

A

Introduction

Over the last few decades, the internet has entered every corner of our lives, from social interactions to entertainment and work, and has fundamentally reshaped our economies, slashing the cost of acquiring and trading information. It has fuelled the digital revolution, fundamentally changing the ways in which we communicate, consume and produce, and it has profoundly transformed international trade, in terms of what we trade, how we trade, and who is trading.



Contents

1. Technological innovations have shaped global trade	16
2. A new world in the making	19
3. Structure of the report	20



The development of digital technologies that leverage the internet to generate, store and process data promises to transform the world economy even more. We are entering a new era in which computers, automation and data analytics are coming together in an entirely new way. Among other functions, the Internet of Things (IoT) – the everyday objects and devices which communicate with one another by means of sensors and other processes – enables the tracking of products along the supply chain and helps to prevent equipment failures. Artificial intelligence (AI) – the ability of a computer or computer-controlled robot to perform tasks traditionally associated with humans – guides robots in warehouses, helps to optimize the packing of products, and allows companies to dive into our preferences and behaviour to offer us tailored products. 3D printing – the process of making a physical object from a three-dimensional digital model – could revolutionize manufacturing by making it possible to fabricate customized products close to consumers.¹ And Blockchain² may enhance the transparency of supply chains, accelerate the digitalization of trade processes and automate contractual transactions. These technologies have the potential to reduce trade costs further and to transform international trade profoundly in the years to come.

While this is not the first time that technology has reshaped the world trading order, the pace of adoption of new technologies keeps accelerating. The shift from analogue to digital technologies has changed the world beyond recognition in only a few decades, whereas earlier technological revolutions played out over generations. The “New Digital Revolution” that is underway may spread even more quickly.

Understanding how digital technologies are likely to impact on world trade in the years to come, and appreciating the depth and breadth of these changes, are essential in order to harness the opportunities that these technologies open for the benefits of all, to help address the challenges that they may raise and to design policies to maximize the gains from trade. The purpose of this report is to shed some light on the extent to which these technologies are already transforming global trade and will transform it further in the years to come, and to discuss how international trade cooperation can help governments reap the benefits of digital trade.

1. Technological innovations have shaped global trade

The world economy has been shaped by various phases or “waves” of global integration – each one driven by underlying changes in transport and

communications technologies which reduced trade costs over an expanding range of economic activities, led to ever wider and deeper levels of integration and connectivity among national economies, and in turn required new forms of international trade cooperation, rules and institutions to consolidate and reinforce these structural trends. Indeed, it is the critical interplay between technology-driven structural change in the global economy, on the one hand, and the ability of the world trading system to manage these changes and adjustments, on the other, which has largely determined whether global integration has advanced or gone into reverse over the past two centuries.

(a) First wave of integration, 1815-1914

The Industrial Revolution marked the first major turning point for world trade. Although the outlines of a world economy had begun to take shape in the 17th and 18th centuries – as advances in ship design and navigation led to the opening of new trade routes to Africa, the Americas, and Asia (Maddison, 2008) – it was the commencement of the Industrial Revolution in the late 18th century, and the new technologies that accompanied it, that began to lower transport and communications costs dramatically, triggered the massive expansion of trade, capital and technology flows, and led to a process of economic integration that is now referred to as “the first age of globalization” (Ikenberry, 2000). These breakthroughs in transport and communications technologies opened up national economies to trade and investment in ways that differed radically from the past, relentlessly eroding what economic historian Geoffrey Blainey famously termed “the tyranny of distance” (Blainey, 1968).

Steamships were the first revolutionary technology to transform transportation in the 19th century. At first, steamships carried only high-value freight on inland waterways, but a series of incremental technological improvements over subsequent decades – screw propellers, the turbine engine, improved hull design, more efficient ports – resulted in faster, bigger and more fuel-efficient ships, further driving down transport costs, and opening up transoceanic steamship trade to bulk commodities, as well as luxury goods. By the late 1830s, steamships were regularly crossing the Atlantic; by the 1850s, service to South Africa had begun; and, with the opening of the Suez Canal in 1869, which created an important short cut to Asia, transoceanic steam shipping took over Far Eastern trade routes as well.

Railways were the other major transport breakthrough of the early Industrial Revolution, rapidly lowering inland trade costs in the same way that steamships

were lowering overseas trade costs, and ensuring that regional and global integration were increasingly complementary. The world's first freight rail line, the 1825 Stockton-Darlington route, was soon copied, not just throughout Great Britain, but in the rest of Europe, the Americas, and, by the end of the century, Asia and Latin America as well. A transcontinental line linked the East and West coasts of the United States by 1869 (Findlay and O'Rourke, 2009), the Canadian-Pacific railroad was completed by 1885, and the Trans-Siberian Railway by 1903. Worldwide railway lines increased from 191,000 kilometres in 1870 to nearly 1 million kilometres in 1913 (Fogel, 1964). Breakthroughs in refrigeration after the 1830s reinforced the impact of steamships and rail, allowing for the transport of chilled meat and butter over great distances (Mokyr, 1992).

Other technologies contributed to an even more dramatic lowering of communications costs. The development of the telegraph in the mid-19th century was as revolutionary in its day as the internet is now, effectively ushering in the modern era of instantaneous global communications. The first successful transatlantic telegraph message was sent in August 1858, reducing the communication time between Europe and North America from ten days – the time it took to deliver a message by ship – to a matter of minutes. By the end of the 19th century, American-, British-, French- and German-owned cables linked Europe and North America in a sophisticated web of telegraphic communications. As transoceanic steamships linked up distant markets, railways connected emerging industrial centres and telegraphs linked financial centres, world trade and investment surged.

It is estimated that international trade costs for France, Great Britain, the United States and 18 other trading powers fell by almost 25 per cent relative to their domestic trade costs between 1870 and 1913, explaining roughly 55 per cent of trade growth in that period (Jacks et al., 2008). Although technology was the major driver of this process, growing international economic cooperation and the spread of liberal economic policies both reflected and reinforced the underlying integrationist trends.

First, Great Britain removed many of its tariff barriers and trade restrictions unilaterally with the repeals of the Navigation Acts and the Corn Laws between 1846 and 1860, providing a powerful push towards more open international trade. Next, in 1860, Great Britain negotiated the Cobden Chevalier Treaty with France which, by reducing trade barriers between the world's then two biggest economies on a conditional most-favoured nation (MFN) basis, created an

incentive for other European countries to conclude similar bilateral trade agreements. Next, in the 1870s, again following Great Britain's lead, the world's major economies shifted to the gold standard and fixed exchange rates, adding perhaps the most important pillar to global economic stability during that period.

While there was no equivalent of today's major multilateral economic organizations, a number of new international agencies developed during this period to manage some of the specific policy challenges associated with the technology-driven economic integration. The International Telegraphic Union – the world's first inter-governmental organization – was created in 1865 in order to link national telegraphic systems into a single international network. In a similar way, the Universal Postal Union was formed in 1874 to help harmonize trans-border postal delivery.

This combination of technological change, trade opening and nascent international cooperation fuelled a period of extraordinary regional and global trade and economic integration. International trade expanded by 486 per cent between 1870 and 1913 (Jacks et al., 2011) – corresponding to an annualized growth of 4.12 per cent, substantially above the 2.1 per cent annual increase in world gross domestic product (GDP) reported by Maddison (2001) for the same period. Indeed, economic historian Kevin O'Rourke (2002) argues that “the most impressive episode of international economic integration which the world has seen to date were the years between 1870 and the Great War”.

(b) Disintegration, 1914-1945

The first age of globalization rested on simple but fragile foundations when the First World War delivered a fatal blow – destroying not just the liberal economic order but the assumption, remarkably widespread in the 1800s, that technology-driven integration and interdependence alone were sufficient to underpin international cooperation and peace. Trade was massively disrupted, the gold standard collapsed, economic controls and restrictions were widespread, and Europe, the former core of the world economy, was left devastated and exhausted. Although the 1920s saw some modest progress in efforts to restore the pre-1914 economic order, the Great Depression delivered a devastating blow from which the 1930s never recovered. Economic insecurity fed political insecurity, resulting in the rise of political extremism, the breakdown of collective security, a race to re-arm, and ultimately the outbreak of the Second World War. The average level of trade costs increased by 10 per cent in the 20 years from 1919 to 1939 (Jacks et al., 2008).

The failed attempt to rebuild the global economy after 1918 arose partly from an inability to recognize a fundamentally changed post-war era, and that there could be no easy return to the pre-war “golden age” of open and stable trade. Countries underestimated the immense challenge of restructuring wartime industries, finding work for millions of unemployed soldiers, or coping with raw material and food shortages. They were also slow to recognize that mobilizing countries behind total war – and then addressing the post-war demand for more activist public policies – had required unprecedented government involvement in economies, which complicated efforts to rebuild international economic cooperation in the interwar years. The lack of global economic leadership was perhaps the biggest obstacle to interwar recovery. As Charles Kindleberger famously argued, “the 1929 depression was so wide, so deep, and so long because the international economic system was rendered unstable by British inability and United States unwillingness to assume responsibility for stabilizing it” (Kindleberger, 1973).

Even during this period of disintegration between 1914 and 1945, underlying technological advances in transport and communications continued and, in some instances, even accelerated. War actually fuelled innovations in transoceanic shipping, for example, including the introduction of better boilers to convert steam, the development of turboelectric transmission mechanisms, and the replacement of coal-fired plants with oil and diesel engines. In 1914, almost the entire world merchant fleet, 96.9 per cent, was made up of coal-burning steamships; this declined to about 70 per cent in the 1920s, and less than 50 per cent from the latter half of the 1930 (Lundgren, 1996). Railway networks also expanded rapidly between the two world wars. By 1937, 5.7 per cent of the world’s railways were located in Africa, 10.2 per cent in Latin America and 10.9 per cent in Asia (Findlay and O’Rourke, 2009). By the late 1920s, diesel and electric locomotives were increasingly replacing steam engines. The interwar period also witnessed the mass adoption of the motor vehicle. Initially limited to transporting passengers in urban areas, large motorized trucks were soon serving on feeder routes to the main railways lines, and eventually they were competing with those lines. Adoption was particularly rapid in the United States: in 1921 there was one commercial motor vehicle for every 85 Americans, whereas in 1938 there was one for every 29 (Maddison, 2008).³

A clear lesson from the interwar period is that while technological advance is an essential enabler of increasing international trade and economic integration, it does not guarantee them – the policy and political contexts matter just as much.

(c) A second wave of integration, 1945-2000

The world economy underwent a process of “re-integration” after the Second World War, returning to the integration path that had abruptly been derailed by the First World War and by the economic and political chaos that followed (Findlay and O’Rourke, 2009). Indeed, the world economy grew far faster between 1950 and 1973 than it had done before 1914, and its geographical scope was far wider, ushering in a “golden age” of unprecedented prosperity (Maddison, 2001). World trade rose by nearly 8 per cent a year, while world per capita GDP rose by nearly 3 per cent a year.

As in the past, this process of re-integration was fuelled by further breakthroughs in transport and communication technologies and rapidly declining trade costs – which fell by a further 16 per cent between 1950 and 2000 (Jacks et al., 2008). Technological change in ocean shipping, including the use of containerization, contributed to a substantial decline in *ad valorem* transport charges – the cost of transport as a share of the value of the traded good – from around 10 per cent in the mid-1970s to around 6 per cent in the mid-1990s (Hummels, 2007).

Likewise, electrification, improved rail design, high-speed trains, intermodal freight, and other innovations have further reduced rail transport costs. The rapid expansion of air freight represented yet another major transportation breakthrough in the second half of the 20th century. With the development of Federal Express in the late 1970s, promising next-day delivery of freight through a dedicated fleet of cargo carriers, the costs of air freight fell by three-quarters in less than a decade (Dollar and Kraay, 2002).

Communications costs have fallen even faster thanks to satellites, fibre optic cables and other telecommunications innovations. A three-minute telephone call from London to New York cost about US\$ 250 in 1930. It now costs 2 cents – zero if one is Skyping. Meanwhile, according to International Telecommunication Unions (ITU) data, the number of mobile phones had grown to exceed the number of people on earth by 2014 – and will reach 13 billion by 2019. Overall, declining trade costs were estimated to account for 33 per cent of the trade growth from 1950 to 2000 (Jacks et al., 2008).

One important by-product of this second wave of integration was the growing internationalization of production and distribution. Just as rapidly falling transport costs in the 19th century led to globalization’s “first unbundling” – the end of the

need to produce close to the point of consumption – the second wave of integrationist technologies has led to globalization’s “second unbundling” – the end of the need to perform most production stages near one another (Baldwin, 2006). Production has come to be managed increasingly through complex global supply chains – effectively world factories – which locate various stages of the production process in the world’s most cost-efficient locations.

These global value chains (GVCs) vary depending on what, where and how they produce. Some focus on mass-market consumer products, others on capital goods, and others still on services and on agricultural and natural resources products. GVCs have also continued to evolve as more efficient suppliers arise, new technologies open up, underlying economic conditions change, or consumers’ tastes shift. All rely on increasingly sophisticated, seamless and flexible trade and investment networks that allow a wide range of geographically dispersed firms and service providers to deliver “just-in-time” output, at required specifications, in a tightly sequenced and coordinated way. It is estimated that upwards of 80 per cent of global trade now takes place within the international production networks of multinational enterprises.

There was one important difference between the first and the second waves of global integration: whereas the 19th-century wave was accompanied by only rudimentary efforts at international economic cooperation, the 20th-century wave, by explicit design, was built on a foundation of new and mutually reinforcing multilateral economic institutions known collectively as the Bretton Woods system. Thus, the International Monetary Fund would restore exchange rate stability and encourage monetary cooperation, preventing a return to the currency wars and financial chaos of the 1930s; the World Bank would provide soft loans for rebuilding war-torn countries and for accelerating economic development in poorer ones – the opposite of the revanchist spirit that had poisoned relations after the First World War; and the International Trade Organization (ITO) (a projected predecessor of the WTO) would lower tariff barriers and strengthen trade rules, gradually relaxing the protectionism and hostile regional blocs that had suffocated the world economy in the interwar years.

However, when the US Congress failed to ratify the ITO charter in the late 1940s, countries were forced to rely on the General Agreement on Tariffs and Trade (GATT), which had initially been designed to be a temporary tariff-cutting agreement until the ITO was formally established, and embodied most of the ITO’s key commercial policy rules. Although the GATT

was never intended as an international organization, it gradually came to play that role, both lowering tariffs and strengthening trade rules through eight successive “rounds” of negotiations, until its replacement by the World Trade Organization on 1 January 1995.

2. A new world in the making

As the remainder of this report makes clear, the world economy is being reshaped by an even newer wave of technologies, driven by innovations in telecommunications, computing and the global information networks they have produced. If the 19th century was marked by the falling cost of trading commodities, and the 20th century by the falling cost of trading manufactured products, the 21st century will most likely be marked by the falling cost of trading information. Thanks to fibre optic cables, satellites and digital technology, the cost of overseas telecommunications is approaching zero. As the power of computer chips has multiplied – following Moore’s Law (that the power of integrated circuits roughly doubles every two years – see Section B) – the price of computing power has also fallen dramatically. Meanwhile, the internet has emerged, almost by accident, as the embodiment of the “global information superhighway” first predicted in the early 1990s, serving not just as a new means of global communication, but also as a vast source of global information. The fusion of technologies that is currently coming about – often dubbed the Fourth Industrial Revolution – promises to reshape and reimagine the world economy in even newer and more fundamental ways. In this context, four technological innovations – the IoT, AI, 3D printing and Blockchain – are discussed in this report.

These developments have many implications, but the perhaps most important is that they have the potential to accelerate the process of global integration even more. The digital economy is already transforming the way ideas-based products move across borders – from financial services to data processing, medical information and entertainment. It is making itself felt in the ways in which knowledge, skills and expertise can be sourced from around the world, and in the ways in which production can be integrated, 24 hours a day, across times zones and borders.

However, something more fundamental is also going on. Digitalization is also rapidly spreading the very factors of production – technology, information and ideas – that make economic advances possible. Just as digitalization is dramatically expanding trade in some products, such as entertainment, it could reduce trade in others due to re-shoring of

“workerless” factories or to 3D printing. The further unbundling of production in some sectors will go hand in hand with the re-bundling of production in others. This widening circle of technology will, no doubt, continue to transform the world economy in the years to come.

3. Structure of the report

The World Trade Report 2018 examines how digital technologies are transforming global commerce today and are likely to impact it further in the years to come. It provides a qualitative analysis of the changes at play and tries to quantify the extent to which global trade may be affected over the next 15 years. It is, therefore, largely forward-looking. The report also discusses policy options for international trade cooperation in the digital era.

The report is structured in three main parts.

Section B discusses how digital technologies are transforming the economy. It describes the rise of digital technologies and examines how they are changing the economy, by giving rise to new markets, goods and services. It also discusses some of the concerns about privacy, market concentration and the digital divide that have arisen, and examines the challenge of measuring the value of digital transactions, including cross-border transactions.

Section C discusses the nature of what we trade, how we trade, and who trades what. It examines how digital technologies are affecting international trade costs, and how such effects create new opportunities and raise new challenges. The section also discusses how digital technologies affect the composition of trade in goods and services and impact intellectual property, and it examines the determinants of comparative advantage in the digital age, as well as the potential impact of digital technologies on global value chains. It concludes by quantifying the potential impact of important trends in technological development with projections on international trade to 2030, using the WTO Global Trade Model.

Section D focuses on the national and international policy dimensions of the digitalization of international trade. It discusses how international trade cooperation can help governments harness digital technologies, seize the opportunities that they create, and address the challenges that arise. It provides examples of measures taken by governments and discusses whether and how international cooperation can help governments reap the benefits of digital trade and at the same time achieve their public policy objectives, both now and in the future. The section identifies certain aspects of policies that may warrant international cooperation.

Endnotes

- 1 This report does not cover 3D printing of organic material, i.e. bioprinting.
- 2 As defined in Section B of this report, a blockchain is a tamper-proof, decentralized and distributed digital record of transactions (distributed ledger). It is made of a continuously growing list of records, which are combined in “blocks” that are then “chained” to each other using cryptographic techniques – hence the term “blockchain”. Blockchain is, technically speaking, only one type of distributed ledger technology. However, today, the term “blockchain” is commonly used to refer more generally to distributed ledger technology and to the phenomenon surrounding it. Like many other studies, this report will use the term “blockchain” in a generic way to refer to distributed ledger technologies.
- 3 The growing importance of motor vehicles was in turn one of the main factors underlying the rise of petroleum as an increasingly vital energy source for the world economy and the rapid growth in the trade of petroleum products.