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Out of the Factory and into the Back Office: Globotics for Sustainable Development

Richard Baldwin and Dmitry Grozoubinski

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Richard Baldwin & Dmitry Grozoubinski, 2023

Introduction

The post-1990 model for economic development turned on offshoring and industrialization. The formula was, at least conceptually, straightforward: a country would improve its investment climate, regulatory setting, infrastructure, and trade policy to the point where G7 firms would see the nation as a good place to extend their global value chains in manufacturing. The presence of the early foreign manufacturers – and especially the application of the G7-firms' technology to low-wage workers – would trigger a snowball process that le d to an expanding industrial basis, rapid income growth, and broader economic development. More investment would create more good manufacturing jobs locally, bring further technology and an upskilling of the workforce – all of which made the country even more attractive for further foreign investment. The ultimate result was rising living standards. This worked for a handful of emerging economies located proximate to the manufacturing giants: US, EU, and Japan (and China since the 2010s), but the mechanism seems to have been gummed up.

A combination of globalization and robotics (globotics) looks poised to render this development model obsolete (e.g. Loungani et al. 2017; Hallward-Driemeier and Nayyar 2017). This old model is being scissored by two blades. This first is the ending of the offshore expansion phase (more on this below). The second is digital technology that is reducing the labour cost share in manufacturing and thus reducing the advantage of placing labour-intensive stages of production abroad. That is the bad news. The good news is that the

same digital technology ('digitech') is opening a new pathway to prosperity for developing nations.

The impact of globotics is likely to be felt quite strongly in developed nations (Brynjolfsson and McAfee 2014, Baldwin 2019),[1] but it is the implications for development that truly loom transformational – increasingly it is services and not manufacturing that look to be the future of trade-led development.

There are three reasons for this.

- First, many of the reasons we previously considered manufacturing to be pro-development - tradability, scale, innovation and learning-by-doing — increasingly also define services (Ghani and O'Connell 2014, Schwarzer and Stephenson et al 2019).
- Second, a combination of vastly improved digitech and a pandemic driven quantum leap in remote work acceptance is making services easier to trade (OECD 2019).
- Third, other aspects of digital technology ('digitech') are changing the nature of manufacturing by replacing the 'manu' with robots, so that we now speak of 'robofacturing', (Gilchrist 2016).

Understanding the nature of this transformation is critical for officials, international organizations, and development professionals working to support developing countries to better position themselves to seize opportunities, improve livelihoods and avoid being left behind.

[1] This paper draws on previous work the authors have published; it is intended as a policy piece aimed at a broader audience rather than a free-standing piece of original research.

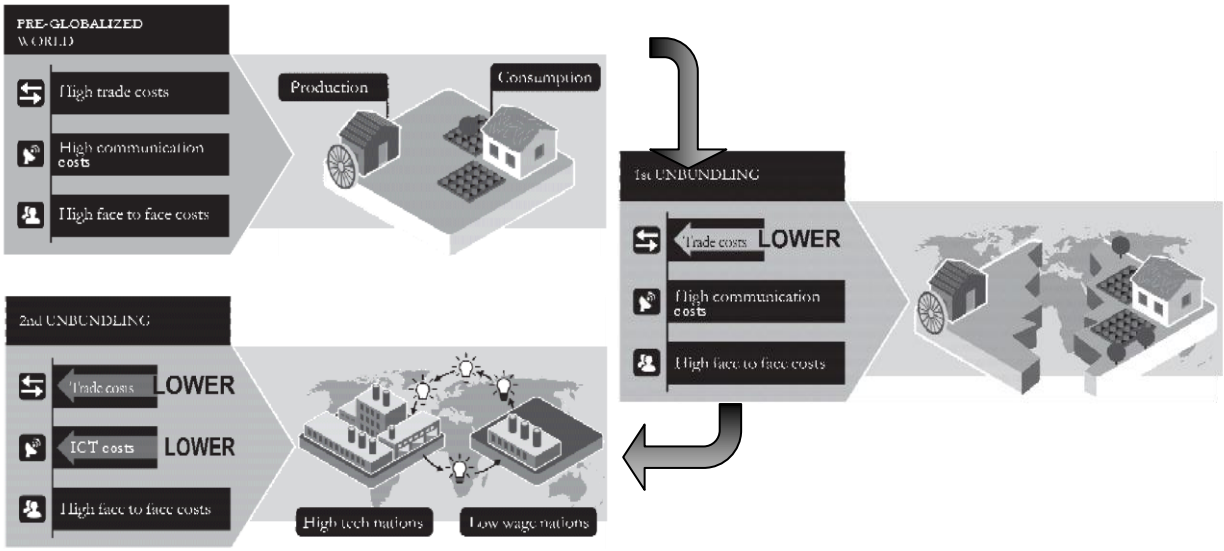
This paper will briefly outline the theoretical framework behind the intersection of globotics and development before making the case for why a China-style manufacturing development model will be supplanted in effectiveness by an India-style services export model in coming years. It will then explore the policy implications of the Indian-style model before finally offering some reflections on the role of the multilateral trading system in this future.

How and why globalisation changed: Globalisation as three great unbundlings

Globalization has undergone a radical transformation since its inception in the early 19th century. To grasp its intricacies and the driving forces behind it, the Three-Cascading-Constraints (3CC) model serves as a useful framework, as depicted in Figure 1. For further elucidation, refer to Baldwin's seminal works in 2006 and 2016.

In the days of horse-drawn carts and sailboats, technology was limited, thus restricting the flow of goods, ideas, and people. As a result, the majority of the global population's economic activity was confined to the village level (as depicted in the top panel).

Figure 1: Summary of the "three cascading constraints" view of globalization.



Source: Author's elaboration

The advent of steamships and railroads drastically reduced the cost of long-distance trade, paving the way for the first unbundling of globalization (depicted in the middle panel). Despite this development, the world remained far from flat, as communication and face-to-face costs continued to present constraints. As a result, manufacturing coalesced into factories and industrial districts, not to minimize trade costs, but rather to lower communication and face-to-face costs.

This microclustering led to a surge in innovation in industrialized nations, and such advancements were largely localized due to the prohibitive cost of disseminating ideas. As a result, the knowledge per worker ratio in the North grew at a much faster pace than in the South, ultimately causing the North-South income divide, famously known as the Great Divergence, which took place during the period of 1820 to 1990.

The bottom panel represents the second unbundling phase or the offshoring expansion phase, where remarkable advancements in information and communication technology (ICT) facilitated the organization of complex production processes even across international borders. Given the significant wage gap that emerged during the first unbundling phase, it became profitable for G7 firms to offshore some labour-intensive stages of production. To ensure seamless integration with onshore operations, these firms transferred their know-how along with the jobs. Thus, the flow of knowledge, previously confined to G7 factories, became a central player in globalization (represented by the light bulbs in the bottom panel).

This newfound ability to transmit information allowed a select few developing nations to rapidly industrialize, leading to the massive relocation of industry from the North to the South. This Southern industrialization, coupled with the commodity super-cycle it triggered, resulted in an unprecedented increase in emerging market income growth rates.

To paraphrase Martin Wolf's interpretation of the 3CC framework, the steam revolution allowed massive flows of goods across borders while the ICT revolution enabled the movement of factories and knowledge. Up until 1990, globalization was predominantly about the crossing of goods borders, however, it now encompasses both goods and knowledge. The Great Divergence was a result of the former, while the Great Convergence is attributed to the latter.

As Baldwin (2016) noted, "the three-cascading-constraints narrative plainly admits the possibility of a third unbundling, if face-to-face costs plunge in the way coordination costs." Indeed, we are currently witnessing the third unbundling phase, where cross-border trade in services is thriving, as Martin Wolf astutely observed, with offices now crossing borders, along with goods and factories.

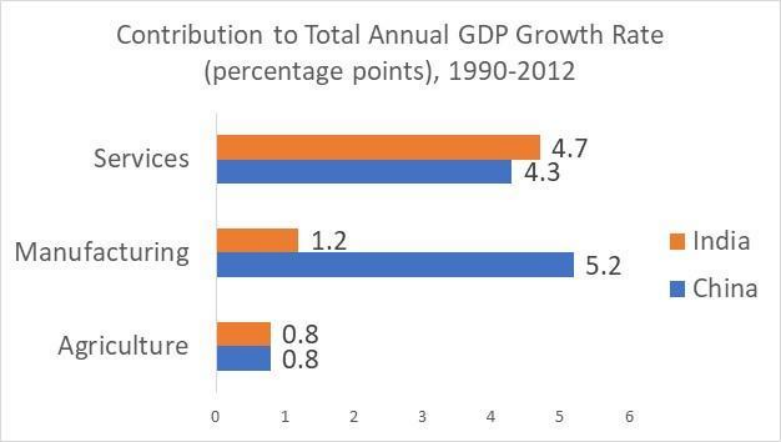
What the third unbundling means for development: Service-led vs Industry-led

Since the 1950s, development theory has emphasized the significance of industrialization for economic development. China represents a classic example of this trade-and-development paradigm. India, on the other hand, followed a different path in its development journey, with most policy and academic discussions centered around manufacturing. However, the actual developments in India were different, with the services sector driving growth, as noted by Basu (2018), who stated: "What India saw subsequently was a most unusual growth pattern for a developing country. It was not the manufacturing sector that led India's growth but the services sector."

Two charts provide a vivid comparison between China, which relied on manufacturing for its growth, and India, which relied on services. Figure 5 illustrates the sectoral contribution to

overall GDP growth, calculated for agriculture, manufacturing, and services. Although China's overall growth rate was higher, at 10.3%, compared to India's 6.7%, the chart clearly demonstrates that while manufacturing dominated growth in China, services were the driving sector in India's case.

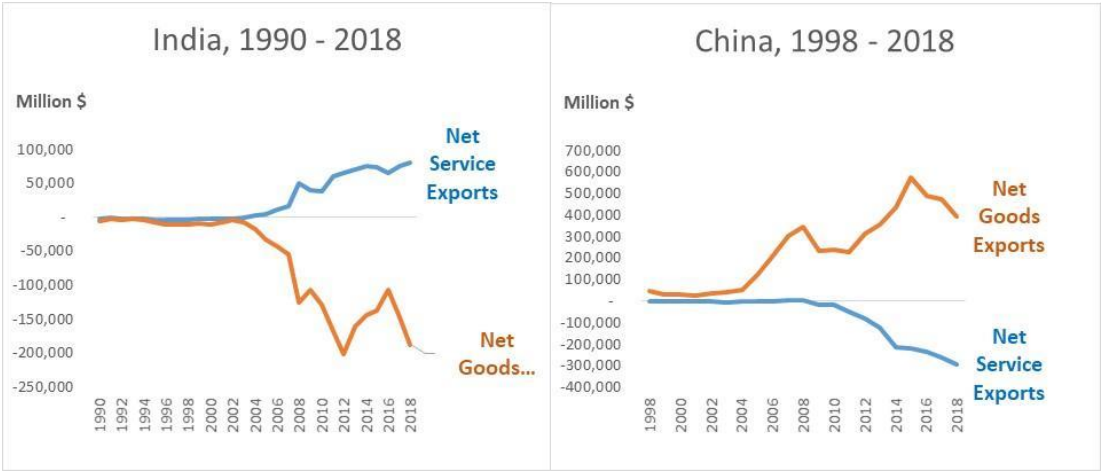
Figure 2: Contribution of different sectors to total GDP growth rate, 1990–2012



Source: Based on data from Ghani and O'Connor (2014)

The second chart, depicted in Figure 6, illustrates the evolution of net trade positions in goods and services for India and China. As neither nation is a significant commodity exporter, the majority of goods exported are manufactured goods. During the period of rapid growth starting around 1990, India became a significant net exporter of services and a net importer of goods, while the reverse was true for China. The positive balance of trade in goods for China indicates a comparative advantage in goods, while the negative balance in services suggests the opposite.

Figure 3: Evolution of net trade positions, India and China



Source: Elaboration by authors based on online World Bank Data.

Despite these contrasting macro-level differences, there are two intriguingly similar development stories underlying the data. This paper will begin by exploring China's development journey.

Increasingly Non-Viable? – The China Development Path

It is easy to understand why governments all over the world looked to the Chinese model of development as a template. That model, implemented throughout the late 20th and early 21st centuries, saw China lift hundreds of millions of its citizens out of poverty, establish a strong middle class and grow to superpower status. As significant percentages of its population moved from fields into factories, wages grew, livelihoods improved, and political stability reigned. That kind of example is hard to argue with. While the Chinese pathway is closing or closed for most developing nations, it is terribly difficult to entertain alternatives.

Moreover, the assumption that industrialisation is synonymous with economic development is so widely held that it is hard to get policy makers and analysts to even think about alternatives. The reason for this is that analysts simplify complex reality into mental models as a means of comprehending and making sense of the world around them, as Douglass North noted. The problem with such models, as Stephen Hawking said, is that: “When such a model is successful at explaining events, we tend to attribute to it, and to the elements and concepts that constitute it, the quality of reality or absolute truth.” This is the case with the manufacturing-led growth model, which has been adopted by many nations and is often considered an absolute truth.

But it is time to re-evaluate and stop viewing this model as an absolute truth. The Chinese development pathway, which was once a model for other developing nations, is becoming less accessible for two reasons: increased automation and increased competition.

Automation making manufactures more non-traded

Digitally-led automation is taking the jobs out of manufacturing, and this is undermining the Chinese model in two critical ways. First, it makes industrialisation a less attractive development pathway (Loungani et al. 2017, Hallward-Driemeier and Gaurav 2017). With few exceptions, industrialisation is no longer enabling transformations based on a big share of the population walking out of the fields and into factories because the vast demand for unqualified labour which drove that movement in the late 20th century no longer accompanies the opening of new factories.

Second, automation is lowering manufacturing's labour-cost share and thus lowering the incentive to produce manufactured goods far away. For example, Adidas moved some of its shoe manufacturing from Asia to Germany, but the new German factory uses robots to automate shoe production instead of having them made by hand in Asia. While German labour is more expensive, the near- shoring enables the shoes to be made more quickly and closer to its sales outlets.

Competition from the emerging market manufacturing 'winners'

International competition is another important factor. In a nutshell, it is hard for developing nations to get into manufacturing since East Asian, Central European, and Mexico manufactures are already so far ahead. They got ahead because the second unbundling changed the nature of comparative advantage. Industrial offshoring of labour-intensive stages to nearby developing nations transfigured industrial competition by allowing producers in

some developing nations to combine low wages with advanced technology. The resulting high-tech-low-wage combinations undermined the competitiveness of other developing nations who are competing the traditional way – with low-wages and low-tech. Dani Rodrik called this 'pre-mature industrialisation' but it was really just international competition – not unlike the industrial competition that allowed Victorian England to undermine existing industrial capacity in many nations in the 19th century. While a few emerging markets like Vietnam are continuing down this high-tech-low-wage path, the fact that distance is critical in this GVC offshoring means that only developing nations sufficiently near the world's high-tech manufacturing hubs: North America, the EU, and North East Asia have a chance. Faraway nations – say those in sub-Saharan Africa and South America – have little chance. There are just too many good alternatives that are closer to the hubs and in any case, the low hanging fruit in the offshoring phase has been picked. What's the evidence?

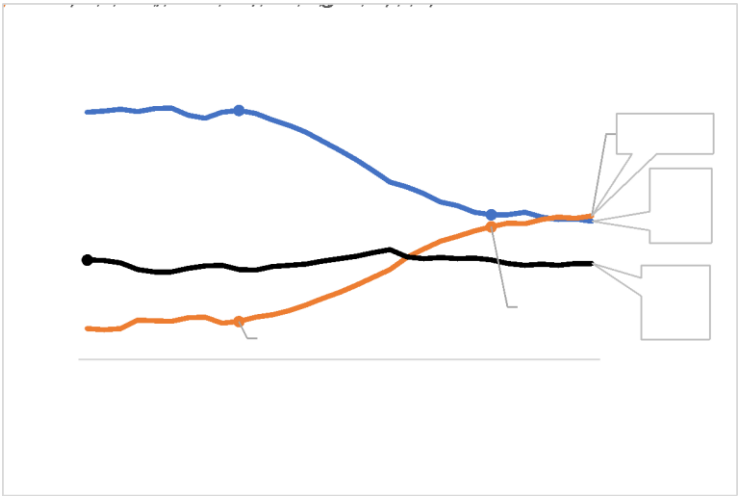
In the public debate on deglobalisation, a standard explanation is that global value chains (GVCs) have unwound and are unwinding (Antras 2021). Note that the terminology on this has not stabilised. The unwinding is also known as 'reshoring', 'shortening of global supply chains', 'friend-shoring', or 'near-shoring'. Moreover, GVCs are also known by the more descriptive label 'global supply chains' (GSCs), although authors differ on the exact definition of these terms. [2]

[2] For historical reasons, many authors limit the label 'global value chains' to trade which crosses borders at least twice. For example, the foreign inputs into my exports have crossed borders twice; once as a foreign part, and second as part of my export good. Global supply chains is often take as a more general term for any use of foreign inputs into domestic production (whether the production is sold locally or exported).

The offshoring expansion phase has ended

Reshoring manufacturing is comprised of two components. Firstly, the end of the offshoring expansion that increased trade in manufactured goods during the early stage of globalization's "second unbundling." Secondly, it is characterized by the simplification of global supply chains, both within and between nations. We can observe that the phase of offshoring expansion has come to an end.

Figure 4: High-income countries' share of world manufacturing GDP, 1997-2020, and ratio of world value added to gross output (%), 1995-2018
The offshoring-expansion phase has ended.



Source: Baldwin (2022) VoxEU.org used with permission. Data from https://stat.unido.org/database/National%20Accounts%20Database .

Figure 4 tracks the evolution of the G7's share in global manufacturing from 1990 to 2020. We observe a striking trend where the G7 nations, consisting of France, Germany, Italy, Britain, Japan, Canada, and the US, held a dominant two-thirds of the world's manufacturing sector until the end of the 1990s. However, a rapid decline occurred from the late 1990s to mid-2010s, with their share dropping from 66% to 38%.

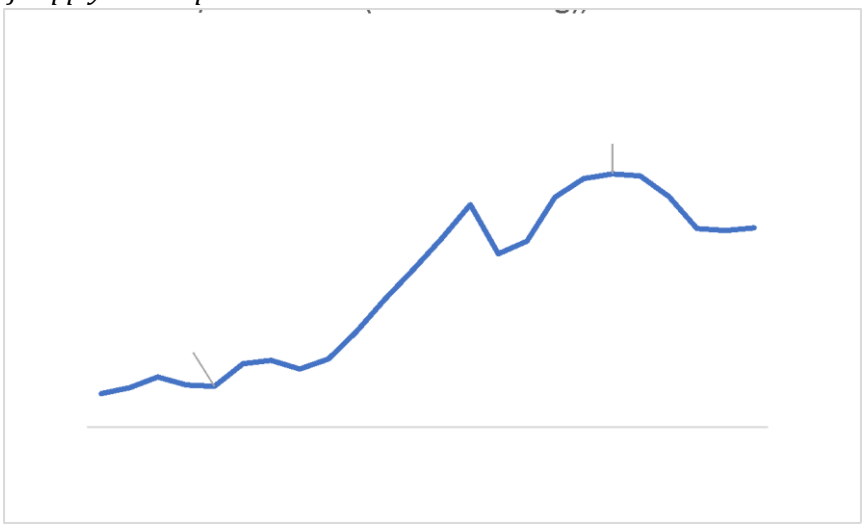
Recent developments suggest a plateauing, or at least a slowing of the decline, in the G7's share. On the other hand, the chart displays the figures for the I6, which consists of six

rapidly industrializing emerging economies - China, India, Korea, Indonesia, Thailand, and Brazil - that gained over 0.5% in their global manufacturing share between 1990 and 2020. It's noteworthy to mention that the I6's gain is a direct reflection of the G7's loss and that their rate of growth slowed significantly around mid-2010s.

The trends exhibited by both the G7 and I6 are aligned with the notion that the easiest opportunities for combining high-tech and low-wage labor in emerging market factories have been exhausted. The low-hanging fruit has been picked, so to speak.

Figure 5 presents an alternate form of evidence indicating the termination of the offshore-expansion phase. The chart displays the ratio of manufactured intermediate goods to total manufactured production, which serves as a metric for the extent of production fragmentation. To put it another way, a decrease in the ratio indicates a reduction in the length and complexity of supply chains. A comparable trend is observed in the share of manufactured intermediates in the total share of all manufacturing exports, implying that the unwinding of supply chains is occurring both domestically and globally. The cause of this phenomenon merits further investigation.

Figure 5: World ratio of value of intermediates to GDP in manufactures, 1995-2018.
The intensity of supply chains peaked in 2013.



Source: Baldwin (2022) used with permission. Data from
https://www.oecd.org/sti/ind/measuring-trade-in-value-added.htm

As it turns out, Information and Communication Technology (ICT) has a dual impact on the fractionalization of the manufacturing process. Certain aspects of ICT affect communication and organizational technologies, referred to as coordination technologies (CT). These technologies enhance the transmission of information, instructions, and ideas and reduce the cost of coordination. This results in a specialization of tasks and encourages fractionalization, leading to an increase in offshoring, foreign direct investment (FDI), and trade in parts and components.

On the flip side, ICT also facilitates the automation of processes, making it easier for workers to master a broader range of tasks through information technologies (IT). As IT essentially equates to automation, it reduces the cost of grouping multiple tasks into a single occupation, thus disfavoring specialization. This can be observed through advancements in factories that function as computer systems, where industrial robots, computerized machine tools, and guided vehicles serve as peripherals. The advent of additive manufacturing, or 3D printing,

represents the ultimate example where a single worker can perform all tasks through the operation of a single machine.

In short, coordination technologies and information technologies have conflicting impacts on fractionalization, with better CT favoring fractionalization and better IT discouraging it. The impact of ICT is complex, leading to either an increase or decrease in the number of tasks per occupation and the number of occupations per stage. During the 1990s and early 2000s, the coordination technologies dominated, resulting in the expansion of supply chains. However, since 2013, the evidence suggests that information technologies have gained the upper hand.

Looking forward there are also clear storm clouds on the horizon for goods trade, and thus the China development model. The international rules-based trading system and broad tolerance (if not necessarily enthusiastic acceptance) of the liberal consensus around the desirability of free, predictable trade is fracturing. Conflict between major powers, populist sentiment and concern about climate change is spurring moves and countermoves by regulators, tax authorities and national budget holders. The seas are growing rough for international investment and large waves make for cautious sailors inclined to hug friendly shores.

The India Development Path - From Delhi to Desktop

As the China pathway decreases in viability in part due to the rise of digitech, that rise is opening another by making remote workers less remote – a key point since remote workers are so much cheaper. Through more robust telecommunications, dedicated and constantly improving collaboration and co-working platforms, radically improved machine translation, and the much-hyped (but still dubiously practical) Metaverse, digitech has allowed the rise of internet platforms that do for international trade in services what eBay and Alibaba have done for international trade in goods.

The ability to browse, engage, task, remotely manage and securely pay services providers located in countries on the other side of the world with vastly lower costs of living (and thus labour), these are facilitating international price arbitrage in the service sector (in the form of service-sector offshoring). For the average person this is most visibly occurring in the Business-to-Consumer (B2C) sector by empowering a range of freelancers and SMEs abroad to sell services like graphical design, personal assistant work or transcription directly to clients. However, a potentially far more significant transformation is occurring within the business-to-business space and inside individual firms as they cut costs by purchasing their services abroad, and outsourcing or relocating their internal business processes overseas.

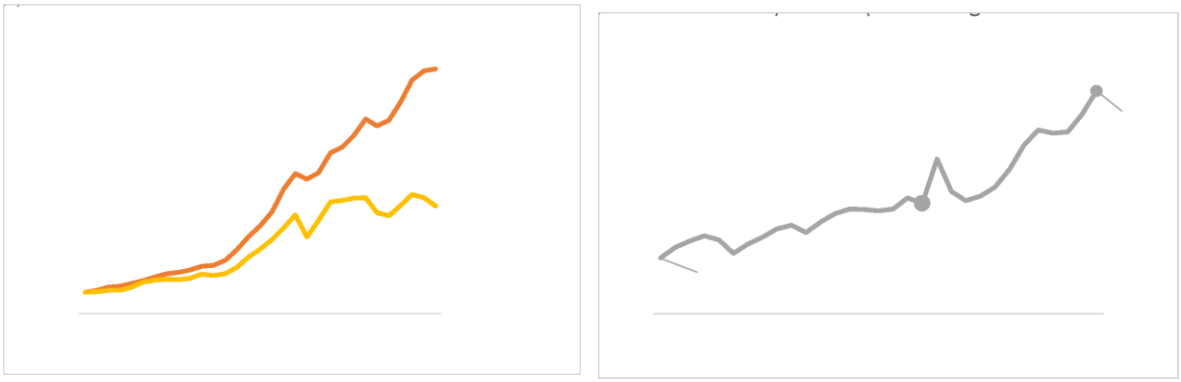
Though India is not unique in benefiting from this trend, the sheer scale of its global offering in areas like IT and accounting is symbolic of this approach. 2021 analysis found that on Freelancer.com, one of the largest global services contracting platforms in the world, a full quarter of those offering their services were based in India (Baldwin, Cardenas, and Fernandez, 2021). Factors including strong urban IT infrastructure, a robust higher education sector, the prevalence of English language skills, and the absence of anything like the Great Chinese Firewall all contributed.

Other commercial services (OCS) trade has grown much faster than goods trade

The focus on OCS (Offshored Commercial Services) trade is significant as it primarily consists of activities similar to trade in goods, where goods are produced in one economy and sold to another (referred to as Mode 1 trade). As depicted in Figure 4, global OCS flows have grown at a faster rate than trade in goods for several decades, with the gap between the two becoming more pronounced after the 2008-09 global financial crisis. While trade in goods has shown some recovery since 2010, it has remained stagnant overall. By contrast, OCS

have continued to grow rapidly. Between 1990 and 2020, goods expanded 5 times while OCS multiplied by 11 times.

Figure 6: Trade in 'other commercial services' (OCS) has growth twice as fast as goods trade since 1990, and now constitutes 20% of all international commerce



Source: Author's calculations based on WTO (trade data).
Note: The series here are not as a share of GDP, the are values indexed to 1990 = 100 to stress the trends.

The right panel of Figure 4 demonstrates the transformation in the significance of services in international trade. In 1990, OCS represented a mere 9% of total trade in goods and services, however, by 2020, this figure had increased three-fold, with no indications of slowing down.

Role of policy

Perhaps most curious about the meteoric rise of India as an exporter of services is that it occurred, if not precisely in spite of Indian Government policy, then certainly against the backdrop of policies focused strongly in other directions.

India gained its independence from British imperialism in 1947 and implemented a development strategy based on classic 1950s principles. Through significant state intervention alongside an explicit anti-trade regime, it sought to drive development via rapid industrialization. A central planning body guided by Soviet-style five-year plans focused massive resources on the creation and expansion of large industrial state-owned enterprises.

This led to inefficiencies of the type characteristic of centrally planned systems, but with Indian attributes.

To take just one example, consider the Haldia fertilizer plant (Das 2000). Established in the 1970s, it employed around 1,500 workers and hailed as a success of the strategy. Staff were diligent, showed up to work, and aptly maintained the facilities. Many were housed in a nearby newly built township that had excellent roads, schools, and homes. There was just one issue however. Due to a range of problems the plant failed to produce a single ounce of fertilizer for 21 years.

State-owned enterprises, however, were not the only problem. To keep private firms aligned with the plan, firms need a government license to expand, produce new goods, change the input combination, import inputs or move production plants. On top of this heavy-handed intervention, hiring manufacturing workers was (and still is) a risky business in India given its extreme employment protection laws, which, even today, are stricter than those of many Southern European nations. The result was widespread shortages, delays, and bottlenecks resulting in Indians having to wait eight years to buy a scooter, for example.

When in the 1980s and beyond India liberalized (somewhat), and increased its openness to outside investment and trade, its growth accelerated considerably, making the country one of the success stories of the 21st century. At first glance this would seem to vindicate an industrialization strategy, suggesting that it was India's specific implementation of it and not the underlying approach itself that was the problem - as evidenced by the rapid growth which coincided with a changed approach. Except that's not what happened. In a rapidly growing India, it was services that led the way (Murthy 2005; Nayyar 2012; Basu 2015).

For a range of cultural and economic reasons, the Indian education sector historically favored high-quality universities focused on science, technology, and engineering disciplines. This

led to a surplus of highly qualified and talented technology workers which might otherwise have fostered an advanced manufacturing base like those in Switzerland or Germany. However, a combination of policy restrictions, lack of access to capital, poor transportation infrastructure and distance to global manufacturing hubs in the US, Germany, Japan and China decreased both foreign competition and domestic manufacturing innovation. The global value chains driving industrial development since the 1980s flowed around, not through India.

Services, by contrast, was largely unaffected by the constraints holding back manufacturing. The service sector, especially in IT services, was untouched by transportation issues, faced no explicit import or export barriers and remained largely untaxed. Further, the Indian market was not large enough to allow IT firms to pursue a purely domestic strategy, forcing them to compete globally and thus refine their offerings. This, combined with what Basu (2015) calls 'India's over-production of engineers throughout the 1960s, 1970s, and 1980s' meant that India was well placed to meet a growing, Silicon Valley spurred, demand for tech workers precisely at a time when countries like the US were underproducing engineers. Empowered by relatively higher Indian spending on higher education (see Weiner 1991), India produced top-tier IT professionals, receiving over 50% of US non-immigrant work visas requiring specialized skills.

As early as the early 2000's, the outcome was plain to see. India had emerged as a prime location for IT and knowledge-based jobs that were offshored from advanced economies, and Western firms were shifting their research and development activities to the country in order to reduce costs and avoid talent shortages. India was becoming host to outsourced call centers and many so-called business process outsourcing (BPO) activities, including many back-office jobs like medical billing, business administration, and labor-intensive insurance-related

services. Beyond simply outsourcing, India began to produce its own world-beating multinationals like Infosys, HCL, and Wipro, which remain success stories to this day.

Likely environmental-sustainable impact

The offshoring of office jobs from rich nations to emerging economies is likely to have a profound impact on the triad of carbon emissions, international trade, and global growth.

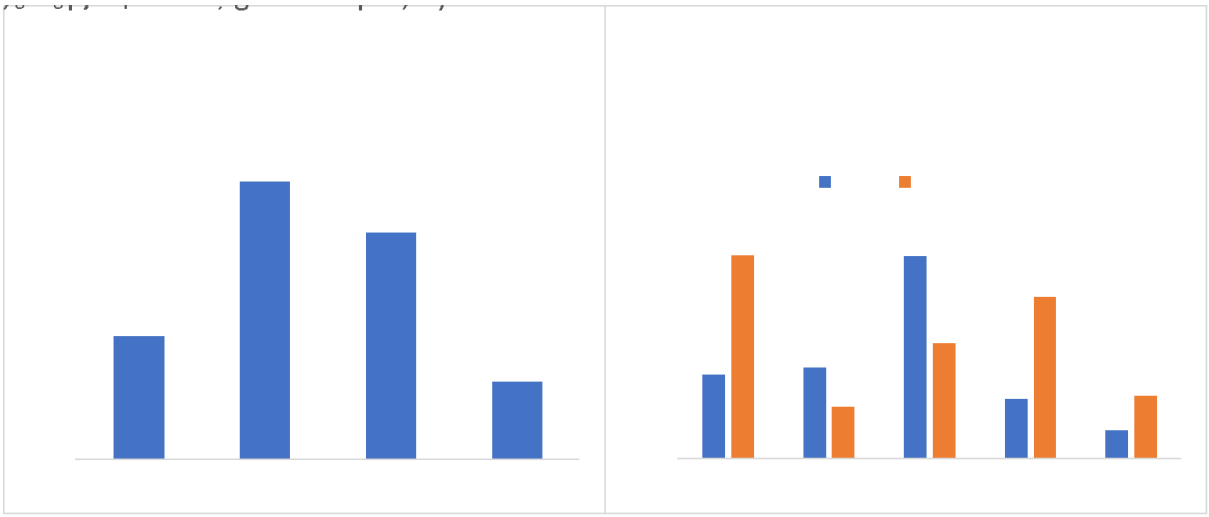
The starting point is the realisation that trade is what happens when things are made in one nation and sold in another. Deeper globalisation, which means more thorough arbitrage, has its big effects by changing the international location of production. Bringing the abstraction to the case at hand, this means that boom trade in intermediate services will change where those services are produced. Most likely, more will be produced in emerging economies and less in advanced economies.

The second point of departure concerns the carbon vertex of the triad. Here the linchpin fact is that all economic activity produces CO2, but the carbon intensity varies radically across sectors and across economies, as Figure 7 shows. If trade shifts the production pattern within a nation, it will shift the economy's average carbon intensity. The left chart shows that for the whole world, manufacturing is about three times as carbon intensive as services, so a globalisation trend that shifts workers and economies away from manufacturing and toward services will – other things equal – reduce the carbon emissions per dollar of output produced. That's the good news.

The less good news is the emerging economies (Non-OECD in the chart) are more carbon intensive than OECD nations in most sectors – with agriculture and mining being the exceptions. This can be seen in the right-hand chart. Thus a trend in globalisation that shifts service activity from OECD nations to non-OECD nation will – other things equal – increase

the world's carbon intensity. The point is that the OECD average CO2 intensity in the service sector is 44 tonnes per million dollars, while in non-OECD nations it is 96.

Figure 7: Carbon intensity (tonnes per $million of gross output), 2018, by sector and OECD vs Non-OECD



Source: Carbon dioxide emissions embodied in international trade dataset (2021 ed.), OECD.stat.org

The last vertex to check in the carbon-trade-growth triad is the growth corner. Offshoring office jobs to emerging economies is likely to boost global growth overall, but especially that of the emerging economies that receive the offshored jobs. They will benefit from the investment and job creation that comes with the offshoring of office jobs, while industrialized countries will benefit from the lower costs associated with outsourcing.

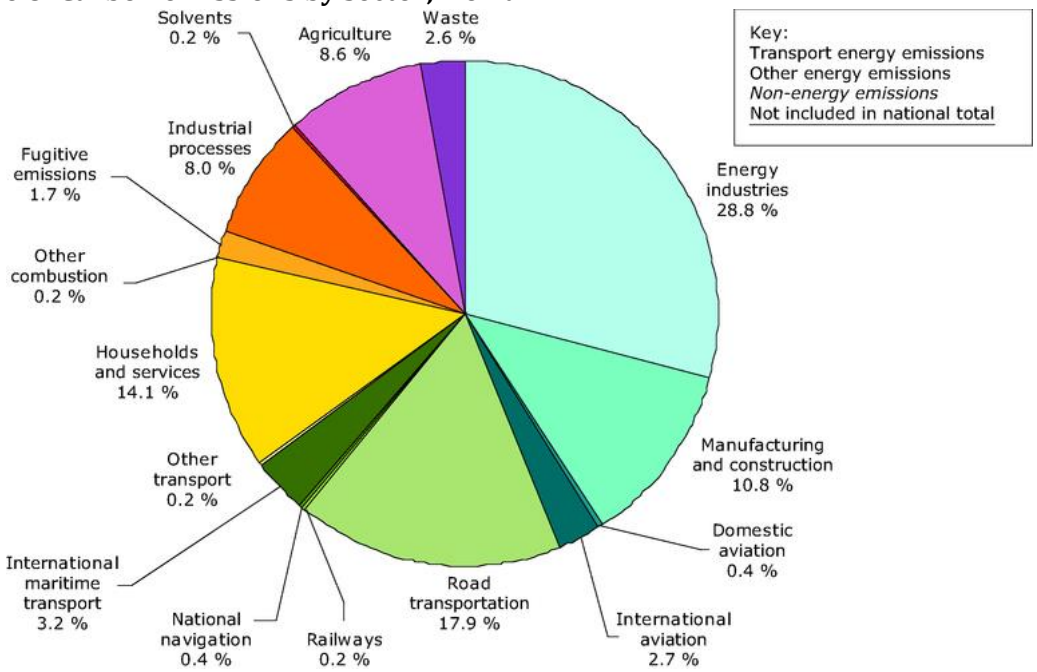
Here the sticking point is that non-OECD nations have a much higher carbon intensity than OECD nations. This can be seen in the first pair of columns in the right chart. Thus, a change in globalisation that stimulates growth in non-OECD nations will increase emissions even more than would an increase in OECD growth. This is the inherent tension in the three aspects of sustainability. Equalising world income inequalities by raising growth rates in poor nations will harm the environmental aspect of sustainability– if carbon intensities remain fixed. Since the new Bangalore-like growth that is likely to be driven by telemigration will

appear first for urban-based, middle income workers in middle income nations, the growth is likely to strain social sustainability within nations.

The same is clearly also true in OECD nations as the arguments in Baldwin (2019) make clear. Service-sector and professional workers have never faced automation or globalisation on this scale and they may well push back just as manufacturing workers did since 1990. In short, this new growth will not be evenly distributed, and some regions and communities may be left behind. But it will mean that the emerging market miracle will continue and spread geographically which will reduce income inequality across nations.

To summarise, the offshoring of office jobs to emerging economies will have a significant impact on the interplay between global carbon emissions, international trade, and worldwide growth. Although there will be advantages to be had, there will also be challenges, and it will be crucial for policy-makers to weigh these impacts carefully as they shape the future of the global economy.

Figure 8: Carbon emissions by sector, world



Source: data from https://www.eea.europa.eu/data-and-maps/figures/total-greenhouse-gas-emissions-by-sector-in-eu-1/ener01_fig2_v1.xls/at_download/file

The last point to cover is the nexus between physical transportation, carbon emissions, and the sectoral composition of trade. The headline facts here are displayed in Figure 8. Carbon's largest sources are the energy, road transportation, and industrial sectors. In terms of transportation, international shipping and aviation account for about 3% of global emissions each. Agriculture contributes significantly to global carbon emissions, primarily through the release of methane and nitrous oxide, potent greenhouse gases, during livestock digestion and fertilizer application. In addition, deforestation for agricultural expansion and the use of fossil fuels for farming activities also contribute to the sector's carbon footprint.

Mining is another major supplier of emissions, with the extraction and processing of coal, oil, and gas being some of most important emission sources. Heating and lighting also play a role, with the majority of the world's energy for heating and lighting being generated from fossil fuels, leading to significant carbon emissions. Lastly, industry is a major contributor to global carbon emissions, with manufacturing and construction processes emitting large

amounts of greenhouse gases. Fossil fuels used in industrial processes, in particular the production of cement and the generation of heat and power, are key emission springs.

As trade shifts to more local production of manufacturing and more trade in services, few goods will be shipped internationally and thus the contribution of international transportation to climate change will drop – other things equal. But while this is a popular and obvious implication, it is not empirically very important since international transportation constitutes only a narrow share of emissions, as Figure 8 shows . International maritime transportation accounts for about 3% of total emissions. In modest shifts in production across nations will have vastly larger effects given the very large difference in carbon intensity that are documented in Figure 7.

The Policymaker Question - How to be of Services?

The implications of the above for policymakers may initially seem grim. The Chinese development model is increasingly non-viable as digitech, competition and a changing world render marginal its role as a source of jobs in the economy and threaten its stability. At the same time, the Indian model appears to have evolved almost by historical accident as its over-abundance of technical professionals found themselves unable to perform the manufacturing work envisioned for them but in the right place to take advantage of a global boom in demand for their skills in services. Yet there are still clearly lessons to be learned from the Indian experience, as well as that of other states like the Philippines that are successfully riding the globotics wave in services.

The surplus of Indian engineers and tech workers which powered its supremacy in IT outsourcing was fortuitous, but also driven by consistently strong investment in higher education. While India may not have deliberately set out to create an exportable base of

highly skilled service professionals, that was the end result and it's something other governments can emulate. Whereas lower-skilled manufacturing jobs outsourced in the past required primary and secondary education, the services exports of today and tomorrow often require tertiary qualifications. Investments to strengthen the availability of high quality training, and to provide incentives for more learners to take them up could pay dividends.

The Philippines also offers some potential lessons, as their rise as a services exporting hub was at least partially driven by a deliberate government strategy, including an IT-BPM Roadmap 2022. The government there built on the strong local customer-service culture by providing tax incentives to service exporting businesses and establishing special economic zones to encourage their proliferation.

Having built a solid start with call center operations, they then identified policy barriers to moving up the services value chain and into Business Process Operations (BPO) and addressed them through two key laws: the Data Privacy Act of 2012, which established penalties for unauthorized use or disclosure of personal information, and the Cybercrime Prevention Act of 2012, which set up a legal framework to identify, prevent and punish cybercrime. Much as an investment protection regime and predictable legal system are central to attracting FDI into the manufacturing sector, so too will frameworks that give foreign clients the comfort that their data will remain secure become key points of differentiation among the potential services export hubs of the future.

As in India, education plays a key role in Filipino competitiveness in the services export and BPO space. For example, their Service Management Program offers specialized courses for students of business administration, management, or IT, with the goal of placing them in entry-level IT-BPO positions. The program also includes a 'train the teachers' initiative, teaching IT-BPO subjects to the industry's standards, which has spread to 17 higher

education institutions and counting. While programs of this sort require careful planning, stakeholder input and resources to implement, policymakers should consider that most could be run for decades on a fraction of the funding required to upgrade a single port facility or bridge to facilitate goods trade.

Beyond education the Philippines model offers replicable policy examples such as strengthening human capital through industry public-private partnerships, actively advocating for foreign investment into the sector, and building up the brand reputation of select services exports through targeted marketing programs.

Beyond the examples of India and the Philippines, there is a broader argument to be made for the reconceptualization by governments of the 'units' which will drive development - to stop thinking about factories and start thinking about cities.

Cities in the words Enrico Moretti have become the 'brain hubs' (Moretti 2013) where people meet, exchange ideas, and where their ideas compete and evolve. They are where service workers and service firms find one another, Cities facilitate matching between service workers and service firms - implicitly benefiting from each other's knowledge creation via face-to-face interaction and social networking. Cities should not be thought of as simply amalgamations of people, but as complex workspaces that generate ideas, innovation and competitiveness (Bas ter Weel et a. 2010). Fostering attractive, vibrant and energetic cities will attract high-quality jobs and lock them in with agglomeration forces.

The Rules Based Trading System

Much as development theory focused on industrialization throughout much of the 20th and early 21st centuries, so too did the international rules based trading system fixate overwhelmingly on trade in goods. This is understandable. Until very recent history, the list

of services which could be delivered remotely was limited. The majority of services trade was therefore occurring either through tourism, commercial presence or temporary entry. Of these, the first and second were generally considered desirable and the last was so heavily restricted and controversial that international trade policy generally looked elsewhere for potential liberalization.

To an extent, services trade benefited from this benign neglect. When the General Agreement on Trade in Services (GATS) was negotiated ahead of its 1994/5 inclusion in the core WTO Agreements, the seeming impossibility of delivering (or conversely regulating to prevent the delivery of) the vast majority of services remotely lead many governments to include sweeping commitments on so called ‘mode 1’ or remotely delivered services. Like scheduling full market access in unicorn horns and dragon’s teeth, this was likely viewed by policymakers at the time as a way of making their offer appear broader and more generous without any commercial implications.

More recently, trade in services has regained some prominence in the international trading system - though still remaining firmly in the shadow of disputes around steel, agricultural subsidies and electric vehicles.

A 2011 decision granting WTO members the ability to provide preferential market access in services to Least Developed Countries (LDCs) went unused for half a decade until 5 February 2015 when over 25 developed and developing countries indicated sectors and modes of supply where they intended to provide preferential treatment to LDC services and service suppliers - a number that has since grown to 50. This so-called ‘LDC Services Waiver’ was extended until 2030 at the Nairobi WTO Ministerial.

A 1998 decision by Members to agree a moratorium on applying tariffs to ‘electronic transmissions’ became the focus of heated discussions at the 2022 WTO Ministerial

Conference as the required unanimity to extend it looked uncertain. The lapsing of this moratorium would have (theoretically) allowed the application of import duties on everything from a song purchased on the Apple iStore to individual emails received in a professional context. The ultimate decision to extend this waiver until the 13th WTO Ministerial Conference (or March 2024, whichever comes first) drew signs of relief from the business community which maintained that any attempt to actually implement such tariffs would be largely futile but involve massive compliance and administration costs.

Plurilaterally, a group of 50 countries (including the then-28 member European Union) spent several years in negotiations on a comprehensive new Trade in Services Agreement (TiSA). This would have included a range of individual commitments on market access and national treatment as well as horizontal obligations around the transparency, predictability and reasonableness of services regulation and licensing. This agreement ultimately failed to conclude due and negotiations were frozen at the end of 2016 in the face of a hostile incoming Trump administration and strong transatlantic disagreements on the privacy and data flows provisions.

More recently, some of the horizontal elements of the TiSA were harvested by a subsection of the membership into a plurilateral agreement titled 'The Joint Initiative on Services Domestic Regulation' which was concluded at the end of 2022. To date some 70 WTO members have signed on to its provisions.

While none of the above is meaningless, it seems reasonable to say that international rules have played a muted role in the growth of globotics driven services exports to date. India, whose remarkable experience this paper has already discussed, achieved much of its impressive growth while being intensely sceptical of the international trading system and trade agreements more generally. The Philippines too, achieved its services growth largely

without signing free trade agreements and it's certainly difficult to point to anything plausibly catalytic for services trade expansion in any of the few deals it did sign.

So what then is the link between this coming globotics derived development model, the international rules based trading system, and trade policy more generally?

Scenario 1: Stay out of the Way

Beginning from the premise that a shift to a more services-led development path is being driven by factors independent of international trade rules, and without significant new protections, there is an argument that the best thing the multilateral system can do is nothing. This position argues that the existing GATS commitments are sufficient legal cover and that greater scrutiny from governments, even in the context of trying to help by creating supportive rules, may do more harm than good.

Much of the growth in services exports is occurring in the intermediate services sector which is inherently difficult to regulate or restrict market access in, but not impossible. Certainly governments have historically been better able to regulate the end point of services delivery than the intermediate steps (for example, requiring that a lawyer be qualified and locally bar certified in order to present legal arguments, but leaving the process of preparing their remarks or undertaking the legal research that informs them unregulated).

An outlook that is optimistic about the prospects of services-led development but pessimistic about international rules-based lawmaking might therefore conclude that the existing system is adequate, and any attempt to change it in lieu of this trend is only likely to focus the attention of governments which may respond by regulating these currently open spaces in trade restrictive ways.

Scenario 2: Build Levees Before the Flood

Much of the rules based system can be thought of as preventative - a set of mutually agreed commitments whereby governments swear off policy approaches they know may prove tempting down the line. Establishing such commitments is, naturally, easier at times when major powers aren't already inclined toward implementing such policies. The inclusion of significant remote delivery (Mode 1) commitments in the GATS and the agreement of the 'E-Commerce Moratorium' can both be partially attributed to their timing - no one at the time was seriously contemplating the policies these agreements made illegal.

To-date the shift toward digitally enabled services exports has occurred in loosely regulated intermediate services or liberalized sectors, but there is no guarantee intermediate services will remain unregulated if there is a backlash among G7 nations about previously sheltered jobs heading overseas. While it is unlikely governments will be able to prevent a small business owner having their logo designed by an artist in Ukraine they found via Freelancer, Upwork or Fiverr, the regulatory toolkit is not entirely empty. Restrictions on data flows and privacy, more restrictive conditions on the hiring of freelancers and other measures could throw spanners into the machinery of business process outsourcing.

Such moves would likely do more harm than good by hurting the competitiveness of local firms in an ultimately futile rearguard action to protect jobs in previously sheltered industries. However, as history has shown time and again, neither the aggregate harm nor the ultimate futility of a protectionist measure are guarantees that it won't be contemplated or even implemented.

Therefore, assuming an optimistic outlook on the ability of the rules based trading system to reach consensus (multilaterally or among a dominant subsect of members) and a pessimistic view of potential government reactions to the services-led development phenomenon, an

argument can be made for a robust attempt to negotiate new rules now - before significant interest in restrictions manifests.

Scenario 3: The System, Not the Rules

Perhaps the most realistic scenario assumes that securing the benefits of a transition toward a services-exports led development model could use a helping hand from the international trading system, but that the system can contribute in ways other than the adoption (or more likely, the negotiation and failure to reach multilateral consensus on) new binding trade rules.

The trading system, and the WTO at its heart, can play an important role in a number of ways beyond rulemaking. The services transition can benefit from robust policy support domestically, and the system can play an important role in highlighting the needs, sharing best practices and encouraging regional coordination. For policymakers who have spent decades pursuing industrial growth strategies, fomenting services exports will be an entirely new field - and one they'll have to learn quickly. The system can help in this regard.

Inevitably, frictions and disagreements will arise between trading partners as their regulators and legislators navigate these new waters. The WTO through its regular committee structures and established dispute procedures can help de fuse tensions and provide alternatives to conflict escalation.

Finally, the international development community itself looks to the WTO for leadership on 'aid for trade' through the work of the aid for trade committee, the Aid for Trade Global Reviews and the work of the development division. Just as policymakers will be looking for answers on how to support this transition, so too will the international development community need guidance and best-practice sharing on how it can be of greatest and most efficient assistance. The WTO could assume a leadership and coordinating role in the aid for

trade space around these issues as well as redirecting the work of its in-house development facilities such as the Enhanced Integrated Framework.

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