

Technology, fragmentation and the new uncertainty*

di Christine Lagarde

It is a privilege to deliver this year's Global Risk Memorial Lecture here in Bologna.

It is also fitting to speak about risk in Italy, because it was here that the modern concept of risk was born. Not just the financial instruments, the insurance contracts, the double-entry bookkeeping^[1], but something more fundamental: the idea that an opaque future could be made knowable through observation and reason., but something more fundamental: the idea that an opaque future could be made knowable through observation and reason.

Before the Italian Renaissance, the unknown was largely understood as fate – forces beyond human comprehension. Galileo overturned that belief in the natural sciences, insisting that the universe could be tested and understood. But the revolution in commerce began even earlier.

In the merchant cities of Venice, Genoa and Florence, scholars and merchants began to believe that if you observed enough voyages, you could discern patterns in what had previously seemed random. You could measure danger and price it. And through measurement, you could even tame the unknown itself.

Luca Pacioli, a Franciscan friar working just a few hundred kilometres from here, published the first systematic account of this new approach in 1494. The very word *risico* entered European languages from Italian maritime trade.

That insight was powerful and, for centuries, remarkably durable. It underpinned modern finance, probability theory and, ultimately, the quantitative frameworks on which central banks and policymakers currently still rely.

But today we may feel that this approach is reaching its limits. The global order we have lived under for decades is being upended. New technologies look set to reshape our economies.

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The defining feature of this moment is not simply that risks are rising. It is that we are leaving a world where risk can be measured and modelled, and entering one of genuine uncertainty.

The instinct to turn inward when the future becomes this unclear is natural. But I will argue this evening that acting on it would make the situation worse for all of us, cutting off the very gains our economies most need.

From risk to uncertainty

The Italian merchants who invented risk measurement succeeded because the world they operated in had a broadly stable underlying structure.

Trade routes were dangerous, but the dangers were recurring – even storms followed seasonal patterns. By recording outcomes systematically, they could estimate probabilities and put a price on danger.

That is the essence of risk: a stable enough system that past outcomes can guide future decisions.

For most of the last 30 years, we also lived in such a world. The trading system was anchored by multilateral rules. The monetary framework rested on credible central banks. The geopolitical order provided a predictable backdrop.

Within that structure, historical data could guide policymakers. They could model distributions and calibrate policy to insure against shocks.

Even when severe disruptions occurred, they remained, in an important sense, shocks within a stable structure. The dotcom crash, the Asian financial crisis, even the global financial crisis of 2008: each tested the system severely, but the underlying architecture of the global economy held.

I believe we are no longer in that world. We are moving into a world of uncertainty.

This is what the economist Frank Knight^[2] defined as the condition you face when the underlying structure itself is shifting; when the system that generated yesterday's data may not be the system generating tomorrow's outcomes.

The shocks we now face are themselves transforming the structure.

A pandemic exposed the fragility of global supply chains and triggered a lasting shift towards reshoring. Russia's invasion of Ukraine redrew the map of European security. And the global trading system has itself become a site of conflict, as dependencies are exploited and trade policy is wielded as a weapon.

The pace of change is striking: monitoring by the World Trade Organization shows that the share of G20 trade affected by new tariffs and import restrictions rose more than fourfold between October 2024 and October 2025, the largest jump since monitoring began.^[3]

At the same time, we are witnessing the most significant technological shift since electrification.

Three years ago, broadly accessible artificial intelligence (AI) models did not exist. Today, AI is driving an unprecedented build-out of data centres and energy infrastructure across continents and looks set to profoundly reshape industrial processes and labour markets.

These two forces – technological transformation and geopolitical fragmentation – pull in opposite directions. One could dramatically raise our growth potential. The other could dramatically lower it. The result is a range of possible outcomes wider than anything we have faced in decades.

By one estimate, AI could lift annual productivity growth by up to 1.5 percentage points, an effect not seen since the early 20th century.^[4]

By another, severe fragmentation could reduce global output by up to 7% of GDP over a decade, equivalent to the combined economies of Germany and Japan.^[5]

With ageing populations, rising investment needs and limited fiscal space across most of the advanced world, where the world economy ends up between those outcomes could hardly matter more.

Navigating uncertainty

So how can we act under this kind of uncertainty?

Traditional macroeconomic models are not a sufficient guide, because they were calibrated on a world that may no longer exist: one of stable trade relationships and without a technology as pervasive as AI.

But there are two ways forward.

The first is to make our models better at handling uncertainty, which is what we are doing at the ECB. We have complemented our baseline forecasts with more systematic use of scenario analysis, which allows us to explore alternative futures without relying solely on past data.

We began this practice during the pandemic^[6], and have since published scenarios capturing other dimensions of the new environment: a cut-off of Russian gas, an

escalation of conflict in the Middle East, the effects of trade fragmentation, higher defence spending.

These scenarios have sharpened our understanding of how events might unfold. For example, in March 2022, just weeks after the Russian invasion of Ukraine, our baseline projected inflation at around 5% for that year. The adverse scenario we published alongside it already pointed to inflation exceeding 7% – close to the final figure of over 8%.^[7]

The second avenue is to look beyond the data window our models use. If the recent past is no longer informative, we need to look further back to episodes where the forces at work more closely resemble those we are seeing today.

This will not predict specific outcomes, but it can illuminate the current dynamics and the dangers ahead.

And if we look at the configuration in front of us today – extraordinary technological change unfolding alongside an erosion of global integration – there is a striking parallel.

A century ago, the 1920s delivered a wave of general-purpose technologies. The internal combustion engine transformed transportation. Assembly lines revolutionised manufacturing. Electrical networks brought power to factories and homes.

In the United States, output per worker in manufacturing nearly doubled between 1919 and 1929.^[8]

This technological optimism spilled into stock markets, fuelling a wave of exuberance. The Dow Jones rose nearly sixfold between 1921 and 1929.^[9]

But in parallel, the international environment was fracturing.

The pre-1914 era of open trade and capital flows – what historians call the “first globalisation” – had been shattered by the Great War. World trade as a share of global GDP, which had risen to about 21% in 1913, fell back to around 14% by 1929. By 1938, it had dropped to just 9%.^[10]

For much of the 1920s, technology and fragmentation appeared to develop on separate tracks. Many general-purpose technologies could diffuse through domestic infrastructure and national supply chains.

But fragmentation still exacted a heavy toll. War debts and reparations poisoned international financial relations throughout the decade, making cross-border capital flows fragile and politically contested. The damage came through a different channel: destroying the economic conditions in which their gains could be broadly realised.

When confidence finally broke – first with the Wall Street crash of 1929, then with a wave of bank failures across Europe – the absence of a functioning international order contributed to turning what might have been a severe recession into the Great Depression.

There was no framework left to coordinate a response or prevent the retaliatory spiral that followed: the Smoot-Hawley tariffs and the descent into economic nationalism.

This is the pattern history reveals. What looked like two independent forces were actually a single, compounding risk.

Technology and the international order were deeply interconnected, yet policymakers in the 1920s acted as if they were separate domains. Markets priced technological gains as if they could be sustained in a fracturing world. Policymakers allowed the trading system to fragment as if this would not constrain growth.

That pattern should shape how we think today. When two forces of this magnitude develop simultaneously, we should assume they interact with each other. And we should ask whether capturing the upside of one requires managing the downside of the other.

Today, financial markets do not appear to see this. In 2025, the S&P 500 hit record high after record high, even as effective US tariff rates reached their highest levels since the 1930s.

But the link between technology and the international order is actually far tighter today than it was a century ago.

Why AI cannot be separated from the global economy

In the 1920s, fragmentation damaged the economy around the technology. Today, it attacks the inputs on which AI itself depends, through three channels.

First, AI is uniquely dependent on physical trade, and that trade relies on a highly concentrated, multi-country supply chain.

Ford could vertically integrate within Michigan. AI chip manufacturers cannot. China refines around 90% of critical minerals and rare earths. The Netherlands' ASML is the sole supplier of extreme ultraviolet lithography. Advanced chip design is concentrated in the United States. Final fabrication is dominated by TSMC in Taiwan.

One estimate finds that building self-sufficient semiconductor supply chains across each major region would cost over USD 1 trillion in upfront investment alone and raise prices by 35-65%.^[11]

So countries trade instead, and the scale is striking: in 2025, around 42% of the increase in global goods trade was linked to AI-related investment.^[12]

AI is driving a resurgence in goods trade at precisely the moment fragmentation threatens to sever it.

Second, AI needs market scale to justify its economics.

The costs of the largest training runs are approaching the billion-dollar mark.^[13]

But once the models are trained, the marginal cost of deployment is near zero. That business model only functions if developers can spread fixed costs across a vast global market.

For example, the EU accounts for one-fifth of the global AI market^[14], and leading US tech companies derive around a quarter of their total revenues from Europe.^[15]

If markets fragment through divergent standards, data localisation or outright restrictions, the investment logic would collapse. Unlike Ford in the 1920s, a national AI champion cannot survive on domestic demand alone.

Third, AI scales with diverse data, and fragmentation directly degrades it.

Frontier models learn from vast troves of information spanning a variety of languages, institutions and real-world contexts. Research shows that larger and more diverse training data produce materially better results, even when computing power is held constant.^[16]

When data are restricted by localisation requirements or incompatible privacy regimes, models become parochial and brittle, performing well at familiar tasks but failing at the edge cases of a global economy.^[17]

Fragmentation degrades the intelligence of the technology itself.

In sum: in the 1920s, technology could keep delivering for a time, even as the international order frayed. With AI, that window may be much narrower. The technology's dependence on global integration is so fundamental that fragmentation would begin to erode it almost immediately.

The more AI becomes central to global growth, the more geopolitical fragmentation becomes systemically costly.

And this leads to a paradox we cannot ignore. At precisely the moment when the case for international cooperation is strongest – when the potential gains from integration are larger than at any point in living memory – the will to cooperate is at its weakest.

But that is a mistake. Every major economy, including the United States, has a direct and urgent interest in containing fragmentation – not out of attachment to the global order, but because the alternative is economic self-harm.

The case for layered cooperation

So how do we act on that interest in a highly uncertain world?

Robust strategies under uncertainty have a common feature: they do not depend on any single assumption holding true. They build in layers – if one fails, the others still hold.

The approach I want to outline has three such layers. Each is valuable on its own, but together they provide the resilience that uncertainty demands.

The first layer is the broadest: reforming the global institutions that *already* represent our common denominator.

As I argued recently at Columbia University, we should not be drawn into the fatalism about the international order that currently prevails. [\[18\]](#)

Nearly all countries are part of the International Monetary Fund and World Bank and 166 are part of the World Trade Organization. That is a hard-won foundation on which we should be building. We certainly should not destroy it.

The multilateral system has real flaws. But the answer is to fix the rules, not abandon the system. And this is not just the view of multilateralists: even the United States has put forward concrete reform proposals.

Those who dismiss this approach as naive should consider what they are offering instead. The balance-of-power model has been tried before. The history I have described today should remind us how it ended.

The second layer is narrower: deeper cooperation among allies.

This is currently difficult, and we should be honest about that. Alliances are under strain. Trust between partners who could once count on each other's support has been eroded.

But focusing on supply chains could actually break us out of the zero-sum logic that is currently driving us apart. When each partner can see that their own prosperity depends on what others are uniquely placed to provide, cooperation becomes self-interest.

Consider semiconductors. As I mentioned earlier, no single country, however powerful, can command the full range of capabilities that AI demands. If a country wants to reduce its vulnerability to the parts of the supply chain controlled by rivals, it has to work more closely with allies that hold indispensable positions in that supply chain.

That requires a common strategy: procurement rules and content requirements that favour supply chains running through allied countries; coordinated export controls that prevent leakage of critical technologies; and joint investment in the research that will define the next generation of chokepoints.^[19]

The third layer is minimum viable cooperation with rivals.

This is the hardest layer because it requires working with countries you actively distrust. But it may also be the most important – the greatest fragmentation risks run through relationships between rivals.

We have a partial precedent. Arms control during the Cold War did not depend on trust between the United States and the Soviet Union. It depended on the principle of “trust but verify”: mutual vulnerability and a shared recognition that the alternative was worse.

Economic interdependence is more complicated, because the vulnerabilities are not symmetric. Right now, a restriction on Chinese critical raw materials could shut other economies down within weeks. That is precisely why building allied cooperation in parallel is so important: the less exposed we are to coercion, the more credibly we can negotiate.

But even with these efforts, significant risks associated with this interdependence will remain, and we need frameworks to manage them. One could imagine something like a critical supply chain accord – major economies committing to maintain baseline flows of essential inputs even during periods of tension, subject to transparent monitoring and clear consequences for violation.

AI itself may offer more promising ground. Whatever our rivalries, no country has an interest in AI systems that destabilise financial markets, escape effective human control or expose their citizens to large-scale fraud and manipulation.

That should make it possible to negotiate a basic code of conduct, even among rivals – starting with transparency on the most dangerous capabilities and mechanisms to manage incidents before they escalate.

None of this will be easy. But it is also where the cost of failure is highest.

Together, these three layers provide the resilience that a world of genuine uncertainty demands.

Multilateral reform will move slowly. Allied coalitions will face political setbacks. Cooperation with rivals will be tested by every escalation. But if one layer weakens, the others hold.

That is the logic of layered cooperation, and it is the most robust response we have to the uncertainty of our time.

Conclusion

Let me conclude.

In 1347, Genoese merchants were confronted with political fragmentation across the Mediterranean, which rendered trade unpredictable. Corsairs disrupted trade routes and rival city-states competed violently.

In response, these merchants drafted the first known insurance contract as a means of sharing risk across borders.^[20]

This enabled them to pool their exposure and continue trading, even when the future could not be predicted.

They recognised that, in times of uncertainty, cooperation becomes more valuable.

We face a similar choice today. We can repeat the errors of the 1920s, treating technology and geopolitics as separate tracks until they inevitably collide.

Or we can embrace layered cooperation, recognising that in an era of systemic uncertainty, the most robust strategy is resilient integration – starting with strengthening the lowest common denominator.

In a world that is pulling apart, the most important act of risk management is to hold the essential connections together.

Thank you.

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