

Shattering

Lise was determined to make this Tuesday like any other day. She arrived at her work early and stayed late editing an associate's paper, careful not to arouse suspicion that the day would be any different than any other. She returned to her apartment that night to pack two small bags and walked in the darkness to her friend and colleague Otto Hahn's house. Early the next morning, she was driven to the train station. She had no money, so Otto gave her his mother's diamond ring, in case she might need it as a bribe for the border guards. She was headed for Bad Nieuweschans, a small town on the German-Dutch border, hoping that its remoteness would mean less attentive guards who would allow her to leave Germany.

Lise was born in Austria, but when Germany annexed Austria in March 1938, she lost her citizenship and her passport. Her friends were worried, not only that she would lose her position as head of the Kaiser Wilhelm Institute for Chemistry, but, as a Jew, that her life might be at risk. In April 1938, Niels Bohr pleaded with her to come to Copenhagen to lecture, all expenses paid, but she hesitated to leave Germany without a permanent job position.

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The next month she learned that the Ministry of Education was reviewing her status, and Lise knew that her days in Germany were numbered. She accepted Bohr's offer, and the next day went to the Danish consulate for a visa. But the consulate declared that her Austrian passport was invalid and declined her a visa. Bohr, the most celebrated Danish scientist in history, winner of the Nobel Prize for his work on atomic structure and quantum physics, tried to intervene with the authorities, to no avail. He urgently contacted his friend, Dirk Coster, the prominent Dutch physicist, for help. The Netherlands did not permit foreigners to work in the country, but Coster began raising private funds from his circle of scientists to sponsor Lise for at least a few years. He and his colleagues wrote to the Dutch Ministry of Justice, "it would be of great value and also esteem to the development of physics in the Netherlands if a scientist of (her) quality could work in this country."

There was still the matter of money, and Coster was only able to raise enough to cover a year of expenses. The bigger problem was the letter Lise received on 16 June from the German Ministry of the Interior informing her that she would lose her position at the Kaiser Wilhelm Institute and furthermore, given her prominence as a scientist, would not be permitted to leave Germany. The authorities clearly did not understand irony.

Meanwhile, the Swedish Academy of Sciences offered Lise a position at their new institute devoted to

nuclear research. She was happy to accept, but there was still the problem that Germany would not let her leave, and the Netherlands had yet to approve her entry visa. Lise was heading to the border in hopes of a miracle.

Shattering is the theme of this letter and an apt description of Lise's life and work. The world she knew of close collaboration with colleagues around Europe was shattering as the world hurtled toward another world war. Her work involved shattering atomic nuclei in hopes of uncovering new particles. She believed she was on the precipice of a great discovery. But her work, her life, her world, hung in the balance as her train sped to the Dutch border.

Our world is shattering before us. Perhaps not to the extreme that Lise witnessed in 1938, we hope, but it is clear that many of the assumptions we had, about geopolitics, about investing, need to be reexamined in light of the extraordinary events of a global pandemic, a European land war and a reordering of the world's economy and balance of power.

World War One brought an abrupt end to the previous period of global integration. Unfortunately, in the aftermath of the war, countries chose to erect barriers to trade. The Tariff Act of 1930 (Smoot-Hawley) was only the most notorious trade action,¹ and between 1928-1933 world trade fell by 50%. Trade did not recover until after the Second World War, and surpassed its 1914 peak only in the late 1970s (Chart 1).

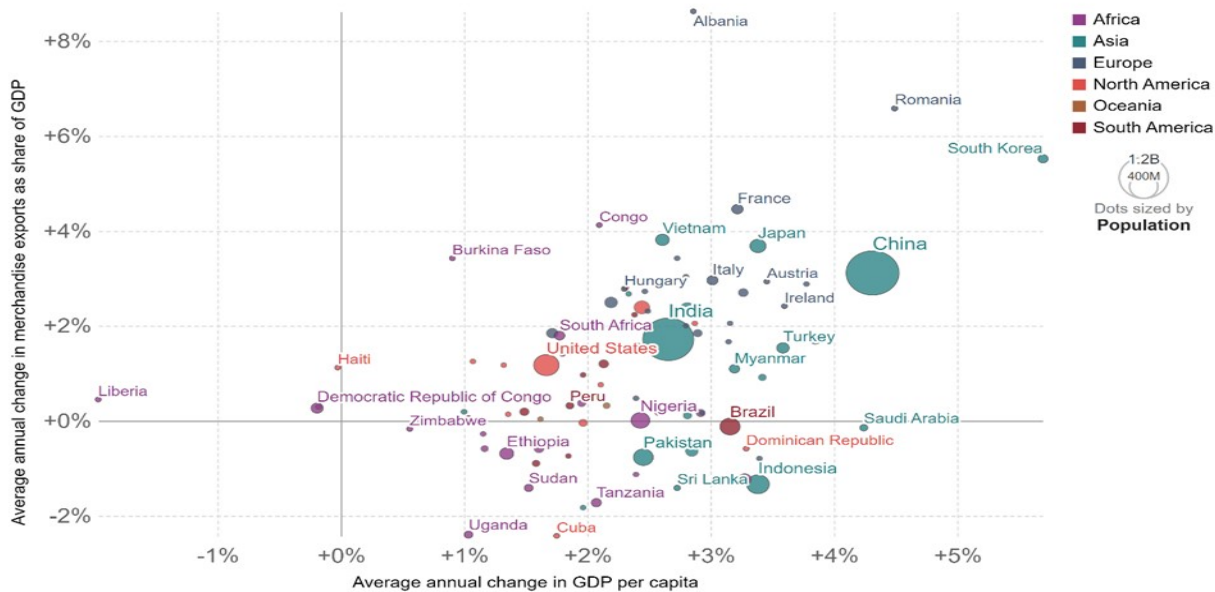
Chart 1 Value of exported goods as share of GDP, 1827-2014



Source: Fouquin and Hugot (CEPII 2016)

¹ Tariffs were imposed on over 20,000 items, second only to the 1828 Tariff Acts.

Chart 2

Growth of GDP and trade, 1945-2014**Average annual change in real GDP per capita vs. Average annual change in exports as share of GDP**

Source: Fouquin and Hugot (CEPII 2016), Maddison Project Database 2020 (Bolt and van Zanden (2020))

Since 1945, and especially after 2001 when China joined the World Trade Organization, billions of people have been lifted out of poverty, not solely due to trade, but in large measure because of it. There has been a clear positive relationship between economic growth and openness to trade (Chart 2).

Our era of globalization came to an abrupt halt with the global financial crisis of 2008. We have yet to recover and are unlikely to do so. Brexit in 2016 and Trump's withdrawal from multilateral trade pacts were signs that further global integration was under assault. More recently, calls for "self-sufficiency" have emanated from world leaders from Joe Biden and Emmanuel Macron to Narendra Modi and Xi Jinping, with his call for "dual circulation" in China's economy.

Many viewed the global pandemic and now see Russia's assault on Ukraine as temporary interruptions of global integration that, in fact, peaked fifteen

years ago. Rather, these events will accelerate global disintegration and prioritize national interests over economic efficiency with profound implications for investors.

The pandemic highlighted the vulnerabilities of global supply chains. Companies will be forced to source secondary suppliers at a cost of efficiency. Very little "on-shoring" has yet to occur, but political leaders have raised the rhetoric in favor of and expanded the definition of "national champions" across a growing number of industries, from energy to semiconductors. This risks promoting rent-seeking² corporations extracting governmental favors under the guise of "national security."

² The attempt to gain wealth without any reciprocal contribution of welfare, resulting in misallocation of resources.

More importantly, the pandemic and the Ukraine war are accelerating the division of the global economy into two incompatible economic blocs, an updated economic Cold War. That this has been China's aim for years has been abundantly clear, although most in the West chose to ignore the obvious and hope that China would embrace the existing world economic framework. The trillion-dollar Belt-and-Road Initiative and the Asian Infrastructure Investment Bank are just part of China's efforts to build an economic order outside existing (Western) institutions.

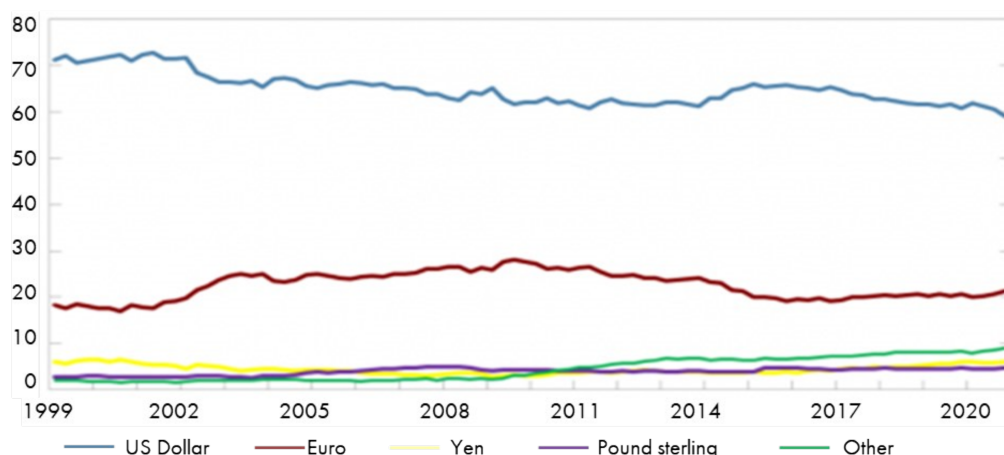
The unprecedented sanctions imposed on Russia by the West, as justified as they may be, will accelerate the bifurcation of the global economy. Private citizens of an unfriendly country, we call them oligarchs, have had their assets seized without due process.³ Even peaceful civil disobedience among citizens of democracies have been met by freezing assets, as was the case in Canada when protesting truckers lost access to their bank accounts.⁴ The foreign currency reserves of Russia's Central Bank have likewise been

frozen, and the message is clear that any person, company or country that might potentially run afoul of Western standards should hold assets outside the reach of Western sanctions. This is, in no way, a defense of Russia's horrific actions in Ukraine, or a criticism of sanctions, but merely the logical implication of these policies.

One possible consequence of financial sanctions and the potential bifurcation of the global economy is the threat to the US dollar as the world's reserve currency. The dollar is more than a symbol of US economic and political dominance, its reserve status accrues to the US an enormous financial benefit, an "exorbitant privilege,"⁵ that allows the US, alone, to finance itself with its own currency.

Over the past twenty years, the share of US dollars held by central banks declined from 71% to 59% (Chart 3). Euros currently represent about 21% of central bank reserves, with Yen and Sterling at about 5% each. The Renminbi represents less than 3% of world currency reserves.

Chart 3 **Currency composition of Global Foreign Exchange Reserves percentage, 1999-2021**



Source: IMF

³ Under a declaration of a national emergency by the President pursuant to the US international Emergency Economic Powers Act.

⁴ Access was subsequently restored.

⁵ The phrase was coined (as a complaint) by then-French finance minister Valéry Giscard d'Estaing in the 1960s.

US dollar dominance has receded, but it is still the world's central currency, and it is hard to see what supplants it. Cryptocurrency boosters would like to think that private digital currencies will soon replace government money, but this is unrealistic. Private digital currency markets are too small and too volatile, they cannot be used in transactions and, most importantly, governments will never permit their fiat currencies to be usurped by private money.

A global currency does exist in the form of the IMF's Special Drawing Rights (SDR) backed by a basket of currencies, but it has gained little traction since being created in 1969. Gold, or other commodities, cannot be used in transactions, so that leaves another national currency as the only potential replacement for the US dollar. The renminbi would be the most likely one given China's size and prominence in the global economy.

But this also seems far away. The renminbi is nonconvertible and rule of law in China is suspect. Having a reserve currency does accrue significant advantages, but it requires a willingness to give up much control over the currency, something China seems loathe to do.

The US dollar will remain the world's reserve currency. But the forces pulling the world economy apart, including sanctions that froze the assets of Russia's central bank, will accelerate. The world appears determined to embrace a closed, two-bloc economic regime, led by China and the US, respectively.

Fragmentation of the world political and economic order will mean a less efficient global economy. Supply sources will be duplicated, inventory, especially of critical, supply-constrained materials and commodities, will be hoarded, and more military spending will crowd out productive uses of capital.

It has been a long time since inflation factored into investors' calculus, but it is likely to be a fixture in the years to come. We've explained previously why inflation will be higher and for longer than the Fed or the markets expect.⁶ This will represent an enormous challenge for investors.

Real (after-inflation) yields are severely negative (Chart 4). Valuations across asset classes are high, and so earning a positive real return will be very difficult.

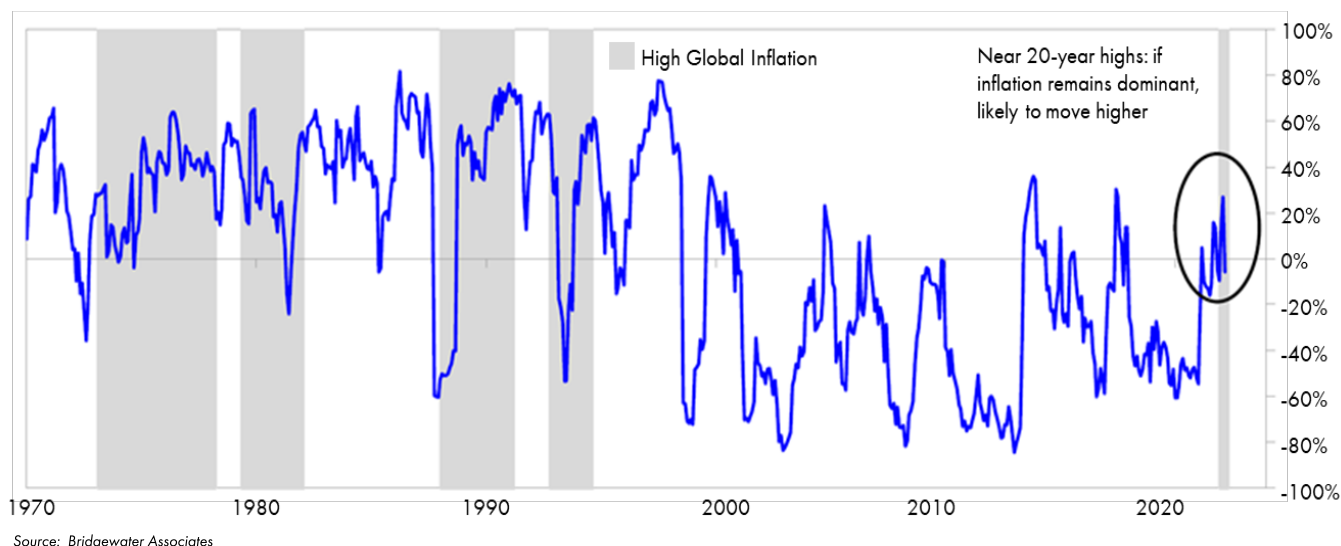
Chart 4 Real Fed Funds Rate, 1971-2022



Source: Bloomberg, L.P.

⁶ https://www.angelesinvestments.com/isights/video_pdf_presentations/webinar-replay-pandemic-inflation-war-investing-amidst-uncertainty

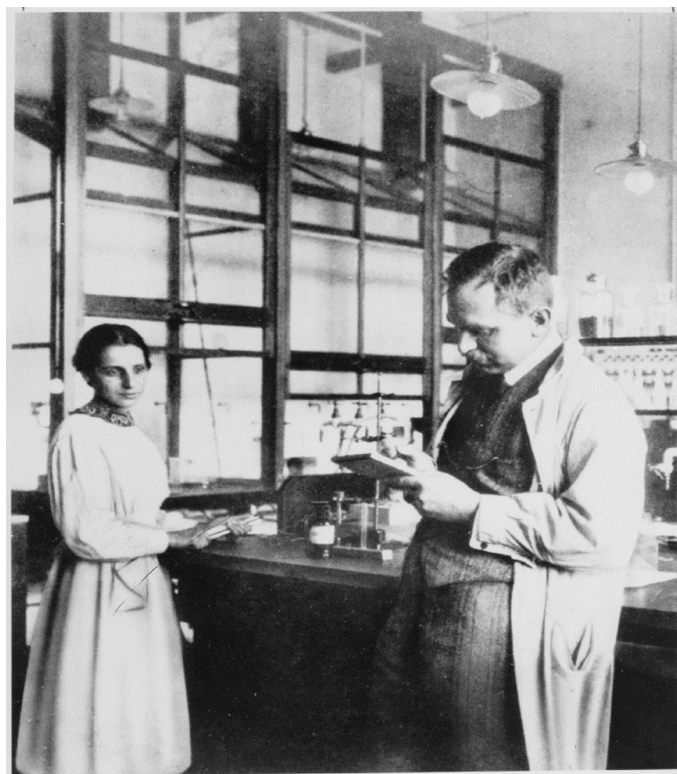
Chart 5 1-Year Correlation: World Equities vs. Bonds



Inflation also poses a challenge to traditional portfolio construction. When inflation is low and stable, as we've experienced for most of the past few decades, stocks and bonds are negatively correlated, thus providing a means for portfolio diversification and high risk-adjusted returns. However, when inflation is high, the correlation of stocks and bonds turns positive, and bonds offer little diversification benefits (Chart 5). In a high inflation environment, investors are forced to accept high levels of equity volatility with no guarantee of high returns. Such an environment requires a very different approach to investing than has been so successful over the past decades.

The global pandemic and the Ukraine war have shattered our assumptions of the geopolitical order and altered our economic priorities in service to national security interests. We are headed toward a more uncertain future, much as Lise was on that train to the Dutch border and an unknown fate.

Women were not permitted to attend college when Lise graduated high school in 1892, so she became a French teacher. But phys-



Lise Meitner and Otto Hahn in Berlin, 1913

ics was her passion, and when the ban on women in higher education was lifted, she enrolled at the University of Vienna, earning her Ph.D. in 1905.⁷ It was one thing for women to be allowed into college, another thing entirely to be hired in academia, and Lise found that there were no jobs available to her.

Max Planck, the great German scientist who developed quantum theory, was vocal in his opposition to women in universities, much less in his laboratory, but he made an exception for Lise, inviting her to be his assistant in Berlin. It was there she met the chemist Otto Hahn, who had been given a woodshed on campus for his make-shift lab. Lise was permitted to work there, as it had a separate entrance, but was not allowed into the university buildings, forcing her to a restaurant down the street when she needed to use the toilet.

Hahn was interested in looking for new isotopes when atomic nuclei were blasted by particles, but Lise was more interested in the beta (electron) radiation that ensued. They co-authored numerous papers before Otto was called to serve in the First World War. Lise was forced to conduct experiments alone, and in 1918, discovered a new element, protactinium (Pa) derived from uranium. In 1926, she became the first female physics professor in Germany.

Enrico Fermi bombarded uranium with neutrons and discovered new isotopes of uranium. Lise and Otto Hahn decided to examine these new isotopes. Hahn was convinced that they all emanated from a single uranium isotope, but Lise was not sure. She speculated that they could form from multiple isotopes of uranium. She couldn't quite prove that, and her calculations didn't quite add up. Something was missing.

Lise directed Otto Hahn to conduct new experiments, and he confirmed to her that one of the results of the bombardment of uranium was that it resulted in the element barium (Ba). But barium has an atomic mass that is 40% less than uranium. This is too large a difference to be explained by radioactive decay. Lise had Hahn redo the experiment and recheck the data, and it was all correct. But Lise could not account for how barium was created from uranium.

It was at this point that the noose was closing in around her. Dirk Coster, the Dutch physicist trying to get her an entry permit to the Netherlands, decided to accompany Lise on the train to the border. The day before he left for Berlin, a neighbor of his happened to be an influential politician from a farming family near the border, and Coster traveled with him to Nieuweschans to talk to the Dutch immigration officials there about allowing Lise entry to the Netherlands and, as they were friendly with their German border guard colleagues, help persuade them to allow her to leave Germany.

At the train station in Berlin, Lise did not want to board the train and risk almost certain arrest. On the train, she repeatedly told Coster that she would return to Berlin rather than try to cross into the Netherlands. Coster held firm, but did tell her to let him hold Hahn's diamond ring lest it raise suspicion. At the border, thanks to the careful preplanning two days before, Lise was allowed into the Netherlands.

The next day, Dirk Coster received a telegram from Wolfgang Pauli, himself a Nobel Laureate in Physics, saying, "You have made yourself as famous for the abduction of Lise Meitner as for the discovery of hafnium!"⁸ Lise traveled on to Sweden where she met up with her nephew, the physicist Otto Frisch.

⁷ Her supervisor was Ludwig Boltzmann, the great physicist in thermodynamics. Her thesis was titled *Examination of Maxwell's Formula*

⁸ Hafnium (Hf) was discovered by Coster in 1923.

One day that winter, she and Frisch skied in the Swedish mountains and sat down on some logs to discuss the mystery of how barium could be created from uranium. The first challenge was to determine whether the uranium nucleus could even be split apart, breaking the strong force that binds subatomic particles together. With pen and paper, Lise calculated that uranium's charge would be high enough to overcome the strong force if sufficiently provoked.

The bigger problem was that these two new nuclei would be driven apart by electrical repulsion by very high energy, which she calculated as 200 MeV.⁹ Lise remembered the formula for computing the mass of nuclei, and showed that the two new nuclei would be one-fifth lighter than the original nucleus. One-fifth of the mass of the nucleus equaled 200 MeV. It all fit. She rushed off the mountain to submit her results.

Lise and Frisch published their findings in February 1939, and it astounded the scientific world. Frisch had asked a biologist friend the name they had for cell division, and was told it was called "fission." Lise Meitner had worked out the mechanics of nuclear fission. The atomic age was born.

In 1945, the Swedish Academy of Sciences awarded the Nobel Prize in Physics to Otto Hahn and Lise Meitner for their "discovery of the fission of heavy atomic nuclei."

Well, no. The prize went to Hahn alone. Years later, the minutes of the Academy's meetings revealed that the jurors could not believe that a woman had contributed equally to the discovery of nuclear fission, and so chose to ignore her central role. Otto Hahn, along with Dirk Coster, Niels Bohr, Max Planck, Max Born, and numerous other luminaries protested her ex-

clusion, to no avail. Lise Meitner was nominated for the Nobel Prize in Chemistry nineteen times, and for the Nobel Prize in Physics twenty-nine times. She never won, but was never bitter. She died peacefully in 1968 at the age of 89.

Lise Meitner shattered barriers as she shattered nuclei. She overcame extraordinary obstacles, as a female scientist in turn-of-the-century Europe, and as a Jew in Nazi Germany. Her remarkable perseverance and sheer brilliance led to the discovery of nuclear fission and the birth of the atomic age. Her world shattered before Nazi aggression, but her discovery of nuclear fission would have equally profound consequences.

We cannot know all the consequences of a global pandemic and a brutal war, but we can accept that the foundations of our world have been shaken, if not shattered. As investors, we must accept that the old rules may no longer apply. We must face the present and our future as Lise Meitner faced hers, as Ukrainians are facing theirs: with determination and heroism.



⁹ Mega-electron Volt.

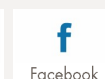


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January 2022

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