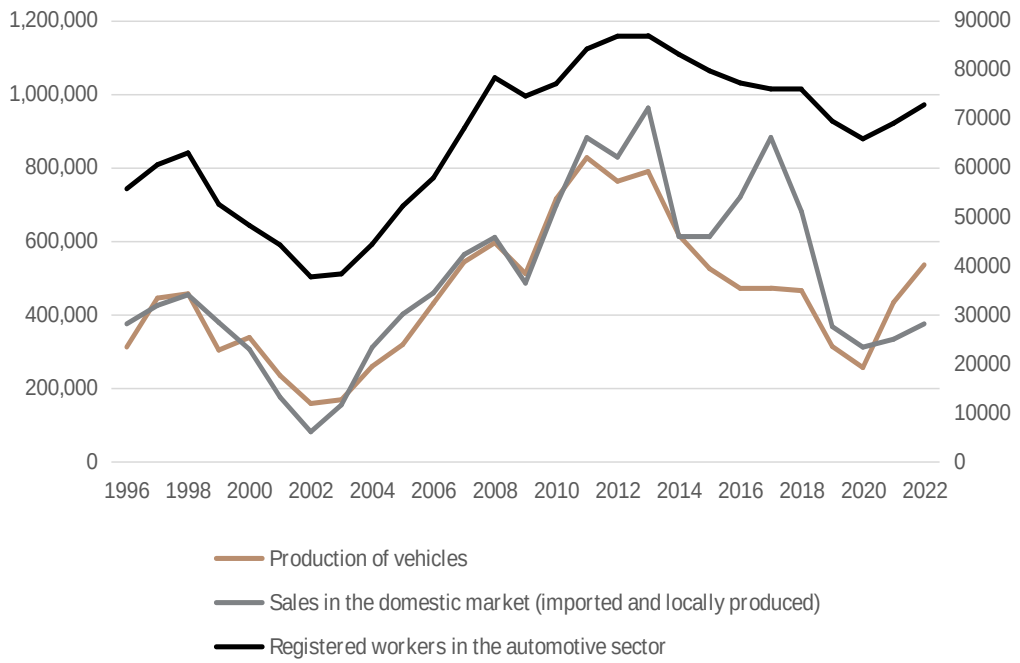
After the Southeast Asian crisis of 1998 and the 1999 devaluation of Brazil, Argentina faced increasing difficulties in obtaining external credit and, with no more public companies to privatize, the rigid Convertibility regime imploded, leading to a deep economic crisis in late 2001 that included a fall in GDP of 25% and levels of unemployment and poverty that were around 25% and 50%, respectively. This severe crisis caused the exit of the government and the end of the neoliberal era, originating a new phase in the Argentinian economic history.

In this new stage Argentina and Brazil signed the Mercosur Automotive Policy agreement (PAM) in which they unified their automotive trade tariffs, setting fees for vehicles produced outside these countries at 35%, giving a strong protection to their Argentinian- or Brazilian-made counterparts. For imported parts and accessories that had regionally

produced counterparts, tariffs were established at 14 to 18%, while a 2% tariff was applied to parts that could not be obtained regionally made. Lastly, a limit was established for tariff-free automotive trade between Argentina and Brazil and was given the name "flex". This limit sets a maximum amount for the vehicles and parts that one country could export to the other without tariffs. The limit in 2001, the first year of "flex" implementation, was set at 1.105. This implied that for Argentina, for every 1 US dollar (hereafter u$s) in automotive goods exported to Brazil, a maximum of u$s1.105 could be imported from Brazil tariff-free.[iii] These rules instituted the legal bases that shaped the sectoral trade between these countries in the following years.

After the crisis of 2001, a series of disruptive economic policies were implemented, such as a 200% devaluation of the Argentinian peso (hereafter AR$), which resulted in the exchange rate rising from AR$1 being equivalent to u$s1 to AR$3 being equivalent to u$s1. Moreover, during those years the Argentinian economy was favoured by a context of high international prices for agricultural products which enabled it to gain significant trade surpluses (Kulfas, 2016). Thus, these factors generated the recovery of the economy that also led to the rapid increase in production and sales in the automotive sector (see Chart 1).

Chart 1 – Production of vehicles and sales in the domestic market (imported and locally produced) (units) (left axis) and registered workers in the automotive sector (annual averages) (right axis) (1996-2022)



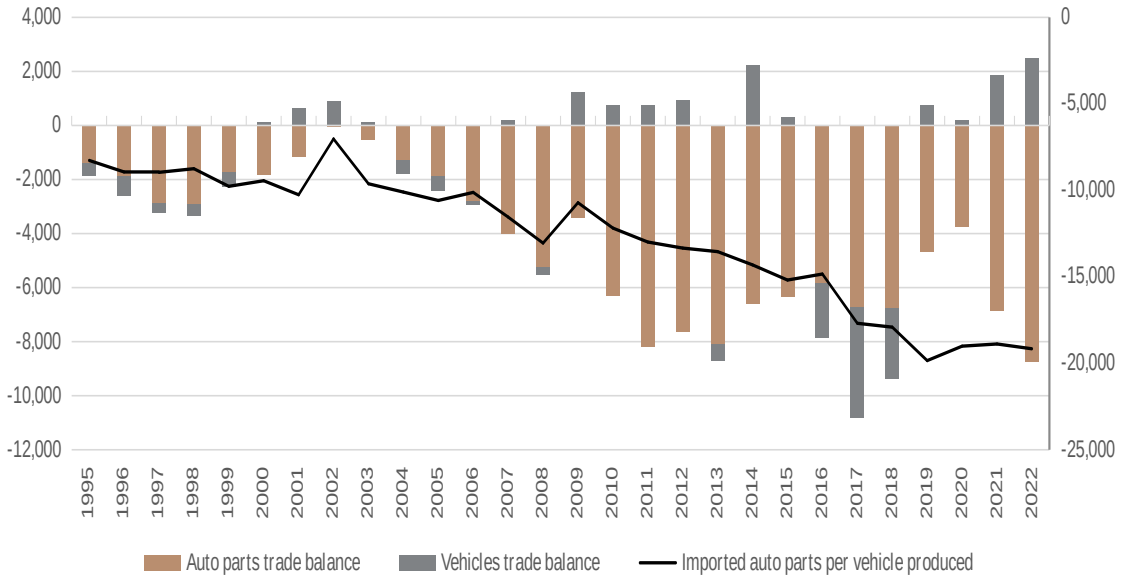
Source: authors own elaboration based on ADEFA, ACARA and OEDE.

From 2008 to 2009, several political and economic breaks arose as a result of the international economic crisis, the government conflict with agricultural companies, a rise in inflation, growing capital flight and increasing problems with net exports (Gaggero et al., 2015; Kulfas, 2016). In the automotive sector it implied drops in 2009 (see Chart

1). Nonetheless, at the end of that year production was reactivated based on Brazil's domestic demand, the revaluation of the Brazilian real and demand stimulus policies in Argentina. Therefore, a second cycle of automotive growth started. However, this new phase had different features from the first one due to higher imports of auto parts that were increasing with the greater vehicle production and accentuating the sector's trade deficit (see Chart 2). Regarding this, in 2008, a new law was introduced (Law 26,393) which, through tax incentives, encouraged automakers to use parts produced in the country, but the effects of such legislation did not have a significant impact on the reduction of the sectoral deficit (Pérez Artica, 2019).

After Cristina Fernandez de Kirchners re-election in 2011,[iv] the problems with the external sector of the country were exacerbated by a rise in capital flight, energy deficits and falling international commodity prices (Gaggero et al., 2015; Schorr & Wainer, 2014). At the sectoral level, the growing automotive deficit, which was increasing in accordance with the production of vehicles, deepened the general external problem (see Chart 2). Therefore, the Argentinian government increased import controls to reduce the growing deficit of the automotive industry. Between 2008 and 2011 it did so by increasing the tariff positions of the sector reached by import permits called Non-Automatic Licenses (LNA) and then, in 2012, with more restrictive permits called Advance Import Affidavits (DJAI) (Perez Almansi, 2020).

Chart 2 - Imported auto parts per vehicle produced (current US dollars) (right axis) and trade balance of vehicles and auto parts (million current US dollars) (left axis) (1995-2022)



Source: authors own elaboration based on ADEFA, AFAC and COMTRADE

At the end of 2013 the growth that the automotive sector was experiencing began to diminish, given Brazil's economic stagnation and its falling vehicle demand. Moreover, the Brazilian government was implementing the *Inovar-Auto* incentive program, which aimed at attracting automotive investments to their market, and caused the loss of numerous investments to Argentina. Added to this was the contraction of the local market due to the increase in domestic prices, the devaluation in 2014 and the rise in local interest rates. In this context, in 2014 the Argentinian government renewed its bilateral agreement with Brazil and reduced the flex from 1.95 to 1.50, lowering the number of vehicles and

auto parts that could be imported from the neighboring country. Furthermore, the *ProCreAuto* plan was established, which consisted in credits at subsidized rates for the purchase of those low- or mid-range models manufactured in the country.[v]

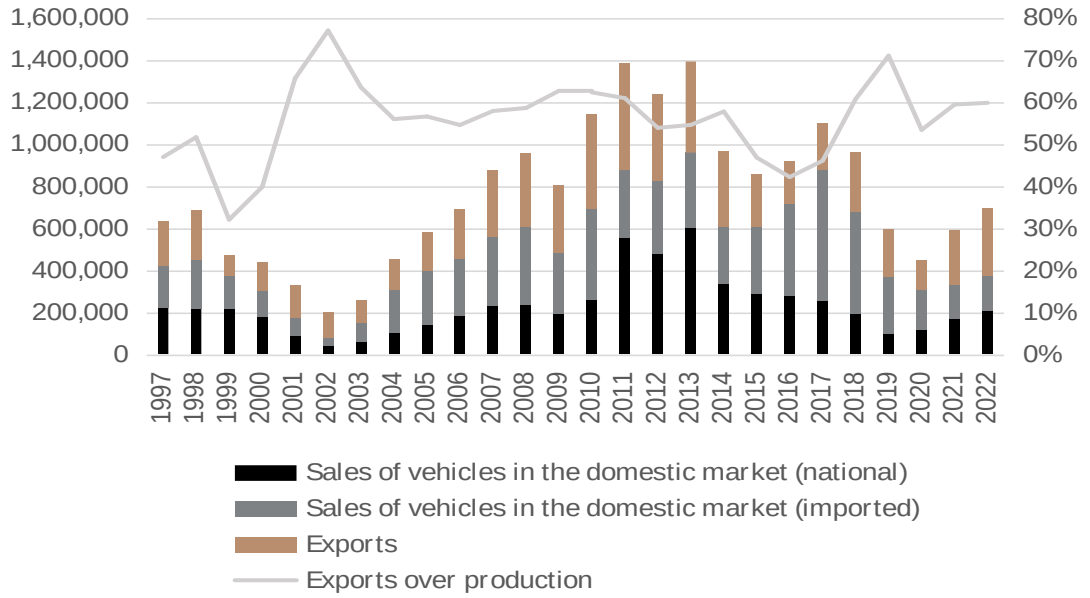
In summary, during this stage there was a strong expansion of the Argentinian automotive industry driven by the increasing demand from Brazil and the raising domestic market after the crisis. This was evidenced by the growth in production, sales, exports and jobs in the sector. However, the trade balance of the complex was persistently in deficit, worsening the levels recorded in the 1990s. This is mainly explained by the growth in auto part imports, which increased with the higher number of vehicles produced in the country. This was continuously aggravated after the crisis of 2008-9 and contributed to the growing problem of lack of foreign exchange in the Argentinian economy.

4.Trade opening and productive specialisation (2016-2019)

In 2015 the candidate of the previous government lost the presidential election with Mauricio Macri, leader of an alliance of different opposition parties. This change implied a turning point in the orientation of macroeconomic and productive policy. The new administration implemented a policy based on trade openness and financial and exchange rate deregulation, marking a notable break with the previous stage (Burgos, 2017). This new program had a strong impact on the decline of the general industrial sector (Santarcángelo et al., 2019).

Regarding the automotive industry, several public policies were implemented. Among them are those related to trade openness, such as the replacement of the restrictive DJAIs by the Integral Import Monitoring System (SIMI), which contained a smaller number of tariff positions. Furthermore, the aforementioned macroeconomic and sectoral regulatory changes, in the context of the recession of the Brazilian market, resulted in a strong increase in import penetration in the domestic vehicle market (see Charts 2 and 3). In addition, the auto parts imports per vehicle produced grew steadily from 2016 until 2019 in the context of drop in vehicle production levels (see Charts 1 and 2).

Chart 3 – Sales of vehicles in the domestic market (imported and locally produced), exports of vehicles (units) (left axis) and exports of vehicles over production (percentages) (right axis) (1997-2022)

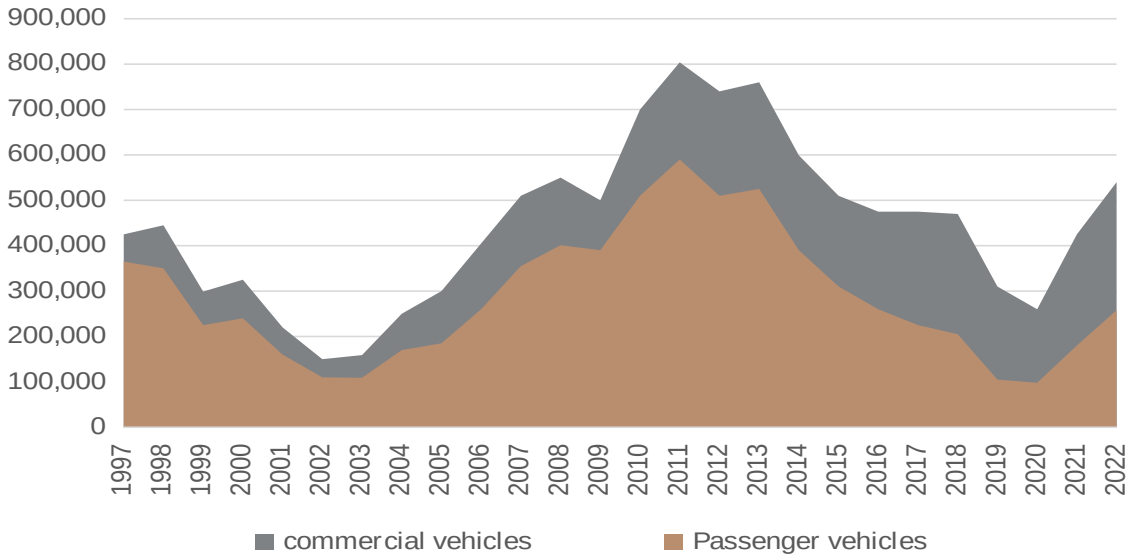


Source: authors own elaboration based on ADEFA

On the other hand, in 2016 the Law 27,263 on the Regime for the Development and Strengthening of Argentinian Auto Parts was issued, which stated an electronic tax credit to automakers that buy national parts.[vi] In 2018, after the raise in international interest rates and the deepening of the internal economic inconsistencies,[vii] Argentina began to run out of sources of external credit, so it turned to the International Monetary Fund (IMF) who granted it one of the highest loans in the history of the organization. This economic-financial crisis led to the devaluation of the local exchange rate,[viii] and the increase in state tax collection. In addition, taxes of AR$3 per u$s1 were established on exports of industrial products, which affected both automakers and exporting auto part firms. In 2019 the economic crisis deepened, accentuating the drop in consumption, production and employment, among other indicators. This situation caused the sharp decrease in automotive activity, which reached almost 300,000 vehicles produced, the lowest value of the decade (see Chart 1).

However, this drop was not homogeneous in all the industry. The fall in fabrication was centered on passenger vehicles, but practically did not impact on commercial vehicles, which gained share in the automotive industry (see Chart 4). This segment of commercial vehicles is mainly dominated by medium pick-up light trucks. The first models of these vehicles that were produced in Argentina were the Ford Ranger and the Toyota Hilux and in 1997. In particular, the latter had an outstanding growth during the current century reaching the production of 165,815 units in 2022,[ix] a historical record for a model in the country (Perez Almansi, 2022b). In 2010 the pick-up Volkswagen Amarok was included in the list of the main light commercial vehicles produced in the country (see Tables 1 and 2).[x] Then, over the last years the manufacturing of the models Nissan Frontier (2018) and Renault Alaskan (2020) started.

Chart 4-Production of vehicles in Argentina by type (units) (1997-2022)



Source: authors own elaboration based on ADEFA.

This change of specialisation in the Argentinian industry also responds to a new automakers division of labour in Latin American light commercial vehicle production. In it, Argentina is increasingly playing a role of producer of medium pick-ups, Brazil small ones and Mexico the biggest ones (see Table 1). In this sense, the only medium pick-ups still being produced in Brazil are the Chevrolet S-10 and the Mitsubishi L200. On the other hand, Mexico has been manufacturing the medium trucks Toyota Tacoma and Nissan NP300 for several years and in 2022 the Chinese company JAC Motors in association with the Mexican Giant Motors Latinoamérica started the fabrication of the LCV JAC Frison.

Table 1-Latin American country of production of models of light commercial vehicles (2022)

Type of vehicle	**Firm**	**Model**	**Country of production**
Small	Chevrolet	Montana	Brazil
	Ford	Maverick	Mexico
	Fiat	Toro	Brazil
		Strada	Brazil
	Renault	Duster Oroch	Brazil
	Volkswagen	Saveiro	Brazil
Medium	Chevrolet	S-10	Brazil
	Ford	Ranger	Argentina
	Honda	Ridgeline	-
	Isuzu	D-Max	-
	JAC	Frison	Mexico
	Mitsubishi	L200	Brazil

	Nissan	NP300	Mexico
		Frontier	Brazil (until 2015) Argentina (since 2018)
	Renault	Alaskan	Argentina
	Toyota	Hilux	Argentina
		Tacoma	Mexico
	Volkswagen	Amarok	Argentina
Big/Full-size	Chevrolet	Silverado	Mexico
	Ford	F-150	-
	Dodge (Stellantis)	Ram	Mexico
	GMC (GM)	Sierra	Mexico
	Nissan	Titan	-
	Toyota	Tundra	-

Source: authors own elaboration based on ADEFA, ANFAVEA, AMIA and specialised References.

The novelty of the production of these vehicles in Argentina is that they were mainly oriented for export (70%—80% of their production) and the same model was not manufactured in other Latin American country (see Table 1).[xi] At the beginning, its exports were mostly centered in Brazil, taking advantage of the trade benefits between these countries. But during the second decade of the century these exports were also directed to other nations, mainly in Latin America, where these vehicles did not have preferential treatment (i.e., Central America and Caribe) (see Table 2). This positive performance of these medium pick-up trucks in foreign markets shaped the export orientation of the Argentinian automotive industry since 2016 (see Chart 3). This process was mainly explained by the use of these vehicles in the primary sector (agriculture, mining, oil & gas), predominant in Latin American economies, and its use for recreational activities too. The good exports results were important for the Argentinian economy due to its external problems; however, the trade deficit of the sector was maintained as the passenger vehicles (until 2019) and auto parts balance were profoundly negative (see Chart 2).

Moreover, it is interesting to note that this productive specialisation of the automotive industry in Argentina was mainly driven by the market without any public policy that implied the orientation of the supply. This evolution contrasts greatly with Thailand trajectory where the "national product champion" policy was an important pillar in its specialisation in pick-up trucks (Doner, 2009; Natsuda & Thoburn, 2020; Pérez Artica et al., 2022). For example, Toyota offshored the production of the Hilux in Thailand with the Innovative International Multi-Purpose Vehicle (IMV) plan in 2002 and, among several factors, the Thai Automotive Master Plan influenced this decision (Natsuda y Thoburn 2020: 126). Likewise, in 2003 Toyota established the R&D center in Thailand, mainly oriented to the design and development of the Hilux model. This center, with another one in China, are the only Toyota centers in developing countries, and its creation generated a strong dependence of the Argentinian subsidiary to Toyota Thailand. Therefore, not only the process of automotive specialisation differs in the cases of Argentina and Thailand, but also their importance in the roles of the LCVs value chain in the MNCs international organization.

In summary, between 2016 and 2019 a strong retraction of the local automotive industry was seen that deepened the problems of the previous phase. Thus, in addition to the sharp falls in vehicle production and the loss of jobs in the sector, the deficit of the automotive complex was accentuated. On the one hand, a high level of imports of auto parts was maintained while the production of vehicles was falling. Furthermore, growing deficits in imports of finished vehicles were added, worsening the situation of the industry. However, this general path of the sector was not homogeneous among the 12 OEM companies of the automotive complex,[xii] in which the trajectory of Toyota, Ford and Volkswagen stand out as they led the medium pick-up trucks specialisation of the country.

5.The Covid-19 pandemic and its effects in the automotive industry

In 2020 a new government came into power, and it had to face the main effects of the Covid-19 crisis. In the automotive sector, production shrank to the lowest record since 2004. However, in 2021 vehicle manufacturing started to rebound. This growth was mainly driven by external demand (see Chart 3), as the internal market did not follow the same recovery (see Chart 1). Moreover, this expansion was not only explained by pick-up trucks, because it also included the passenger cars segment (see Chart 4). Mainly, there were two new passenger car models of the emerging firm Stellantis that shaped this evolution, the Fiat Cronos (released in 2017) and the Peugeot 208 (released in 2020). However, these vehicles had a different orientation compared to the Argentinian LCVs because they were mostly sold in the internal market and its exports were almost exclusively concentrated in Brazil (see Table 2).

Table 2 -Most produced vehicle models in Argentina and its destination (units and percentages) (2021)

Models	Production	Internal market	Brazil	Foreign markets except for Brazil
Light commercial vehicles				
Toyota Hilux	116,961	21%	44%	35%
Ford Ranger	46,624	29%	46%	25%
Volkswagen Amarok	42,762	44%	32%	24%
Passenger vehicles				
Fiat Cronos	70,876	58%	41%	1%
Peugeot 208	34,000	47%	49%	4%

Source: authors own elaboration based on ADEFA.

Furthermore, from 2019 to 2022 the imported auto parts per vehicle produced maintained high records (approximately u$s19,000 per vehicle), and in 2022 the worst auto parts trade deficit of the history was registered (see Chart 2). Nonetheless, some features of these imports have also been changing. While the main group of products remained the transmission systems and engine parts, its origins changed in the last decade. In 2010 the auto parts imports came mainly from Brazil (55%), but in 2022 the neighbor country only explained 33% of them, while new Asian players gained field. These are the cases of Thailand (13%), China (11%) and Japan (6%), which were the main origins of auto parts imports in Argentina after Brazil in 2022. In particular, the rise of Thailand in this field is

mostly explained by the increment of Toyota vehicle production because some of its parts, such as the transmission systems and engine parts, come from this country.

Moreover, in the last years the new government designed new policies for the sector. On the one hand, in 2022 the Law for the Promotion of Investments in the Automotive and Auto Parts Industry and its Value Chain was passed in the Congress. Its main purpose is to give tax incentives for investments and exports of automakers which decide to locate regional exclusive productive platforms in the country, rise their exports and use more Argentinian auto parts in their vehicles.

On the other hand, in 2021 a Sustainable Mobility bill was sent to the National Congress, but until the end of 2023 it was not voted. However, some local small and medium enterprises started to produce electric city-cars on a small scale (Sero Electric, Volt Motors and Coradir). Moreover, in 2021 the National University of La Plata and the national firm Y-TEC opened a small plant of cells and lithium ion-batteries (LIBs) due to its access to large lithium reserves in the north of Argentina. Furthermore, during 2023 a new law on lithium was being discussed in the government (Buenos Aires Herald, 18/4/2023). However, the macroeconomic problems of the country, the conflicts among the different political sectors of the government and the national elections of the year make the implementation of these attempts extremely difficult.

6.Conclusions

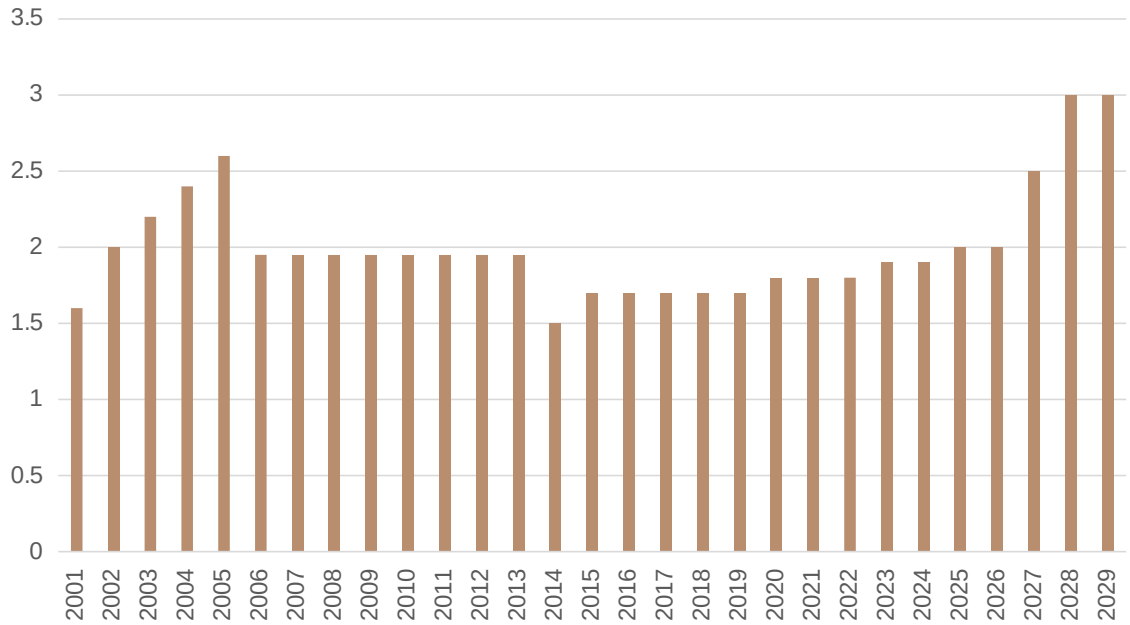
In this chapter, the recent trajectory of the Argentinian automotive industry was analysed, highlighting its different stages, main sectoral policies, productive specialisation and main issues. Firstly, it was described its expansion after the 2001-2002 crisis and the associated problems, including a significant trade deficit and the widespread use of imported inputs. After the Cambiemos government took office, the automotive complex experienced a sharp decline, which exacerbated the negative trade balances of the industry.

However, while the production of passenger cars was decreasing, the manufacture of light commercial vehicles increased over the last decade. This path generated a productive specialisation of the Argentinian automotive industry in medium pick-up trucks in the second decade of the 21st century. The particularity of this trajectory is that this process was driven by the market, with a limited intervention of the state, differentiating this case from the Thai manufacturing profile based on its "product champion" policy. Moreover, this new specialisation of production of light commercial vehicles was explained by a new MNCs division of labour in Latin American countries.

In 2019, a new government came into power and had to face the Covid-19 pandemic resulting in a sharp contraction of the sector. In the post-Covid years, the productive profile of medium pick-up trucks remained geared towards foreign markets, but some new passenger car models were also produced. Furthermore, the new government initiated some attempts to promote the EVs market and opened a small LIBs plant, seeking to leverage the vast lithium reserves in the north of Argentina. However, these recent efforts are still in their infancy, and their future remains uncertain.

7.Annex

Chart 1 -Flex value for the automotive trade between Brazil and Argentina (2001-2029)



Source: authors own elaboration based on documents from ALADI.

Table 1 - Main features of the Argentinian economy and its automotive sector

GDP (2021)	487 billion (current US dollars)
GDP per capita (2021)	10,636 (current US dollars)
Production of vehicles (2022)	536,893 units
Sales (2022)	376,257 units
Main component export	Transmission systems
Main policies in the sector	"Flex" coefficient (2001) to regulate automotive trade with Brazil.
	Law 26,393 (2008) and Law 27,263 (2016) automakers tax incentives to buy auto parts produced in the country.
	Law 27,686 (2022) tax incentives for investment and exports of automakers which decide to locate regional exclusive productive platforms in the country, rise their exports and use more Argentinian auto parts in their vehicles.
Economic integration	Regional (Mercosur)
Industrial policy	Horizontal

Source: authors own elaboration.

8.References

Barragan, F. (18 April 2023). "Lithium: record exports and battery-production fine print". https://buenosairesherald.com/business/mining/lithium-record-exports-and-battery-production-fine-print

Burgos, M. (2017). El nuevo modelo económico y sus consecuencias. Ediciones del CCC.

Doner, R. F. (2009). The politics of uneven development: Thailands economic growth in comparative perspective. Cambridge University Press.

Gaggero, A., Gaggero, J., & Rúa, M. (2015). Principales características e impacto macroeconómico de la fuga de capitales en Argentina. Problemas del Desarrollo, 46(182), 67-90. https://doi.org/10.1016/j.rpd.2015.06.002

Ford (5 April 2016). "Ford invests $170 million in South Africa to build the all-new everest SUV, creating 1,200 new jobs". https://media.ford.com/content/fordmedia/fna/us/en/news/2016/04/05/ford-invests-170-million-in-south-africa-to-build-new-everest-suv.html

Kulfas, M. (2016). Los tres kirchnerismos. Una historia de la economía argentina 2003-2015. Siglo XXI.

Morero, H. (2013). El proceso de internacionalización de la trama automotriz argentina. 36.

Natsuda, K., & Thoburn, J. (2020). Automotive Industrialisation: Industrial Policy and Development in Southeast Asia (1.ª ed.). Routledge. https://doi.org/10.4324/9780429445354

Perez Almansi, B. (2020). La política de comercio exterior en el sector automotor argentino. Un análisis sobre el poder empresarial de sus actores y su influencia en el Estado nacional (2002-2015) [Maestría, Universidad Nacional de San Martín]. https://ri.unsam.edu.ar/handle/123456789/1822

Perez Almansi, B. (2021). La reconfiguración asimétrica de la industria automotriz argentina (1976-2001). Anuario Centro De Estudios Económicos De La Empresa Y El Desarrollo, 15(13), 91-118.

Perez Almansi, B. (2022). The Argentinian Automotive Industry after the Convertibility Crisis: The Exceptionality of the Toyota Case (2002-2019). Gerpisa and Program on Vehicle and Mobility Innovation Colloquium, Detroit. https://www.researchgate.net/publication/362805723_The_Argentinian_Automotive_Industry_after_the_Convertibility_Crisis_The_Exceptionality_of_the_Toyota_Case_2002-2019

Pérez Artica, R. (2019). Política industrial en América Latina. El caso de los recientes regímenes autopartistas en Argentina. Revista Galega de Economía, 28(3), 73. https://doi.org/10.15304/rge.28.3.5809

Pérez Artica, R., Pérez Ibáñez, J. I., & Perez Almansi, B. (2022). Reconsidering automotive development strategies in Argentina in the light of the ASEAN experience. Revista de Historia Industrial — Industrial History Review, 31(86), 79-113. https://doi.org/10.1344/rhiihr.38042

Santarcángelo, J., Wydler, A., & Padín, J. M. (2019). Politica Economica y Desempeño industrial. 19.

Schorr, M., & Wainer, A. (2014). La economía argentina en la posconvertibilidad: Problemas estructurales y restricción externa. Realidad Económica, 286, 137-174.

Schvarzer, J., Rojas Breu, M., & Papa, J. (2003). La industria automotriz argentina en perspectiva: La reconversión de la década del noventa como prólogo a la crisis actual. CESPA.

---

[i]otes

See Table 1 of the Annex for more data about the sector and its relevance to the country.

[ii] Besides, throughout the decade, and especially since 1996, the national production of engines decreased, until its disappearance (Schvarzer et al., 2003).

[iii] To see all the values of the flex over the period refer to Chart 1 of the Annex.

[iv] Cristina Fernandez de Kirchner is the wife of the former President Nestor Kirchner, and she was elected President in 2007 and 2011.

[v] This policy finished at the end of 2015 when a new government came into power.

[vi] This law replaced the previous one (Law 26,393). The amount of the credit varied from 4 to 15% of the value of the parts and components acquired in the country.

[vii] For example, in 2017 the trade deficit was the highest of the last 25 years.

[viii] Which went from AR$20 for u$s1 in 2017 to AR$60 for u$s1 in 2019, including restrictive exchange controls.

[ix] This amount includes Hilux and SW4/Fortuner, the passenger vehicle that is produced in the same platform of the pick-up. However, 85% of that production is of Toyota Hilux.

[x]**0** Then, this model was also produced in Germany until 2020 and in Ecuador from 2018 to 2020. This was Volkswagen's first pick-up truck. However, to share product development costs and take advantage of economies of scale and scope, Volkswagen handed over production of the new version of the Amarok to Ford, which will be based on the platform of the new Ranger. This transfer was made as part of a more general global agreement between the two automakers announced in mid-2020 (Ford, 10/6/2020).

[xi]**1** The joint fabrication of the same vehicle models between Argentina and Brazil was experienced in the passenger cars segment during the first decades of the century, harming the Argentinian subsidiaries due to its smaller market.

[xii]**2** To the automakers already installed before the convertibility crisis (Iveco, Fiat, Ford, General Motors, Peugeot-Citroen, Renault, Mercedes-Benz, Volkswagen, and Toyota) are added two Japanese firms: Honda in 2011 and Nissan in 2018. However, Honda stopped producing cars in 2020. There is also Scania, but it is excluded from the analysis since it is dedicated to the production of transmission systems and not to the manufacture of vehicles.

Techno-geopolitical Competition

Yubin Qin – Tianjiao Jiang

This research is funded by the Shanghai Planning Office of Philosophy and Social Science (project number 2024TRC009).

1.Abstract

As competition between great powers intensifies and science and technology continue to advance, driven by the logic of techno-geopolitics, the United States launches technological competition against China. Technology has become the primary source of power. The techno-geopolitics of the Biden administration has resulted in four specific practices: strengthening investments to rebuild internal strength, upgrading unilateral measures for technological competition with China, deepening Indo-Pacific involvement in industrial chains, and building technology containment alliances against China. However, the Biden administration's strategy for technology competition is limited due to several factors, including China's active actions, the lack of a realistic basis for an anti-China alliance, and the limited industrial carrying capacity of China's neighboring countries. Therefore, China should respond by developing a scientific and technological (S&T) model that emphasizes self-improvement and openness, creating a fair competition paradigm based on bilateral consensus, and fostering an inclusive global innovation ecosystem through multilateral coordination.

Keywords: Techno-geopolitics, technology competition, alliance system, techno nationalism

The Indo-Pacific region is currently experiencing significant competitive dynamics due to the return of great power competition. The United States aims to maintain its strategic priority in the region while containing China (The White House, n.d.). Furthermore, the Fourth Industrial Revolution has accelerated the redistribution of geopolitical power (Khan et al., 2022: 458), dramatically shifting the dimensions of great power competition (Yan, 2019). Emerging technologies, such as artificial intelligence (AI), are being used as instruments of geopolitical power (Miailhe, 2018). Technological developments have the potential to wipe out geopolitical gains or losses for a nation (Butler, 2001: 654). Control over the generation and transfer of key technologies, domination of supply chains, and mastery of technological standards are increasingly important indicators of power. The Biden administration has developed a science and technology strategy towards China based on techno-geopolitics, in the context of great power competition and the coupling and resonance of the Fourth Industrial Revolution. The goal is to limit China's technological progress and industrial upgrading and hinder its advancement to the high end of the industrial chain, while also promoting the relocation of middle and low-end industries from China to Southeast and South Asia. This could hinder China's progress and weaken its industrial base, potentially strengthening U.S. technological hegemony. Techno-geopolitics, also known as the geopolitics of technology, incorporates the fundamental principles of traditional geopolitical theory, including power, spatial structuralism, and conflict. However, it also attributes geopolitical power to science, technology, and knowledge. It focuses on the impact of technology on a country's

comprehensive strength, strategic policy, and the pattern of international political economy and S&T competition. (Butler, 2001; Khan, K. et al., 2022).

2.U.S. Behavior in Techno-geopolitical Competition with China

China is currently in a critical phase of upward mobility within the global high-tech industry chain. According to techno-geopolitics, a country will respond geopolitically to the technological advancements of others (Butler, 2001: 654). The Biden administration has emphasized the use of comprehensive means to limit China's development and impede its rise. The administration has initiated a Science and Technology competition with China based on the two-tiered logic of 'strengthening oneself' and 'weakening competitor' at four levels: domestic construction, bilateral competition, Indo-Pacific regional intervention, and cooperation with extraterritorial allies. Firstly, localizing of high-tech industries is promoted through increased domestic investment. Under the techno-geopolitical logic, countries pursue specific technologies to enhance their geopolitical status. This concept has shaped the Biden administration's domestic industrial policy. Since taking office, President Biden has increased financial and policy support for domestic science and technology research and development, industrial chain reorganization, and high-tech enterprises. The goal is to rebuild U.S. science and technology superiority, boost domestic economic growth, and compete with China. As stated in the *National Security Strategy*, the United States' international influence depends on a stronger domestic foundation. To achieve this, the U.S. will invest more in the workforce, strategic sectors, and supply chain, with a particular focus on key emerging technologies (The White House, 2022). Following this principle, the Biden administration has increased resources and implemented strategic propositions through executive orders and the promotion of bills in various subfields to support the development and upgrading of local industries. Techno-geopolitics consider technology a crucial element of geopolitical power. The Biden administration's policies and resource allocation will significantly enhance domestic economic and technological advantages, consolidating its power advantage over China. The administration's techno-nationalist initiatives to revitalize the domestic manufacturing sector will also negatively impact China and the global innovation ecosystem.

Secondly, the Biden administration aims to strengthen export controls and economic sanctions to intensify the science and technology blockade against China. According to the administration, the ability to innovate in science and technology is a crucial source of national strength, and China is the only 'near-peer' competitor. The *National Security Strategy* states that the United States must prevent strategic competitors from benefiting from U.S. investment and expertise through export controls, investment screening mechanisms, and regulation of foreign investment. The Biden administration strongly supports techno nationalism and continues to limit China's science and technology development through various means. On the one hand, it is increasing export controls and restricting high-tech exports to China. The Biden administration has expanded the embargo on Chinese high-tech enterprises by putting them on the 'Entity List', 'Unverified List', and other technology control lists. This includes high-performance computing, surveillance technology, semiconductor manufacturing, aerospace, AI, and other key technology sectors. Additionally, an embargo on China has been imposed. However, the Biden administration has been implementing de-Sinicization measures in all fields, from research and development to production and operation, which has resulted in the suppression of Chinese technology enterprises. This has accelerated the de-Sinicization process of the entire industry. Meanwhile, the Biden administration has continued to impose economic sanctions on Chinese companies, including those in aerospace,

electronic communications, semiconductors, and other key technology areas. The administration has also utilized discriminatory laws to compel Chinese companies to increase information disclosure.

Thirdly, inducing its Indo-Pacific allies to build an exclusionary technological network squeezing China's space for regional cooperation. According to the theory of hegemonic stability, the hegemonic economy uses its influence to create international regimes dominated by itself and uses international mechanisms to advance its own goals (Gilpin, 1987:75-80). The *100-Day Reviews under Executive Order 14017 report* recommends America strengthen its cooperation with QUAD, G7, and others to ensure the resilience of the supply chain for key products (The White House, 2021). The Biden administration has taken the actions of "high-end blockade" and "low-end extrusion" to establish an anti-China technology network: on the one hand, it proselytizes Indo-Pacific economies with tech advantages to form or upgrade the bilateral framework and multilateral mechanism, forming an encirclement and blockade of China in the high-end industrial chain. Bilaterally, America first established the Competitiveness and Resilience (CoRe) Partnership with Japan to deepen cooperation in technology research and development, standard setting, export control, and resilient supply chain, then strengthened cooperation with South Korea in semiconductors, AI, key supply chains, key technologies, and other areas. Multilaterally, QUAD has set up two major mechanisms, the Critical and Emerging Technology Working Group and the Quad Tech Network (QTN) and announced the strengthening of the cooperation in technical standards, semiconductor supply, 5G, biotechnology, cybersecurity, and other areas. In the semiconductor field, the United States even coerced Japan, Netherlands, South Korea, China Taiwan, and other partners to jointly limit the development of mainland China; On the other hand, to attract the cost advantage of the Indo-Pacific countries to undertake the transfer of industries in the basic production link, thereby replacing part of China's role in the industrial chain. The Biden administration engages in bilateral cooperation projects with Indo-Pacific countries based on their respective technical and geopolitical advantages. For example, the United States signed a memorandum of cooperation on the semiconductor supply chain with Malaysia, which has a semiconductor industry base. At the multilateral level, the Biden administration has actively attracted Indo-Pacific countries to integrate into the alliance system such as the Indo-Pacific Economic Framework (IPEF), which focuses on containing China in trade and technology policy, digital economy, supply chain, and clean energy.

Fourthly, forcing its traditional European allies to form a technological alliance to limit Chinas technological development. Leading international rule-makers can invest more in technology standards to create a "lock-in" effect, forcing catch-up players to choose between accepting a technology path or cutting themselves off from the technology market (Liu & Li, 2022: 52). The *National Security Strategy* emphasizes the importance of strengthening cooperation in biomedicine, sustainable development, supply chain security, and clean energy. It also highlights the need to work with partners to build an international technology ecosystem that consolidates the leadership of the United States (The White House, 2022:33). To fully mobilize the resources of allies for the techno-geopolitical competition against China, the Biden administration, on the one hand, established new international technological mechanisms (Macias, A. & Tausche, K., 2021). The U.S.-EU Trade and Technology Committee (TTC) is a mechanism for U.S.-European cooperation on science and technology standards, supply chain security, emerging technologies, export controls, and investment reviews to counter China. On the other hand, the Biden administration has embedded the issue of technological competition into existing international mechanisms, guiding the alliance system to extend cooperation

and expand the technological containment of China. The U.S. has actively utilized the nested alliance system, taking the Five Eyes Alliance as the core circle and driving NATO to transform into an anti-China science and technology alliance. Additionally, the Biden administration is actively planning for technological competition with China through bilateral collaboration. The Netherlands, the United Kingdom, and Canada have all become important partners in the U.S. efforts to contain China. The purpose of this collaboration, for the Democratic administration which emphasizes multilateralism, is to repair the trust deficit left by Trump and to consolidate and enhance U.S. leadership in technology. The Biden administration has incorporated technological issues into established international norms and created new mechanisms for countering China. This may diminish China's influence in international technological mechanisms and, more significantly, threaten its position in the global and regional innovation system.

3.The limits of the U.S. approach

Under high pressure from the United States, China's technological development still maintains a strong momentum. Nevertheless, the trust that America enjoys within the alliance system and the international community has been weakened. The policies introduced by the Biden administration may not fully reflect the objective reality. Containing China may be difficult due to the absence of a solid foundation for the technological alliance against China, the limited industrial carrying capacity of relevant countries, and China's active actions. First of all, there is a divergence of alliances and partners in the techno-geopolitical blockade towards China. Because of their close economic ties with China, relevant countries prefer to maintain relatively neutrally between China and the United States. On the one hand, most Indo-Pacific countries avoid getting involved in the U.S.-China competition but rather try to find a balance between the two great powers. China has been South Korea's largest export market for nearly a decade and is of irreplaceable value to South Korean industries. The economic cost that would be caused by following the U.S. all the way is undoubtedly an unbearable price for South Korea. The Japanese government and companies have also been careful to maintain a delicate balance in their technological and economic cooperation with the United States due to the growing economic ties with China. Since the Kishida administration took office, China and Japan have held several rounds of bilateral talks, agreeing to seek a "constructive and stable" bilateral relationship (Ministry of Foreign Affairs of Japan, 2020: 46). In addition, ASEAN and India have also shown some reluctance to cooperate with the United States. ASEAN countries are skeptical of QUAD, preferring to see it as a platform with "symbolic and diplomatic value" rather than a key initiative in the Indo-Pacific region (Laksmana, 2020: 107). India even announced after the first round of offline ministerial talks at IPEF that it would temporarily withdraw from the trade negotiations, citing a lack of consensus among countries and possible discrimination against developing countries in the agreement.

European countries also hope to remain neutral between China and the United States. Due to the existence of extensive common interests, although the EU views China as an economic competitor and systemic rival, it still emphasizes the need to strengthen cooperation and contacts with China, promote common interests at the global level, and build balanced and mutually beneficial bilateral economic relations (European Commission, 2019). German Chancellor Olaf Scholz and French President Emmanuel Macron expressed their opposition to decoupling and continued to deepen economic cooperation with China during their visits to China. The concept of strategic independence further helps Europe to get rid of the "U.S. dominates and Europe follows" model, easing pressure on China (Yan, 2021:130). As the Russia-Ukraine conflict drags

on, the EU's demand for cooperation with China has increased. The changing domestic political landscape in the United States has also overshadowed the Biden administration's efforts to coordinate with allies. Republicans prefer unilateral action in the technological competition with China and see coordination with allies as a waste of time. This could exacerbate friction between the United States and its allies, disrupting or even undermining relevant policies.

Secondly, there are practical limitations to replacing China's production capacity. China has developed an industrial system with multiple production links, comprehensive industrial categories, and complete support facilities. In contrast, countries in South and Southeast Asia have weaker infrastructure, lower technical quality of their labor force, and limited ability to replace Chinese industries. Additionally, the relocation of industries during the early stages of the epidemic led to an increase in wages and industrial land prices in affected countries, thereby weakening their cost advantages. Furthermore, investing in Southeast Asia presents challenges for relevant enterprises due to the influence of customs, traditions, religions, ethnicities, political systems, social governance, and industrial policies. The transfer of industries has become increasingly dependent on human capital levels and industrial support capabilities due to the new technological revolution (Sun & Hou, 2021). Southeast Asian and South Asian countries face challenges such as a shortage of skilled personnel and low technical proficiency among their labor force. Additionally, they lack the ability to construct large-scale infrastructure, which has resulted in the stagnation of regional economic development and industrial capacity. The application of AI has led to the clustering of high-tech companies and labor-intensive industries in first-mover areas (Dong, Tan & Zhao, 2022). Due to the lack of necessary carrying capacity in most Southeast Asian and South Asian countries, and the continued spread of new technologies, the United States' efforts to replace China's production capacity with some Indo-Pacific countries and de-Sinicize the industrial chain will face significant constraints.

Thirdly, as China's technological capabilities continue to improve and foreign technological cooperation continues to expand, the effectiveness of Western technological containment continues to weaken. On the one hand, China has consistently pursued technological self-improvement and is committed to leading development through independent innovation. Despite facing technological suppression by the United States, China has made significant progress in technology. For example, In 2021, journal articles from China about AI accounted for 39.78% of the world's total publications, and its citations accounted for 29.07%, making China the largest contributor to AI study (Nestor M. et al., 2023: 34-35); On the other hand, compared to the United States behavior of forming cliques to block normal S&T exchanges, China has always actively participated in many levels of S&T cooperation, committed to improving technological governance and promoting human peace and development by promoting global technological innovation cooperation, which has won the support of vast areas of the world, especially developing countries. Furthermore, U.S. financial and technological companies are attracted by China's consumer market and have a large presence in China. They believe that the deep integration between the two countries makes it almost impossible to limit China's progress in various technological fields. It is necessary to protect its business interests in China while competing with China. Mainstream opinions in the U.S. technology industry not only criticized the U.S. government's approach to Chinese technology companies but also called on the two countries' technology industries to strengthen ties and avoid a "cold war" (Birnbaum & Lapowsky, 2021). To mitigate the negative impact of the U.S. government's extreme measures, domestic interest groups in the United States have increased pressure on the government and tried to influence

policies. Compared with the U.S. approach of securitizing and politicizing economic and technological issues, China actively seeks cooperation and actively promotes economic, trade, and technological cooperation with countries around the world based on mutual benefit, which will inevitably win the support of most countries.

4.Policy Implications

According to the techno-geopolitical logic, the goal of a leading country is to defend its technological leadership, while hindering other countries' efforts to achieve technological independence and impeding their pursuit of technological advancement (Wong, 2022: 112-120). The technol-geopolitical competition between the United States and China has intensified under the Biden administration, leading to high-intensity competition and even confrontation. To respond to this, China must proceed with caution.

Firstly, based on its conditions, China must establish a pattern of science and technology development that equally values self-reliance and openness. On one hand, it plays a crucial role in upgrading the country's leading industries, expanding investment in technological research and development, and achieving national technological independence. China should continue to improve its scientific research innovation system and scientific research environment construction. It should optimize the allocation of scientific research resources and promote the S&T innovation-driven development strategy. Additionally, it should adopt a whole-of-government, whole-of-society approach to implementing strategic and basic technological projects. Furthermore, China should continue to promote reform and opening-up policy and build a competitive open innovation system. Create an internationally competitive science and technology innovation ecosystem by improving the open market economic system for socialism. Provide necessary support and convenience for high-tech enterprises to invest in China and enter the Chinese market while ensuring compliance. Enterprises with S&T competitiveness should be encouraged to expand globally. By transferring part of their production capacity, they can help China achieve industrial upgrading and assist underdeveloped countries in achieving growth. China can continue to provide policy and resource support for enterprise globalization by promoting development initiatives and rational industry distribution among regions.

Secondly, the United States and China should focus on areas of bilateral consensus to build a healthy paradigm of great power competition. (1) Resume cooperation in areas of common interest and expand channels for bilateral S&T cooperation. Although the techno-geopolitical competition between the two nations has become increasingly fierce, the common interests have not disappeared. In response to climate issues of common concern to China and the United States, the two countries can jointly promote scientific research cooperation and implementation of measures in the fields of decarbonization, renewable energy, green agriculture, greenhouse gas emission reduction, carbon capture and storage, and further expand cooperation in the fields of natural disaster prevention, carbon trading, atmospheric and marine science, etc. (2) Establish norms for a new type of great power competition. Reshaping the narrative of strategic competition and breaking through the "tragedy of great power politics" is not only a practical necessity to prevent the deterioration or even rupture of Sino-US S&T co-ecology but also an inevitable requirement to promote global governance over science and technology. China and the United States must eliminate ideological bias and hostility, take the improvement of governance capabilities, the enhancement of institutional innovation capabilities and the expansion of contributions to the international community, rather than techno-geopolitical gains and losses, as the main dimensions of competition, and develop together in healthy

competition. (3) Establish a bilateral science and technology mutual trust mechanism to reduce the negative impact of U.S. technological nationalism. At a time when techno-geopolitical competition among major powers is becoming increasingly fierce, the dregs of technological nationalism are emerging (Luo, 2022). To minimize the negative impact of technological nationalism, China and the United States need to conduct timely and appropriate communication on issues such as science and technology policies or regulations and industrial planning, establish verifiable, perceptible and guaranteed bilateral mutual trust under the United Nations (UN) framework, and even conclude bilateral agreements that allow moderate techno-nationalist measures, to avoid falling into a technological security dilemma. People-to-people exchanges are also an important way for both sides to resolve strategic doubts.

Finally, cultivate an inclusive global innovation ecosystem through multilateral coordination. China should proactively promote pragmatic technical cooperation with Europe and neighboring countries, taking advantage of the disagreement between the United States and its partners in terms of S& development and industrial layout. Bilateral problems should be properly resolved, and unavoidable conflicts should be managed or shelved to maximize the cooperation space. Using China-EU cooperation as an example, China should support Europe in advancing its strategic independence in various fields and help Europe overcome its historical dependence on the United States. At the same time, we should actively broaden and deepen China-EU S&T cooperation, promote the implementation of the China-EU Joint Roadmap for Future Science, Technology and Innovation Cooperation, and collaborate on the areas identified by the China-EU Co-funding Mechanism and the Horizon Europe framework. On the other hand, human society is currently facing unprecedented challenges. As responsible powers, China and the United States should promote the establishment of a fair, reasonable, and inclusive science and technology innovation ecosystem under the UN. They should also advocate for the creation of a multilateral framework for technology transfer, application, and sharing. This will help guide technology transformation from being a tool for great power competition to a solution for mankind's common problems.

5.Conclusion

With the continuous development of human science and technology, technology itself and its political use are becoming more and more important. The changes in the international environment and the rise and fall of great powers are taking on new forms. Some countries are taking extreme techno-nationalist measures to seize techno-geopolitical interests, devoting a lot of energy to contain and suppress the development of other countries. This not only results in a waste of resources available for technological development in their own countries, but also leads to the trend of confrontation, polarization, and fragmentation in the global technological ecosystem. This will intensify the tension in international relations. China, which is in a critical period of national rejuvenation, needs to handle the techno-geopolitical logic with caution and maintain an open and inclusive global S&T innovation environment while attaching importance to the key value of science and technology. In this process, issues such as how to manage the competition driven by techno-geopolitics among major powers, how to resolve the zero-sum situation in the technological field, and how to avoid the balkanization of the global technological ecosystem are common challenges faced by China and the United States.

6.References

Birnbaum, E., & Lapowsky, I. (2021, March 15). *How Tech Workers Feel about China, AI and Big Techs Tremendous Power*. Protocol. Retrieved from https://www.protocol.com/policy/tech-employee-survey/ tech-employee-survey-2021.

Butler, D. L. (2001). Technogeopolitics and the struggle for control of world air routes, 1910–1928. *Political Geography, 20(5)*, 635-658. https://doi.org/10.1016/S0962-6298(01)00006-3.

Dong, Z., Tan, Y., & Zhao, H. (2022). Does Artificial Intelligence Technology Induce Industry Reverse Gradient Transfer. Academic Monthly, 8, 55-66. doi: 10.19862/j.cnki.xsyk.000469.

European Commission. (2019, December 3). EU-China-A Strategic O-utlook. Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/ PDF/uri=CELEX:52019JC0005.

Gilpin, R. (1987). The political economy of international relations. Princeton, NJ: Princeton University Press.

Khan, K. et al., (2022). Geopolitics of technology: A new battlegrou-nd? Technological and Economic Development of Economy, 28(2), 442–462. https://doi.org/10.3846/tede.2022.16028.

Laksmana, E. A. (2020). Whose Centrality? ASEAN and the Quad in the Indo-Pacific. The Journal of Indo-Pacific Affairs, 3(5), 106-117.

Liu, X., & Li B. (2022). International Technology Standards and Great Powers Competition: A Case Study of Information and Communications Technology. Journal of Contemporary Asia-Pacific Studies, 1, 40-58+158.

Luo, Y. (2022). Illusions of Techno-Nationalism. Journal of Internatio-nal Business Studies, 53, 550-567. https://doi.org/10.1057/s41267-021-00468-5.

Macias, A. & Tausche, K. (2021, September 28). U.S. Needs to Wor-k with Europe to Slow Chinas Innovation Rate, Raimondo Says. C-NBC, https://www.cnbc.com/2021/09/28/ us-needs-to-work-with-europet-slow-chinas-innovation-rate-raimondo-says.html?qsearchterm=US%20n-eed%20to%20work%20with%20europe%20to%20slow%20China.

Maslej, N. et al. (2023, April). The AI Index 2023 Annual Report. Institute for Human-Centered AI, Stanford University. https://aiindex.stanford.edu/wp-content/uploads/2023/04/HAI_AI-Index-Report_2023.pdf.

Miailhe, N. (2018). The geopolitics of artificial intelligence: The return of empires? Politique étrangère, 1, 105-117. https://www.cairn-int.info/ journal--2018-3-page-105.htm.

Ministry of Foreign Affairs of Japan. (2022). Diplomatic Bluebook 2023. Retrieved from https://www.mofa.go.jp/policy/other/bluebook/2023/
pdf/pdfs/2023_all.pdf.

Sun, H. (2020). Offensive Techno-Nationalism and China-U.S. Tech War. Global Review, 5, 46-64+158-159. doi: 10.13851/j.cnki.gjzw.202005003.

Sun, Z., & Hoo, Y. (2021). Industrial Intelligence and Industrial Gradient Transfer: Re-Examination of the "Flying Geese Theory". The Journal of World Economy, 7, 29-54. doi: 10.19985/j.cnki.cassjwe.2021.07.003.

The White House. (n.d.). U.S. Strategic Framework for the Indo-Paci-fic. Retrieved December 22, 2023, from https://trumpwhitehouse.archi-ves.gov/wp-content/uploads/2021/01/IPS-Final-Declass.pdf.

The White House. (2021, June). Building resilient supply chains, revi-talizing American manufacturing, and fostering broad-based growth: 100-day reviews under Executive Order 14017. Retrieved December 22, 2023, from https://www.whitehouse.gov/wp-content/uploads/2021/06/100-day-supply-chain-review-report.pdf.

The White House. (2022, October). National Security Strategy. Retrie-ved December 22, 2023, from https://www.whitehouse.gov/wp-content/uploads/2022/10/Biden-Harris-Administrations-National-Security-Strategy-10.2022.pdf.

Yan, X. (2019). Transcending Geopolitical Strategic Thinking. Quarter-ly Journal of International Politics, 4, 4-7. doi: 10.16513/j.cnki.qjip.
2019.0022.

Wadhams, N. (2021, March 1). Biden Putting Tech, Not Troops, at C-ore of U.S.-China Policy. Bloomberg. Retrieved December 22, 2023, from https://www.bloomberg.com/news/articles/2021-03-01/biden-putting-tech-not-troops-at-center-of-u-s-china-strategy.

Wong, P. N. (2022). Techno-Geopolitics: U.S.-China Tech War and the Practice of Digital Statecraft. London: Routledge.

Yan, S. (2021). European Strategic Autonomy and Chinese Strategic New Thinking Towards the EU. Fudan Journal (Social Sciences Edition), 6, 126-136+165

How Geopolitics-oriented Policies Constrain Electric Vehicles Development

Xu Peng

1.Abstract

The world needs to decarbonize transportation, a sector that is now responsible for about a quarter of the worlds carbon dioxide emissions. Electric vehicle (EV) offers hope as climate challenges grow. In the United States and the European Union (EU), new regulatory targets aim for an EV share of 50-plus percent by 2030. As demand has increased globally, so has competition of the governments for leadership in the futureof transport.

China has been taking active industrial policies since 2000 that have bolstered domestic production and stimulated demand of EVs. Governments in the developed economies increasingly react to strategic competition with China by resorting to policies with a strong geopolitical orientation. This paper assesses the implication of the rapidly changing geopolitical landscape on EV development. It argues that these policies seeking to reshape the geographical distribution of EV supply chains severely challenge the trade and investment liberalization rationale which induce global trade diversion and distortion, erosion of the developing countries right to develop, and disruption of the global governance order.

This paper consists of three parts. Part I offers an overview of the global policy environment for EV development. Part II examines the impact of such more recent trade policies as carbon tariffs, subsidy, rules of origin, as well as trade sanctions on Russia taken by EU and U.S. on critical raw materials and batteries supply chains respectively. Part III highlights how the geopolitics-oriented policies by developed economies are likely to clash against the current trade disciplines and distort the global trading order.

Key words: geopolitics, electronic vehicle, critical raw material, battery supply chains, CBAM, USMCA, CMA, IRA, rule of origin, sanction, constraint

2.How Geopolitics-oriented Policies Constrain Electric Vehicles Development

We are living in an era where advanced technologies such as automation, digitization, and new business models have dramatically changed the way industries work. The automobile sector, which is shifting gears to completely new ways of mobility solutions such as electric vehicles (EVs), is no exception. This global shift towards an electric future in the automotive sector underlines the importance of supply chains. There is an urgent need to understand how to manage supply chain disruptions caused by current geopolitical events.

3.Global Policy Environment for Development of EV

A. Climate Change and Electronic Vehicle Market

The world needs to dramatically reduce its greenhouse gas emissions. Governments across the world are seeking to cut emissions as they adopt net zero targets for the coming decades. Reaching net zero is also a goal of the Paris Agreement, whose signatories include 193 countries and the EU. That leads to a shift to renewable sources of energy, and in particular, decarbonizing transportation, a sector that is now responsible for about a quarter of the world's carbon dioxide emissions.

Electric vehicles (EV) offers hope as climate challenges grow. Over the past 20 years, we have seen the rapid adoption of mobile electronics and the development of batteries and energy storage. That application has paved the way for huge advances in EV industry. To date, more than 20 countries have announced the full phase-out of internal combustion engine (ICE) car sales over the next 10-30 years. Moreover, more than 120 countries (accounting for around 85% of the global road vehicle fleet, excluding two/three-wheelers) have announced economy-wide net-zero emissions pledges that aim to reach net zero in the coming few decades.

Over the last decade a variety of support policies for EVs have been instituted in key markets which helped stimulate a major expansion of EV production. The global market for EVs is booming. Three markets dominated global sales. China, as the largest market, accounts for around 60% of global electric car sales. More than half of the electric cars on roads worldwide are now in China. In Europe, the second largest market, electric car sales increased by over 15% in 2022. Electric car sales in the United States – the third largest market – increased 55% in 2022, reaching a sales share of 8%. Globally, EV adoption differs quite significantly by region though. A total of 14% of all new cars sold were electric in 2022. Europe and China have similar adoption rates as a percent of volume, running somewhere close to 20 to 25 percent of new vehicles sold. But it is something like 5 to 7 percent of new vehicle sales being electric in the US.

B. Geopolitical Tensions and Global Trade Supply Chain Crisis

It has been noted that the use of terms such as "decoupling," "derisking," "reshoring," "nearshoring," and "friendshoring" in corporate presentations increased more than 20-fold between 2018 and 2022, which tells the very geopolitical feature of the world economy. The COVID pandemic leads to a shift towards nationalism and protectionism in the Western world that has led to tensions between nation states. Conflict between nation states has interfered with the smooth flow of global supply chains. The challenges of the COVID pandemic, the current geopolitical tensions between east and west, and sanctions imposed in response to the war in Ukraine have raised the risk to international trade supply chains and focused attention on improving supply chain resilience and security.

Geopolitical disruptions have impact on the design of supply chains. The US and EU initiatives aim to build independent battery supply chains for EVs from mines to battery plants, to substantially reduce reliance on China due to geopolitical risks. Meanwhile, due to the US sanctionsHuawei is trying to build an advanced independent semiconductor industry to shed reliance on Western semiconductors.

The ongoing conflict in Ukraine has rapidly exposed the vulnerabilities of todays global supply chains operations. Sanctions imposed by countries around the world include restrictions on trade finance, banking, individual Russian citizens, export bans and airspace restrictions, among others. Russias dominant role in global energy, industrial metals and soft commodities supply pushed commodity price inflation to the highest level. The EU and the U.K. have also banned Russian ships from docking at ports, which poses a significant risk to European supply chains. The automotive sector is facing disruption due to rising costs and the availability of nickel, copper, platinum group metals, aluminum and steel products. Escalating Russia risks, complex automotive supply chains and dependence on key metals make the global supply chain rather volatile.

4.Assessment of Recent Geopolitics-oriented Trade Policies

Recent years have witnessed the growing use of trade measures as geopolitical weapons. This paper mainly focuses on the four most important EV-related trade policies with strong geopolitical features: EU Carbon Border Adjustment Mechanism (CBAM), USMCA automotive rules of origin, US-Japan Critical Minerals Agreement, as well the sanctions on Russia.

C.EU Carbon Border Adjustment Mechanism

There is a consensus that reducing greenhouse gas (GHG) emissions to as close to zero as possible by mid-century is required to mitigate the worst impacts of climate change. Carbon pricing has been deemed a successful and efficient approach in cutting GHG emissions. The Carbon Border Adjustment Mechanism (CBAM) is a new tool of the EU aimed at extending the EU emissions trading system to import goods. It is intended to create future parity in competition between product manufacturers within the EU and outside the EU, while eliminating incentives for relocation to countries with lower decarbonization ambitions (carbon leakage).

EU importers of goods covered by the CBAM register with national authorities where they can also buy CBAM certificates. The price of the certificates will be based on the market value of a certificate from the EU Emissions Trading System (ETS), thereby treating CO2 emissions incurred within and outside the EU equally, creating a level playing field. EU importers declared the emissions embedded in its imports and surrenders the corresponding number of certificates each year. If importers can prove that carbon price has already been paid during the production of imported goods, the corresponding amount can be deducted.

Since October of 2023, many EU importers are subject to quarterly reporting requirements for imported goods, CO2 emissions, and CO2 taxes already paid in the countries of origin. With the start of emissions certificate trading for imported goods from 2026, higher manufacturing costs, and higher compliance costs in the automotive industry can be expected in the long term. Although the exact and more precise assessments of the CBAM on the economy, industry and climate can only be made after 2026 at the earliest, certain assumptions about the effect of CBAM can be made. One possible outcome is that the production of automobiles may become more expensive due to the inclusion of raw materials and components in the CBAM system. Currently, the emission certificate price in the ETS is in the range of EUR 90 to EUR 100 per ton of CO2 and has more than doubled in the past two years. With the introduction of CBAM and the expansion of the ETS to include the building and transport sectors, it is possible that the certificate price

will continue to rise in the long term. From the exporter's perspective, the CBAM looks no different from a tariff placed on their exports proportional to the carbon content. EV production relies heavily on raw materials such as steel and aluminum. The UNCTAD report shows that CBAM would substantially curtail exporting goods in carbon-intensive sectors such as steel and aluminum. The additional costs due to the introduction of CBAM would be passed on to consumers and the EV price would increase in the coming years.

Ironically, although the CBAM would be effective in reducing carbon leakage, it has less value in mitigating climate change as the mechanism would cut only 0.1% of global CO2 emissions.

D.USMCA automotive rules of origin and US-Japan Critical Minerals Agreement

The United States-Mexico-Canada Agreement entered into force on July 1, 2020, replacing the 1994 North American Free Trade Agreement (NAFTA). The USMCA automotive rules of origin changed those of NAFTA to impose a series of new requirements in the auto sector, among which are the following: (1) the specified Core Parts need to be originating viewed separately from the vehicle as a whole; (2) there must be a sufficient level of North American-sourced steel; (3) There must be a sufficient level of North American-sourced aluminum; (4) There must be a sufficient level of labor content value at wages of US$16 per hour or above.

In August 2022, the US enacted the Inflation Reduction Act (IRA), introducing the Clean Vehicle Credit. This is a subsidy for the purchase of qualifying battery or fuel cell operated vehicles in the form of a tax credit. To qualify for the full subsidy, a vehicle must, among others, be equipped with a battery that has at least some of its critical mineral content either recycled in North America or extracted and processed in the US or a country with which the US has a Free Trade Agreement or a Critical Minerals Agreement (CMA). However, a number of U.S. trading partners do not have a free trade agreement with the United States. On March 28. 2023, United States and Japan sign the Agreement on Critical Minerals Agreement, allowing electric vehicles using critical minerals sourced or processed in Japan to qualify for U.S. Inflation Reduction Act (IRA) tax credits. The US and the EU are also negotiating an agreement that would allow EU companies to receive some of the green subsidies provided by the US IRA.

The Agreement is the first in a number of new deals with limited scope. The GATT Article XXIV 8 (b) provides that "[a] free-trade area shall be understood to mean a group of two or more customs territories in which the duties and other restrictive regulations of commerce (except, where necessary, those permitted under Articles XI, XII, XIII, XIV, XV and XX) are eliminated on substantially all the trade between the constituent territories in products originating in such territories." According to this provision, CMA reached between the United States and Japan/EU shall not be construed as regional free trade agreements and thus shall not be allowed as an exception of the most-favored-nation treatment. Rather than they are protectionist measures creating discriminative effects against other WTO Members.

E. Sanctions on Russia

There has been no economy the size of Russias placed under such a wide array of commercial restrictions since the 1930s. The sanctions were imposed on Russia by 38 North American, European, and Asian governments. This wide range of legal, commercial, financial, and technological restrictions, been labelled a 'sanctions

revolution', has drastically impeded Russias access to the world economy and has delivered powerful economic shock. Additional sanctions on Russian oil and gas exports would magnify these effects further.

Batteries seem to be the core challenge. It is a large energy storage device that will go through multiple cycles in its life, and it contains precious metals. A typical EV battery pack, for example, needs about 8 kilograms of lithium, 35 kilograms of nickel, and 14 kilograms of cobalt. These minerals are extremely vulnerable in the event of trade disruptions because their global production is highly concentrated. About 70 percent of current global lithium production is in Australia and Chile, and the majority of global cobalt production is in the Democratic Republic of Congo. The top three producers of nickel, namely, Indonesia, Philippines and Russia, control more than 60 percent of supply. So, these countries have an outsize impact on supply.

With the popularity and the increase in demand for EVs, so goes the demand for the raw materials that go into the battery. It is estimated that by 2030, 40 percent of global battery demand could come from China. The International Energy Agency predicts that demand for copper will need to grow by a factor of 1.5, for nickel and cobalt to double, and for lithium to increase six times by 2030. Moreover, minerals are often hard to substitute.

The combination of concentrated supply and widespread demand has led to extensive commodity trading. Many countries rely heavily on imports from only a few suppliers. New trade restrictions have doubled since Ukraine War as producers impose curbs on shipments. It is estimated by an IMF research team that due to the fragmentation of critical material markets, the inability of the China-Russia bloc to import copper, nickel, lithium, and cobalt from mining countries such as Chile, the Democratic Republic of Congo, and Indonesia would lead to an additional price increase of 300 percent, on average. Acquiring minerals would be more expensive, which would lead to fewer EVs. In the longer term, critical minerals used to make EVs are highly vulnerable to more severe geopolitical constraints.

5.Free Trade, the right to develop, and International Rule of Law

A. Can "Make in America" be a Real Free Trade Agreement?

Stringent rules to establish the origin of a product, with the goal of increasing the regional value content in production at the expense of extra-regional value content, is an example of discrimination. This can be best illustrated by the Tesla new plan to move to Mexico. In February 2023, Tesla is reportedly planning to start up its new factory in Mexico in the first quarter of 2025. The most recent beneficial reasons to invest in the Mexican auto industry were created by the Inflation Reduction Act, which specified that many EV batteries, battery parts, and materials originating in Mexico are eligible for consumer subsidies in the United States of up to $7,500 per vehicle. In addition to the all-important North American market, Mexican-made vehicles can be exported mostly duty-free to the nearly 50 additional countries that have free trade agreements with Mexico or are co-parties to the Comprehensive and Progressive Trans-Pacific Partnership. These countries include the 27 members of the European Union, the UK, Israel, Japan, and Korea. By contrast, Chinese-made autos are currently subject to a 25% penalty tariff when imported into the United States today, making it impractical to import Tesla directly from its Shanghai factory to the U.S. a situation estimated to last for the foreseeable future.

According to a Chinese media report, Tesla has given this date to several Chinese suppliers. Several Chinese suppliers were cited in a Chinese media report, saying that Tesla has told them that if they fail to get local production up and running in Mexico by 2025, it will not only be difficult to get a Giga Mexico order in the future but orders for other Tesla plants could also be lost. According to one supplier, the production costs for the same component in Mexico are about 15 per cent higher than in China. This means that the purchase price for Tesla would be around 18 to 20 per cent higher.

What could be expected is a more discriminatory regionalism designed to increase, rather than reduce barriers to trade with nonmember. This type of regionalism would be less efficient and, ultimately, weaker. As Cecilia Malmstöm points out, "The US calls the critical minerals pact a 'free trade agreement'， but in reality the agreement is much more limited." Regionalism without the anchor of multilateralism may be more exposed to the powerful forces of disintegration.

B. Level Playing Field or Development as Freedom?

Carbon pricing is considered one of the strongest climate policies currently available and is set to play a key role in the decarbonization of the global economy. There are currently 73 carbon pricing mechanisms in operation worldwide, covering almost a quarter of global GHG emissions. The two main carbon pricing mechanisms used are carbon taxes and the emissions trading system. Carbon tax rates vary greatly worldwide, ranging from less than one U.S. dollar per ton of carbon dioxide equivalent (USD/tCO_2e) to more than 150 USD/tCO_2e in countries such as Sweden and Uruguay.

UNCTAD has warned that the EU CBAM could change trade patterns in favor of countries where production is relatively carbon-efficient but has less effect on mitigating climate change. American manufacturers are on average less carbon-intensive than most of their foreign competitors. In particular, the U.S. economy is almost 50% less carbon-intensive than its trading partners like China (3x more) and India (4x more). The introduction of a CBAM results in declines in exports in developing countries in favour of developed countries, which tend to have less carbon intensive production processes. In fact, the PRC, and other large non-OECD countries, such as India, Indonesia, and Thailand, currently share the view that CBAM is a protectionist and discriminatory policy measure, and concerns remain on CBAMs incompatibility with World Trade Organization (WTO) rules. Unilateral trade measures that require developing countries to adopt Greenhouse Gas (GHG) mitigation policies that are comparable in effect to those adopted by developed countries could not be justified under Article XX of the General Agreement on Tariffs and Trade (GATT).

These outcomes of CBAM are also at odds with the principle of common but differentiated responsibilities articulated in the United Nations Framework Convention on Climate Change and reaffirmed in Article 4(3) of the Paris Agreement. The principle of common but differentiated responsibility means that developed countries should invest in and take the main responsibility for the development and diffusion of the technologies needed to transform energy-intensive industries. More than 70 percent of the key EV equipment suppliers, for both coating and general cell assembly equipment, are based in Asia, with the remainder evenly split between North American and Europe. Having gotten rich burning the fossil fuels that are responsible for the majority of historical greenhouse gas emissions, it is very wrong for a set of the world's wealthy countries now wants to collude to prevent mostly developing economies from benefitting from the green energy boom through higher prices for their commodity exports.

C.Multilateralism at the Crossroad?

We have entered an era where governments are embracing more unilateral tools to resist foreign economic influence and reinvigorating national industrial policies. States are using entry into their markets to gain global regulatory power. Now that the EU has opened the door, other nations, including the United States, are developing their own versions of CBAM policies. A US version of the CBAM was introduced in Congress by Senator Whitehouse and colleagues to boost domestic manufacturers and address climate change. Starting in 2024, the adjustment would apply to carbon-intensive products of domestic producers and importers. Given the multiple design features of CBAMs and the policy decisions that must be made, one can expect to see a good deal of variation as other nations develop their own versions. Given that sovereign nations are under no obligation to align their CBAMs with those of other nations, what will be the impact on international trading regime?

By its very nature, the WTO stresses the primacy of the multilateral system and rejects unilateralism. In the WTO shrimp-turtle case, the Panel writes: “If an interpretation of the chapeau of Article XX were to be followed which would allow a Member to adopt measures conditioning access to its market for a given product upon the adoption by the exporting Members of certain policies, including conservation policies, GATT 1994 and thew WTO Agreement could no longer serve as a multilateral framework for trade among Members as security and predictability of trade relations under those agreements would be threatened.” “[I]f one WTO Member were allowed to adopt such measures, then other Members would also have the right to adopt similar measures on the same subject but with differing, or even conflicting, requirements. If that happened, it would be impossible for exporting Members to comply at the same time with multiple conflicting policy requirements. “Market access for goods could become subject to an increasing number of conflicting policy requirements for the same product and this would rapidly lead to the end of the WTO multilateral trading system.”

Discriminatory regionalism may also be leveraged to achieve nontrade objectives such as ensuring higher labor and environmental standards, the adoption of domestic rather than global standards, or redirection of supply chains for national security reasons. In promoting the US version of CBAM, Senator Chris Coons claims that “[a]s the E.U., which is our largest trading bloc that shares our core values, gets closer and closer to imposing tariffs on American products because of their carbon border adjustment mechanism, finding a way to reconcile their approach and our approach … would make sense.” Both US-Japan and US-EU CMA address that “[s]trong environmental and labor provisions will help ensure greater supply of sustainability sourced critical raw materials”. These practices are reflective of a trend towards greater use of coercive trade measures to advance environmental and other policy objectives and thus are contrary to the spirit of multilateral trade rules and could increase integration costs and hinder efficiency. Economist Michele Ruta argues that "the trend toward strengthening ties with friends and loosening them with non-friends is making regional trade less about integration and more about discrimination".

D.Is Trade Sanction Panacea?

As the global economy is far more integrated, today’s sanctions have global economic effects far greater than before. Higher commodity prices, transaction costs, bigger supply

bottlenecks and trade losses affect more people around the world. We should reconsider sanctions as a powerful policy instrument with global economic implications.

Trade sanctions are taken to impact on the behavior of the target States. Economic power is used to exert political leverage. Political manipulation of the institutions by members in pursuit of their perceived national interests may be unavoidable once political considerations are allowed to be freely taken into account. However, trade policy measures usually are not the best instruments for achieving social objectives. This is because trade sanctions do not directly affect the root cause of social problems. Since sanctions combine foreign policy objectives and economic measures, when used, they always generate resentment and resistance. It is almost inevitable that trade sanction will lead to an escalation in trade disputes. They could be followed by retaliatory and counter-retaliatory action. The result then would be an undermining of the global trading system.

Countries may have very different preferences regarding trade linkage issues, which reflect differences in economic development levels, and differences in culture. Imposing sanctions is usually the privilege of large, powerful economies that have considerable bargaining power. Smaller, weaker economies with little bargaining power tend to oppose the use of sanction. The effectiveness of trade sanctions will be limited if the targeted nation does not have the resources to enforce certain regulations. In such cases, the sanction may make it harder for the country to achieve social improvements.

While this is recognized, trade policy is often attractive because it can be used in an attempt to induce countries to apply certain social norms. If the developing countries are members of the WTO agreements, there is the strong possibility of their compliance. However, the mere fact that the developing countries are likely to comply with binding rules doesnt necessarily mean that the outcome is appropriate. If the rules are inappropriate, then a strong enforcement mechanism would actually worsen an inappropriate outcome.

In Bangladesh, the threaten to export when the Harkin bill on banning products using child labor was being considered in the U.S. Congress led to the discharge of female children in textiles, who were often forced instead into prostitution by destitute parents. The ban on ivory trade also provides a case in point. The ivory-trade ban has reduced the value of the elephant products so much that it is no longer profitable to cull the herd. An unfortunate environmental consequence is that bush land is being decimated by the increased number of elephants, which is endangering other species.

Recent research shows that RTAs with child labor bans, paradoxically, can have the opposite effect: they shrink childrens wages and sometimes lead poorer households to send more of their children into the labor market to make up for the lost income. This is not a new story, though. The execution of European import bans on tropical hardwood logs (together with tariff escalation on timber-product imports) has encouraged Indonesia to ban log exports. But since felling and timber-product exports have been allowed to continue, this policy has simply lowered the domestic price of logs and thereby raised effective assistance to Indonesias furniture and other timber-using industries to extremely high levels. With lower log prices and lower-quality saw-milling techniques than in importing countries, it is not surprising that less of each tree is now used and little reduction in logging has been observed since the log export ban was introduced.

The Russia-Ukraine situation has irreversibly changed the international landscape. Sanctions taken in response to Russias actions, especially energy-related sanctions, have

pushed inflation high across Europe and exposed the energy vulnerability of countries such as Germany. In response, there has been substantial investment within Europe for renewable energy sources, and a drive to become energy-self-sufficient within Europe. The UK has recently greenlit the development of a new oil field in the North Sea – the Rosebank development – arguably in conflict with its net zero targets. These developments evidence general skepticism towards international trade in global policymaking.

6.Conclusion

The recent geopolitics-oriented trade policies taken by the developed economies would seriously undermine international efforts to fight climate change and adversely constrain the development of EVs. They are of protectionist and discriminatory nature. Multilateral cooperation is essential to prevent vicious spirals where countries impose trade restrictions as a risk management tool. A revival of multilateralism is necessary in an age of conflict.

7.Reference

International Energy Agency. (2021). Global EV Outlook 2021 (p. 46).

International Energy Agency. (2023). Global EV Outlook 2023 (p. 9).

Hensley, R. (2022). Electric vehicles are here, and large-scale adoption is … near? Retrieved January 24, 2024, from https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/electric-vehicles-are-here-and-large-scale-adoption-is-near

Aiyar, S., Chen, J., Ebeke, C. H., Garcia-Saltos, R., Gudmundsson, T., Llyina, A., Kangur, A., Kunaratskul, T., Rodriguez, S. L., Ruta, M., Schulze, T., Soderberg, G., & Trevino, J. P. (2023). Geoeconomic fragmentation and the future of multilateralism.

IMF Staff Discussion Notes. Retrieved January 24, 2024, from https://www.imf.org/en/Publications/Staff-Discussion-Notes/Issues/2023/01/11/Geo-Economic-Fragmentation-and-the-Future-of-Multilateralism-527266

Bednarski, L., Roscoe, S., Blome, C., & Schleper, M. C. (2023). Geopolitical disruptions in global supply chains: A state-of-the-art literature review.

Production Planning & Control. Retrieved January 24, 2024, from https://www.tandfonline.com/doi/full/10.1080/09537287.2023.2286283

European Commission. (n.d.). Carbon border adjustment mechanism. Retrieved from https://taxation-customs.ec.europa.eu/carbon-border-adjustment-mechanism_en

Statista. (n.d.). Daily European Union Emission Trading System (EU-ETS) carbon pricing from 2022 to 2023. Retrieved from www.statista.com

United States-Mexico-Canada Agreement. (n.d.). Chapter 4.

United States Congress. (2022). H.R.5376 – Inflation Reduction Act of 2022. Retrieved January 24, 2024, from https://www.congress.gov/bill/117th-congress/house-bill/5376

Office of the United States Trade Representative. (2022). United States and Japan sign critical minerals agreement on March 28, 2022. Retrieved January 24, 2024, from https://ustr.gov/sites/default/files/2023-03/US%20Japan%20Critical%20Minerals%20Agreement%202023%2003%2028.pdf

International Energy Agency. (2021). Global EV Outlook 2021 (p. 46).

International Energy Agency. (2023). Global EV Outlook 2023 (p. 9).

Hensley, R. (2022). Electric vehicles are here, and large-scale adoption is … near? Retrieved January 24, 2024, from https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/electric-vehicles-are-here-and-large-scale-adoption-is-near

Aiyar, S., Chen, J., Ebeke, C. H., Garcia-Saltos, R., Gudmundsson, T., Llyina, A., Kangur, A., Kunaratskul, T., Rodriguez, S. L., Ruta, M., Schulze, T., Soderberg, G., & Trevino, J. P. (2023). Geoeconomic fragmentation and the future of multilateralism.

IMF Staff Discussion Notes. Retrieved January 24, 2024, from https://www.imf.org/en/Publications/Staff-Discussion-Notes/Issues/2023/01/11/Geo-Economic-Fragmentation-and-the-Future-of-Multilateralism-527266

Bednarski, L., Roscoe, S., Blome, C., & Schleper, M. C. (2023). Geopolitical disruptions in global supply chains: A state-of-the-art literature review. Production Planning & Control. Retrieved January 24, 2024, from https://www.tandfonline.com/doi/full/10.1080/09537287.2023.2286283

European Commission. (n.d.). Carbon border adjustment mechanism. Retrieved from https://taxation-customs.ec.europa.eu/carbon-border-adjustment-mechanism_en

Statista. (n.d.). Daily European Union Emission Trading System (EU-ETS) carbon pricing from 2022 to 2023. Retrieved from www.statista.com

United States-Mexico-Canada Agreement. (n.d.). Chapter 4.

United States Congress. (2022). H.R.5376 – Inflation Reduction Act of 2022. Retrieved January 24, 2024, from https://www.congress.gov/bill/117th-congress/house-bill/5376

Office of the United States Trade Representative. (2022). United States and Japan sign critical minerals agreement on March 28, 2022. Retrieved January 24, 2024, from https://ustr.gov/sites/default/files/2023-03/US%20Japan%20Critical%20Minerals%20Agreement%202023%2003%2028.pdf

Szczepański, M. (2023). EU-US Critical Minerals Agreement: Building Stronger Supply Chains Together. European Parliamentary Research Service. Retrieved January 24, 2024, from https://www.europarl.europa.eu/thinktank/en/document.html?reference=EPRS_BRI(2023)733906

Azevedo, M., Baczyńska, M., Hoffman, K., & Krauze, A. (2022). Lithium mining: How new production technologies could fuel the global EV revolution. McKinsey. Retrieved January 24, 2024, from https://www.mckinsey.com/industries/metals-and-mining/our-insights/lithium-mining-how-new-production-technologies-could-fuel-the-global-ev-revolution

British Geological Survey; US Geological Survey. (2023).

Breiter, A., Horetsky, E., Linder, M., & Rettig, R. (2022). Power spike: How battery makers can respond to surging demand from EVs. McKinsey. Retrieved January 24, 2024, from https://www.mckinsey.com/capabilities/operations/our-insights/power-spike-how-battery-makers-can-respond-to-surging-demand-from-evs

Evans, C., Santoro, M., & Stuermer, M. (2023). A critical matter: Fragmentation of critical mineral markets would slow the shift to clean energy. Finance and Development. Retrieved January 24, 2024, from https://www.imf.org/external/pubs/ft/fandd/2023/12/fragmentation-of-critical-mineral-markets-evans-santoro-stuermer.htm

SAFE Electrification Coalition. (2022). Fact Sheet—IRA EV Tax Credits. Retrieved January 24, 2024, from https://electrificationcoalition.org/wp-content/uploads/2022/08/SAFE

Notes

1 https://ec.europa.eu/eurostat/web/products-eurostat-news/w/ddn-20231215-3

2 https://ec.europa.eu/commission/presscorner/detail/en/ip_23_1668

3 https://www.mcid.gov.ro/programe-europene/pnrr/

4 https://transilvaniadih.ro/en/news/tediht-secures-funding-to-boost-digital-innovation-in-northwestern-romania/

5 www.transilvaniadih.ro

6 https://blog.axway.com/product-insights/b2b-integration/einvoicing/romania-e-invoicing-requirements

7 https://dealroom.co/blog/central-and-eastern-european-an-efficient-and-resilient-startup-region

II.Digital Transformation

Shaping the Future by Nurturing Sustainable Industrial Innovation Ecosystems in the Digital Intelligence Era: One of The Important Roles of Higher Education

Youmin Xi – Feifei Zhu

1.Abstract

This paper examines the impact of new technologies in the digital intelligence era, focusing on the dual aspects of disruption and innovative opportunities. It discusses the evolution of industrial innovation ecosystems, emphasizing the integral role of higher education, particularly Xi'an Jiaotong-Liverpool University (XJTLU), in fostering these ecosystems. The paper highlights the necessity for industry leaders skilled in integrating various ecosystem elements and delves into future-oriented talent development strategies. It concludes with a call for further research into ecological management within these emerging ecosystems, considering the paradigm shifts in traditional management strategies necessitated by digital intelligence mechanisms.

2.Introduction and background

In the era of digital intelligence, the emergence of disruptive technologies is undeniably beneficial for social development and progress, both in terms of enhancing efficiency and creating new industries (Vinuesa et al., 2020; Barakina, Popova, Gorokhova, & Voskovskaya, 2021). However, the sprouting of Neo-Luddism serves as a reminder: new technologies, such as the continuously evolving artificial intelligence (AI) and robotics, are also disruptive forces reshaping many industries and the job market, triggering anxiety and paradigm shifts, thereby affecting social dynamics (Saveliev & Zhurenkov, 2021; Tarnoff, 2014; Doctorow, 2021; Horgan, 2007; Conniff, 2021). Facing these challenges, resistance and anxiety are futile. Only by reshaping our mindset through disruptive innovation and development mechanisms can we move forward into the future.

Digital intelligence technologies favor "sharing, symbiosis, and human-machine integration," leading to the formation of various ecosystems. Economic and social development mechanisms will adjust accordingly, and traditional management controls will cede significant space to intervention and evolution. Therefore, for individuals, interest-driven learning to develop expertise and unique value in a certain field, integrating into the corresponding ecosystem is essential. For organizations, promoting deep integration of "industry, university, research, government, and society" to form an innovative ecosystem and a shared destiny community will become an inevitable trend. However, digitization, corporate digital transformation, barrier elimination in ecosystem creation, and ecological governance face many challenges. Education, especially universities with their non-profit nature, independence, and fairness, can act as the

adhesive, catalyst, and promoter in this innovative ecosystem. Through interaction and collaboration with the government and industry, integrating shared resources, and stimulating competitive and cooperative innovation for mutual benefit, universities can help society resist the disruptive effects of technology, while also creating new engines for economic development and enhancing the society's adaptability and development capacity. XJTLU has years of exploration and innovative practice in this area and will be analyzed in this article.

The global environment is currently characterized by uncertainty, ambiguity, complexity, changeability, and scarcity (UACCS) (Xi, Y., & Li, C. 2023). In an era of continuous technological evolution, human existence, social-economic development, and modes of operation in education, business, and industry have undergone revolutionary changes. Numerous studies have discussed the negative impact of rapid AI improvements on the economy and society. These include job displacement due to AI and automation, especially affecting low-skilled workers even the knowledge workers by recent quick iterating of the ChatGPT; market dominance risks and economic inequality exacerbated by large tech companies; and concerns over privacy, data security, ethical issues, cognitive decline due to technology overreliance, and increased systemic vulnerability. However, new technologies also bring opportunities, such as enhanced productivity and efficiency, creation of new industries and jobs, and data-driven decision-making effectiveness. Technological development has broken geographic barriers, accelerating global economic integration and ecologization of industries. This paper aims to focus on the opportunities presented by new technologies, analyze how to integrate various societal elements to form a community of shared interests, and build an innovative ecosystem to gain ecological dividends, emphasizing the crucial role of higher education in enhancing societal adaptability to technological disruptions.

3.Literature Review

AI and advanced technologies have significantly transformed various sectors of society, including education. The integration of AI in education is revolutionizing teaching methodologies and learning experiences. AI tools like intelligent tutoring systems, adaptive learning platforms, and educational data analytics are reshaping educational paradigms (Vinuesa et al., 2020; Barakina, Popova, Gorokhova, & Voskovskaya, 2021). However, these advancements also bring forth challenges, particularly in terms of ethical considerations, data privacy, and the potential widening of the digital divide (Saveliev & Zhurenkov, 2021). Despite these challenges, AI and advanced technologies offer unparalleled opportunities. They can tailor learning experiences to individual needs, thus enhancing student engagement and learning outcomes (Barakina et al., 2021). With the challenges and opportunities brought by new technology, education system especially higher education needs to lead the education reform with the purpose of future-oriented talent cultivation, and step into society to perform the role of promoting sustainable social development.

Universities play a pivotal role in the initial stages of innovation ecosystems, acting as attractors that lay the groundwork for technological advancement and support ecosystem expansion (Heaton, Siegel, & Teece, 2021). As these ecosystems develop, universities contribute significantly by orchestrating information flow and fostering entrepreneurship through various programmes. In the renewal and transformation stages, they combat urban blight and economic decline, engaging in activities that rejuvenate local communities. Case studies of institutions like Carnegie Mellon University and University of California Berkeley demonstrate successful models as innovation hubs, showcasing

how universities can effectively lead in the innovation ecosystem (Heaton et al., 2021). Furthermore, the broader economic development role of universities, particularly in collaboration with industry, is subject to ongoing research and debate (Trippl, Asheim, & Miorner, 2015; Wakkee, van den Bosch, & Kreijns, 2019).

In their capacity as network orchestrators, universities influence the evolution of entire ecosystems, facilitating knowledge mobility and promoting innovation appropriability, thereby spreading value across regions (Milwood & Roehl, 2018; Dhanaraj & Parkhe, 2006). The Alliance for Innovation in Porto Alegre is a prime example, demonstrating how universities can engage various stakeholders to support innovative and internationally recognized cities (Fonseca, 2018). In emerging economies, universities play a critical role in orchestrating ecosystems conducive to entrepreneurship and innovation, often taking on place leadership functions where other institutions may be less effective (Goddard, Hazelkorn, Kempton, & Vallance, 2016; Trippl et al., 2015). This role is essential for mobilizing a broad number of local and regional stakeholders, reflecting the combined top-down and bottom-up approaches necessary for fostering innovation and social development.

4.Discussion and Analysis

Evolution of Industrial Innovation Ecosystem

In the digital and intelligent era based on new technologies, economic activities have broken free from many constraints of the planned and market economies, such as unit concepts and organizational boundaries, leading to a trend of de-boundarization (Heaton et al., 2021). This has given rise to popular and unique sharing mechanisms, termed the sharing economy. Additionally, de-boundarization has facilitated the aggregation and integration of complementary and cooperative elements, resulting in a noticeable ecologization across many fields, even heralding the advent of an ecological era. The evolution of these ecosystems is driven by symbiotic mechanisms (Heaton et al., 2021). The interconnectedness and immediacy of global information have dissolved the boundaries of regional or local markets, fostering market integration, direct producer-consumer interactions, and challenging the viability of intermediaries. The sharing, symbiotic mechanisms, and market integration in the digital economy are leading to business model transformations, industrial upgrades, and the emergence of new industries.

Digital transformation, driven by new technologies, is fundamental to the formation of industrial ecosystems or new industrial paradigms. According to the Ministry of Industry and Information Technology of China, by July 2023, China had nearly 8000 digital workshops and intelligent factories, with over 2500 completing digital transformation and 209 becoming world-class intelligent manufacturing demonstration factories (Ministry of Industry and Information Technology of China, 2023). By 2022, the scale of China's digital economy reached approximately 50.2 trillion yuan (about 7.25 trillion USD), accounting for 41.5% of its GDP (China National Bureau of Statistics, 2023), highlighting its significant role in the overall economy.

However, building digital parks alone is insufficient without integrating industrial value networks, as it risks creating digital islands and a lack of connection between digital and business operations. Moreover, integrating industry elements and enterprises is necessary to form clustering effects and ecological value. Some regions have already built industrial internet clusters, supply chain ecological parks, and high-quality industrial development

demonstration zones, marking progress on the digital and internet foundations. But without integrating industry value networks and relevant elements, it's challenging to form a good industrial ecology. The elements of an industrial ecosystem include society, government, industry, education, and research, influencing each other in an innovative and collaborative process.

The aggregation and evolution of these elements into an ecosystem are driven by their interdependent needs and shared goals. The main objective of building an industrial ecosystem is to harness ecological dividends, which manifest in three aspects: shared dividends from cost-saving and increased effectiveness through shared platforms and resources; symbiotic dividends from cooperation, stimulation, and competition within the ecosystem, leading to new ideas, businesses, and models; and system integration and optimization dividends, not just a simple entry of elements into a community, but requiring integration, innovation, system optimization, and overall upgrading, such as enhancing the community's brand, increasing resource efficiency, reducing transaction costs, expanding new businesses, and benefiting all ecosystem members through the ecosystem's integration power and dissemination ability, similar to how the sum of the system is much greater than its individual parts, allowing the industry to enjoy system dividends.

The Role of Higher Education in Fostering Industrial Innovation Ecosystems

Revisiting the critical elements of industrial ecosystems - society, government, industry, education, and research - their needs are indeed interdependent. Society requires resources for sustainable development, government depends on cooperation for effective governance, industry relies on support for talent, technology R&D, and policy for innovation, education needs development resources to nurture future talents, and research adapts to application scenarios and future trends. Higher education, especially universities, with their fairness, independence, and non-profit nature, plays a vital role in two key areas:

5.As a Catalyst and Adhesive for Industrial Innovation Ecosystems

Universities could utilize their strengths and social functions to link society, government, industry, and research, providing a platform for ecological cooperation. For instance, Xi'an Jiaotong-Liverpool University (XJTLU) has established an educational system parallel to three models over 17 years. XJTLU's 1.0 model innovates and upgrades traditional programme-based education, creating a flat, networked modern university operation system and building new interactions and cooperation between the university and society. The 2.0 model, addressing challenges of intelligence, robotics, and connectivity, launches Syntegrative Education, exploring industry academies in collaboration with businesses, experimenting with future higher education content, and campus forms, as well as multi-campus collaboration, creating a sustainable "Education, Innovation, and Entrepreneurship Community" with the government and businesses. In the 3.0 model, the university acts proactively as a "catalyst" and "adhesive," emphasizing societal integration to support interest-driven learning, lifelong education, innovation, entrepreneurship, corporate R&D, and industry upgrading (Xi, 2022).

In the 3.0 model, the College of Industrial-Entrepreneurs, in short CIE, (Xi'an Jiaotong-Liverpool University, 2023b) focuses on future societal and industrial development. Leveraging XJTLU's technological platform and international network, it integrates domestic and international resources. Organizing professional teams to enter businesses

or industries, the College collaborates in a 'clinical consultation' manner to research, design, and implement industrial upgrading and innovative development plans. Concurrently, it enhances and cultivates relevant talent, fostering and supporting a range of future-oriented and dynamic industries, and nurturing a group of industry leaders who will lead the future and excel globally. At the same time, the CIE is committed to continuously aggregating, creating, and consolidating solutions and knowledge systems for the development of the industrial ecosystem. It aims to build a friendly, strong, and personalized support platform for the nurturing and growth of industry leaders, as well as to promote the iterative upgrading and innovative transformation of the industrial ecosystem. (Xi'an Jiaotong-Liverpool University, 2023a). For instance, the Belt Road Initiative (BRI) has been proposed by Chinese President Xi Jinping over 10 years (Ministry of Foreign Affairs of the People's Republic of China, 2013). A lots of discussions and actions have been carried out. But from the ecology perspective, there is huge room to release its potential via building more ecosystems by their stakeholders to benefit the countries and regions around BRI. Currently, the CIE is working with the entrepreneurs in mid Europe countries and partners in various industries, including finance sector, to develop a branch of CIE, i.e. CIE (BRI) to support the building of industrial ecosystems.

Furthermore, universities can leverage new technologies to build online education platforms, gradually expanding to an industry ecosystem resource integration platform, providing a digital foundation for the creation of industrial innovation ecosystems. XJTLU's X-Eco Mall (Xi'an Jiaotong-Liverpool University, 2023b) establishment exemplifies this approach. Universities can also use their international academic networks to organize events or conferences, linking ecosystem elements to discuss future trends, challenges, and solutions, stimulating innovation and expanding the industrial ecosystem's scope and influence. For example, XJTLU's Global Entrepreneurial Dream-Chasers Competition (Xi'an Jiaotong-Liverpool University, 2022), supported by the government and various industries, saw participation from hundreds of teams from universities worldwide, infusing fresh talent and ideas, projects and products as well into industry and socio-economic development.

6.Cultivating Future-Oriented Talents

In the digital intelligence era, the cultivation of industry leaders, capable of integrating various elements of the industrial ecosystem, is crucial. These leaders would blend value networks, digital resources, enterprises, and innovation elements to develop a shared, symbiotic, cooperative, and mutually beneficial industrial ecology. To meet such kind of talent needs, XJTLU has conducted research and practice in education, especially for future leaders. They introduced the XJTLU HeXie (Harmonious) Education Model (Xi, Y., Zhang, X., & Li, N. ,2022), centered around the HeXie (Harmonious) Management Theory framework. This model focuses on three stages of human life - learning, growth, and being, encompassing five types of learning: inherited learning, reflective cognition, explorative integration, interest-driven accumulation, and mind-upgrading progress. These learning types span a person's life, integrating literacy, professional, and management education to continuously upgrade and advance the mind, forming a harmonious mindset essential for industry leaders. XJTLU SE (2.0) is using industry schools to integrate the disciplinary education with management and entrepreneurial training as well as cross-culture leadership development to train the future industrial leaders. The CIE is trying to use "clinic" way to upgrade the development of industry and at same time to nurture the Industry-Entrepreneurs who could integrate the resources from

different sector or institutions and build the industrial ecosystems by crossing the boundary of companies and institutes.

7.Conclusions and Recommendations

This article explores the challenges and opportunities brought by new technologies to society, analyzing approaches to mitigate negative impacts while seizing opportunities for sustainable development. It discusses the evolution of the industrial innovation ecosystem and demonstrates the role of higher education, specifically using Xi'an Jiaotong-Liverpool University as a case study. The article also raises important research areas within the theme of industrial innovation ecosystems, such as the meaning of management or governance in this context, necessary adjustments in traditional management strategies, and the introduction of new concepts such as digital intelligence mechanisms and Industry-Entrepreneur etc. in the era. The need for further exploration of these issues, both in practice and theory, is emphasized.

8.References

Conniff, R. (2021). Neo-Luddisms Tech Skepticism. The New Republic.

Dhanaraj, C., & Parkhe, A. (2006). Orchestrating innovation networks. Academy of Management Review, 31(3), 659-669.

Doctorow, C. (2021). I'm a Luddite. You should be one too. Lens.Education 2021; Eskindarov 2021. Digital Technologies and AI in Education. European Journal of Contemporary Education.

Faccin, K., Kniess, C. T., & Bataglia, W. (2020). Universities as orchestrators of innovation ecosystems: The case of the alliance for innovation in Brazil. Industry and Higher Education, 34(2), 117-130.

Fonseca, A. (2018). Universities as orchestrators of the development of regional innovation ecosystems. Universities and Knowledge Society Journal, 15(2), 1-15.

Goddard, J., Hazelkorn, E., Kempton, L., & Vallance, P. (2016). The Civic University: The policy and leadership challenges. Edward Elgar Publishing.

Heaton, S., Siegel, D. S., & Teece, D. J. (2021). Universities and innovation ecosystems: A dynamic capabilities perspective. Innovation and Entrepreneurship, 29(4), 921-942.

Horgan, J. (2007). Against Technology: From the Luddites to Neo-Luddism. Physics Today.

Milwood, P., & Roehl, W. (2018). Orchestrating the network: The role of universities in regional innovation ecosystems. Regional Studies, 52(7), 897-908.

Ministry of Industry and Information Technology of China. (2023). Digital China Development Report 2022 Released: China's Digital Economy Ranks Second in the World. BusinessWire.

Saveliev, A., & Zhurenkov, D. (2020). AI and Social Responsibility. Kybernetes.

Tarnoff, B. (2014). The new Luddites: Why former digital prophets are turning against tech. New Statesman.

Vinuesa, R., Azizpour, H., Leite, I., Balaam, M., Dignum, V., Domisch, S., ... & Nerini, F. F. (2020). The role of artificial intelligence in achieving the Sustainable Development Goals. Nature Communications, 11(1), 1-10.
Ministry of Foreign Affairs of the People's Republic of China. (2013).

President Xi Jinping delivers important speech and proposes to build a Silk Road Economic Belt with Central Asian countries. Retrieved from https://www.fmprc.gov.cn/mfa_eng/topics665678/3755_666062/2013zt/xjpfwzysiesgjtfhshzzfh_665686/201309/t20130913_707056.html

Xi, Y. (2022). XJTLU is poised to lead education reform in China. Times Higher Education.

Xi, Y., Zhang, X., & Li, N. (2022). 和谐教育之道：西交利物浦大学办学探索与实践. [The way of harmonious education: The exploration and practice of running Xi'an Jiaotong-Liverpool University].

Xi, Y., & Li, C. (2023). Envisioning and Exploring Future Transnational Higher Education and Management Models: The Transformation of Higher Education in the UACC World. In G. Morris & L. Li (Eds.), Handbook of Research on Developments and Future Trends in Transnational Higher Education (pp. 397-424). IGI Global. https://doi.org/10.4018/978-1-6684-5226-4.ch021

Xi'an Jiaotong-Liverpool University. (2022). XJTLU Global Entrepreneur Dream-Chasers Competition. Retrieved from https://www.xjtlu.edu.cn/en/study/departments/entrepreneurship-and-enterprise-hub/dream-chase-rs.

Xi'an Jiaotong-Liverpool University. (2023a). University-Industry Research Collaborations. Retrieved from https://www.xjtlu.edu.cn/en/research/projects.

Xi'an Jiaotong-Liverpool University. (2023b). XJTLU launches College of Industr - Entrepreneurs, X-Eco Mall. Retrieved from https://www.xjtlu.edu.cn/en/news/2023/11/xjtlu-launches-college-of-industry-entrepreneurs-x-eco-mall

Digitalization and small businesses – a Romanian perspective

Mariana Nicolae

The content of the present paper represents the author's contribution to the panel entitled **Digitalization and small businesses** that was part of the international conference "The Economic Impact of Emerging Technologies" organized on the 20th of November 2023 by the Mathias Corvinus Collegium (MCC) in Budapest, Hungary.

The author's contribution to the panel discussions addressed the following points:

- Brief context of digitalization across Europe
- What is the general picture of digitalization of small businesses in Romania?
- What can Romania offer to potential investors in digitalization?

1.Brief context of digitalization across Europe

The buzz words of today's world are many, from many areas, but it somehow seems that the most popular ones come from artificial intelligence (AI) and computer science related fields. Digitization, the process of converting information into a digital format, and the larger digitalization concept referring to the adoption of digital technologies are being used in various contexts by people who have a vague idea of what they really mean or, on the contrary, being well aware of both their meaning and their increasingly important impacts on the world. Gobble (2018) underlines that the two-letter distinction between the two words is very small indeed, however the gap in meaning and content is huge. She also discusses the importance of the two when related to innovation, which is another of the concepts that seem to decide on the viability of organizations in the world today. Quoting Brennen & Kreiss (2016), Gobble draws attention to the ambivalent quality of digitalization which serves "both as an organizing mode across social domains and as a destabilizing force."

With this in mind, it is important to look at the positive aspects of digitalization which increases efficiency and productivity in various sectors such as business, healthcare, education, and government. Automation of repetitive tasks allows organizations to focus on more complex and value-added activities. Digitalization allows global connectivity through instant communication and through establishing networks on a global scale. Access to information becomes easier, enabling individuals to learn, research, and access information from anywhere in the world. And the list may continue also including the transparency of government services and more social connectivity. At the same time, however, we cannot overlook the challenges of digitalization including serious concerns about privacy, cybersecurity, and the already increasing digital divide. Addressing these challenges is crucial to ensuring that the benefits of digitalization are accessible and equitable for all.

There is a lot of professional and academic literature on the subject. A significant document for our present discussion was released in September 2023 by the European Union (EU): The EU Report on the state of the Digital Decade. It is the first report on the

subject and as such it critically examines the EU's progress towards a successful digital transformation as it had been proposed in the Digital Decade Policy Programme 2030[1] .The report is relevant to our discussion because it shows the need to fasten and deepen the collective efforts, in all areas including policy measures, investments in digital technologies, skills and infrastructures. The practical significance of the report consists in the concrete recommendations to Member States, in this case Romania, but also Hungary, before they adopt their national strategic roadmaps and gives them time for their future adjustments.

The Digital Decade Report (2023) underlines the need to accelerate and deepen the collective efforts, including through policy measures and investment in digital technologies, skills and infrastructures because they are critical geopolitical, societal, economic and environmental enablers which may help the EU, its Member States, the various local communities and businesses to contribute to the global conversations of the present.

In terms of its digital infrastructure, the EU situation is relatively in concordance with the foreseen targets for 2030. Also, the figures for the digital transformation of businesses show a relatively positive development, as presented in **Figure 1** below.

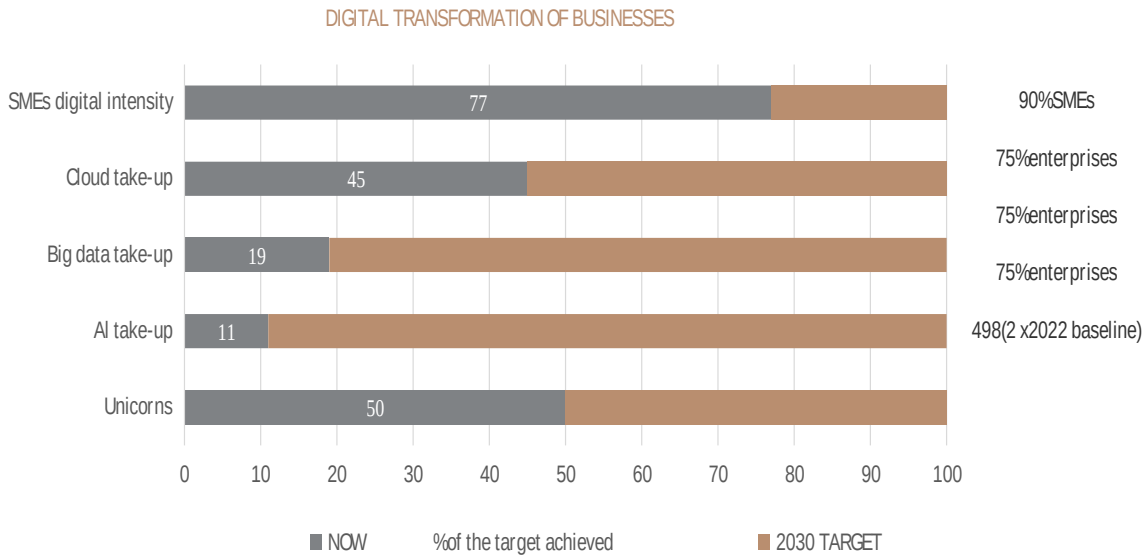


Figure 1. Digital transformation of businesses. Present vs. 2030. Source: Digital Decade Report (2023), p.3.

The composite index measuring digital intensity in small and medium-sized enterprises (SMEs) is derived from the survey on ICT usage and e-commerce in enterprises and it was compiled for the first time in 2015. It measures to what extent the EU vision has been materialized in the concrete technologies and applications that are being used by SMEs. The vision sets a target for 2030 in which more than 90% of EU (SMEs) should reach at least a basic level of digital intensity. Figure 1 shows that 70% of this indicator has already materialized with only 30% to go until the 90% target is reached in 2030.

However, Figure 1 also gives a less positive picture about the rest of the indicators which are slower in materializing: cloud take-up of enterprises is 45% out the 75% which should be reached in 2030; big data take-up of enterprises is only 19% out the 75% target. The

slowest moving indicator is the AI take-up of enterprises which is 11% out of 75% target by 2030.

This slow rate of adoption of AI in the EU does not come as a surprise. For various reasons, which are not the focus of the present paper, European companies adopt new technologies about 10-15 years later than American ones do. As Meyers & Springford (2023) show in their policy brief The EU is very slow in taking up AI. In 2021, only 8 % of EU enterprises used the technology in any form. Meyers & Springford offer a detailed discussion of what AI is or is not in terms of economic impact, of the need to regulate the field and make it safer both for companies and individual citizens, and conclude strongly that "the EU's biggest economic risk stems not from the deployment of AI – but that it fails to adopt it and drifts further down the economic league table."

And if we look at **Figure 2** we may understand the policy recommendations better. The EU's position in the global information and communication technology (ICT) ecosystem is not a good one. The EU's share of global revenue in the ICT market has sharply fallen in the last 10 years, from 21.8% in 2013 to 11.3% in 2022, while US's share increased from 26.8% to 36%. At present, the EU heavily relies on foreign countries for over 80% of digital products, as well as for services, infrastructures, and intellectual property. As an example, the US and the EU are up to 75-90% production-dependent on Asia for semiconductors.

There is a lot to say about how China compares with the US and the EU, as it is again very interesting to look at the Rest of the World (RoW), even if this is a very diversified group, with descriptions that might differ significantly. Again, however, this is not the focus of this article.

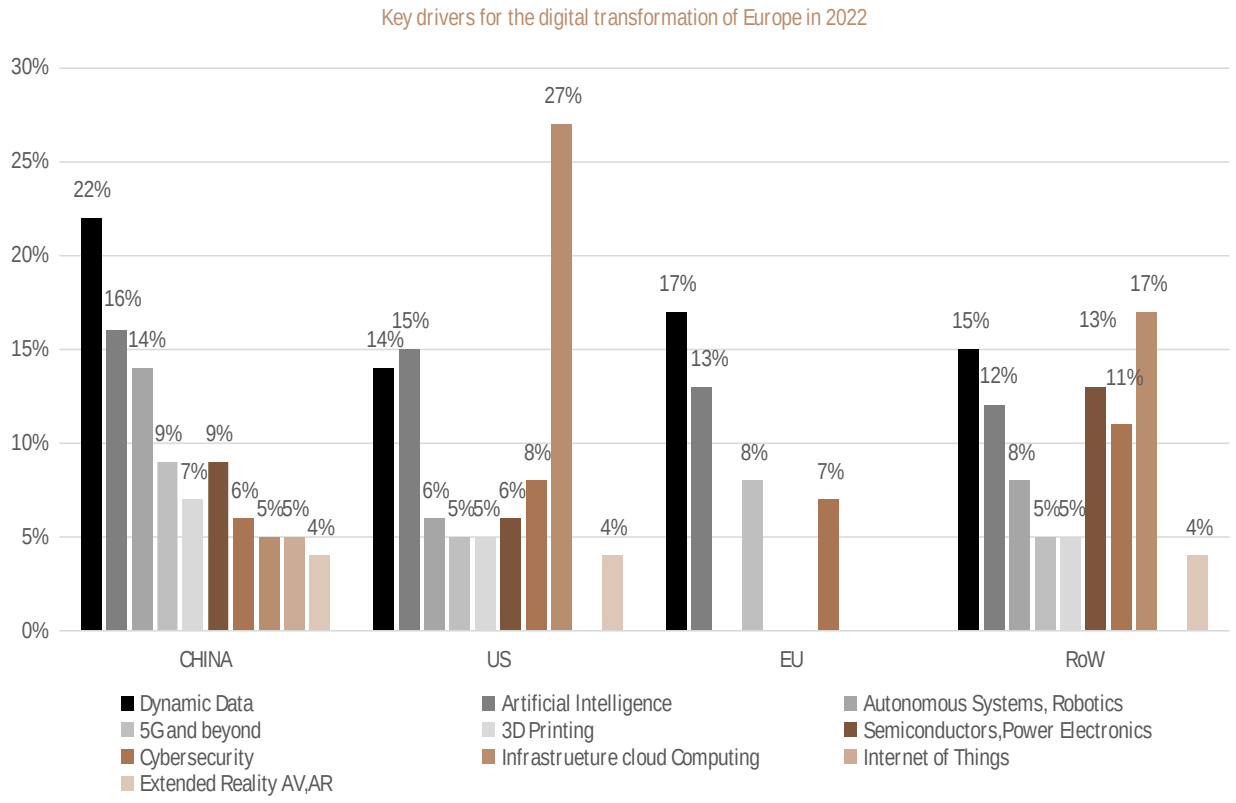


Figure 2. Composition of activities by digital area in some geographical areas between 2009-2022. Source: Digital Decade Report (2023, p. 7)

If we look, nevertheless, at digital skills we have the situation presented in Figure 3. In terms of basic digital skills, the target to be achieved in 2030 is 80% individuals aged 16 to 74 need to have at least basic overall digital skills. That level is at present 68% of target although Eurostat[2] considered that in 2023, only 56% of people in the EU aged 16 to 74 had at least basic overall digital skills. Clearly, the differences between the member states were visible with highest in the Netherlands (83%), followed by Finland (82%), and Denmark (70%) and, at the lower end of the range, were Romania (28%) on the last place, followed by Bulgaria (36%) and Poland (44%).

The digital skills indicator is one of the key performance indicators in the context of the Digital Decade, which sets out the EU's vision for digital transformation.

In terms of digital public services the data presented in **Figure 3** might look optimistic, but the truth is that there are important differences between member states

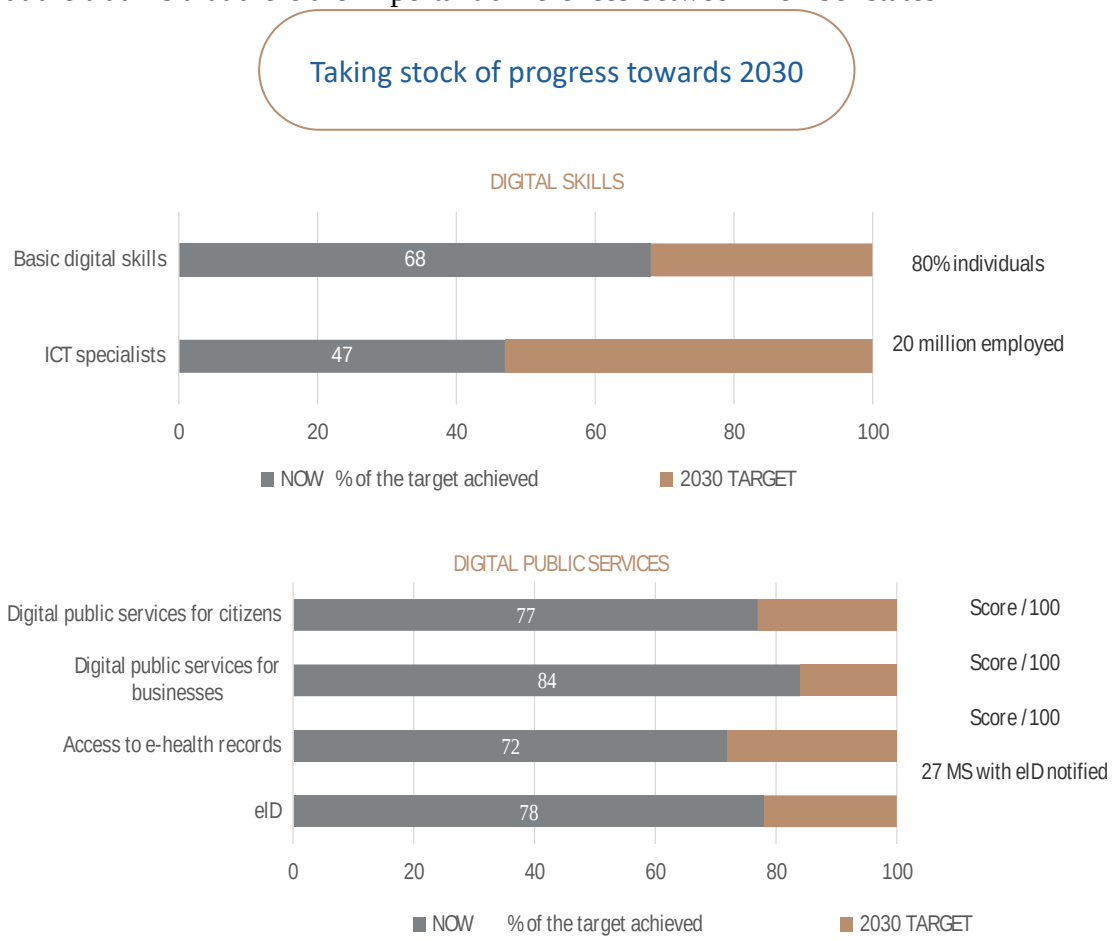


Figure 3. Digital public services and the digital skills necessary to access them by 2030. Source: Digital Decade Report (2023, p. 4)

It is also relevant to look at what other sources than the EU documents say about the state of digitalization in what is called "the largest integrated single market in the world" [3]. A Deloitte report [Alfonso et al., (2023)] explains the downward trends of the EU showing that if in the early 2000s, 41 of the world's 100 most valuable companies were based in Europe, in 2023 only 15 still remained in the EU. Also, in 2000, in terms of the combined value of the world's 1,000 largest listed firms and their profits, Europe was were their headquarters were. In 2023, those figures have decreased by almost 50%.

One explanation for this given by the Deloitte report is the rise of Chinese companies. However, another important factor has been lately Europe's lack of innovation, especially digital innovation, with positive effects on trade and investment. Deloitte considers that the optimism of the Digital Decade Report (2023) in setting targets for 2030 is based on the innovation performance of the bloc that increased by about 10% since 2015, overtaking Japan and getting closer to countries such as Australia, Canada, South Korea and the United States.

2.What is the general picture of digitalization of small businesses in Romania?

Briefly put, according to the Romania Annex of the Digital Decade Country Report 2023, Romania is much below the EU average on both basic digital skills and ICT specialists, with a particularly wide gap on basic digital skills (28% vs 54% EU average) where the EU target is at 80% of the population for 2030. The proportion of ICT specialists in total employment is 2.8%, versus the EU average of 4.6%.

Nonetheless, the proportion of ICT graduates among all graduates is significantly higher than the EU average (6.9% versus 4.2%). On a negative note, a lot of those graduates chose to emigrate, though this trend has been slowed down or even reversed after the lessons forced by the COVID 19 pandemic on everybody to accept remote working. On a positive note, Romania also has one of the highest proportions of female ICT specialists in the EU, at 25.2%. Sustained, comprehensive efforts in the areas of basic digital skills and ICT specialists are paramount for Romania's digital transformation. Romania started to implement several important measures under its NRRP (National Recovery and Resilience Plans), including setting up a new legislative framework for the digitalisation of education and the launch of various grant schemes.

The digitalization of businesses remains a major challenge in Romania. The adoption of advanced technologies like cloud computing services, artificial intelligence and big data have been significantly below the EU average. However, the gap with the EU average is slightly smaller for SMEs with at least a basic level of digital intensity, at 53%, compared to an EU average of 69% in 2022. Several ongoing measures are expected to lead to progress in the area, including a support scheme under the NRRP, aimed at both the development and the adoption of digital technologies by SMEs, and an ongoing European Regional Development Fund (ERDF) measure aimed at developing innovation clusters, and thereby a more innovation driven ICT sector.

This situation is not only challenging for Romania's businesses, but it also offers opportunities or, in the Eurojargon of the official EU documents, the country has scope to improve its performance in the digital transition and to contribute to the collective European efforts to achieve the EU's Digital Decade targets.

If, however, we are reading Romanian government documents the general picture of Romania's digitalization status becomes more optimistic and promises all the support needed to catch up with the relevant EU figures. But clearly and expectedly, Romanian government structures and especially their individual members also focus on their own agendas which include point scoring with the media and, mainly, in 2024, with the electorate.

However, that government support is mostly difficult to get and extremely bureaucratic. The Ministry for Research, Innovation and Digitalization obtained a slight increase for the grants to SMEs given as state support to certain SMEs. At the end of October, they approved the grants to a total of 603,545 euros. This sum is almost insignificant compared to the required amount of effort to access it.

On the other hand, the same Ministry of Research, Innovation and Digitization, as the coordinator of reforms and investments from the National Recovery and Resilience Plan of Romania[4]is relaunching the competitive call to finance public libraries to become hubs for the development of digital skills. The amount of the funding is 16,788,220 euros. This is a very rewarding call from a financial point of view and very useful to increase the level of digital education of people in remote areas of the country where the libraries are probably among the few sources of information but are generally in very dilapidated conditions.

Besides the government structures dealing with digitalization and the adoption of competitive IC technologies, there are also private entities and NGOs with the same interests. For example, The European Digital Innovation Hub in Transilvania (TEDIHT) is a regional consortium consisting of 14 organizations, 6 partners and 8 associated partners, which was created in 2017 by the main innovation actors from the North-West region of Romania. TEDIHT's mission is to strengthen the regional innovation ecosystem and accelerate the digital transformation process of SMEs and the public sector. It also facilitates accession to funding for digitalization. It recently secured funding for SMEs in the Northwestern Region of Romania, of over 2.5 million Euros[5].

According to the European Digital Innovation Hub in Transilvania[6]only 8% of the Romanian companies are digitalized if we look at the country figures, by sector only 6% from the metallurgical production companies and by size 20% of the SMEs.

Another consultant from the Northeastern development region of Romania, Fediuc (2023), draws the attention on the various realities that the concept of digitalization may cover. For some small businesses it might mean simply using Excel or an accounting app. This, partly, explains the anxiety of the small businesses in Romania about the introduction of the mandatory electronic invoicing system (e-factura) [7].

An interesting and comprehensive study of the digitalization issues of SMEs in Romania was performed by EIB, (2023) at the request of the Romanian Ministry of Investments and European Projects. The study shows that in spite of the challenges slowing down the digital transformation of Romanian SMEs, which include limited knowledge, digital skills and access to finance, there are also positive elements in connectivity infrastructure. The study considers that supporting SMEs to digitalize their business processes is a historic opportunity and underline the existing targeted finance for the development of the innovation ecosystem.

3.What can Romania offer to potential investors in digitalization?

CEE is the fastest-growing ecosystem in Europe in terms of enterprise value, funding, and average funding per startup, according to specialized reports in investments.[8]

Romania seems to be one of the leading countries in the region showing signs of fast growth since 2017, in various ways. It is home to one of the most well-known IPOs in the region (UiPath), three successful unicorns (UiPath, Bitdefender, Elrond), and a wave of new startups awaiting to take off (Fintech OS, Soleadify, eMag, Tokinomo, Flowx AI). Romania's particular strength lies in enterprise software, process automation, developer and collaboration tools, software development, cybersecurity, and marketing & sales, creating value and attracting VC funding.

According to its entrepreneurs, interviewed by Simion (2022), the Romanian startup ecosystem is, an example of a bottom-up approach. The first wave of Romanian tech entrepreneurs did not wait for government action, but forged their own path and pushed for systemic progress.

Simion (2022) shows that the best areas for investment according to some of the members of this ecosystem are the industries that are actively contributing to sustainability (such as innovative solutions in AgriTech; improving access to healthcare through HealthTech and the circular economy in the fashion, food or consumer electronics industries). Also, industries in which there is a favourable market and industry environment including local skills/talent and investment. Examples of these industries are cybersecurity, applied AI (e.g. Robotic process automation (RPA), intelligent automation, optimised decision-making), and gaming.

By way of conclusions, I would like to mention one of the correct observations made by Alfonso (2023) who noted that one of the difficulties to companies making greater use of The NextGenerationEU (NGEU) programme is the significant effort this required. Only 3% of EU companies report applying for an NGEU-related tender. Spain (8%) and Romania (5%) have the highest rates of applications and, in my opinion, this is indeed good news for potential investors in digitalization.

4.References

Bianca Iulia Simion, 2022, Romania - The fertile ground for tech startups, https://seedblink.com/en/2022-12-01-romania-the-fertile-ground-for-tech-startups

Carmen Fediuc, 2023, Caravana #NEdigitalizăm, https://www.adrnordest.ro/event/caravana-nedigitalizam-iasi/

Decision (EU) 2022/2481 of the European Parliament and of the Council of 14 December 2022 establishing the Digital Decade Policy Programme 2030, OJ L 323, 19.12.2022.

Digital Decade Report, 2023, *2023 Report on the state of the Digital Decade*, https://digital-strategy.ec.europa.eu/en/library/2023-report-state-digital-decade

Digital Decade Country Report 2023: Romania, https://digital-strategy.ec.europa.eu/en/library/2023-report-state-digital-decade

European Investment Bank (EIB), 2023, Digitalisation of SMEs in Romania. An assessment of the level of digitalisation of SMEs in Romania and recommendations to increase their level of digitalisation, https://www.eib.org/en/publications/20230198-digitalisation-of-smes-in-romania

https://www.mcid.gov.ro/programe-europene/pnrr/

J. Scott Brennen, Daniel Kreiss. 2016. Digitalization. International Encyclopedia of Communication Theory and Philosophy 23 October: 1–11. https://onlinelibrary.wiley.com/doi/abs/10.1002/9781118766804.wbiect111

MaryAnne M. Gobble (2018) Digitalization, Digitization, and Innovation, Research-Technology Management, 61:4, 56-59, DOI: 10.1080/08956308.2018.1471280

Report on the state of the Digital Decade, 2023, https://digital-strategy.ec.europa.eu/en/library/2023-report-state-digital-decade

Stefano Alfonso, Luca Bonacina, Miguel Eiras Antunes, Carlos Bofill, Hilde Van de Velde, (2023), Futureproofing Europe: How the NextGenerationEU programme is inspiring companies to transform, Deloitte Insights, https://www2.deloitte.com/uk/en/insights/economy/next-generation-eu-fund.html?gad_source=1&gclid=Cj0KCQiAwbitBhDIARIsABfFYIKbVX9LGjG7p9iN9H4_pS809RE112DsyhVcaoT1IfN3OGL_mZ31ARYaAuuYEALw_wcB

The European Digital Innovation Hub in Transilvania, www.transilvaniadih.ro

Zach Meyers, John Springford, 2023, How Europe can make the most of AI, Policy brief, https://www.cer.eu/publications/archive/policy-brief/2023/how-europe-can-make-most-ai#section-6

Notes

1 Decision (EU) 2022/2481 of the European Parliament and of the Council of 14 December 2022 establishing the Digital Decade Policy Programme 2030, OJ L 323, 19.12.2022.

2 https://ec.europa.eu/eurostat/web/products-eurostat-news/w/ddn-20231215-3

3 https://ec.europa.eu/commission/presscorner/detail/en/ip_23_1668

4 https://www.mcid.gov.ro/programe-europene/pnrr/

5 https://transilvaniadih.ro/en/news/tediht-secures-funding-to-boost-digital-innovation-in-northwestern-romania/

6 www.transilvaniadih.ro

7 https://blog.axway.com/product-insights/b2b-integration/einvoicing/romania-e-invoicing-requirements

8 https://dealroom.co/blog/central-and-eastern-european-an-efficient-and-resilient-startup-region

The impact of digital transformation driven by new technologies on economic and social environment of China

Yuehong Xu

1.Introduction

With the rapid development of digital technology, the economy of China is also undergoing unprecedented changes. Digitalization has become an important driver of the economic growth of China, not only changing the traditional economic model, but also giving rise to many new industries and business models.

First, the widespread application of digital technology has promoted the transformation and upgrading of the economy of China. The traditional manufacturing and service industries have begun to gradually transform to the direction of digitalization and intelligence, Chinese enterprise have improved production efficiency, reduced costs, optimized resource allocation, through the introduction of artificial intelligence, big data, cloud computing and other technical means, and the competitiveness and market adaptability of Chinese enterprises were further enhanced. At the same time, emerging digital economy fields such as the Internet, the Internet of Things, and intelligent manufacturing are also rising rapidly, new vitality were injected into economic growth.
Second, digital technology has also changed people's consumption habitats and behavior patterns. With the popularization of smart phones and the development of mobile Internet, consumers can shop, pay, and socialize online anytime and anywhere, which makes traditional retail and e-commerce integrate with each other to form a more convenient and personalized consumer market. At the same time, digital technology has also promoted the development of new service industries such as online education and telemedicine to meet people's growing needs.

However, the rapid development of digitalization also brings some challenges. On the one hand, the application of digital technology has intensified market competition, and some traditional industries are facing the risk of being eliminated. On the other hand, digital technology has also brought about issues such as data security and privacy protection that led to changes in the social environment, and it is necessary to strengthen the formulation and implementation of laws and regulations.

2.Understand the Era of AI and Digitization in China

Digital empowerment in China

Digital empowerment is not only to simply transform traditional business into digital form, but also to change the business model, improve production efficiency, and optimize user experience through the use of advanced technologies and tools such as artificial intelligence, big data analysis, and the Internet of Things, so as to provide enterprises with more efficient, accurate, comprehensive, and intelligent management and marketing methods, promote the development and innovation of enterprises, and achieve rapid growth of enterprises. The digital empowerment process of Chinese enterprises is roughly

realized through three stages: digital transformation, digital upgrading, and digital transformation. (Figure 1)

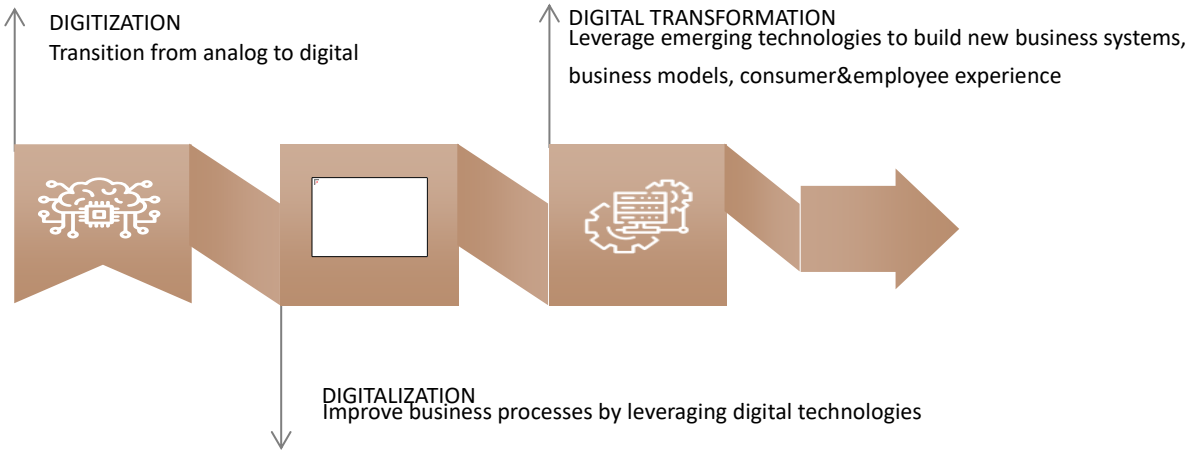


Figure1 The process of digital empowerment in China

From Digitalization to Digital Transformation was called Industrial digitalization. From Digitalization to Digitization was called digital industrialization.2

Figure 2 shows the scale of industrial digitalization and digital industrialization in China from 2016 to 2021, and the scale of industrial digitalization has been far exceeding the scale of digital industrialization during these years.

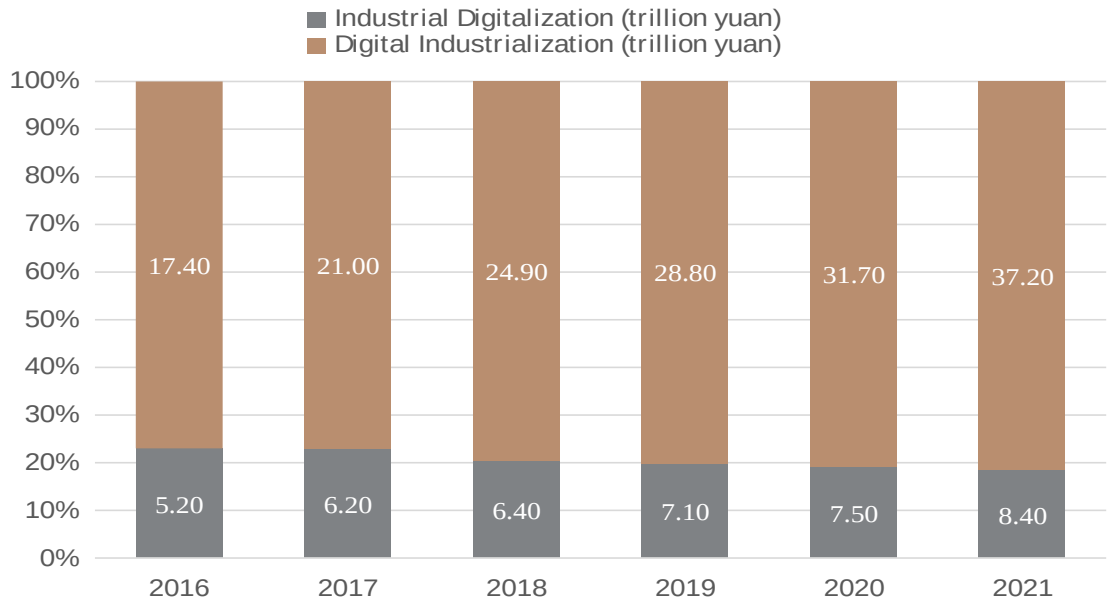


Figure 2 2016-2021The scale of China's industrial digitalization and digital industrialization (trillion yuan)

According to the data, the overall scale of China's digital economy increased year by year from 2016 to 2022, reaching 50.2 trillion yuan in 2022, a year-on-year increase of 10.3%,

and is expected to reach 70.8 trillion yuan in 2025. This process has given rise to many new application scenarios and new business formats.[3]

Deconstruction and Analysis of the Development of Digital Economy in China (2022)

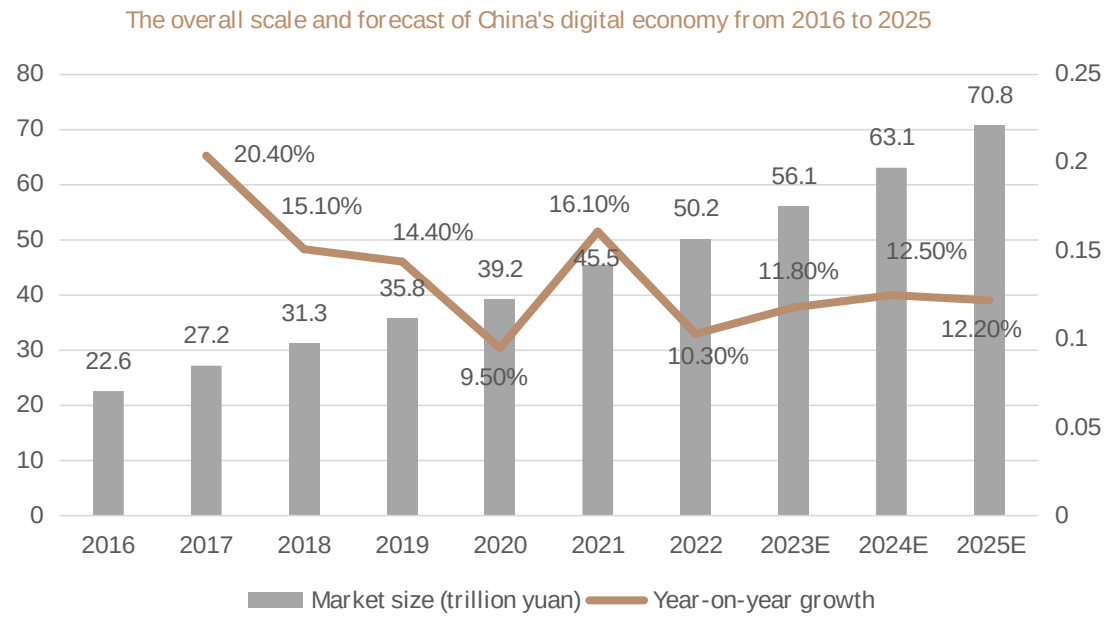


Figure 3: Overall scale and forecast of digital economy of China from 2016 to 2025

Figure 2 shows that from 2016 to 2022, the overall scale of the digital economy of China has increased year by year, reaching 50.2 trillion yuan in 2022, a year-on-year increase of 10.3%, and is expected to reach 70.8 trillion yuan in 2025. This process has given rise to many new application scenarios and new business formats.[4]

The layout of the Chinese government in improving the digital economic of China

Act1: Establish a sound policy system.

Chinese government compile the "Digital Economy Innovation Leading Development Plan "in the 14th five-Year Plan.Explore the construction of collaborative governance Policies for the digital economy.2021.

Act2: Digital integration of the real economy.

Chinese government accelerate the digital transformation of traditional industries, layout a number of national digital transformation promotion centers, Encourage the development of digital transformation Common support platforms and industry"data brains",[4]Also, Chinese government Promote the integration, innovation, and integrated application of cutting-edge information technology.

Act3: Chinese government continuously expanding the digital industry.

Encourage the development of platform economy, sharing economy, "Internet plus" and other new models and Business forms. Figure 4 shows the cloud service market scale and rapid growth of the cloud services market.

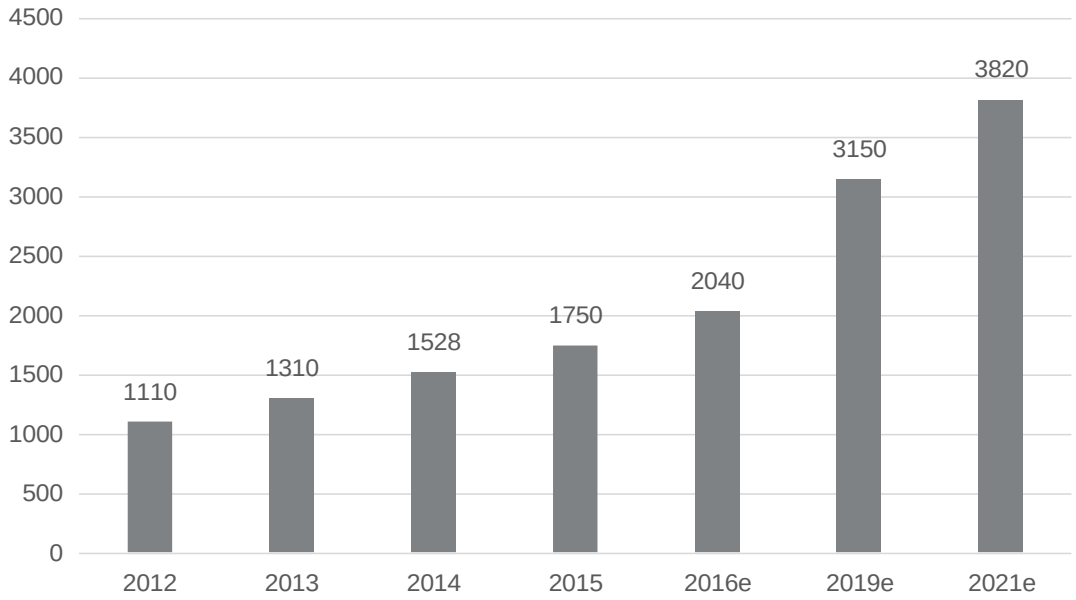


Figure 4 the cloud service market size (100 million yuan) of China from 2012 to 2021
Data source: woshipm.com

Act4: Chinese government promote the circulation of data elements.

Implement actions to cultivate the market for data elements; explore rules for data circulation, further promote the sharing and opening of government affairs data; carry out pilot projects for the development and utilization of public data resources; establish mechanisms for the collection, formation, sharing, and integration of big data for government and social activities.

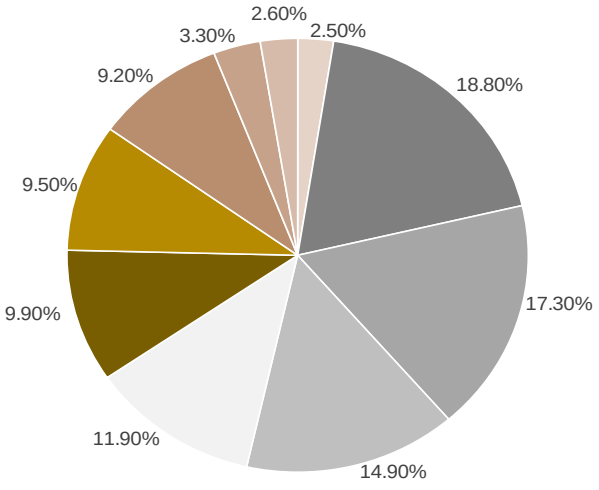


Figure 5 The types of products available in the Cloud Marketplace of China
Data source：www.chyxx.com

Act5: Promote the construction of digital government

Deepen the intensive construction, integration and sharing of government affairs information systems; further promote the establishment of a national integrated government service platform and a national data sharing and exchange platform.

Act 6: Deepen International Cooperation

Built Silk Road e commerce, promote international dialogue and practical cooperation in smart cities, e-commerce, and cross-border data.

Act7：Establish The National Big Data Bureau

Promote the construction of National digital economy innovation and development pilot zones.

The impact of digital transformation on Chinese economy

The impact of digital transformation on Chinese economy is mainly carried out from the following three dimensions: the adjustment of industrial structure, the transformation of economic growth mode, and the transformation of the job market.

The adjustment of the industrial structure is mainly manifested in three aspects: first, to promote the optimization of the industrial structure by promoting the upgrading of traditional industries, promoting the development of emerging industries, and making the industrial structure more rational; The second is to stimulate the innovation vitality of enterprises, promote the development of new technologies, new products and new formats, and form new economic growth points to form innovation-driven; The third is to promote the upgrading of the service industry by promoting the development of the service industry in the direction of intelligence and personalization, and improving the quality and efficiency of the service industry.

The transformation of economic growth mode is mainly manifested in intensive growth, green development, and high-quality development. Intensive growth is conducive to promoting the transformation of economic growth from extensive to intensive and improving the efficiency of resource utilization and economic benefits. Green development will help promote the development of environmental protection industry and circular economy and promote the harmonious coexistence of economy and environment. High-quality development is achieved by improving the quality and added value of products and services.

The changes in the job market are mainly manifested in the following: promoting the development of the job market in the direction of high skills and high efficiency, and putting forward higher requirements for the skills of workers; New forms of employment and career fields such as e-commerce customer service and data analysts have been born; Lowering the threshold for entrepreneurship and innovation, stimulating the vitality of social innovation, and promoting entrepreneurship to drive employment are emerging in an endless stream.

3.The impact of digital transformation on Chinese society

The impact of digital transformation on Chinese society is mainly manifested in the following three aspects: the change of information dissemination, the innovation of education mode, and the impact on lifestyle.

The change in the mode of information dissemination is achieved by speeding up the speed of information dissemination, diversifying the means of information dissemination, and enhancing the interactivity of information dissemination. Accelerating the dissemination of information depends on advancing technology and strengthening the construction of information infrastructure; Diversified information dissemination is achieved through social media, blogs, podcasts, videos, etc.; People can participate in information dissemination through online comments, likes, re tweets, etc., so as to enhance the interactivity of information dissemination.

The innovation of the education model is mainly reflected in the development of online education， the realization of personalized education and the sharing of educational resources.

The impact on lifestyles involves changes in the way people consume, work, and socialize. Online shopping and mobile payment have become the mainstream of China's current consumption methods. Remote work and online meetings have become the norm in all walks of life in China. Social media, instant messaging, etc., have become the main means of communication that people have essential.

4.Challenges and countermeasures for digital transformation of China

While digital economy of China is developing rapidly, it is also facing the following severe challenges: data security and privacy protection, the increasingly prominent digital divide, and the improvement of laws and regulations that need to be followed up urgently.

For data security and privacy protection, it mainly involves the risk of corporate and individual data being leaked, and the inevitable infringement of personal privacy in data collection and processing, which is causing concern and controversy in Chinese society. To this end, it is necessary to strengthen the research and development and application of data security technology, establish sound data protection laws and regulations, and improve the data security awareness of enterprises and individuals.

The problem of the digital divide is mainly caused by regional and group differences. The uneven development of digital transformation in different regions has led to a widening of the digital divide between regions, which in turn affects economic development and social stability. Groups of different ages, occupations, and income levels face different challenges and opportunities in the process of digital transformation, resulting in different degrees of group differences. To this end, only by increasing the construction of digital infrastructure, increasing the penetration rate and application level of digital technology, and promoting the balanced development of the digital economy can it be improved.

The problems of laws and regulations are mainly manifested in two aspects: the lag of laws and regulations and the conflict of laws and regulations. In the process of China's digital transformation, on the one hand, some traditional laws and regulations have been

unable to adapt to new development needs, resulting in legal gaps and regulatory loopholes. On the other hand, there are conflicts between different laws and regulations, resulting in weak supervision and increased difficulty in enforcement. To this end, only by strengthening the formulation and improvement of laws and regulations and establishing a legal system that adapts to digital transformation can we improve regulatory efficiency and enforcement.

5.Conclusions and prospects

Conclusions of the study

Digital transformation has played a significant role in promoting China's economic growth, accelerating high-quality economic development by improving production efficiency, promoting innovation, and optimizing resource allocation.

Digital transformation has also had a wide impact on China's social sector, such as improving people's livelihood and well-being, promoting social fairness and justice, and improving the level of public services, promoting social harmony and progress.

Digital transformation has played an important role in China's industrial upgrading, consumption upgrading, and governance model innovation, providing strong support for the sustainable development of Chinese economy and society.

Recommendations for future research

In-depth research on the application and development of digital transformation in different industries and regions, summarize lessons and lessons, and provide a scientific basis for policy formulation.

Pay attention to data security, privacy protection, ethics and other issues in the process of digital transformation and put forward corresponding solutions and policy suggestions.

Strengthen international cooperation and exchanges, learn from advanced international experience, and promote the international influence of China's digital transformation.

Deepen interdisciplinary research on digital transformation, sustainable development, and ecological civilization construction, and contribute China's wisdom and solutions to building a community with a shared future for mankind.

The digital transformation of the Chinese government has gone through three stages of development: e-government, "Internet + government service" and digital government.[7] The current stage of digital government emphasizes the construction of digital thinking, guided by the service needs of the people, exploring the value of data, and effectively exerting digital productivity. At present, leading provinces in China have basically achieved the continuous optimization of the digital business environment through integrated government services such as "one network for all", "one run at most", "one network for unified management" and "one network for coordination", and the level of online government services has jumped to the top of the world. However, how to further realize the data-driven and intelligently managed digital government and enhance the people's sense of gain, the government still faces some practical problems and challenges.

In terms of government coordination, government departments cooperate but do not coordinate, government affairs and social information are still difficult to get through, and data exchange, circulation and sharing are not smooth. Information barriers have led to a discount in the quality and efficiency of government services, for example, some provincial and municipal data exchange platforms stay in specific areas within the service jurisdiction, with a single function, and have not yet formed a joint force to benefit the people.[8]

In terms of government operations, whether it is the approval of business for the benefit of the people or the rapid response to public events, most of them are currently at the level of passive management and post-event management, and there is still a big gap between them and the goal of efficient and intelligent management. For example, for the supervision of the storage and transportation of dangerous goods, a data-driven intelligent early warning system is needed to help the government identify problems and make decisions in a timely manner and improve the efficiency of risk prevention and disposal.

In terms of digital inclusion, the penetration rate of digital government services needs to be improved. In the face of digitally difficult groups, such as the elderly and some traditional enterprises, the penetration rate is still relatively limited due to usage Xi, condition constraints and digital literacy. The government needs to continue to implement inclusive digital services at the grassroots level, so that the value of data and digital convenience can benefit the masses.

In terms of the development of the service industry, the enabling space of digital government needs to be vigorously expanded. At present, the development of the industry is still affected by the concept of "emphasizing investment over operation, supervision over empowerment, and short-term over long-term". [9]According to the local economic environment and regional characteristics, how to use big data to accurately attract investment, identify leading industries, and efficiently allocate resources to promote digital transformation is still a top priority for Chinese government to improve its digital operation capabilities.

In the future, the construction of "digital intelligent government" needs to highlight data-driven, data-centric, widely identify and activate the value of data, and use data value to comprehensively empower public services, social governance, people's livelihood security, industrial economy, and other fields.

6.References

Cao, Y. (2023). Digital Transformation: Reshaping Competitive Advantage. *Tsinghua Management Review*, (06), 93-99.

Jiao, H., Zhang, R., & Yang, J. (2023). Enterprise Strategic Choice and Digital Platform Ecosystem Construction in the Context of Digital Economy: A Case Study Based on the Perspective of Co-Performance. *Management World*, (12), 201-229. doi: 10.19744/j.cnki.11-1235/f.2023.0144.

Li, W. (2023). The underlying theoretical logic of the development of the digital economy, the strategic deployment of developed countries and China's response. *China Soft Science*, (05), 216-224.

Lu, Z., Deng, L., Huang, X., & Liao, S. (2023). An empirical study on the promotion of regional high-quality development by digital economy. *China Soft Science*, (12), 175-184.

Qiao, Y., & Ma, S. (2023). The impact and opportunities of the digital economy to promote the development of the real economy. *China Business Review*, (24), 15-18. doi: 10.19699/j.cnki.issn2096-0298.2023.24.015.

Wang, D., Hu, J., Li, L., & Hu, X. (2023). Digital Economy Development: Logical Deconstruction and Mechanism Construction. *China Soft Science*, (04), 43-53.

Wang, L., Qin, Z., & Peng, D. (2023). Value-added structure of digital economy and modernization level of industrial chain. *Statistics and Decision*, (24), 102-107. doi: 10.13546/j.cnki.tjyjc.2023.24.018.

Wei, J. (2023). Logical Reconstruction of Digital Industry Organization. *China Soft Science*, (09), 22-29.

Wu, Q., & Yao, Y. (2023). Enterprise Digital Transformation and Supply Chain Configuration: Centralization or Diversification. *China Industrial Economics*, (08), 99-117. doi: 10.19581/j.cnki.ciejournal.2023.08.005.

Technological transformation in the world: AIs, robots and electric vehicles. Dominant Design Shift as a Window of Opportunity in the Automotive Industry?

Martin Schröder

1.Abstract

Electrification of automotive powertrains marks a significant shift in the industry's dominant design. This shift is frequently portraited as a challenge and an opportunity. The significant number of electric vehicle start-up carmakers indicates that the shift to an emerging dominant design is indeed perceived as an opportunity by entrepreneurs. In Southeast Asia, Viet Nam is still a minor but growing car-making country. In 2017, Vinfast, a privately-owned carmaker, was founded with the ambition to turn itself and Viet Nam into a significant player in the global automotive industry. Since 2022, Vinfast exclusively focuses on battery electric vehicles. This paper will investigate the case of Vinfast, to elaborate on the interrelated issues of dominant design change and entry barriers to the automotive industry. Despite dominant design transition, significant entry barriers remain, mainly due to steel body production, a costly, vertically integrated production step and the remaining need to system integration, which are both performed by carmakers. As significant parts of the incumbent dominant automotive industry design that seemingly will remain unchanged, it is argued that while entry into the automotive industry has become relatively easier, it nevertheless remains a daunting task for start-up carmakers.

Keywords: automotive industry, electric vehicle, dominant design transition, Viet Nam, Vinfast

2.Introduction

The electrification of automobiles marks a significant shift in the industry's dominant design. A dominant design is a de facto standardised product which is inter alia characterised by equipment-intensive production, high (co-)specialisation, and incremental innovations of product and production processes (Abernathy and Utterback 1978). Changing a dominant design is not easily achieved as change is expensive due to the nature of the product design. In other words, altering a single attribute or process has ramifications for various other attributes or processes because of co-specialisation among a product, its components, their production processes and production equipment, and firms that engage in the design, utilisation, and incremental improvement of this highly interrelated dominant design.

The current shift in the dominant design of the automotive industry includes two aspects (Alochet, MacDuffie, and Midler 2023). First, the power source used for propulsion is changed, i.e. fossil fuels are replaced by electricity. Second, the dominant design shift

further includes the powertrain, i.e. the parts of a vehicle that transform the power source into propulsion of the wheels. Thus, instead of internal combustion engines (ICE) and related transmissions transforming fossil fuels into motive power, battery electric vehicles (BEV) use batteries and electric motors to drive the wheels.

The dual, interrelated shift of the dominant design of automobiles is frequently portrayed as a challenge (Vervaeke 2012) and as an opportunity (Freyssenet 2011). A shift in an industry's dominant design is a window of opportunity that allows new firms to enter the industry. Simultaneously, the shift from one dominant design to another certainly entails Schumpeter's notion of creative destruction, i.e. as technologies and related know-how becomes superfluous, a number of incumbent industry players will no longer be able to compete in the changed industry.

However, while analysing the ongoing transformation of the automotive industry is necessary, the focus on changing technology should not be exaggerated. While a significant aspect of the dominant design is being transformed, other aspects remain firmly entrenched. One aspect of the dominant design that remains largely unchanged is that vehicles use an all-steel body.[xiii] The all-steel body aspect of the dominant design has been dubbed Buddism after Edward Budd, an early proponent and developer of all-steel vehicle bodies (Nieuwenhuis and Wells 2003; 2007). It will be argued that this aspect of the automotive industry's dominant design remains largely unaltered, and that this aspect of the dominant design remains a significant entry barrier into the industry. Further, it will be argued that while BEVs have a simpler product architecture, carmakers still must integrate numerous systems into a functioning vehicle, which is another type of entry barrier that start-up carmakers must overcome to compete in a transforming automotive industry.

3.Literature Review: Is the Automobile Dominant Design Shift Exaggerated?

The automotive industry in clearly undergoing its most significant transformation within the last century. The significance of the power source and powertrain shift (Alochet, MacDuffie, and Midler 2023) lies in the fact that key technologies developed and manufactured by carmakers are being replaced by different technologies. While the automotive industry is characterised by significant outsourcing of component production to suppliers, the powertrain remained subject to carmakers' vertical integration (Klier and Rubenstein 2021). Hence, it cannot be too surprising that the powertrain paradigm shift absorbs most attention in discussions on the contemporary automotive industry and its future direction. Some researchers even claimed that any firm capable of investing between USD 1 and 2 billion could design, develop, and manufacture an EV in the rather short timeframe of three to five years because the entry barriers to making EVs are significantly lower compared to making ICE vehicles (Perkins and Murmann 2018).

Especially China has attracted much scholarly attention in this context. It has been early observed that the Chinese government and Chinese Original Equipment Manufacturers (OEM) focussed their technology development efforts on plug-in hybrid vehicles (PHEV) and BEVs in order to leapfrog into the electric vehicle age. This leapfrogging was clearly motivated by the insight that catching up in ICE technology was a steep challenge. Thus, leapfrogging to electric vehicles can be regarded as a strategy to level the industrial

playing field as the electric powertrain is still novel for all industry players (Wang and Kimble 2011). A recent assessment of Chinese policy reaches the conclusion that the strategic leapfrogging effort has paid off, at least in the industry sub-fields of electric buses and EV batteries (Altenburg, Corrocher, and Malerba 2022).

Simultaneously, the Chinese case suggests that this success is linked to a high rate of failed industry entry. By 2019, more than 500 EV start-ups had been registered in China alone, of which only 60 had developed concept vehicles (Song, Suzuki, and Aou 2019). Even fewer start-up carmakers have proceeded to vehicle production. Thus, while entry is arguably indeed easier due to the change in the powertrain part of the dominant design, other aspects of the dominant design do not change and build a significant entry barrier. One aspect of the automobile industry's dominant design, the all-steel body, remains rather firmly entrenched. The significance of Buddism lies in the fact that the all-steel body drastically reduced the bottleneck of the painting process which was reduced from lasting weeks to a single day (Nieuwenhuis and Wells 2007). Further, while Henry Ford pioneered the moving assembly line, these lines initially mainly produced vehicle components and vehicle chassis, which were later combined with bodies. Thus, many carmakers did not produce vehicle bodies but concentrated on parts and chassis. Only with the increased use of the all-steel body did the car production process take a form which is standard today. Today, all relevant incumbent carmakers operate factories that consist of press, body, paint, and assembly shops to make cars. As can be seen from this basic sequence, the first three stages are intrinsically linked to the all-steel body dominant design aspect pioneered by Budd. Furthermore, the all-steel body requires huge initial investments but also allow lower unit costs at high production volumes (Nieuwenhuis and Wells 2003). Hence, significant economies of scale associated with car production are linked to the all-steel body.

In the context of vehicle electrification, the continuing dominance of the all-steel body means that while the shift levelled the industrial playing field in terms of one aspect of the dominant design — the powertrain — another important aspect remains unchanged. Hence, significant entry barriers remain and make entering the industry a serious obstacle. Would-be EV producers still need to make huge investments to set up automobile factories. Management research has framed this issue of scaling up production as acquiring ordinary capabilities (Murmann and Vogt 2023). They are labelled as ordinary capabilities because they are not new to incumbent firms but are a significant obstacle to start-ups.

Responding to Perkins and Murmann's (2018) claim that BEVs mainly require financial muscle and up to five years to become market ready, MacDuffie (2018) points out two important issues that contradict the claim that greater BEV powertrain modularity is making market entry mainly a question of financial resources. First, while the powertrain itself is more modular, it needs to be integrated with other vehicle systems such as braking, steering, and suspension. Hence, despite increased modularity of the drivetrain, BEVs product architecture will continue to have integral characteristics[xiv]. Second, component integration affects vehicle performance and user experience to a significant degree, meaning that start-up BEV carmakers will only survive if they successfully integrate components and systems into a sum that is larger than its constituting parts. Both points strongly suggest that start-up BEV carmakers still need to learn to be system integrators.

4.The Case of Vinfast

The example of Vinfast, a Vietnamese start-up carmaker, may serve as an illustration for remaining industry entry barriers related to the all-steel body and system integration. This case is relevant for the discussion of automobile firm management and the future of the automotive industry as a whole because it allows to highlight issues related to entry into this industry.

Economies of scale entry barrier: successful production capacity expansion and remaining issues

Vinfast was founded in 2017 as a subsidiary of Vingroup, Viet Nam's largest conglomerate. The start-up initiated production in 2019, starting to make conventional ICE vehicles. These vehicles were based on outdated platforms Vinfast bought from BMW and General Motors (GM). As Vinfast lacked experience in manufacturing and system integration, the newcomer mainly sourced components from suppliers which used to supply the original BMW and GM models (Schröder 2021).

To produce its vehicles, Vinfast created a new factory in Haiphong which cost around USD 2 billion. This factory has an annual production capacity of 250,000 vehicles. As Vinfast plans to expand to the USA through a dedicated factory in the country, it started to construct a new plant with an annual production capacity of 150,000 vehicles in North Carolina. This plant requires an investment of USD 4 billion, of which USD 1.25 billion can be gained as investment incentives from the state of North Carolina if certain requirements are achieved (Associated Press 2023). These plants are mainly engaged in body making and assembly, i.e. they are not engaged in making any powertrain components. Besides this major expansion, Vinfast also plans to set up a smaller manufacturing plant in Indonesia (Luu 2023): the planned factory should cost around USD 150 to 200 million and have an annual production capacity of 30,000 to 50,000 vehicles. While no further details about this planned site are available, the intended production capacity strongly suggests that this facility will only engage in assembly, not in body making.

The resulting production capacity of these investments is roughly 400,000 units per year, which is less than the production capacity of niche producers such as BMW, Mercedes-Benz, Mazda, or Subaru. Hence, despite huge investments into production capacity, Vinfast will be a niche player in the automotive industry for the foreseeable future.

Nevertheless, the Vietnamese start-up carmaker takes steps that many industry entrants fail to achieve, namely transitioning from prototypes to production and creation of in-house production capacity. To realise this milestone achievement, Vinfast received financial support from Vingroup, including personal investment from Vingroup's founder Pham Nhat Vuong (Nguyen 2023). Further, Vinfast could list on the NASDAQ to access the North American and global capital market. This hurdle may be very difficult to clear for other EV start-ups, suggesting that many of these numerous firms will fail because they cannot finance entry the automotive industry due lack of supporting investors. Therefore, while the focus on electric powertrains as a chance for industry entry is understandable, remaining entry barriers remain high, at least partly due to the remaining required investment into all-steel body production capacity.

One important remaining issue should not be overlooked. In-house production capacity with economies of scale is only one half, the realisation of the economies of scale through

production and sales is the other half. So far, Vinfast has mainly addressed the first half by massive investment into production capacity in Viet Nam and the USA. Regarding the second half, Vinfast has been less successful. In 2022, it sold just below 23,000 vehicles, suggesting that the start-up OEM only utilised about 10 per cent of its production capacity.[xv] While Vinfast has positioned itself in a position that allows it to serve the likely growing EV market, convincing customers with its product offerings remains an open task. Arguably, this task is closely related to the second entry barrier of system integration.

System integration entry barrier: ordinary capabilities as a stumbling block?

As discussed in the preceding section, Vinfast is arguably rather successful in addressing the first entry barrier of economies of scale. However, an equally important question is the product quality turned out by the newly established production plants. To assess Vinfast's product quality, one can rely on independent press reviews of its products. The following assessment will mainly rely on reviews for the US market, mainly because it represents one of the most demanding markets in terms of quality and competition by basically all globally relevant OEMs. Hence, the US market can proxy as a global benchmark for customer requirements. Further, Vinfast is one of the key markets targeted by Vinfast for its global expansion, so the market will be important for the realisation of its ambitions.

The first model assessed is the Vinfast VF8. This is simply due to the fact that it was the first model exported to the US market. By extension, reviewers' assessment should not be influenced by pre-conceived opinions based on experience or brand reputation. Hence, it can be assumed that assessments are relatively free of potential biases towards the Vinfast brand.

While many reviewers found little to complain about the exterior and interior design as well as the driver controls of the VF8, the main complaint of several reviews was the ride experience itself. Issues involved acceleration, braking, suspension (Evans 2023; Hall 2023; Stern 2023) and driver assistance system (Evans 2023; Hall 2023). However, a follow-up review conducted in 2025 led the reviewer who also conducted a review in 2023 to simply conclude that the VF8 still had the worst ride experience within its class of vehicles (Hogan 2025). A review that made references to various other reviews of the model culminates in a scathing verdict:

"But the real commonality between al of these accounts is that overnight, the VF8 has obliterated the notion that there are no terrible cars for sale anymore. Frankly, it's hard to remember the last time a car released to overwhelming disdain; a car that every critic agreed simply wasn't ready." (Ismail 2023)

While one does not necessarily need to adopt the vocabulary of critics, they capture underlying issues that are highly relevant for the question if EV start-ups only need substantial financial resources and some time to become ready for competition.
However, as start-ups may learn from experience and improve their product offerings, the second model released for sales in the USA, the VF9, should also be assessed indirectly through reviews.

Before turning to the reviews, it is however necessary to point out an issue related to available reviews. All available reviews (Joubert 2024; Vaughn 2024; Wong and Ewing 2024) at the time of writing pointed out that they just drive the VF9 for about 15 to 45 minutes which is insufficient for a proper in-depth review. Also, there are noticeably

fewer journalistic reviews available for analysis compared to the VF8. Thus, critics may complain that Vinfast prevents independent journalists from a proper assessment of their products.

With this important qualification out of the way, the available reviews cautiously evaluate the VF9 as an improvement over the VF8 (Joubert 2024; Vaughn 2024; Wong and Ewing 2024). Some reviewers still report sensor malfunctions (Vaughn 2024; Wong and Ewing 2024). While acceleration is marked as unresponsive, Vinfast is aware of the issue as an over-the-air update addressing this issue is planned (Joubert 2024). Steering was identified as lacking precision (Joubert 2024) and the turning cycle of the vehicle was described as larger than any comparable car (Vaughn 2024) which obviously impacts the handling of the VF9. However, suspension is described as satisfactory and markedly better in comparison to the VF8 (Jourbert 2024; Wong and Ewing 2024).

Overall, the case of Vinfast strongly suggests that MacDuffie (2018) is correct when pointing out that the electric car remains a highly complex product whose subsystems still need to be integrated into a product that meets the consumer standard for automobiles. Aforementioned performance issues indicate that ordinary capabilities[xvi] are indeed not easily acquired. Reviewers identified issues with acceleration, braking, steering, and suspension are all hinting at the underlying problem of system integration. All these functions are typically controlled by components and systems produced by suppliers and integrated by OEMs. Apparently, Vinfast did choose to not spend more time on finetuning the interaction between various components and systems and instead rushed the VF8 to the market. As one reviewer pointed out, all the identified issues should be fixable given sufficient engineering time, but the delivered VF8 vehicles felt closer to pre-production prototypes (Evans 2023). Hence, the start-up carmaker arguably should be able to fix identified issues. However, the recent follow-up review of the VF8 (Hogan 2025) suggests that at least the VF8 has not received notable quality upgrades. Conversely, the VF9 reviews, despite their aforementioned limitations, suggest that Vinfast has at least addressed some system integration issues such as suspension and is continuously working to also address acceleration-related issues through control software updates. Thus, regarding its capability to learn and improve, the VF9 indicates that this capability exists but the VF8 re-review suggests that Vinfast's engineering resources may be too limited to address existing and newly launched vehicles simultaneously. Thus, while Vinfast displayed its capability to learn from experience, an open question is if the start-up OEM can recover from initially highly negative reviews and unsatisfactory customer experience leading to weak brand reputation.

The case of Vinfast highlights that while EVs may be developed and brought to the market at truly remarkable pace, speed-to-market is hardly the only criterion that matters for competition in the transitioning automotive industry. Apparently, other aspects of the established dominant design such as ride experience influence customer perception in creating a minimum standard that new products such as EVs need to meet to survive in the competition that involves incumbent and start-up carmakers.

5.Conclusions

Regarding Perkins and Murmann's claim about the need for financial muscle to enter the automotive industry via EV production, the case of Vinfast both supports and contradicts this assertation. It is supportive in the sense that significant financial investment is required to develop and produce EVs. As a subsidiary of Vingroup, Vinfast benefitted

from the financial support of the conglomerate as well as financial resources provided by Vingroup founder and chairman Pham Nhat Vuong. This form of support is rather exceptional, suggesting that entrants which lack such support will find it more difficult to just start competing against incumbent carmakers and other EV start-ups. Further, Vinfast's successful listing on the NASDAQ highlights that access to financial markets may be another factor that influences the ability to enter the transitioning automotive industry. While some other EV start-ups such as Fisker, Lucid[xvii] or Rivian have been listed on stock exchanges, this option to receive investment is also far from easily achievable for many EV start-up carmakers.

As for the second entry barrier of system integration, the case of Vinfast strongly suggests that ordinary capabilities related to system integration are not easily attainable by start-up EV carmakers. While Vinfast produces a drivable product, reviewers in rare unison are agreeing that the product is not market ready and identify functions that require system integration capabilities as the main issues. While all these issues should be fixable, the open question is if Vinfast can recover from the negative brand reputation earned by rushing the product to the market. While this question is currently unanswerable, two scenarios can be constructed from automotive industry history.

The first scenario can be based on the Yugo made by Zastava Automobiles of Yugoslavia (later: Serbia). When the vehicle was exported to the USA in the mid-1980s, it quickly gained a reputation for low reliability which proved to be impossible to overcome. While Zastava Automobiles continued to produce the Yugo until 2008, the car basically was only soled in Serbia and few neighbouring countries.

The second scenario can be based on Hyundai's expansion to North America, which included production in Canada and sales in Canada and the USA (Chung 1998). Its plant in Bromont, Canada only produced cars from 1988 to 1991. As Hyundai initially failed to convince customers in these markets, it rather quickly decided to shutter down the Canadian plant. the Korean OEM learned many lessons for production and organisation which later were employed to become one of the largest carmakers in the world (Wright, Suh, and Leggett 2009).

While it remains to be seen which brand development scenario can be applied to the case of Vinfast, its case is highly important to the discussion on the nature of entry barriers to the automotive industry. Economies of scale arguably remain a significant entry barrier which is unaffected by the changing dominant design and the fact that the electric powertrain is simpler and more modular than its ICE counterpart. System integrations remains a challenging task that is not easily achievable, arguably because absorbing ordinary capabilities is not a problem of funding but of time-consuming processes of learning, imitation, and innovation. While money may buy time needed for these design-related processes, competition in the highly competitive automotive industry only allow few opportunities to convince customers of brand offerings.

6.References

Abernathy, W.J. and Utterback, J.M., 1978. 'Patterns of Industrial Innovation', *Technology Review* 80(7), pp. 40-47.

Alochet, M., Macduffie, J.P. and Midler, C., 2023. ‘Mirroring in production? Early evidence from the scale-up of Battery Electric Vehicles (BEVs)’, *Industrial and Corporate Change* 32(1), pp. 61-111.

Altenburg, T., Corrocher, N. and Malerba, F., 2022. ‘China’s leapfrogging in electromobility. A story of green transformation driving catch-up and competitive advantage’, *Technological Forecasting & Social Change* 183 (121914).

Associated Press, 2023. ‘Vietnam car maker begins build for North Carolina electric vehicle plant that will employ thousands’, *Associated Press*, 29 July, https://apnews.com/article/north-carolina-vietnam-electric-car-plant-93716679715dd64608f744154e532d5b [25.12.2023]

Brown, E., 2021. ‘The $20 Billion Winner of the American EV Startup Boom: Saudi Arabia’, *Wall Street Journal*, 19 July, https://www.wsj.com/articles/the-20-billion-winner-of-the-american-ev-startup-boom-saudi-arabia-11626687002 [25.12.2023]

Chung, M.K., 1998. ‘Globalization strategies of Korean motor vehicle industry: a case study of Hyundai’, *Actes du Gerpisa* 22.

Evans, S., 2023. ‘2023 VinFast VF8 First Drive: Return to Sender’, *motortrend.com*, 12 May, https://www.motortrend.com/reviews/2023-vinfast-vf8-electric-suv-first-drive-review/ [25.12.2023]

Freyssenet, M., 2011. ‘Three possible scenarios for cleaner automobiles’, *International Journal of Automotive Technology and Management* 11(4), pp. 300-311.

Fujimoto, T., 2007. ‘Architecture-Based Comparative Advantage – A Design Information View of Manufacturing’, *Evolutionary and Institutional Economics Review* 4(1), pp. 55-112.

Hall, E., 2023. ‘Review: Don’t buy the 2023 Vinfast VF 8 City Edition’, *greencarreports.com*, 12 May, https://www.greencarreports.com/news/1139636_2023-vinfast-vf-8-city-edition-test-drive-review [25.12.2023]

Hogan, M., 2025. ‘The VinFast VF8 Stinks. But You Shouldn’t Count Vinfast Out Yet’, *insideevs.com*, 14 January, https://insideevs.com/reviews/745409/2024-vinfast-vf8-review/ [01.02.2025]

Ismail, A., 2023. ‘Critics Agree: The VinFast VF8 is Very, Very Bad’, *jalopnik.com*, 12 May, https://jalopnik.com/everyone-agrees-the-vinfast-vf8-is-very-very-bad-1850432490 [25.12.2023]

Joubert, A., 2024. ‘2024 Vinfast VF 9: Too Expensive For Its Own Good’, *guideautoweb.com*, 25 July, https://www.guideautoweb.com/en/articles/75264/2024-vinfast-vf-9-too-expensive-for-its-own-good/ [01.02.2025]

Klier, T. and Rubenstein, J., 2021. ‘ICE age geography: Powertrain sourcing in Europe and North America’, *International Journal of Automotive Technology and Management* 21(4), pp. 322-342.

Lucid Motors, 2022. 'Electric Vehicle Manufacturer Lucid Group Gearing Up for First International Plant in Saudi Arabia After Signing Agreements with Multiple Agencies', press release, 28 February, https://www.lucidmotors.com/en-ca/media-room/lucid-group-gearing-up-first-international-plant-saudi-arabia [25.12.2023]

Luu, C., 2023. 'VinFast sets sights on Indonesia with $1.2 billion expansion', *Vietnam Investment Review*, 13 September, https://vir.com.vn/vinfast-sets-sights-on-indonesia-with-12-billion-expansion-105152.html [25.12.2023]

MacDuffie, J.P., 2013. 'Modularity-as-Property, Modularization-as-Process, and Modularity-as-Frame: Lessons from Product Architecture Initiatives in the Global Automotive Industry', *Global Strategy Journal* 3(1), pp. 8-40.

MacDuffie, J.P., 2018. 'Response to Perkins and Murmann: Pay Attention to What Is and Isn't Unique about Tesla', *Management and Organization Review* 14(3), pp. 481-489.

Murmann, J.P. and Vogt, F., 2023. 'A Capabilities Framework for Dynamic Competition: Assessing the Relative Chances of Incumbents, Start-Ups, and Diversifying Entrants', *Management and Organization Review* 19(1), pp. 141-156.

Nakazawa, Y., Niwa, T., Nakata, M., Hiwatashi, S., Yoshida, T., Kawachi, T., and Uenishi, A., 2019. 'Development of Future Automobile Design Concept, NSafe-AutoConcept', *Nippon Steel Technical Report* 122, pp. 2-6.

Nguyen, K.G., 2023. 'VinFast to Get $2.5 Billion Infusion From Founder, Vingroup', *Bloomberg*, 26 April, https://www.bnnbloomberg.ca/vinfast-to-get-2-5-billion-infusion-from-founder-vingroup-1.1912381 [30.10.2023]

Nieuwenhuis, P. and Wells, P., 2003. *The automotive industry and the environment: A technical, business and social future*. Cambridge & Boca Raton: Woodhead Publishing & CRC Press.

Nieuwenhuis, P. and Wells, P., 2007. 'The all-steel body as a cornerstone to the foundations of the mass production car industry', *Industrial and Corporate Change* 16(2), pp. 183-211.

Perkins, G. and Murmann, J.P., 2018. 'What does the success of Tesla mean for the future dynamics on the global automobile sector?', *Management and Organization Review* 14(3), pp. 471-480.

Schröder, M., 2021. 'Automotive value chain development in Vietnam: pathways between a new domestic carmaker, supplier development, and differing production systems', *International Journal of Automotive Technology and Management* 21(3), pp. 200-227.

Song, N., Suzuki, H. and Aou, M., 2019. Will Chinese EV start-ups reshape the automotive industry?, Arthur D. Little. https://www.adlittle.com/sites/default/files/viewpoints/adl_chinese_ev_startups-compresse.pdf [30.10.2023]

Stern, P., 2023. '2023 VinFast VF 8 Review: Driving Impressions', *jdpower.com*, 12 May, https://www.jdpower.com/cars/expert-reviews/2023-vinfast-vf-8-review-driving-impressions [25.12.2023]

Takeishi, A. and Fujimoto, T., 2001. 'Modularisation in the auto industry: interlinked multiple hierarchies of product, production and supplier systems', *International Journal of Automotive Technology and Management* 1(4), pp. 379-396.

Vaughn, M., 2024. 'VinFast Launches VF 9 3-Row SUV In US And We Drive One—Briefly', *autoweek.com*, 20 November, https://www.autoweek.com/news/a62953186/vinfast-vf-9-suv-drive-review/ [01.02.2025]

Vervaeke, M., 2012. 'Industrial Designers and the Challenges of Sustainable Development' in Calabrese, G. (ed.) *The Greening of the Automotive Industry*. Houndmills: Palgrave Macmillan, pp. 49-68.

Wang, H. and Kimble, C., 2011. 'Leapfrogging to electric vehicles: Patterns and scenarios for China's automobile industry' *International Journal of Automotive Technology and Management* 11(4), pp. 312-325.

Wong, B. and Ewing, S., 2024. '2025 VinFast VF 9 First Drive: A Rough First Impression', *edmunds.com*, 27 November, https://www.edmunds.com/car-news/2025-vinfast-vf-9-first-drive-review.html [01.02.2025]

Wright, C., Suh, C.-S. and Leggett, C., 2009. 'If at first you don't succeed: globalized production and organizational learning at the Hyundai Motor Company， Asia Pacific Business Review 15(2), pp. 163-180.

[xiii]Notes

This is not to deny that many carmakers pursue the use of materials with a lower weight than steel. Prominent examples are the increased use of aluminium (door, hood) and plastics (front and rear bumper, grille), but despite this trend, car bodies still are mainly made from steel. This is especially true for cars aiming at mass consumers. A recent example of this is Tesla's shift from aluminium bodies to a mix of aluminium and steel bodies to allow its Model 3 to enter the mass market. Thus, while carmakers abandon the all-steel body, they remain firmly committed to a 'mainly steel body'. Further, steel producers develop new steels and vehicle design concepts that would reduce body weight by about 30 percent, a reduction similar to what is achieved by all-aluminium bodies (Nakazawa et al. 2019).

[xiv] For an in-depth treatment of automobile product architecture and product architecture dimensions (integral, modular, open, and closed), refer to Takeishi and Fujimoto (2001), Fujimoto (2007) and MacDuffie (2013).

[xv] A precise calculation of capacity utilisation is not possible because Vinfast also uses the Haiphong plant to manufacture electric buses and BEVs for its export markets (Canada, France, Germany, the Netherlands, and the USA at the time of writing), meaning that actual capacity utilisation will be somewhat larger than suggested by domestic sales. Nevertheless, it can be safely concluded that capacity currently far exceeds actual production.

[xvi] It should be pointed out that Murmann and Vogt (2023) do not identify system integration as an ordinary capability but instead refer to capabilities such as new EV development, EV engineering and design, customer experience, and quality management which are arguably narrower definitions and results of system integration.

[xvii] Lucid Motors is arguably an example for both the importance of access to financial markets and dedicated investors because when the OEM became a publicly traded company in 2021, the majority of its shares were taken over by a sovereign wealth fund of Saudi Arabia (Brown 2021). Due to this strategic investment, Lucid plans to set up the first major automobile manufacturing plant in Saudi Arabia which should have an annual production capacity of 150,000 vehicles (Lucid Motors 2022). From the perspective of Saudi Arabia, investing into an EV start-up is a step to facilitate the transition into an economy that is less dependent on oil and gas export.

EU Artificial Intelligence Legislation: Cooperation and Competition with the U.S.

Xu Yao

1.Summary

Global technological competition is escalating, especially in digital technologies like artificial intelligence (AI) and semiconductors, pivotal to the modern economy and international competition. AI, with technologies like machine learning and deep learning, is transforming industries, prompting nations to invest heavily in AI research and applications to secure a leading edge. The U.S. and China dominate this arena, while Europe, Japan, and South Korea actively pursue key technological breakthroughs. Global AI regulation and legislation display two distinct trends. China and the EU have rapidly implemented regulations, with China introducing the "Interim Measures for the Management of Generative AI Services," a pioneering response to generative AI. In contrast, the U.S. shows a slower, more fragmented approach in AI regulation, marked by ongoing adjustments among government, legislature, and industry. The EU's AI legislative process has significantly gained pace, influenced by emerging AI technologies like ChatGPT, and marking a departure from its traditionally slow legislative efficiency. The EU's new AI legislation, broadening its scope, focuses on risk-based regulation, especially targeting "high-risk AI systems." At the international level, the drive to establish global AI standards continues. The 2023 G7 Osaka Summit underscored the development of AI norms based on democratic values, culminating in the "Bletchley Declaration" signed by key global players, including China, the U.S., and the EU. This agreement signals a phase of competitive cooperation in setting international AI standards. The EU's regulatory approach, guided by principles and governance mechanisms, is poised to significantly influence global AI legislation, despite internal resistance, particularly regarding its potential impact on AI startups and innovation. This evolving landscape suggests an ongoing interplay of regulatory strategies from the EU and market-driven approaches from the U.S., indicating persistent competition and conflicts in AI development and governance.

Global technological competition is intensifying, and this is particularly evident in the field of digital technology, especially in areas such as artificial intelligence (AI) and semiconductors. These technological domains are not only vital pillars of the modern economy but have also become key battlegrounds in international competition. Against the backdrop of globalization, competition in digital technology has emerged as a core factor influencing the overall strength and international status of nations. The rise of the digital economy has further intensified this global technological rivalry. With the widespread adoption of technologies like e-commerce, digital payments, and cloud computing, the digital economy has become a new driving force for global economic growth (Bareis & Katzenbach, 2022; Yuan et al., 2021). Countries are actively developing their digital economies in hopes of securing more advantageous positions in the global market. The competition in this field extends beyond technological aspects and includes

multiple facets such as data governance and cybersecurity. The rapid advancement of artificial intelligence has profoundly impacted global technological competition (Csernatoni, 2021). AI technologies, such as machine learning, deep learning, and natural language processing, are revolutionizing the way industries operate. Nations around the world are actively investing in AI research and applications, striving to gain a leading edge in this field. The U.S. and China are the primary competitors in AI, while European countries, Japan, and South Korea are also making concerted efforts to catch up and achieve key technological breakthroughs in this area. There were bunch of people called for regulation for a long time. As global problems require global solutions, political and industry leaders proposed the establishment of an international AI regulatory agency that could create a unified framework for the regulation of AI technologies and inform the development of AI policies around the world (Erdély & Goldsmith, 2018). Tesla CEO Elon Musk was calling for regulation of artificial intelligence (AI), arguing that “by the time we are reactive in AI regulation, its too late” (Breland, 2017). Currently, global AI regulation and legislation exhibit two distinct characteristics. Firstly, represented by China and the EU, there has been a rapid introduction of regulations, exploring governance of AI from a framework to detailed exploration. Notably, China's "Interim Measures for the Management of Generative AI Services" is the world's first law swiftly enacted in response to generative AI, providing direction, requirements, and support for the development of the national AI industry. Secondly, as exemplified by the U.S., there is ongoing calibration among the government, legislature, and industry sectors. Sam Altman, CEO of OpenAI, previously called for clearer regulation of AI at a congressional hearing. However, existing discussions within the U.S. are not yet sufficient to achieve a swift breakthrough at the legal level.

2.Acceleration of EU AI Legislation

European Commission seeks to legitimize the European AI alternative through beneficial outputs and narratives based on historic technological leadership and that via framing practices the European Commission tries to foster European integration (von Essen & Ossewaarde, 2023). The EU's AI legislative process has significantly accelerated, driven by multiple factors. Firstly, the rapid progression of the EU AI Act is largely influenced by the emergence of AI technologies like ChatGPT. In 2022, the EU AI Act was less prominent compared to the EU Data Act. Given the generally low legislative efficiency within the EU, completing legislative breakthroughs by 2024 was already seen as challenging. However, since the introduction of OpenAI's large language model platform, ChatGPT, in November 2022, major economies have introduced various regulatory policies for the AI industry, forcing the EU to significantly expedite its AI legislative process, surpassing previous expectations. Secondly, the EU has a long history of strict regulation of American tech companies, which has now become a norm. American digital tech giants frequently facing hefty fines in Europe is a common occurrence. With the introduction of new digital governance laws like the Digital Markets Act and the Digital Services Act, Silicon Valley faces increasing regulatory pressures. Since the most competitive and widely used digital platforms in Europe and globally are predominantly American companies, some suggest that the EU might eventually become the de facto regulator of Silicon Valley. Thirdly, the EU has recently achieved a high level of internal coordination in tech governance. Several digital governance-related bills have been rapidly passed, indicating a coordinated acceleration in the regulation of digital platform giants. EU officials, legislators, and researchers have repeatedly emphasized the EU AI Act's focus on technology governance and the high degree of European coordination. Ursula Gertrud von der Leyen, President of the European Commission, has described it

as "the world's first comprehensive legal framework on artificial intelligence, a historic moment." (European commission, 2023).

The new draft of the EU AI legislation features broader applicability and jurisdiction. Compared to previous versions, the current draft underwent substantial adjustments in its scope, primarily regulating two entities in AI systems: the "providers" (mainly the developers of AI systems, who are ultimately responsible) and the "deployers" (specific users of AI systems). However, these definitions are quite broad, encompassing any entity providing AI services, whether as developers, distributors, or even as intermediaries or authorized agents. Additionally, the legislation has an extensive jurisdiction, including extraterritorial application and multiple standards for jurisdiction such as personal, territorial, and substantial.

The EU AI Act is based on risk identification, tailoring regulatory measures for different types of AI systems. It primarily distinguishes four types of risks: unacceptable, high, limited, and low or minor, imposing different regulatory measures and obligations for providers of each type. The focus of the EU's regulation is on "high-risk AI systems," which primarily refer to AI systems that threaten health, safety, the environment, and fundamental rights. The market supervision agencies of each member state will be responsible for overseeing the compliance of high-risk AI systems and have the authority to demand corrective measures from providers of non-compliant AI systems, including prohibition, restriction, withdrawal, or recall of AI systems not meeting the legislative requirements, with penalties up to 30 million euros or 6% of the violator's global annual revenue.

However, there are shortcomings and risks in the current EU AI legislation. Scholars argued that AI Act's goal of bringing about trustworthy AI appears overly ambitious and by itself improbable in practice (Laux, Wachter & Mittelstadt, 2024). Firstly, the EU's definition of AI remains vague. The scientific community has not yet reached a definitive final definition of "AI." The draft proposes a broad and technologically neutral definition. For industry participants, whether their software systems possess "elements of autonomy" will become the primary criterion for whether they fall under regulation. Secondly, the broad definition of regulatory subjects raises concerns about overregulation, particularly regarding the strong regulatory obligations for general-purpose AI, especially foundational models. European legislators aim to establish a complete and systematic regulatory framework for the normative development of the AI field. However, the rapid development and iterative updates of AI in recent years pose significant challenges to achieving the legislative goals, as evidenced by the debates during the bill's deliberation process. Besides, some pro-visions of the Draft AI Act have surprising legal implications, whilst others may be largely ineffective at achieving their statedgoals (Veale & Zuiderveen, 2021). Thirdly, the core legislative goal of the EU AI Act is to reduce the risks of AI to individual health, safety, and fundamental rights, but it does not pay much attention to the social risks posed by AI. Issues in social governance arising from generative AI, such as cybercrime, misinformation, and employment threats, have already surfaced. Nevertheless, the current EU AI legislation still focuses on individual rights and does not adequately address these dangerous factors.

3.Differences in AI Legislation and Regulation between Europe and the U.S.

The U.S. approach to AI legislation and regulation is more fragmented and slower compared to Europe. The legislative efforts in congress are dispersed; Democratic lawmakers have proposed a "National Artificial Intelligence Committee" in the House and an "Artificial Intelligence Safety and Innovation" framework in the Senate. Additionally, state-level legislative bodies have formed various workgroups and committees, introducing related bills. However, these efforts are not only scattered but also lack the fervor from Republicans compared to Democrats. Compared to EU's AI legislation, the U.S. is slower and struggles to rapidly develop a systematic regulatory scheme.

The U.S. is still exploring specific policy and regulatory approaches. The Biden administration proposed the "Artificial Intelligence Bill of Rights Blueprint" in the latter half of 2022 to provide a basis for federal departments in rulemaking. However, not all departments are equally engaged in formulating AI rules; the Department of Commerce and the Federal Trade Commission (FTC) are comparatively more active. Without a mature AI regulatory system and leading agency, the FTC is likely to take a proactive role in future regulation. Key issues include the need for comprehensive legislation similar to the EU, whether a specific agency should oversee regulation, the level of transparency in enforcement, concerns over industry monopolization, and potential stifling of innovation. With the 2024 elections approaching, AI legislation might become a focal point of bipartisan debate. There's a growing belief that the window for compromise between the two parties is narrowing, casting doubt on the progress and clarity of U.S. AI legislation and regulation.

Collaboration on AI legislation and regulation has been ongoing for years between Europe and the U.S. They have repeatedly coordinated AI policies at various levels, using platforms like the U.S.-EU Trade and Technology Council (TTC) to explore standardization of terminology, risk monitoring, and jointly releasing the “Trustworthy Artificial Intelligence and Risk Management Assessment and Measurement Tools Joint Roadmap.” Additionally, at the G7 summit in May 2023, developed countries, led by Europe and the U.S., prioritized setting international standards for AI based on shared democratic values.

However, the implementation of collaborative AI industry development and regulatory policies between Europe and the U.S. has been less successful. Long-standing differences in digital governance, including data privacy, legal conflicts of internal laws versus extraterritorial jurisdiction, and legislative inertia, continue to persist. Bridging these strategic and policy gaps in the short term remains challenging.

Conflicts between AI industry development and regulation are becoming more pronounced. The development path of AI industries represented by U.S. companies like OpenAI, particularly large language models, is in strong conflict with the regulatory approach represented by the EU. The EU's AI Act demands greater algorithmic transparency, causing concerns among AI corporate giants about the exposure of their algorithms and resistance to the legislation. Given the U.S.'s leading position in the current AI industry, companies like OpenAI show the most significant resistance. For instance, ChatGPT was banned first in Italy on March 31, and OpenAI's founder, Sam Altman, claimed that the EU's regulatory model hinders the development of AI

technology. The EU's role as the "regulator of Silicon Valley" remains unchanged in the era of AI regulation.

Moreover, the impact of European and the U.S. AI legislation and regulation on other countries is emerging. Compared to the EU's AI Act, which has a more defined timeline, many countries have not yet established a unified regulatory framework for AI or a systemic definition of AI. Their legislative processes might face pressures from advancements in Europe. Similar to the "Safe Harbor-Privacy Shield" cases, the changes of Trans-Atlantic transboarder data flows, European regulators have adopted a firm stance on extraterritorial jurisdiction (Farrell & Newman, 2016). If such standards are adopted in the final legislation, industry participants in the AI system targeting the EU market will likely need to comply with the EU's AI Act provisions. This includes offering products or services for the EU market or the possibility that their products could be sold or used within the EU, or even if EU-based users could be adversely affected by using their products.

The EU has consistently played a significant role in shaping digital governance norms. This is partly due to its early implementation of data protection and other digital governance laws and partly because the EU's digital services market is crucial for global tech platforms. As a result, the AI legislation passed by the EU is likely to influence global AI legislative content, with other countries referencing its experiences and lessons. The U.S. may also be influenced by the EU (Rojszczak, 2020), thereby expediting the enactment of its own legislation. Yet, while some components of the Act will have important effects on global markets, Europe alone will not be setting a comprehensive new international standard for AI (Engler, 2022).

Complying with European and U.S. AI legislation requirements will be another crucial challenge for AI startups aiming for international operations. Particularly under the current draft framework, closed-source companies with large computational models will face stricter regulations. The legislation focuses on the processing of training data for large models, including the selection process, storage patterns, and security standards of training data. This heightened attention may constrain the development and business deployment of large language models by foreign AI industries, especially leading companies.

4.Ongoing Competition in Markets and Regulation

The AI industry in the U.S. is rapidly developing. With Google's Gemini, positioned as a competitor to OpenAI's GPT-4, launching on December 6, 2023, a new wave of global AI competition is surging. The emergence of ChatGPT and Gemini has had a profound impact on global AI competition. The release of ChatGPT prompted Google to accelerate the development and application of its language model, LaMDA. Google uses LaMDA to provide more intelligent conversational interactions in its search engine and other services, competing with ChatGPT. In terms of industry application, generative AI is integrating more features into educational tools, offering more personalized learning experiences and content. Google's AI is also used to enhance the efficiency of its advertising and recommendation systems, competing with ChatGPT in various industries. After Microsoft integrated ChatGPT technology into its Azure cloud services, Google responded to this challenge by enhancing AI capabilities in its Google Cloud Platform, including launching more intelligent data analysis and machine learning tools, to maintain competitiveness in the cloud computing market. Additionally, this has led to a significant increase in policy and ethical discussions in the AI field and sparked new dynamics in

global cooperation and competition. OpenAI and Google are collaborating with various countries and companies worldwide to develop AI technology. Meanwhile, Google also faces competition from numerous Chinese AI companies, with major manufacturers rapidly developing their own AI technologies.

Currently, Europe is not on par with the U.S. in the development and application of AI technologies. Despite research indicating that the technological disparities among allies could potentially enhance cohesion (Locatelli, 2007), the EU has nevertheless chosen a path of rigorous regulation. The finalization of the European AI law is imminent. The European AI Act, which has largely reached a consensus, marks a significant milestone. Firstly, it is the first comprehensive AI regulatory legislation on a global scale, and overall, its progress has been remarkably swift. The lengthy process of internal EU legislation has often been criticized, but this legislative process has been notably quick. Since the European Commission submitted the EU AI Act on April 21, 2021, it has undergone several rounds of discussion. The European Parliament's plenary session confirmed its position on June 14, 2023. Following the vote in the European Parliament that day, the three main EU institutions immediately held the first "trilogue meeting." Subsequent trilogue meetings on July 18, October 2, and October 24, 2023, led to the political agreement without any fundamental obstacles. It is widely predicted that the institutions will not take long to pass it, and the legislative process could be completed and become effective by early 2024 – although it's important to note that even after passage, the act will come into effect in stages, with full implementation expected by 2026.

Datas externality problem makes it necessary for states to regulate data or even to pursue data sovereignty (Liu, 2021). Moreover, it appears that the EU has become accustomed to exercising robust regulation in the realms of data and technology. Still, there is significant internal resistance within the EU, reflecting the contradictory nature of the EU AI Act. There are considerable objections within the EU, particularly from member states and the AI industry, who believe the current legislation will greatly harm Europe's AI startups. Additionally, some privacy protection organizations have strongly opposed the partial relaxation of AI facial recognition regulations.

However, the principles and mechanisms established by the EU in AI legislation offer useful lessons for global AI legislation. Firstly, the EU's internal legislation often has a strong spillover effect. For example, the General Data Protection Regulation (GDPR) has gradually become an important reference for countries worldwide in establishing data protection mechanisms and is a crucial compliance basis for almost all globally operating companies. Secondly, the final passage of the EU AI Act will become a significant target in the global wave of AI governance. Subsequent legislation in various countries will certainly reference the EU AI Act, adjusting safeguards and exceptions according to their own realities. Thirdly, the implementation of the EU AI Act will be a key observation point for countries, focusing on how to balance regulation and development, and how to respond to concerns from the European AI industry that the new legislation might stifle European AI innovation and application scenarios.

The negotiation for establishing global standards in artificial intelligence is still ongoing. At the G7 Osaka Summit in May 2023, leaders of developed countries expressed their intention to establish international AI norms based on "democratic values." By the end of 2023, China, the U.S., the EU, and about twenty other countries signed the "Bletchley Declaration" in the United Kingdom to safely develop artificial intelligence, marking the beginning of competitive cooperation in setting international AI standards. Countries of

the "Global South" generally wish for deeper cooperation in global AI standards and prefer not to align with specific blocs, which aligns with China's longstanding emphasis on open international collaboration in the field of AI. In this sense, the "EU approach" is likely to grant the EU a greater degree of independence in future international cooperation on AI regulation. The regulatory approach of the EU and the market-driven approach of the U.S. may continue to conflict and compete as AI technology and industries evolve.

5.References

Bareis, J., & Katzenbach, C. (2022). Talking AI into being: The narratives and imaginaries of national AI strategies and their performative politics. Science, Technology, & Human Values, 47(5), 855–881. https://doi.org/10.1177/01622439211030007

Breland, A. (2017). Elon Musk: We need to regulate AI before “its too late.”. The Hill. Retrieved from.

Csernatoni, R. (2021). The technology challenge in the transatlantic relationship. European View, 20(2), 157-165.

Engler, A. (2022). The EU AI Act will have global impact, but a limited Brussels Effect, Brookings Institution. U.S. of America. Retrieved from https://policycommons.net/artifacts/4141277/the-eu-ai-act-will-have-global-impact-but-a-limited-brussels-effect/4949540/ on 16 Feb 2024. CID: 20.500.12592/gct797.

Erdélyi, O. J., & Goldsmith, J. (2018, December). Regulating artificial intelligence: Proposal for a global solution. In Proceedings of the 2018 AAAI/ACM Conference on AI, Ethics, and Society (pp. 95-101).

European commission. (2021, December 9). Statement by President von Der Leyen on the Political Agreement on the EU AI Act. European Commission. https://ec.europa.eu/commission/presscorner/detail/en/statement_23_6474.

Farrell, H., & Newman, A. (2016). The transatlantic data war: Europe fights back against the NSA. Foreign Affairs, 95(1), 124-133.

Laux, J., Wachter, S. and Mittelstadt, B. (2024). Trustworthy artificial intelligence and the EU AI act: On the conflation of trustworthiness and acceptability of risk. Regulation & Governance, 18: 3-32. https://doi.org/10.1111/rego.12512

Liu, L. (2021). The rise of data politics: digital China and the world. Studies in Comparative International Development, 56, 45-67.

Locatelli, A. (2007). The technology gap in transatlantic relations: A cause of tension or a tool of cooperation? Journal of transatlantic studies, 5(2), 133-154.

Rojszczak, M. (2020). CLOUD act agreements from an EU perspective. Computer Law & Security Review, 38, 105442.

Veale, M. & Zuiderveen Borgesius, F. (2021). Demystifying the Draft EU Artificial Intelligence Act — Analysing the good, the bad, and the unclear elements of the proposed

approach. Computer Law Review International, 22(4), 97-112. https://doi.org/10.9785/cri-2021-220402

von Essen, L., & Ossewaarde, M. (2023). Artificial intelligence and European identity: the European Commissions struggle for reconciliation. European Politics and Society, 1-28.

Yuan, S., Musibau, H. O., Genç, S. Y., Shaheen, R., Ameen, A., & Tan, Z. (2021). Digitalization of economy is the key factor behind fourth industrial revolution: How G7 countries are overcoming with the financing issues? Technological Forecasting and Social Change, 165, 120533.

The Impact of Emerging Technologies on the Strategic Landscape: A Vietnamese Perspective

Ngo Di Lan

1.Abstract

This paper critically examines the cascading effects of emerging technologies—such as Artificial Intelligence (AI), Electric Vehicles, and robotics—on Vietnams strategic positioning within the larger context of the Indo-Pacific region. The onset of these technologies' places semiconductor chips at the epicenter of geopolitical tensions, notably between the U.S. and China. Within this landscape, Vietnams growing role in the global semiconductor supply chain, catalyzed in part by the U.S. "friendshoring" strategy, gains newfound importance. This participation may hold the potential to bolster Vietnam's geopolitical influence but could also turn it into a potential flashpoint in the region.

The core thesis of the paper underscores the dual-edged nature of emerging technologies, which introduce both strategic openings and new complexities. On the one hand, these technologies could aggravate existing frictions, such as those in the South China Sea, which may complicate Vietnam's strategic calculus. On the other, Vietnam's involvement in ASEANs regulatory initiatives for AI exemplifies a positive trajectory, potentially reinforcing regional governance structures and mitigating risks.

Beyond Vietnam's particular situation, the paper explores the broader ramifications of these technologies for Southeast Asia as a whole. It suggests that Vietnam's experiences—both positive and negative—could induce shifts in regional dynamics, affecting trade, security, and governance across ASEAN nations.

By weaving these dimensions into an integrated narrative, the paper offers a nuanced assessment of how emerging technologies are shaping not just Vietnam's but also Southeast Asia's strategic landscape. It highlights the far-reaching implications of these technologies on diplomatic relations, ethical norms, and governance frameworks. Consequently, the paper emphasizes the urgent need for a multi-level, coordinated governance approach to navigate the complex challenges and opportunities presented by this technological epoch, both for Vietnam and the broader region.

Keywords: AI, Emerging Technologies, Indo-Pacific, Geopolitical Dynamics, Strategic Landscape

The growing consensus is that the strategic landscape of the Indo-Pacific region has become more complicated over the years, especially given the increasingly intense US-China rivalry (Kapur, 2019). In this context, Vietnam has emerged as one of the pivotal nations, marked by its central geographical position and the dynamism of its economy. Vietnam's recent diplomatic maneuvers are nothing short of a strategic ballet: the elevation of its ties with the US to a comprehensive strategic partnership, swiftly followed by hosting Chinese President Xi Jinping, is a testament to its diplomatic finesse and

strategic acumen (SCMP Editorial, 2023). Concurrently, Vietnam's steadfast adherence to its "Four Nos - One Depend" defense policy articulates its commitment to pursuing strategic autonomy while signaling peaceful intentions to its neighbors and partners (Hai Minh, 2023).

This delicate diplomatic dance takes place against a backdrop of rapid technological evolution, also known as the Fourth Industrial Revolution (Schwab, 2017). Technological advancements, particularly in Artificial Intelligence (AI), Electric Vehicles (EVs), and Robotics, are not mere additions to the arsenal of modern states but are transformative forces that are reshaping the global strategic landscape (Rotolo et. al, 2015). AI's profound implications on cybersecurity, data analytics, and automation, the revolution brought forth by EVs in the energy and transportation sectors, and the transformative potential of Robotics in manufacturing and service industries, collectively denote a seismic shift. This shift while expected to have clear and significant economic impact, will ultimately extend to the very core of geopolitics, defense strategies, and diplomacy, especially in the dynamic Indo-Pacific region.

The central argument of this paper is that the advent and rapid integration of these emerging technologies constitute a double-edged sword, presenting unparalleled opportunities for economic growth while simultaneously introducing unprecedented challenges. Vietnam's journey in this techno-strategic epoch is emblematic of the broader narrative of Southeast Asia—a narrative characterized by a delicate balance between leveraging opportunities for advancement and navigating the complexities of superpower struggle. The following analysis aims to dissect these complexities, unravel the nuanced interplay between technology and strategy, and elucidate Vietnam's evolving trajectory in the Indo-Pacific theater in the broader context of emerging technologies, thereby underlining the broader implications for regional stability, economic vitality, and the architecture of international relations.

2.The Strategic Landscape of Emerging Technologies in the Indo-Pacific

The Indo-Pacific, a region characterized by its vast expanse and strategic significance, is arguably the most critical region in contemporary geopolitics. This vast maritime corridor, stretching from the shores of India to the western Pacific, is not just a geographical expression but a complex mosaic of diverse nations, economies, and cultures. The region's significance is amplified by its role as a central artery for international trade and commerce, with major sea lanes facilitating the flow of goods, energy, and information between some of the world's most vibrant economies (Doyle & Rumley, 2019). Furthermore, the Indo-Pacific's criticality is underscored by its rich, yet vulnerable, natural resources and biodiversity. The environmental security of the Indo-Pacific, encompassing the health of its oceans, the sustainability of its fisheries, and the well-being of its coastal communities, is of paramount importance (Watson & Pandey, 2015). However, the Indo-Pacific's importance transcends its economic, trade or environmental significance. Its vital importance derives from being the epicenter of the intense geopolitical tensions driven by the strategic rivalry between the United States and China.

This superpower struggle, which encompasses a multi-dimensional contest for influence, power, and dominance, casts a long shadow over the region, influencing the strategic calculations of not only those directly involved but also many smaller nations that call this region home. The actions and interactions of these two superpowers, ranging from trade to military posturing are reshaping the regional balance of power and alignment in

numerous ways. As such, the Indo-Pacific is arguably at a pivotal juncture, where the interplay of economic vigor, geopolitical rivalry, and environmental challenges could shape the future not only of the region but of the entire world. The decisions made here, the alliances formed, and the policies implemented will have far-reaching implications, influencing the global order and defining the trajectory of international relations in the 21st century.

It is against the backdrop of this superpower struggle, that we should understand the strategic importance of emerging technologies such as AI, green technologies and robotics. These technologies are not mere incremental advancements, but catalysts poised to redefine the strategic landscape of the Indo-Pacific and beyond. AI, in particular, with its profound implications for cybersecurity, surveillance, and autonomous systems, is set to revolutionize the very foundations of national security and defense strategies. Its capacity to process vast amounts of data, identify patterns that were previously undiscoverable, and make predictive analyses makes it a critical asset in the arsenal of modern nations, potentially shifting the balance of power in intelligence and warfare (Johnson, 2019).

The symbiotic evolution of Artificial Intelligence (AI) and robotics is ushering in a transformative era, where the conceptualization of AI as the brain of machines is no longer metaphorical but a tangible reality. This convergence is driving unprecedented advancements in robotics, transcending traditional boundaries of manufacturing and service industries. Notably, companies like Boston Dynamics are at the forefront of this revolution, engineering robots that combine sophisticated AI with physical dexterity, revolutionizing tasks that were once the sole domain of humans (Bogue, 2016). The applications of such advanced robotics are manifold, ranging from precision manufacturing and logistics to healthcare and disaster response, enhancing efficiency and productivity across sectors.

The green revolution marks a paradigm shift in the global pursuit of sustainable development and energy security (Göpel, 2016). This movement is not just about environmental conservation but is intrinsically linked to the strategic autonomy and economic resilience of nations. The transition to electric mobility, a cornerstone of this revolution, is more than an environmental imperative; it is a strategic maneuver with profound implications. As the world pivots towards EVs, the demand for critical resources like lithium and cobalt has surged, triggering a strategic race to secure these essential materials (Olivetti et. al, 2017). This race, however, extends beyond mere resource acquisition, it will likely reshape global trade dynamics, breakdown old and create new alignments, while prompting nations to reassess their economic and strategic dependencies. Furthermore, the integration of green technologies into the energy sector is catalyzing a shift from traditional fossil fuels to renewable and sustainable energy sources. This transition is not only crucial for combating climate change but also for reducing geopolitical dependencies on oil-rich regions, thereby redefining energy security paradigms. As nations invest in solar, wind, and other renewable energy technologies, the global energy landscape is undergoing a profound transformation, opening new avenues for cooperation and competition in the Indo-Pacific and beyond.

As these emerging technologies continue to evolve and intersect, they collectively herald a new era in the strategic landscape of the Indo-Pacific. Small and medium states in Southeast Asia like Vietnam, situated at the heart of this pivotal region and at the crossroads of these transformative forces, must navigate this evolving terrain with strategic foresight, balancing their technological aspirations with the dominant

geopolitical dynamics of the time. The integration of AI, green technologies, and robotics into the regional fabric presents a complex mosaic of opportunities, challenges, and strategic choices, shaping the future of the Indo-Pacific and its role in the global order.

3.Emerging Technologies as a Double-Edged Sword

The growing adoption of emerging technologies would likely be a double-edged sword, presenting a complex interplay of opportunities and challenges that nations must navigate with astuteness and foresight. As nations strive to harness these technological forces, they are confronted with the dual task of capitalizing on the unprecedented opportunities for economic growth and regional integration, and addressing the multifaceted challenges that accompany this technological transformation.

Advanced AI systems could foster enhanced regional connectivity. This technological leap facilitates smoother cross-border trade, fosters regional supply chain integration, and bolsters economic cooperation. For instance, AI-driven logistics and supply chain management systems optimize trade routes, reduce operational costs, and enhance the efficiency of regional trade networks (Brett, 2023). This heightened connectivity not only strengthens economic ties but also enhances the collective resilience of Southeast Asian nations in the region, making them more robust in the face of global economic fluctuations.

Parallel to the strides in digital connectivity, the global shift towards sustainability presents a strategic opportunity for the region to take the lead in green technology. The abundant natural resources of ASEAN member states, coupled with increasing investments in renewable energy, position the region as a potential hub for sustainable economic models. This transition aligns with global climate goals and attracts international partnerships, positioning the region as a fertile ground for green technology innovation and investment. The leadership in this domain not only contributes to global environmental efforts but also establishes a new economic paradigm, opening doors to sustainable growth and development.

Furthermore, the integration of robotics and automation in manufacturing could reshape the industrial landscape of the region in the near future. For instance, in Samsung's manufacturing plants in Vietnam, which are among the largest of their kind globally, robotics and automation are extensively employed in the assembly of smartphones and other electronic devices (VietnamNet, 2024). These automated systems perform a multitude of tasks, from precision assembly of intricate components to the efficient handling and packaging of finished products. The use of robotics ensures not only higher efficiency and productivity but also a significant reduction in production errors and an improvement in the quality of the final products. By embracing these advanced technologies, nations are transitioning from traditional, labor-intensive industries to high-value, technology-driven sectors. This shift is not just an upgrade of industrial capabilities; it's a transformative move that attracts foreign investment, enhances industrial competitiveness, and paves the way for a new era of economic prosperity in the region.

However, these tectonic shifts would undoubtedly have its share of complexities. The rapid adoption of automation and AI brings to the forefront the challenge of labor market disruptions (Skandul, 2023). The displacement of traditional jobs, especially in labor-intensive sectors, poses a critical socio-economic challenge. In the longer term, nations could be compelled to completely reevaluate their workforce strategies, focusing on

reskilling and upskilling initiatives to ensure that their human capital is prepared for the demands of a technology-driven economy. This transition, while promising in terms of efficiency and productivity, requires a strategic, empathetic and timely approach to workforce development, ensuring that economic progress does not lead to massive social instability.

In addition to labor market challenges, the digital revolution introduces the risk of widening the socio-economic divide. The disparity in access to and adoption of emerging technologies can exacerbate existing inequalities within and between nations (Georgieva, 2024). Addressing this digital divide is imperative to ensure inclusive growth and prevent the marginalization of less technologically advanced communities. Strategic efforts aimed at enhancing digital literacy, developing robust digital infrastructure, and ensuring equitable access to technology are essential in forging a path of balanced and inclusive development.

Moreover, the geopolitical landscape of the Indo-Pacific is intricately tied to these technological advancements. The strategic alignment with global technology leaders, while offering economic and technological benefits, also introduces new dimensions of geopolitical tension and dependencies. The pursuit of supremacy in critical areas like semiconductor production and AI can lead to strategic realignments that may influence regional stability and autonomy. Navigating this intricate web of alliances and dependencies requires a balanced and nuanced approach, ensuring that technological partnerships do not compromise the strategic interests or sovereignty of nations.

4.Vietnam in the New Strategic Landscape

Vietnam's strategic positioning within new strategic landscape has been rather nuanced, reflecting a careful balancing act amidst the region's complex geopolitical dynamics. With an economy that has shown robust growth and adaptability, Vietnam is keenly aware of the need to integrate technologies like AI, green energy, and advanced robotics into its development framework. However, this technological integration is not merely an economic endeavor; it is also a strategic imperative. In a region where the currents of power are predominantly driven by the US-China rivalry, Vietnam's approach to leveraging these emerging technologies is as much about enhancing its economic stature as it is about enhancing its autonomy. By aligning its technological aspirations with a realistic foreign policy, Vietnam seeks to navigate the complex interplay of regional power dynamics, ensuring that its rise as a tech-savvy nation complements its longstanding objectives of national sovereignty and regional stability.

Recent developments have further underscored Vietnam's strategic acumen, particularly its involvement in the global semiconductor supply chain. Semiconductors, often described as the 'brain' of modern electronics, are at the core of today's technological revolution, driving everything from consumer electronics to sophisticated AI systems. Vietnam's foray into this domain is a testament to its forward-looking vision, positioning itself as a vital player in this high-stakes industry (Reuters, 2023). This involvement is not just a significant economic opportunity, but also a strategic maneuver. In the intricate web of global supply chains, control over semiconductor production and distribution is a considerable lever of power. By attempting to position itself as a player in this industry, Vietnam is not just bolstering its economic portfolio but is also subtly enhancing its geopolitical significance.

The concept of friendshoring, championed by the US as a strategy to diversify supply chains away from geopolitical rivals, notably China, presents both an opportunity and a challenge for Vietnam (Ciuriak, 2023). The friendshoring strategy aims to realign critical supply chains with nations that share similar values and governance frameworks, thereby reducing strategic vulnerabilities. For Vietnam, this geopolitical realignment offers substantial economic opportunities, potentially attracting investments, technology, and expertise. However, it also places Vietnam in a delicate position within the broader US-China rivalry, necessitating a careful and strategic approach. Vietnam's response to this evolving scenario will be a litmus test of its diplomatic skill and foresight. By leveraging these developments, Vietnam has the potential to not only enhance its economic and technological stature but also to reinforce its position as a key player in the Indo-Pacific's evolving strategic narrative.

5.Governing Emerging Technologies: Moving Forward

The governance of emerging technologies in the Indo-Pacific and globally presents a labyrinth of interlocking challenges, necessitating a nuanced balance between harnessing the benefits of innovation and mitigating potential risks. As nations grapple with the rapid proliferation of technologies such as AI, green technologies, and advanced robotics, the task of governance extends beyond traditional regulatory frameworks. It encompasses a broader spectrum, addressing ethical considerations, ensuring equitable access, and preventing the concentration of power in the hands of a few key actors, all while fostering an environment conducive to technological advancement.

The Indo-Pacific region, characterized by its diverse socio-economic fabric and varying levels of technological advancement, presents a unique challenge in developing and implementing governance frameworks that are both inclusive and effective. Take, for example, the governance of AI. In nations where AI technologies have been rapidly integrated into sectors like healthcare, finance, and urban management, governance frameworks tend to focus more on issues like data privacy, algorithmic transparency, and ethical usage. Singapore's Model AI Governance Framework is a case in point, offering detailed guidelines and best practices to ensure that AI technologies are deployed in a responsible and ethical manner. However, in other parts of the Indo-Pacific, the focus might be on establishing the basic infrastructure and regulatory environment needed to support AI innovation and adoption, while also ensuring that these technologies do not exacerbate existing socio-economic disparities.

The challenge is further compounded by the need to balance the economic benefits of technological adoption with potential risks. For instance, the integration of automation and robotics in manufacturing can significantly boost productivity and economic growth. However, it can also lead to labor market disruptions, necessitating policies that address workforce reskilling and social safety nets.

Globally, the challenge of governing emerging technologies is not only about managing their direct impacts but also about addressing the broader implications of their uneven distribution and potential to concentrate power. As certain nations and multinational corporations emerge as leaders in technological innovation, the risk of creating a digital divide and a form of technological hegemony becomes more pronounced. This uneven landscape can lead to a scenario where a handful of players hold significant sway over the direction and application of these technologies, potentially marginalizing others and stifling innovation (Kak et. al, 2023). To counteract this, a collaborative and multi-layered approach to governance is essential. This approach should not only involve national

governments but also international organizations, civil society, and the private sector. The aim is to create a governance ecosystem that fosters fair competition, stimulates innovation, and ensures the equitable distribution of the benefits of emerging technologies.

The creation of such an ecosystem requires a concerted effort to establish international norms and standards that guide the development and deployment of these technologies. Initiatives like the European Union's General Data Protection Regulation (GDPR) set a precedent in this regard, aiming to protect data privacy and set boundaries for the operation of AI and data-driven technologies (Khan & Mer, 2023). Similarly, forums like the G7 and G20, and international organizations like the United Nations and the World Economic Forum, have a crucial role to play in facilitating dialogue and cooperation among nations. These platforms can help in forging a consensus on ethical standards, regulatory frameworks, and mechanisms for dispute resolution. Moreover, they can serve as incubators for global partnerships and collaborative projects, ensuring that advancements in technology are not just the prerogative of a few but are accessible and beneficial to all.

However, crafting these global governance frameworks is not devoid of challenges. It requires navigating complex issues such as intellectual property rights, trade barriers, and national security concerns. There's also the task of ensuring that these frameworks are adaptable and resilient enough to keep pace with the rapid evolution of technology. This is where the role of continuous dialogue and engagement becomes paramount. Multi-stakeholder forums that bring together policymakers, industry leaders, academia, and civil society can foster a more inclusive and well-rounded perspective on how to govern emerging technologies. Through these collaborative efforts, it's possible to strike a balance between nurturing innovation and preventing the concentration of power, thereby steering the development of emerging technologies towards a future that is prosperous, equitable, and sustainable for all.

The governance of emerging technologies, therefore, requires a multifaceted strategy. At the national level, it calls for policies that foster innovation, support research and development, and facilitate the upskilling of the workforce to adapt to new technological paradigms. At the regional level, particularly in the Indo-Pacific, it demands mechanisms that promote technology transfer, ensure regional connectivity, and address the unique challenges and opportunities that these technologies present. And at the global level, it necessitates international collaboration to establish ethical norms, regulatory standards, and governance frameworks that transcend national boundaries and reflect the interconnected nature of these technological advancements.

Overall, the governance of emerging technologies is a complex endeavor, one that must be navigated with strategic foresight and collaborative effort. It requires a balanced approach that recognizes the transformative potential of these technologies while being cognizant of their inherent risks and challenges. By adopting a multi-level, coordinated governance strategy, nations, particularly in the Indo-Pacific, can not only harness the benefits of technological advancements but also ensure that their integration into the socio-economic fabric is harmonious, inclusive, and conducive to long-term stability and prosperity.

6.Conclusion

In navigating the intricate and ever-evolving landscape of technology advancements, all nations are finding themselves at the nexus of monumental shifts. As this paper has argued, the integration emerging technologies, particularly AI, advanced robotics, and green technologies, into the regional and global fabric weaves a complex narrative of strategic opportunities juxtaposed against formidable challenges. The nuanced approach of nations like Vietnam, in leveraging these technologies for economic growth and development while adeptly managing the socio-economic and strategic intricacies inherent in this new era, reflective of a deep-seated awareness of the dual-edged nature of these technological breakthroughs.

As we look toward the future, it is evident that the fabric of the Indo-Pacific will continue to be shaped by the forces of technological innovation, geopolitical struggle, and multilateral governance. The path forward demands a concerted effort from all relevant stakeholders—governments, big businesses, and international bodies—to foster an environment where the symbiosis of technology and strategy engenders a landscape that is resilient, equitable, and conducive to equitable and sustainable growth. The task forward is twofold: to continue to harness the vast potential of emerging technologies as a catalyst for economic and strategic empowerment, and to navigate the complex interlocking set of challenges with a vision that is as pragmatic as it is progressive. In this endeavor, the strategic initiatives, policy frameworks, and international collaborations will not just define the trajectory of individual nations but also the collective futures of the Indo-Pacific, steering this pivotal region towards a future replete with peace and prosperity.

7.References

Brett, D. (2023, October 10). AI set to play a key role in customs brokerage. Air Cargo News. Retrieved from https://www.aircargonews. net/technology/ai-set-to-play-a-key-role-in-customs-brokerage/

Ciuriak, D. (2023). The Economics of Supply Chain Politics: Dual Circulation, Derisking and the Sullivan Doctrine. Derisking and the Sullivan Doctrine (April 30, 2023).

Doyle, T., & Rumley, D. (2019). The rise and return of the Indo-Pacific. Oxford University Press.

Georgieva, K. (2024, January 14). AI Will Transform the Global Economy. Let's Make Sure It Benefits Humanity. IMF. Retrieved from https://www.imf.org/en/Blogs/Articles/2024/01/14/ai-will-transform-the-global-economy-lets-make-sure-it-benefits-humanity

Göpel, M. (2016). The great mindshift: how a new economic paradigm and sustainability transformations go hand in hand. Springer Nature.

Hai Minh. (2023, August 6). Prime Minister reassures Viet Nam's "f-our nos" defense policy. en.baochinhphu.vn. https://en.baochinhphu.vn/prime-minister-reassures-viet-nams-four-nos-defense-policy-11123080610460922.htm

Johnson, J. (2019). Artificial intelligence & future warfare: implications for international security. Defense & Security Analysis, 35(2), 147-169.

Kak et al. (2023, December 5). Make no mistake—AI is owned by Big Tech. MIT Technology Review. Retrieved from https://www.technologyreview.com/2023/12/05/1084393/make-no-mistake-ai-is-owned-by-
big-tech/

Kapur, A. (2019). Geopolitics and the Indo-Pacific region. Routledge.

Khan, F., & Mer, A. (2023). Embracing Artificial Intelligence Technology: Legal Implications with Special Reference to European Union Initiatives of Data Protection. In Digital Transformation, Strategic Resilience, Cyber Security and Risk Management (pp. 119-141). Emerald Publishing Limited.

Olivetti, E. A., Ceder, G., Gaustad, G. G., & Fu, X. (2017). Lithium-ion- battery supply chain considerations: analysis of potential bottlenecks in- critical metals. Joule, 1(2), 229-243.

Reuters. (2023, December 10). Nvidia CEO aims to set up a base in Vietnam. Reuters. Retrieved from
https://www.reuters.com/technology/nvidia-ceo-aims-set-up-base-vietnam-2023-12-10/

Rotolo, D., Hicks, D., & Martin, B. R. (2015). What is an emerging technology? Research policy, 44(10), 1827-1843.

Schwab, K. (2017). The fourth industrial revolution. Currency.

SCMP Editorial. (2023, December 18). Hanoi now Master of Fine balancing act. South China Morning Post. https://www.scmp.com/comme-nt/opinion/article/3245389/hanoi-now-master-fine-balancing-act

Singapores Approach to AI Governance. Retrieved from https://www.pdpc.gov.sg/Help-and-Resources/2020/01/Model-AI-Governa-nce-Framework

Skandul, E. (2023, August 14). AI is going to eliminate way more j-obs than anyone realizes. Business Insider. Retrieved from https://www.businessinsider.com/ai-radically-reshape-job-market-global-economy-emp-loyee-labor-innovation-2023-8

VietnamNet. (2024, January 8). Samsung workers globally face the ri-sk of mass layoffs. https://www.vietnam.vn/en/nguoi-lao-dong-cua-sam-sung-tren-toan-cau-doi-mat-nguy-co-bi-sa-thai-hang-loat/

Watson, I., & Pandey, C. L. (2015). Introduction: Environmental Security in the Asia-Pacific. In Environmental Security in the Asia-Pacific (pp. 1-30). New York: Palgrave Macmillan.