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Next Digitalization and Globalization Scenarios: The Role of Europe

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Next Digitalization and Globalization Scenarios: The Role of Europe

1 Introduction

Globalisation is undergoing a major transformation in the wake of the events of recent years and the change in the geopolitical context that it entails. COVID, the supply chain crisis and the consequent economic polycrisis to which the wars in Ukraine and the Middle East have recently been added have been seeds of this change. In addition, the new presidency in the US will give rise to a new stage, the already baptized Trump 2.0. Meanwhile In the EU with the reports by Dragui (Draghi, 2024) and Letta (Letta, 2024) there is an in-depth reflection on how these changes will be responded to, with a significant situation of technological weakness and lack of productivity of our main companies and economies, which speaks of a response based on Open Strategic Autonomy policies.

In this sense, the intersection between globalization and digitalization constitutes a critical axis for understanding the socioeconomic dynamics facing these changes. This work integrates key indicators of globalization (KOF Globalization Index) and digitalization (IMD World Digital Competitiveness Ranking and NRI) to establish a baseline situational analysis and propose a methodological framework inspired by path dependency theory. Thus, by selecting key events, it will be possible to project four strategic scenarios related to globalization and digitalization. In addition, this study incorporates an analysis of potential fragmentation and competitiveness in Europe, and how a more or less united Europe could take advantage of each of these scenarios

One aspect on which there is no doubt in the literature is that competitiveness and globalization are intrinsically linked. However, studies suggest that globalization can promote economic growth, but it could also worsen income inequality in some situations. High-income countries tend to benefit more from the positive effect of globalization on economic growth compared to other income groups (Bourguignon, 2013). As cited by Bergh et al. (2017) “Among high-protection countries, more globalised countries have lower income inequality. Among low-protection countries, there is no clear linear pattern (although the data might suggest an inverse-U relationship)“. Currently, the conclusions are still open.

On the other hand, an additional element that has been incorporated into globalization is digitalization and its subsequent acceleration in recent years. According to (Skare & Riberio Soriano, 2021) and other related studies, globalization is a necessary but not sufficient condition for the adoption of digital technologies across countries. In addition, there are researchers who analyse patterns of global convergence in ICT (Saba & David, 2020), although they do not consider the new digitalisation environments or the more structural configurations of countries' economies.

In addition, the challenge of measuring the impact of the digital economy in many groups of countries persists (Oloyede et al., 2023) and digital divide and convergence is a common area for study.

All of the above is built upon the foundations of a dynamic of globalization and a geopolitical environment that had remained approximately constant over the past 25 years and was inherited from the agreements reached after the Second World War. In these agreements, the United States achieved global predominance in the areas of trade, military, and technology. However, a notable milestone was China's entry into the WTO on December 11, 2001. Over the past quarter century, China has increased its share of global trade from 4.3% to 21%. The silent giant of the 19th and 20th centuries has now found its own voice and is presenting an alternative world order. Now, the world is shifting to some extent toward the Pacific. China, which began as the global factory and the favorite destination for manufacturing outsourcing, now leads in knowledge generation and competes in digitalization with the United States and other countries. As observed by the Institute for Scientific Information, between 2009 and 2021, China multiplied its volume of published academic research articles by five, and currently surpasses the combined output of Europe, the United States, Japan, and South Korea in intellectual production. According to a 2021 study by Cyber Creative Institute, 40% of 6G patents are generated there. Part of the origin of these changes is undeniably stemming from the rivalry for leadership between these two superpowers. This creates significant links that associate current geopolitical risks with advanced technologies. For sample Huang et al. (2024) have measured this in the Chinese case and in the semiconductor, 5G, and rare earth industries, concluding that in the short term and by the middle of this decade, geopolitical risks are those with the greatest impact.

Thus, by using globalization and digitalization indicators to understand the current situation and by projecting four scenarios—taking into consideration path dependency theory as well as the prevailing circumstances of contingency, reinforcement, and blocking for each projected scenario—we will attempt to answer our research question:

Can we better understand the relationship between digitalization and progress of countries in terms of the previous and immediate globalization?

Which we would accompany with another series of interrelated questions: Can we describe how the different digitalisation paths of groups of countries could be altered by these immediate changes? What different digitalisation policies would you apply to them? Is digitalisation a homogeneous global response to progress? What role should the EU play in the face of all of the above?

1.1 Research organization

First, in section **Error! No se encuentra el origen de la referencia.** we shall introduce the methodological aspects associated with the construction of the projected scenarios.

Section 2.1 is dedicated to explaining Path Dependency Theory, its relationship with innovation dynamics and globalization, especially those that apply to technological lock-ins, and how to overcome them. Section 2.2 presents several globalization and

digitalization indices that are used after that for a first analysis in Section 3, describing the current situation for the countries. Section 4 contains the main body for this paper. First, in Section 4.1 and Section 4.2 with an approximation for the key aspects that will build these scenarios in terms of the Path Dependency and the prior indices analysis, and then, a detailed presentation for each scenario. Section 5, finally, is dedicated to preliminary conclusions.

2 Methodological Aspects for the Construction of the Scenarios

2.1 Influence of Path Dependency Theory in Determining Potential Global Scenarios

Path dependency theory explains how initial decisions, often contingent upon temporary circumstances, can create self-reinforcing mechanisms that steer economies, industries, or institutions toward specific trajectories. It thus offers a critical framework for understanding how past technological, institutional, and economic decisions shape current dynamics of global digitalization, creating reinforcing and blocking situations that prioritize continuity over disruption. Path dependency not only reveals patterns of technological lock-in but also asymmetries in digital access, and it allows us to identify mechanisms for overcoming historical inertia through contingent situations.

Although initially developed for technological evolution processes, it has been used in other fields as well. Vincensini (2001) uses this theory to analyse the evolution of ownership structures in Central Europe, challenging post-socialist institutional transformation. Nunn et al. (2021) argues that an understanding of a city's path dependency is key to optimizing the effectiveness of future adaptation to accelerating (relative) sea-level rising. (Thaler et al., 2023) study path dependencies explaining that there is often a key barrier to adapting to changing risks in the future climate change.

Three fundamental elements underpin this theory: contingency factors, positive feedback mechanisms, and, finally, lock-in circumstances.

The first element, contingency, refers to early decisions or circumstances that, although they may seem arbitrary, unexpected, or suboptimal, set a specific technological path. The second fundamental element consists of positive feedback mechanisms, where the adoption of a technology generates increasing returns through network effects, economies of scale, and complementary investments. The third element, lock-in, occurs when, over time, switching costs—whether financial, institutional, or social—make deviating from the established path prohibitively expensive.

Applicable examples so far could include: Competitive path dependencies had an important influence on the evolution of the procurement process and the size of the overall subsidy for the deployment of the Ireland's national broadband plan (Healy et al., 2022). And related to 'Gigabit strategy' in EU "when gigabit targets are defined, the

technological choices that occur within individual Member States are shaped by the complex and dynamic interaction between a series of path dependencies” (Briglauer et al., 2020)

These cases illustrate how historical paths create cumulative advantages and systemic constraints, shaping a fractured global landscape where innovation coexists with structural inequalities.

2.1.1 Path Dependency and Innovation Dynamics

Endogenous Growth Models

The endogenous growth model proposed by Redding (Redding, 2002) posits that innovation is path-dependent due to the cumulative acquisition of knowledge. For example, Japan’s leadership in robotics emerged from post-World War II investments in precision manufacturing, which created a feedback loop of R&D and skilled labor.

In (Tsangaris et al., 2024) the need to incorporate spatial elements into endogenous growth processes is made explicit and “provide numerical examples demonstrating the importance of spatial dependent policy measures in achieving a balanced regional development”. That is, the regional interference of policy measures is very important and accounts for the “sticky” capabilities. The success of Switzerland in precision instruments and pharmaceuticals, or that of Italy in textile design and fashion, illustrates how initial advantages in specific knowledge can be maintained over generations through specialized educational institutions, apprenticeship practices, and industrial networks. These patterns explain why innovation capabilities tend to be geographically “sticky”, persisting in specific regions even in the face of intense globalization and digitalization.

2.1.2 Mechanisms of Technological Lock-In within the Context of Globalization

Network Externalities and Compatibility

Network externalities are particularly evident in digital platforms, where the value for a user increases with each additional user who joins the platform. Cloud platforms like AWS, Google, or Microsoft Azure demonstrate how, once a platform reaches critical mass, users find it prohibitively expensive to switch to alternatives—even when those alternatives may offer better privacy or security features

Sunk Costs and Incremental Innovation

Companies often prioritize incremental improvements over radical changes to maximize returns on existing investments. The gradual transition of the automotive industry toward electric vehicles (EVs) reflects this dynamic. This pattern can be seen across multiple sectors, where established firms tend to refine existing technologies

rather than pursue disruptive innovations that could cannibalize their profitable product lines.

Institutional and Political Reinforcement

Government regulations and subsidies can entrench specific technologies through persistent incentive structures. At the beginning of the 2000s, European Union (EU) regulators for electronic communications established an effective framework that imposed asymmetric conditions on incumbent operators and created a fertile environment for alternative operators. The regulation focused on affordability and incentivizing take-up. This regulatory reinforcement accelerated broadband and mobile deployment, but ultimately delayed innovation and the introduction of next-generation networks (such as 5G) in the mid-2010s and 2020s, especially when compared to more flexible Asian markets. This case demonstrates how policy decisions can have lasting effects that persist long after the initial conditions have changed (Briglauer et al., 2019).

2.1.3 How to Overcome Path Dependency

Nations must develop effective policies to overcome path dependency and generally combine multiple instruments that simultaneously address the technological, economic, and social dimensions of change.

Creation of New Trajectories

Actors can deliberately forge new trajectories through strategic investments and long-term vision. The creation of TSMC in Taiwan turned the island into a global leader in semiconductor manufacturing. Creating new trajectories requires understanding not only the technological dimensions but also the regulatory and normative aspects of change. The creation of new technological trajectories often involves challenging dominant narratives and reimagining possible futures, combining technological development with institutional work that builds new sociotechnical configurations.

Institutions, both formal and informal, act as “carriers of history,” transmitting values and practices that shape the available technological options. But institutions not only limit, they also enable certain technological trajectories. This institutional dimension explains why similar technologies can follow very different paths in different national contexts, even when the economic fundamentals are comparable. Exogenous shocks, such as climate crises or pandemics, can destabilize entrenched trajectories, opening “windows of opportunity” for change. The COVID-19 pandemic accelerated the adoption of telemedicine, overcoming regulatory and cultural barriers that had persisted for decades.

Technological Hybridization

The combination of old and new technologies mitigates lock-in by creating “transition bridges” that facilitate gradual adoption. Hybridization reduces switching costs and enables the co-evolution of complementary technologies, making transitions that would otherwise be prohibitively disruptive for both producers and users more feasible.

Hybridization not only facilitates technological transitions but can also generate distinctive innovations between paradigms. For example, smart grids combine traditional electrical infrastructure with advanced digital technologies, creating possibilities that would not be feasible within each paradigm in isolation (I et al., 2016). Hybrid zones between technological trajectories can be particularly fertile for innovation precisely because they combine diverse repositories of knowledge and practices, allowing for novel recombinations that would be difficult to conceive within a single paradigm.

2.2 Globalization and Digitalization Indices

In order to establish a starting point, we will attempt to provide a current snapshot of existing globalization and digitalization. There are various indicators that measure globalization and digitalization, each covering different dimensions and aspects of the phenomenon. Let's look at the most prominent ones.

2.2.1 General Globalization Indices

The interest in measuring globalization using composite indices and a multidimensional understanding emerged at the beginning of the 21st century and has undergone significant evolution (De Lombaerde & Iapadre, 2012). The A.T. Kearney and Foreign Policy magazine globalization index, published between 2001 and 2007, was considered the first attempt to construct a composite measure of globalization by incorporating the degree of a country's economic integration into the world economy, the internationalization of its citizens' personal contacts, internet usage, and the extent of its international political engagement. The OECD has also worked on multiple indices that measure international trade, foreign direct investment, the activity of multinational enterprises, global value chains, and aspects of international production and dissemination of technology and knowledge.

For our study, we will consider the KOF Globalization Index. This index, developed by the KOF Swiss Economic Institute at the Swiss Federal Institute of Technology in Zurich since 1970, provides a score that ranks countries according to their degree of integration and connection with the rest of the world.

The index under consideration comprises three sub-indices designed to capture distinct dimensions of globalization: economic, political, and social. The political dimension is operationalized through several indicators: the absolute number of embassies, memberships in international organizations, and participation in United Nations Security Council missions. Economic integration is assessed using indicators of flows—including trade, foreign direct investment, portfolio investment, and income payments to foreign nationals, all expressed as a percentage of GDP—as well as restrictions, such as non-tariff barriers, mean tariff rates, taxes on international trade, and capital account restrictions. In the social domain, indicators are grouped into three categories. The first, interpersonal contacts, include international voice traffic, remittances as a percentage of GDP,

international tourism, and the share of the foreign population. The second, information flows, encompasses internet bandwidth, international patents and high technology exports as well as television and internet access jointly with press freedom. Finally, cultural proximity is proxied, i.e. by the number of McDonald's outlets per capita and civil liberties.

2.2.2 Global Digitalization Indices

On the other hand, there are indices that focus on global digitalization from a multifactorial perspective.

The IMD World Competitiveness Center Team (2024) analyzes and ranks the extent to which 64 countries adopt and explore digital technologies leading to transformation in government practices, business models and society in general. It based in three factors which are divided in 9 subfactors and more than 59 criteria:

Knowledge: The know-how necessary to discover, understand, and build new technologies. Talent, Training, Education and Scientific Concentration.

Technology: Context that enables the development of digital technologies. Regulatory Framework, Capital and Technological Framework

Future Readiness: Level of country preparedness to exploit digital transformation. Adaptative Attitudes, Business Agility and IT Integration

Of these variables, approximately 38 are hard data obtained from international institutions, while the remaining ones come from perception surveys conducted among mid- and senior-level executives, with an average sample of 90 business leaders per country.

The **Network Readiness Index (NRI)** (Portulans Institute, 2024) is a key indicator for assessing nations' digital preparedness. First published in 2002 by the World Economic Forum, the NRI has been currently published by the Portulans Institute since 2019, following significant methodological and conceptual revisions. The current edition evaluates 54 indicators across 133 economies, effectively doubling its scope compared to 2019. The index has evolved from a techno-centric perspective—focused on ICT infrastructure and business adoption—to a much more holistic approach since 2022, especially emphasizing the role of Public-Private Partnerships in advancing digital readiness globally. It covers these areas:

Technology: Evaluates the technological infrastructure essential for a country's participation in the digital economy including digital content, applications, scientific output and software. Also measures readiness for emerging technologies like Artificial Intelligence (AI), the Internet of Things (IoT), and investment in new tech trends

People: Examines the capabilities and digital skills of individuals, businesses, and governments to leverage technology effectively.

Governance: Focuses on the trust policies (cybersecurity, data protection, and user trust), regulations, and institutional frameworks that support a networked society.

Impact: Captures the broader effects of digital readiness on the economy, quality of Life and SDG Contributions. Its sub-pillars are:

3 Analysis of the Current Situation According to Globalization and Digitalization Indices

3.1.1 Globalization: Prosperity and Vulnerability

Globalization has ruled wealth creation over the past 25 years. The KOF index drives global GDP with an $R^2 = .98$ (Bechtel, 2022). Between 2017 and 2022, Switzerland, the Netherlands, and Belgium—and generally European countries—led the KOF ranking, while developing economies such as Pakistan and Bangladesh had index scores below 50¹. Gradín (2024) analysing trends in global inequality from 1950 to 2020 confirms a sustained and pronounced decline observed since 2000, which was temporarily interrupted by the COVID-19 crisis; however, this downward trend is expected to persist at least until 2028. Also, using the same KOF index and comparing with GDP Carare et al. (2018) express that “Globalization (especially economic one) increases the growth rate of output significantly over the sample for all groups of countries, and it also exposes a country to a negative impact on short-term growth of a financial crisis”. In other words, globalization is both a source of strength due to the relationships it creates and, at the same time, could become a source of instability if those relationships were to break down.

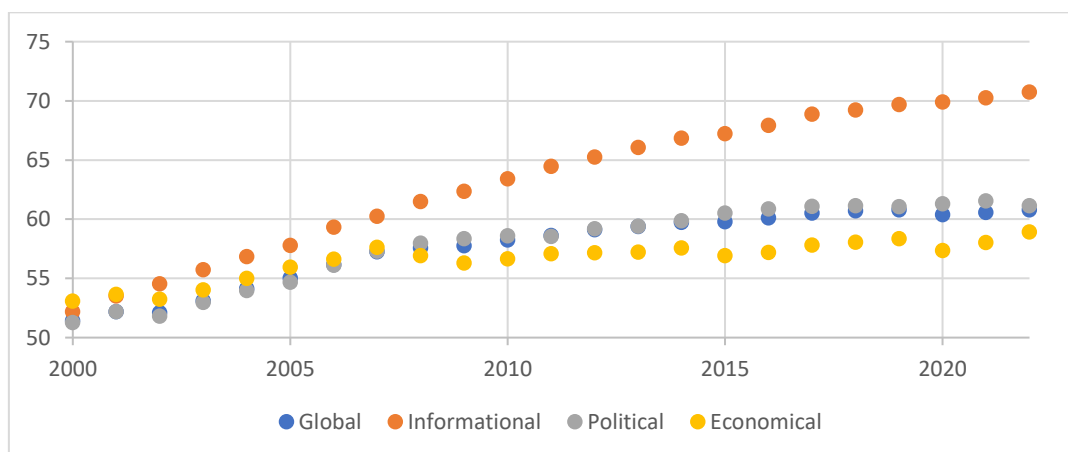


Figure 1. Global KOF value for the world, including its informational, political, and economic subindices (author elaboration)

On the other hand, most of the growth in globalization, according to the KOF Index, comes from informational sources. Meanwhile, the economic and political contributions have varied over time due to the financial crises of 2009 and 2015, as well as the COVID-19

¹ <https://es.statista.com/estadisticas/600230/ranking-de-los-50-paises-con-el-mayor-indice-de-globalizacion/>

crisis. And notably, since 2020, contradictory trends have emerged between economic and political globalization subindices.

In terms of the EU and its globalization, it is necessary to consider the role played by Germany, which accounts for more than 20% of the GDP of the Member States (Eurostat sources) and has been a strong driver of globalization. Its industrial production model has relied on cheap gas energy and robust trade with China. However, the lack of investment in new infrastructure and the high dependence on mature industries should be considered major lock-ins according to the theory of Path Dependency.

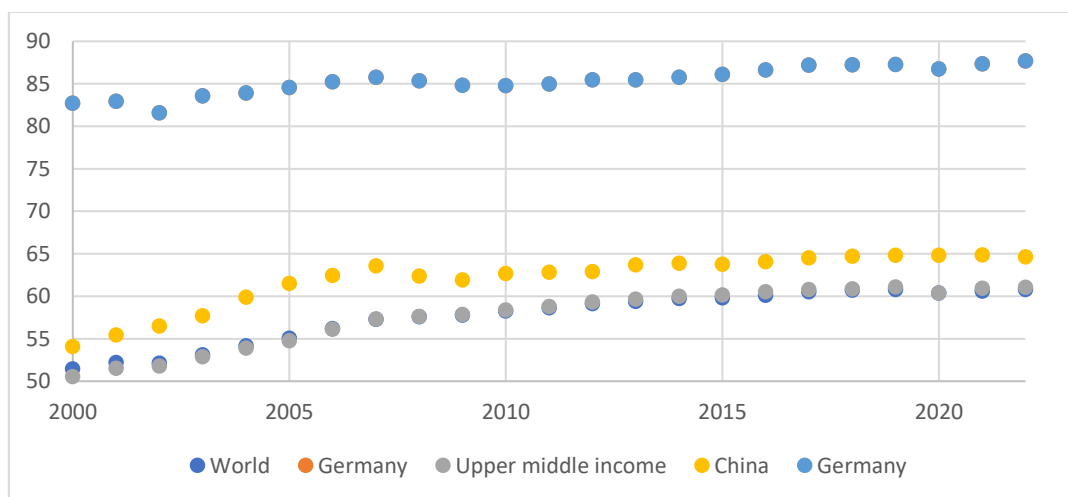


Figure 2. Global KOF evolution for Germany, China, upper-middle income economies, and the World

3.1.2 Digitalization as a Driver of Country Competitiveness

The last **2024 IMD World Digital Competitiveness Ranking** (The IMD World Competitiveness Center Team, 2024) was focused on the uneven development of digital infrastructure, geopolitical tensions, and the impact of emerging technologies. It ranked The European Union, the UAE, and Singapore in an advantage position compared to the US and China, where they explain that “the ‘rule of digital law’ is still not fully upheld”. Also, Europe’s fragmented capital markets and financing systems are major obstacles to its digital competitiveness.

Furthermore, the ongoing geopolitical tensions have led to increased competition for digital dominance among most developed countries. The result has been an added layer of complexity to digital competitiveness, that is, the fragmentation of global digital governance.

Singapore secures the top spot in the 2024 WDCR ranking, progressing two positions overall. This achievement is driven by a one-rank improvement in the Knowledge factor to reach second, maintaining a robust first position in the Technology factor, as well as achieving a noteworthy leap of nine positions to claim first place in the Future Readiness factor.

Countries like Korea and Norway have high rates of internet penetration along with advanced 5G infrastructure that enables their digital services and smart city projects,

allowing them to stay at the forefront of digital competitiveness. In contrast, many developing economies, in Africa, Latin America, and parts of South Asia, have an inadequate or inconsistent digital infrastructure. In this sense, limited broadband access, slow internet speeds, and unreliable electricity service are significant constraints for participating in the digital economy. For example, in Africa, only 33% of the population used the internet in 2021, compared to 87% in Europe.

The **Network Readiness Index 2024** (Portulans Institute, 2024) reveals a complex global digital landscape where significant disparities exist between regions and development levels. At the top of the rankings, the United States leads with exceptional performance across technology adoption and innovation metrics, particularly excelling in areas like AI development and digital business transformation.

Singapore, in consonance with IMD, continues to stand out as a leading force in the global digital landscape, holding 2nd place overall thanks to its strong governance and highly connected business sector. China, ranked 17th, excels in several areas, notably leading the world in AI scientific publications and the size of its domestic market. However, China still faces notable challenges regarding regulatory frameworks and privacy protection.

South Korea jumped to 5th place in 2024 after implementing its "Digital New Deal". Investing 23.4 trillion KRW from 2020 to 2022 and 58.2 trillion by 2025 has created high-quality jobs, leading the market with a 93% 5G coverage.

Meanwhile, Europe continues ranking at the top of the NRI: Finland, Sweden, the Netherlands, Switzerland, the United Kingdom, Germany, and Denmark are rounding out the top 10 NRI ranking. Notably, the United Kingdom has moved up to eighth place, and Germany and Denmark are ranked at ninth and tenth, respectively. But it is strange to see Germany belonging to this top leading group where other EU digitalization index (DESI) doesn't rank it so high.

India emerges as the country with the greatest relative progress: it climbed 11 positions (from 60th to 49th place) between 2023 and 2024, with a 7.4% improvement in its score. India secured 2nd place in the group of lower-middle-income countries, just behind Vietnam. For India² its key performance was being first in the indicators related with AI scientific publications, AI talent concentration and ICT services exports. Second in FTTH, international internet bandwidth and mobile broadband internet traffic within the country. Third in domestic market scale and fourth in annual investment in telecommunication services. Vietnam entered the top 50, ranking 47th, driven by semiconductor investments totaling USD 6.5 billion in 2024 and new ASEAN interoperability agreements.

For Latin América Latina we highlight México (62nd): 12% growth in e-commerce (2023-2024), but lagging in cybersecurity (ranked 89th). Brazil (55th): Leading in digital payments (78% penetration), though with low investment in fiber optics (23% of households).

Africa has the highest number of economies (20) surpassing expectations in at least one pillar, with 14 countries performing well in Governance. Rwanda and Kenya excel across all four dimensions, while Ghana, Malawi, Zimbabwe, Senegal, Tanzania, and Burundi demonstrate strength in three pillars.

² [Press Note Details: Press Information Bureau](#)

Table 1 resumes Strengths and Weakness for main geographical regions according to NRI.

Region	Average NRI 2024 Score	Strengths	Weaknesses
North America	71.5	Leadership in digital innovation, advanced infrastructure, robust tech ecosystem.	Inequality in access and usage, privacy and security concerns.
Europe	64.6	Strong regulatory framework, good governance, high digitalization of public services.	Digital divide between countries, lower adoption in some rural areas.
Asia & Pacific	54.7	Rapid growth, infrastructure advances, leadership in AI and emerging technologies.	Disparities between countries, challenges in regulation and data protection.
Middle East	53.2	Significant investments in infrastructure and digital transformation, especially in Gulf states.	Limited digital inclusion in some countries, reliance on oil in the digital economy.
Latin America	44.2	Improvements in infrastructure and access, growth in startups and innovation.	Uneven infrastructure, digital skills gaps, low investment in innovation.
Sub-Saharan Africa	32.5	Progress in governance and digital inclusion, leadership in countries like Mauritius.	Limited infrastructure, low internet penetration, scarce resources for innovation.

Table 1. Average NRI score, Strengths and Weaknesses detected for global regions. Source: author own elaboration.

4 Projected Scenarios

4.1 Current Systemic Relationship Between Globalization and Digitalization

Considering the reflections made in Section 3, we outline the main relationships between globalization and digitalization to map after that the key aspects in the 2025–2030 Scenarios Transition.

Those are the main relationships.

A. Synergies and Structural Tensions

At present, digitalization acts as an accelerator of globalization, primarily through **digitized value chains**, with platforms such as Alibaba and Amazon reducing transaction costs and facilitating cross-border trade for small and medium-sized enterprises (30% of the Spanish SME are selling online³). Also through global data flows: **International mobile traffic** in April 2024 grew at an annual rate of 35% (2017–2023), with 5.5 billion internet users in 2024⁴.

As indicated by the KOF index and as we saw in 3.1.1 the majority of globalization growth over the last ten years has come from its informational component. Figure 3 shows this.

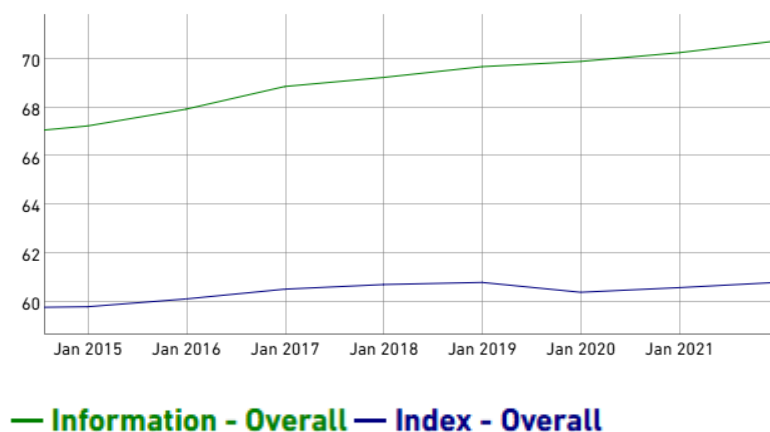


Figure 3. Information KOF index vs overall KOF index. Source: KOF site.

Because, in reality, globalization does not refer exclusively to the exchange of goods or capital. There is a highly significant dynamic of exchanging intangible flows—such as knowledge or internet traffic—as well as the movement of people, which truly shape globalization. In this sense, no region can be self-sufficient anymore (McKinsey Global Institute, 2022).

However, divergences arise regarding the current **model of global digitalization**:

Global Digital Divide: While approximately 93% of the population in high-income countries used the Internet in 2024, the proportion drops to just 27% in low-income countries. This asymmetry limits their ability to integrate into global value networks.⁴ The

³ [202404_informe-economia-digital.pdf](#)

⁴ <https://www.itu.int/en/mediacentre/Pages/PR-2024-11-27-facts-and-figures.aspx>

GSMA report "The Mobile Economy Sub-Saharan Africa 2024"⁵ indicates that mobile internet penetration in Sub-Saharan Africa reached only 27% in 2023 and that, although growth is expected, the usage gap remains at 60%, the highest in the world. The report projects that, without structural changes and significant investments, the region will continue well below 40% penetration over the coming years.

Regulatory Fragmentation: Divergent regulations on privacy (GDPR vs. CCPA) and digital taxation generate compliance costs that especially impact emerging economies.

B. Regional Geographic Patterns

Figure 4 shows KOF 2022 on the X axis and IMD 2024 on the Y axis. A trendline is also displayed to identify countries that are taking advantage of globalization and digitalization. In Figure 5, changes in NRI ranking positions (2019-2024) are compared to KOF 2022. There are no appreciable differences between global KOF index for the countries from 2019-2022.

The cross-analysis of KOF versus IMD/NRI would reveal four general patterns of regional clusters:

1. **Advanced Digital Globalizers.** Singapore (SG), Switzerland (SE), Sweden (SE): High scores in all indices. Example: Singapore (1st in IMD, 1st in KOF Global Economic level) combines trade openness with leadership in governmental AI⁶.
2. **Traditional Globalizers.** Germany (DE), Japan (JP): High economic globalization (KOF >85) but lagging digitalization (IMD <70). Germany ranks 23rd in IMD 2024 and dropped from 18th in IMD 2020 exhibiting weakness related with communications. technology and the development and application of technologies⁷.
3. **Isolated Digitalizers.** India (IN), Brazil (BR), Indonesia (ID): Technological dynamism (7% growth in internet users in India⁸) with low global integration (political KOF <40). They have experienced a great achievement, scaling in NRI ranking since 2019.
4. **Dual Laggards.** African countries as Nigeria (NG) or Botswana (BW) . Latinoamerican countries as Venezuela (VE), Perú (PE), or Argentina (AR): Indices below the 25th percentile in those dimensions. Besides, those countries are losing positions in NRI ranking. For sample, less than 7 percent of African microenterprises use smartphone and computers⁹ compared with the 60-70% in EU (data from Eurostat).

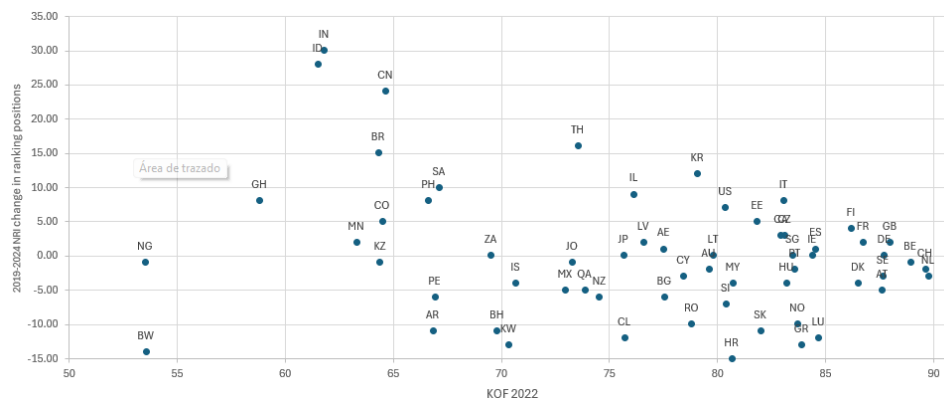
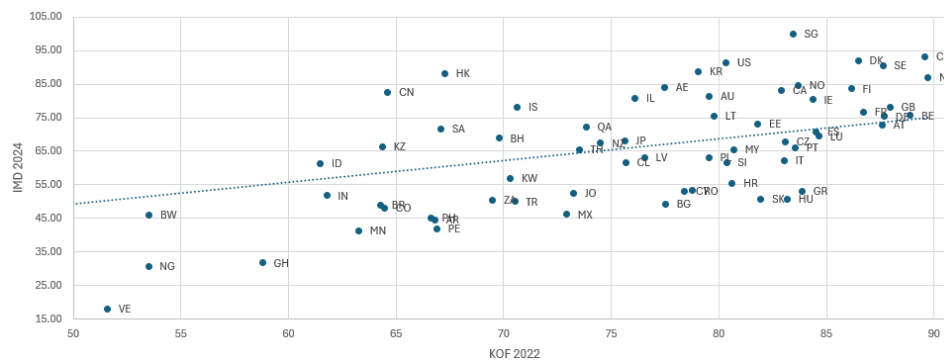
⁵ https://event-assets.gsma.com/pdf/GSMA_ME_SSA_2024_Web.pdf

⁶ <https://oxfordinsights.com/wp-content/uploads/2024/12/2024-Government-AI-Readiness-Index-2.pdf>

⁷ <https://imd.widen.net/s/xvhldkrrkw/20241111-wcc-digital-report-2024-wip>

⁸ https://www.iamai.in/sites/default/files/research/Kantar_%20IAMAI%20report_2024_.pdf

⁹ <https://www.ifc.org/en/insights-reports/2023/digital-technologies-in-africa>



4.2 Key Aspects to Consider in the 2025–2030 Scenarios Transition

When constructing scenarios using the Path Trajectory theory, we could find two opposing sides. The first is the strong global inertia established over the past decade, which reinforces or blocks the current leadership positions of the same countries over the rest. In contrast, there are other disruptive elements that could act as triggers for short-term change.

Within the first area, we could consider the follow effects:

A. The creation of knowledge and investment in key technologies.

According to (WIPO, 2024) patent creation is experiencing a prolonged period of acceleration. Applications had doubled from around 1 million in 1995 to approximately 2 million by 2010, and reached the 3.55 million mark in 2023, such that Asian patent offices account for 68.7%, an increase of 10.3 percentage points since 2013. The United States and Europe largely depend on non-residents to generate patents.

As reported by *The cost of compute power: A \$7 trillion race* by McKinsey, there is a race to scale data centers¹⁰ costing between \$3.7 trillion and \$7 trillion by 2030.

At least 20 countries will have launched national quantum computing strategies by 2025¹¹, redefining the technological landscape with a global investment exceeding \$40 billion

B. China, developing its technological hegemony through new pathways

In the Asia-Pacific axis, China is building an alternative to the Western technological short-range communications Bluetooth and WiFi standards (Star Flash, impulsed by SparkLink Alliance¹²), with closed and strongly regulated digital ecosystems (WeChat, Alipay) and a huge investment in R&D for critical technologies following its “Made in China 2025”

This “state digital capitalism” leverages previous trajectories (e.g., the state banking system) to avoid Western lock-ins, although it creates new dependencies in semiconductors (especially for the most advanced, imported from Taiwan).

C. Access Gaps and Digital Inequalities

While digital transformation is vital for boosting economic progress and fostering equitable societies in developing nations, its effect on reducing income disparities depends heavily on two factors: the effectiveness of governance structures and the specific approaches taken to implement digital technologies (David et al., 2025; Ho et al., 2025).

As outlined by UN figures “An estimated 3.6 billion people, almost half of the world’s population, currently do not have access to the Internet. Least developed countries are the least connected, at only 19 per-cent of their populations.”¹³ Some regions are still far from universal access, with just 43% of South Asia and 37% of Sub-Saharan Africa connected¹⁴.

Key factors blocking these inequalities in developing countries could be the **adoption costs of mobile infrastructure** where an entry-level mobile-broadband basket costs more than 20 times more in low-income economies than in high-income economies¹⁵, and the **poor digital literacy and adoption of digital technologies**, where less than 10 percent of the population shops online¹⁶.

But also, in the other direction, it is necessary to consider disruptive factors or accelerated triggers of change that could play a greater or lesser role in the proposed scenarios and might break apart groups of countries with similar levels of digitalization.

Among others we can consider:

¹⁰ <https://www.mckinsey.com/industries/technology-media-and-telecommunications/our-insights/the-cost-of-compute-a-7-trillion-dollar-race-to-scale-data-centers>

¹¹ <https://www.quareca.com/quantum-initiatives-worldwide/>

¹² <https://sparklink.org.cn/en/>

¹³ https://www.un.org/digital-emerging-technologies/sites/www.un.org.techenvoy/files/general/Universal_Connectivity_Summary_PDF.pdf

¹⁴ <https://ourworldindata.org/grapher/share-of-individuals-using-the-internet>

¹⁵ <https://www.itu.int/en/ITU-D/Statistics/Documents/publications/prices2023/ICTPriceBrief2023.pdf>

¹⁶ <https://unctad.org/publication/digital-economy-report-2021>

A. Policies based on force and the strengthening of South-South relations.

Relationship models based on 'force' and the breakdown of traditional conventions between countries, which are closer to superiority-inferiority models. This aspect would last at least until the US midterm elections in November 2026. In this sense, and as a response, there could be a shift towards increased cooperation among developing countries to address common challenges through the exchange of resources, knowledge, and experiences tailored to their local contexts.

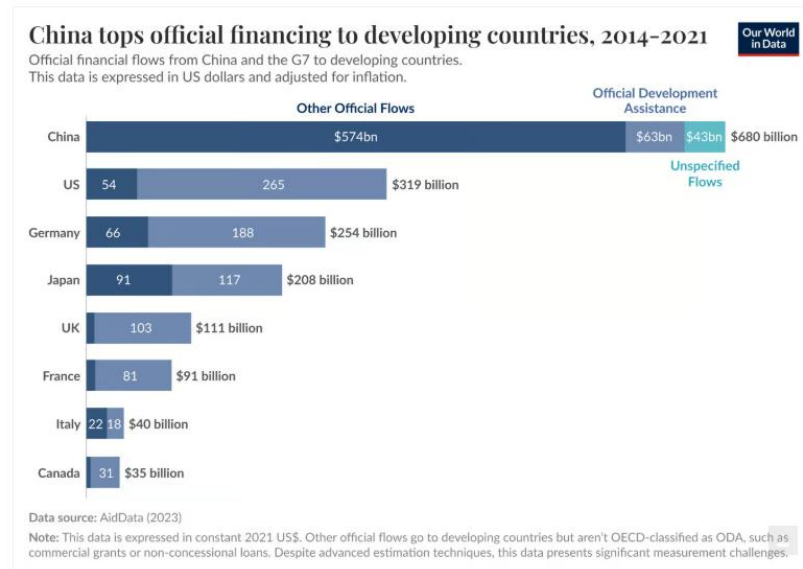


Figure 6. Official financing to developing countries, 2014-2021. Source: Our World in Data¹⁷.

Conversely, foreign aid serves as a tool for global influence in developing countries. China has extended substantial loans through its Belt and Road Initiative (categorized as Other Official Flows in Figure 6), in contrast to the traditional Official Development Assistance provided by Western countries. The United States' leading role as a donor is currently being reconsidered, which could present an opportunity to reshape patterns of global influence.

B. Reconfigurations in Digitalization Leadership

Abrupt reconfigurations in Asian countries that are rapidly digitalizing. As reported by the NRI index, between 2019 and 2024, Korea stands out, having risen from 17th to 5th position during this period. India (rising from 79th to 49th), Indonesia (from 76th to 48th), China (from 41st to 17th), Vietnam (from 63rd to 45th), and Thailand (from 56th to 40th) also stand out, leading the group of lower-middle-income economies and displacing, or on the verge of displacing, mid-ranking European economies with less digital momentum (such as Slovakia, Slovenia, Romania, Greece, Hungary, Bulgaria, and Croatia)

A particularly interesting case is that of Ukraine, which, according to the NRI, rose from 67th to 43rd position during this period (climbing 24 places): the war has been a driver for digitalization, but the foundations for that growth were laid just before¹⁸.

¹⁷ https://ourworldindata.org/what-is-foreign-aid?utm_source=OWID

¹⁸ <https://www.hks.harvard.edu/centers/cid/voices/ukraines-digital-transformation-innovation-resilience>

C. Disruptive Technologies in the arena

Mastery and investment in these technologies yield high returns and could bring about significant changes for the countries that lead them.

Artificial Intelligence: As outlined by The Global AI Index¹⁹ this technology is dominated by far for US and China. Most Top 10 NRI performers also appear in the first positions but India is challenging in the 10th position²⁰. India has the third largest AI talent pool globally and produces a large number of STEM graduates, which has driven the expansion of its AI ecosystem. Considering Europe and the The Global AI Index UK (3rd), France (4th) and Germany (5th) are leading this ranking.

Cybersecurity: According to the latest forecast from the International Data Corporation (IDC) *Worldwide Security Spending Guide*, global security spending is expected to grow by 12.2% year on year in 2025. The United States and Western Europe will continue to account for more than 70% of global security spending in 2025.

Sustainability and Data Centers: As reported by World Economic Forum²¹, countries need to adopt green energy technologies to ensure the sustainable expansion of their digital economies and the widespread use of AI. In this way, Nordic countries achieve 92% of data centers powered by renewables²²²³. South Korea reduces ICT energy consumption by 18% through neuromorphic architectures²⁴²⁵²⁶.

4.3 Scenario 1: Dual Convergence (High Globalization plus High Convergent Digitalization)

In this Scenario and according to Path Dependency Theory, reinforcement considerations prevail, creating a positive circle.

	Digitalization	Economy	Institutions and Regulation
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¹⁹ [The Global AI Index](#)

²⁰

https://static.googleusercontent.com/media/publicpolicy.google/es//resources/india_ai_opportunity_agenda_en.pdf

²¹ <https://www.weforum.org/stories/2025/01/the-essential-energy-shift-for-sustainable-genai/>

²² <https://www.datacenterdynamics.com/en/product-news/polar-announces-new-ai-ready-data-center-powered-by-100-percent-renewable-energy-in-norway/>

²³ <https://carboncredits.com/areim-raises-977-million-to-drive-green-data-center-expansion-in-the-nordic-region/>

²⁴ <https://www.eurekalert.org/news-releases/1063102>

²⁵ <https://www.amo.de/en/blog/2025/01/30/energize-a-joint-korean-eu-partnership-for-energy-efficient-neuromorphic-hardware/>

²⁶ <https://www.silicon.co.uk/expert-advice/the-high-performance-low-power-promise-of-neuromorphic-computing>

Contingencies	<p>Blockchain platforms could accelerate decentralized economies and act as disruptors of international trade.</p> <p>European national companies could lead in certain advanced communications or clean technologies. There is potential for niche leadership (e.g., quantum semiconductors) by third countries integrating them into value chains.</p>	Progressive access to alternative “clean” energy is facilitated.	
Reinforcements	<p>Greater integration of the global semiconductor supply chain and, more broadly, the entire ICT sector.</p> <p>Countries already leading in digital development maintain their positions.</p>	The export of digitalization to developing countries fosters improved living conditions.	<p>Multilateral institutions oversee agreements between countries.</p> <p>EU digital regulation is foundational, focusing on citizen guarantees regarding access to digital services.</p>
Lock-ins	Weak lock-ins due to dual ecosystems of American vs. Chinese platforms, though some hybridization by third parties is allowed.		There are no differential incentives for creating a Digital Single Market.

Table 2. Path Dependency forces for Scenario 1. Source: author's own elaboration.

It would have been the potentially continuationist scenario up to 2019, or at least the ideal scenario prior to the 2020s and their associated phenomenon of polycrisis. It's the context in which digitalization is viewed as a tool that would fundamentally improve people's quality of life and eliminate asymmetries between regions. Despite the existing crises, the resilience provided by digitalization would have enabled a rapid and healthy recovery. In this regard, we have the work of Y. Liu et al. (2024), which examines China's role after COVID and how investment in digitalization played a significant role in the bilateral reconstruction of global value chains, especially in those countries that are more financially developed.

The most relevant global process mentioned is bridging the digital divide especially in rural areas. (Bergantino et al., 2025) states that “higher digitalization levels correlate with lower poverty and social exclusion” in line with many other studies. Additionally, studies such as Stratu-Strelet et al. (2023) argue the value of ICTs for consolidating democracies, in this case in Eastern European countries.

Would there be a global growth consensus aligned with the UN's 2030 Agenda using SDGs, showing general signs of improvement, as we see in Figure 7 for indicator 9.5.1: “Research and development expenditure as a proportion of GDP.”

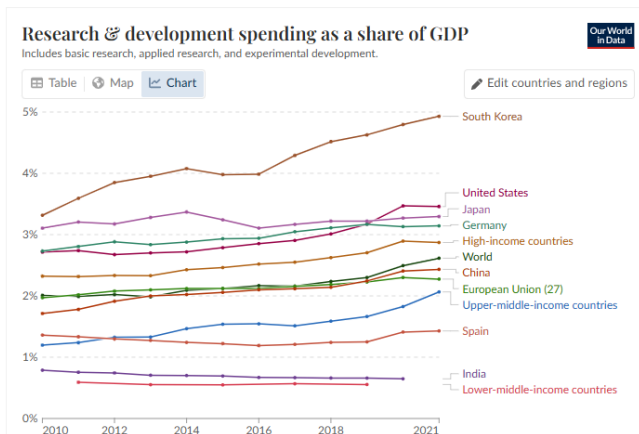


Figure 7. R&D development spending as a share of GDP. Source: Our World in Data²⁷

Connectivity is considered key to achieving them, especially in less developed countries (Madon & Masiero, 2025). In this regard, we would additionally have Indicator 9.c.1: “Proportion of population covered by a mobile network, by technology”, shown in Figure 8, or Indicator 17.8.1: “proportion of individuals using the Internet”, shown in Figure 9.

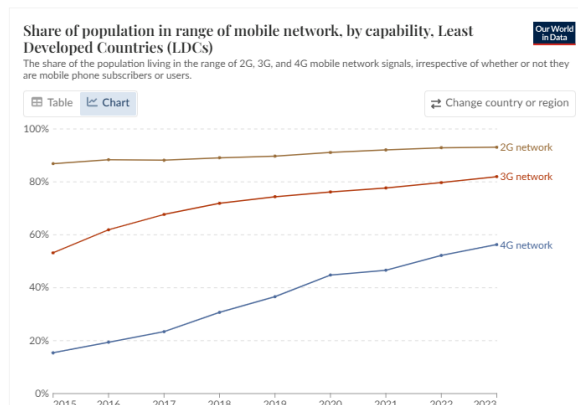


Figure 8. Share of population in range of mobile network. Source: Our World in Data²⁸

²⁷ https://ourworldindata.org/grapher/research-spending-gdp?tab=chart&time=2010..latest&country=OWID_EU27~USA~CHN~OWID_WRL~OWID_LMC~OWID_UMC~OWID_HIC~JPN~KOR~IND~ESP~DEU

²⁸ <https://ourworldindata.org/grapher/population-covered-by-mobile-network-by-network-capability?country=~Least+Developed+Countries+%28LDCs%29>

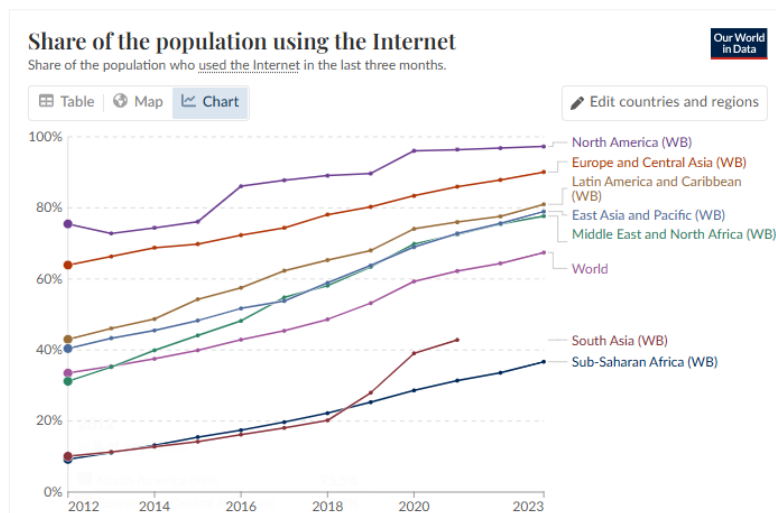


Figure 9. Share of population using the Internet. Source: Our World in Data²⁹

One would then observe a certain global convergence in inequality, as measured by the GINI coefficient, particularly among the most populous and poorest countries; however, this would not occur in the wealthiest nations (especially in the US, which would be one of the most unequal advanced countries), thereby justifying the pessimistic anti-globalization sentiment taking root there. Figure 10 reveals this.

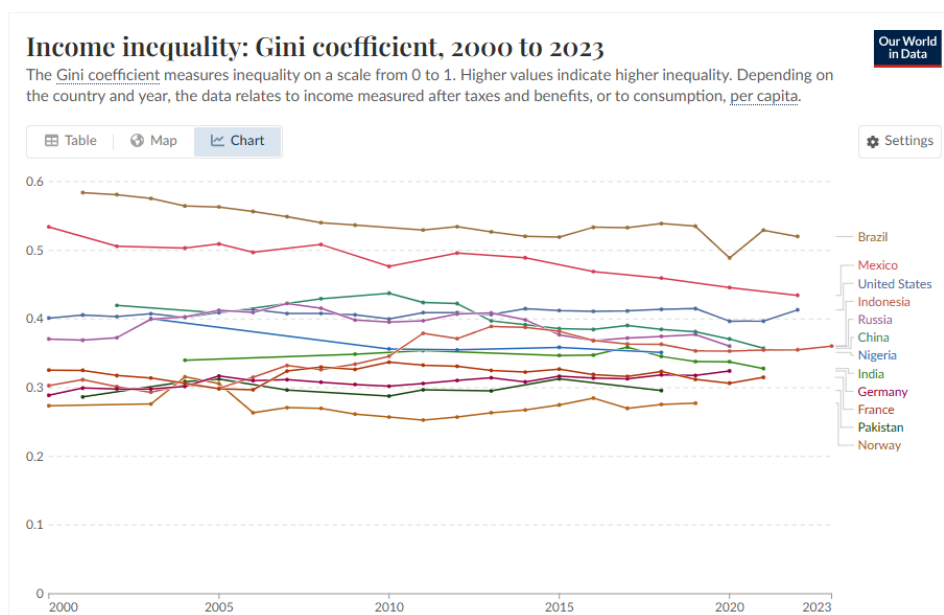


Figure 10. Evolution of the GINI indicator. Source: Our World in Data³⁰

Although world trade has declined several times since 2000—in the crises of 2009 and later in 2013 and 2020—it has managed to recover and return to growth. The current situation is therefore apparently transitory, and trade, and consequently the economy, will recover shortly. Figure 11 shows this.

²⁹ <https://ourworldindata.org/grapher/share-of-individuals-using-the-internet?time=2012..latest>

³⁰ <https://ourworldindata.org/grapher/economic-inequality-gini-index?tab=chart&country=BRA~USA~CHN~RUS~DEU~IND~IDN~NGA~PAK~MEX~FRA~NOR>

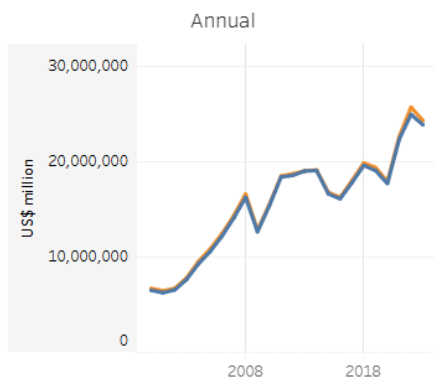


Figure 11. Evolution of world merchandise trade. Source: WTO³¹

The ranking among different geographic areas in digital terms (according to the indices reviewed in the study) would remain unchanged, maintaining continuity, although the less developed countries would show a marked improvement. The reduction of gaps, inequality, and inclusion among groups of countries would surely be driven by widespread Internet access or mobile connectivity, improved digital skills, and, more broadly, there would be a link to better life expectancy or health (Figure 12), with technology playing a major role by facilitating access. (W. Wang et al., 2024).

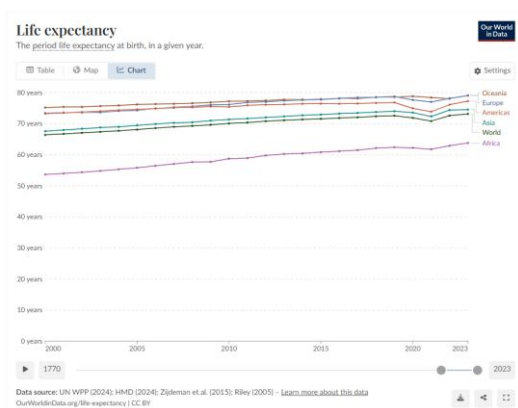


Figure 12. Life expectancy. Source: Our World in Data³²

This scenario would, in the short term, entail the potential development of additional LLM technologies or platforms for generative AI—at least for the most advanced systems—and possibly the emergence of alternative leaders (new digital ecosystems) among the most developed countries and even some other emerging middle-income nations such as India, fundamentally accelerated by the export of professional services. Perhaps the enhanced

³¹ https://stats.wto.org/dashboard/merchandise_en.html

³² <https://ourworldindata.org/grapher/life-expectancy?time=2000..latest>

ability to train large LLMs using shared data at lower energy cost would enable AI to achieve a greater practical impact. Figure 13 explains these phenomena.

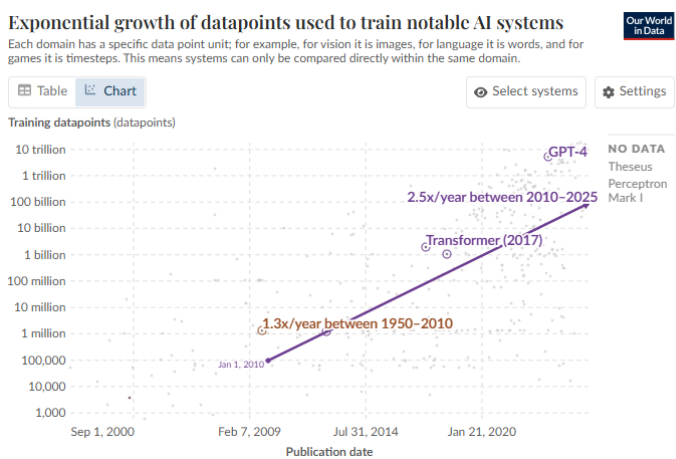
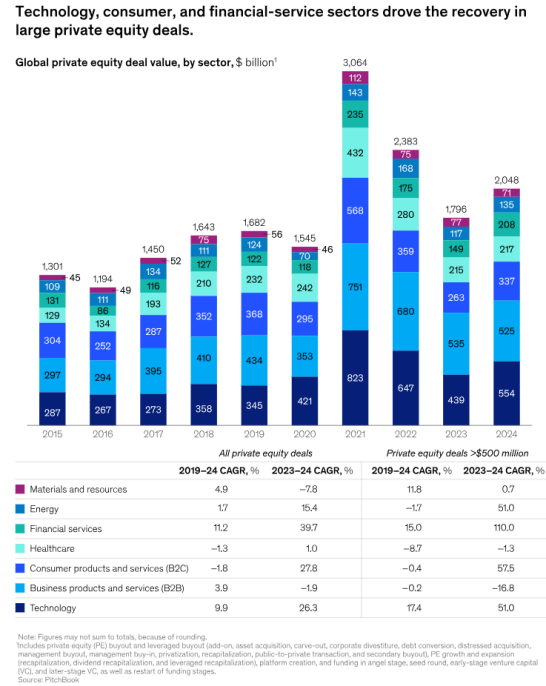


Figure 13. Notable AI systems and datapoints. Source: Our World in Data³³

It's an 'open' scenario that would foster innovation and investment in it, the exchange of knowledge, and would encourage situations where the vision of opportunity outweighs that of risk, and thus innovation breaks through possible blockages. (Rauch, Madeleine; Wenzel, Matthias; and Wagner, 2017).

Global venture capital investment opportunities in advanced technologies therefore take precedence, as measured by "Private Equity Deal", and these could be responsible for the potential improvement. Figure 14 explains this.



³³ <https://ourworldindata.org/scaling-up-ai>

Figure 14. Global private equity deals. Source: Mckinsey³⁴

A potentially key technology would be all that relates to blockchain technology, as it would act as a disruptor of international trade (Böhmecke-Schwafert, 2024), accelerating global economic integration, especially by enabling fast, secure, and intermediary-free international transactions.

A high level of collaboration among all countries is also enabled, which would accelerate the adoption of standards such as 6G. The global digital sector would become increasingly integrated. No systemic risks are perceived if parts of the sector's value chain are not located in a specific geographic area, for example, semiconductors in Taiwan. South Korea could combine its leadership in 6G (with \$15B investments planned by 2026) with digital free trade agreements with ASEAN.

It is true that European countries would remain at the top of the rankings, although they would be challenged by Asian nations (Singapore and Korea) and especially by China. Perhaps the Chinese digital ecosystem is attractive and dynamic enough to forge a hybridization or symbiosis with the American one, or at least there would be an ever-growing dual competition (coexistence) between the two. But, by and large, there would be no restrictions preventing a third region from aligning with either without limitation.

Specific aspects of the scenario for the EU.

This would be a relatively beneficial scenario for Europe, as long as it could maintain a sufficient pace of investment in R&D or promote a certain Digital Single Market. Or at least, it could benefit from using third-party platforms without systemic risk (such as using the American or Chinese digital ecosystem) and could relatively easily lead in some sets of new technologies (for example, “clean” technologies or those Fintech solutions that facilitate global flows). Perhaps, due to global openness, there may not be enough incentives to accelerate an internal digital market, except for aspects of regulatory interoperability.

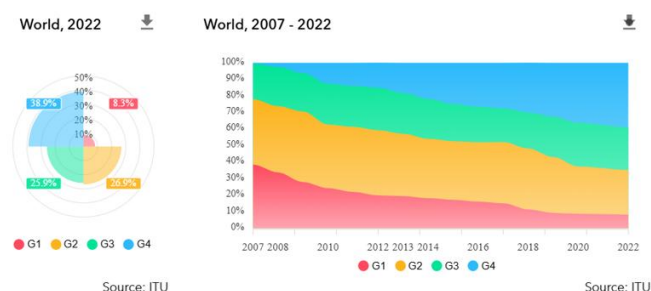
Leading European companies such as NOKIA, SAP, or Siemens could take advantage of globalization to export their services, considering that a large part of their value chain would not be located in their countries of origin. In this regard, da Ponte et al. (2023) state that in 2021, 57.5% of Nokia's electronic equipment production was outside the EU, and this figure could continue to serve as a benchmark.

In general, there has been technological convergence among the different EU countries, although the global perspective of its economy prevails—that is, external trade, especially for the stronger economies such as Germany. The most advanced regions develop cutting-edge projects associated with the specific characteristics of their economies. An example of this is that in the ports of Rotterdam, Hamburg, Malmö, and Copenhagen, tests are being carried out with blockchain platforms (Farah et al., 2024)

³⁴ <https://www.mckinsey.com/industries/private-capital/our-insights/global-private-markets-report>

European regulation and its institutions would focus on guaranteeing freedom of access, protecting citizens from platform abuse, and governments would prioritize education to enhance the sophistication of the population and ensure the welfare state.

Evolution of the generations of ICT regulation worldwide



Generations of regulation are based on ICT Regulatory Tracker scores:

G1 Command & control approach:	0 < 40
G2 Early open markets:	40 < 70
G3 Enabling investment & access:	70 < 85
G4 Integrated telecom regulation:	85 ≤ 100

Figure 15. Evolution of the generations of ICT regulation worldwide. Source: ITU³⁵

A large part of the digital regulation implemented so far has had this purpose (Digital Market Act or Digital Services Act), with the aim of improving access. The EU would be seen globally as collaborative and friendly, acting as an exporter of “regulation” due to its sophistication. Figure 15 shows that.

4.4 Scenario 2: Asymmetric Globalization (High Globalization but with Divergent Digitalization)

In this Scenario and according to Path Dependency theory, block in considerations prevail with mixed and ambivalent winners and losers.

	Digitalization	Economy	Institutions and Regulation
Contingencies	Formerly wealthy areas (in the EU or US) that have become impoverished due to deindustrialization incorporate innovation and digitalization into their business models in order to find new pathways.	DAO financing strategies that could enable global venture capital.	

³⁵ <https://app.gen5.digital/tracker/charts>

Reinforcements	<p>Extreme specialization of IT sector agents within their global value chain.</p>	<p>Differences between those who generate technologies and those who consume them become more pronounced.</p> <p>Talent migration towards the most innovative economies.</p> <p>The most advanced countries have access to more sustainable energy resources as a tool for competitiveness.</p>	<p>Global institutions and democracies act as guarantors and stabilizers of potential tensions through regulation.</p>
Lock-ins	<p>Concentration of power in a few global platforms(mainly in US and China), which are the only ones capable of investing in critical technologies such as AI or Quantum, which will transform business scenarios.</p> <p>Dual investment in large data centers. The most advanced and the most powerful chips are located in the most advanced regions meanwhile second line are developed in other countries.</p> <p>Patents are used as a barrier to the innovation of others.</p>		<p>The EU regulates to prevent abuses of power by platforms.</p>

Table 3. Path Dependency forces for Scenario 2. Source: author's own elaboration.

This would have been another of the most likely scenarios so far as an alternative to the previous one, reinforced by COVID and subsequent inflationary crises and supply chain disruptions. It is one of the most highly regarded scenarios in terms of the uneven

resilience of economies, where the response of different societies has not been the same and where digitalization has played an important role as a catalyst. (Dyba & Di Maria, 2024).

Globalization and digitalization are working, although increasingly asymmetrically, fundamentally benefiting the wealthiest, since technological advances—especially improvements in AI—do not lead to a distribution of the wealth generated (Acemoglu et al., 2023). Moreover, even in the most advanced countries or those experiencing accelerated digitalization, there is an intensification of social inequality. For sample, Yeo & Jung (2024) examine socioeconomic impacts of digital transformation, focusing on Korean economy based on Social Accounting Matrix (SAM) multiplier analysis. They discover that digital transformation accelerates growth, benefiting digital capital-intensive industries and high-skilled labor but contributes to employment polarization and worsens income inequality. Traditional wealthy areas, now potentially impoverished or displaced from traditional activities by digitalization and globalization, must reinvent themselves and find new types of innovation niches (Breznitz, 2021).

This is a scenario of strengthening alternative leaders who challenge the United States in its role as a global catalyst—primarily referring to China, which, for example, uses unequal aid to third countries to consolidate its global policy. (R. Wang & Yang, 2025), as seen in Figure 6.

Nevertheless, in the face of the polycrisis, a stabilizing phenomenon persists among the major democracies, although gaps are beginning to emerge between the different blocs. Figure 16 reflects this situation with Russia, China, Africa and South America.

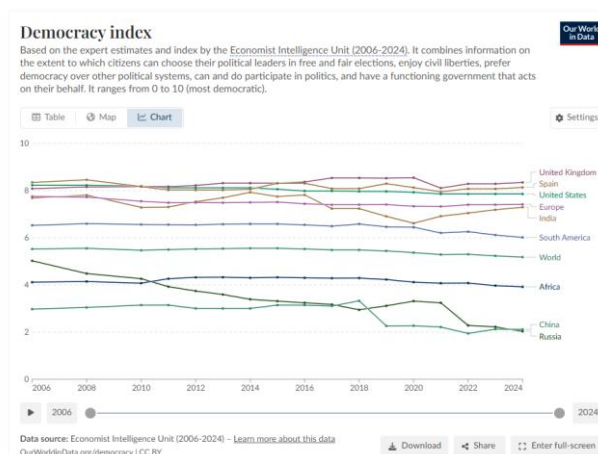


Figure 16. Evolución de calidad democrática global. Source: Our World in Data³⁶

In terms of digitalization and knowledge creation, there would be a process in which some countries develop more than others. **An indicator to consider in this scenario is the “patent war” or the creation of scientific content. Another could be the number of**

³⁶ https://ourworldindata.org/grapher/democracy-index-eiu?tab=chart&facet=none&country=OWID_EUR~OWID_WRL~OWID_AFR~RUS~USA~OWID_SAM~CHN~ESP~GBR~IND

platforms, especially hyperscalers, since there would be a potential concentration of power among them.

The lock-in processes of platforms, especially those of US hyperscalers, are much more intense than in the previous scenario, as they seek to prevent the creation of alternative third-party ecosystems, specially, the Chinese one. In this scenario we might consider Stargate Project³⁷ which intends to invest \$500 billion over the next four years building new AI infrastructure for OpenAI in the United States. It will begin deploying \$100 billion immediately. This infrastructure will secure American leadership in AI.

There will be strong competition among these hyperscalers and likely a significant potential increase in their market capitalization. There could still be sufficient investment in the wealthiest regions to take advantage of these platforms, always using them practically to digitalize their industries. These advanced regions, especially the EU, do not generate alternative technologies, although they use the existing ones and achieve improvements in their local economic prospects. In particular, the network effects of platforms offering Cloud services and incorporating AI services would become especially relevant (Hagiu & Wright, 2025). Although AI, as mentioned, could also be an additional source of labor inequalities (Cazzaniga et al., 2024).

According to the NRI index, the top performers stand out even more from the rest, as they are able to invest in the most advanced technologies (e.g., quantum or AI) and have the most dynamic startup ecosystems. We would therefore see the consolidation of giant platforms (Alibaba, TikTok) in China or the US. Indirectly, countries in middle positions could benefit, although without creating any specific innovation, being shifted in the global value chain towards the sophisticated consumption of digitalization. The most lagging countries according to NRI, unable to develop or lead any technology of their own, can only aspire to improve their competitiveness by incorporating digitalization into their population at the lowest possible cost.

Global specialization processes deepen, with the patterns identified for each region becoming more pronounced, but without creating diversity or alternatives: semiconductor production in Taiwan, platforms owned by the US or China globally deploying their data centers. Less developed countries find neither incentives nor opportunities to identify technological niches to differentiate themselves. In this sense, the risks associated with the digital talent drain to more innovative economies would intensify.

We could also see the rise of DAOs when it comes to financing ventures (VC), taking advantage of the benefits of globalization and the deregulation of Fintech: “Decentralized autonomous organizations (DAO) are blockchain-powered organizations that can run on their own without any central authority or management hierarchy” (Alon et al., 2025).

Less developed countries could still benefit from globalization and digitalization, although to a lesser extent, if they are able to invest in the use and access to the technologies led by the more advanced countries.

For example, in this sense, Mexico, integrated into the USMCA trade agreement—which, under this scenario, would not be revoked—has a much lower level of digital sophistication compared to the US. Only 23% of Mexican companies use digital

³⁷ <https://openai.com/index/announcing-the-stargate-project/>

technologies, and 5.3% use data analysis tools,³⁸ reaching 15% that use AI among the most advanced segment of large companies. México, therefore, will be highly dependent on US technology, for example, with cloud investments from Google, Microsoft, and Amazon planned from 2025 onwards, valued at 10 billion dollars..

In summary, there is fundamentally a transfer of technology and knowledge for its use, not for its generation. Strong support from multilateral organizations (UN, etc.) is needed, as they should play a relevant role in mitigating the growing differences between geographic areas.

Specific aspects of the scenario for the EU.

In this scenario, a fragmentation of Europe's space would create greater tensions and dependencies on external actors. Europe's weaknesses thus become more evident, as do the objectives of the Digital Compass 2030³⁹, designed at the time and after the COVID crisis, they will not be achieved uniformly across all countries, and weaknesses and regional gaps are especially evident along the East and South axis. It is a phenomenon that not only occurs in the EU but also in other major regions in transition, such as China, where digitalization facilitates economic growth but can also create imbalances, in this case between the eastern and western regions (H. Liu et al., 2024). But in the case of the EU, it is not seen as a systemic risk in the short term; rather, it is understood as a factor to be corrected in order to maintain competitiveness.

A critical dependence is detected on traditional sectors that are no longer competitive as a result of the accelerated (digital) transformation of their rivals, such as Germany and the internal combustion automotive sector. However, in other cases like Italy, although it does not rank highly in DESI, with a strategic focus on fashion, food, and furniture, and by changing its business models, it could position itself sectorally in digital markets, improving the competitiveness of its SME companies (Matarazzo et al., 2021).

The European Commission, through its Digital Compass, had already identified four critical gaps to address in 2030. In term of Infrastructures: all EU households should have gigabit connectivity covered by 5G; the production of cutting-edge and sustainable semiconductors should be 20% of world production; 10,000 climate neutral highly secure edge nodes; and Europe should have its first quantum computer. In term of Business adoption: three out of four companies should use cloud computing, big data and Artificial Intelligence; more than 90% SMEs should reach at least basic level of digital intensity; and the number of EU unicorns should double. In terms of Public services: all key public services should be available online; all citizens will have access to their e-medical records; and 80% citizens should use an eID solution.

Being ambitious, these objectives would be complex to achieve in this scenario, since there is no pursuit of a well-oiled single digital market and no widespread major investment commitment in this regard: this scenario does not generate sufficient incentives to join forces among Member States. And if intermediate figures were reached,

³⁸ <https://www.theciu.com/publicaciones-2/2025/2/10/uso-de-herramientas-digitales-e-ia-en-empresas>

³⁹ <https://espanadigital.gob.es/sites/espanadigital/files/2022-06/Br%C3%BAjula%20Digital%202030.pdf>

these would be “sufficient” to continue operating under a single framework with low European expectations and to guarantee our well-being in the medium term.

In this scenario, leadership in advanced technological developments, as well as digital sovereignty, is therefore limited. The study by da da Ponte et al. (2023) would be applicable, where, through a synthetic multidimensional indicator regarding 5G, they detected “a deficit of human capital, limited effective capitalization of our tech companies, and an innovative electronics ecosystem that has been shrinking in recent years, related to the large volumes of imports and production functions outsourced to other global regions”. And in this sense, what was described by Rossi (2024) would also be applicable, where, using the example of 5G and 6G, he suggests “demand-side innovation that support co-invention and public-private collaborations on a much more significant scale than it is presently the case” and considering their vertical industry applications and high costs of rollout and adoption exist a “picking winners” phenomena resulting in a lock-in phenomena.

Finally, market regulation tools (DMA, DSA, etc.) are sufficient to protect key privacy issues against platforms, and these are the areas where the focus is placed and further explored. Europe exports “regulation” as a source of short-term advantage and should benefit from improved productivity by investing in the digitalization of companies and preventing Big Tech from abusing their dominant position in critical sectors such as finance, in order to open up their data silos (Bassens & Hendrikse, 2022).

4.5 Scenario 3: Isolated Digitalization (Reconfiguration of Globalization plus High Digitalization)

Scenario of rupture and new contingent forces. According to Path Dependency theory, contingencies prevail alongside reinforcements.

	Digitalization	Economy	Institutions and Regulation
Contingencies	The global digitalization chain fractures or reorganizes; only those who can incorporate the greatest number of digitalization elements into their closest or	Tariff barriers and other national policies are reshaping globalization among “friendly” economies. Bilateral relations or coalitions with limited objectives are being promoted. ⁴⁰ Open Strategic Autonomy Policy in the EU.	The World Trade Organization (WTO) is beginning to lose its regulatory capacity. Excessive regulation,

⁴⁰ <https://securityconference.org/publikationen/munich-security-report-2025/>

	<p>most friendly value chain benefit.</p> <p>Creation of transnational European champions in key technologies such as AI</p> <p>Dual use of technology, especially cybersecurity, considering the protection of critical infrastructures.</p> <p>Alternatives to LLMs in AI that do not use high-power chips.</p>	Brain drain from regions that become “geopolitically isolated”.	<p>seen as a brake in the EU, is generating new dynamics.</p> <p>Promotion of the European Digital Single Market.</p>
Reinforcements	<p>Competition between major blocs, the US and China, fostering exclusive technologies.</p> <p>Migration to Cloud/AI and the short-term digitalization of industries are key to strengthening their competitiveness.</p> <p>Open semiconductor architectures are being promoted to avoid dependencies on non-exportable American architectures, especially for AI.</p>	<p>There is a strong emphasis on the creation of digital talent, as it is complex to obtain it from outside.</p> <p>Development of alternative energy sources to enhance manufacturing competitiveness (especially in the EU).</p> <p>The trade in services, mainly those related to technology, continues to grow, despite tariff tensions.</p>	<p>ETSI, ITU, 3GPP, and GSMA continue to operate, although regional standards are being established, especially for 6G.</p> <p>Data protectionism and technological sovereignty strategies. India, with its Digital India Act and 1.4 billion internet users projected by 2028, could develop self-sufficient digital ecosystems.</p>

Lock-ins	Global platforms, in order to maintain their competitiveness, must adapt their positions to local or regional visions.		
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Table 4. Path Dependency forces for Scenario 3. Source: author's own elaboration.

This global scenario would never have been considered, perhaps only partially under the Trump 1.0 policies due to the threat of a trade war between the US and China. The WTO, the World Bank, the IMF, and other multilateral organizations would continue to operate, although their capacity for influence would be reduced.

There are global—or at least asymmetric—fragmentation processes underway that are profoundly reshaping what we understood as globalization in geopolitical terms, as inherited from the Bretton Woods agreements after World War II. The US is no longer formally considered the “global policeman” or is shifting its commercial interests. As a result, bilateral relations are starting to prevail, although there may not be a significant short-term decrease in the total volume of goods and services traded worldwide.

Fors ample, according to (McKinsey Global Institute, n.d.) There is a strong trend toward the reconfiguration of globalization according to political and geographical distance, with globalization increasingly occurring between closer and “friendly” countries. Foreign Direct Investment is no longer diversified and focuses only on “friendly geographies” (friend-shoring) and on critical sectors to be controlled (raw materials). Aiyar et al (2024) demonstrates that FDI flows are becoming more concentrated among countries with similar geopolitical alignments, particularly in critical sectors like semiconductors.

Symptoms of these changes may arise from tariff reconfigurations or trade tariffs that violate the agreements established by the WTO. To what extent are these policies beneficial? It is not the purpose of this paper but according to Dinopoulos et al (2024), studying last 2018-19 tariff war and developing a multi-country trade model state, “Generally, an optimal bilateral (country specific) tariff raises the tariff-employing country’s welfare (real income) at a social cost of higher extreme inequality. It reduces income disparities in the tariff-targeted region at the expense of lower welfare”. However, there are also opposing and less optimistic views: according to Kreuter & Riccabon (2023), for example, in a scenario of sectoral tariff increases, there would be a decrease in GDP and consumer welfare depending on their network centrality, the elasticity of substitution between foreign and domestic varieties, and the ratio of net-of-tax prices of domestic and foreign varieties “their network centrality, the elasticity of substitution between foreign and domestic varieties, and the ratio of net-of-tax prices of domestic and foreign varieties”

Figure 17 shows a possible slowdown in the WTO’s capacity, as measured by the number of requests for dispute settlement and petitions to the Dispute Settlement Body. Since

2019, the dispute tribunal has been deactivated.⁴¹ Due to the United States' refusal to appoint judges to the WTO Dispute Settlement Body, some countries have decided to move forward on their own through what has been called a multiparty agreement (Multiparty Interim Appeal Arbitration Arrangement, MPIA)

Gráfico 4: Número de diferencias iniciadas, grupos especiales iniciales establecidos y notificaciones de apelación en el procedimiento inicial

1º de enero de 1995-31 de diciembre de 2024

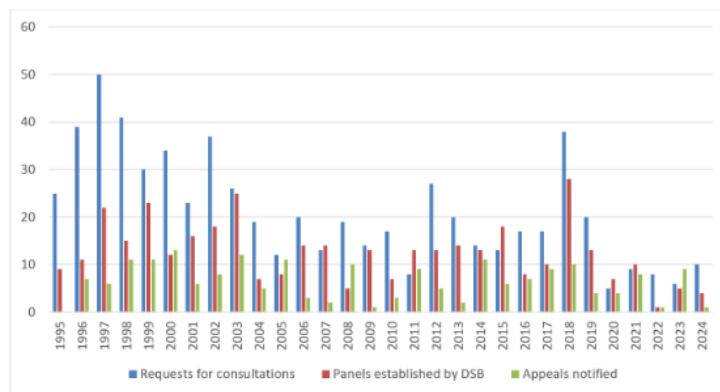


Figure 17: Disputes initiated, initial panels, and notifications in the initial procedure. Source: WTO⁴²

Privileged relationships between geographies will be strengthened: UK with the US, Korea with Africa, although these relationships will tend to be asymmetric and focused on the benefits of friendshoring or the extraction of critical materials. The EU is potentially projecting itself onto Latin America through a series of trade agreements⁴³ and competes for this space with China, or perhaps new trade opportunities are established between Europe and China as an alternative. In general terms, relationships of convenience are sought in response to the fractures that have emerged.

An important aspect could be the strengthening of the nature of trade flows, such that, even in the presence of weakness in merchandise trade, the exchange of digital services would continue to grow⁴⁴. This is shown in Figure 18 and Figure 19.

⁴¹ This appellate body, which is the very heart of the WTO, is composed of seven judges who are selected based on geographical criteria and enjoy very broad political representation. Chosen by consensus (unanimity), they serve a four-year term, which can be renewed once. If, for example, the US or China is involved in a dispute, it is ensured that a judge from those countries does not participate in order to guarantee autonomy and independence of judgment. However, since 2019, this body has not been operational because the US has systematically refused to appoint the judges who should replace those whose terms have expired.

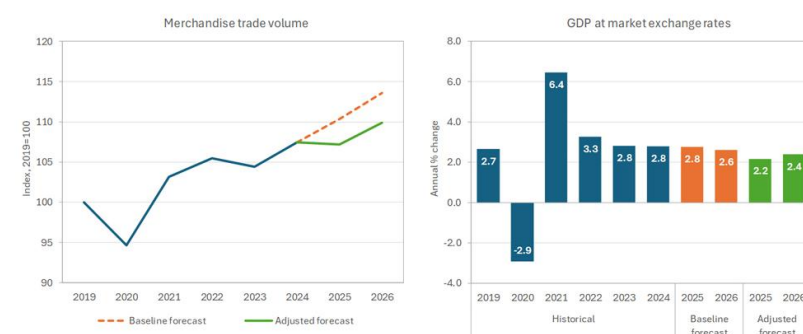
⁴² https://www.wto.org/spanish/tratop_s/dispu_s/dispustats_s.htm

⁴³ [Americas and the Caribbean - European Commission](#)

⁴⁴ https://www.wto.org/spanish/news_s/news25_s/tfore_16apr25_s.htm

Chart 1: World merchandise trade volume and GDP growth, 2019-2026

Index, 2019=100 and annual % change

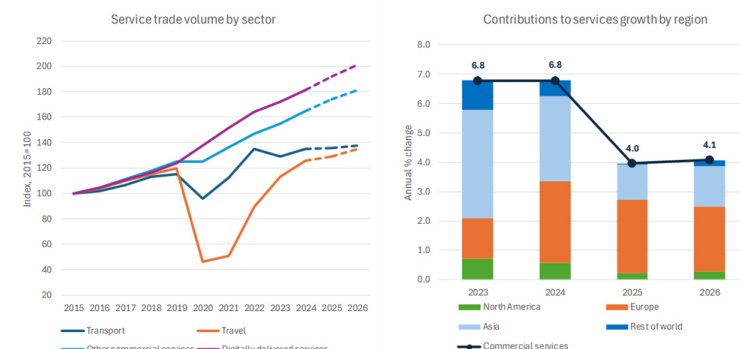


Note: Trade refers to average of exports and imports. Figures for 2025 and 2026 are projections. Sources: WTO for historical trade statistics. WTO secretariat estimates for trade forecasts. Consensus estimates based on data from OECD, World Bank, IMF, UN, national statistics and WTO calculations for GDP.

Figure 18. World merchandise trade volume and GDP growth for 2025-2026. Source: WTO⁴⁵

Chart 7: Commercial services trade volume adjusted forecast, 2015-2026

Index, 2015=100 and annual % change



Note: Trade refers to exports. Figures for 2025 and 2026 are projections. Source: WTO estimates.

Figure 19. Commercial services trade forecast for 2025-2026. Source: WTO⁴⁶

Only regions with technologically consolidated champions and sufficient critical market mass would benefit: the United States and China stand out, increasingly at odds in terms of AI development, seeking exclusive bilateral relationships to continue securing their own advantages and thus export their technology and technological acceleration to their own ecosystems. This phenomenon of intense competition for digital leadership is in line with what is described in the IMD article and its 2024 index. But both ecosystems would consolidate as the only option for progress; you either belong to one or to the other. For sample Shao et al. (2025) Studying the decoupling between the Chinese and US economies during the Trump era and the first tariff war (2016–2021), it was found that “decoupling uncertainty affects capital expenditure but not R&D investment,” which would indicate that technological progress could perfectly well continue in this scenario.

The official technological standardization bodies (“de jure” organizations) such as ETSI, ITU, 3GPP, and GSMA would remain in place; however, in practice, actual deployment would tend to generate sub-standards, especially for 6G. This has already been

⁴⁵ https://www.wto.org/english/res_e/booksp_e/trade_outlook25_e.pdf

⁴⁶ https://www.wto.org/english/res_e/booksp_e/trade_outlook25_e.pdf

experienced with 5G, with a series of prohibitions and commercial bans, for example in the case of Huawei (Mascitelli & Chung, 2019), caused by the technological dominance of Chinese capabilities during Trump's first term. However, in this new standard, the role of operators would change radically as they enter into direct competition with platforms, since 6G will be born with native Cloud integration and full virtualization

The creation of digital talent is being reinforced because it is no longer possible to acquire it from other regions due to blocked transfers, and eventual talent leakage between regions may occur. In this context, and according to the Global Digital Index (HUAWEI/IDC, n.d.), "frontrunner" countries, those capable of generating technology stand to benefit the most, as they can convert their STEM graduates into domestic ICT professionals. In these countries, as cited by the GDI index, 95% of STEM graduates find ICT jobs, compared to just 50% in less sophisticated countries and 15% in the least digital developed group.

The migration to the cloud remains important as a tool for the data economy; however, regions without established cloud champions are likely to seek private alternatives. This could mean that the valuation of companies like Google, Microsoft, or AWS may be affected if they are unable to provide security guarantees or adapt to local environments through significant investments. In a fragmented environment, the market capitalization of these tech giants will depend on balancing the pressures of higher infrastructure and regulatory compliance costs against the opportunities from overall market expansion and their ability to establish dominant positions in multiple regional ecosystems.

As cited by García-Canal et al. (2024) "Despite the opportunities associated with the scalability of digital assets in a process known as hyperscaling, very few digital platforms operate on a truly global scale... Besides cultural or institutional differences, our model shows that the presence of local network effects becomes a critical factor that promotes imitation and prevents international organic growth by the first mover", that is, in a fragmented environment, global platforms lose their competitive advantages.

The hyperscale giants will need to urgently adapt their global expansion strategies to respond to these new realities. In Spain, for example, Amazon, Microsoft, Google, and Meta are planning investments that exceed 21 billion euros⁴⁷.

On the other hand, let's discuss the Chinese model for accelerating local semiconductor production and the resulting collateral effects. In China, since 2022, a test of this isolationist scenario has occurred with the blockade on importing the most advanced chips, especially for AI—not only from NVIDIA but also AMD—due to the "Foreign Direct Product Rule" (FDPR) that affects non-US companies using chips manufactured with American technology. The response was an investment fund in semiconductors (Big Fund III) valued at \$47.5 billion, representing the largest investment the country has made in this industry, which has succeeded in creating 7nm chips like Huawei's SoCs.

One of China's most promising strategies has been its commitment to RISC-V, an open-source architecture that it can freely use to develop its own chips without interference from the United States. **This architecture, described as "geopolitically neutral," represents a pathway for China to develop processing capabilities independent of**

⁴⁷ [Amazon, Microsoft, Google y Meta invertirán 21.000 millones en España | Economía digital](#)

controlled US technologies. Investment in RISC-V-focused startups had reached \$1.18 billion by mid-2023, demonstrating China’s strong commitment to this technological alternative.

Chinese authorities have prioritized the use of local alternatives. Regulators have provided “guidance” to companies to choose local suppliers such as Cambricon Technologies and Huawei, thereby strengthening the national technology ecosystem.

One of the most notable effects associated with this scenario has been the relocation of manufacturers out of China to other Asian countries, mainly Vietnam. Vietnam has emerged as an attractive alternative, with an ambitious plan called C = SET + 1 (C stands for Chip, S for Specialized, E for Electronics, T for Talent, and +1 for Vietnam, which will strive to become a new and safe destination for the global semiconductor supply chain). The goal is for its semiconductor and electronics industry to generate revenues exceeding \$100 billion by 2050. This phenomenon is already being described by (Yang & Chan, 2023) who found that tensions between China and the US have sped up the move of electronics production from China to Vietnam and changed how production is organized in the region, mainly because of concerns about costs and capabilities, but especially due to the risks arising from political tensions and disruptions caused by the pandemic.

Specific aspects of the scenario for the EU.

In this scenario, a fragmentation of the European space—not only in terms of capital but also of exchanged knowledge—would make us particularly vulnerable. This is the scenario identified by Draghi and Letta, which is currently being addressed by the Competitiveness Compass, but which should be urgently accelerated. The concept of Open Strategic Autonomy should be applied directly in this context, especially with respect to “friendly” geographies (with a potential rapprochement with the UK?), and there is an urgent need to intensify the Single Market and accelerate the transition in critical sectors: Energy intensive sectors, such as steel, metals, and chemicals. Mobility and technology neutrality is key for competitiveness: automotive sector. Sustainable Transport Investment Plan: ports and maritime industry, while additional efforts will also be deployed to strengthen EU cross-border rail connectivity, including a plan for an ambitious European high-speed rail network. EU agriculture and food production. Also, Europe must invest more in modernising and expanding its network of energy transmission and distribution infrastructure, accelerating investment in electricity, hydrogen and carbon dioxide transport networks as well as storage systems.

Without a Digital Single Market, only the strongest or most advanced European countries would benefit, and only partially, since there is no critical mass for creating champions, nor the capacity to achieve scale or fully exploit existing capabilities. In such a scenario, there could be incentives to break current technological lock-ins (such as those imposed by US and Chinese platforms and ecosystems), although significant investment would be required. The European Commission speaks of an approximate budget of 5% of Member States’ GDP over the next five years. Perhaps it would be necessary to accept fragmentation in certain elements of the value chain (given the self-interest in securing the supply of advanced chips). At least, there is an urgent need to digitalize domestic industries—using either local or third-party solutions—in order to guarantee the supply of critical goods (such as pharmaceuticals, food, etc.)

Moreover, faced with a scenario of fragmentation and the local momentum for digitalization and investment, there will be incentives to repatriate talent originating from the most technologically advanced regions (Kenney et al., 2013).

The European Union, for example, following this scenario, is developing a European cloud through initiatives such as GAIA-X—a federated cloud project led by Germany and France—which aims to host and process data under the exclusive control of European Union entities. Or through the promotion of AI gigafactories⁴⁸ to enable the development and deployment of frontier AI models across sectors and for public interest applications. The plan includes tripling data center infrastructure over seven years and aims to mobilize 20 billion euros for this purpose⁴⁹.

In this regard, regulations such as the Data Act and, internally, the Interoperable Europe Act would be used to harmonize and facilitate interoperability within Europe, but most importantly, to protect data when dealing with third countries. Europe could become a leader in this type of initiative—not only in financial data, but also in value chains such as logistics. Data is seen as more than just personal use protection; it is regarded as a source of wealth through its sovereign and interoperable exchange.

Finally, excessive regulation can be seen as a brake, and there are strong incentives to create transnational champions in the telecom sector (this would be the most favorable scenario for that purpose) that can offer integrated cloud or technological solutions to European companies in their digitalization—very likely aligned with the new vision for 6G.

4.6 Scenario 4: Systemic Fragmentation with the Risk of Multiple Conflicts (Breakdown of Globalization, Autarky of Leading Economies, Accompanied by Significant Downward Pressure on Digitalization)

Scenario of major disruption and new contingent forces that reconfigure globalization, with a tendency toward a slowdown in global digitalization. According to Path Dependency theory, contingencies fundamentally prevail.

	Digitalization	Economy	Institutions and Regulation
Contingencies	Autarky and digital resilience, and the development of technologies	‘Tariff war’ or profound changes in	Dynamics between strong and weak countries prevail, with

⁴⁸ [Public Consultation on the AI GigaFactories - EuroHPC JU](#)

⁴⁹ <https://elpais.com/tecnologia/2025-04-09/la-ue-quiere-triplicar-su-capacidad-en-centros-de-datos-en-siete-anos.html>

	<p>for local use without seeking standardization. Focus on AI, space (satellite) technologies, or robotization (drones), incorporating strong cybersecurity aspects.</p>	<p>global trade flows, which cause severe instability and may potentially lead to a deep economic crisis or conflicts of a military nature.</p> <p>FDI collapses and alternatives for self-financing are sought; this will likely delay investment in advanced data centers for AI.</p> <p>Control of critical materials and energy sources, with a focus on ensuring their supply.</p> <p><i>Central Bank Digital Currency</i> (such as the digital yuan) that accelerate alternative flows to the dollar as an international medium of exchange.</p>	<p>a possible chaotic outcome and no multilateral consensus.</p> <p>Ineffectiveness of the UN and the WTO.</p> <p>A significant cooling (lack of political cooperation and commercial decoupling) in US-China relations.</p> <p>Duality of the EU's response to profound changes: either an acceleration of institutions and the Single Market, or their weakening and fragmentation due to political tensions.</p> <p>Use of European antitrust laws against major foreign platforms.</p>
Reinforcements	<p>Difficulty for weaker economies to digitize, as their own or external resources are diverted and prove insufficient.</p> <p>Cooperation between advanced European economies and third parties to maintain legacy digital infrastructures while advancing their own new ones, with special</p>	<p>Alternative digital leaders strengthen their position: e.g., India forging hybrid alliances.</p>	<p>Incentives to fragment the internet and break its governance, except in the islands of friendly regions.</p>

	emphasis on cloud migration, which would accelerate.		
Lock-ins	Blocking of technologies with potential military use.	Talent is prevented from moving to other geographies, especially to non-friendly ones.	

Table 5. Path Dependency forces for Scenario 4. Source: author's own elaboration.

Until now, this would have been considered the least likely scenario. In this risk scenario, Trump 2.0 policies would attempt to restructure the global trading system. As stated by Miran (2024) this 'traditional' system was based on an overvalued dollar for decades, which would have acted as the world's reserve currency, negatively impacting US exports. However, on the other hand, this strong dollar would have allowed the US to finance its high national deficit throughout all these years, attracting external capital flows and invigorating its global financial and technological sector, thereby shaping an American economy strongly oriented toward services and consumption.

There would therefore be a search for the repatriation of productive capacity to the US, which would be rationalized by the aim of mitigating the growing internal inequalities among its middle classes resulting from globalization. This worsening of internal inequality in the countries that have benefited most from globalization was initially raised by Milanovic (2016) and has since been studied by many scholars in terms of its different factors: technological progress, openness, and policy. For example, Vuković & Damijan (2025) argue that, in response to the disenchantment with globalization (as a reaction from an impoverished middle class), there are alternatives based on policies such as public expenditure on education, employment protection legislation, and direct income taxes that would promote a more equal distribution in these more advanced countries.

And in this scenario of deglobalization, fragmentation into two blocs would intensify. The US would seek to isolate China, as it would see it as its main competitor. Furthermore, in the dialogue and exchange of goods and services that the US would pursue with its partners, this relationship would be highly asymmetric. As a consequence, and as an escalation of this policy, dialogue between nations would now tend to be measured not by their capacity to exert influence, but rather domination—a so-called “hard power.”

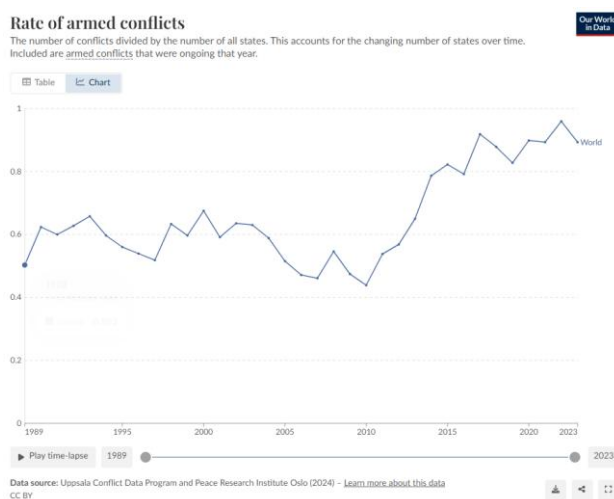
The creation of coercive processes or the intensification of distrust would generate rivals rather than commercial partners and accelerate the breakdown of global governance rules. The most powerful countries may return to viewing globalization in terms of their ability to exert power pressures: all or nothing, in a scenario resembling the globalization models of the late 19th and early 20th centuries, where each 'empire' traded mainly with its colonies and where the US tended economic autarky.

Indeed, we would find ourselves in a situation of new alignments. For example, He et al. (2025) reveal China's current capacity for influence and the alignment of third parties due to its arms export capabilities are highlighted. There are also other alignments, particularly among the BRICS, which—beyond just China—are developing strategies similar to Western approaches to digitalization and sovereignty, while seeking opportunities for mutual collaboration through information exchanges (Belli et al., 2024).

A potential initial trigger for this scenario would be a “trade war” or an unresolved tariff clash between several countries, along with an intense process of destruction of the global order reminiscent of the Hawley-Smoot Tariff Act of 1930 following the global crisis of 1929. Based on Dinopoulos et al. (2024) a scenario of tariff war “(i.e., moving from factual to Nash-equilibrium tariffs) substantially lowered welfare and top-income inequality in all countries” although “The tariff war did not significantly impact US and EU unemployment. Still, it reduced unemployment in China and the rest of the world”. On the other hand, Chen et al. (2025) and considering global value chains, they hold an opposing view, as they suggest that mitigating these geopolitical tensions would improve “economic resilience and welfare.

This fragmented scenario would imply also a significant risk of military conflicts or a major diversion of resources toward rearmament, to the detriment of the welfare state and, more generally, of society's digitalization⁵⁰. There would also be a high likelihood of escalating conflicts or tensions between rivals due to cyberattacks⁵¹.

This is the scenario that would occur if no solution-oriented narratives are generated for current conflicts, leading to a successive increase in armed conflicts as seen in Figure 20. Potencialmente si existiera un conflicto bélico entre bloques que no quiere decir que éste fuese global. El mercado entre dichos bloques de países se estanca fruto de una guerra de aranceles donde pocos o ninguno salen beneficiados.



⁵⁰ <https://www.usfunds.com/resource/how-ai-is-reshaping-aerospace-defense-investment-opportunities/>

⁵¹ <https://www.nu.edu/blog/cybersecurity-statistics/>

Figure 20. Rate of armed conflicts. Source: Our World in Data⁵².

It is crucial that the exchange of economic and knowledge flows would be seriously threatened:

- Foreign Direct Investment plummets. A vicious cycle of low foreign investment and limited modernization would be created, as it is shown in figure Figure 21.

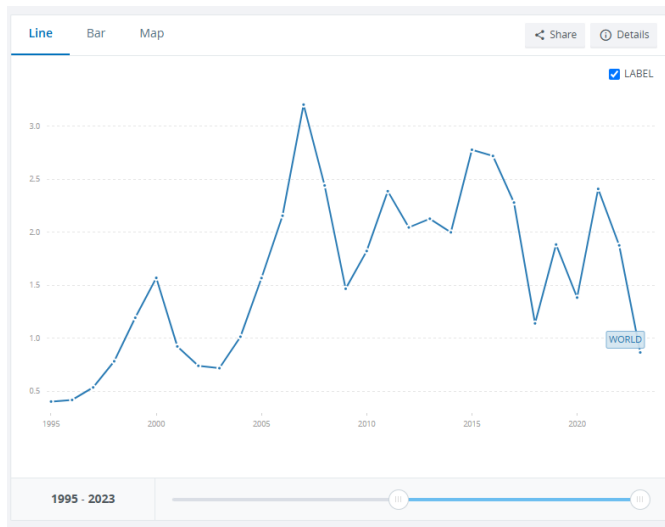


Figure 21. Foreign Direct Investment, net inflows (BoP, current US\$). Source: World Bank⁵³

- The same happens with global capital flows.
- The number of global patents also declines and becomes concentrated on dual-use technologies, with a blockage of technologies intended for military purposes.

Generally speaking, patents in force would tend to be held by national residents (following the current pattern seen in China, where this is already the case as it is shown in Figure 22), which is in stark contrast to the pattern until now, characterized by an exchange of knowledge between regions.

⁵² https://ourworldindata.org/explorers/conflict-data?time=1833..latest&country=~OWID_WRL&Conflict+type=All+armed+conflicts&Measure=Conflict+rate&Conflict+sub-type=All+sub-types&Data+source=Uppsala+Conflict+Data+Program&Sub-measure=All+ongoing+conflicts

⁵³ <https://data.worldbank.org/indicator/BX.KLT.DINV.CD.WD>

Non-resident applicants accounted for nine out of 10 patents in force in the UK
1.8. Patents in force at the top 10 offices, 2022

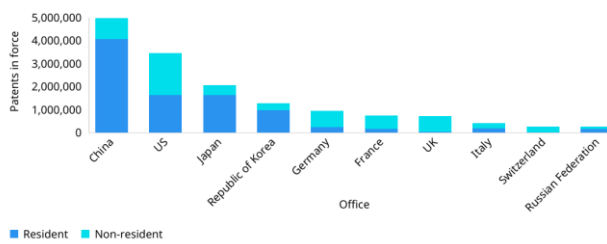


Figure 22. Patents in force at the top 10 office, 2022 for Resident and Non-resident. Source: WIPO⁵⁴

In a scenario of severe breakdown in international relations and significant fragmentation of the global supply chain, there is enormous interest in controlling the transit spaces for goods: Panama Canal (handles 5%-6% of the world market and 40% of US container traffic), South China Sea (one-third of global shipping), Red Sea (12% of the world market). There is an energy or supply crisis that could become chronic. In this scenario, a potential invasion or temporary blockade of Taiwan, which could endanger the supply of advanced semiconductors, becomes especially significant. Taiwan, despite the relocation of its production capacity to other regions, will remain critical in the coming years, especially due to the development of innovative semiconductor packaging technologies by TSMC, such as Chip-on-Wafer-on-Substrate (CoWoS) and System-on-Integrated-Chip (SoIC), which are key differentiators in the most powerful AI processors. R. C. Liu et al. (2025) study strategies for "diversification and stockpiling" that are only useful in the long term and propose "recommendations to fortify energy security, expand critical material stockpiles, and institutionalize international collaboration through multilateral mechanisms," which precisely in this scenario of global fragmentation would be rendered ineffective.

Autarky and digital resilience, along with control of critical materials, are the most crucial factors. Insufficient investments to develop alternative technologies in weaker countries—which, unable to acquire them from others, are left lagging behind (using obsolete semiconductor alternatives, for example)—force these nations to "submit" to one of the established geopolitical blocs they align with. So, there would also be a strong asymmetry in technological development between countries and organizations, as described by the World Economic Forum.⁵⁵

This scenario implies a strong technological refocusing on advanced military applications that absorb part of the investment previously allocated to non-military innovation: advanced developments in electronic warfare, AI for military purposes, autonomous warfare systems, and efficient manufacturing of conventional military equipment through Industry 4.0. Ukraine serves as a laboratory for this digitalization scenario since 2019, as demonstrated by the NRI index, which shows its remarkable progress. In the words of Itzhak & Ferri (2023), and after just one year of war, a dynamic began to "deny the digital capabilities of each other" and the "importance of digital services to the region's operational continuity" became evident. Also state "Ukrania implanted satellite public telecom as backup and moved its critical and sensitive data under fire to cloud services

⁵⁴ <https://www.wipo.int/edocs/pubdocs/en/wipo-pub-941-2024-en-world-intellectual-property-indicators-2024.pdf>

⁵⁵ <https://www.weforum.org/publications/global-cybersecurity-outlook-2025/digest/>

outside its country's borders (Poland) with the significant help of global cloud solution providers". In contrast, Russia has also undergone a similar process of sophistication, as it rose from 48th to 41st place, despite having experienced a process of autarky and disconnection (isolation) from the traditional global digitalization chain (Martynova & Shcherbovich, 2024). Russia would be an example of a country that has accelerated its drive for independence, where the telecom regulator—Roskomnadzor (Federal Service for Supervision in the Sphere of Telecom, Information Technologies and Mass Communications)—has received additional powers to block internet traffic. What is undeniable is the increasing degree of the control over the information flows and extensive traffic filtering.

Digital sovereignty is being reinforced in the most advanced countries in terms of protecting digital services against third-party interference or cyberattacks. Cybersecurity is an essential tool for safeguarding critical infrastructure. Indirectly, due to policies restricting data sharing, there would be an impact on digital services exports (Gupta et al., 2022).

In terms of multilateral organizations, it implies the collapse or at least the inoperability of the WTO and the UN or other regulatory bodies. The Internet could become fragmented, as could its governance and mobile phone standards. Major digital ecosystems become isolated and deliberately incompatible. There is a strong incentive to create alternative digital platforms, even if they are delayed or ineffective, in order to guarantee digital sovereignty. Furthermore, payment platforms based on Central Bank Digital Currency alternatives to the dollar (such as the Digital Yuan) would begin to gain significance for economic exchanges within non-aligned blocs, such as the BRICS.

Here, traditional lock-in processes in the global digital chain do not work, and despite global inefficiencies, there are significant national interests in creating alternative local solutions.

In conclusion, the most vulnerable will see their progress and digitalization halted or compromised, and consequently, there would be a sharp increase in intraregional inequalities (e.g., West Africa vs. South Africa) due to the limited investment in digitalization. They might find support in new friendly geographies and their digitalization capacity if the U.S. ultimately withdraws its global influence. Only the most advanced regions could feel partially benefited if they are able to finance technological advances aimed at achieving maximum self-sufficiency, especially regarding AI data centers, and if they have a sufficiently sophisticated internal market that encourages innovation.

Specific aspects of the scenario for the EU.

The EU would face significant transformations, for example, the German economy shifting towards strong and rapid rearmament, with a major focus on digital resilience. The EU would also have to face the unavoidable challenge of optimizing its internal digital market. As a highly sophisticated consumer and innovator of technology in the digitalization of its society, businesses, and public administrations (Hernández de Rojas et al., 2024), it should use this capability to build an internal market of sufficient critical size, emulating the efforts being made in the U.S. and China.

If a robust single market does not exist, could there be significant tensions in the supply of basic materials including food or energy. Even with a “Critical Raw Materials Act” in place, it might be insufficient to address this risk. According to Distefano et al. (2024) being a gradual shift towards the relative decoupling of GDP from material use in the EU27, significant import dependencies from the rest of the world, particularly for fossil fuels (90.9%) and metal ores (86.2%) exist, where nearly all EU27 countries exceed the 65% import dependency threshold. And propose a “necessity for integrated policy interventions at the EU level, combining supply and demand measures, technological advancements, and behavioral changes to achieve relative dematerialization”.

The significant European savings, which are necessary for investment in technological programs, would be encouraged not to flow abroad (perhaps because systemic risks would advise against it) and would instead be used for this internal transformation. Already in the current European Competitiveness Compass, financial instruments are being considered to retain European savings by using savings plan strategies.

There would be cooperation with external third parties (e.g., the U.S.) based on deeply instrumental interests — such as deploying data centers to keep non-critical legacy infrastructures operational while technological alternatives are developed — or, depending on the intensity of the shift, while new digital standard layers are 'built' or high-cost critical projects (e.g., space initiatives that replace third-party alternatives and provide military intelligence data to critical infrastructures). Regardless of the scenario, prioritizing migration to the Cloud would remain essential to ensure data integrity.

EU institutions could collaborate closely with “like-minded” third parties (such as Norway, the UK, and Canada) and accelerate the development of transcontinental champions in terms of critical infrastructure security or defense⁵⁶ considering relevant mergers in the sector⁵⁷ of AI (France is a leader country for generative AI). Strategies are established to maximize the resilience of data networks with strong backup through alternative options (such as internal roaming or satellite), or by enabling migration to clouds in secure regions to ensure continuity, for example, of the financial system.

Finally, European regulation could be used in a protectionist and perhaps even asymmetric way (that is, distinguishing between allies and non-allies) as a tool for tariff negotiations, taking into account the imbalance in digital services and the dominance of major platforms from third countries. For sample, under DMA regulation European Commission, appointed six businesses as gatekeepers: Alphabet, Amazon, Apple, ByteDance, Meta and Microsoft. Also, under this position we had that The European Commission has fined Google billions of euros for practices like favoring its own services in search results and creating barriers for competitors⁵⁸.

⁵⁶ https://www.thalesgroup.com/es/countries-europe/espana/press_release/indra-thales-firman-acuerdo-colaboracion-para-impulsar-el

⁵⁷ <https://www.eleconomista.es/actualidad/noticias/13248477/03/25/airbus-thales-y-leonardo-sacan-la-artilleria-y-se-preparan-para-una-oleada-de-fusiones.html>

⁵⁸ [EU court rules Google must pay €2.4bn fine*](#)

5 Preliminary Conclusions

Pure scenarios are unlikely to exist; rather, hybrid scenarios will prevail, with some regions of the world in one scenario and others in different ones, and two possible trajectories emerging in the context of risks to globalization:

Tectonic fragmentation: Incompatible technological blocs (the West vs. China vs. India).

Adaptive interoperability: Minimum common standards with divergence in upper layers.

In general, there would be cooperation on basic standards (6G, cybersecurity), while competition would persist in end-user applications and platforms, with complex short-term substitution.

As initial recommendations for glocal governance to overcome the identified risks, we propose the following general policies:

Regulatory Harmonization: Establish standards for cross-border data flows, mitigating fragmentation risks and overcoming security threats.

Targeted Investments: Digital cohesion funds in the EU (to accelerate non-national convergence phenomena within the EU) and the unblocking of the Americas Act in the U.S. to restore digital collaboration across the Americas by incorporating cross-cutting digital aspects. In (Cheng et al., 2024) two aspects are addressed: “increased Geopolitical Risks significantly hinders green technology spillovers through both FDI and imports. Additionally, the research demonstrates that advancements in local green technology levels (GTL), marketization (Mark), and intellectual property rights protection (IPRP) can mitigate the adverse effects of GPR”

Cooperation in Hybrid Education and Digital Approach: STEAM programs with international trade components, leveraging, for example, global MOOC platforms.

The construction of these scenarios is a call for coordinated action among states, businesses, and civil society, as they pose a risk to the most vulnerable.

Except for the first scenario, the others cast doubt on patterns of widespread global growth and progress, and especially scenarios 3 and 4 call into question important aspects related to the SDGs (Sustainable Development Goals), mainly caused by the Sino-US trade frictions (Ma et al., 2024). In general, they imply a risk to people-centered digitalization processes and a breakdown of the current model. As noted by the ITU report (ITU, 2025), closing the digital divide will require increasing investment in infrastructure by \$1.6 trillion, ensuring that the next wave of globalization is inclusive and sustainable.

5.1 Specific Recommendations for the EU

Considering the EU and the seemingly most challenging scenarios, resilience and strong coordinated unity among its Member States are required, although we believe that these difficulties provide the necessary incentives for its development.

In all of them, except for the first scenario, a single market and the implementation of the initiatives identified by Letta and Draghi—which correspond to the Competitiveness Compass—would be required.

In this regard, there are ongoing initiatives that could increase such resilience. However, in the EU, the presence of multiple national technology champions—especially smaller ones lacking investment capacity—creates friction for disruptive policies and, in the short term, would foster lock-ins according to path dependency theory.

The creation of favorable trajectories for the European environment requires strong involvement from public administrations—not from a simplistic regulatory standpoint (“limiting through regulation” perspective), but rather to enable better circulation of intangibles among EU countries and regions, thereby strengthening both public and private investment.

6 Criticisms of the Proposed Model

Path dependency profoundly influences technological progress by favoring continuity over disruption. Yet, we are currently in an environment that would prioritize global disruption. While lock-in effects can stabilize industries and reduce uncertainty, they may also stifle innovation and perpetuate suboptimal systems. Policies and businesses should balance incremental improvements with strategic investments in emerging technologies, leveraging exogenous shocks and institutional flexibility to navigate such transitions. Future research should explore hybrid models that integrate path dependency with complexity theory, offering dynamic frameworks for sustainable technological evolution.

This study could take advantage of strong analytical tools among the main factors detected for creating each scenario. Also, as a technique for country clusters and future positions, Dynamic Projection or ARIMA models could be used taking into account: investments in 5G and quantum computing, green energy subsidy policies, or geopolitical conflicts (such as potential restrictions on semiconductors).

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