

IN HONOUR OF KANCHAN CHOPRA, 2026 RECIPIENT OF THE INSEE LIFETIME
ACHIEVEMENT AWARD

TRADE, AID, AND PLAGUE

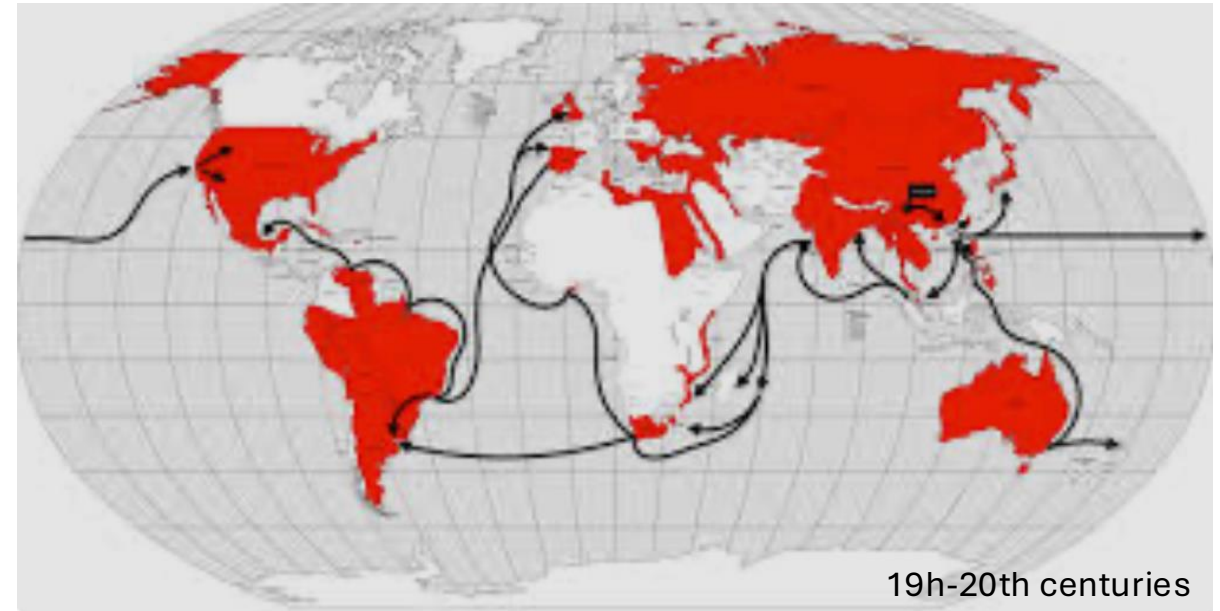
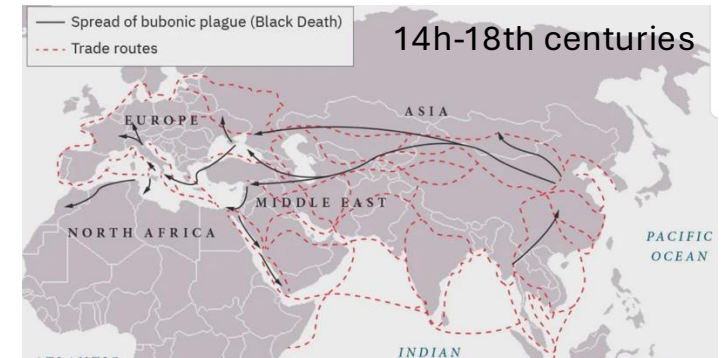
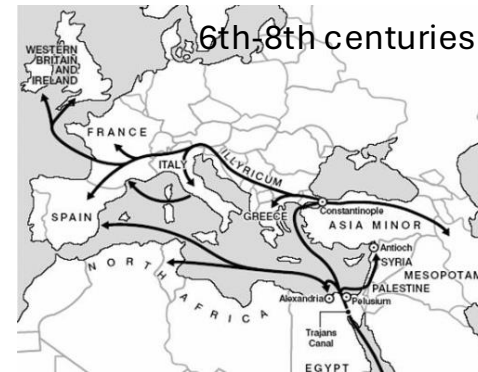
THE CHANGING WORLD ORDER AND EMERGING INFECTIOUS DISEASE RISKS

CHARLES PERRINGS

August 5th, 2026

Trade and plague

- The characteristics of plague
 - Disease agent: *Yersinia pestis*
 - Wild reservoirs: mostly rodents
 - Disease vectors: fleas
- The three plague pandemics
 - The Justinian plague: 6th-8th centuries
 - The Black Death: 14th-18th centuries
 - The Third plague: 19th-20th centuries
- In all cases the geographical spread involved major trade routes

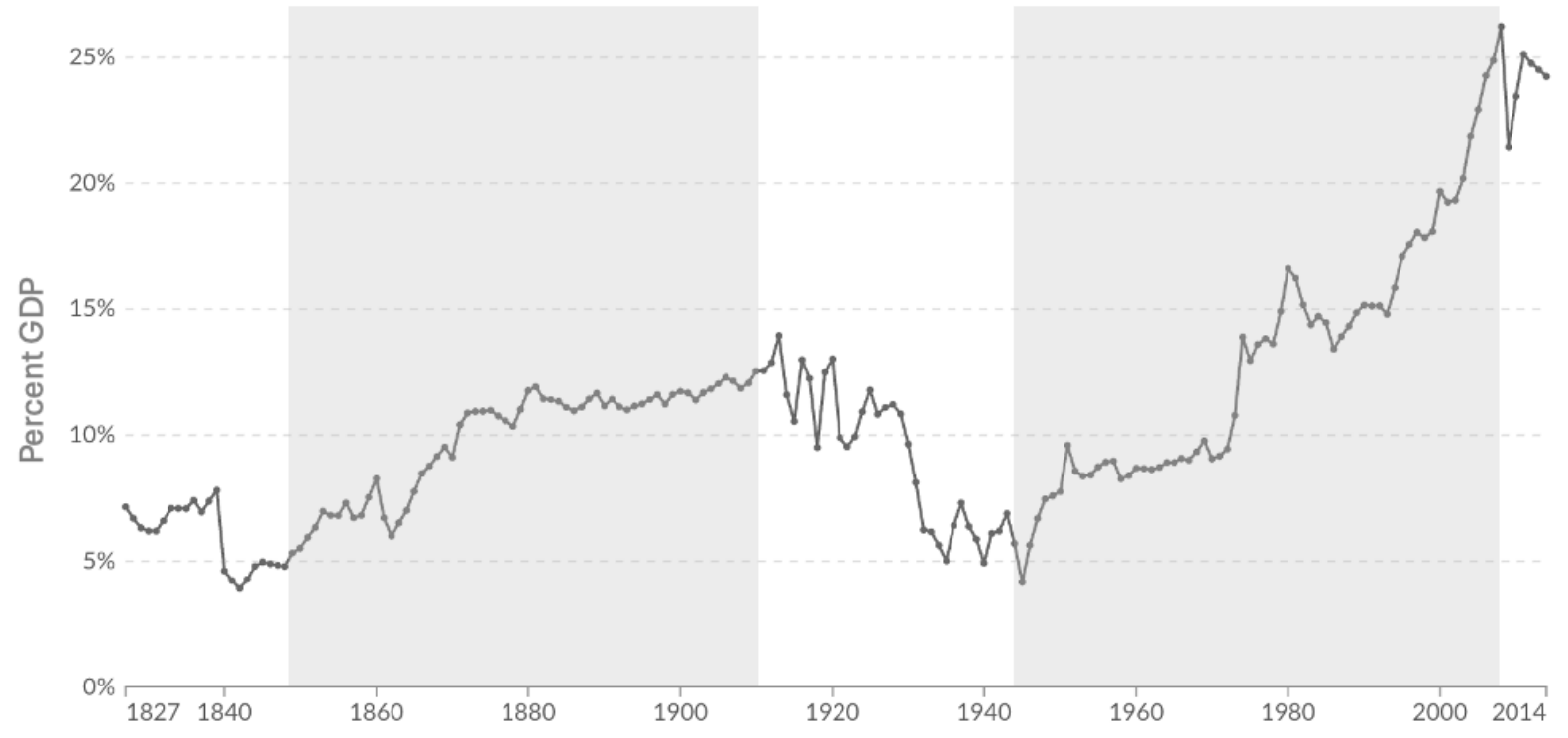


A Road Map

- The long history of trade and infectious disease
- Globalization since the mid-nineteenth century
 - the post war international order
 - the rise and fall of the WTO
 - tariff and non-tariff barriers
- Factors in the emergence and geographical spread of zoonotic diseases
 - novel zoonotic diseases emerging during the second wave
 - drivers of the geographical spread of infectious diseases
 - effective distance
- Disease surveillance and control in a globalizing world
 - development assistance for health
 - policy changes since 2008
 - impacts on surveillance capability, health spending and poverty
- Conclusions

Waves of globalization

- Since the mid-19th century there have been two waves of global integration
- During each wave national economies became more open
- After each wave international cooperation declined



The value of exported goods as a percentage of global GDP, 1827-2014.

Source: Esteban Ortiz-Ospina, Diana Beltekian, and Max Roser, Trade and Globalization, <https://ourworldindata.org/trade-and-globalization>.

The post war international order

- Designed to assure peace, security, and economic stability in the absence of any supranational authority
- International treaties: Charter of the United Nations (1945), General Agreement on Tariffs and Trade (1947)
- Intergovernmental bodies: the UN, the World Bank, the IMF
- UN aimed to avoid another world war and assure collective security
- WB and IMF aimed to support reconstruction and economic stability by managing economic integration and growth



Evolution of the post war international order

- UN—became less focused on avoiding conflict, more focused on the regulation of other aspects of the global commons
- WB and IMF—moved from reconstruction in Europe to poverty alleviation worldwide, market liberalization, and provision of global public goods
- GATT—successive rounds of multilateral negotiations (Geneva 1947, Annecy 1949, Torquay 1950–1951, Geneva 1955–1956, Dillon 1960–1961, Kennedy 1964–1967, Tokyo 1973–1979, Uruguay 1986–1994) expanded issues beyond tariff reductions and increased the number of participant countries, culminating in the formation of the WTO in 1994

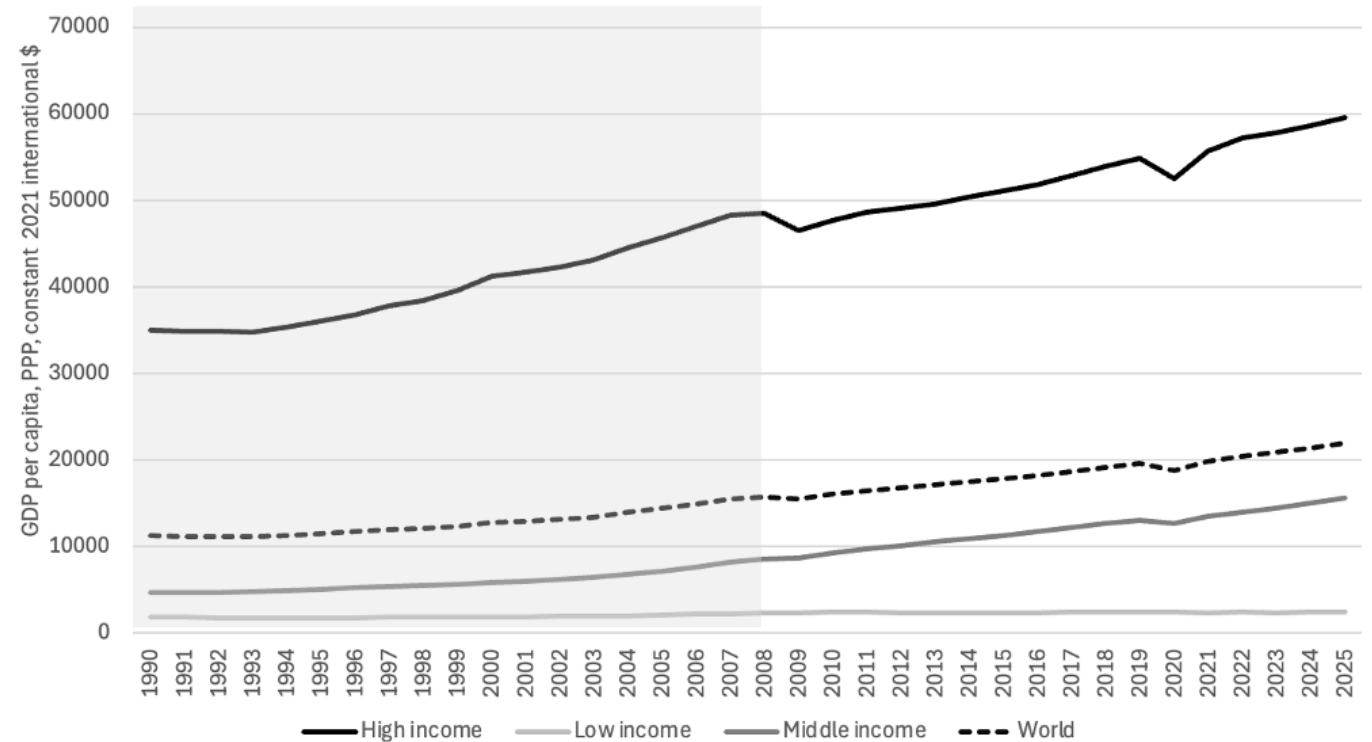
Evolution of the post war international order

- By 1994 the set of global public goods provided by the intergovernmental bodies had expanded beyond collective security and economic stability to include health and the environment
- Major international agreements included
 - United Nations Framework Convention on Climate Change (1992)
 - Convention on Biological Diversity (1992)
 - United Nations Convention to Combat Desertification (1994)



Benefits of the international order

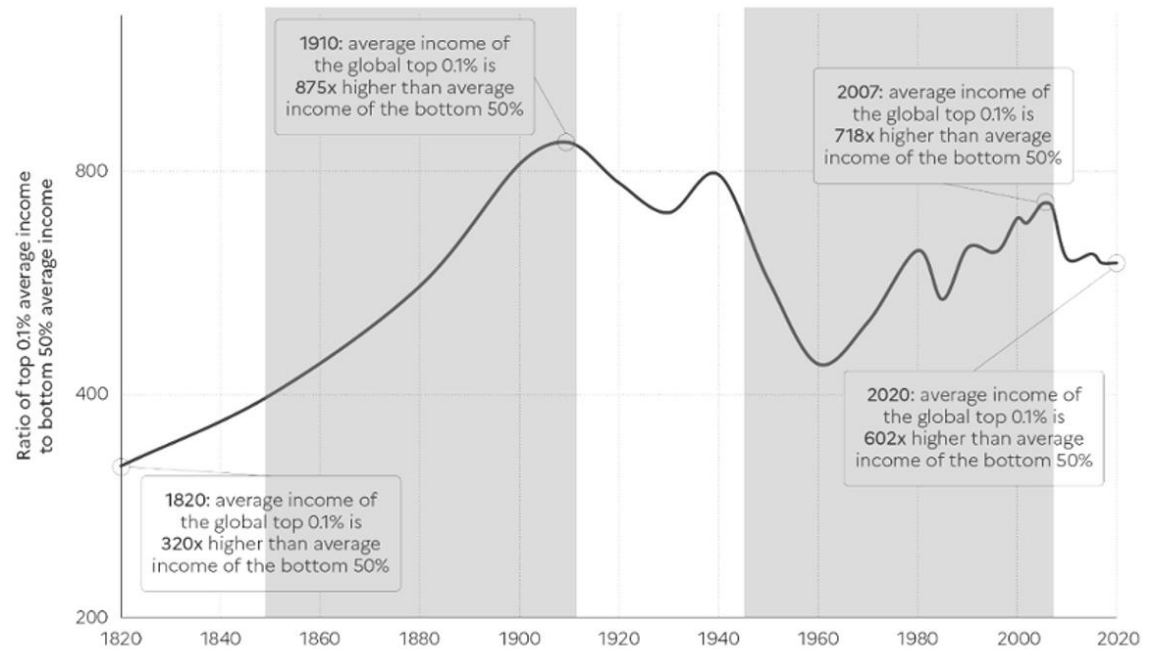
- Peace between major powers
- Collective security via NATO. and the United Nations
- Decolonization
- Trade liberalization price effects
- Economic growth and stability
- Poverty reduction
- International dispute resolution



World Bank. 2025. GDP per capita, PPP (constant 2021 international \$)
World Bank, Washington DC

Costs of the international order

- Loss of sovereignty
- Proxy wars and military interventions
- Economic control via World Bank, IMF
- Increasing income and wealth inequality
- Commodity dependence, price vulnerability, and low diversification
- Environmental impacts including natural resource depletion, biodiversity loss, climate change
- The emergence and geographic spread of infectious disease



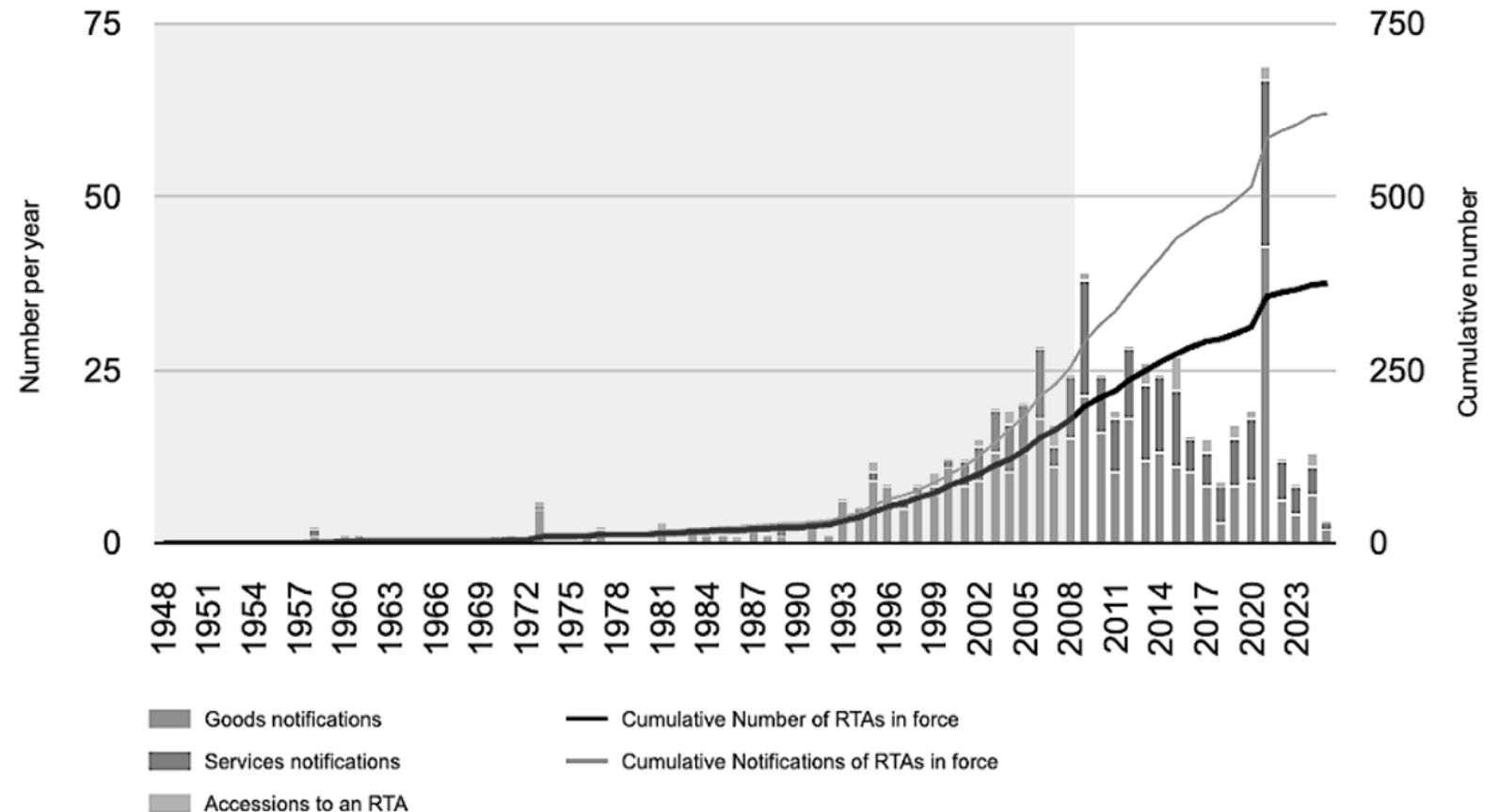
Source: (Chancel et al. 2022)

The unravelling of the post war international order

- The 2008-2009 recession marks the end of trade growth above GDP growth
- It also marks a sharp acceleration in the rate at which the post war international order unravels
- The WTO multilateral Doha negotiations collapsed in July 2008 when India and the USA failed to agree on a special safeguard mechanism in agriculture that would allow LICs and MICs to raise import duties on agricultural products if imports surged

The growth of preferential trade agreements

- The Uruguay Round was the last multilateral negotiation to be concluded.
- Countries had already been moving away from a whole world approach and towards negotiation of preferential trade agreements between a few countries

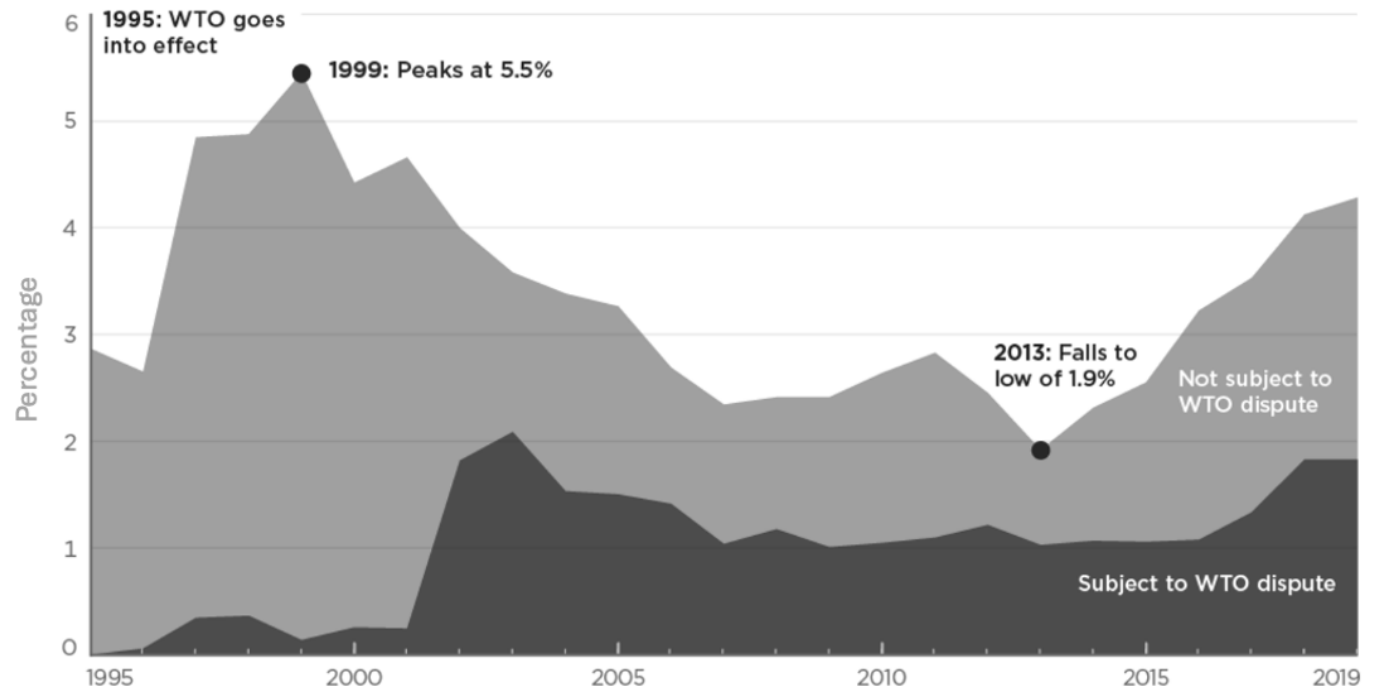


Regional Trade Agreements in force, by year and focus.

Source: WTO, Regional Trade Agreements Database

Undermining the WTO dispute resolution mechanism

- Under the WTO more antidumping and countervailing duties by HICs were subject to dispute by LICs and MICs
- An increasing proportion of disputes were upheld
- From 2011 the USA refused to make new appointments to the WTO appellate body. By 2019 the body was dead.

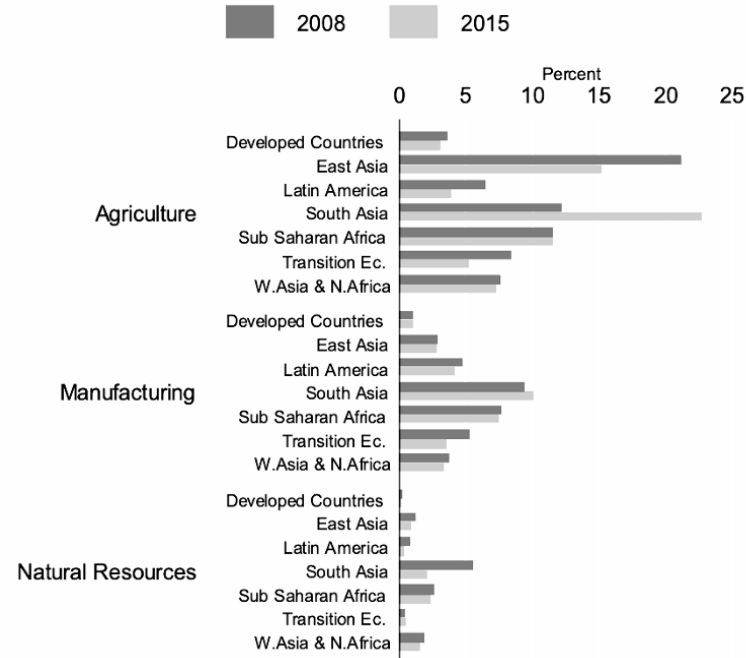


The share of US imports covered by a trade remedy either undisputed or subject to WTO dispute
Source: Brown and Keynes (2020)

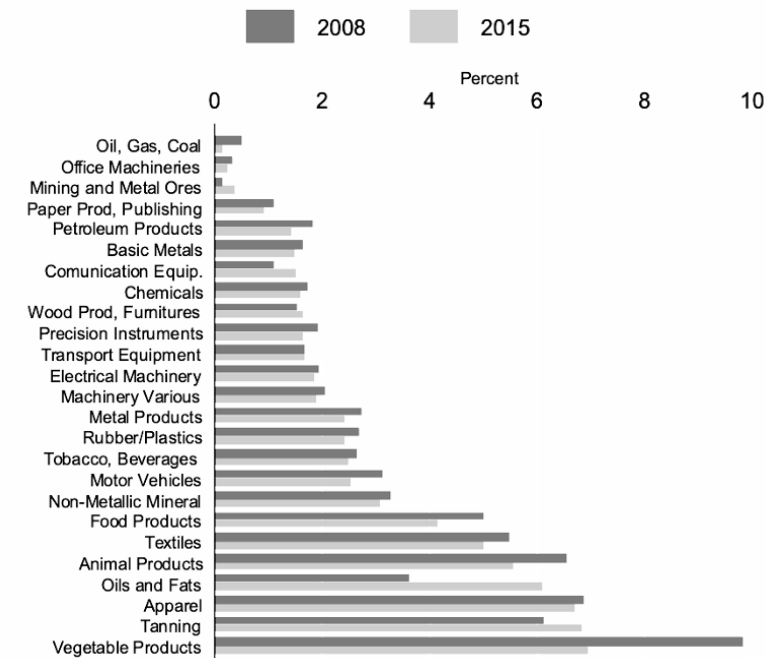
Tariffs by sector, region, and product group after 2008

- Until 2025 no major changes in global tariffs
- In 2025 the Trump administration abandoned existing trade agreements and levied tariffs averaging 14% (trade restrictiveness index calculated to be 21%)
- Regions targeted were East Asia, South Asia, and Sub-Saharan Africa

A. Average tariffs by sector and region



B. Average tariffs by product groups

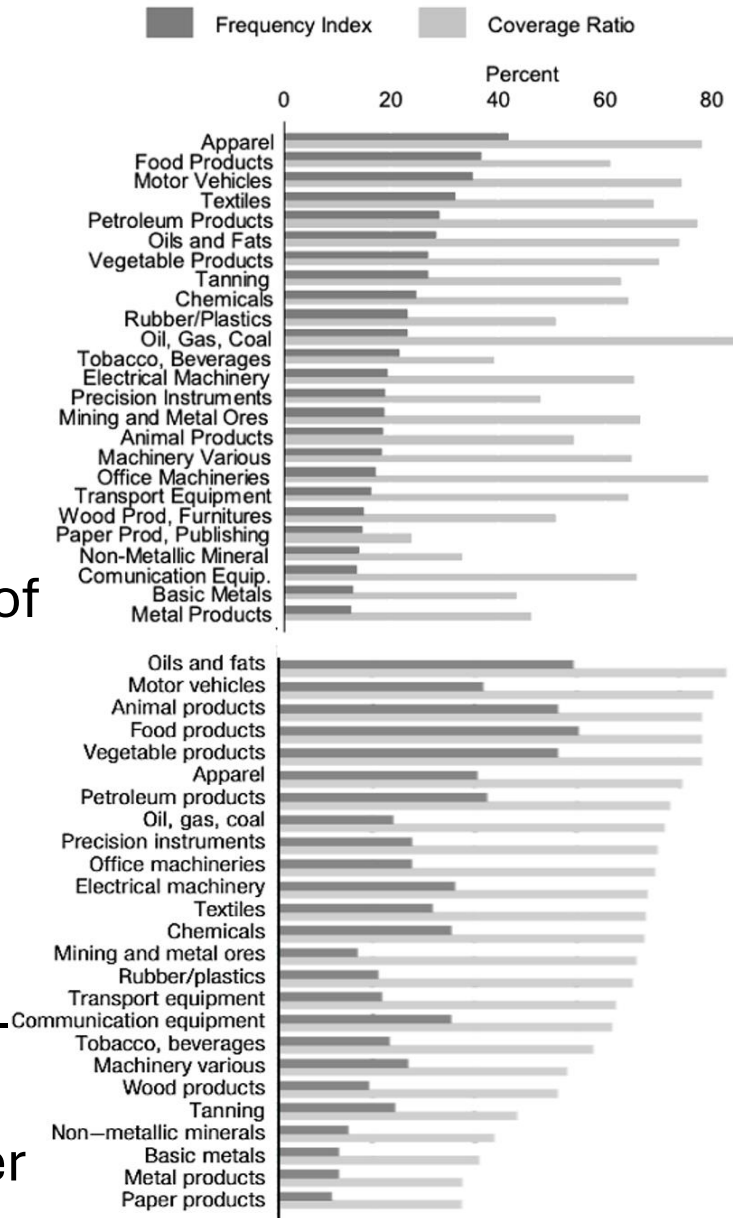


Source: UNCTAD (2017)

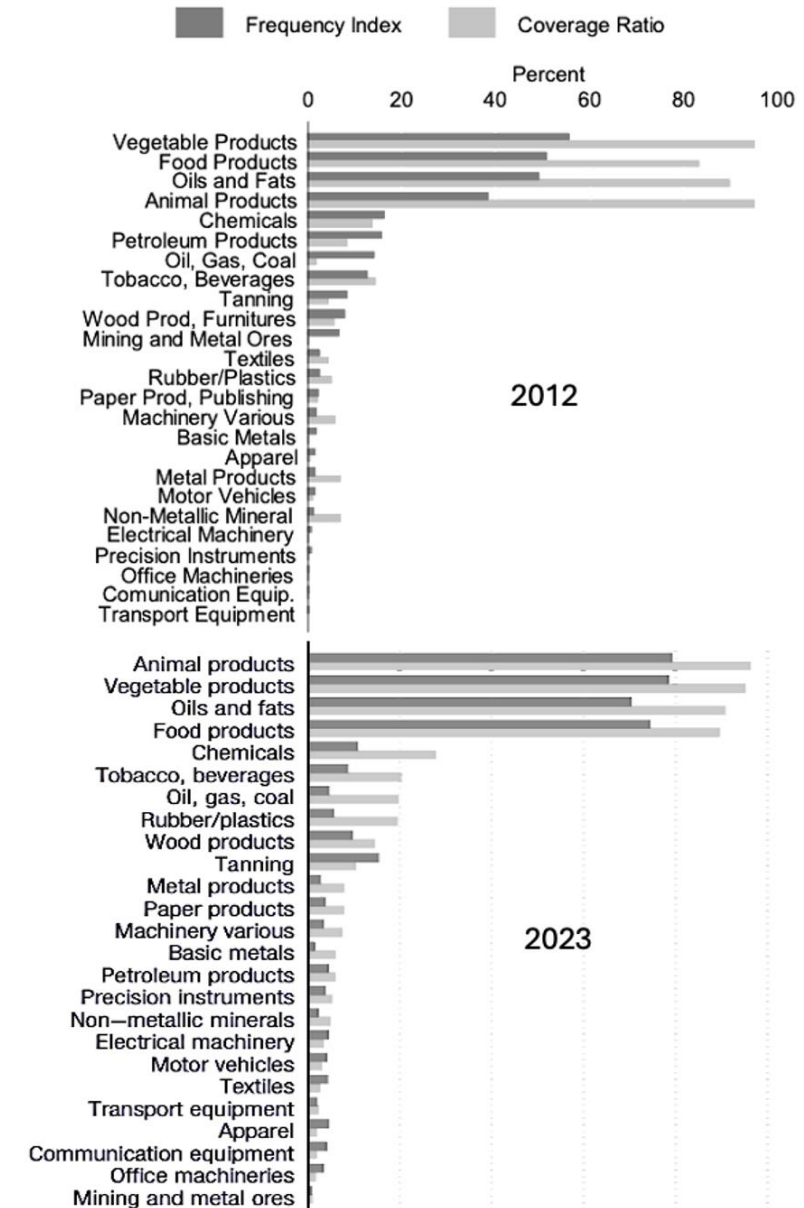
Non-tariff barriers (TBTs and SPSs) after 2008

- SPS measures affect agricultural, fishery, and forestry products.
- TBTs affect a wider range of products and sectors
- The frequency index and the coverage ratio of both measures increased between 2012 and 2023— affecting more commodities and a greater share of global trade.

A. Technical barriers to trade (TBTs).



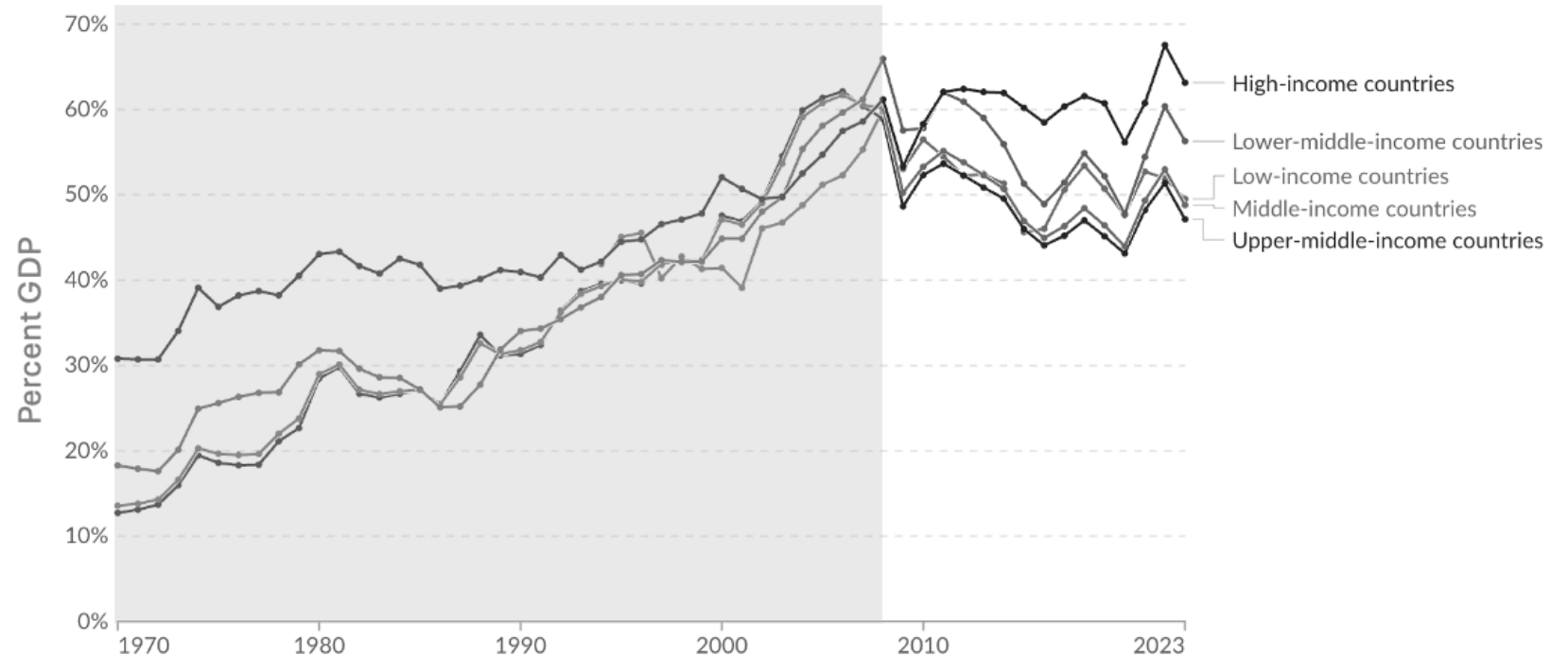
B. Sanitary and phytosanitary measures (SPSs)



Source: UNCTAD (2013, 2023)

Trade share of GDP after the second wave

- Since the 2008-2009 recession trade has stopped growing as a share of GDP
- The effect is strongest in developing countries

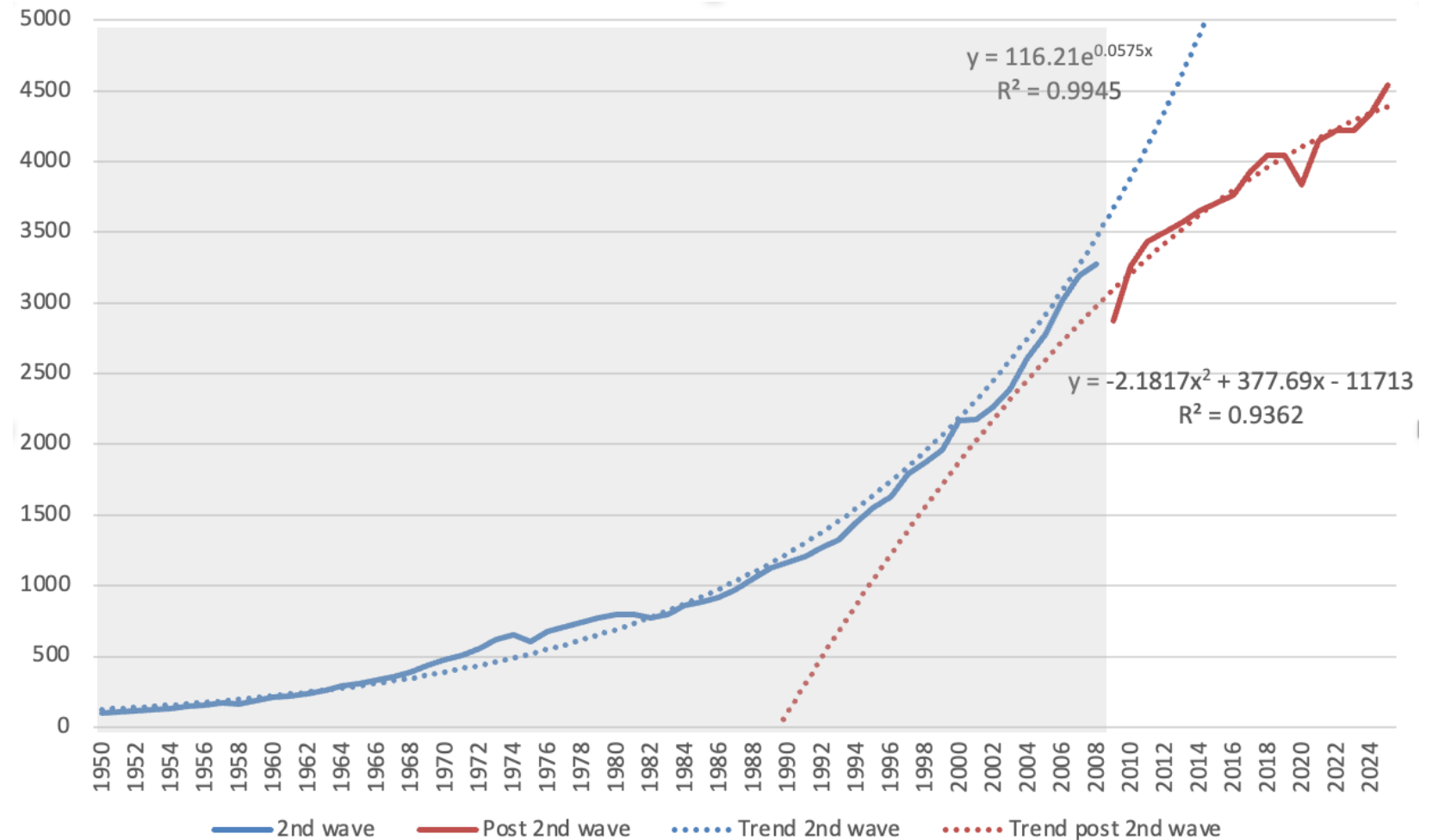


Trade as a share of GDP by income group, 1970 to 2023.

Source: Esteban Ortiz-Ospina, Diana Beltekian, and Max Roser, Trade and Globalization, <https://ourworldindata.org/trade-and-globalization>.

Volume index of trade growth

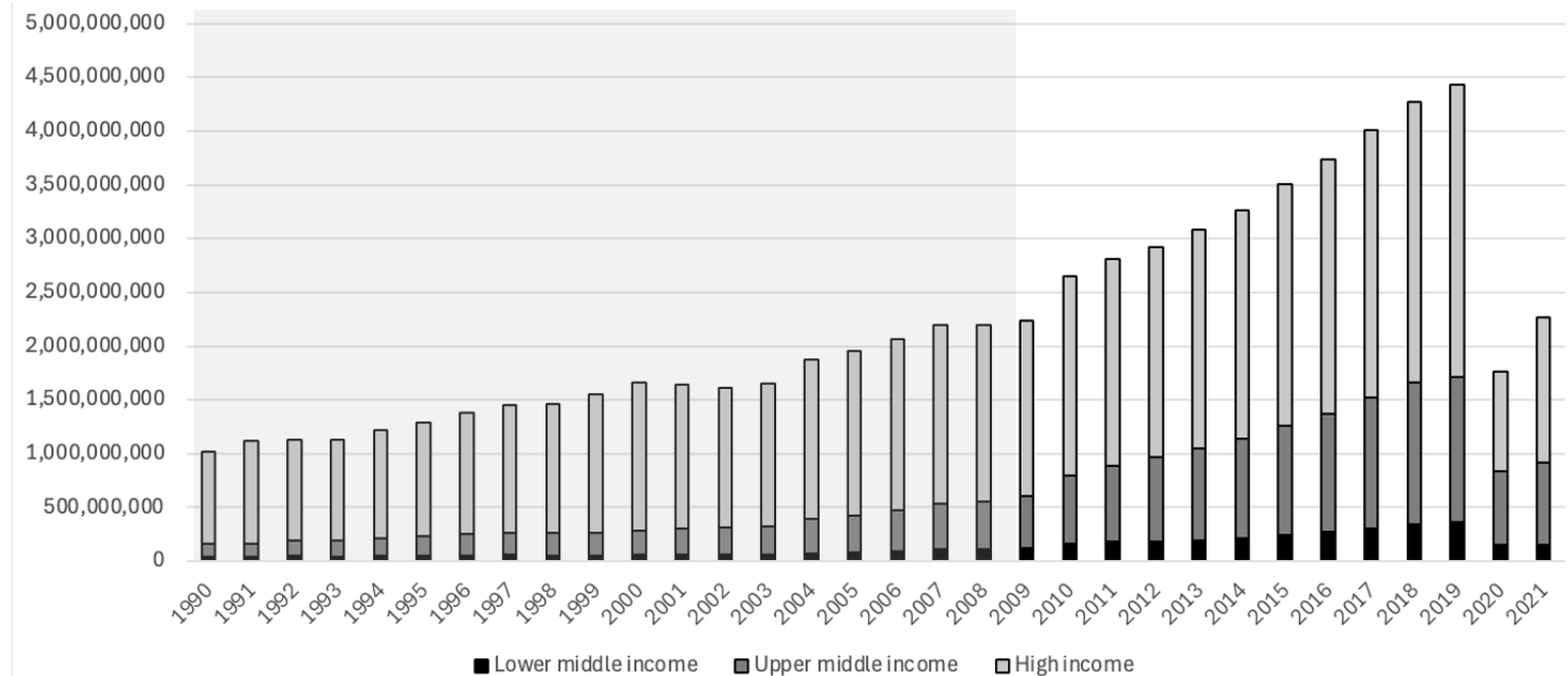
- Index of the volume of world trade since 1950 (1950 = 100)
- 2008 marks a break in trade volume growth



World Trade Organization. 2025. Evolution of trade under the WTO
Geneva

Volume growth of air travel

- Air transport by income group, 1990-2021 showing the number of passengers carried
- Numbers in low-income countries are below the level that would be visible on the graph



World Bank. 2025. Air Transport: Passengers Carried. World Bank, Washington DC.

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Drivers of disease emergence

- Rural population growth in biodiverse tropical forests
- Deforestation, forest degradation as a result of land use change
- Insecurity of land tenure
- Weak regulatory systems
- Ineffective biosecurity and public health systems



Congo Basin: deforestation between 2000 and 2023

Emerging infectious diseases reported 1945-2024

2023	Xue-Cheng virus	China
2022	Langya henipavirus	China
2022	Avian influenza A(H3N8)	China
2021	Alto Paraguay virus	Argentina
2021	Avian influenza A(H5N8)	Russia
2021	Avian influenza A(H10N3)	China
2021	Yezo virus	Japan
2020	Guinea worm sp. nov.	Vietnam
2019	SARS-CoV-2	China
2018	Avian influenza A(H7N4)	China
2017	Rat hepatitis E	China
2016	Ntwetwe virus	Uganda
2014	Bourbon virus	USA
2014	Avian influenza A(H5N6)	China
2013	Avian influenza A(H7N9)	China
2013	Avian influenza A(H10N8)	China
2013	Colpodella spp. Heilongjiang (HLJ)	China
2013	Sosuga virus	Uganda
2013	Variegated Squirrel Bornavirus 1 (VSBV-1)	Germany
2012	Middle East respiratory syndrome (MERS)	Saudi Arabia
2012	Mojiang paramyxovirus	China
2011	Influenza A(H3N2)	USA
2011	Plasmodium cynomolgi	Malaysia
2009	Bas-Congo virus	DRC
2009	Candidozyma auris	Japan
2009	Heartland virus	USA

2009	Influenza A(H1N1)	Mexico
2009	Severe fever thrombocytopenia syndrome	China
2008	Lujo virus	Zambia
2005	Human T-lymphotropic virus (HTLV) 3	Cameroon
2003	Chapare virus	Bolivia
2003	SARS-CoV-1	China
1998	Nipah virus	Malaysia
1994	Sabia virus	Brazil
1994	Hendra virus	Australia
1993	Sin Nombre virus (Hantavirus)	USA
1991	Guanarito virus	Venezuela
1986	Human immunodeficiency virus 2.	Guinea Bissau
1986	European lyssavirus 2	Finland
1986	Australian bat lyssavirus	Australia
1982	Human T-lymphotropic virus 2	DRC
1981	Human immunodeficiency virus 1	DRC
1980	Human T-lymphotropic virus 1	DRC
1976	Ebola virus	DRC
1969	Lassa fever virus	Nigeria
1968	Influenza A(H3N2)	China
1967	Marburg virus	Uganda
1958	Crimean-Congo hemorrhagic fever	DRC
1957	Influenza A(H2N2)	China
1952	Chikungunya virus	Tanzania
1952	Hantavirus	Korea
1947	Zika virus	Uganda

Disease spillover hotspots

- Central and West Africa,
 - Chikungunya (Tanzania, 1952)
 - Zika (Uganda, 1954)
 - Congo hemorrhagic fever (DR Congo, 1958)
 - Marburg fever (contracted from grivet monkeys from Uganda, 1967)
 - Lassa fever (Nigeria, 1969)
 - Mpox (DR Congo, 1970)
 - Ebola virus disease (DR Congo, 1976)
 - HIV/AIDS (DR Congo, 1981)
- East and South-East Asia
 - Hantavirus diseases (Korea, 1952)
 - Highly pathogenic avian influenzas H2H2 (China, 1957), H2N3 (China, 1968), H5N1 (China, 1997)
 - Nipah virus infection (Malaysia, 1998)
 - SARS (China, 2003)
 - COVID-19 (China 2019)

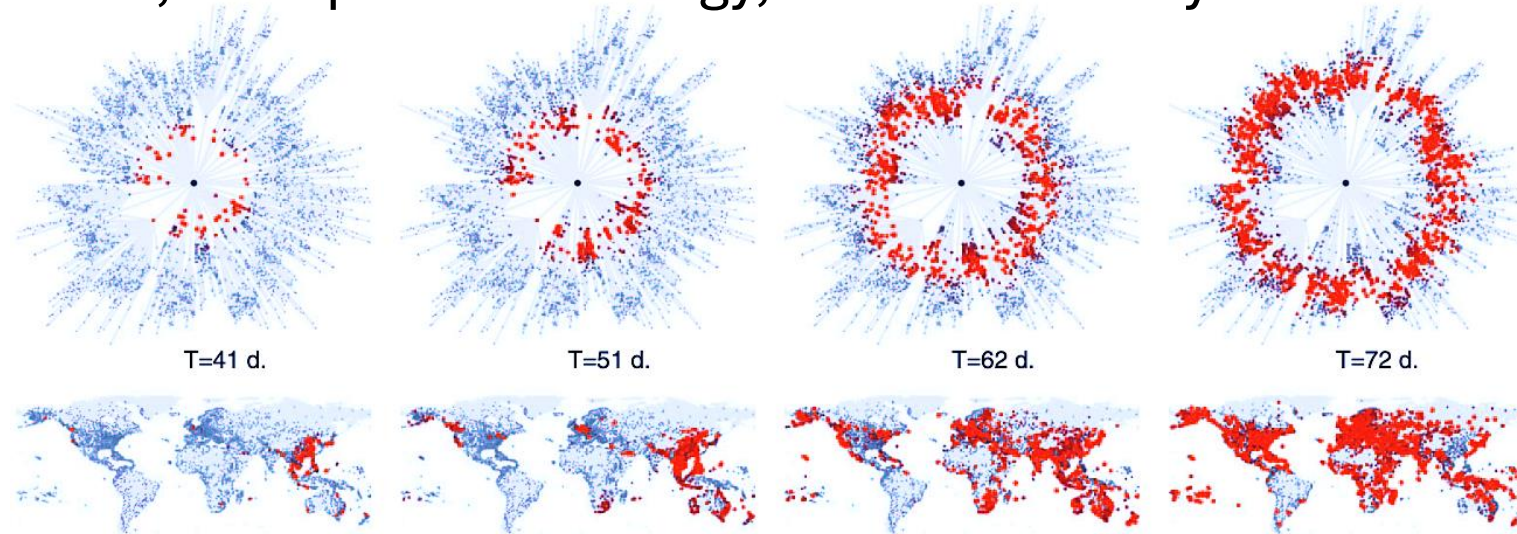
Drivers of the geographic spread of infectious disease

- The physical movement of infected people and materials
 - Exploration
 - Troop movements
 - Refugee flows
 - Migration
 - **Trade and travel**
- The physical movement of infected mammals, birds, reptiles, insects, zooplankton, shellfish and fish
 - Mammal and bird migration
 - Air and ocean currents
 - **Trade and travel**

The geographic spread of infectious disease

- The spread of infectious disease between two points depends on the “effective distance” between them—which measures the ease with which infections spread via trade or travel
- Factors include the physical distance between the points, trade or travel frequency and volume, transport technology, and biosecurity measures

Simulated model disease originating in Hong Kong spreads at constant speed in effective distance



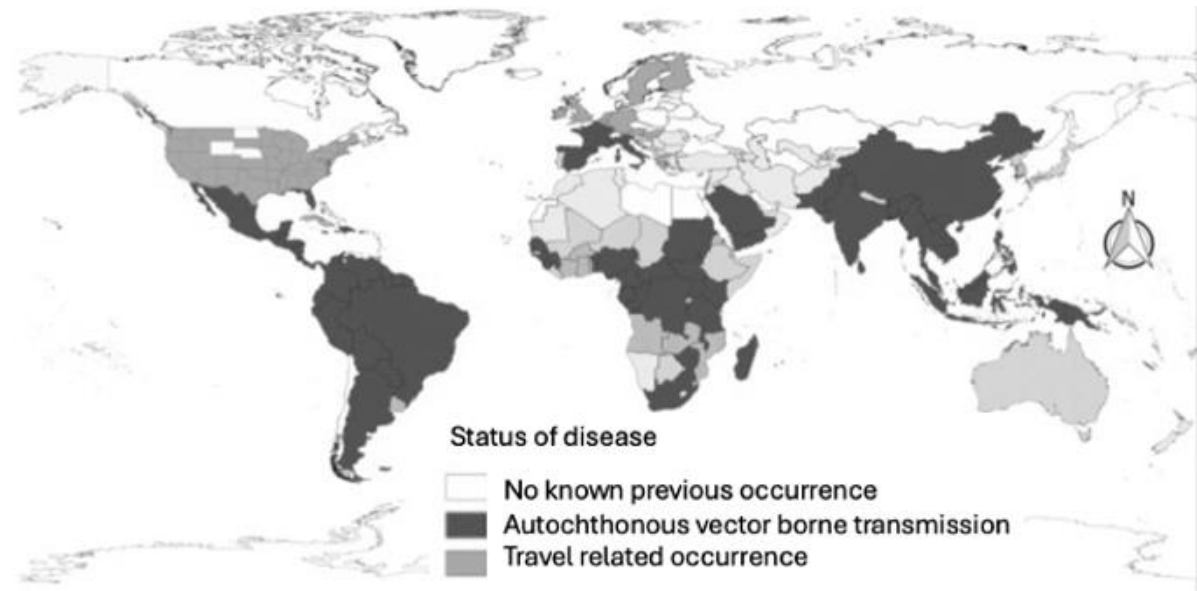
Brockmann, D., and D. Helbing. 2013. The hidden geometry of complex, network-driven contagion phenomena. *Science* **342**:1337–1342.

Trade/travel growth and effective distance

- Trade/travel growth during the first and second waves reflected
 - Increased trade volumes along existing trade routes
 - Opening of new markets and trade routes
 - Development of new transport technologies
 - Marine (shipping routes, power source, construction, specialization, containerization)
 - Air (propeller, jets, wide-bodies)
 - Land (road, rail, power source)
- All innovations reduced the effective distance between trade centers
- Whether local outbreaks spread beyond a country's borders depends on
 - Trade/travel patterns
 - Trade/travel volume
 - Biosecurity, sanitary and phytosanitary standards applied by exporters

Vector borne arboviral diseases

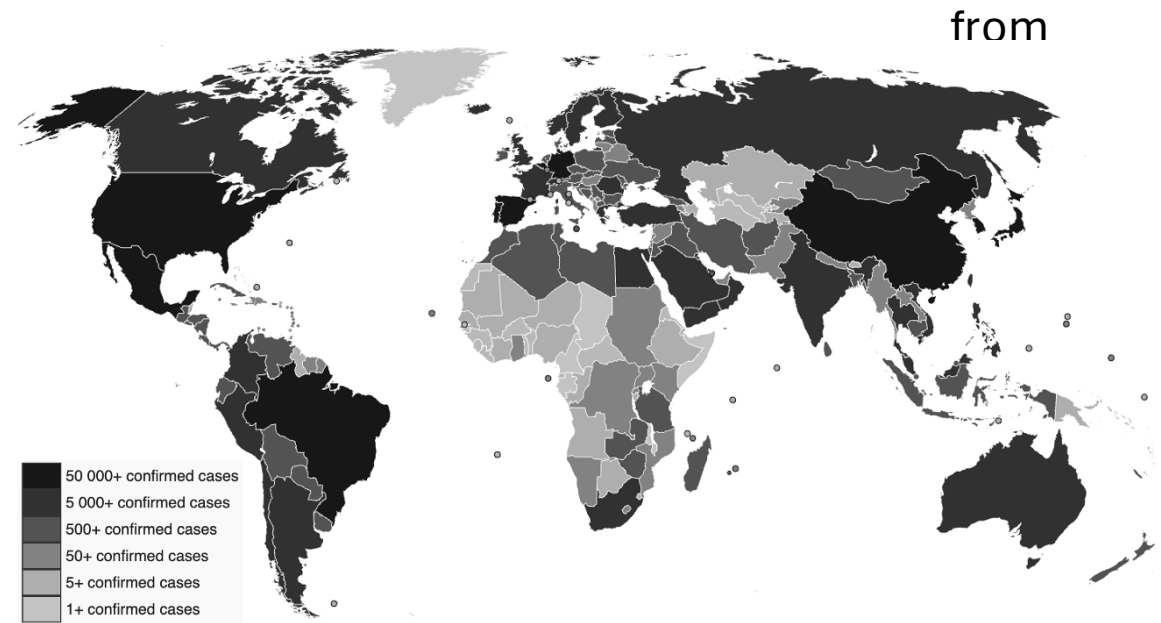
- Arboviral diseases transmitted by mosquitoes include yellow fever, Dengue fever, zika, and chikungunya
- Geographic spread
 - movement of vectors via the trade in goods
 - travel by infected people
- Chikungunya
 - Initial spread within Africa involved labor migration and refugee flows
 - Spread from Africa to Asia, the Caribbean, the Americas and Europe involved both containerized shipment of infected mosquitoes and air travel by infected people



Chikungunya spread. Source Leta et al, (2018)

Diseases involving person-to-person transmission

- Diseases involving person-to-person transmission include HIV/AIDS, COVID-19, SARS, influenza A viruses (H_1N_1 , H_2N_2 , H_3N_2)
- The 2009 H1N1 pandemic
 - Geographic spread involved air travel from Mexico, where spillover occurred
 - Analysis showed that geographic spread to major city clusters reflected effective distance between Mexico and clusters
 - Spread within clusters then depended on contact patterns
 - The fewest cases occurred in countries with the weakest air connections with Mexico and the United States



H1N1 cases as at May 2009. Source: Wikimedia commons

COVID-19

- Effective distance was a strong predictor of first arrival times of COVID-19
- Countries well connected to Wuhan (Japan, Thailand, South Korea, Hong Kong, Taiwan, and the United States) had the shortest first arrival time: between 12 and 22 days
- Countries at the greatest effective distance from Wuhan recorded the longest first arrival time (Choi et al. 2022).
- Most of the 24 countries that had not reported transmission within 90 days were small, low- or middle-income, landlocked or island developing countries that were not well connected to the global system (Li et al. 2021).

A Road Map

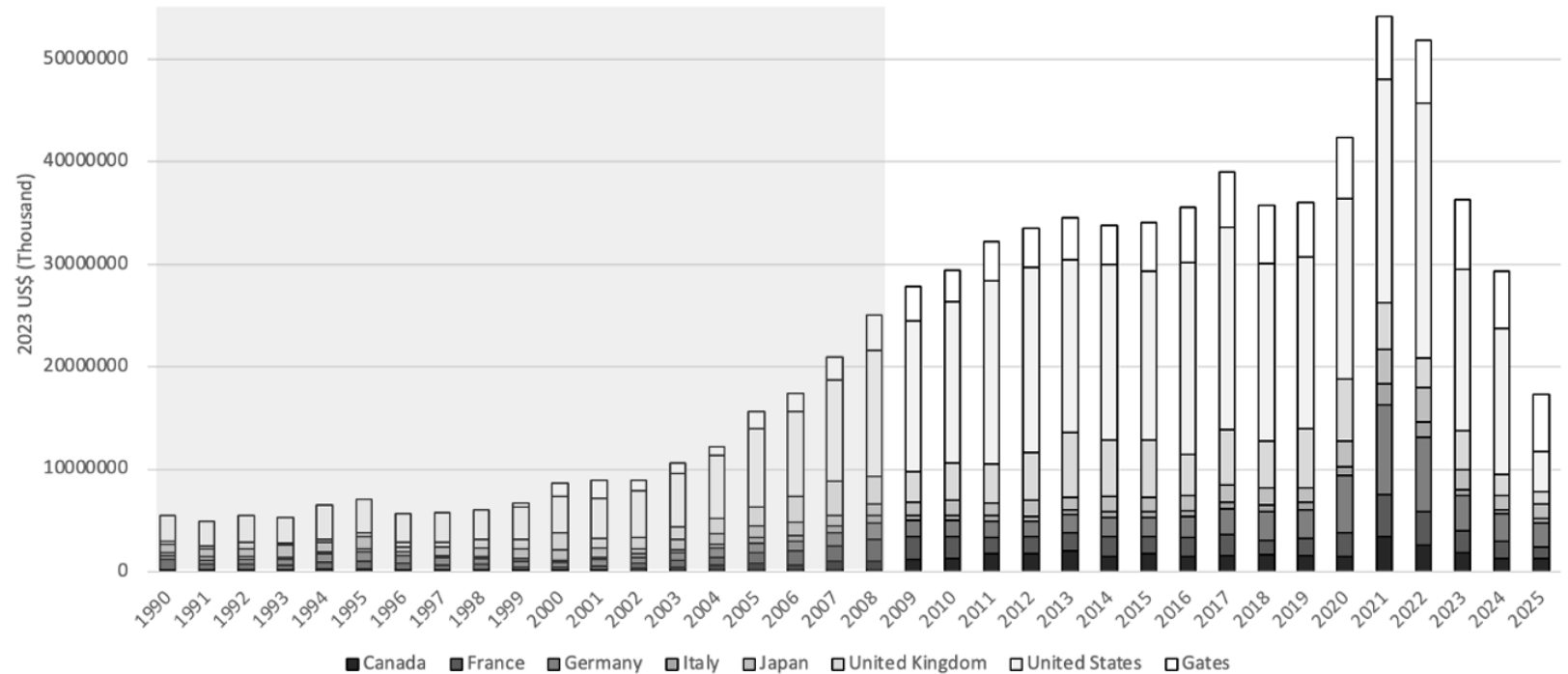
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Disease surveillance and control in a globalizing world

- The international architecture of disease surveillance and control comprised the World Health Organization, the World Animal Health Organization, the International Health Regulations, the Sanitary and Phytosanitary Agreement
- The IHR and SPS Agreement
 - allowed importers to defend themselves against disease risks by restricting trade
 - encouraged exporters to mitigate the risks they posed to others by adopting appropriate health, sanitary and phytosanitary conditions
 - obliged developed countries to provide technical health, sanitary and phytosanitary support to developing country exporters
- There remains a substantial gap between the health, sanitary and phytosanitary capacity in developed and developing countries.

Development assistance for health (DAH)

- The gap has been met by DAH and investment by the WB, WHO, WAHO, FAO
- In 2000s PEPFAR and Gates had major effects
- DAH peaked during COVID, but has since declined sharply

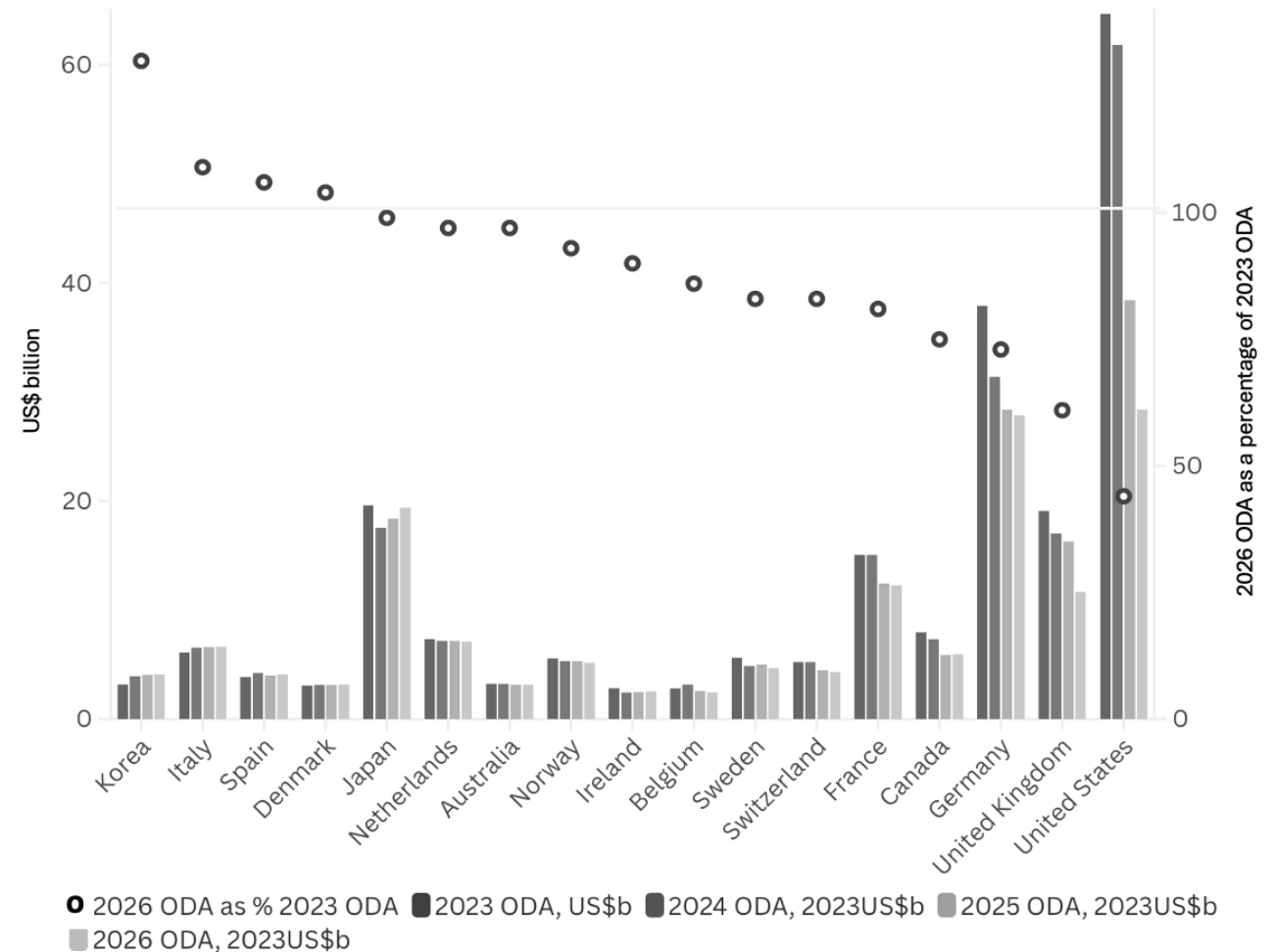


Development assistance for health by G7 countries and the Gates Foundation, 1990-2025. Data for 2024 and 2025 are provisional estimates.

Data source: (Institute for Health Metrics and Evaluation (IHME) 2025)

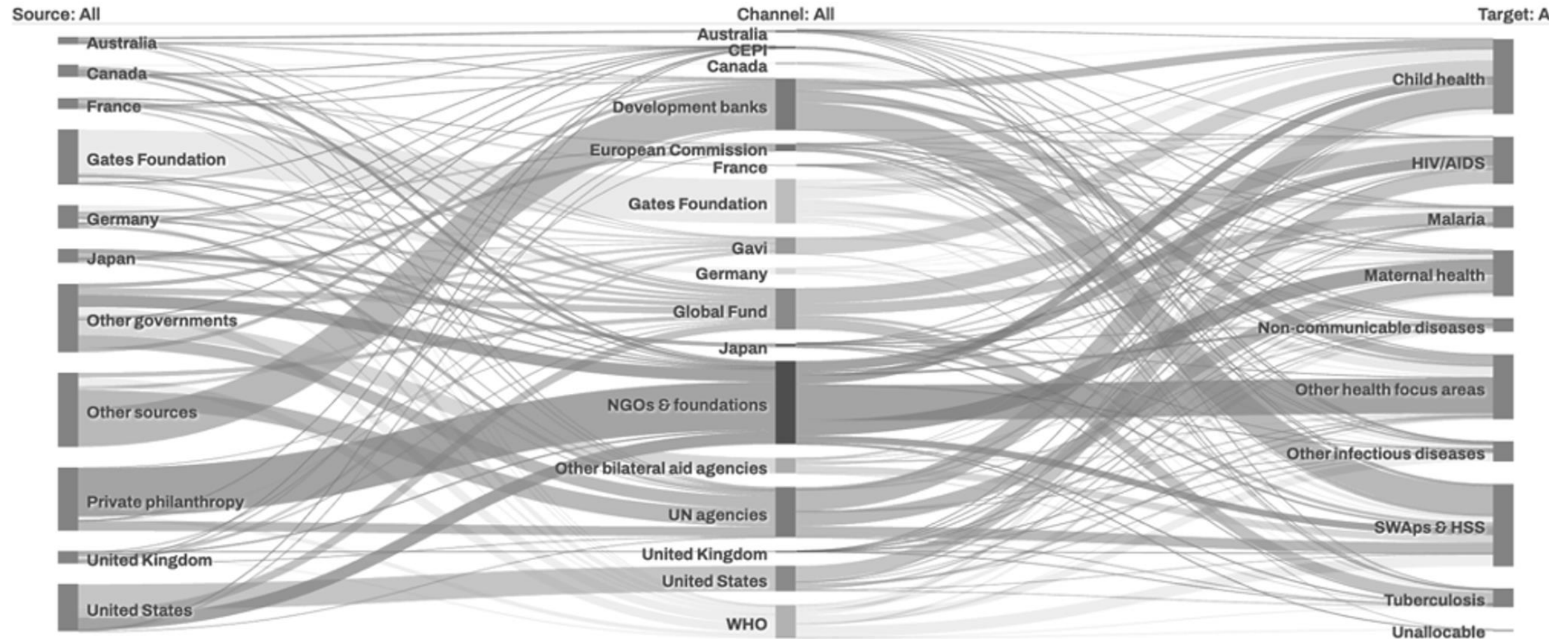
Changes in DAH 2023-2026

- In 2026 the US and UK are expected to reduce ODA over 2023 levels by 62% and 40%
- Korea, Italy, Spain and Denmark—expect to increase official development assistance in 2026
- All other countries expect to reduce their contributions



Changes in ODA provision, 2023-2026. Source: Huckstep et al. (2025)

Sources and health areas targeted by DAH

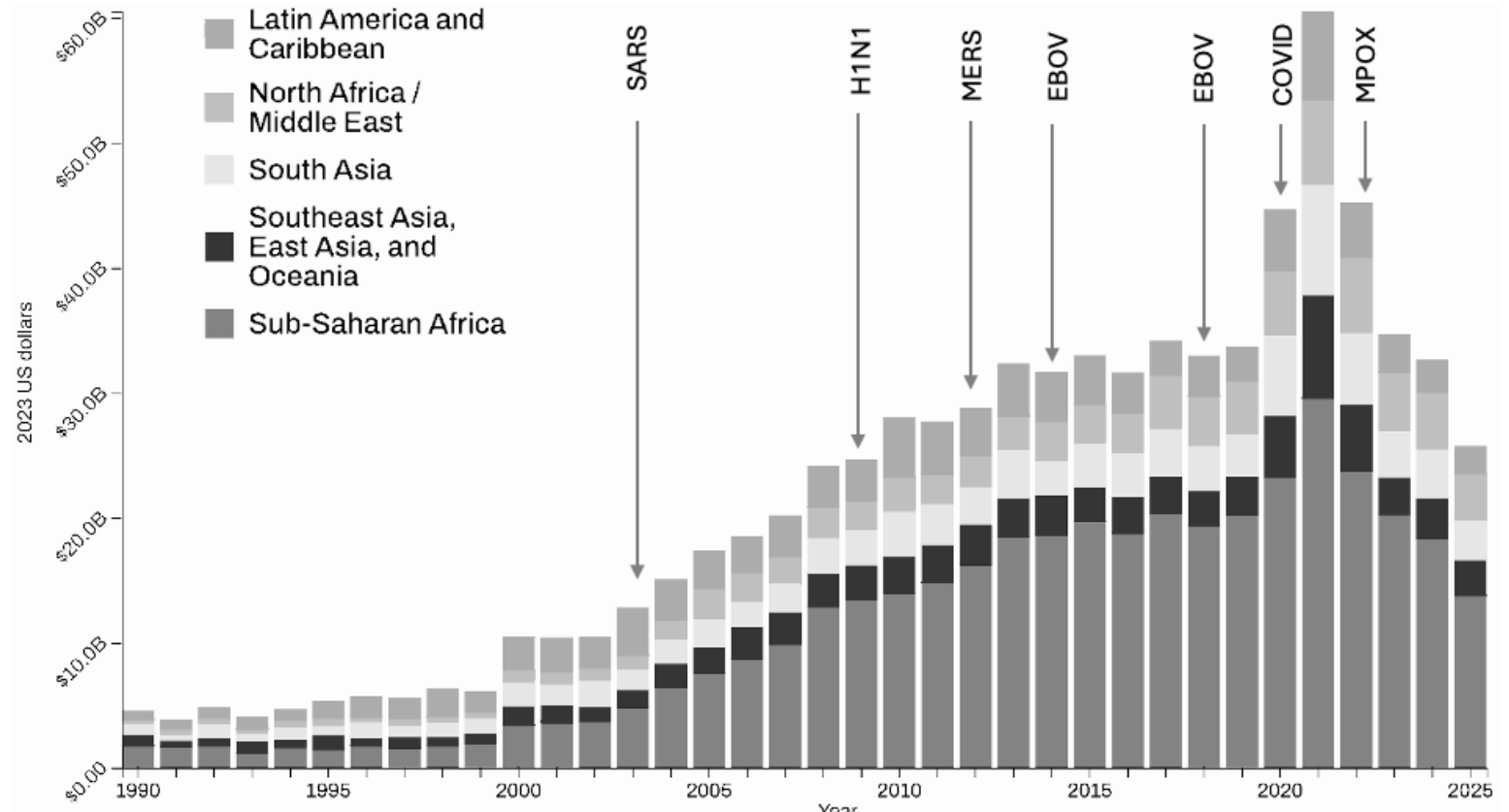


DAH 2025, by source, channel, and target. The width of each bar is proportional to the share of global development assistance for health spending accounted for by source, channel or target.

Source: Institute for Health Metrics and Evaluation (2025)

DAH by region 1990-2025

- The largest increases in DAH since 2001 have gone to Sub-Saharan Africa—origin of HIV, chikungunya, Zika, Ebola, Mpox, Lassa fever, and many more zoonotic diseases
- Since 2021 DAH has fallen to pre-2008 levels

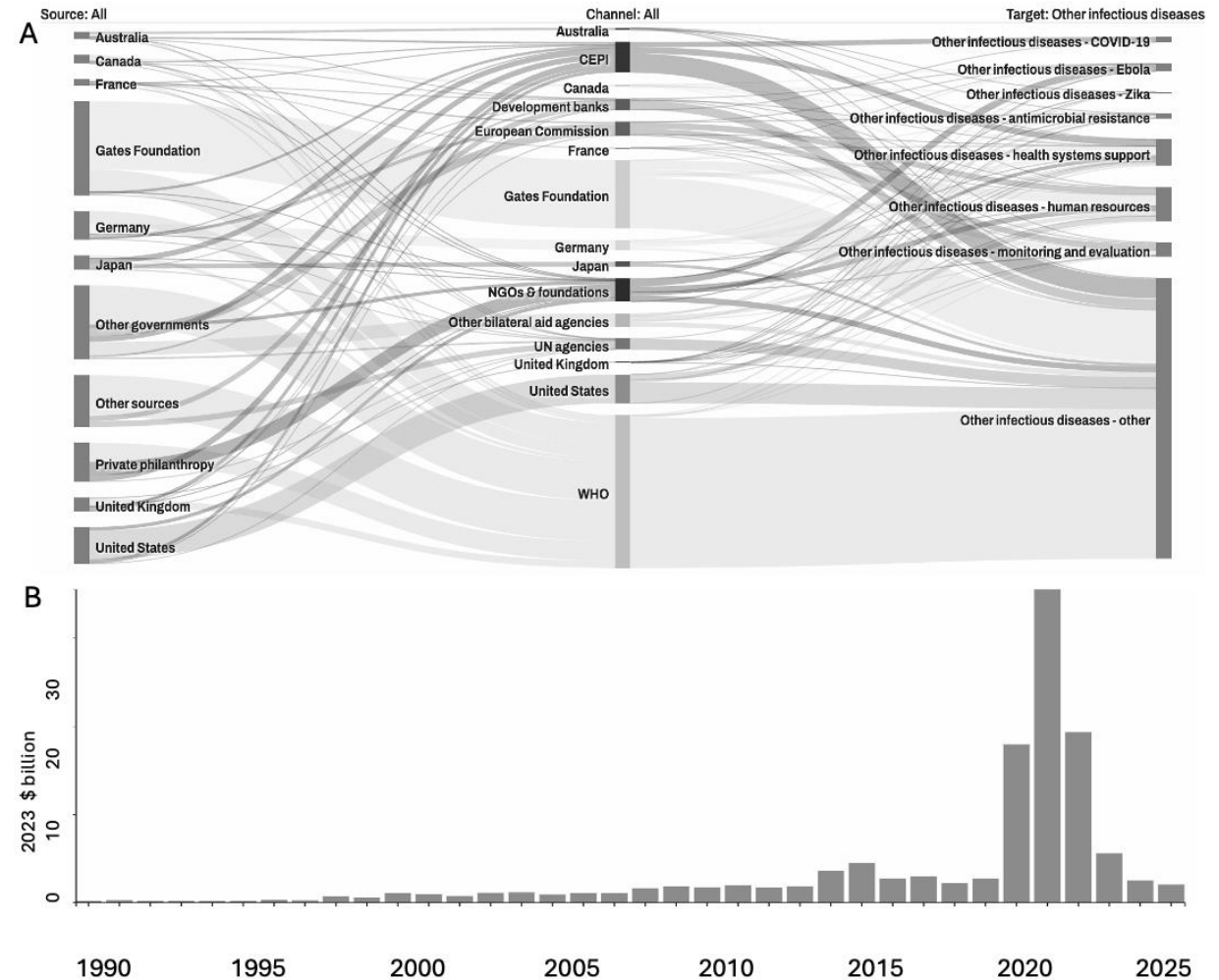


Source: Institute for Health Metrics and Evaluation (2025)

DAH for other infectious diseases

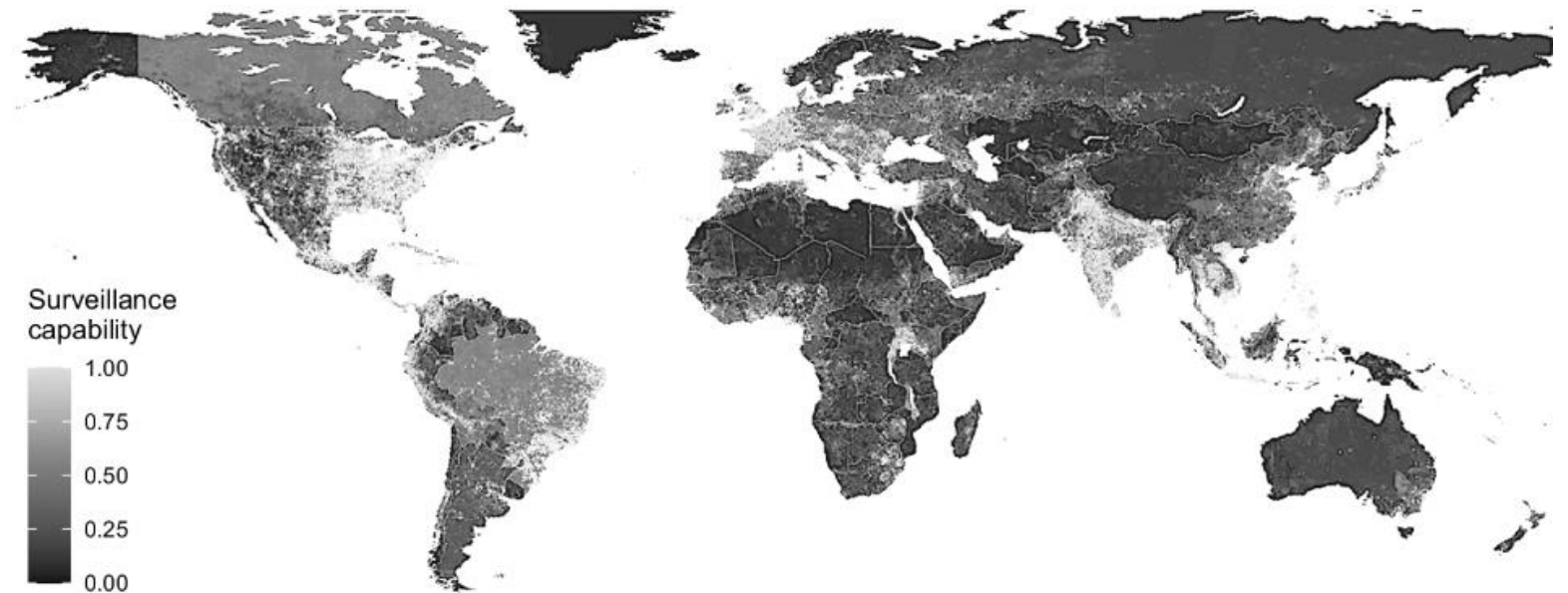
Panel A: Allocation by source, channel and target in 2025. The width of each bar in Panel A is proportional to the share of global development assistance for health spending accounted for by source, channel or target.

Panel B: total DAH for other infectious diseases 1990-2025.



Relative surveillance capability for emerging acute viral infectious diseases

- Disease surveillance and monitoring are better shot public goods
- There is variation both within and between countries
- While capacity in HICs is generally better than in LICs or MICs, there are exceptions (India, Uganda, Brazil)

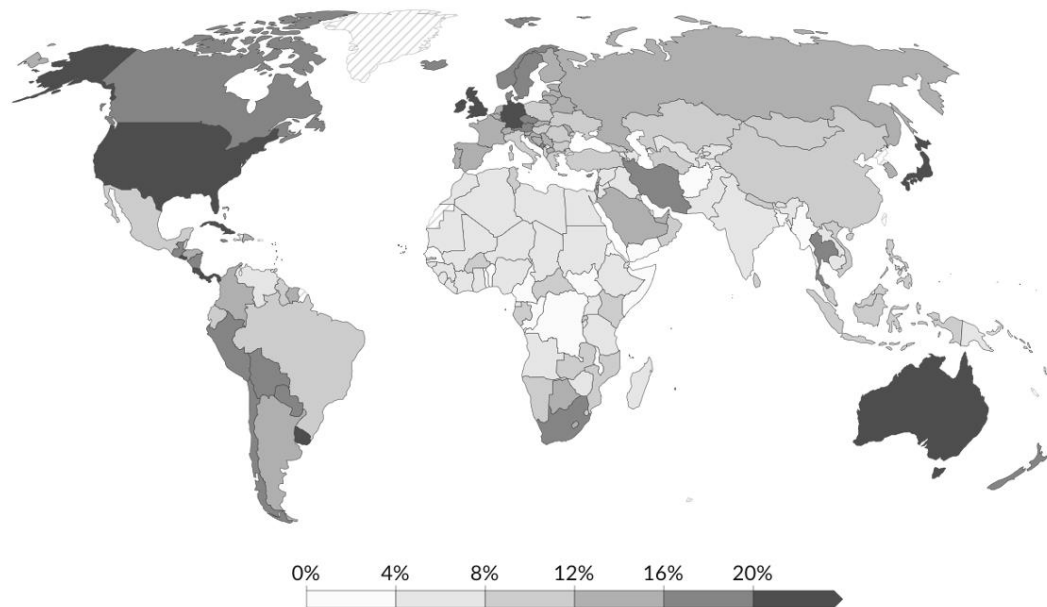


Areas colored black indicate that viral infections are unlikely to be publicly reported. Areas colored light gray indicate that viral infections are very likely to be publicly reported.

Source: Lim et al. (2025).

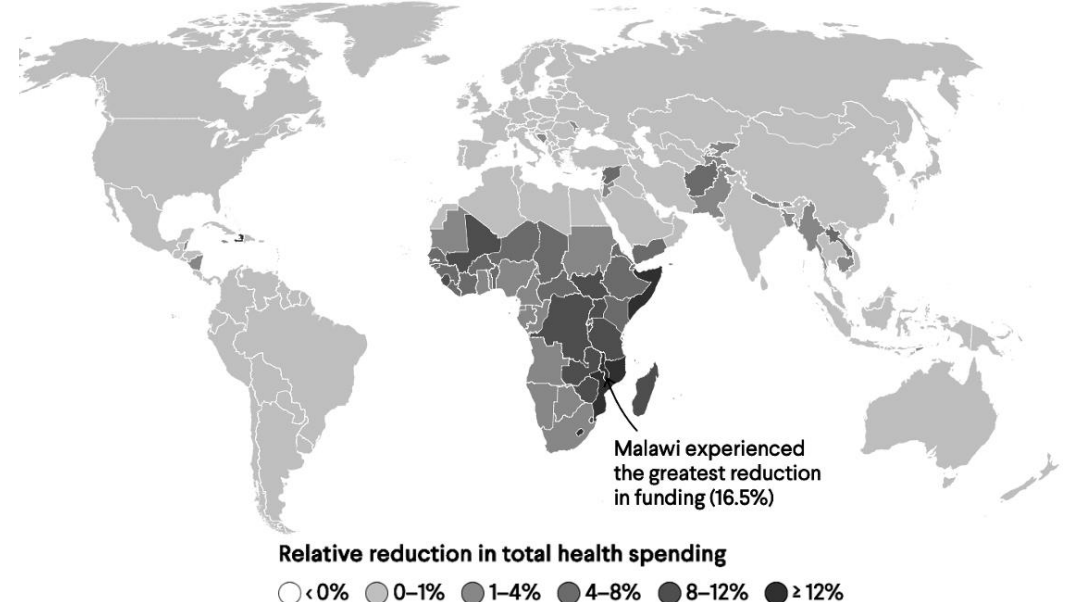
Health spending share of total government spending 2022

- The countries with the lowest health expenditures are in emerging infectious zoonotic disease hotspots in Central Africa and East and Southeast Asia, and are most heavily impacted by cuts in DAH



Domestic general government health expenditure as a percentage of total expenditure

Source: Ortiz-Ospina et al. (2025)

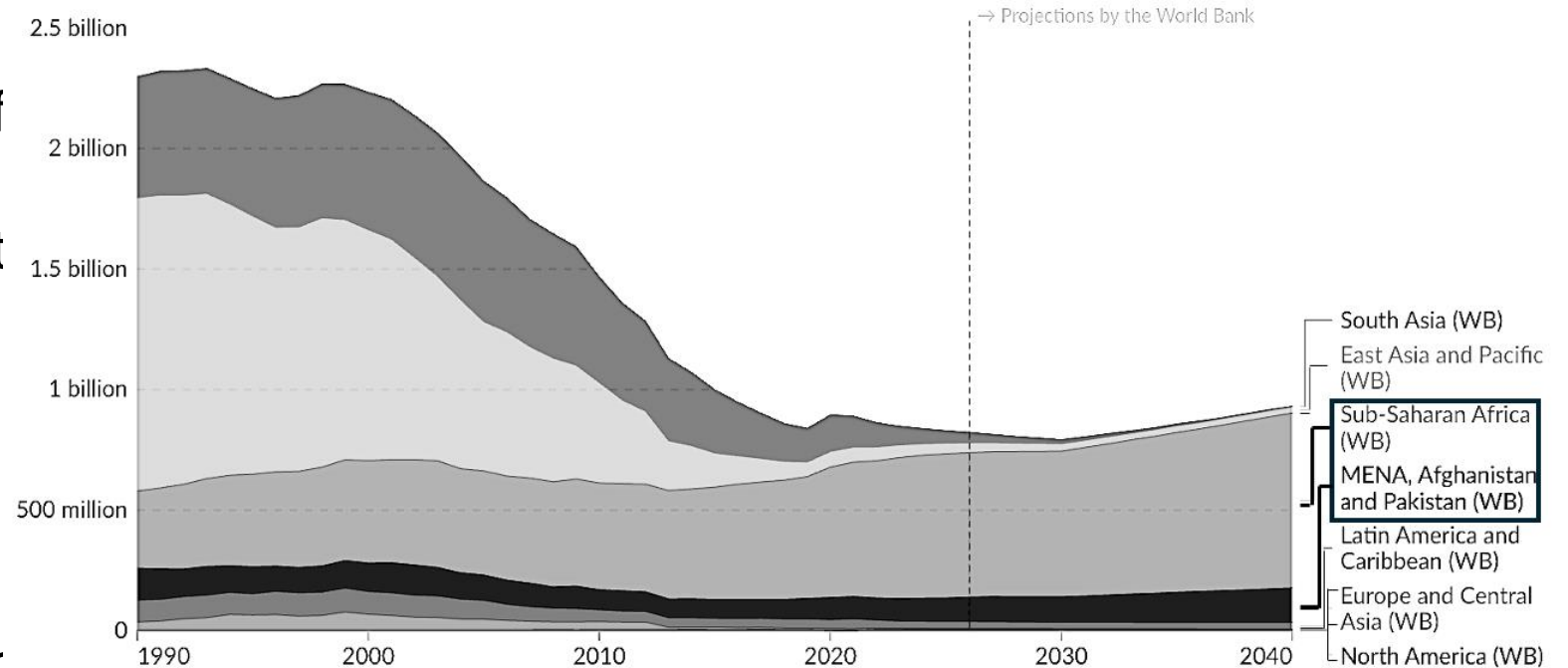


The relative loss in total health spending due to reduced DAH in 2025

Source: Krugman (2025)

Extreme poverty projections by region to 2040

- Feedback effects between high burdens of infectious disease, high levels of debt, or conflict and instability lead to productivity decline in conflict-affected states, trapping many in an equilibrium in which income levels are not far above subsistence



The number of people below the International Poverty Line of \$3 per day. The data are adjusted for inflation and differences in living costs between countries. Projections are from the World Bank. From 2026–2030 they are based on growth forecasts from the World Bank and IMF. From 2031, they are based on observed 2015–2024 growth rates.

Source: Roser (2025)

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Future emergence hotspots

- The disease emergence hotspots of the future will continue to lie in low-income countries
 - that are biodiverse
 - where people depend on forest products for their livelihood
 - where resources for disease surveillance, monitoring, prevention and treatment are limited
- Feedbacks between disease, productivity, conflict and insecurity has trapped many rural households in an equilibrium involving forest exploitation (at close-to-subsistence income levels) that raises the risk of spillover events

Future spread risks

- Feedbacks between commodity dependence, unstable and fluctuating income, and declining investment in alternative activities has trapped many countries in a pattern of production and trade that increases the risk of geographic transmission
- Investment in biosecurity and health will likely remain depressed in due to
 - crowding out of health expenditures by debt servicing obligations
 - reallocation of international development assistance
 - decline in national funding for the World Health Organization

Last words from the book on which this talk is based

“Absent a concerted global effort to set those countries on to a different path, they are likely to remain trapped in a low-level equilibrium that ... preserves their status as the most likely source of emerging infectious diseases. The ... decline in international development assistance, the erosion of the rules-based post-war world order, and the defunding of many of the intergovernmental organizations established to support the goals of the world order, will make it harder for those countries to escape the trap...There will be collective price to pay for this at some point. One can only hope that a more reasoned policy-mindset prevails before the payment falls due.”

Thank you