

Pendulum

Aristarchus of Samos was the first to propose a heliocentric model of the universe, 2,300 years ago. Observing the time it took for the Earth's shadow to engulf the Moon during a lunar eclipse, Aristarchus applied some basic geometric calculations to determine the relative size and distance of the Moon and the Sun to the Earth. He determined that the Moon was much smaller, and that the Sun was many times larger than Earth. Given the enormous size of the Sun, he postulated that it was the Earth that revolved around the Sun, and not the other way around.

If this heliocentric model were true, then the only explanation for day and night is the rotation of the Earth on its axis. Both hypotheses, that the Earth revolves around the Sun and rotates on its axis, are not demonstrably true. No one sees or feels the Earth move,¹ nor do the stars change relative position in the sky, known as stellar parallax, which would be a consequence of the heliocentric model.

¹ Except for Carole King.

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So the heliocentric model is observably false, which is why Aristotle favored the geocentric model of the universe. Since we all remember Aristotle and no one has heard of Aristarchus, the geocentric model prevailed until 1543, when Nicolaus Copernicus revived Aristarchus' ideas with his own detailed calculations.² Still, even Copernicus could not explain the absence of stellar parallax: the positions of the stars relative to their background should change if the Earth were moving. Copernicus also challenged the prevailing theology of humans' privileged position in the universe, and did not find favor among the religious authorities. Galileo, among others, would later be prosecuted for espousing such heresy.

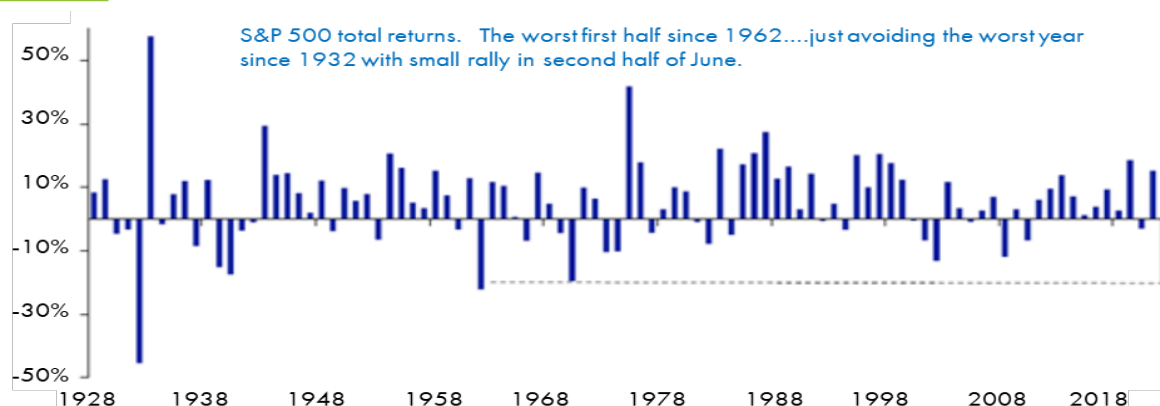
Despite Copernicus' compelling mathematical proofs, the heliocentric model of the universe was not widely accepted for centuries. Only after Newton formulated his gravitational law more than a hundred years after Copernicus did most scientists accept the heliocentric model. Even then, there was no observable proof that it was correct, and most people, especially the religious establishment, remained unconvinced of its veracity.

Unconvinced, until one day in 1851 when an unknown polymath unveiled a simple experiment that proved, definitively, that the Earth rotates on its axis, the heliocentric model of the universe must be correct. The public demonstration of this experiment caused a sensation that swept the world as it was duplicated in cities across the globe. The Earth really does rotate on its axis, even if no one can feel it turning.

That experiment resonates with us today as we observe the forces reshaping our world. We sense that the old order is over, with many of its assumptions and structures invalidated, even as the rules and framework of the new model are still being formed.

Russian tanks rolling across Ukraine shattered the geopolitical order in a way that had not been seen since 1939. With the benefit of a few months of hindsight we see, too, that the Ukraine war was the catalyst for a historic drop in virtually all asset prices. US equities fell more than 20% in the first half of 2022, about as bad as 1970 and 1962, the worst starts to a year going back to 1932 (Chart 1). Treasury bonds, allegedly the safest investments on

Chart 1 First Half Returns of the S&P 500 Index, 1927-2022



Source: Bloomberg Finance LP, Deutsche Bank, Updated as to close on Thursday, June 30.

² *Dē revolutionibus orbium coelestium* (On the Revolutions of the Celestial Spheres).

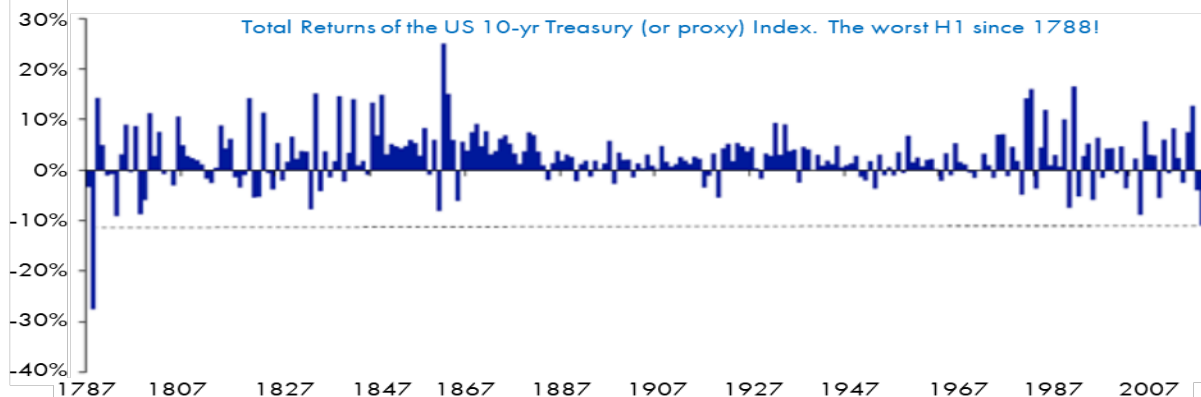
the planet, lost more than 10% of their value in the first six months of the year, a decline not seen since 1788 (Chart 2).

The Russian invasion sent energy prices soaring, especially in Europe. Natural gas that was €20 per MWh a year ago is now over €100/MWh (Chart 3). Electricity in Germany that cost about €60/MWh

a year ago has also quintupled to around €300/MWh.

Food prices have also soared, doubling over the past year (Chart 4), adding another 100 million people globally with acute food insecurity. Political unrest is often preceded by sharp spikes in food prices, as Marie Antoinette and Nicholas II would attest.

Chart 2 First Half Returns of US 10-Year Treasury Bond (or proxy), 1787-2022



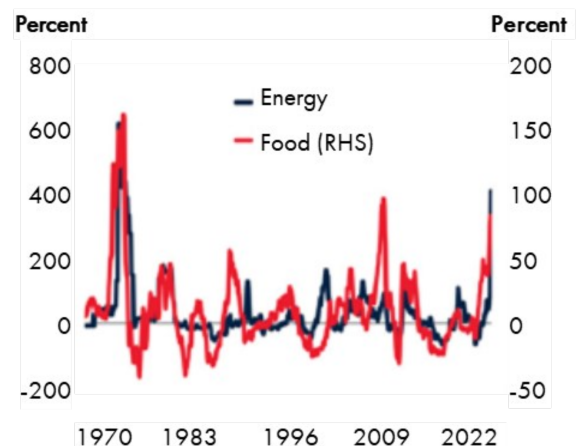
Source: GFD, Deutsche Bank

Chart 3 Dutch TTF Natural gas Futures (EUR/MWh), 2018-2022



Source: 2022 Bloomberg Finance LP

Chart 4 % Change in World Energy and Food Prices, 1970-2022



Source: World Bank, Global Economic Prospects, June 2022. Figure shows percent change in monthly energy and food price indexes over a 24-month period. This facilitates a comparison of the April 2020 trough with the most recent data (April 2022). Due to data limitations, prior to 1979, the energy price change is proxied using the oil price change.

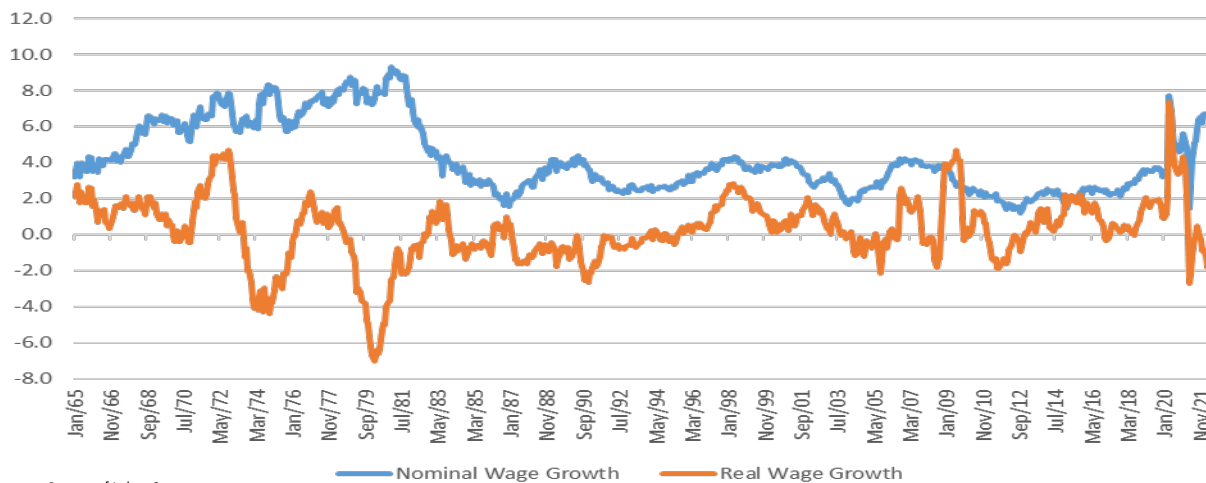
The World Bank forecasts the sharpest deceleration in the world economy in more than 80 years. Cumulative output losses from the start of the pandemic in 2020 through 2024 are expected to be more than 20% of world GDP, nearly the size of the entire US economy.

Wages for American workers are up more than 5% over the past year, the most in forty years, but infla-

tion also remains over 8 ½%, so *real* earnings for workers are actually declining (Chart 5).

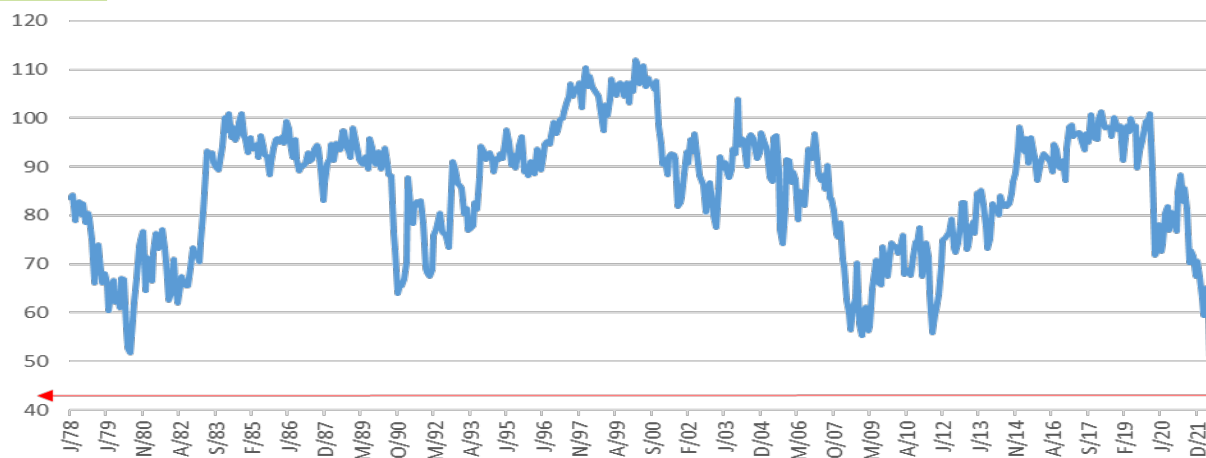
All this has put consumers in a bad mood. The University of Michigan survey of consumer sentiment has plunged to a record low, worse than in the Global Financial Crisis of 2008, worse than while in the gas lines of 1979 (Chart 6).

Chart 5 Nominal and Real Wage Growth, 1965-2022



Source: Bureau of Labor Statistics

Chart 6 University of Michigan Survey of Consumer Sentiment, 1978-2022



Source: University of Michigan

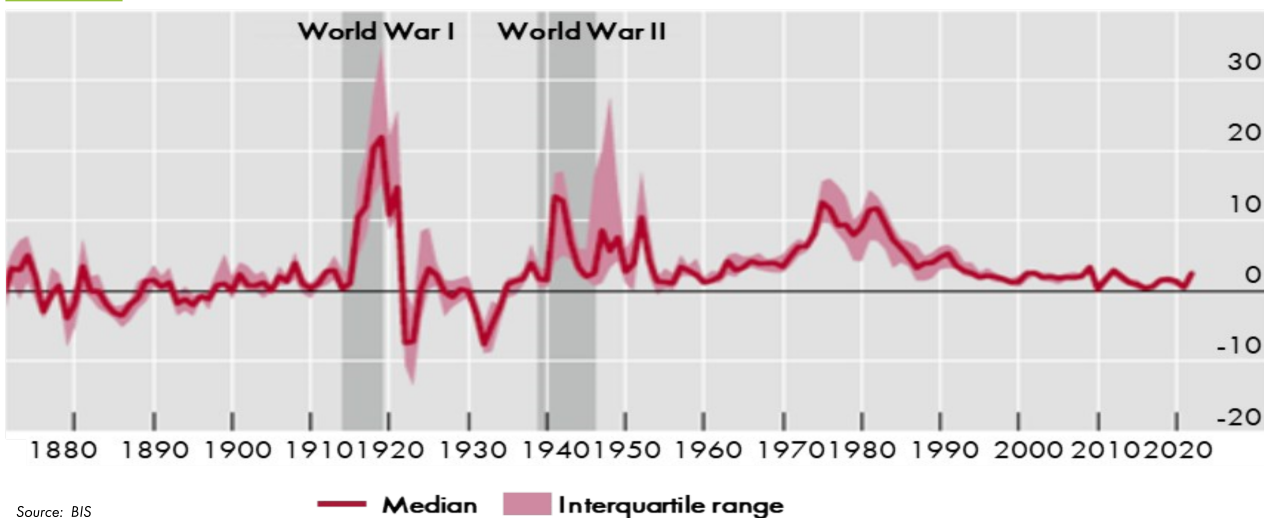
Over the past two years the world economy has been buffeted first by the global pandemic and then by the war in Ukraine. At the highest level, these are enormous humanitarian disasters. Their impact will be immense on economics, investing and politics, and we examine each in turn.

Stagflation was a word that entered our vocabulary in the 1970s³ to describe simultaneous stagnant economic growth and high inflation, a condition that was not supposed to occur according to the standard economic model of the day.⁴ Outside of wars, inflation had been moderate, until the 1970s (Chart 7). Contrary to accepted wisdom, the inflation of the 1970s was not caused by high oil prices, but by a massive expansion of the money supply by the Fed. Similarly, today's high inflation is not a result of "transitory" supply chain bottlenecks, but by another massive increase of the money supply.⁵

This high inflation is occurring at a time when the US economy likely contracted in the first half of this year. Thus we have the classic definition of stagflation.

Recent economic challenges in China have contributed to global stagflation. Over the past two decades, China has accounted for a quarter of the world's economic growth, and its growth rate is expected to fall by half this year.⁶ Some of the slowdown is self-imposed, as the zero-COVID policy continues to shutdown large segments of the economy, but some is structural, such as the decline in the working-age population, the fall in labor productivity and extreme leverage in the financial sector. China has been an important source of both economic growth in the world and a powerful disinflationary force, and its impact on both global growth and inflation is likely to reverse.

Chart 7 **World Inflation, 1870-2021**



Source: BIS

³ British politician Ian Macleod is credited with the first usage of the word in 1965.

⁴ The Phillips Curve, named after British economist A. William Phillips, postulates a trade-off between economic growth and inflation, or more specifically, between unemployment and wage growth. To my continued surprise, it persists in most economists' models today.

⁵ For a more detailed discussion of the roots of inflation please see our webinar: https://www.angelesinvestments.com/insights/video_pdf_presentations/webinar-replay-pandemic-inflation-war-investing-amidst-uncertainty.

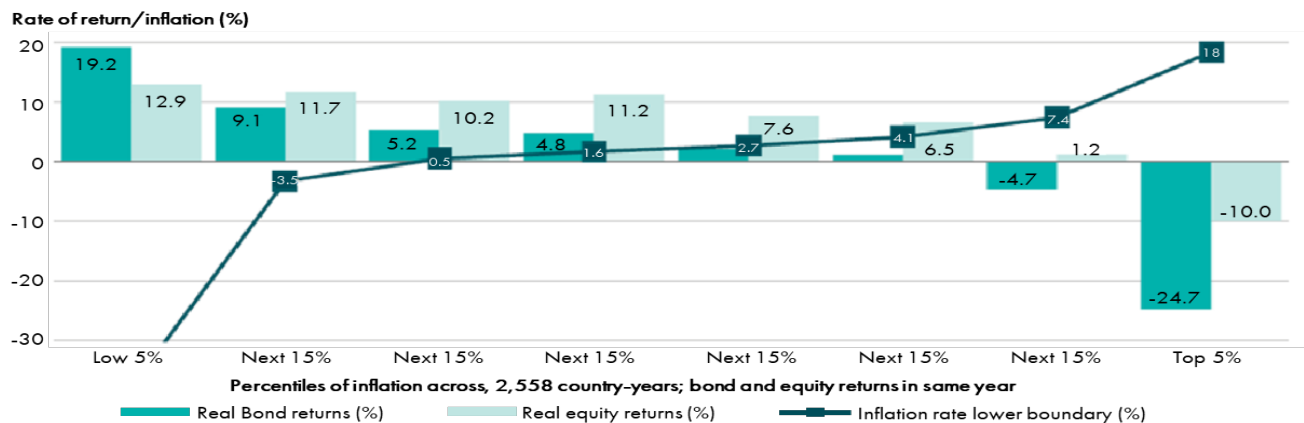
⁶ From around 8% in 2021 to around 4% in 2022.

Reigning in inflation is the first priority of central bankers. The Bank for International Settlements (BIS) notes that “transitions from low- to high-inflation regimes tend to be self-reinforcing...inducing behavioural changes that entrench it”⁷ The BIS finds that in a low inflation regime, relative price changes fade without having an impact on aggregate prices. A low inflation regime is self-equilibrating. This is not true in a high-inflation environment, where relative price shocks tend to flow through to overall inflation. It is imperative that central banks withdraw liquidity in order to avoid persistent high inflation.

Inflation has numerous implications for investors, all negative. There is an inverse relationship between inflation and real returns to investors, as Chart 8 demonstrates. The highest inflation periods result in extremely negative real returns, whereas low inflation is associated with very positive real returns.

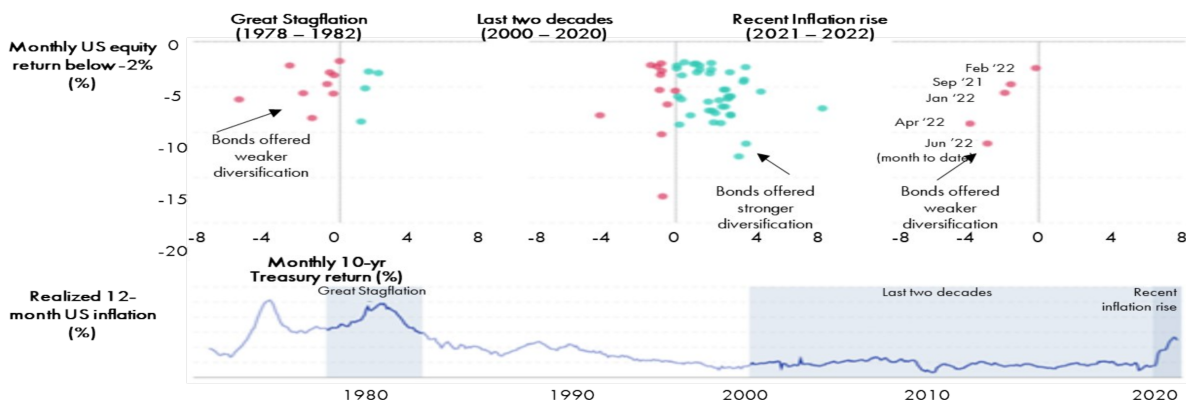
Another challenge inflation presents to investors is reducing the ability to diversify portfolios, as correlations between equities and bonds shift from negative to positive (Chart 9). Investment returns are determined largely by the path and level of inflation.

Chart 8 Real Returns of Stocks & Bonds Under Different Inflation Regimes, 1990-2021



Source: Credit Suisse Global Investment Returns Yearbook 2022

Chart 9 Equity Bond Correlation Shifts With Inflation, 1978–2022



Source: MSCI

⁷ Annual Economic Report, Bank for International Settlements, June 2022.

Globalization has seen two extended periods of expansion over the past two centuries, peaking in 1914 and again in 2009 (Chart 10). Britain's Corn Laws of the 1840s catalyzed the first spurt of globalization, as the Marshall Plan did for the second wave following the Second World War.

In each period a global hegemon enforced the rules of international order, Britain in the 19th century, the US in the latter half of the 20th century. As David Ricardo demonstrated 200 years ago, trade, via comparative advantage, is the one win-win in economics: all trading partners are better off trading than maintaining a closed economy.

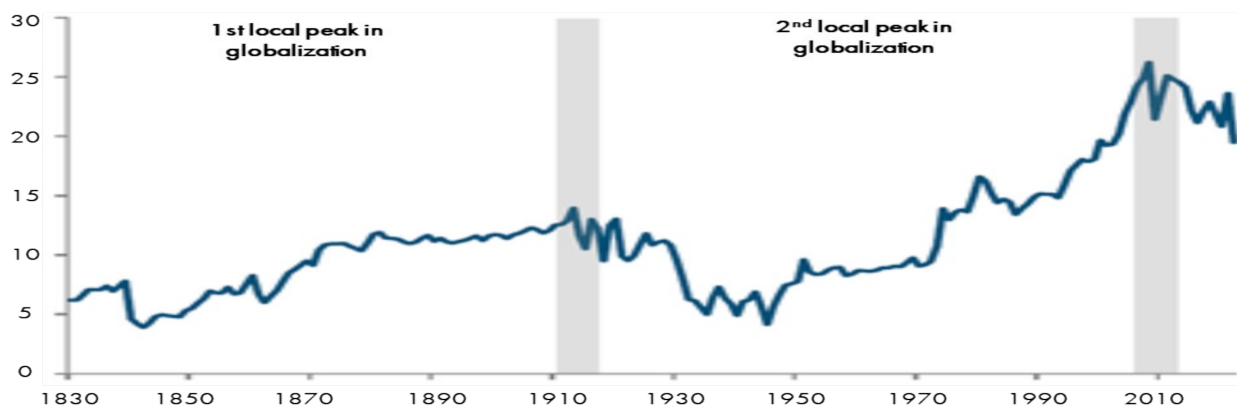
Trade creates a dependence on imports, and the offshoring of some jobs that come with it creates domestic inequalities. Inequalities beget social polarization, which is seen in countries around the world, from Europe, including the Nordic countries, to Asia, to North and South America. Women's rights and religious freedoms are endangered across the globe. Property rights of women are restricted in 76 coun-

tries, and gender discrimination costs the world economy more than \$12 trillion a year.⁸

Job losses from globalization can be overstated though. According to Adam Posen, president of the Peterson Institute for International Economics, only 1 in 150 jobs lost in the US in recent years can be attributed to competition in the Chinese manufacturing sector. Economic inequalities, discrimination and social polarization are urgent problems for many countries. Attributing them to globalization is reductive, misleading and unconstructive.

Globalization creates a more efficient world economy partly by increasing a dependence on imports. A turning point in the support for globalization occurs when the hegemon's leadership is challenged or forced (or chooses) to retreat. This was the case in the UK in the 1920s, whose economy was ruined in the First World War and had to abandon its role as the global enforcer of the rules. China emerged as the leading dynamic economy following the Global Financial Crisis of 2008, coinciding with the US disengagement from world responsibilities. This is manifest in the decline of world trade (Chart 10), spurred by a

Chart 10 Value of Global Exported Goods as Share of GDP, %, 1830-2016



Source: Fouquin and Hugot (CEPII 2016), Goldman Sachs GIR

⁸ OECD estimate, 2016

rise in discriminatory trade restrictions (Chart 11), as well as in the 75% decline in immigration over the past five years (Chart 12).

A final factor to note that will contribute to deglobalization in the future is the urgency to decarbonize. Russia's war has had an immediate impact on energy prices, but the evidence mounts daily that climate change is a serious threat to the global economy.⁹ We will, by necessity, shift from a global energy system based on hydrocarbons to a more local, frag-

mented system of electrical energy, which is much more costly to produce (although getting less so), store and transmit.

A deglobalizing world will trade economic efficiency for security, and pro-growth supply reforms for redistributive policies. Some will see these trade-offs as necessary or desirable. But there are consequences of such trade-offs. The world of widespread economic expansion and moderate inflation is behind us. Investors will have to adapt to the new economic order.

Chart 11 Trade Interventions, 2009-2021

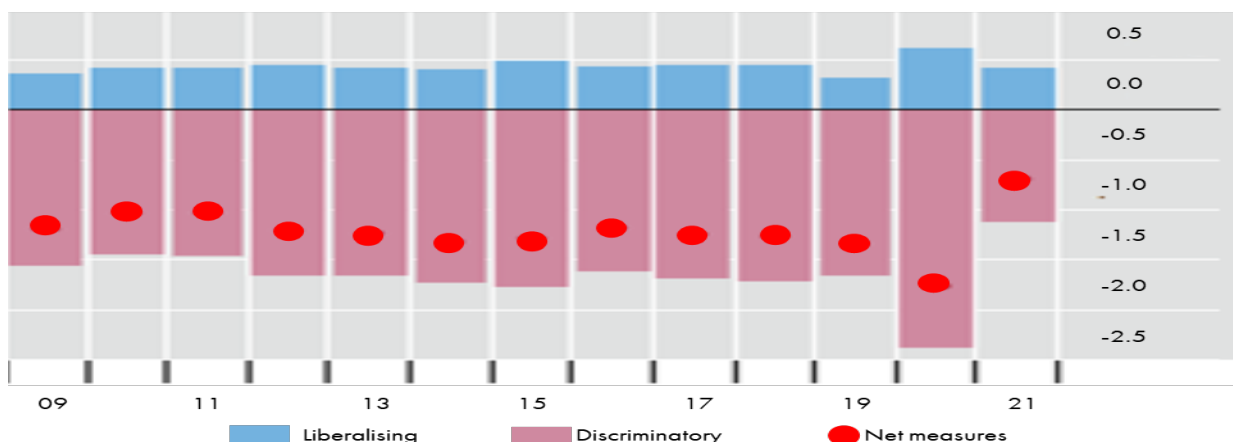


Chart 12 Net International Migration, July 1, 2010–June 30, 2021



⁹ Clearly, climate change is primarily a threat to the environment, to biodiversity, to world health as well.

You are invited to see the Earth turn.” This cryptic letter was received by the leading scientists of France on 2 February 1851. “Be at the Meridian Room of the Paris Observatory the next day,” it said.

The letter came from Jean Bernard Léon Foucault, a medical school dropout who dabbled in photography. He had no academic credentials, no prestigious sponsorship, but he did have a dream at 2 a.m. a few weeks earlier that he noted in his journal.

Newton’s first law states that “an object in motion stays in motion with the same speed and direction unless acted upon by an unbalanced force.” Thus, if you set a pendulum in motion it should swing in a straight line. But if the Earth is rotating, that pendulum should swing in a circle, reflecting the rotation of the Earth, modified by latitude. This is not a dream most of us would ever have, but it was fortuitous that Foucault did.

“Modified by latitude” refers to the Coriolis force, described by Gaspard-Gustave de Coriolis in an 1835 paper.¹⁰ He noted that a spinning sphere rotates faster at its equator than at its poles, thus a pendulum should complete a circle faster at the poles than at the equator. Foucault devised a very simple formula for this calculation: $T = 24 / \sin q$, where T is the time for a pendulum to complete a full circle, and q is the degree of latitude of the pendulum. According to this formula, a pendulum at a pole would complete a full circle in 24 hours,¹¹ and would not rotate at all on the equator.¹² In Paris, the pendulum would be expected to turn 270° in a day.

The demonstration at the Paris Observatory was a success, although the elites of the French scientific

community were not impressed. The following month Foucault replicated his demonstration at the Panthéon and invited the public. He attached a large 28 kg brass bob to a very long (67 meter) wire from the top of the dome. He had a wood floor installed in the marble lobby and covered it with sand. A pointer at the end of the bob would trace a line in the sand, proving its rotation.

It, too, was a success, and hundreds of thousands flocked in the coming months to witness this extraordinary demonstration of the Earth’s rotation. Cities around the world soon hung their own Foucault’s

pendulum, as it was known. They are still found in hundreds of museums, in the lobby of the United Nations in New York, and, of course, in the Panthéon.

Foucault’s pendulum changed how we understand our world. It was the first demonstrable proof that the Earth rotates on its axis and must revolve around the Sun. Most transitions to a new order are not so clear. Our society has been fragmenting for some time, both internally, as we see growing inequalities, political polarization, a loss of trust in our institutions and in

each other, and externally as we withdraw from treaties, global institutions and our military commitments, restrict immigration and erect barriers to the flow of goods and capital.

The pendulum is swinging in a new direction, one with consequences we can foresee and with implications that we can only imagine. We will adapt and adjust to this new world order in time, but we will have to do that without the clarity that Foucault’s pendulum brought to world 170 years ago.

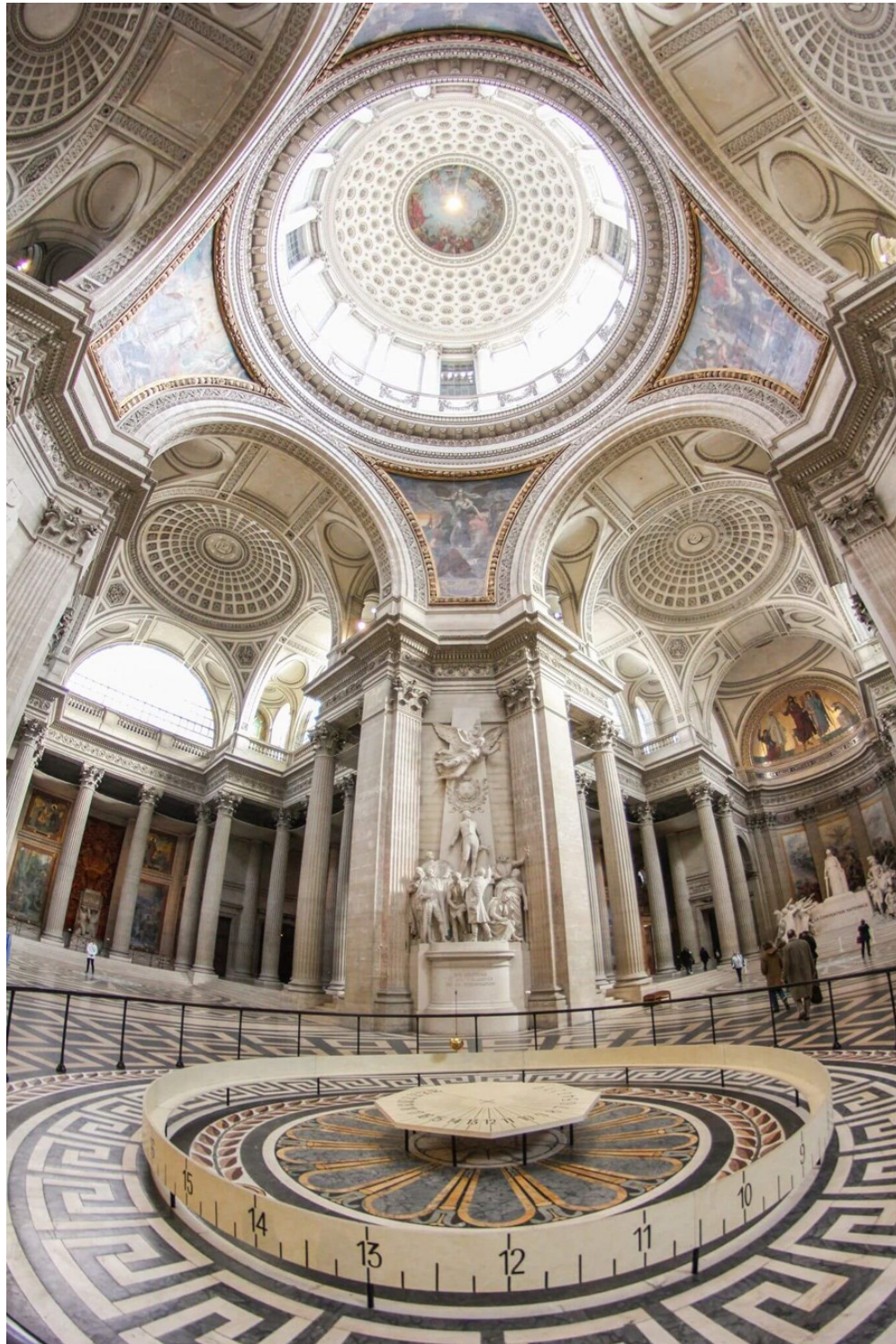


¹⁰ *Théorie Mathématique des Effets du Jeu de Billard.*

¹¹ Because the poles are at 90° latitude and the sine of 90 is 1.

¹² Because the equator is at 0° latitude and the sine of 0 is 0.

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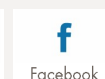
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