Index Investor LLC

Annual Three Year Scenarios Update

2022

About Index Investor LLC

- Since 1997, the mission of Index Investor and Retired Investor has been to help investors, corporate, and government leaders better anticipate, more accurately assess, and adapt in time to emerging macro threats
  - We provided early warning of the 2000, 2008, and 2020 crashes
- Index Investor is affiliated with Britten Coyne Partners and the Strategic Risk Institute LLC
- Britten Coyne has offices in London and Denver, and advises clients how to establish methods, processes, structures, and systems that enable them to avoid strategic failures
- The Strategic Risk Institute provides online and in-person courses leading to a Certificate in Strategic Risk Governance and Management

Agenda

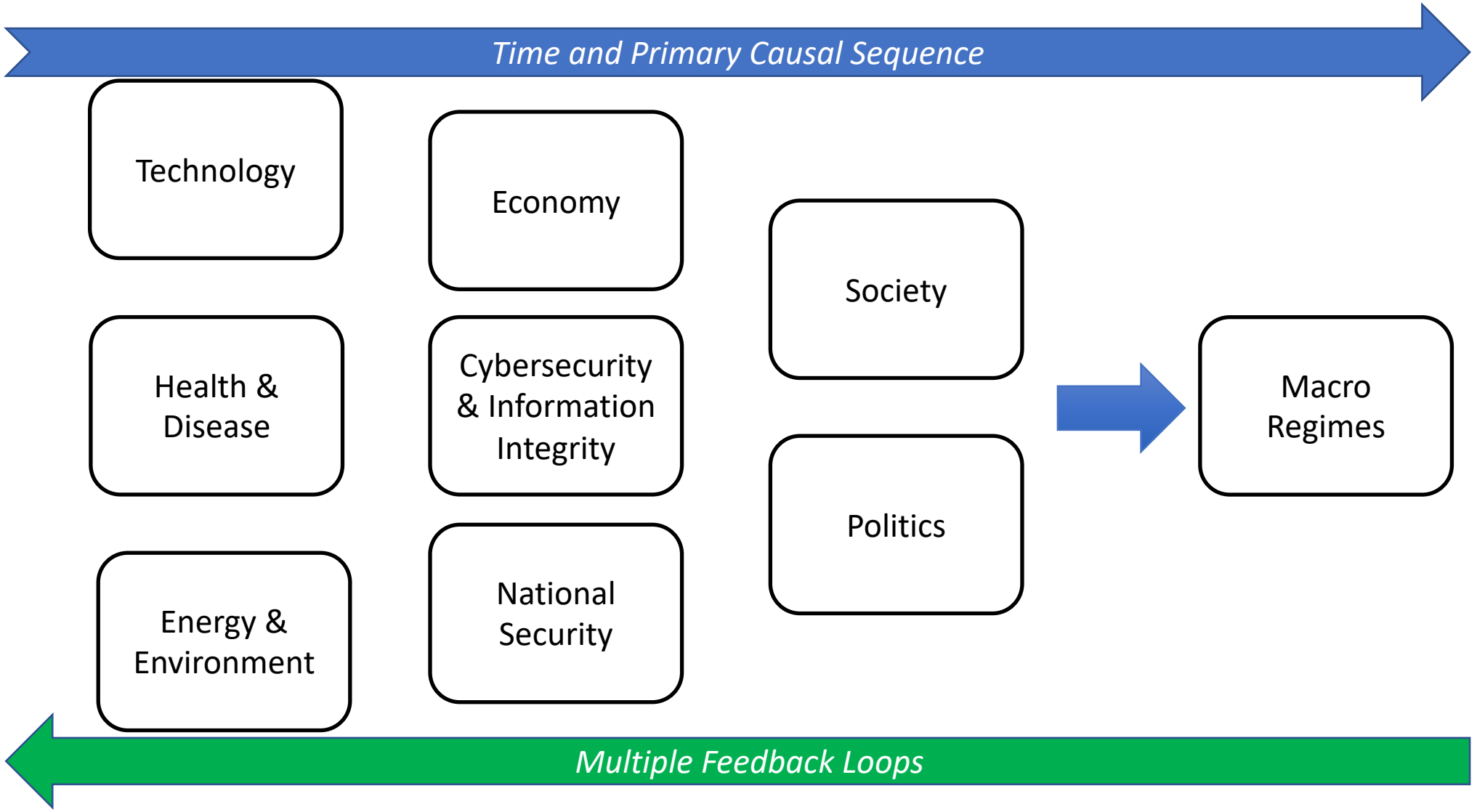
- Our Goals and the Underlying Forecasting Challenge We Face
- Multipath Methodology
- Slowly Changing Trends and Tipping Points
- Critical Uncertainties, Probabilities, and Scenarios
- Prospective Hindsight: Finding Paths that Lead to Each Macro Regime
- Conclusions and Implications
- How to Further Improve Your Forecast Accuracy

The Challenge: Forecasting Macro Regimes at a 36 Month Time Horizon

Background

- At the Index Investor, we provide insights about the evolving dynamics of the global macro system, and early warning of emerging threats that lie beyond the detection horizon and analytical capabilities of quantitative algorithmic methods
- Our goal is to identify and analyze the interaction of deep trends and uncertainties in a range of issue areas in order to accurately forecast the probabilities of four possible macro regimes, at 12 and 36 month time horizons
  - Normal Times (e.g., when equities deliver the best relative returns)
  - High Uncertainty (e.g., short Treasuries, foreign bonds, Swiss Franc)
  - High Inflation (e.g., real return bonds, property, commodities)
  - Persistent Deflation (e.g., long term bonds, consumer staples equities)

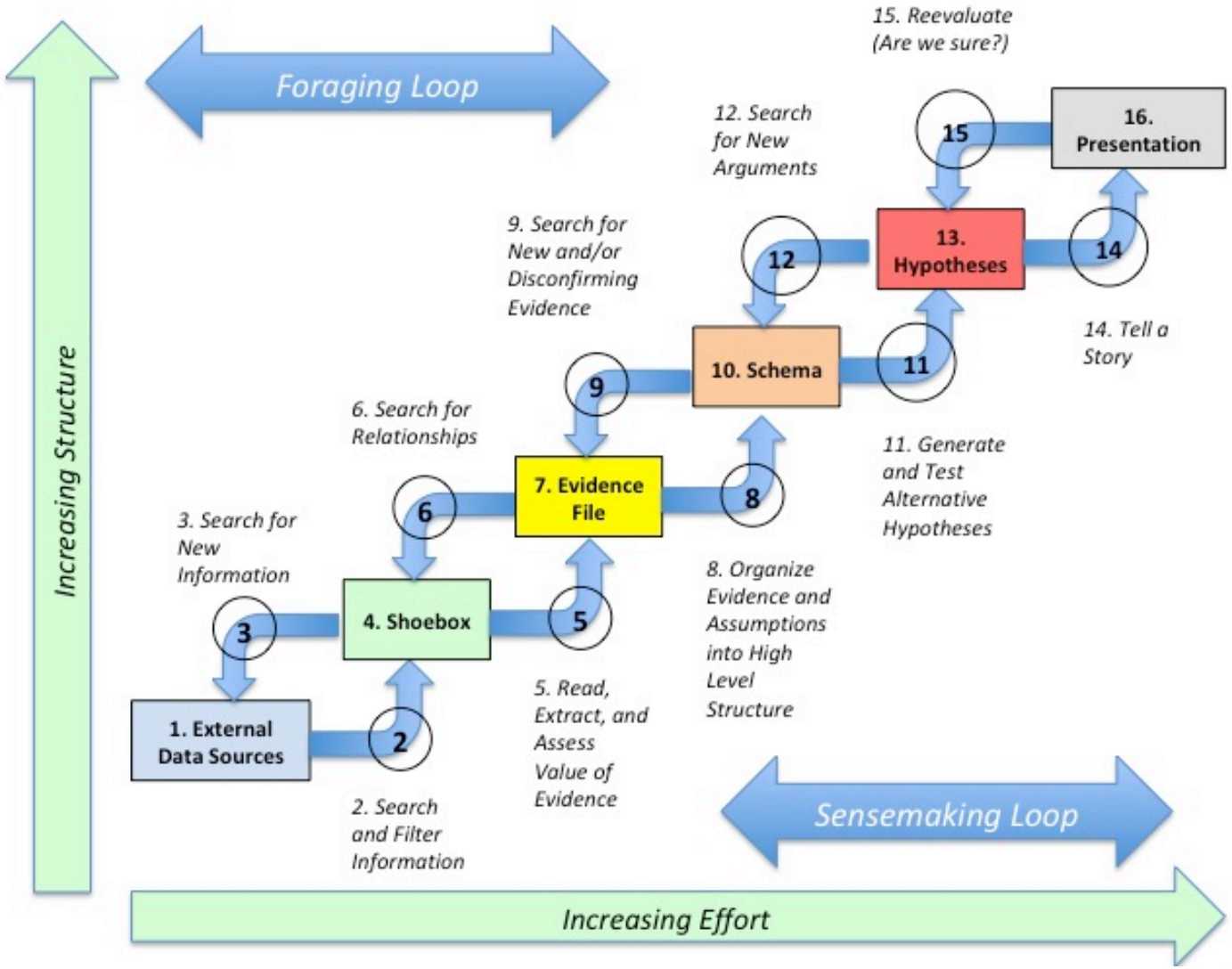
Regimes Emerge from a Complex Adaptive System



Our Forecasting Process Has Three Anchors

- The first is the what we learned from four years on the Good Judgment Project
  - Ask the right forecasting questions! What are the key causal drivers and critical uncertainties that underlie the target of your forecast?
  - When answering them, start with Base Rates, then use new high value evidence to update your estimates over time
    - In the cases of unique events and evolving systems, these base rates are inescapably noisy
  - Be ever alert to surprises. They warn that your mental model is wrong, and may indicate substantial discontinuities lie ahead
  - As Thomas Schelling famously noted, "*There is a tendency in our planning to confuse the unfamiliar with the improbable. The contingency we have not considered seriously looks strange; what looks strange is thought improbable; what is improbable need not be considered seriously*."
- The second is Pirolli and Card's dual top-down and bottom-up model of foraging and sensemaking in complex adaptive systems, as described by the graphic on the next slide

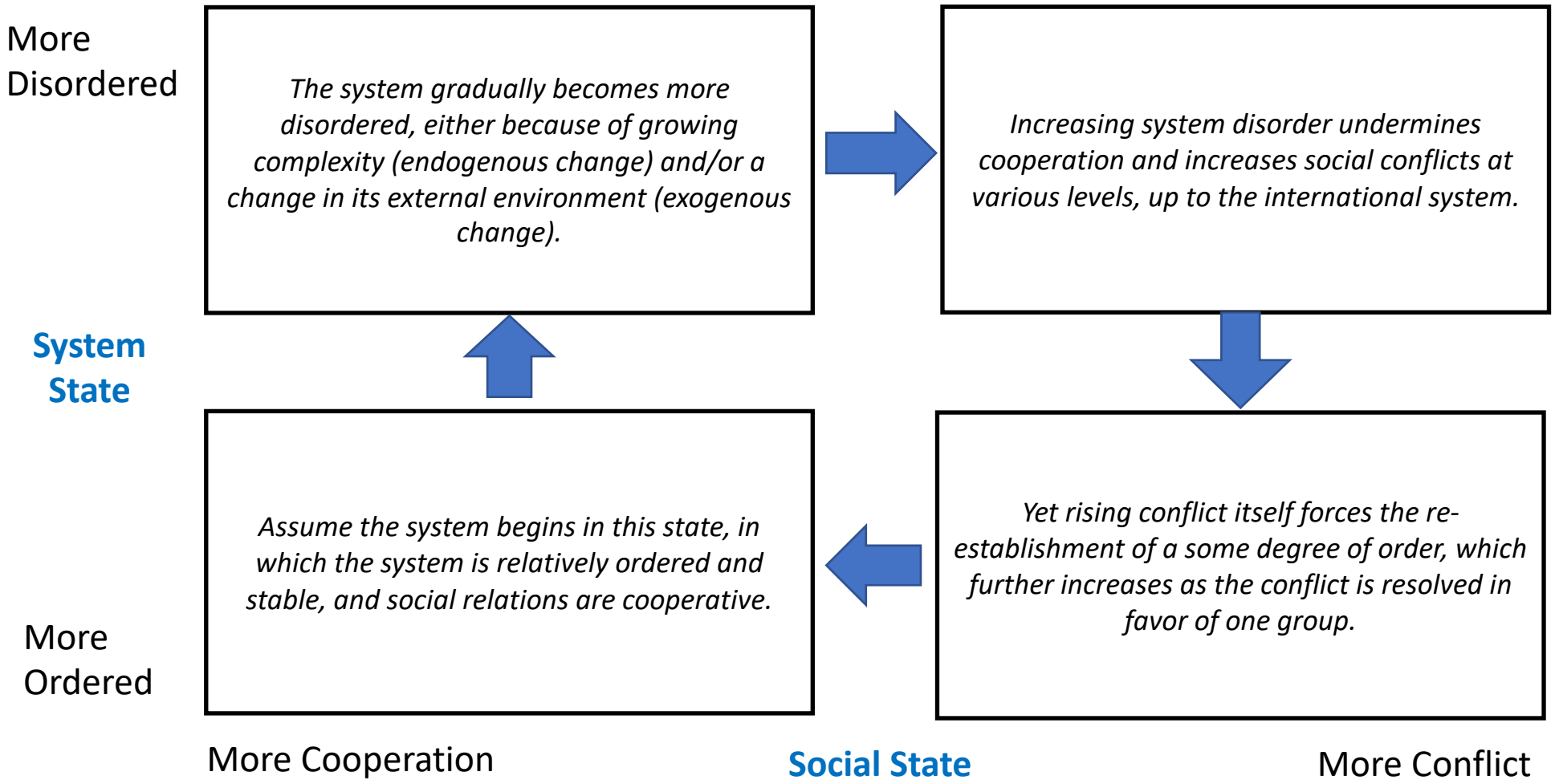
Pirolli & Card's Foraging/Sensemaking Model



Our Third Anchor: The Macro System's Deep Historical Dynamics

- Beneath the drivers and uncertainties in different issue areas, our reading of history and complex adaptive systems theory suggests that there are even deeper dynamics at work, which are driven by interacting degrees of system order/disorder and social cooperation/conflict
- This yields four different states. A crude reading of history suggests they last for roughly ten years
- Growing disorder and conflict of the 1930s gave way to the more ordered but still conflict ridden 1940s, which in turn evolved into the relatively more ordered and cooperative 1950s., which gave way to the increasingly disordered, but still cooperative 1960s, and then the disordered and relatively conflict ridden 1970s
- The system became more ordered again as conflict intensified in 1980s, which ended with the fall of the Berlin Wall and dissolution of the Soviet Union. This was followed by the more ordered and cooperative 1990s. Once again disorder increased during the 2000s, and in the just ended 2010s it grew worse and cooperation gave way to much higher levels of domestic and international conflict
- Assuming this model of macro dynamics has some predictive validity, in the 2020s conflict will increase. However, that should also drive the system towards a more ordered state (e.g., due to heightened fear of new existential threats, such as more powerful and aggressive China)

The Macro System's Deep Historical Dynamics



Multipath Methodology

Multipath Analysis: A Structured Approach to Reasoning About Key Trends and Critical Uncertainties

- Start by identifying important but slowly changing trends that are hard to change but easy to ignore until they pass a critical threshold (i.e., a "tipping point")
  - Estimate when that point will be reached, and what consequences will result
- Identify the key causal drivers of your forecasting goal, the critical uncertainties that will have the biggest effects on their outcomes, and their likely consequences
  - Given base rates (if available) for these uncertainties, and accumulated high value evidence, estimate your subjective probabilities of different outcomes
- Identify potential causal relationships between these drivers (e.g., chronological relationships, path dependencies and key feedback loops)
- Identify different paths through time and across trends and uncertainties that could lead to the emergence of different macro regimes
- For more on this, see our May 2019 article, "*Multipath Analysis: A Systematic Process for Reducing the Dimensionality of Global Macro Forecasting Challenges*"

Slowly Changing Trends

Two Slowly Changing Long-Term Trends are Critical

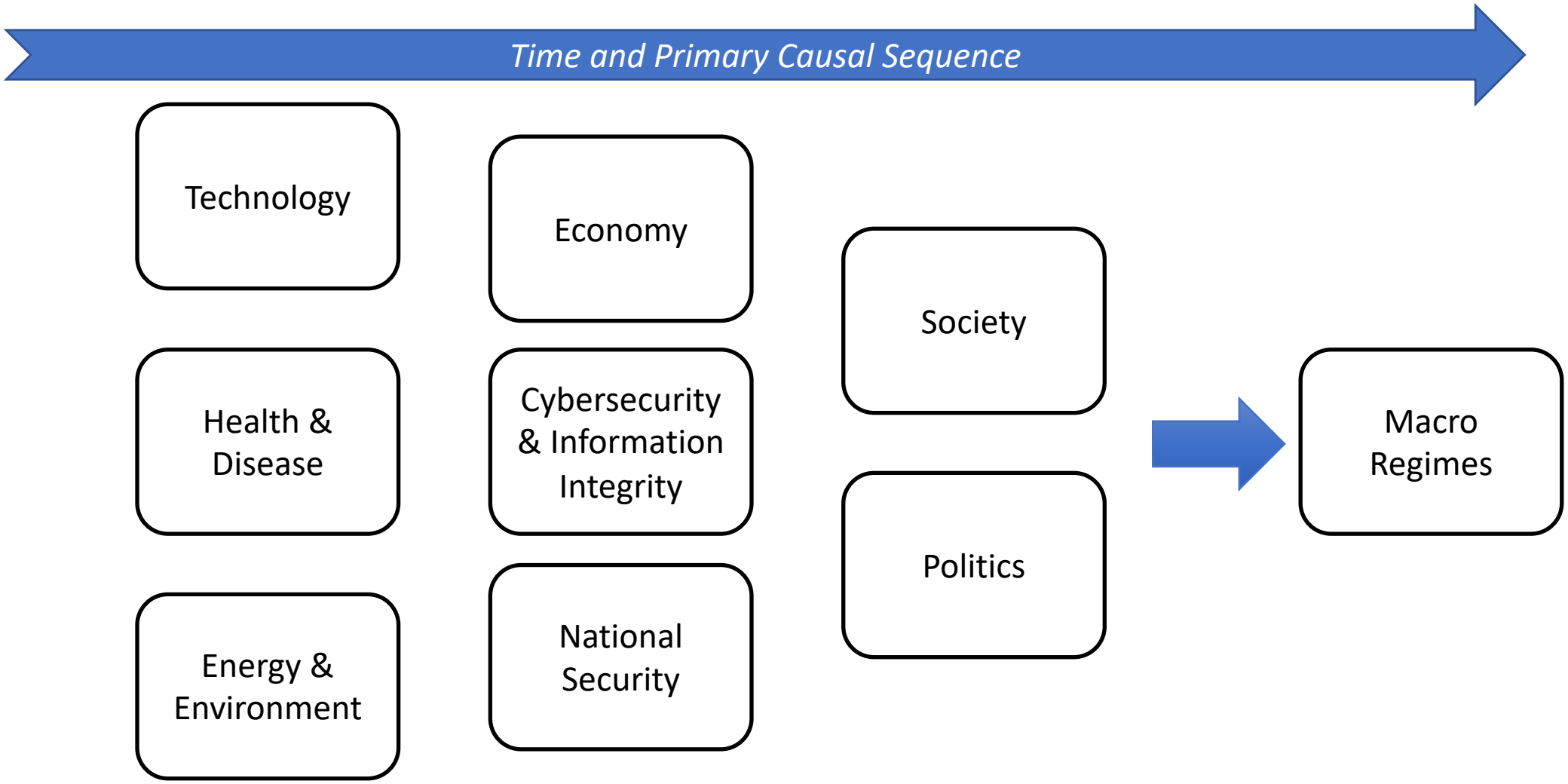
- Demographics
  - Around the world, baby boomers are retiring and living longer
  - Fertility is declining in developing nations
  - The Working Age Population (WAP) will therefore decline and, in the absence of productivity gains, put downward pressure on economic growth
  - Higher immigration can offset this. However, aging may also lower nations' cultural capacity and political willingness to absorb larger immigration flows
  - Differential birth rates across ethnic groups is also changing the makeup of the electorate in many countries.
  - In some cases this is weakening social cohesion and increasing political polarisation and conflict

Long-Term Trends (cont'd)

- Climate Change
  - As we have noted in our Evidence Files, the global climate is a very complex system, and models that seek to forecast both the timing and consequences of warming are subject to substantial uncertainties
  - While people disagree about the relative importance of various underlying causes, the evidence is clear that our planet is (on average) growing warmer (at an accelerating rate), and this is causing a range of effects
  - The critical point is that we cannot say with any significant degree of confidence how close we may be to potentially critical tipping points, such as a substantial weakening or shutdown the the Atlantic Meridional Overturning Circulation, that could potentially trigger major consequences (e.g., for food supplies and/or migration flows)

Critical Uncertainties, Probabilities, and Scenarios

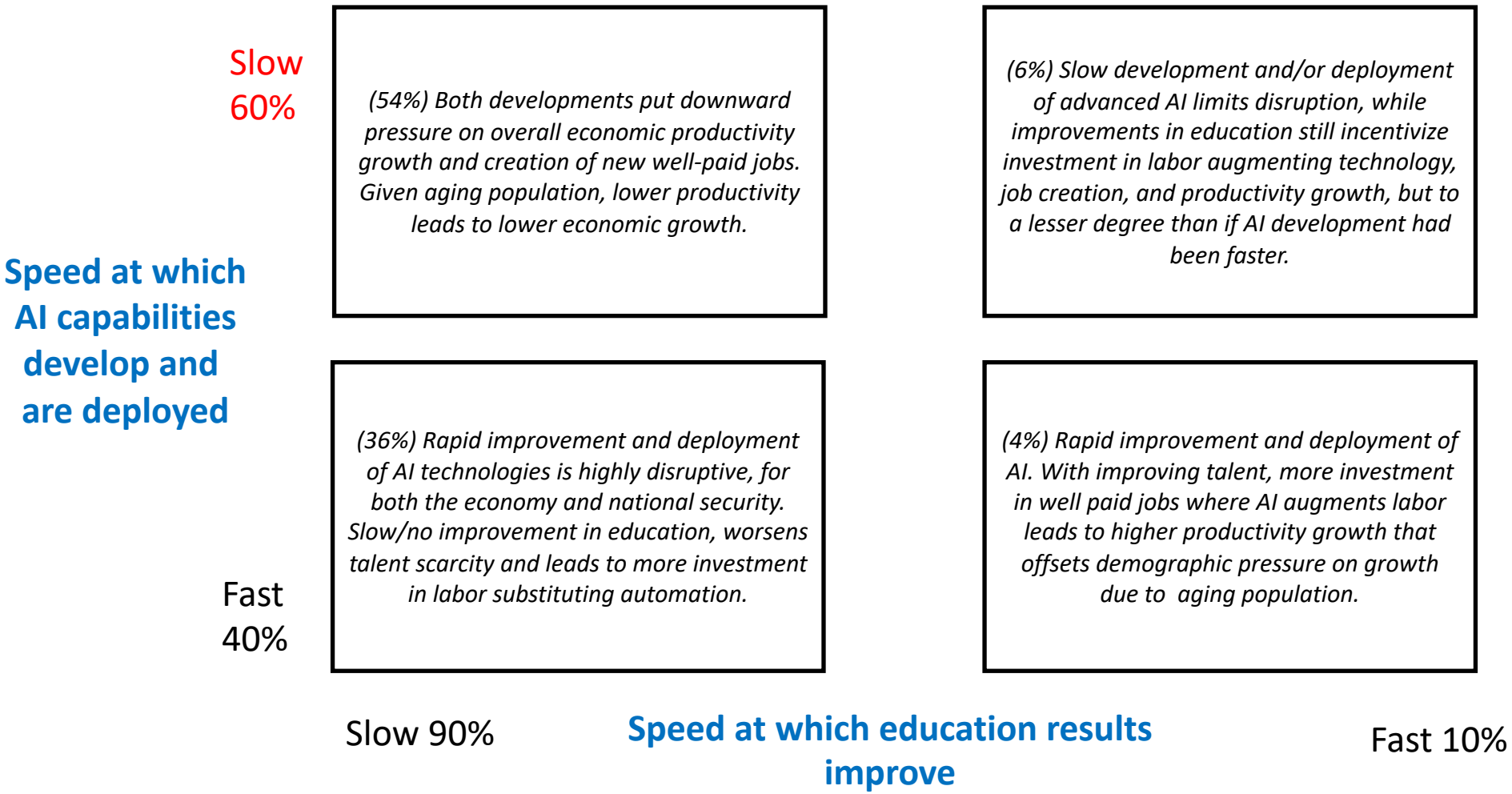
We Have Created Scenarios Based Critical Uncertainties in Nine Areas



Technology Uncertainties

- Will AI that is capable of causal and counterfactual reasoning about complex adaptive systems be developed and deployed by 1Jan2025?
  - This will mark an order of magnitude change in AI's capabilities
  - Probability forecast: 40% yes; 60% no
- By 1Jan2025, will the US achieve a substantial improvement in education, reskilling, and lifetime learning results, to induce the creation of more new jobs in which advanced AI is used to augment rather than substitute for labor? If this doesn't happen, there will likely be more investment in labor substituting automation and much weaker growth well-paid jobs
  - Probability forecast: 10% yes; 90% no

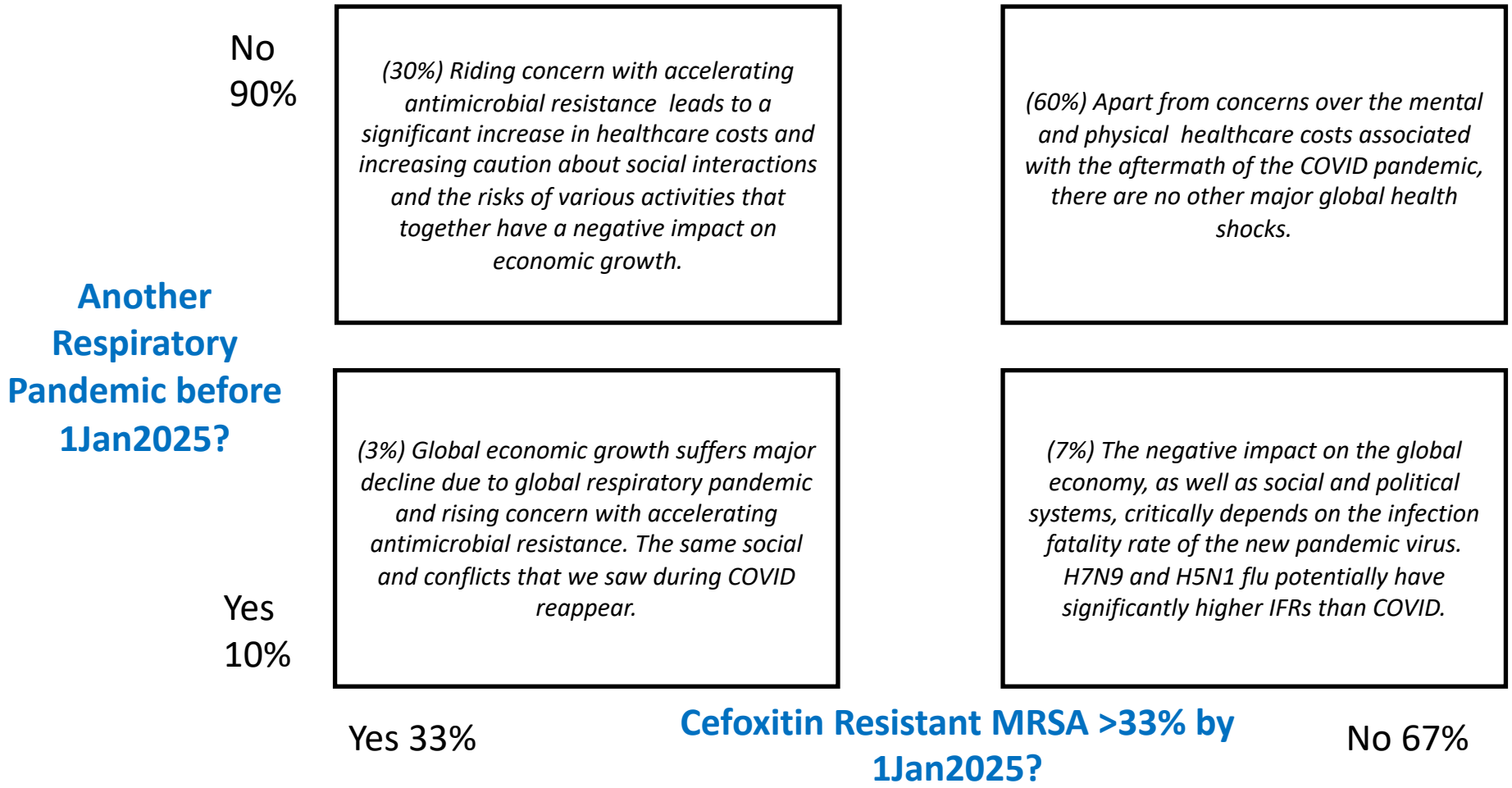
Technology Scenarios



Health and Disease Uncertainties

- By 1 Jan2025 will the world experience another major respiratory pandemic, caused by influenza or another virus?
  - Reference: ”*Intensity and Frequency of Extreme Novel Pandemics*”, by Marani et al
  - Probability forecast: 10% yes; 90% no
- Growing Antimicrobial (also known as antibiotic) resistance. By 1 Jan 2025, will the World Health Organization report that the median value of patients resistant to the use of Cefoxitin to treat Staphylococcus aureus (MRSA) infections (currently 21%) is greater than 33%?
  - References: WHO, “*Global Antimicrobial Resistance and Use Surveillance System (GLASS) Report: 2021*”, and “*Antibiotic Resistance, Mutation Rates and MRSA*”, by: Leslie Pray
  - Probability forecast: 33% yes; 67% no

Health and Disease Scenarios

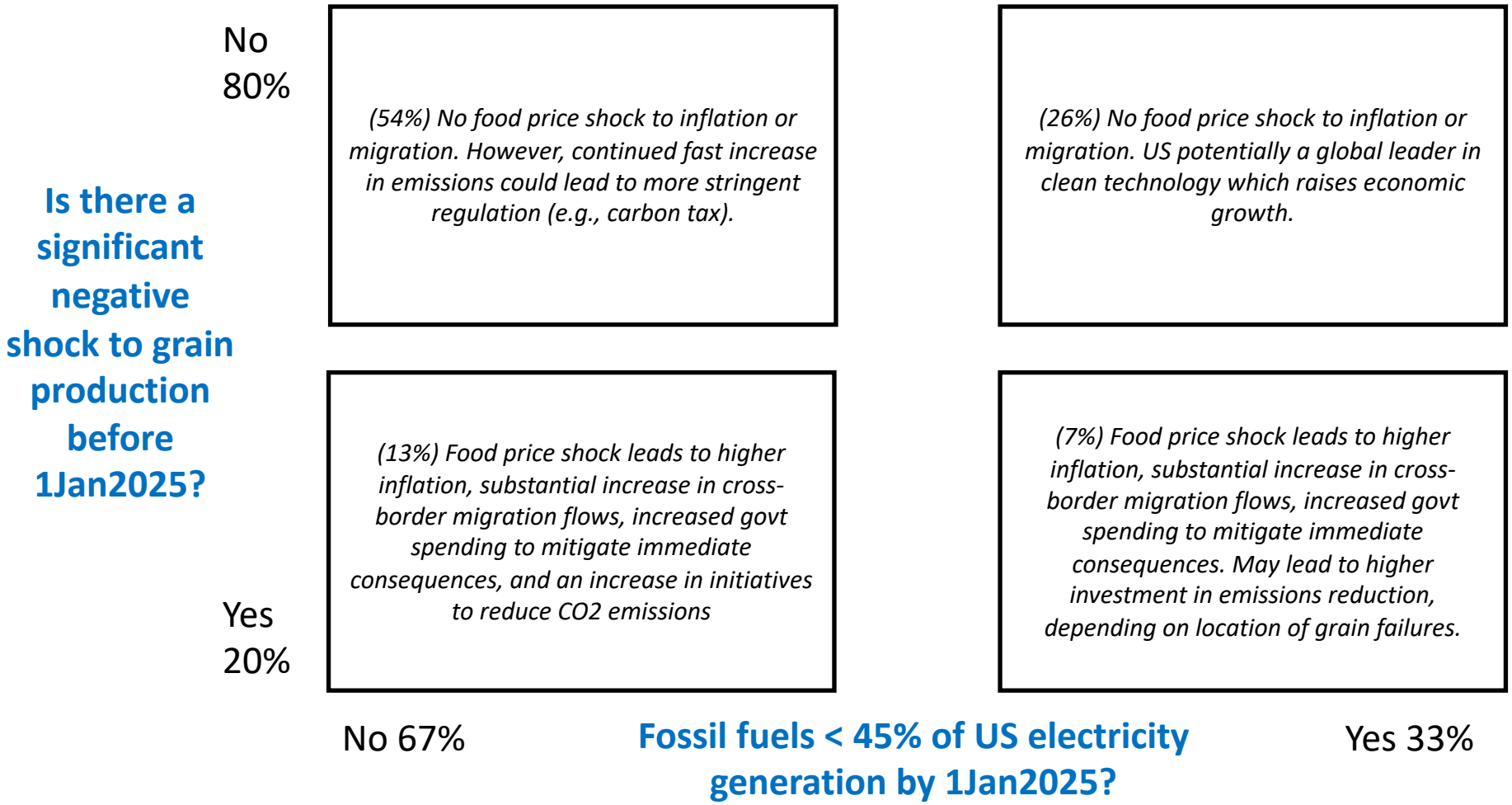


Energy and Environment Uncertainties

- Will there be a significant negative shock to grain production (>10% reduction in the annual global wheat or corn crop) before 1 Jan 2025?
  - Probability forecast: 20% yes; 80% no

- Will fossil fuels be used for 45% or less of US electricity generation by 1Jan2025? According to the US Energy Information Administration, in 2020 they accounted for about 60%.
  - Probability forecast: 33% yes, 67% no

Environmental Scenarios



Economic Uncertainties

- Will labor productivity growth in the US non-farm business sector be equal to or greater than 2.8% by 1Jan2025?
  - Between 1947 and 1973, average annual US labor productivity growth was 2.8%. Between 20027 and 2019 it fell to 1.4%. With a declining working age population, increased labor productivity is critical for economic growth
  - Raising productivity requires a combination of improved technology, higher public and private investment, and/or workers with more knowledge and skill
  - Probability forecast: 40% yes; 60% no
- Debt (included unfunded defined benefit pension plans) is at high levels, and in the coming years, some of it must be restructured. Conflict driven restructuring will slow growth (and risk a loss of confidence in the US Dollar); while a less disruptive cooperative approach would sustain a higher rate of growth
  - Probability forecast: Conflict driven 80%; Cooperative 20%

Economic Scenarios

Is labor productivity => 2.8% by 1Jan2025?

Yes 40%

No 60%

(32%) Improving technology, rising public and private investment, and better education and worker reskilling results boost productivity. But complex credit structures and political opposition lead to conflict driven debt restructuring.

(12%)) Improving technology, rising public and private investment, and better education and worker reskilling results boost productivity. Changed bankruptcy procedures and political deals (e.g., more pension funding and no benefit cuts in exchange for better education system results) lead to cooperative debt reduction.

(48%) Weak demand, failure to improve human capital, and pressure for higher government transfer payments limit public and private investment and productivity gains. Complex credit structures and political opposition lead to conflict driven debt restructuring

(8%) Weak demand, failure to improve human capital, and pressure for higher government transfer payments limit public and private investment and productivity gains. Changed bankruptcy procedures and political deals lead to cooperative debt reduction.

Conflict 80%

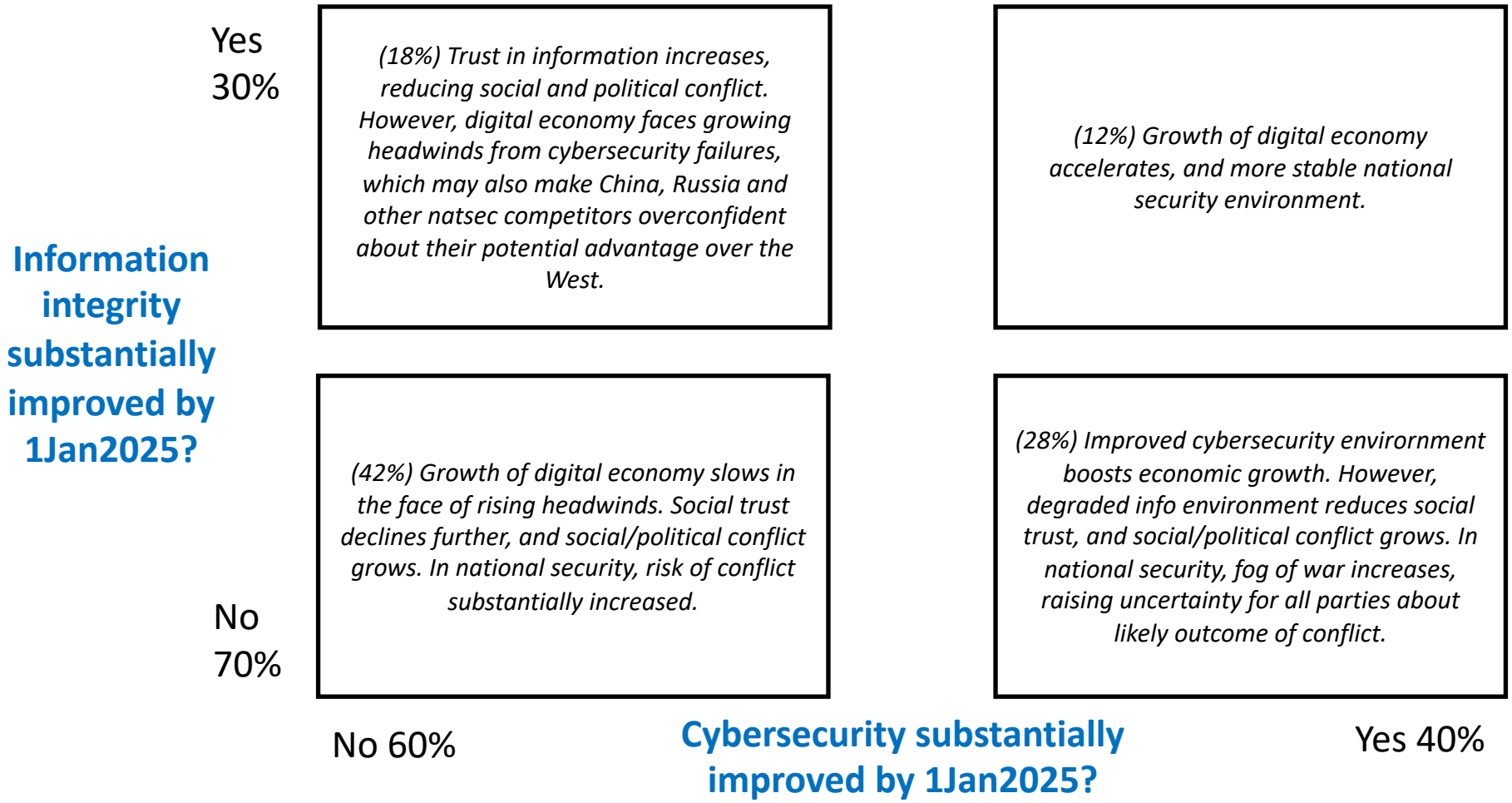
How are global debt problems resolved?

Cooperation 20%

Information Integrity and Cybersecurity Uncertainties

- The rise of fake news and fake images/videos have highlighted information integrity (accuracy and reliability) as a pervasive issue. If not resolved, it will depress the growth of our digital economy, and also have negative implications for national security.
  - Probability forecast: Substantial gains in information integrity by 1 Jan 2025: 30% yes; 70% no
- In recent years the cybersecurity environment has also been degraded, as evidence by increased hacking, ransomware attacks, data theft/espionage, etc. In this area, the advantage lies with the attacker who must be right only once; the defender must be right all the time
  - Probability forecast: Cybersecurity substantially improves by 1 Jan 2025: 40% yes; 60% no

Information Integrity and Cybersecurity Scenarios



National Security Uncertainties

- We have written extensively about the intensifying conflict between the United States and China (e.g., "*Will Xi Jinping Launch a Surprise Attack on Taiwan Before the 20th Party Congress of the CCP in November 2022? And What Happens if He Does?*" in our October 2020 issue).
  - Probability forecasts: Will US and Chinese forces have a violent conflict involving more than 100 deaths before 1 Jan 2025? 75% yes, 25% no
- Before 1 Jan 2025 will there be a major advance in technology and/or doctrine that provides an adversary with a major military advantage over the United States and its allies?
  - Probability forecast: 60% yes; 40% no

National Security Scenarios

US/China Conflict with >100 casualties before 1Jan2025?

No 25%

Yes 75%

(15%) While damage from war with China is avoided, realization of the west's vulnerability leads to a large, sustained increase in military spending and change in the structure of the economy to higher investment, higher taxes, and lower consumption.

(10%) Increased focus on building an Anglosphere-led global alliance to contain China. Increase in military spending, but no major restructuring of national economies.

(45%) Long-term disruption of global supply chains and damage from cyberattacks lead to higher inflation, as well as negative economic growth until large, sustained increase in military spending restores demand – but with higher investment, higher taxes, and lower consumption.

(30%) Long-term disruption of global supply chains and damage from cyberattacks lead to higher inflation, as well as negative economic growth until large, sustained increase in military spending restores demand, but without major economic restructuring.

Yes 60%

Adversary Gains Significant Military Advantage over US by 1Jan2025?

No 40%

Social Uncertainties

- Will income (after government transfer payments), education, health, and other measures of socially corrosive inequality in the United States increase or decrease between now and 1 Jan 2025?
  - Probability forecast: 67% increase; 33% decrease

- Martin Gurri has described the current situation as follows: “The digital battering of institutions has entered the recurrent nightmare phase: less a tidal wave than a maelstrom that threatens to swallow the entire system of politics and government. An angry public remains fixated on negation to the edge of nihilism.” Will growing individual alienation/anomie, declining social capital, and rising anger at elites strengthen or weaken in the United States between now and 1 Jan 2025?
  - Probability forecast: 80% increase; 20% decrease

Social Scenarios

Will various inequalities (income, wealth, education, regional) increase/decrease by 1Jan2025?

Decrease 33%

Increase 67%

(26%) Aggressive policies by the Biden administration reduce some inequalities (e.g., income after transfers and taxes) However, the absence of increases in middle class jobs leads to further increases in alienation, decreases in social capital, and worsening social conflict.

(7%) Aggressive policies lead to a rise in well paid middle class jobs and falling income inequality after transfers and taxes. The introduction of universal national service and/or rising realization of the existential danger posed by the worsening conflict with China renews social capital and reduces social conflict.

(54%) The aftermath of COVID worsens multiple inequalities, while the mutual antagonism of left and right populists proves to be stronger than the intensifying China threat, leading to continued increase in social conflict and erosion of social capital.

(13%) The aftermath of COVID worsens multiple inequalities. However, the introduction of universal national service and the rising threat posed by China renews social capital and reduces social conflict.

Increase 80%

Individual alienation and fragmentation of social bonds between now and 1Jan2025?

Decrease 20%

Political Uncertainties

- Following the loss of confidence public sector institutions during the COVID pandemic, will government institutions' competence and capacity for effective action to successfully address critical problems facing the nation (and the public's confidence in them) increase or decrease between now and 1 Jan 2025?
  - Probability forecast: 20% increase; 80% decrease

- Will there be a major crisis of political legitimacy in the United States following the presidential election in November, 2024?
  - Probability forecast: 67% yes; 33% no

Political Scenarios

Major Political Legitimacy Crisis in US Following 2024 Presidential Election?

No
33%

Yes
67%

(24%) Centrist political parties of both the left and right strengthen and the appeal of populist political extremes weakens. However, bureaucratic resistance to reforms and ineffective government response to existential threats reduces the perceived legitimacy of political and government institutions.

(6%) Centrist political parties of both the left and right strengthen and the appeal of populist political extremes weakens. The perceived legitimacy of political and government institutions improves, and national capacity for collective action increases (e.g., due to political leadership and/or common perception of an existential threat).

(56%) The political center further erodes and the populist extremes continue to strengthen as the bureaucracy's poor performance further weakens confidence in and the perceived legitimacy of political and government institutions.

(14%) The political center continues to weaken and the populist extremes continue to strengthen. However, political capacity for collective action (and the perceived legitimacy of political and government institutions) increases due to exceptional political leadership or shared fear of an existential threat.

Decreases 80%

Government competence and capacity to address critical issues

Increases
20%

There Are Feedback Loops Between Many of These Issues that We Haven't Explicitly Considered

- This framework focuses on the time-based dependencies between the eight causal drivers we identify
- It does not explicitly discuss feedback loops between these drivers, some of which are often equally important
  - For example, in the economy labor productivity gains depends not only on improvements in AI technology and human capital quality, but also on the willingness of businesses to invest, which in turn depends on the extent of their uncertainty about future demand, taxes, and other factors
  - This uncertainty is strongly affected by uncertainties about the expected outcomes for other causal drivers
  - As John Maynard Keynes long ago noted, the "state of confidence" has a critical impact on willingness to spend and invest, thus on future demand

Prospective Hindsight: Finding Paths Through Eight Uncertainties that Lead to Each Macro Regime

The Challenge of the Forecasting Complex Systems

- Even after using these scenarios to reduce the dimensionality and complexity of our macro forecasting challenge, we are still left with a seemingly unwieldy 65,536 (4^8) possible combinations of scenario outcomes, if we assume all combinations can occur.
- For this reason, we use these scenarios as tools for reasoning both forward and backward in time to better understand the dynamics that could produce different macro regime outcomes, and to identify potential sources of future non-linearities and discontinuities
- This method also makes it much easier to gain an edge by developing early warning indicators and more efficiently sifting through the daily data deluge to identify high value information that is much more likely to be observed (or not observed) if a particular outcome for a critical uncertainty is developing

Prospective Hindsight

- Human beings are much better at explaining why something happened in the past than they are at forecasting what will happen in the future
- “Prospective Hindsight” takes advantage of this, and asks forecasters to assume something has already happened, and to explain the causal sequence that led to it
- Forecasters using this method usually place higher probabilities on different outcomes than forecasters who use traditional methods that reason about the future from the perspective of the present

Interacting Paths that Lead to Each Macro Regime in on 1Jan2025: Return to the Normal Regime

- Improvements in education lead to increased creation of well paid jobs as advanced AI is deployed at an accelerating rate (4% probability)
- No new global respiratory pandemic, and no acceleration in the rate at which antimicrobial resistance is growing (60%)
- Significant reduction in fossil fuel use for electricity generation, and no food supply/price shock (26%)
- Cooperative debt reduction and higher labor productivity growth lead to faster economic growth, despite shrinking working age population (12%)
- Improved information integrity and cybersecurity reduce misinformation and uncertainty, leading to faster growth of the digital economy (12%)
- Violent conflict with China is avoided and there is no loss of US military advantage due to negative technology and/or doctrine surprises (10%)
- Inequality and alienation decrease, reducing social conflict (7%)
- Government competence and capacity improve, and there is no legitimacy crisis following the 2024 US presidential election (6%)

Interacting Paths that Lead to Each Macro Regime by 1Jan2025: Extended High Inflation Regime

- Slow deployment of advanced AI along with failure to improve education results both limit productivity growth (54%)
- Second respiratory pandemic and accelerating antimicrobial resistance severely disrupt supply chains (3%)
- No reduction in fossil fuel use for electricity generation and a food supply/price shock (13%)
- Cooperative private sector debt and public pension debt reduction limits demand reduction, but slow productivity growth weakens supply chains (8%)
- Information integrity/cybersecurity challenges not met, leading to disarray in supply chains (42%)
- Conflict with China substantially damages global supply chains, but there is no negative military capability surprise (30%)
- Increased taxes and transfer payments reduce inequality and boost demand, but absence of job creation increases individual alienation and social conflict (26%)
- Government fails to address critical challenges, legitimacy crisis, and loss of confidence in the US dollar (56%)

Interacting Paths that Lead to Each Macro Regime by 1Jan2025: The Persistent Deflation Regime

- Failure to improve education worsens talent shortage, leading to more labor substituting investment when advanced AI technologies are deployed, which puts pressure on governments' social safety net budgets (36%)
- Another global respirator pandemic and accelerating antimicrobial resistance substantially weaken demand (3%)
- Weak reduction in fossil fuel use for electricity generation (but green infrastructure projects only provide weak growth boost). No food supply/price shock (54%)
- Conflict driven private sector debt restructuring (debt deflation) and conflict driven public pension debt reduction, along with low productivity growth, raise uncertainty and reduce private sector demand (48%)
- Information integrity/cybersecurity challenges not met; uncertainty increases, reducing private sector demand (42%)
- Conflict with China and a negative capability surprise sharply increase uncertainty and reduce private sector demand (45%)
- Inequality increases (further weakening growth). Individual alienation increases and social conflict grows, increasing uncertainty and depressing growth (54%)
- Government competence decreases and 2024 legitimacy crisis both weaken private sector demand (56%)

Interacting Paths that Lead to Each Macro Regime by 1Jan2025: The High Uncertainty Regime

- Within each of the eight issue areas, the lower left outcome is the worst, and the upper right the best
- The other two are mixed; their development is more likely to increase uncertainty in that issue area
- The more of these uncertain outcomes that emerge across the eight issue areas, the more likely it will be that the macro system will be in the High Uncertainty Regime

Conclusions and Implications

Correlation of Forces / Net Assessment

- During the Cold War, the Soviet Union and the United States used similar methods to analyze the interaction of multiple factors in order to reach conclusions about the current state and likely future evolution of the global system
  - The Soviet Union used “Correlation of Forces” analysis
  - The United States used “Net Assessment”
- The application of either method to today’s circumstances would almost certainly reach the conclusion that the next three years will be a very dangerous period, with far more possible downside than upside outcomes
  - Moreover, the potential negative impact of many of these outcomes has probably been underestimated, sometimes badly so, by many investors

Highest Probability Scenario Outcomes by 1Jan2025, by Issue Area

- Slow deployment of advanced AI and slow/no improvement in education results (54%)
- No global respiratory pandemic after COVID, and no acceleration in rate at which antimicrobial resistance is growing (60%)
- No food price shock, but fossil fuel reduction targets aren't met and actual demand stimulus from green investments is weaker than hoped (54%)
- Labor productivity growth <2.8%, with intense conflicts over restructuring private sector debt and public pension debt (48%)
- Neither information integrity nor cybersecurity challenges are successfully met; both continue to worsen producing a substantial increase in uncertainty (42%)
- Conflict with China with >100 casualties and technological / doctrinal surprise gives an adversary a significant (if likely temporary) military advantage over the US (54%)
- Inequality increases and social conflicts grow in many nations (54%)
- Government competence and capacity to address critical challenges does not improve, and the US experiences a crisis of political legitimacy after the 2024 presidential election (54%)

The Rough Time Sequence of Different Drivers Highlights Key Leverage Points/Warning Indicators

- Early deployment of advanced AI capabilities (causal and counterfactual reasoning) and substantial improvement in education and reskilling results are important indicators at they will have a strong impact on productivity and the extent and nature of future job creation
- Another global respiratory pandemic, particularly one caused by an influenza virus with a significantly higher Infection Fatality Rate than COVID would be a major negative shock to the world economy, especially at a time when public and private debt levels are already very high. Accelerating antimicrobial resistance would also have a negative, but less significant impact on global supply chains and demand
- Lower fossil fuel use for power generation (without large price increases for end users) and a significant demand boost from the Biden administration's green spending plans both critically depend on three key assumptions that are very uncertain:
  - That large amounts of new transmission can be built, grid-scale battery storage can be quickly deployed, and the grid control challenges posed by a substantial increase in variable renewable generation (from wind and solar) can be overcome

Leverage Points and Warning Indicators (cont'd)

- A food supply/price shock driven by climate change would almost certainly trigger more aggressive regulatory actions to force larger emissions cuts more quickly, which would almost certainly be accompanied by significantly higher energy costs. In turn, this would very likely have a substantial negative impact on both demand and inflation, similar to the 1973 and 1979 oil price shocks
- The potential negative impact of worsening cybersecurity and information integrity conditions in multiple areas (the economy, national security, society, and politics) has almost certainly been underestimated by many
- The potential negative impacts of increasing public pension funding deficits (which have grown much worse as interest rates have declined, and will grow worse still when asset class valuations return to normal), as well as the negative impact of prolonged conflicts over private sector debt restructuring have also been underestimated

Leverage Points and Warning Indicators (cont'd)

- War risk, and the consequences of war, are always underestimated by investors, and the probability of a substantial violent conflict between China and the United States (most likely over Taiwan) is no exception to this rule
- An underappreciated risk is that the confluence of technological and military doctrinal trends may lead to the shock discovery that an adversary or adversaries of the United States and its allies (ie., China and Russia) have developed a significant military advantage
  - E.g., see, "*Technology and Strategic Surprise: Adapting to an Era of Open Innovation*", by Audrey Cronin; "*Emergent Technology, Military Advantage, and the Character of Future War*", by Mark Ghilchrist; and "*Capability Surprise*" by the US Defense Science Board

Leverage Points and Warning Indicators (cont'd)

- As political conflicts have become more driven by identity (and anger at elites) rather than policy issues, social and political uncertainties have become deeply intertwined. Inequality reduction is critical; however, the relative emphasis on achieving it via redistribution (tax and transfer payments) or via the creation of more well-paid jobs is also important. The former will very likely generate more conflict than the latter
- Job creation, economic growth, reduced social conflict, and demonstrated improvement in the governments' competence and capacity to successfully meet the large challenges facing the United States and other nations are all critical to weakening left and right populism and renewing the political center – speeches alone will not accomplish this

Leverage Points and Warning Indicators (cont'd)

- The most important "wild card" that could dramatically alter this forecast is the almost certain reaction to the outbreak of violent conflict between the United States and China that involves significant casualties and causes permanent damage to global supply chains
  - Regardless of economic and social conditions, this would almost certainly reduce political polarization, as well as trigger the removal of bureaucratic obstacles that have blocked improvements in government competence

A Final Word of Caution

- In their paper "*False Precision, Surprise, and Improved Uncertainty Assessment*", Parker and Risbey highlight five conditions – all of which exist in the global macro system today – that increase the potential for surprise
  - System complexity is high
  - We have limited knowledge about what has caused past system behavior
  - We are overconfident about the extent of our understanding of the system's causal processes
  - The number of times in the past the system's behavior has surprised us
  - The extent to which the system is operating under novel conditions
- Unfortunately, any surprises that emerge over the next three years seem much more likely to be on the downside than the upside

How to Further Improve Your Forecast Accuracy

To Improve Your Predictive Accuracy, Combine This Forecast With Others

- Research has found that three steps can improve forecast accuracy. The first is seeking forecasts based on different forecasting methodologies, or prepared by forecasters with significantly different backgrounds (as a proxy for different mental models and information). The second is combining those forecasts (using a simple average if few are included, or the median if many are). The final step, which significantly improved the performance of the Good Judgment Project team in the IARPA forecasting tournament, is to "extremize" the average (mean) or median forecast by moving it away from 50% and closer to 0% or 100%.
- Forecasts for binary events (e.g., the probability an event will or will not happen within a given time frame) are most useful to decision makers when they are closer to 0% or 100% rather than the uninformative "coin toss" 50%. As described by Baron et al in "*Two Reasons to Make Aggregated Probability Forecasts More Extreme*", forecasters will often shrink their probability estimates towards 50% to take into account their subjective belief about the extent of potentially useful information that they are missing.
- When you average multiple forecasters' estimates, you are including more information, which should reduce forecast uncertainty and push the mean estimate closer to 0% or 100%. However, this doesn't happen when you use simple averaging. For this reason, forecast accuracy is increased when you employ a structured "extremizing" technique to move the mean estimate closer to 0% or 100%. You can download our extremizing XLSX model here