

A hand holding a globe with a network overlay. The globe is rendered in a grid of dots and lines, with a network of orange and red lines extending from it. The background is a solid teal color.

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Toward a successful metaverse

The case for measuring enabling factors

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Acknowledgments

The Inclusive Internet Index (3i), developed by Economist Impact and supported by Meta, is a benchmarking tool to assess country-level progress toward an accessible internet for all. The 3i evaluates internet inclusion across four categories: Availability, Affordability, Relevance and Readiness. In its sixth iteration, published in 2022, it covered 100 countries and 99% of the world's population.

As the internet evolves, new technologies like artificial intelligence and cloud computing are shaping its future. Research suggests that the metaverse holds significant potential, with a projected value of up to US\$5trn in revenue by 2030. This background paper emphasizes the importance of consistently assessing the country-enabling factors that are necessary to build a successful metaverse. It presents the findings of a literature review, detailing metaverse definitions, enabling factors, opportunities, challenges and examples of progress thus far.

This is the first stage of an independent Economist Impact research program, supported by Meta, the culmination of which is a cross-country benchmarking framework that measures progress across specific enabling factors. This framework will be published later in 2023.

The background report was produced by a team of Economist Impact researchers, editors and designers, including:

- Vaibhav Sahgal: project director (vaibhavsahgal@economist.com)
- Walter Pasquarelli: project manager
- Shubhangi Pandey, Edwin Saliba: research analysts
- Jeremy Gantz: sub-editor
- Amanda Simms: copy-editor
- Maria Angel Gonzalez: designer

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Executive summary

The metaverse's immense promise is at once clear and clouded in uncertainty. The word's etymology—it combines the Greek word for “beyond” with the latter syllable of “universe”¹—signals limitless possibilities. Today, the term “metaverse” is attached to a variety of applications and digital environments related to education, healthcare, entertainment and social interactions, accessible via both new technologies such as augmented reality (AR)/virtual reality (VR) headsets and older ones like desktop-based systems. Yet no single conceptualization of the metaverse holds sway: it is still in its infancy, leaving considerable space for research and debate.

What is clear, however, is that the metaverse holds significant potential to alter how organizations conduct business and how individuals socialize, shop, work and play. But before the metaverse can reach its potential at scale, a number of market, organizational and consumer barriers need to be addressed. Our research finds that a comprehensive tool is needed to measure countries' progress building the metaverse and identify areas requiring policy attention and investment. For such a tool to be meaningful, a nuanced and rigorous understanding of metaverse-enabling factors is required. To that end, Economist Impact, supported by Meta, is conducting foundational research to develop a country assessment framework. Our ultimate goal:

provide policymakers, business leaders and people interested in the metaverse ecosystem with a reliable diagnostic that can both map the current landscape and flag areas for improvement.

This background paper constitutes the first milestone of our research program. Through a review of leading published literature on the metaverse, we set out to identify definitions, enabling factors, opportunities, challenges and country examples. Key findings, which will inform subsequent phases of our program, are summarized below.

There is a lack of consensus around definitions of the metaverse and requirements for successful scaling. Technology corporations, venture capitalists, consulting firms, academia and media have all proposed ideas. There are common attributes in current definitions, however: immersiveness, a need for interoperable virtual worlds and the use of digital avatars, for example. Multi-stakeholder collaboration will be needed not only to establish a common definition, but also to develop common technical standards that support interoperability, as well as technologies and infrastructure enabling a successful metaverse.

The building blocks for the metaverse are already in place, aligned with the four pillars of our Inclusive Internet Index: Availability,

Affordability, Relevance and Readiness.²

Availability includes connectivity infrastructure (e.g., fixed and wireless broadband, including Wi-Fi, and mobile 4G and 5G), technology (e.g., artificial intelligence and cloud capabilities), and hardware (e.g., headsets, smartphones and computers). Affordability covers connectivity and hardware costs. Relevance involves relevant content and user experience and community-building initiatives. Readiness encompasses digital literacy, governance, regulations and standards, workforce readiness, and investment. All of these factors are essential for stimulating competition and innovation in the technology sector, which powers the development of a successful metaverse.

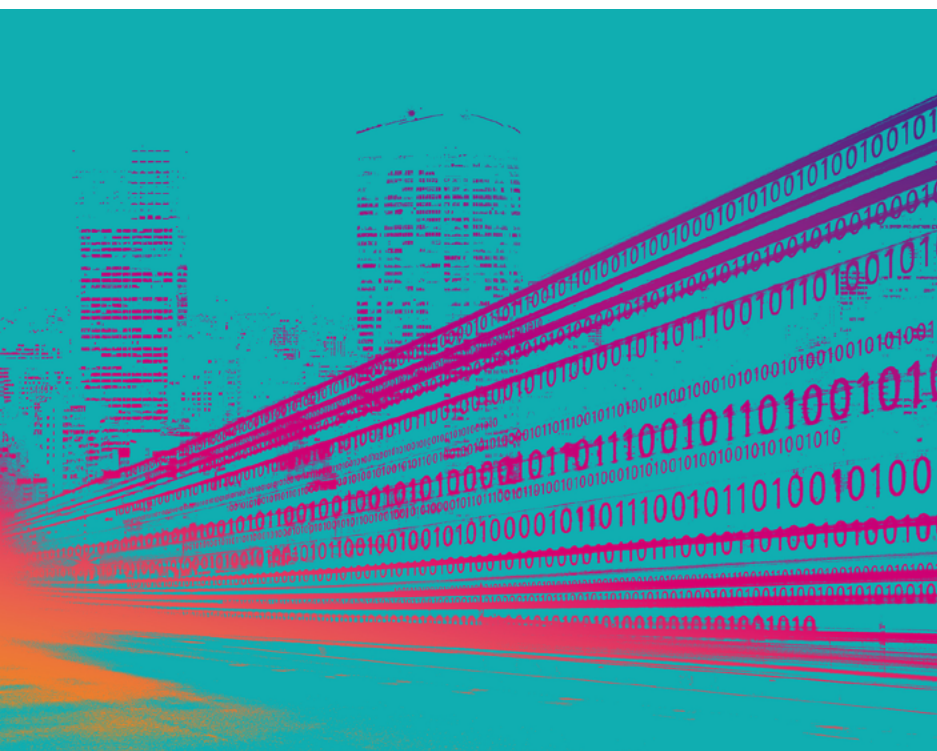
Wide-ranging social and economic benefits are apparent, but can only be realized if barriers are overcome. We identified four high-potential applications: learning and education; work and collaboration; social interaction; and entertainment. Forecasts suggest that the

metaverse economy could potentially generate up to US\$5trn in value by 2030.³ But first market, organizational and consumer-related barriers must be addressed. Market barriers involve establishing technical standards, favorable policies and robust digital infrastructure. Organizational barriers include user attraction, retention and technology development. Consumer-related barriers pertain to affordability, the performance of extended reality technologies, and acceptance and trust.

A standardized approach for measuring countries' progress toward metaverse adoption is needed to track progress. Asia-Pacific shows increasing demand for VR gaming devices, while affordability remains a key barrier to wider internet adoption and metaverse engagement. Governments and industries around the world have launched metaverse initiatives, such as the Metaverse Seoul project in South Korea, K-pop labels' virtual events, Dubai's Virtual Assets Regulatory Authority entering the metaverse and the Indonesian government's MetaNesia platform. In the EU, the market for VR and AR was an estimated €7bn in 2021 and is projected to reach €34bn by 2026.⁴ Yet there is no single approach for measuring metaverse readiness that allows countries to track and compare progress.

The forthcoming country assessment framework will address these gaps while measuring progress towards metaverse adoption. Economist Impact will publish the framework, along with other insights drawn from a set of expert interviews, an expert panel and secondary research, in the form of a whitepaper later this year.

In 2023 the purpose and potential of the metaverse remains up for debate. Its significance and applications will certainly evolve in the coming years as technologies mature and accessibility grows—not unlike the internet itself during the last 50 years. We hope this paper, and the larger research program of which it is a part, deepens knowledge of a fast-changing landscape, bringing the future into focus.



Introduction

The transformative impact of the internet is inarguable. It is now so deeply embedded into societies that people around the world can no longer easily imagine communicating with friends and family, shopping, learning and working without it. Yet just a few decades ago, skepticism about the internet's value and potential abounded. "No online database will replace your daily newspaper, no CD-ROM can take the place of a competent teacher and no computer network will change the way government works,"⁵ noted a famous 1999 *Newsweek* article.

Importantly, the internet is by nature ever-evolving. It has birthed new kinds of economic activity and social structures, as well as technologies such as cloud computing, artificial intelligence (AI) and extended reality (XR)⁶—and these technologies in turn have reshaped the internet.

They also enable the metaverse, which some view as the future of the internet.⁷ One recent study of the metaverse forecasts an opportunity worth up to US\$5trn by 2030, with the potential to redefine economies and societies.⁸ Just like the internet, the metaverse could catalyze rapid global transformation. Countries need to prepare for change with the right information tools.

Evolution of the Inclusive Internet Index (3i)

Since 2017 Economist Impact, supported by Meta, has produced the Inclusive Internet Index (3i)

annually. The 3i serves as a benchmark to measure, track and compare country-level progress toward creating an accessible, affordable and relevant internet that all citizens are ready to use.⁹ By providing detailed and country-specific understanding of the state of the internet, this tool shapes critical policy conversations across the globe.¹⁰

The 3i provides a rigorous benchmark of internet inclusion across four categories: Availability, Affordability, Relevance, and Readiness.

- Availability: the quality and breadth of available infrastructure required for access and levels of internet usage.
- Affordability: the cost of access relative to income and the level of competition in the internet marketplace.
- Relevance: the existence and extent of local language content and relevant content online.
- Readiness: the capacity to access the internet, including skills, cultural acceptance and supporting policies.

In its 2022 iteration, the 3i assessed 100 countries across these four categories, covering 99% of the world's population.¹¹

Six years after the index's debut, much progress has been made on global internet inclusivity. And a new research question is now at hand: **what are the enabling factors that countries should prioritize to build a metaverse that benefits both the economy and society?**



Looking ahead: an enabling framework for the metaverse

This paper offers foundational research to support the development of an indicator framework that measures metaverse readiness at the country level. The overarching objective is to help countries identify strengths and opportunities as they look to build out the metaverse.

To develop an analytical framework for a benchmarking tool, we will draw on insights drawn from a literature review, interviews and an expert panel with leading thinkers. This will allow us to integrate all salient aspects such as new technological developments, opportunities and capabilities, as well as trust and safety requirements. We will also leverage knowledge accumulated through the 3i project, considering its framework and indicators.

A successful research project starts with clear and relevant questions. To wit:

- **Development requirements:** what does it take to build a successful metaverse and how

can countries across different contexts work toward this goal?

- **Definition:** how should we define the metaverse? What definitions are already in use? What makes the metaverse distinct from the web in terms of its user experience (UX), opportunities and barriers to adoption?
- **Components:** what principal components constitute the metaverse?
- **Acceleration:** what is needed to increase progress towards scaling the metaverse?
- **Status of progress:** to what extent is progress being made across key indicators of metaverse development?
- **Applicability:** what makes countries best prepared to build and take advantage of the metaverse?

What follows offers answers—which, taken together, represent the first milestone on the path to building a metaverse-focused benchmarking tool to be published later in 2023.

Chapter 1: understanding the metaverse

The term “metaverse” is a combination of the prefix “meta” (meaning “beyond” in Greek) and the word “universe.”¹² The term was coined in the 1992 science fiction novel *Snow Crash*, written by Neal Stephenson. In this novel, humans can interact with each other in a virtual 3D space, which reflects the real world to an extent, and is accessible via digital agents.¹³

Leading voices from across industries have presented different definitions of the metaverse. We examine them below, along with key concepts, characteristics and the stakeholders in the metaverse ecosystem.

1.1 Defining the metaverse

The metaverse can be thought of as a contested term; no single conceptualization currently captures the differing—and often-competing—perspectives of all ecosystem participants. Still, many definitions do overlap to some extent, putting forward the ideas of an “immersive” experience, interoperability, digital avatars and a persistent “always on” virtual world, for example.

One frequently cited definition comes from Matthew Ball, author and CEO of Epyllion, an investment company working with metaverse applications. Ball describes it as “a massively scaled and interoperable network of real-time

rendered 3D virtual worlds and environments. These can be experienced synchronously and persistently by an effectively unlimited number of users with an individual sense of presence, and with continuity of data, such as identity, history, entitlements, objects, communications and payments.”¹⁴ The metaverse thus allows its users to have an immersive experience in a virtual environment, in which they can interact with each other, conduct business and forge social connections through their virtual “avatars”.¹⁵

Markus Weinberger, from Aalen University in Germany, provides a similar definition, which highlights avatars or digital representations of users as a core constituent of the metaverse. According to Weinberger, “the Metaverse is an interconnected web of ubiquitous virtual worlds partly overlapping with and enhancing the physical world. These virtual worlds enable users represented by avatars to connect and interact with each other, to experience and consume user-generated content in an immersive, scalable, synchronous and persistent environment.”¹⁶

While Ball and Weinberger focus on the idea of a shared environment, others highlight the metaverse’s ability to simulate the physical world. “The metaverse is the convergence of two ideas that have been around for many years: virtual

reality and a digital second life,”¹⁷ a *New York Times* article notes. It goes on to explain that the metaverse is a virtual reality serving as a computing platform for living a second life online, through avatars.¹⁸

Global technology firm Sensorium, by contrast, emphasizes the metaverse’s decentralized nature. It anticipates countless virtual spaces in the future, and “each will have their own economies, communities, infrastructures and areas of interest.”¹⁹ The firm adds, “whether you’re using a virtual reality headset, AR glasses or just your smartphone, you’ll be able to enter a new level of immersion and interactivity in the metaverse, where users can feel both an individual and social sense of presence.”²⁰

1.2 Presence in the metaverse

The concept of “presence” helps illuminate what the metaverse is (or could be) across a range of different technologies. A key idea is that the metaverse should allow users to behave and feel in a virtual digital environment as they would in the real world.²¹ In 2010, Mennecke et al. proposed the embodied social presence theory. It notes that avatars provide users with a sense of embodied presence by forming bonds through avatar interactions, building relationships with others and ultimately experiencing a sense of co-presence.²²

An enhanced sense of presence is closely tied with enhanced UX in the metaverse.^{23,24,25} In fact, research suggests that improvements in user interface (UI) and UX design may be central to making the metaverse more accessible^{26,27} and thus more commercially viable.²⁸ As technologies such as AR and VR advance, more immersive experiences will be possible, creating a stronger sense of “presence.”²⁹

However, in the absence of AR/VR headsets, the metaverse can still be accessed in non-immersive 2D environments. For example, most users of immersive online games (e.g., Fortnite) and

gaming platforms (e.g., Roblox) are not wearing AR/VR headsets.³⁰ But both Fortnite and Roblox are considered part of the metaverse because they include many features associated with the metaverse, such as persistent avatars, social interaction and virtual economies.³¹

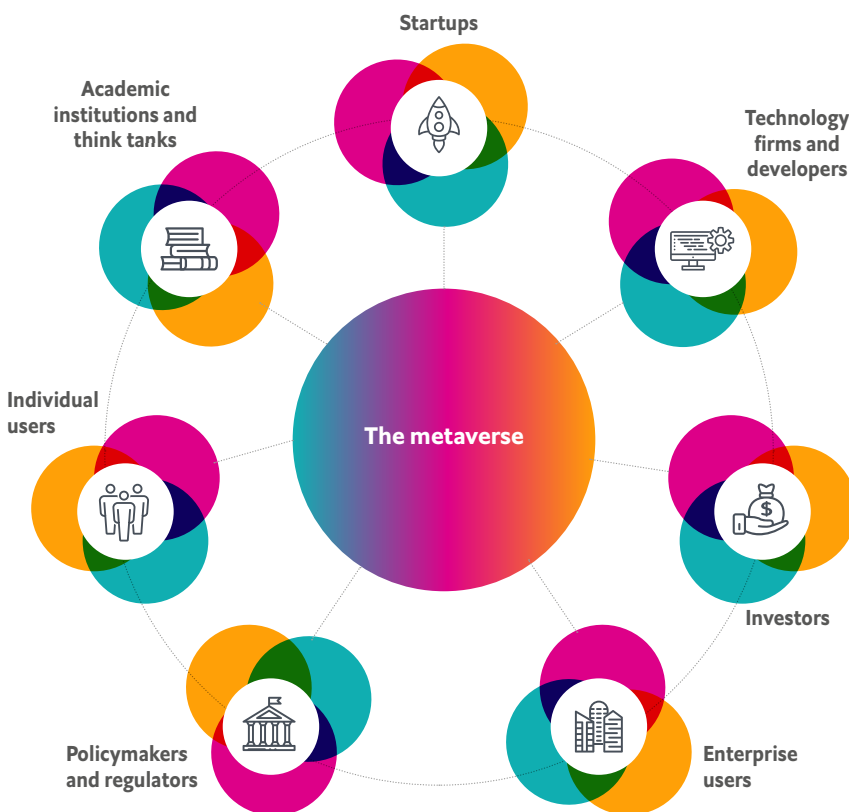
1.3 The evolution of the internet

Some definitions of the metaverse posit it as the internet’s next evolutionary step. “In simplest terms, the metaverse is the internet, but in 3D,”³² argues Ed Greigg, chief disruptor at Deloitte.³³ Others view it as a distinct phenomenon.^{34,35} For example, Jerry Michalski, a senior industry fellow at the Royal Melbourne Institute of Technology, observes that the metaverse experience will be more similar to a 3D TV than the web.

At the same time, it is clear that the existence of the metaverse is predicated upon a universal communication platform provided by the web.³⁶ (In simple terms, the internet is the underlying network infrastructure connecting devices worldwide, while the web encompasses all accessible, interconnected websites and web pages.)

Importantly, Web3 and the metaverse should not be conflated, although the two phenomena do dovetail to some extent. Web3 is referred to as the web’s next iteration.^{37,38} In contrast to Web2—the current version of the web, characterized by concentrated activity within large platform economies—it is characterized by distributed technologies (e.g., blockchain) and decentralized organizations rather than centralized on servers owned by corporations.³⁹ While the decentralized protocols supporting Web3 may facilitate interoperability in a metaverse, the two things are by no means synonymous. The metaverse broadly refers to virtual worlds in which users can interact with each other and engage with applications and services.⁴⁰

Figure 1: The metaverse ecosystem



Source: Economist Impact

1.4 Stakeholders in the metaverse ecosystem

A complete understanding of metaverse-enabling factors requires knowledge of all stakeholders in the emerging metaverse ecosystem. They range from corporations to startups, users, developers, investors, policymakers, academia and civil society organizations.⁴¹ Collaboration, communication and co-responsibility among these key actors—detailed below—are prerequisites for developing a successful metaverse.⁴²

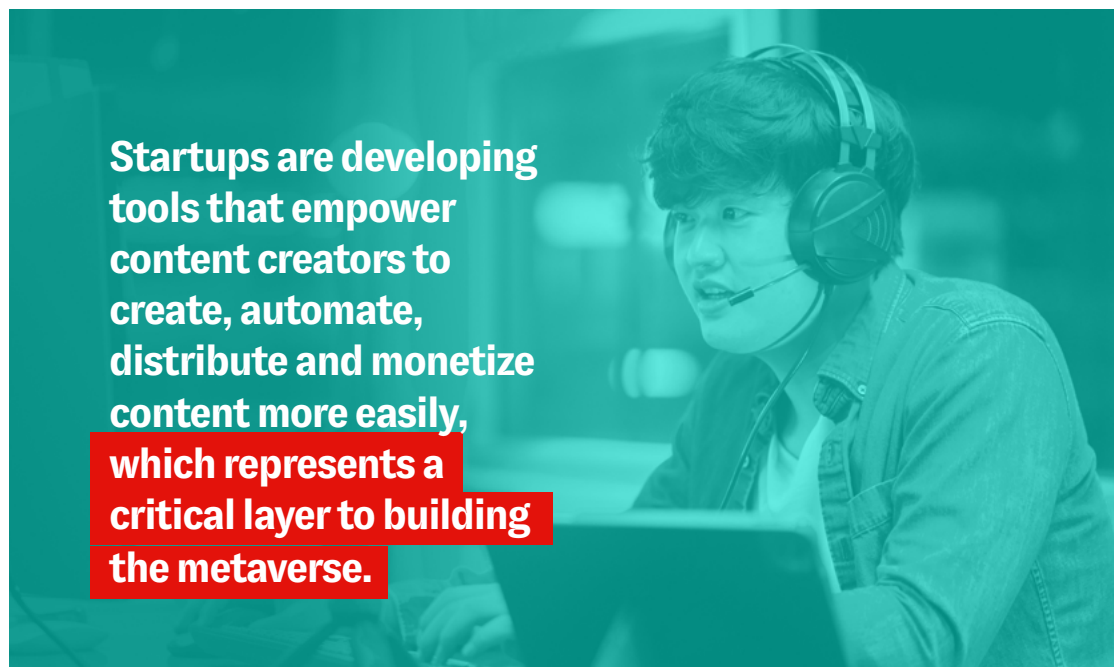
a. **Technology firms and developers** are driving the metaverse forward through innovation. Crucially, they are developing its technological

foundations: AI, 3D modeling and AR/VR, for example.⁴³ Developers possess the technical skills to create engaging applications that pull users into immersive virtual worlds.⁴⁴ For example, developers are creating interactive games and architectural and automotive visualizations on virtual platforms, using Unreal Engine, a developer tool owned by Epic Games.^{45,46}

b. **Startups** also play a substantial innovation role. These companies are often more agile and experimental than bigger technology firms.^{47,48} Examples of startups building experiences for the metaverse are InWorld AI, which uses AI-backed technology to generate virtual characters, and The Sandbox, a decentralized gaming platform providing virtual real estate.⁴⁹ Another example pertains to the creator economy; startups are developing tools that empower content creators to create, automate, distribute and monetize content more easily, which represents a critical layer to building the metaverse.⁵⁰ In order to scale up their business models, startups can partner with other organizations, seek venture capital (VC) funding, and sometimes engage in merger and acquisition opportunities.

c. **Investors**, including VC, private equity, angel and institutional investors, fund both startups and more mature firms. According to a survey conducted earlier this year, the majority of VC and institutional investors plan to increase their metaverse investments over the next five years.⁵¹ Research from NASDAQ highlights that, in 2022 alone, VC investors closed 216 metaverse-funding deals, totaling almost US\$2bn—benefiting both startups and ecosystems that fund early stage startups (e.g., Amonica Brands).⁵²

d. **Enterprise users** often look to increase employee productivity using metaverse-related technologies, while many industries benefit from new business processes, such as banking, education, healthcare, entertainment and retail.⁵³



“Employees in a metaverse could work on projects in real-time regardless of their physical location. Teams could brainstorm, communicate and share ideas more easily and effectively, which would increase productivity and creativity,” notes Sanjar Mohamed, chief metaverse officer at Eikonikos.^{54,55}

- e. **Individual users** currently access metaverse platforms to play games, access entertainment (e.g., live concerts and events) and socialize. (Roblox, Minecraft and Fortnite are currently the virtual worlds with the most users.⁵⁶) In a recent survey of 1,000 people conducted by consulting firm Blue Label, 84% of respondents noted they use metaverse-related technologies for personal enjoyment.⁵⁷
- f. **Policymakers** introduce legislation and rules that can influence the development of metaverse technologies, while **regulators** ensure compliance with these rules. Policymakers, whether at the national or supranational level, should focus on stimulating a balanced dialogue that makes the most of economics and social opportunities while

carefully considering the potential risks associated with the metaverse.⁵⁸ Policymakers may also offer policy support to a burgeoning ecosystem, including: supporting research initiatives, investing in network infrastructure, and providing incentives for businesses and innovators. For instance, the US and Japanese governments are jointly investing US\$4.5bn in the research, development and deployment of next-generation networks to enable better connectivity.⁵⁹

- g. **Academic institutions and think tanks** conduct research on emerging technologies and often serve as a talent pipeline. The first AR head-mounted display system, for example, was created in the 1960s by Ivan Sutherland, an associate professor of electrical engineering at Harvard University.⁶⁰ Universities are also breeding grounds for in-demand talent—software engineers, data scientists and cybersecurity specialists.⁶¹ More broadly, academia (including think tanks) helps drive debate over the economic, political and social implications of the future metaverse.

Chapter 2: building the metaverse

For the metaverse to reach its potential, an array of components and enabling factors will need to be in place. Guided by the 3i's pillars—Availability, Affordability, Relevance and Readiness—this chapter examines the necessary building blocks for a successful metaverse (see Figure 2).

2.1 Availability

2.1.1 Connectivity infrastructure

A prerequisite for establishing a metaverse is robust connectivity infrastructure, such as next-generation Wi-Fi, to connect devices to content.

2.1.2 Tech stack

A number of key technologies that constitute the tech stack are required to develop the metaverse.^{63,64}

Cloud computation and storage: the metaverse generates vast volumes of data.⁶⁵ Where large amounts of sensitive data are involved, there is also a risk of data leakage, tampering, theft or loss, especially if the metaverse relies on a central storage system.⁶⁶ To enable the metaverse's capabilities, it is estimated that a thousand-fold increase in computation beyond what state-of-the-art semiconductor chips can deliver as of

Figure 2: Building blocks of the metaverse identified in the literature (based on 3i pillars⁶²)

Availability	Affordability	Relevance	Readiness
Connectivity infrastructure	Connectivity cost	UX	Investment
Tech stack	Hardware cost	Community-building	Digital literacy and Workforce readiness
User hardware			Governance (regulation and standardization)

Source: Economist Impact research and analysis, 2023

2023 is required.⁶⁷ Cloud technology can enable computation and storage of such large amounts of data generated in a metaverse.⁶⁸

AI: AI fetches and processes vast amounts of data to enable greater automation and support decision-making. It will also be used to power intelligent virtual assistants, or other agents, that can interact with users.⁶⁹ AI-generated synthetic media can also make virtual worlds appear hyper-realistic, contributing to the feeling of “presence” in a metaverse.⁷⁰

Payment and digital asset ownership systems: new forms of digital commerce in the metaverse will require payment systems to evolve. In particular, the global nature of transactions will cast existing shortcomings in cross-border payments technologies into even sharper relief. Central banks are working to improve cross-border payments; by October 2022, roughly 90% of the world’s central banks were pursuing central bank digital currency projects.⁷¹ However, these efforts remain piecemeal and could take long to implement.⁷² Similarly, digital asset ownership will be vital to fostering a robust digital economy in the metaverse⁷³, but technical standards and implementations in the space are still nascent.

2.1.3 User hardware

AR/VR headsets are well-known examples of hardware that enables users to immerse themselves in virtual worlds.⁷⁴ Other devices can enrich sensory experiences, for instance, haptic glove prototypes and digital scent technology.^{75,76} At the same time, screen-based devices such as desktop computers, laptops and smartphones also enable 2D access to the metaverse.⁷⁷

2.2 Affordability

2.2.1 Connectivity cost

Unaffordable internet connections put the metaverse out of reach. According to the International Telecommunication Union (ITU), the average fixed-broadband price basket⁷⁸ dropped 4% year-over-year in 2022.⁷⁹ Many consumers may not have noticed. An Economist Impact survey conducted last year found that only 37% of respondents⁸⁰ believed the internet was more affordable since the onset of the pandemic. High costs are one of the key reasons why 2.9 billion people are not connected to the internet globally, the vast majority (96%) living in developing countries.^{81,82}





Research suggests that **approachability is a key determinant** of whether an individual chooses to use a platform again

2.2.2 Hardware cost

The global VR market is expected to grow significantly between 2022 and 2030, reaching a value of US\$87bn in 2030.⁸³ That doesn't mean VR is poised to go mainstream, however.⁸⁴ The price of VR headsets, for example, ranges from a few hundred to more than US\$3,000. At these price points the equipment is inaccessible to a large number of people; for reference, the annual income per person in the least developed countries was US\$1,165 in 2021.⁸⁵ However, the metaverse is already being accessed through devices such as smartphones;⁸⁶ Fortnite and Roblox users mostly navigate 3D environments through 2D screens.⁸⁷

2.3 Relevance

2.3.1 UX

UX design is an interdisciplinary field that combines elements of psychology, computer science and design.⁸⁸ It involves creating functionalities that support intuitive, engaging and immersive experiences for users.⁸⁹ Research suggests that approachability is a key determinant of whether an individual chooses to use a platform again—a factor of commercial viability.^{90,91} The iPhone offers a powerful example

of the market power of UX. Widely considered a category-defining product, a great deal of the iPhone's success derives from its sophisticated UX and interface simplicity.⁹²

2.3.2 Community-building

A key reason why the internet and social media have been successful is their capacity to foster dynamic communities. In essence, this means transposing social life from the physical to the online world via seamless communication systems.^{93,94} Companies such as Epic Games (parent company of Fortnite) are interested in cultivating a sense of community among users to achieve long-term retention.⁹⁵ In April 2020, 27.7m viewers attended a series of live virtual performances by rapper Travis Scott on Fortnite. Two years later, Epic Games raised US\$2bn in funding from global entertainment company Sony and investment company KIRKBI (which founded the Lego Group) to bolster its own metaverse expansion plans.⁹⁶

2.4 Readiness

2.4.1 Investment

Building out the metaverse requires big money, for both new and established companies pushing innovation forward. Metaverse-related investments rose to US\$120bn in the first five months of 2022 alone—more than double the US\$57bn invested in 2021.^{97,98} The market size of the metaverse was estimated to be roughly US\$478.7bn in 2020 and is anticipated to rise to US\$783.3bn by 2024.⁹⁹

Notably, there are examples of public-sector investment in the metaverse.¹⁰⁰ In February 2022, South Korea's Ministry of Science and Information & Communications Technology announced plans to set up a US\$180m fund to invest in the country's metaverse industries.¹⁰¹ Developing metaverse technology (such as AR/VR and blockchain) is a "national priority" for South Korea, noted the country's president, Yoon Suk-yeol.

2.4.2 Workforce readiness

The metaverse will be built by skilled tech workers at home in the realms of AR/VR, AI, 3D rendering and more. Companies and countries must be ready to acquire and develop top talent.¹⁰² Demand for a metaverse-ready workforce is already on the rise in markets like India, which saw an estimated 55,000 job openings related to the metaverse in July 2022. Sought-after skills included AI/ML programming, AR/VR, gaming, UI/UX design and blockchain.¹⁰³

2.4.3 Digital literacy

Digital literacy consists of a wide range of abilities—including cognitive, physical, sociological and emotional—that individuals need to acquire in order to participate in digital spaces, including the metaverse. For instance, digital literacy translates into knowledge of how to run software or operate digital devices, the ability to create new content, evaluate the quality and validity of information, or even understand the formal and informal rules in cyberspaces.¹⁰⁴

2.4.4 Governance, regulation and standards

Well-defined policy and regulatory frameworks are crucial for ensuring an environment where metaverse technologies can thrive. Some countries, such as India,¹⁰⁵ are not yet keen to develop a specific regulatory framework for the metaverse given its nascent status. But regardless of what regulations are enacted by governments, interoperable technologies and standards developed by nongovernmental actors will be essential to building an open and inclusive metaverse.^{106,107} The Metaverse Standards Forum, for example, aims to bring together various standards organizations and companies for industry-wide co-operation on interoperability standards.¹⁰⁸ And in December 2022 the ITU established a focus group on the metaverse to mobilize governments, industry leaders and academia, laying the groundwork for development of open and inclusive standards for the metaverse.¹⁰⁹

Chapter 3: assessing the opportunity and challenges

The potential social and economic impacts of the metaverse are huge—but by no means assured. The metaverse economy could generate up to US\$5trn in value by 2030.¹¹⁰ While the US and Chinese markets are expected to reach US\$158.09bn and US\$87.15bn respectively by that time,¹¹¹ the global user base is projected to reach 700 million.¹¹² That is a significant portion of the world’s population, portending societies even more deeply mediated—and potentially disrupted—by digital technologies.

This chapter explores the potential benefits and current areas of application of the metaverse, as well as barriers to scaling.

3.1 Emerging opportunities and use-cases

Beyond monetary value, the metaverse promises an enormous range of applications across industries. We identified the four main areas of emerging impact: learning and education; work and collaboration; digital twins; and social interaction and entertainment. Some of the use-cases described are already emerging, while others could take years to enter the mainstream.

3.1.1 Learning and education

Metaverse technologies offer immersive learning opportunities in which students can explore

virtual environments and engage with other students (through XR and desktop-based technologies).^{113,114}

For example, the Stanford Virtual Heart is a 3D model that allows medical students to better understand how the organ works.¹¹⁵ “The heart is a complicated three-dimensional organ, and it’s really hard to describe what’s going on inside of it,” explains David Axelrod, MD, clinical assistant professor at Stanford University School of Medicine.¹¹⁶ Wearing VR headsets, students can inspect and manipulate a heart, see detailed visualizations of how a particular defect can affect its functioning, for instance.

Metaverse applications can be geared to specific groups and disciplines.¹¹⁷ A study by Barbara Ludlow, chair of the West Virginia University department of special education, describes how VR-based education can support children with special needs, particularly in remote rural areas. Interactive technologies, such as brain technology interaction, VR and AR promise sensory stimulation that could facilitate and enhance the learning experience for this population.^{118,119,120}

3.1.2 Work and collaboration

Immersive work platforms are set to support the labor market’s transition toward remote or hybrid working.¹²¹ These platforms aim to enhance

social connection and collaboration, while facilitating a range of activities like onboarding and training. One use-case is helping improve team interactions among remote workers. NextMeet, in India, is developing a metaverse workplace solution offering a higher sense of presence through a virtual office accessible with XR-headsets.¹²²

Corporate interest appears to be growing. One study found that 82% of surveyed executives “expect metaverse plans to be part of their business activities within the next three years.”¹²³ In line with this, Accenture bought 60,000 XR headsets in 2021 to train its employees to use metaverse technologies.¹²⁴

However, the impact on productivity of working in the metaverse remains unknown. Some studies indicate that it can help combat the fatigue of regular remote work by enhancing teamwork and collaboration through avatars.¹²⁵ Conversely, it has been observed that one week of working in the metaverse can increase anxiety by 19% and decrease productivity by 16%.¹²⁶ Nevertheless, the metaverse opens up new possibilities to rethink workspaces—both in the office and at home—and create more engaging work environments for employees.¹²⁷

3.1.3 Digital twins

A digital twin is a “virtual representation of an object or system that spans its lifecycle, is updated using real-time data, and leverages simulation, machine learning and reasoning to help decision-making.”¹²⁸ They are essentially virtual real-time representations of objects or systems.

In the context of a particular system or environment (e.g., a factory, logistics center or port), digital twins can be used to run simulations, understand performance issues and propose potential improvements.^{129,130}

Digital twins in manufacturing allow employees to operate virtual machines, which then

execute commands on physical devices, making factories more efficient, safer and productive through virtual operations in the metaverse.¹³¹ Immersive experiences can be used to train employees remotely and monitor different types of operations, without facing occupational safety risks.¹³² German auto manufacturer BMW has already created a digital twin of its production lines, expanding the possibilities of monitoring and improvement.¹³³

Beyond manufacturing, numerous applications have been identified, including power-generation, infrastructure, healthcare services and urban planning.¹³⁴ There are challenges to widespread adoption, however. Creating a model-based environment is essential for digital twins, which can be complex and costly.¹³⁵ And regular maintenance is necessary to ensure that it accurately reflects physical asset changes.¹³⁶

3.1.4 Social interaction and entertainment

The metaverse promises new virtual spaces in which people around the world can gather through avatars to socialize and be entertained in new ways. Hennig-Thurau et al. (2022) describe this as a “real-time multisensory social interaction”. Given its experience creating virtual platforms, the gaming industry has been at the forefront in this field.¹³⁷ Roblox, an online gaming platform launched in 2006, had on average 66.2 million daily active users in March 2023.¹³⁸

Beyond gaming, such platforms allow creators and developers to build immersive and interactive content, while engaging with global and diverse audiences. For example, Sotheby’s, a British auction company, has created a digital replica of its headquarters in Decentraland, where visitors can explore and purchase digital art from non-fungible token artists.¹³⁹

Wearing VR headsets for longer periods of time may cause side effects, at least for some users, however. One study observed that VR

headset usage can lead to increased exhaustion compared with 2D interactions, although this fatigue tends to diminish with time. Enhancing the physical experience of sustained VR headsets usage could help support wider adoption among the public.^{140,141}

3.2 Challenges to scaling

Three main categories of challenges to scaling emerged from our literature review: market, organizational and consumer-related. Each is described below, along with how they could be overcome.

3.2.1 Market barriers

These are systemic challenges to building a successful metaverse, including a lack of interoperability standards, policy and regulation.

- a. **Lack of interoperability.** The internet achieved ubiquity because common standards were created and implemented to ensure that different technical components seamlessly interact and function. Aligning on similar technical standards for the metaverse will require multi-stakeholder collaboration to build technical solutions for interoperability on a case-by-case basis. Without the development of these standards, it will be difficult to achieve frictionless UX.¹⁴² Agreeing on standards would require considering privacy, security and safety interests, while addressing technical, usage and jurisdictional aspects.^{143,144,145} One area stakeholders could focus on how existing standards and structures from the 2D world—such as application programming interfaces (APIs)¹⁴⁶—either already applied or might be repurposed for immersive spaces and 3D objects.¹⁴⁷
- b. **Policy and regulation fostering innovation and safeguarding trust.** Ideally government regulatory action protects the interests of citizens and consumers, while helping to foster and enable innovation. Getting this

balance right is difficult. For example, the EU is widely considered to be one of the most influential players in the regulatory field. Its policies influence countries beyond Europe—a phenomenon called the “Brussels effect”.¹⁴⁸ The General Data Protection Regulation (GDPR) and the Digital Services Act are two examples of such influential regulatory frameworks.¹⁴⁹ On the other hand, some stakeholders have voiced concerns about the EU’s approach being too restrictive, at the expense of opportunities for innovation.¹⁵⁰

3.2.2 Organizational barriers

The companies building the metaverse face two main barriers to growth: technical constraints impacting the user experience and relatively slow and costly technology development.



- a. **Low concurrent user ceilings discourage users.** Metaverse platform developers must enable greater numbers of users to participate in virtual environments.¹⁵¹ A relatively low number of concurrent users¹⁵² can degrade UX quality and discourage new people from joining.¹⁵³ For instance, Second Life attracts a daily average of over 10 million users. However, the number of concurrent users ranges only from 27,000 to 51,000.¹⁵⁴ This relatively low number of simultaneous users can leave the virtual world seeming rather empty, discouraging people from spending more time on the platform.

There are strategies being tested to boost the number of concurrent users, such as introducing AI-bot players.¹⁵⁵ But in general, companies will need to improve technical capacity and promote meaningful content and experiences in order to attract and retain more users in the metaverse.¹⁵⁶

- b. **Relatively long technology development timelines.** Metaverse breakthroughs are dependent on progress being made across the technology ecosystem (e.g., infrastructure, streaming, graphics processing, headset size, and hand detection and eye-tracking technologies).^{157,158} Given the time needed to develop these, experts estimate that the metaverse will become mainstream in the next 10-15 years.^{159,160} Challenges include high costs, long R&D timelines and limited funding for hardware startups.¹⁶¹

3.2.3 Consumer barriers

Three types of consumer barriers are apparent: affordability of XR technologies; performance of XR technologies; and trust and privacy concerns.

- a. **High-priced headsets.** With prices ranging from a couple of hundred dollars to more than US\$3,000, AR/VR headsets are currently out of reach for many consumers around the world.^{162,163,164} In the future, lowering the price

of improved headsets of smaller size and increased comfort will require generational leaps in VR/XR technologies and across supporting technologies (such as computing power, batteries and wireless connectivity).¹⁶⁵ Although these headsets are not the only point of entry to the metaverse, they offer a more immersive UX compared with computers and smartphones.¹⁶⁶

- b. **Significant technical requirements and bulky products impact UX.**¹⁶⁷ Setting up XR technologies requires high-performance computing power. Less-advanced tools have lower graphical capability, battery capacity and interoperability, which are detrimental to UX.¹⁶⁸ A lag in signaling while using haptic gloves, for example, confuses people, not unlike someone missing a step when going down stairs. Similarly, AR technologies remain bulky and cannot be worn like everyday glasses.¹⁶⁹ As with affordability, improving features will require generational leaps in technology.¹⁷⁰
- c. **Trust, privacy and security concerns.** Some individuals and companies are unlikely to trust companies with personal data generated in the metaverse.¹⁷¹ In February 2023, the Center for Growth and Opportunity conducted a poll of Americans to understand how they view their relationship with the current tech giants. The results of the poll noted that the majority of respondents mistrusted platforms that use personal information.¹⁷² The 2022 Edelman Trust Barometer, a global survey, found that only 44% of respondents trusted social media companies (the lowest percentage among all industries), although technology companies were ranked as the most trusted that same year.¹⁷³ Emphasizing that trust would continue to be a challenge, a 2022 survey in the US and the UK showed that “privacy concerns” and “monetization of personal information” are the second- and third-biggest barriers to metaverse adoption.¹⁷⁴

Chapter 4: country progress thus far

The economic and social potential of the metaverse is vast but uncertain. To establish first-mover advantage and bring the future into focus, some countries have begun jumping into the fray, planting virtual flags. For example, Dubai launched a metaverse strategy in July 2022, aiming to become one of the world's top ten metaverse economies.¹⁷⁵ It plans to create 40,000 virtual jobs by 2030 and attract 1,000 companies specializing in blockchain and metaverse technologies.¹⁷⁶

Scaling trajectories will vary significantly across countries, however, and are hard to predict.¹⁷⁷ Studies by Boston Consulting Group¹⁷⁸ and Deloitte¹⁷⁹ outline possible directions that metaverse development could take. There is a need for more nuanced analysis of the areas that require policy attention and investment.

The table below offers examples of international and country-specific progress towards metaverse development, structured around the four pillars of the 3i: Availability, Affordability, Relevance and Readiness.



Availability	Affordability
<p>Examples:</p> <ul style="list-style-type: none"> Over the past few years, fixed internet speed has been increasing across several developed economies, including Europe and North America. However, progress remains unequal across countries and between rural and urban areas. For example, the weighted average upload speed of internet service providers in the US was up to 58.4 Mbps in 2021, a notable increase of 91% since 2019.¹⁸⁰ In Europe, fixed line upload speed improved by 44% in 2021 compared with the previous year, reaching a value of 46.2 Mbps.¹⁸¹ In 2017 the South Korean government created a US\$34.5m fund dedicated to startups specializing in VR gear and metaverse content.¹⁸² While North America continues to hold the largest AR/VR market share, Asia-Pacific's share is expected to expand the most in the coming years, with China, India, Japan and South Korea experiencing the highest demand for head-mounted gaming device displays in the VR market.¹⁸³ In Asia-Pacific (excluding Japan), spending on AR/VR is expected to be worth US\$14.8bn by 2026, growing at a CAGR of 40.1% across the preceding five years.¹⁸⁴ 	<p>Examples:</p> <ul style="list-style-type: none"> The sixth iteration of the 3i, published in 2022, noted that high internet connection prices remains a key barrier to wider adoption. At the same time, it also highlighted a year-on-year decline in the cost of mobile prepaid services and monthly fixed-line broadband, which presents an opportunity to drive greater usage as network coverage increases.¹⁸⁵ Similarly, the costs of technology required for metaverse development can be expensive, a key challenge for emerging economies as they look to increase engagement.¹⁸⁶ A study published in December 2022, identified the Netherlands (a high-income country) as having the highest capacity to embrace the metaverse, supported by one of the highest average fixed broadband speeds, of 106.51 Mbps, and US\$6,000 worth of high-technology exports per person in 2021.¹⁸⁷ A country's level of economic development is not the sole determining factor vis à vis metaverse adoption, however. A 2022 survey found people in emerging economies to be much more upbeat about its potential compared with most high-income countries.¹⁸⁸ But affordability is a key factor.
Relevance	Readiness
<p>Examples:</p> <ul style="list-style-type: none"> Last year the Seoul metropolitan government launched an ambitious new project—Metaverse Seoul—aimed at providing citizens with virtual access to a wide range of city services. The government, along with the technical developers, is using user feedback to improve the platform.¹⁸⁹ In November 2021 NVIDIA revealed a plan to create a digital twin of the earth that is powered by an AI supercomputer, with the goal of predicting and understanding the impacts of climate change.¹⁹⁰ 	<p>Examples:</p> <ul style="list-style-type: none"> Dubai's Virtual Assets Regulatory Authority in May 2022 became the world's first virtual assets regulator to enter into the metaverse, establishing a digital HQ in The Sandbox, a virtual world.¹⁹¹ In a survey of over 5,000 consumers and 1,000 business leaders in the US, conducted by PwC in 2022, 46% of respondents highlighted "hiring people with skills in metaverse-related areas" as the top priority for capitalizing on the metaverse.¹⁹² In August 2022 the Indonesian government launched its own metaverse platform, MetaNesia. Developed by state-owned telecommunications company PT Telkom Indonesia, MetaNesia aims to help Indonesian businesses compete with foreign services.¹⁹³ In the EU, the VR/AR market reached an estimated €7bn in 2021 and is projected to grow 37% annually to reach €34bn by 2026.¹⁹⁴

Next steps



While studies have analyzed select enabling factors needed to develop a successful metaverse, a significant gap remains: no widely accepted methodology for consistently measuring country-specific progress exists. There is a clear need for a cross-country benchmarking tool that illuminates what is required to develop a successful metaverse, and how this might differ geographically. Such a tool can also help address the need for a working definition of the metaverse among ecosystem participants around the globe.

We considered a number of analytical approaches to fill the gap in discourse, but an index-based or benchmarking methodology was deemed most appropriate for two key reasons.

First, because it is based on a standardized set of metrics, this methodology is particularly conducive to the development of a diagnostic tool. It allows stakeholders to identify key gaps in their enabling ecosystems and then set targets and build roadmaps—all while comparing performance to other countries with similar interests and tracking change over time.

Second, beyond its diagnostic utility, benchmarking enables examples-based learning, offering success stories or different progress pathways for consideration based on interventions that may have been implemented by other countries with varying levels of success. In other words, it makes progress toward an ambitious goal less daunting. Countries can and should learn from each other.

In the coming months, we will conduct a series of in-depth interviews with global experts and convene an expert panel discussion. We will publish the indicator framework, along with key findings from additional research, by the end of 2023.

Appendix: methodology

This background paper is the result of a thorough review literature review. Sources were selected based on Economist Impact editorial guidelines, which value integrity and independence. Whenever possible, we drew on the insights of sources with no vested interests in promoting or scaling the idea of a metaverse. Our method was primarily discursive, generating insights and analysis through comparison, contrasting and discussion of the literature presented.

Chapter 1: we reviewed existing definitions of the metaverse from leading voices, drawing from industry papers, academic literature, gray literature and policy documents.

Chapter 2: we identified and analyzed key components of the metaverse after studying a number of existing frameworks proposed by organizations such as Boston Consulting Group,¹⁹⁵ Deloitte¹⁹⁶ and Huawei.¹⁹⁷ We also reviewed academic research by authors such as Arpan Kumar Kar and P.S. Varsha and Svend Hollensen et al.¹⁹⁸

Chapter 3: this chapter's analysis of the most promising opportunities for the metaverse (and barriers for scaling) began with a review of industry reports discussing areas of metaverse applications. We selected the four most promising areas based on the number of mentions, as well as current impact and activity. To better understand barriers, we reviewed industry, policy and civil society reports, as well as credible news sources and leading experts.

Chapter 4: our description and analysis of countries' progress scaling their metaverse capabilities is based on a review of policy papers as well as country-specific technology investment strategies.

Endnotes

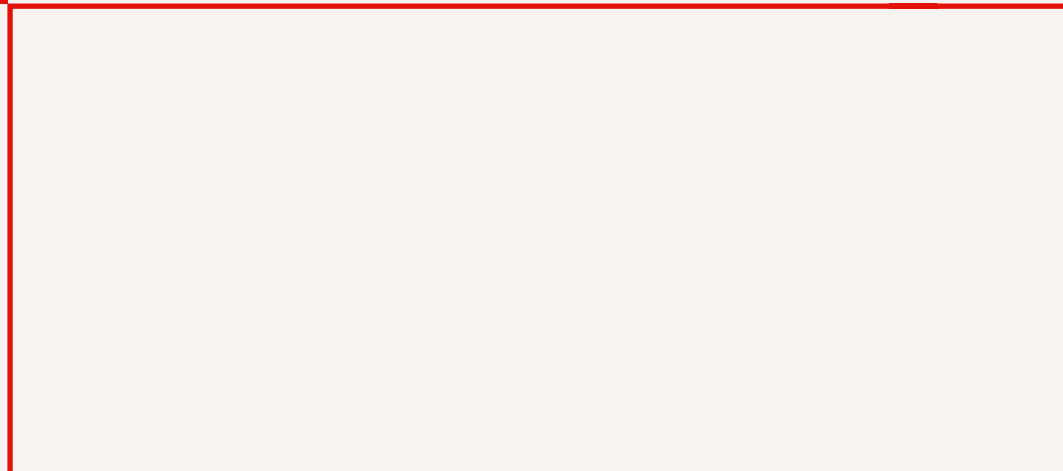
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LONDON

The Adelphi
1-11 John Adam Street
London WC2N 6HT
United Kingdom
Tel: (44) 20 7830 7000
Email: london@economist.com

GENEVA

Rue de l'Athénée 32
1206 Geneva
Switzerland
Tel: (41) 22 566 2470
Fax: (41) 22 346 93 47
Email: geneva@economist.com

SÃO PAULO

Rua Joaquim Floriano,
1052, Conjunto 81
Itaim Bibi, São Paulo,
SP, 04534-004, Brasil
Tel: +5511 3073-1186
Email: americas@economist.com

NEW YORK

900 Third Avenue
16th Floor
New York, NY 10022
United States
Tel: (1.212) 554 0600
Fax: (1.212) 586 1181/2
Email: americas@economist.com

DUBAI

Office 1301a
Aurora Tower
Dubai Media City
Dubai
Tel: (971) 4 433 4202
Fax: (971) 4 438 0224
Email: dubai@economist.com

WASHINGTON DC

1920 L street NW Suite 500
Washington DC
20002
Email: americas@economist.com

HONG KONG

1301
12 Taikoo Wan Road
Taikoo Shing
Hong Kong
Tel: (852) 2585 3888
Fax: (852) 2802 7638
Email: asia@economist.com

SINGAPORE

8 Cross Street
#23-01 Manulife Tower
Singapore
048424
Tel: (65) 6534 5177
Fax: (65) 6534 5077
Email: asia@economist.com