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INSIDE THIS ISSUE

editor introduction

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In our February issue's introduction, we noted that the interest rate and inflation "tide" was going out, exposing organizations with weak risk practices. In the banking sector, our prediction came true faster than expected, as the tide carried out a number of banks which, with hindsight, had been swimming naked for some time. While Silicon Valley Bank, First Republic Bank, and Credit Suisse are the headliners, more names are feeling the pinch of depositor fears and the return of systemic risk. In the coming months we will better understand what happened at failed institutions, and whether acts to resolve them are working, as well as who else is at risk.

This quarter's Intelligent Risk features a sweeping breadth of thought on traditional risks and, unique we think to our publication, non-traditional and emergent risks. Specifically, our capstone article by cryptocurrency expert Tania Reif analyzes the turbulent events of the past year in the cryptocurrency industry, clarifying misperceptions and drawing conclusions about its future. Other perspectives on cryptocurrencies are shared by Michael Jacobs and Malcolm Gloyer. Peter Ding lays out a Value of Risk approach to quantifying operational risks using a structured parametric framework, while co-authors Adham Jaber and Ibrahima Diarra take a look at the effect of climate change on sovereign default risk. At the macro level, there are articles about globalization by Aleksei and Valeriy Kirilov, inflation by Tanushree Datta, and geopolitical risk by Merlin Linehan. In the non-traditional space, we feature Alan Franklin's insights on child labor issues in supply chains, where traditional risk management approaches have failed.

If you're interested in sharing your thoughts in a future Intelligent Risk or providing feedback on something you read in this issue, we welcome your emails to iriskeditors@prmia.org or by posting a blog or discussion contribution on PRMIA's Intelligent Risk Community webpage.

Synopsis

This article interprets the turbulent events of the past year in the cryptocurrency markets, clarifying misperceptions, and explaining why the crypto ecosystem is likely to survive, thrive and reward investments provided risks are well managed.

understanding the 2022 crypto saga risk and opportunities

by **Tania** Reif

crypto's downfall or resilience?

The title cover of The Economist in late November 2022 was "Crypto's Downfall" and featured articles such as "How Crypto Goes to Zero". By early 2023 Senator Warren launched an "Anti-Crypto Army" re-election campaign ad, the White House report pronounced crypto assets as "lacking in fundamental value", and numerous media debates discussed why the "crypto ponzi" has not yet fully imploded.

In the meantime, BTC (bitcoin) recovered more than 80% in the first quarter of this year, outpacing stocks and gold, amid an aggressive and ongoing interest rate hiking cycle (as priced by the markets at the time of writing).

It is easy to understand the public's skepticism around crypto. Over the last year spectacular token implosions, poor risk management practices and outright fraud earned the ecosystem its dire reputation. A serious analysis and debate is therefore warranted and welcome. One that seeks to detangle the true pitfalls from the widespread misinformation.

The crypto ecosystem is particularly vulnerable to misjudgment because the new technology obfuscates the ability to differentiate what is inherently a crypto-specific hazard from one that routinely plagues multiple asset classes all throughout history. This article argues that the 2022 crypto saga was mostly a consequence of the latter, playing out without a lender of last resort to cushion the blow. The lesson that naturally follows is not that crypto is inherently hazardous, but that the asset class demands careful and selective token vetting, responsible risk management, and proper custody.

It is thus my firm belief that investors that engage with the crypto asset class, deferential to these best practices, will embrace and benefit from the exciting path of growth and financial inclusion that the asset class promises to deliver in the near future.

As we journey back through 2022, note that nothing that unfolded was caused by flaws in the underlying crypto technology, nor was this technology undermined by the events. If one liked decentralized blockchains in 2021, one should like them now. Actually, even more so, because as we will see below, it was the centralized players, and not the decentralized ones, that shoulder the burden of the downfall.

timeline of the crypto hard landing

It is useful to break the events of the last year in four broad episodes before we discuss more details:

i. May 2022: The triggering event can be traced back to the implosion of an ill-designed attempt at an algorithmic stablecoin (Terra/Luna). Stablecoins are similar to fixed exchange rate regimes in the fiat world – this was akin to a traditional emerging market currency peg collapse.

ii. Summer 2022: Subsequent bankruptcy stress followed among the centralized institutions that had irresponsibly high levered positions on the collapsed stablecoin system, its underlying assets and/or other illiquid tokens. The resulting broad deleveraging episode further dragged down the crypto "bluechips" such as BTC and ETH in a liquidity scramble amplifying systemic stress. (Three Arrows Capital (3AC), Celsius, Voyager, Genesis, BlockFi).

iii. November 2022: Outright fraud is exposed in large crypto exchange FTX and its sister trading-arm Alameda, who had also suffered losses in the above episode, but misappropriated customer funds to coverup them up and delay bankruptcy. Further de-risking and deleveraging ensued. (FTX/Alameda)

iv. Early 2023: Banking sector fragility surfaced first in crypto-friendly bank Silvergate. A few days later broader deposit withdrawal pressure exposed more systemic banking sector vulnerabilities by March prompting government backstop liquidity injections. (Silvergate, Signature, Sillicon Valley Bank, Credit Suisse).

As we examine these events below, note that all of the above, a peg blowup, over-levered shadow lenders, and even fraud, are nothing new to traditional markets. The difference here is only that there was no government backstop to cushion the blow. These were not technology-led failures, there were no major hacks, nor protocol bugs – the underlying crypto 'bluechip' blockchains worked well throughout.

spring cleaning

By April 2022 the interest rate tightening cycle had already begun denting crypto prices, but these followed the expected crypto-beta to global markets. May and June were starkly different – the outsized price collapse was clearly led by events idiosyncratic to the crypto ecosystem, which is why I choose May 2022 as the starting point for our story.

The Terra/Luna stablecoin peg fell victim to the classic unravelling dynamics akin to a sovereign's attempt to fix the value of its currency to the USD without plentiful, liquid and reliable access to the underlying asset. When the eventual run resulted in the inevitable peg failure, the high yields offered to local currency holders failed to compensate for the massive and abrupt currency depreciations (typically over 50% in emerging markets).

The UST(Terra) stablecoin had followed the same script by attracting capital with high interest rates (20%) unbacked by a sustainable revenue stream nor with sufficient reserves. The eventual peg unravelling was made materially worse by the fact that reserves were held largely in Bitcoin (BTC) instead of USD. The forced BTC dump needed to defend the peg resulted in broad contagion.

Note that the problem lay in the algorithm's financial architecture design – not in its code.

The collapse of UST uncovered a number of players clipping yield on the back of the unsustainable protocol – exposing widespread poor risk management. The ripple effects of the system's strains pressured another 'peg' (stETH/ETH) in June, worsening the stress. The resulting pressures on collateral forced out lenders Celsius and Voyager and toppled crypto-fund 3AC with bankruptcy.

As is typical in disorderly deleveraging episodes - especially without a lender of last resort - forced selling of "bluechip" quality coins was necessary as players scrambled for liquidity. Price pressure on BTC also prompted miners, pressured by energy costs, to sell into weakness exacerbating the June mayhem.

the "JPMorgan of crypto"

In the months that followed, Sam Bankman-Fried (SBF), VC darling and head of Bahamas-based exchange FTX and its sister trading-house Alameda, earned the ironic title of the "JPMorgan of crypto" for his efforts trying to "save" some of the troubled crypto lenders.

Yet by November, a run on FTX exposed that Alameda had suffered losses stemming from the May debacle but covered them, using FTX customer deposits. Further allegations include the use of customer funds to purchase real estate, extend political donations and pump frontier tokens, including FTX's own highly centralized FTT token. The artificially inflated FTT valuation had then been used as collateral by Alameda, further increasing the system's fragility.

Fraud is not new; but the consequences for the crypto ecosystem are dire because, unlike the traditional banking system, it operates with no lender of last resort. There is no central bank nor FDIC ready to backstop depositors who may have misguidedly understood FTX as a quasi-bank.

Contagion then delivered the final blow to crypto lenders BlockFi and Genesis. The latter's parent company Digital Currency Group (DCG) is also the parent company of Grayscale Bitcoin Trust (GBTC), which saw its discount fall beyond 40% to the underlying as fears on the potential dissolution of the trust began to weigh on prices.

In the meantime, trading, borrowing and lending in decentralized exchanges (DeFi) operated smoothly during the whole debacle. The centralized players mentioned above, and their management's misconduct, turned out to be the weak link.

the new year

Crypto markets closed the year in December still oozing from the aftermath of the FTX fallout. End-of-year redemption flows culminated in low liquidity with net selling on light trading volumes.

After price implosions, bankruptcies and loss of deposit funds, it is no surprise that crypto entered 2023 under an aura of skepticism and contempt, with the public unable to disentangle the irresponsible players from the assets themselves. Even insiders remained on the sidelines unsure of how many remaining skeletons were yet to surface.

However, underneath all the drama of 2022, the underlying fundamentals of the crypto ecosystem continued to improve throughout the year, despite the price drawdown. The blockchains continued to function and the technology space built and developed throughout.

Crypto adoption improved. The number of unique addresses holding at least 0.01 BTC increased 20% and retail (less than 10 BTC) share is estimated at 17% up from 10% in 2017. Crypto active developer activity increased by 5% over the year and the number of smart contracts deployed on the Ethereum mainnet almost tripled. Hong Kong announced plans to legalize retail crypto trading in a u-turn; Brazil passed regulation that allows the use of crypto as a means of payment; the BIS' new standards allow central banks to hold crypto reserves up to 2% by 2025 and Ethereum (ETH) underwent a successful merge to Proof of Stake.

Further, we saw the largest ever withdrawal of BTC from exchanges into custodians/wallets which minimize the risk of fund misappropriations and price tampering, while cleaner leverage and light positioning coincided with the beginning of a Fed cycle moderation.

On the back of all these factors, January welcomed crypto with an exuberant rally, exposing the extreme bearish sentiment and positioning at 2022 year-end. The month kicked off with an aggressive short-squeeze on reassuring macroeconomic data and moderating inflation. The generalized disbelief in the recovery rally gave way to catch-up flows from sidelined capital mid-month which sustained the new price range. Overall BTC shot up around 50% in a few weeks.

banking sector fragility spills over to crypto

As the first quarter settled, banking sector turmoil intensified. What initially began as a struggle to meet deposit withdrawals by crypto-friendly bank Silvergate soon exposed widespread banking fragility on outsized interest rate risk – independent of the bank's crypto exposure. Silvergate turned out to be the canary in the banking mine as deposit runs soon toppled Silicon Valley Bank and the quarter ended with the closure of Signature Banks, the takeover of Credit Suisse and the stress at First Republic Bank.

The banking turmoil affected the crypto ecosystem in several important ways. Paramount was that Silvergate and Signature were the only banks providing 24/7 on/off ramps from fiat to crypto, and thus were an important counterparty for many funds and exchanges. Most importantly, dominant fiat-backed stablecoin USDC had some 8% of reserves at Sillicon Valley Bank (SVB). The resulting outflow pressure forced a de-peg of the fully-backed stablecoin, partly because there was no path to access USD reserves over the weekend. USDC traded as low as 0.88 but regained its peg on Monday after access to the banking system was restored and SVB's depositor backstop was in place.

Of note, the direction of systemic risk spillover went from traditional banking to crypto, despite fears of the opposite.

The combination of the USDC stablecoin de-peg plus the banking system stress saw flows turning to BTC seeking safety. The Fed's backstop to the banking stress, which involved a sizeable liquidity injection of around $300 billion, cemented the next leg of the BTC rally.

risks and opportunities

The remarkable performance of BTC in the midst of a banking crisis cemented its digital gold credentials. When under proper custody, Bitcoin simply exists outside the banking system, or any centralized system, and provides digital scarcity - similar to gold's physical scarcity. Bitcoin's correlation with gold increased to 0.6% for the month, while its correlation to stocks fell to 0.2%. And thus, BTC topped its January rally with another 20% in March.

If 2022 was evidence that BTC is not a good hedge against cost-push inflation, 2023 suggests that BTC does a fine job against "monetary-led" inflation and banking stress. After all, BTC was born out of the banking stress of 2008.

Yet crypto tokens are certainly not created equal, the thousands of different alternative coins offer very different value propositions than that of BTC, and some, no value at all. Thus, a key lesson of 2022 is that protocol risk is key and careful vetting is just as important as proper custody.

In the near term, however, the more systemic risks for the space lay squarely on the regulatory backlash. The March "de-banking" of the crypto sector together with several other regulatory clampdowns in February sparked accusations of a hostile US government stance against legal crypto business and innovation. Kraken shut down its staking operations and paid a $30 million fee to settle with the SEC. Paxos and Coinbase received Wells notices on trading unregistered securities and Binance faces CFTC charges of money laundering and terrorist financing. When the dust settles, the ecosystem will likely emerge strengthened.

The core of the crypto technology, where it is decentralized, cannot be shut down, just as the internet cannot be shut down. Regulators will likely have little choice but to learn to adapt and live with it. Any regulatory missteps along the way, just as we see in Hong-Kong today, will probably reverse. Simply, it is in the political and economic interest of every country to embrace inevitable innovation.

Early adapters will likely be rewarded.

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Synopsis

Risk quantification is crucial for advancing risk management. Data deficiency and omnipresence of operational risks undermine applicability of typical quantification methods. The VoR approach reengineers the probability of default framework and leverages nonparametric stochastic processes, providing a versatile and agile method for quantifying operational risks.

Value of Risk (VoR) method – a complex approach for quantifying operational risks

by **Peter** Ding

introduction

A frequently cited quote, “if you can’t measure it, you can’t manage it,” might be a little overstated, but it would be less arguable to say “if you can’t measure it, you can’t precisely manage it.” Quantification of risk is indispensable for substantive advances of operational risk management.

unsuitability of VaR approach

Compared with typical analytical methods, the Value at Risk (VaR) approach is more robust and flexible. It used to be widely adopted in the discontinued Advanced Measurement Approaches (AMAs) for calculation of operational risk capital. Reliability and accuracy of VaR estimates depend on quantity and quality of modeling data. Operational risk is notorious for data deficiency in terms of availability, completeness, and comprehensiveness. Therefore, the direct implementation of the VaR method could not satisfactorily quantify operational risks.

robustness of value of risk (VoR) approach

Quantifying operational risk must overcome the obstacle of data deficiency. Additionally, to make quantification exercises more insightful and useful, risk driving factors need to be connected to risk consequences. The VoR approach leverages a structured parametric framework to overcome data challenges and build connections between risk driving factors and risk consequences. Based upon this foundation, a nonparametric stochastic process is added to deal with uncertainties and volatilities of the risk parameters.

probability of disruption framework

The probability of default approach for credit risk is a universally applicable risk quantification framework. Reengineering it to Probability of Disruption approach for operational risk may effectively address data deficiency challenges. Major modifications of the probability of default approach are captured in Figure 1.

Probability of Disruption approach reengineered from Probability of Default approach

Risk parameter	Denotation for Credit risk	Denotation for Operational risk	Modulation for Operational risk
PD	Probability of Default	Probability of Disruption	failure/misfunction of people, process or system, or external events that cause operation abnormality and loss
EAD	Exposure at Default	Exposure at Disruption	assets, systems, processes or people that are subject to risks
LGD	Loss Given Default	Loss Given Disruption	• Direct costs • Indirect costs • Incompliance costs • Opportunity costs

Figure 1: Probability of Disruption approach

mutations of exposure at default

Unlike the homogenous exposure of credit risk or market risk, exposure of operational risk is heterogenous and varies from risk to risk. The nature and measurement of operational risk’s Exposure at Default (EAD) has various forms such as employees and vendors, technology assets and physical assets, software applications and hardware equipment, on-premise and in-cloud data centers. There is not a universally applicable formula and measure to assess and express various forms of EAD. However, a general cascade like the following in Figure 2 helps ensure systemic identification of EADs for various risks.

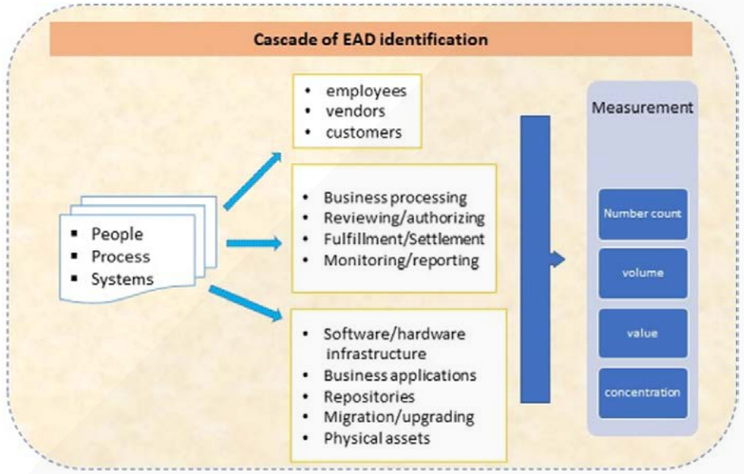

Figure 2: EAD Identification Approach

Probability of Default (PD) and Loss Given Default (LGD) may be deemed as properties of risk exposure. As height and weight describe physical characteristics of a person, PD describes a risk exposure's susceptibility to risk occurrence and LGD describes severity of consequences if risk events have occurred. A risk may impact multiple categories of risk assets or risk exposures. For instance, cyber attacks may impact customer access to a digital banking platform, employee access to business applications, or damage a bank's data center facilities. Plural forms of EADs need multiple one-to-one matching PD and LGD suites.

mutations of probability of default

Credit risk has many mature methodologies underpinned by theoretical bases to calculate PD. Few mathematical or analytical theories may be directly applied to operational risks. Empirical analysis methods have to resort to assessing operational risk PD. The PD method for one risk cannot be ported to other risks because different risks are driven by different risk factors. However, a generic design, illustrated in Figure 3, may provide a common framework to facilitate a consistent and compatible mechanism for different risks.

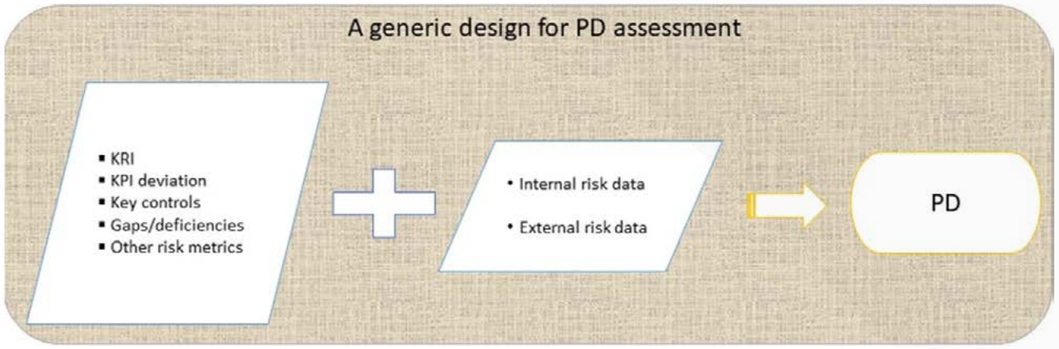

Figure 3: Probability of Default Assessment Design

mutations of loss given default

LGD may diverge more than EAD because operational risks usually cause wide-spreading impacts and the consequences of a risk event are typically multifaceted and incur losses from various aspects. There is no one-size-fits-all solution for different risks. Sorting out a risk's LGD with a generic constitution of operational risk losses may miss significant cost components and fail to ensure comprehensiveness and consistency. Such compatible LGDs will enable meaningful aggregation of financial losses of various risks. Figure 4 presents a commonly adopted categorization of loss components.

LGD constitution	
Risk cost category	**Illustration**
Direct costs	Loss of funds, damage of assets, increased expenses, repair and restore operations
Indirect costs	Customer compensation, counterparty compensation
Incompliant costs	Fines imposed by regulators and clearing/settlement organizations, legal suits
Opportunity costs	Loss of revenue due to business disruption, customer attrition, reputational impacts

Figure 4: Loss Component Categorization

overlay of nonparametric stochastic process

Multiplication of the three risk parameters represents the foundation of Anticipated Loss (AL):

$$AL=PD\times EAD\times LGD$$

The three risk parameters, especially PD and LGD, are volatile and full of uncertainties from various sources. A simple arithmetic operation of the above equation cannot cope with the parameters' uncertainty and volatility and produce a convincing AL value. A nonparametric stochastic process is leveraged to incorporate the volatilities and uncertainties; it is relatively less data-dependent, more flexible, and relatively easier when it comes to integrating external references and risk expert opinions than parametric solutions. Through simulations, it can produce a reasonable estimate with limited data and few assumptions about the distributions and interrelations of the driving factors.

The eventual loss distribution is essentially a joint distribution that is formed with individual distributions of the risk driving factors. The distribution-joining process faces a choice between marginal and conditional integration. Conditional distributions better reflect interrelationships between risk-driving factors and provide more precise estimates. Conversely, they can substantially increase model complexity and require extensive supporting data and analysis to interpret correlations between risk driving factors. Marginal distribution is not as precise or risk responsive as conditional distribution, but requires less data and modeling effort. In practice, the choice may be made based on the purpose and required precision of the analysis and data availability.

Marginal vs Conditional joint distribution		
Joint distribution	**Pros**	**Cons**
Marginal	• Requires less data • Simple model • Light computing	• Disconnection between risk cause and risk consequence • Less risk responsive • Unable to support in-depth analysis
Conditional	• Connect risk cause and risk consequence • More precise loss estimate • Support risk cause – consequence sensitivity analysis	• Model complexity • Modelling efforts • Extensive data requirement • Slower model running speed

Figure 5: Marginal vs Conditional Joint Distribution

conclusion

The complex VoR approach exploits both the advantages of structured parametric framework and the benefits of flexible nonparametric stochastic process. It is a versatile and practical approach suitable for operational risks.

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Synopsis

This article humanely explores the toll climate change will take on the common man and individual regions, leading to broader socioeconomic divergence and geopolitical destabilization. How can organizations meet the unprecedented uncertainty that lies ahead in order to safeguard the soundness of their individual institutions and the global economy?

a more unstable world: how climate change will drive geopolitical risk, and how companies can prepare

by **Merlin** Linehan

2022 was the year climate risks could no longer be ignored. A series of extreme weather events put climate in the spotlight of world news. Major rivers including the Rhine, Po, and Yangtze fell to record lows[1]. Heatwaves in China forced many factories to close over the summer[2]. Pakistan suffered devastating, once-in-a-century flooding and extreme heatwaves[3].

Climate change will make extreme weather such as this more frequent and deadly. Floods can cause great human suffering, destroying homes and businesses and encouraging the spread of water-borne disease like cholera. In Pakistan's case, flooding also dealt a deadly blow to an already fragile economy. The chaos and disruption of flooding means lower economic growth, higher debt payments and a massive bill for reconstruction.

The ripple effect of climate change goes well beyond the headlines of new extremes of weather. The impacts will spill over into politics, economics and society, radically reshaping the world. Climate change acts a force multiplier, accelerating existing threats (extreme weather, flooding and drought have always been with us) to make them more common and deadly.

conflict and climate

Climate change-induced drought and desertification in the Sahel region of Africa have driven the rise of extremist and militant groups in the area[3]. Climate change and increasing demand has seen water sources dry up across this already water-stressed region as well. This has driven many farmers and pastoralists from the land. As traditional livelihoods disappear, desperation pushes locals into the arms of extremist groups such as Boko Haram and Daesh[5]. The rise of these groups has sparked a number of conflicts across the Sahel, pitching government forces against these extremists[6].

A hotter world is a more unstable and dangerous world. A world facing more hunger, drought and conflict will experience more geopolitical turmoil as countries grapple over dwindling resources. The construction of the Grand Renaissance dam in Ethiopia has sparked anger in Egypt because it threatens the flow of water on which the country is highly dependent[7]. If the Nile shrinks further as expected due to climate change and growing demand for its water, Egyptian agriculture will become increasingly unviable.

climate risks should not be seen in isolation

Climate risk will comprise a series of shocks that will overlap and overwhelm governments. As temperatures rise, the likelihood of mass crop failures across the globe will increase. Already, many of the world's breadbaskets are under pressure from record-breaking heat and water shortages. The Indus and Ganges River basins in South Asia face the competing burdens of increasing demand, extreme disruptive weather, and rising temperatures—all factors that threaten India's ability to feed its people[8].

A mass crop failure of one or more key regions such as the Ganges, Euphrates or Nile basins would impact millions of people, creating famine and potentially engulfing the world in economic and political chaos. Widespread crop failure along with extreme heatwaves would likely see mass migration that could see the movement of millions of starving and desperate people attempting to cross borders. The movement of Syrian refugees into Europe caused a major political crisis as countries such as Turkey and Greece grappled with millions flocking to their borders[9]. The Syrian war that started the refugee crisis has been linked to climate change by academics[10]. A long-running drought pushed many poor and hungry farmers into cities, which created an angry, politically volatile movement of people eager to protest at the government.

Policy makers and scientist are careful not to attribute an event solely to climate change. However, it will make events like the Syrian drought and subsequent war more common and frequent.

systemic risk

One or more major crop failures would trigger higher global food prices. In turn, this would put major pressure on economies across the world and unleash unpredictable political reactions. Governments may turn to isolationist policies such as export controls on food in an attempt to protect their own populace. Nations could lurch toward extreme politics or lash out at neighbours in an attempt to seize resources such as supplies of water.

The COVID-19 Pandemic was in many ways a foretaste of the future. The virus itself was a major killer, but the second and third impacts were also enormous. Think of the unpredictable economic disruption and societal change – all factors that are still unfolding. In late 2022, the Chinese government shifted from strict lockdowns to relaxing COVID restrictions in a matter of weeks, causing confusion and disruption in and outside China[11].

how can organisations prepare?

Companies need to prepare for a more unstable world. One leader in this regard has been the United States military, which recognises climate change as a "destabilizing and potentially catastrophic transboundary challenge[12]," and has prepared detailed scenarios to prepare for a wide range of unfolding threats.

Other organisations should follow this example and create credible climate-related scenarios that hypothetically could impact their own operations. This might include deep and disruptive economic shocks and loss of markets in badly afflicted regions, supply chain interruptions and widespread political uncertainty. Organisations should develop simulations and exercises that allow them to understand how these scenarios will affect their strategies and how they should respond. Successful firms of the future will not only have a plan for climate change, they will be well positioned to thrive in these adverse circumstances.

While the picture painted around climate change is often bleak, there are causes for optimism. The pressures of this new world could spark a powerful reaction as countries extend and develop innovative technologies to mitigate, or even reverse, the damage of climate change. Think of how quickly vaccines were developed for COVID-19. The same pressures could even see the world pull together politically to develop successful policies and initiatives to combat this existential threat.

Climate change is now firmly in the seat as a driver of geopolitical risk, a trend that will intensify with each major climate related disaster. Businesses should be preparing by understanding and monitoring how climate related risks will disrupt an already volatile world, and what that means for their own strategy and operations.

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Synopsis

Basel III's liquidity risk reforms now incorporate the liquidity impact on banks of collateral required for derivative contracts. However, recent market disruptions have demonstrated that Basel's historical lookback calculation approach can significantly understate a bank's potential derivative cash outflows in times of stress. This article proposes a forward-looking calculation approach which levers the bank's derivative counterparty credit exposure modeling.

a better way of quantifying the liquidity risk of OTC derivatives during market stress

by **Famien** Konan

The Great Financial Crisis (GFC) of 2007-2008 highlighted the systemic risks arising from non-centrally cleared OTC derivatives. In response to this crisis, the Basel III regulatory reforms of the Basel Committee on Banking Supervision (BCBS) incentivized the clearing of derivatives through central counterparties (CCPs) and emphasized the need for strong collateralization of bilateral derivatives, requiring banks to exchange two types of collateral: initial margin (IM) and variation margin (VM).

These margin requirements played a central role in mitigating counterparty risk during the Covid-19 market turmoil of March 2020, while also ensuring that the derivatives markets remained resilient. However, in such times of severe market stress, the amount of margin calls increases drastically as a result of extreme price movements, asset value depreciation and significant shifts in market volatility. Because liquidity dries up within the financial system during such periods, some market participants may encounter difficulty in funding the cash flows that can arise from derivative margin calls with cash-like assets, resulting in the so-called "dash for cash". It is therefore important that banks include in their liquidity forecasts a realistic estimate of the cash flows arising from derivatives.

stress simulations of derivative liquidity risk

As part of the Basel III regulatory reforms, the BCBS introduced the Liquidity Coverage Ratio (LCR) and the Net Stable Funding Ratio (NSFR). The objective of the LCR is to ensure that banks possess a minimum amount of high-quality liquid assets (HQLA) to withstand a 30-days period of market stress, while the goal of the NSFR is to reduce a bank's reliance on short-term funding over a broader time horizon.

For financial derivative contracts, the LCR calculation requires banks to include in their Total Liquidity Outflows not only the expected contractual cash flows (repricing, exercise or maturity), but also additional collateral requirements in an event such as changes in market valuations, changes in the credit rating or creditworthiness or a decline in the value of posted collateral. The NSFR, on the other hand, requires that 5% to 20% of all derivative liabilities must be supported with stable funding.

The BCBS recommendations on liquidity management can be used to facilitate liquidity stress testing for OTC derivative portfolios. They provide a starting point to develop a liquidity risk metric to capture (i) contractual cash outflows, and (ii) contingent cashflows resulting from market stress events. One could define such metric as the Potential Derivative Outflows (PDO), which is the "worst-case" cash flow profile at a given confidence level associated with financial derivatives. The PDO integrates all the liquidity requirements from derivatives shown below in Figure 1.

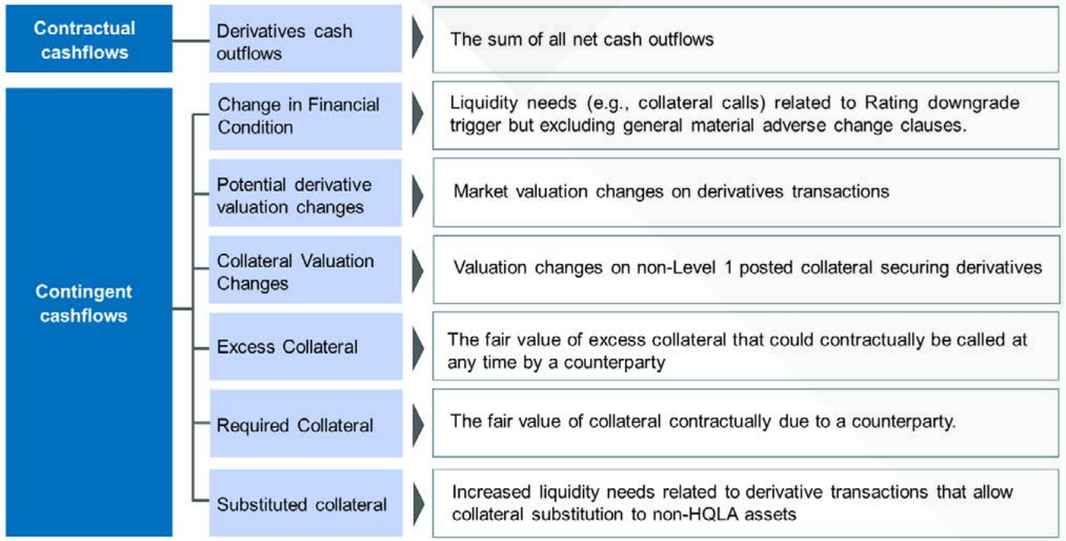

Figure 1 - Liquidity requirements from derivatives

This liquidity metric can be calculated under a range of scenarios consistent with the bank's liquidity risk appetite, such as a market-wide stress scenario lasting 90 days, an idiosyncratic scenario lasting 30 days or a combined scenario lasting 30 days. A more drastic scenario, which is a prolonged market stress over a 1-year time horizon, could also be considered, in line with the NSFR assumptions. An example of a combined 30 days scenario would be motivated by the market moves during the 2008 financial crisis and the recent coronavirus stress, and would include a 75 basis point parallel downward shift in interest rates, a 15% decline in stock markets and a 5% depreciation of the US Dollar, as well as a 3-notch downgrade of the bank's credit rating.

a better way of calculating derivative funding liquidity risk

The standard approach prescribed by regulators to compute potential cash outflows is based on historical cash flows. In the LCR calculation for OTC portfolios, the potential cash outflow corresponds to the largest absolute net 30-day collateral flow realized during the preceding 24 months. The European Banking Authority (EBA) proposes a similar approach, where the additional collateral outflow is the largest difference in collateral posted within consecutive periods of 30 days observed within the preceding 24 months. This standard approach, termed the Historical Look Back Approach ('HLBA'), suffers from the same drawbacks as historical Value-at-Risk (VaR), which include non-representativeness of the current portfolio and strong dependence on the selected historical window, which can omit important disruptive events.

To address these limitations, the PDO could be determined with a forward-looking approach based on the future counterparty credit exposure profile of the OTC portfolio. The rationale behind this method is that a collateral flow at any future time depends on the future credit exposure. Therefore, this forward-looking approach could rely upon the bank's potential future exposure (PFE) model used to evaluate counterparty credit risk (CCR) exposures. The EBA already suggested this method, called the Advanced Method for Additional Outflows ('AMAO'), to institutions with large derivative portfolios that already have an approved Internal Model Method (IMM) for counterparty credit risk.

CCR engines are typically built on Monte Carlo simulation of derivative mark-to-market (MtM) valuations. They generate a set of mark-to-market scenarios based on contractual cash flows, which are aggregated at portfolio or netting level, considering contractual margin rules (as defined in the CSA agreements) to determine CCR metrics such as expected positive exposure (EPE) and potential future exposure (PFE). Because the CCR engines also generate collateral outflow scenarios, they can easily produce liquidity metrics at the step of aggregation across the different Monte Carlo scenarios. More precisely, institutions can estimate their PDO according to the following sequence of steps:

- Scenario generation: Simulate the joint evolution of all risk factors relevant to the portfolio across different scenarios, with a hybrid stochastic model based on stressed inputs (e.g., the stress calibration of the IMM),

- Exposure simulation: Value each trade in the portfolio for each future point in time under each scenario with the projected risk factors, using discount cashflow model or the American Monte-Carlo methodology for exotic products.

- Aggregation: Aggregate the mark-to-market for each netting set (e.g., sub-portfolio or counterparty), and apply the relevant margin rules (e.g., threshold, minimum transfer amount etc.) to simulate a recursive collateral process, which accounts for the potential derivatives valuation changes, and the excess/required collateral. The collateral modelling could also assume immediate collateral delivery at exact collateral call dates, worst-possible collateral composition in case cash and securities are eligible assets, and specific haircuts to reflect the collateral valuation changes.

- **Risk management:** Calculate the relevant liquidity metric based on a netting set-level cash flow profiles across the different scenarios at the required time horizon.

This forward-looking approach provides a more appropriate method for estimating liquidity risk for OTC derivative portfolios, in contrast to historical approaches.

conclusion

Like other financial crises in recent decades, the market impact of the Covid-19 pandemic highlighted the adverse liquidity requirements that may arise in an OTC derivative portfolio during periods of market turbulence. Banks will have to monitor their actual and anticipated margin calls and ensure that those requirements are covered by their liquidity management strategies. The PDO provides a powerful metric to assess the liquidity risk arising in OTC derivative portfolios. Given that this metric leverages an institution's current architecture for measuring counterparty credit risk, it provides a consistent approach for assessing both the liquidity and counterparty credit risk of OTC derivative portfolios.

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Synopsis

In a more globalized world, risks can emerge from unforeseen corners and spread at lightning pace – we saw it firsthand with Covid-19. Businesses are still coming to terms with this realization while others have decided nothing can be done. In fact, risk management strategies can help better understand interconnected risks, facing them proactively, but only once acknowledgement is made that risk is not truly local anymore.

interconnected risk: how risk management strategies help face challenges

by **Shuvajit** Chakraborty

introduction

As parts of the globe have connected over the centuries, their risks have become interconnected. When plague spread in 14th century England, the pandemic affected only a few countries in Europe such as England, France and Italy. There was no sign of it in the Americas, Africa, Australia or East Asia. On the other hand, the recent pandemic of Covid had global spread, infecting almost all the world within three or four months from first confirmed detection in Wuhan, China in December 2019. The interconnections in trade and travel enabled by the advance in technology was taken advantage of by disease-causing agents.

Not only in health, but also in economics and politics, the risks have been interconnected recently. The subprime mortgage crisis originating in the USA in 2007 spread to Europe and into a few Asian economies far from the center of the origin.

In recent years, the Ukraine – Russia war is one of the reasons pushing countries in Asia into recession due to their dependency on these countries for food and fuel. The trade relations being the connecting factor.

reasons for concern

Six interconnected risks have been identified to be of special concern to businesses. These are cyber security, damage to brand and reputation, complex supply chain risk, pandemic, intellectual property, and climate transition. Businesses tend to understand these risks less well, either because they are new or because they are accelerating or changing in profile.

This requires companies to take a fresh look at risk assessment and scenario quantification, and to rigorously test the validity of existing risk management and financing programs[1].

risk enhancing factors

Businesses faced with the above interconnected risks find them enhanced further by the following factors:

- Ignorance – many business operators are not aware of the interconnections of risks their businesses face. These risks may be due to internal or external factors or a combination of both. For example, a bread manufacturer in South East Asia may be aware of the risks that he may have to face due to competition in local markets, changes in consumer preferences or the regulatory environment. But he may not have thought that political relations between two eastern European countries will affect his business. When this happens, it is a shock to him; as has happened when war between Russia and Ukraine pushed wheat prices up, forcing many bakers out of business[2].

- Willful blindness – businesses are aware of the interconnections of their risks attributable to external and internal factors but choose to ignore it. They think the materialization of an adverse scenarios is highly unlikely. Such scenarios are commonly referred to as 'Black Swan' events - referencing the common knowledge in the past that swans are white and that a black swan will never be found[3]. Common knowledge was challenged when black swans were discovered in Australia. Greed or pure laziness may be the contributing factor to ignoring adversity, however unlikely. An example of ignoring the known facts is the over-concentration of manufacturing of electronic goods in China. The multinational business operators were aware of the pitfalls of geographic concentration but maintained confidence in the Chinese government's capacity to control any disruption in the business environment. They received a major shock when the disruption caused by Covid-19 went beyond the control of the Chinese government.

risk management strategies

Strategies to manage interconnected risks must include the following steps:

- Identification – risks must be identified, and their interconnections discovered before they are managed. The experience of peer institutions around the world and the knowledge of the experts may prove to be helpful in this matter.

- Diversification – identification must be followed with diversification. The choices must be made to reduce risk concentrations. The sustainability and resilience of supply chains should be built back by adopting a risk diversification strategy. For example, Apple is moving its production of MacBooks from China to Vietnam to diversify risk.

- Preparation – preparing can be achieved by removing vulnerabilities that a risk might take advantage of. A study by UN University Institute for Environment and Human Security found that "an interconnectivity lens is necessary for building the long-term resilience of communities and ecosystems, making them better able to prepare, respond, and cope with disasters when they strike[4]." For example, making progress towards zero hunger is dependent on also advancing clean water and sanitation, and climate action.

- Fast implementation – once the solution to a vulnerability is developed, by advancement of technology or discovery of innovative application of existing technologies, it must be implemented fast to remove disaster triggers. For example, in Odisha state of India, the loss to life and property due to recurring events of cyclone has been reduced by the application of remote sensing in detecting developing cyclones and fast communication through mass media to evacuate people from the path.

conclusion

The world has become interconnected due to technological advancement and globalization. As a result, risks and disasters have also become interconnected. These interconnections increase the impact of the risks as well as their spread globally. Some businesses are not aware of the total impact of risks, while others prefer to remain blind.

Management of interconnected risks will require businesses to adopt new strategies incorporating both the sustainability and innovative use of technology.

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1 / https://theonebrief.com/navigating-new-sources-of-volatility-in-a-world-of-interconnected-risks/

2 / https://www.oecd.org/ukraine-hub/policy-responses/the-impacts-and-policy-implications-of-russia-s-aggression-against-ukraine-on-agricultural-markets-0030a4cd/

3 / https://en.wikipedia.org/wiki/Black_swan_theory

4 / https://sdg.iisd.org/commentary/guest-articles/managing-disaster-risks-in-an-interconnected-world/

Synopsis

Inflation is still making headlines after the pandemic triggered a series of global economic events and the Russia-Ukraine conflict added to the disruption. How it can be tackled depends on the source of inflation and who acts –government or central bank– but even these actions can overshoot unpredictably.

combatting global inflation

by **Tanushree** Datta

introduction

Per IMF statistics, nearly 110 countries across the globe saw an inflation rate of greater than 7% in 2022[1]. Setting aside countries like Venezuela, Turkiye and Argentina, that have witnessed hyperinflationary trends for endemic reasons, the larger segment of countries in this bucket are facing the repercussions of global headwinds.

Alarm bells are ringing now only because of trends in otherwise historically stable economies. Just three years ago, in 2020, inflation stood at low levels: in Ukraine at 2.7%, USA at 1.2%, Australia and UK at 0.9%, Canada at 0.7%, Korea at 0.5%, and many others, like Germany and Japan, all near or below 0%. In 2022, rates in Russia stood at 13.8%, Ukraine at 20.6%, Poland, Belgium, the UK, Germany, Spain, USA over 8%, and Japan at 2%. This surge threw all economies into disarray.

causes of global inflation

A major chunk of the recent inflationary force is caused by events of the past 3 years. As the pandemic wore on, suppressed demand from previous years resurged to cause moderate inflation in 2021, usual of growth momentum.

The USA, for example, saw inflation of 4.7% in 2021 up from 1.2% in 2020. Much of this was driven by a recovery in transport, energy, and other sectors. Even before the global economy recovered, the Russia-Ukraine conflict led to major upheavals across global markets.

1 / https://www.imf.org/external/datamapper/pcpipch@weo/weoworld/ven

Supply chain shocks and sanctions on Russian-exported oil and gas squeezed the global market leading to a domino effect in prices of energy, transportation, trade restrictions, and eventually core inflation, that manifested itself mostly in food price increases.

In addition, China's multiple lockdowns affected the global supply of manufactured goods through the year. It's gradual reopening is expected to stimulate energy prices as China is the largest international consumer of energy products.

The other factor that was fodder for inflationary headwinds was sovereign debt and leverage. The USA, interestingly, has not witnessed a decline in its central government debt-to-GDP ratio in any year since 2008, except for 2017 and 2021[2]. In the quest to spur economic activity, governments often resort to undesirable measures like deficit spending, making inflationary trends worse.

Central banks globally have begun to attack core inflation through a series of interest rate hikes, as seen recently in the actions from the Federal Reserve (USA) and Bank of Japan.

Yet use of monetary instruments can have serious countereffects. The recent incident at Silicon Valley Bank is a case in point. Prima facie the bank invested a disproportionate amount of assets (57%) into long term Held-to-Maturity treasury bonds and other illiquid securities, relying on the near-zero short term interest rate regime. By conventional wisdom, long term securities are considered a low-risk, safe bet investment. Yet as soon as the rate shocks began to twist the term structure, and cause a yield curve inversion, these illiquid assets lost USD $15 billion in value quickly, causing a capital crunch. At the same time, given the customer base of start-ups and venture capitalist depositors, the bank was also exposed to concentration risk. As rates were hiked, these businesses triggered a bank run both to meet rising working capital needs and for fear of losing unsecured deposits. To put things in perspective, out of USD $174 billion in deposits at the bank only 11% were sub-$250,000 accounts and consequently FDIC insured.

It can be argued that liquidity risk management was poor at the bank. At the same time, it also highlights the wrong-way risks that the use of monetary instruments may trigger in the economy. The rate shocks have now spooked the financial system globally even more than inflation has.

2 / https://www.imf.org/external/datamapper/cg_debt_gdp@gdd/chn/fra/deu/ita/jpn/gbr/usa

tools available to governments and central banks

Even now, governments and central banks have various control instruments at their disposal to manage the surge in inflation without causing other collateral damage, a few of which are contextualized below:

CAUSE FOR INFLATION	ACTOR	ASSUMED EFFECT TIMELINE	ACTION TYPE	ACTION	POTENTIAL PRIMARY IMPACT
DEMAND PULL	Government	1+ years	Fiscal Policy	Reduced Government Expenditure	Public expenditure is a component of demand and reducing it can ease price levels
DEMAND PULL	Government	Immediate	Fiscal Policy	Increased taxes	Increased taxes reduce disposable income lowering demand and prices
DEMAND PULL	Government or Central Banks	Immediate	Monetary Policy	Price & Trade Controls	Governments can impose short term taxes, tariffs and ceilings to control prices
DEMAND PULL	Central Banks	Immediate	Monetary Policy	Exchange Rate Revaluation/ Appreciation	Works better in exporting nations, by making domestic market attractive and diverting exports to domestic sales
DEMAND PULL	Central Banks	Immediate	Monetary Policy	Open Market Operations	Purchase and sale of financial instruments can influence funds rates and deployable capital with banks
COST PUSH	Government	1+ years	Other Policy	Introduce productivity enhancing measures	Leads to increase in production supply and eases prices
COST PUSH	Government	5+ years	Other Policy	Improve infrastructure, logistics, distribution, etc.	Can help increase supply to meet excess demand
CONTROL	Central Banks	Immediate	Monetary Policy	Increase Interest Rates	Can Reduce Money Supply, Investments, and impact consumption demand
EVENT DRIVEN	-	-	-	Fall in price of raw materials	Reduces cost to producers
EVENT DRIVEN	-	-	-	Improved agricultural acreage, harvests	Increase supply to meet demand

Table 1: Inflation Causes and Controls

what if inflation controls overshoot?

While demand-driven inflation is easier to address through money markets, supply-driven inflation that stems from inadequate production, low productivity, long time-to-market, lagging infrastructure and trade barriers, entails longer turnaround times. Most markets faced supply issues once the Russia-Ukraine conflict was underway and during the China lockdowns. The overhang for 2023 stems from the fact that the global supply of everything from oil to manufactured goods and food grains was massively disrupted and fixing the supply chain to restore production is taking longer than hoped.

Coordinated global action too can only be limited in scope and reach. We are more likely to see a flurry of activity from central banks in an attempt to clamp down on demand pressure. Yet these measures, easier to implement and "fail fast" as they are, run the risk of slowing down economic growth, leading to unemployment, recessions and pushing the poorest into greater misery – ingredients of the perfect storm.

The trade-offs for central banks and governments are difficult, and how policies navigate these headwinds in the coming months remains to be seen.

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Synopsis

This article presents an analysis of the impact of asset price bubbles on the markets for cryptocurrencies and considers the standard risk management measure Value-at-Risk ("VaR"). It applies the theory of local martingales, presents a styled model of asset price bubbles in continuous time and performs a simulation experiment featuring one- and two-dimensional Stochastic Differential Equation ("SDE") systems for asset values through a Constant Elasticity of Variance ("CEV") process that can detect bubble behavior. It summarizes a working research paper that is available from the author upon request, containing mathematical details, complete results and references[1].

measuring risk in new asset classes

by **Michael** Jacobs, Jr, Ph.D., CFA

measuring risk in new asset classes

The financial crises of the last decades have been the impetus behind a movement to better understand the relative merits of various risk measures, classic examples being Value-at-Risk ("VaR") and related quantities. The importance of an augmented comprehension of these measures is accentuated in the realm of new asset classes such as cryptocurrencies, as observed in the recent meltdown in these markets. We have subsequently learned from episodes such as this that the pricing models have failed in not incorporating the phenomenon of price bubbles, which in turn added to the severity of the downturn for investors and risk managers who mis-measured their potential adverse exposure to market risk in this domain.

The type of asset price bubble considered here exists only in continuous trading models, and it corresponds to an asset whose price process is a local martingale but not a martingale, which is the type of bubble that is the subject of this study. In economic terms, in this case the risk-adjusted expected discounted cash flows and liquidation value at some finite time horizon do not equal the market price, implying that the asset's fundamental value is not equal to its market price. Such bubbles arise when investors attempt to capture short-term trading profits through trading over a finite horizon where the market price for an asset exceeds its fundamental value, the latter being interpreted as the price paid for the asset to buy and hold until liquidation. In this setting, it is possible to test for the existence of such bubbles without estimating an asset's fundamental value, thereby avoiding the joint hypothesis issue.

1 / The working paper may be found on the Social Sciences Research Network: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4399927

Cryptocurrencies are naturally suited to this form of testing since as they have cash flows, and the fundamental value corresponds to the currency's liquidation value at the model's horizon, which implies that bubbles exist in cryptocurrencies when speculators buy to resell before the model's horizon. This situation appears to be rather plausible in the case of novel cryptocurrencies, which are mainly used as a medium of exchange. Theoretically, if purchased to buy and hold and to use as needed, the transaction demand for these assets should be constrained by the usage of other more standard currencies to execute transactions. However, this expectation is at odds with historical experience, as seen in the unprecedented expansion of cryptocurrency markets over the last decade.

testing for asset price bubbles

In this empirical experiment across several widely traded cryptocurrencies, the estimated parameters of one-dimensional SDE systems do not show evidence of bubble behavior. However, when a two-dimensional system is estimated jointly with an equity market index (in this case the NASDAQ), a bubble is detected, and comparing bubble to non-bubble economies, it is shown that asset price bubbles result in materially inflated VaR measures. The implication of this finding for portfolio and risk management is that, rather than acting as a diversifying asset class, cryptocurrencies may not only be highly correlated with other assets but have anti-diversification properties that materially reduce diversification benefits on portfolios.

The estimation results for the one- and two-dimensional SDE models for the case of Bitcoin and the NASDAQ, as well as the simulation of daily VaR for each of these models, are described below. The results and conclusions for the other five cryptocurrencies in the detailed research paper are similar. Table 1 shows that when the SDE is estimated separately for each of them and the NASDAQ, the parameter estimate for the CEV parameter is either statistically indistinguishable from unity, or else is less than one, and the null hypothesis that it exceeds one, which is indicative of no bubble, should be rejected. However, when the two-dimensional systems are estimated, considering the correlation between the cryptocurrency and equity index processes, all CEV parameter estimates are greater than one and enough so that the null hypothesis that it is less than or equal to one, which is evidence of a bubble in the joint price processes, should be rejected. The second major observation is that the normalized VaR measures are materially elevated in the cases of the two-dimensional SDE models where bubble behavior is detected as compared to the one-dimensional case, which holds Bitcoin and the NASDAQ.

			Drift	Vol.	CEV Exp.	Corr.	Log-L	AIC	99th Prcntl. VaR
Bitcoin	1 Dim. SDE	Estimate	0.1012	1.6586	0.9035				
		Std. Err.	0.0249	0.0167	0.0012	N/A	71,643.73	71,644.33	0.8568
	2 Dim. SDE	Estimate	0.9095	1.1167	1.0390	0.9128			
		Std. Err.	0.2784	0.0638	0.0064	0.0282	41,048.81	41,054.81	0.9902
NASDAQ Equity Index	1 Dim. SDE	Estimate	0.0635	0.0565	1.1012				
		Std. Err.	0.0242	0.0022	0.0851	N/A	60,432.10	60,372.10	0.2718
	2 Dim. SDE	Estimate	0.0752	0.0802	1.5196	0.9128			
		Std. Err.	0.0064	0.0000	0.0014	0.0282	41,048.81	41,054.81	0.4930

Table 1: One- and Two-Dimensional SDE System Estimation Results – NASDAQ and Bitcoin

Finally, Figures 1 through 4 below show graphical depictions of the VaR simulations for Bitcoin and the NASDAQ. The extreme non-normality, i.e., extreme excess kurtosis and skewness, of the simulated loss distribution in the case of the two- versus the one-dimensional model are evident from these plots.

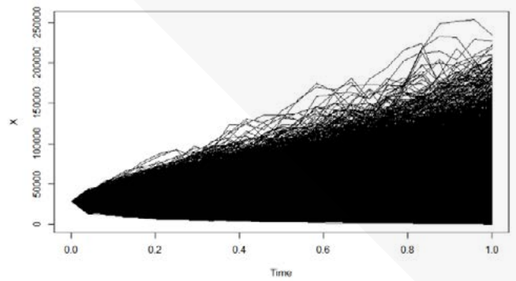

Figure 1: Simulation of One-Day VaR from the Estimation of a One-Dimensional SDE System CEV Model – Bitcoin

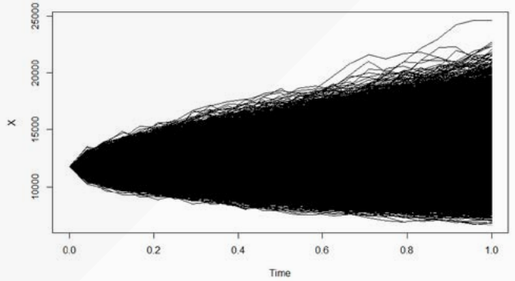

Figure 2: Simulation of One-Day VaR from the Estimation of a One-Dimensional SDE System CEV Model – NASDAQ

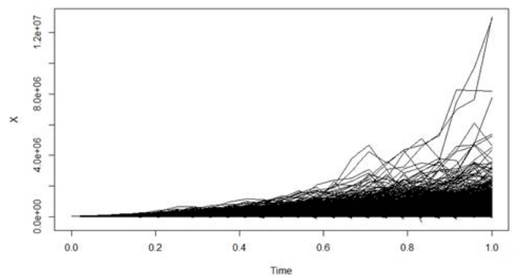

Figure 3: Simulation of One-Day VaR from the Estimation of a Two-Dimensional SDE System CEV Model – Bitcoin

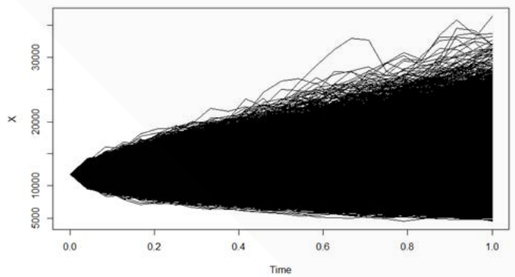

Figure 4: Simulation of One-Day VaR from the Estimation of a Two-Dimensional SDE System CEV Model – NASDAQ

conclusion

Leveraging the deep economic literature of local martingale theory as applied to asset price bubbles in the markets for cryptocurrencies and using historical time series data in a continuous time and finite horizon trading model setting has produced an important finding. The example with Bitcoin and the NASDAQ showed that asset price bubbles are detected in CEV model dynamics derived from calibration of two- versus one- dimensional SDE models where cryptocurrencies are modeled jointly with an equity price index. We note implications of this research for prudential supervision and public policy and the debate over how cryptocurrencies should be regulated, namely that, if there is a powerful interaction between cryptocurrencies and another major risk asset that leads to a self-reinforcing vicious cycle of bubble behavior, the regulatory regime should account for these linkages and that there should be a proper coordination amongst agencies.

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Synopsis

The rise of globalization has brought many economic benefits, but also vulnerability to adverse geopolitical events, resulting in the current trend towards de-globalization. Longer-term, however, economic and political influences are likely to lead to a new globalization model, Globalization 2.0.

de-globalization or globalization 2.0?

by **Aleksei** Kirilov & **Valeriy** Kirilov

Globalization in today's world is so comprehensive that it is impossible to discuss all aspects of this phenomenon in a small article. We will therefore focus only on some issues of economic globalization. Firstly, it should be recognized that, although globalization was historically inevitable, the initial powerful drivers of this phenomenon were political events, starting with China's reorientation towards cooperation with Western countries and, above all, with the United States, in the early 1980s. This led to the rapid development of the Chinese economy, the influx of investment and the transfer of technology and ultimately made China the world's factory. The second driver was the opening of the economies of Eastern Europe and the former republics of the Soviet Union to the goods and services of Western companies.

Of course, no political events could lead to the emergence of global markets for goods and services without the economic motivation of companies. The desire of the largest companies to reduce costs and increase profitability was the factor that made the world the way we see it now. First of all, companies sought to transfer production to countries and regions with cheap labor and raw materials. As a result, our civilization has become very vulnerable to any geopolitical impact, such as the COVID-19 pandemic, the conflict in Ukraine, and trade wars between the US and China.

emerging de-globalization

Currently, the emerging trend of de-globalization is being frequently discussed. Let's try to analyze the reason for this. During the pandemic, most countries found that the delivery of critical goods produced in other regions suddenly became impossible due to disruptions in supply chains. We described possible supply chain risk management approaches in one of our previous articles[1]. As a result, after the pandemic, the governments of a number of developed countries began to motivate businesses to return production capacities to their own countries.

1 / "Impact of the pandemic on global supply chains" https://issuu.com/prmia/docs/intelligent_risk-april_2021_issuu

In the context of the aggravation of the geopolitical situation, many countries are striving to ensure the production of strategically important goods in their own territory. An example would be plans to build factories for the production of chips in the US, Germany and Japan. Another example would be the redistribution of hydrocarbon supplies over the past year. European countries have refocused on the United States and the countries of the Middle East. And China and India have sharply increased their supply of oil from Russia.

Three bills passed by the United States last year can serve as a vivid illustration of the above. The approximately $280 billion Chip and Science Act promotes semiconductor research and manufacturing. The Inflation Reduction Act directs about $369 billion towards clean energy and energy security programs. And most of the $1 trillion infrastructure bill will be spent on boosting US economic competitiveness. Biden administration officials have said that the implementation of these bills will boost economic growth, improve supply security, strengthen domestic manufacturing, and provide well-paying jobs for American workers.

Does this mean the end of the era of globalization? Of course not. In a recent article[2], McKinsey analysts point out the critical role of international trade in the global economy. "No region is close to being self-sufficient. Every region relies on trade with others for more than 25 percent of at least one important type of good. About 40 percent of global trade is "concentrated." Importing economies rely on three or fewer nations for their share of global trade. Three-quarters of this concentration comes from economy-specific choices." Thus, abandoning the international division of labor will lead to unacceptable economic costs.

Consider the recent change in world GDP and the share of international trade in world GDP, shown below in Figure 1.

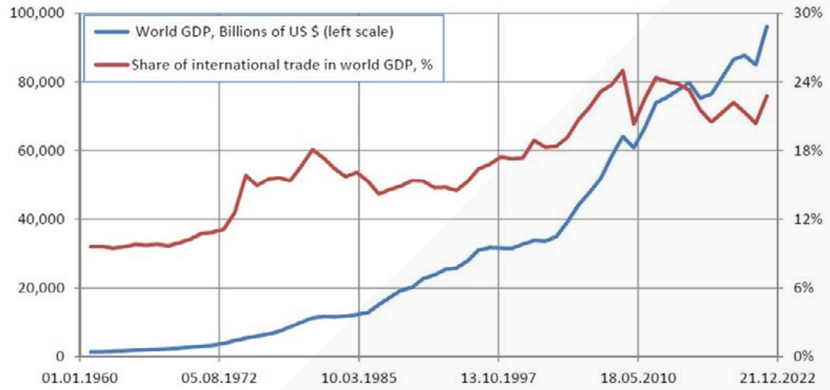

Figure 1, Source: https://stats.wto.org/

As can be seen in Figure 1, over the past 18 years, the share of international trade in world GDP has remained roughly constant in the range of 20% - 25%.

2 / The complication of concentration in global trade, McKinsey Global Institute, January 12, 2023, https://www.mckinsey.com/

Despite the fact that world GDP has more than doubled during this time. Note that the steady weight of international trade has been observed despite a massive stimulus package designed to favor US-made goods in the aftermath of the 2007-08 financial crisis.

At the same time, the European Union introduced new subsidies to protect its agricultural producers. It can be assumed that, at the current level of development of productive forces and technologies, the share of international trade in world GDP is fairly stable.

Consequently, the current desire of countries for greater economic security will lead to a redistribution of financial and commodity flows while maintaining the share of international trade in world GDP. Of course, this will lead to some economic costs and decrease in efficiency.

Another interesting consideration is how the geopolitical picture of the world will change under these conditions. For the past 30 years, the world has developed under conditions of unconditional US dominance. It should also be noted that the last 20 years have been marked by a number of serious conflicts: Iraq, Libya, Syria, Afghanistan and the current situation in Ukraine. There are also a number of frozen conflicts, such as the Arab-Israeli confrontation, the situations in Kosovo and Yemen, etc. Does this mean that, as the US share in world GDP decreases, the international situation will become more unstable and explosive? In our opinion, during the confrontation between the late USSR and the USA, the world was much more stable. If this is true, then it would be more preferable and safer in the current situation to form a bipolar system between the US and China. However, a detailed substantiation of this hypothesis is beyond the scope of this article.

globalization 2.0

Thus, the next stage of globalization, or globalization 2.0, may involve the redistribution of financial, commodity and migration flows within the framework of economic and political unions led by the US on the one hand and China on the other. This will manifest itself, on the one hand, in the growth of protectionism from unfriendly countries, for example, the embargo of the United States and the European Union on oil and gas supplies from Russia, the ban on the export of modern technologies from the United States to China, as well as changes in tariff policy, for example, an increase in tariffs for the supply of goods to the United States from China. On the other hand, within the framework of economic unions between friendly countries, further easing of trade rules and reduction of tariffs will be observed. During the transition period, there may be increased price volatility, such as the change in the price of gas to Europe over the past two years. Going forward, however, these price fluctuations will decrease as new supply chains improve. And in the event of a decrease in geopolitical tension, we will again be able to observe over the next 15-20 years the economic competition of two political systems: the “Western”, based on competition and the “Eastern”, based on a more stringent management of the economy. Historical experience shows that over long time horizons, the economic model based on competition wins.

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Synopsis

Can climate change have an impact on sovereign default risk? The authors find that an increase in temperature anomalies leads to an increase in sovereign Credit Default Swaps (CDS). This effect is driven by the negative effect of temperature on the growth rate of GDP, which harms the debt limit – the maximum amount of debt a country can raise without defaulting – increasing, therefore, the probability of default which leads to a higher CDS premium.

sovereign default risk and climate change

by **Adham** Jaber & **Ibrahima** Diarra

introduction

In the context of an accelerating increase in the global temperature (Figure 1) and the frequency of climate-related shocks such as storms (Figure 2), the interest in the economic impact of climate change is growing among investors and policymakers.

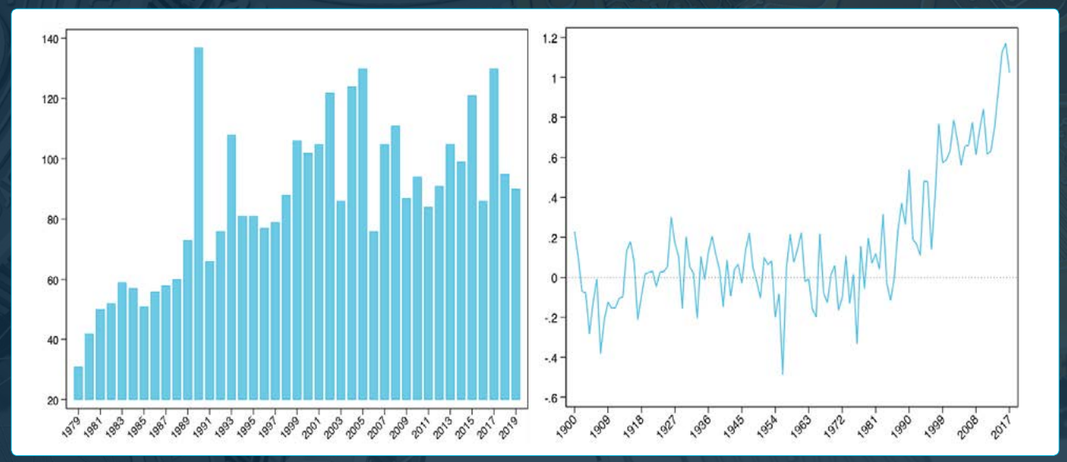

Figure 1 - Frequency of storms over years. Dataset: EMDAT. Authors' elaboration.

Figure 2 - Average temperature deviation from country 1900-1950 historical mean over years. Dataset: Matsuura and Wilmott (2018). Authors' elaboration.

By 2040, the global average temperature is expected to reach 1.5 degrees Celsius higher than pre-industrial levels, even under low greenhouse gas emissions scenarios[1].

1 / Scientific community considers that green gas emissions is the main driver to the anthropogenic climate change (IPCC 2022)

Beyond this threshold, climate-related shocks will intensify, and the socioeconomic impacts of climate change and adaptation-mitigation costs will grow drastically. These climate change-related consequences will negatively impact public finances in two ways:

i. Economic growth will be affected negatively, reducing opportunities for fiscal revenues.

ii. Public spending will increase along with government intervention to address climate change's expected damages.

This is happening while advanced and developing countries are facing an unprecedented increase in their debt-to-GDP ratios. In such a context, climate change will likely worsen governments' fiscal stance, limiting their ability to borrow to cover their financing needs, especially when it comes to financing adaptation and mitigation efforts.

methodology

Climate change is the change in the distribution of climate variables such as temperature (Figure 3)[2]. In the paper, we consider changes in the distribution of temperature deviation from the 30-year moving average as a proxy for climate change. Alternative measures are also considered when assessing the robustness of our results such as temperature deviations from the country-specific and region-specific 1900-1950 mean.

As for sovereign default risk, we use sovereign Credit Default Swaps (CDS) on foreign sovereign debt as a proxy for default risk. We consider sovereign CDS spread at one, three, five, and ten-year maturities. We estimate the effect of temperature deviation on CDS spread using a panel of 76 countries from 1999-2017. The model is estimated using a two-way fixed effect estimator.

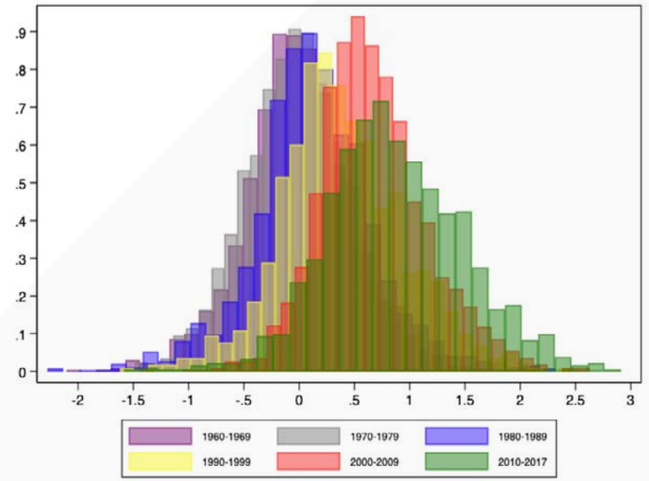

Figure 3 - Temperature deviation's distribution by 10- year window. Dataset: Matsuura and Wilmott (2018). Authors' elaboration.

2 / Changes in the mean and/or variance of weather variables that persist for an extended period.

key findings

We find a robust positive impact of temperature on sovereign CDS spread across the 4 maturities (1-y, 3-y, 5-y, and 10-y maturities): a 1°C increase in temperature from its 30-y moving average, increases the CDS spread by 13.67 to 27.28 basis points. This effect remains statistically and economically significant when using alternative measures of temperature anomalies. Our findings suggest that investors consider climate-related risk in the short, medium, and long term. We also find that geographic location has a role in this effect: the positive effect of temperature deviation on CDS spread comes mainly from the East Asia and Pacific region, that said, countries in this region pay higher default risk premiums due to their higher exposure to climate-related events relative to other regions.

transmission mechanisms

Following our result, we built on the bond pricing equilibrium equation to investigate the main transmission channels through which temperature deviation affects the sovereign default risk proxied by the CDS spread. Our analysis documents a debt limit transmission channel: the increase in temperature deviation harms the future growth of GDP, which in turn lowers a country's debt limit. This increases the probability of default which leads to a higher CDS spread. Interestingly, among the investigated channels, we find a negative effect of temperature deviation on the growth of the GDP but not on the debt-to-GDP ratio or the primary balance.

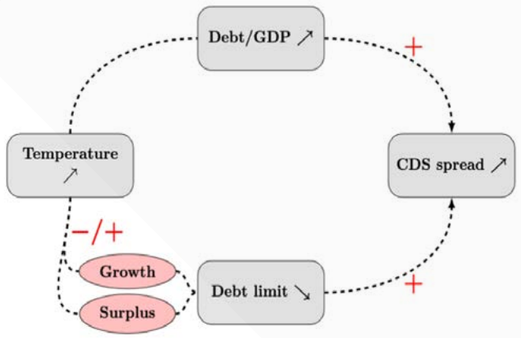

Figure 3 - Transmission channels

policy implication

The findings suggest that climate-related risk should be accounted for when assessing public debt sustainability. The identification of key mechanisms highlights that the growth of GDP is the main channel for an increase in the sovereign default risk. This suggests that climate adaptation and mitigation efforts aiming to reduce climate change's repercussions on growth may also reduce sovereign default risk. This has important implications for the policy responses to climate change in the current context of high debt-to-GDP ratios and limited fiscal space available for countries.

To read the full paper, follow this link.

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Ibrahima Diarra

Ibrahima Diarra is an Economist at the World Food Programme and a Research Fellow at the World Bank. His research focuses on climate change, sovereign default risk, and international development, both from a theoretical and empirical perspective. Ibrahima worked previously as a Financial Analyst at Mazars and as a Researcher in academia. Ibrahima holds a master's degree in Quantitative Finance and a Ph.D. in Economics from the University of Paris-Saclay.

Synopsis

Developed economies, emerging from the Great Financial Crisis in 2008, have seen a secular decline in interest rates and, until recently, increased investor interest in higher-yielding illiquid assets. Traditional risk measures using liquid assets do not fully capture the idiosyncratic risk of these assets. The author proposes an alternative approach to private market portfolios, including how to embed such an approach into an organization's existing governance and risk culture.

An alternative approach for pension funds to manage and monitor risks in a private market portfolio

by **François** Audet

context

The result of the secular decline in interest rates –preceding recent hikes– is a reach-for-yield phenomenon: pension funds have in recent years shifted their traditional 60% stocks/40% bonds approach to a greater allocation toward illiquid assets[i]. Although the traditional historical VaR[1] risk measure for illiquid assets using liquid instruments, such as publicly traded companies and indices, yields similar risk estimates to their private market equivalent by applying a smoothing function to public market proxies (or vice versa using a de-smoothing function)[ii], the idiosyncratic risk of each position is not fully captured. As such, to better capture the specificities of each position, which may at times be sizeable, this article proposes a complementary approach to manage and monitor risks in a private market portfolio.

the approach

The proposed approach is inspired by the banks' process for effectively managing their loan book, which assigns to each position internal ratings aligned with ratings and methodologies produced by Moody's, Standard & Poor's, and other public rating agencies[iii]. More precisely, because of the fundamental analysis performed for each investment, the approach is able to assess the inherent idiosyncratic risks. In terms of process, the assigned rating for a specific investment should be assessed at the time of acquisition and documented accordingly with the appropriate rating rationale. As part of this assessment, internal monitoring covenants[2] (3-5) should also be assigned to the transaction to ensure that the business plan is progressing as expected.

1 / VaR quantifies statistically the extent of possible financial losses within a portfolio over a given period and probability of occurrence.

2 / Internal monitoring covenants are deal-specific metrics (such leverage, free cash flow, EBITDA margin, etc) with specific thresholds used to identify adverse developments.

From an ongoing monitoring perspective (Figure 1), frequent measurement of all covenants in the portfolio should be completed and an annual review of each investment should be done to assess if their respective rating remains appropriate or should be changed (upgraded, affirmed, or downgraded). Furthermore, there should be a process to identify investments requiring closer attention by management.

From a top-down perspective, to aggregate several deal-level ratings, the weighted average risk factor ("WARF") methodology developed by Moody's is used[iv]. This measure has the benefit of ag-gregating the overall credit quality of a portfolio in one single value, which is simple and easy to communicate. The WARF measure also provides insight into the overall portfolio risks, as well as the marginal risk incurred by the portfolio with individual assets.

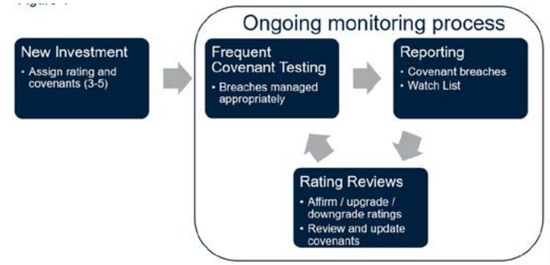

Figure 1 - Ongoing monitoring perspective

To calculate the WARF of an asset class, a credit rating (from AAA to D) in line with rating agencies' taxonomy is required. This letter rating corresponds to a numerical rating factor, which in turn maps to the 10-year probability of default. The WARF is determined by calculating the weighted average of these numerical factors [4]. The overall WARF of an asset class in terms of rating factor can also be mapped to the letter rating. As per Figure 2, the sample portfolio yields a WARF of 712, which is equivalent to a rating of BBB-.

Rating	NAV (Millions)	NAV (%)	WARF
AAA	-	0%	-
AA+	-	0%	-
AA	-	0%	-
AA-	-	0%	-
A+	-	0%	-
A	200	3%	4
A-	200	3%	6
BBB+	500	8%	22
BBB	1,200	20%	72
BBB-	2,200	37%	224
BB+	100	2%	16
BB	800	13%	180
BB-	600	10%	177
B+	0	0%	0
B	-	0%	-
B-	-	0%	-
CCC+	-	0%	-
CCC	-	0%	-
CCC-	-	0%	-
D	-	0%	-
NAV and WARF	6,000	100%	712
Rating Equivalent			BBB-

Rating Factor	Rating
1	AAA
10	AA+
20	AA
40	AA-
70	A+
120	A
180	A-
260	BBB+
360	BBB
610	BBB-
940	BB+
1350	BB
1766	BB-
2220	B+
2720	B
3490	B-
4770	CCC+
6500	CCC
8070	CCC-
10000	D

Figure 2 - WARF methodology and equivalent rating

assessing the desired risk profile

Once the overall WARF of an asset class is calculated, it is then compared to its target risk rating. Like a risk budget in the VaR approach, the target risk rating represents the desired risk of a given asset class with any deviation escalated either to management or the Board of Directors, as necessary. The target risk rating is established at the onset of a new strategy and reviewed annually or more frequently should there be a strategy change. To establish said target risk rating, an assess-ment of the overall strategy is performed, as well as the expected risk and return of the asset class. Typically, a passive investor should expect to earn a higher return when it invests in a sector with a riskier profile. This general risk-return concept should provide guidance in establishing a reasonable and acceptable target risk rating for any given asset class.

the implementation

To implement this approach, a strong governance framework is required. More specifically, buy-in from management and the Board of Directors regarding the proposed approach is required. There should also be appropriate escalation mechanisms with an eventual tie-in to the incentive plan. Finally, the rating assessment process should be part of the investment process, and the risk team must have sufficient expertise and resources to keep pace with said investment process.

There are of course unique considerations to this approach, which should be well understood be-fore it is implemented. In terms of operationalization, it may appear difficult to implement the approach if the pension fund's asset base is substantial, especially considering the various asset classes, sectors, and geographies it is invested in. Furthermore, continuous effort is required to ensure that a strong risk culture is maintained across the organization. Despite these challenges, the main benefit from this approach pertains to the overall process that enables a risk-aware culture with constant dialogue across all asset classes, management, and the Board of Directors.

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Prior to joining PSP Investments, François held various positions at CDPQ as well as GE Capital. François is a Chartered Financial Analyst (CFA) and a Financial Risk Manager (FRM).

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Synopsis

In this article the author discusses a mechanism for gaining synthetic exposure to cryptocurrencies through the use of a technique that simulates the underlying with an algorithm that leverages the concept of delta hedging a derivative. An approach is described utilizing the basic Black-Scholes pricing model and Hull's delta hedging algorithm that can replicate the trend in Bitcoin with observable market inputs (FX rates and short-term interest rates), which is tested on historical data to demonstrate the effectiveness of this hedging approach. This provides a valuable contribution for practitioners as a simple and effective solution to this problem that can be readily implemented in a spreadsheet macro.

cryptocurrency delta hedging

by **Malcolm** Glover

introduction

Derivatives offer an alternative to taking direct custody of cryptocurrencies by investing in their derivatives as a means of accessing exposure to decentralised finance (DeFi). Perpetual swaps are the largest traded contract in cryptocurrency that enable investors to buy and sell cryptocurrencies like Bitcoin without owning any. These contracts do not expire and are designed to track spot prices through regular payments to parties that are in-the-money.

A BTC-PERP perpetual future contract is worth one Bitcoin with funding occurring every 8 hours. Exchanges use the current interest rate and a premium index per minute to calculate the funding rate. Since they are only trading the price value of an underlying crypto asset, the price of a perpetual futures contract has to be close to the actual price of the underlying asset.

The trading system uses a funding rate to ensure that the price of the perpetual futures contract does not move away from the spot market price of the underlying crypto asset. When the market is bullish and the price rises, the funding rate is usually positive, but when the price is falling, the funding rate is usually negative. When the funding rate is positive, there will be a premium payment from those in long positions to traders holding short positions. On the other hand, when the perpetual futures contract trades at a discount below the spot index price, the funding rate will be negative. The sellers will, at this point, pay the buyers a small fee.

a look at the crypto derivative market

In contrast to more traditional asset classes, cryptocurrency derivative investment requires setting up a digital custodian, which can be costly and operationally time-consuming for investors. The unconventional globalised structure of the cryptocurrency market and what this entails for custodians, operators and regulators makes approving cryptocurrency derivatives complex. This is the main reason why few cryptocurrency derivatives are currently available, with those that are available suffering from:

1. High fees - with little leverage from few traders placing multiple orders.
2. Poor infrastructure - unreliable digital wallets.
3. Lack of professional market makers - the main source of illiquidity, as deep liquidity is introduced on the order book by market makers. Due to the lack of a resilient orderbook exchanges, market makers have avoided DeFi derivatives.
4. Capital inefficiencies - the majority of DeFi protocols are capital inefficient and are designed around over-collateralization.

CME futures, including micro Bitcoin futures launched in 2021, are targeted at retail investors who want a cost effective method to fine-tune their Bitcoin exposure, are cash settled and suffer from the 'CME-gap.' The latter feature results from the fact that CME futures do not trade at all times and, unlike physical cryptocurrencies, have an opening and closing price. With the cryptocurrency asset market still developing and volatile there is plenty of opportunity for arbitrage, hence the demand for cryptocurrency derivatives is high. However, the shortage of financial products and regulated trading venues make it difficult for market participants to obtain leverage and, more importantly, to hedge their exposure to adverse price movements.

delta hedging as an alternative

A delta hedge trading strategy that replicates the performance of an option by buying and selling the underlying asset in proportion to changes in the option's hedge ratio can be used as an alternative to expensive, illiquid and operationally complex cryptocurrency derivatives. A spreadsheet model with embedded macros replicating Hull's[1] Black Scholes[2] based delta hedging technique with a market momentum and trade reversal suppression measure was calibrated using Bank of England US$ vs £ exchange rates, 1-month US LIBOR and geometrically weighted historical US$ vs £ exchange rate volatility to simulate 91-day options.

Next, using this model with Bitcoin price data downloaded from Investing.com[3], 91-day Bitcoin options were simulated from 2012 to 2022. Comparative performance figures for Bitcoin, delta hedging and 1-month US LIBOR were then generated based upon these calculations for the entire and selected simulated periods by cumulating consecutive 91-day plans.

1 / Hull, J. C. "Options, Futures, and Other Derivatives" 3rd edition Prentice Hall 1997 Pages 312 - 317

2 / Black, F. and M. Scholes "The Valuation of Option Contracts and a Test of Market Efficiency", Journal of Finance, 27 (May 1972), 399-418

3 / https://uk.investing.com/crypto/bitcoin/historical-data

In a 2015 paper, Statistical Analysis of the Exchange Rate of Bitcoin[4], the authors did a statistical autocorrelation and partial-autocorrelation analysis of the log-returns of the exchange rate of Bitcoin against the US Dollar where the probability plot for generalized hyperbolic distribution was the closest fit out of fifteen of the most popular parametric distributions used in finance. Daily returns from a simulated delta hedging trading strategy using the exchange rate of Bitcoin against the US Dollar from 2012 to 2023 have a standard deviation of 3.8% as compared to unhedged Bitcoin having a standard deviation of 9.2%. Delta hedging buy and sell transaction costs are assumed to be 0.1% with a 4% floor (the delta hedge equivalent of an option premium but calculated using historic rather than market-implied volatility, making delta hedging cheaper than an options-based hedging strategy).

Using a logarithmic scale (so that a constant percentage change is seen in Figure 1 as a constant vertical distance so a constant growth rate) performance is seen as a straight line, demonstrating the delta hedging model's long-term success in protecting US$ based investors who are investing in Bitcoin against downside risk from their Bitcoin exposure throughout this period.

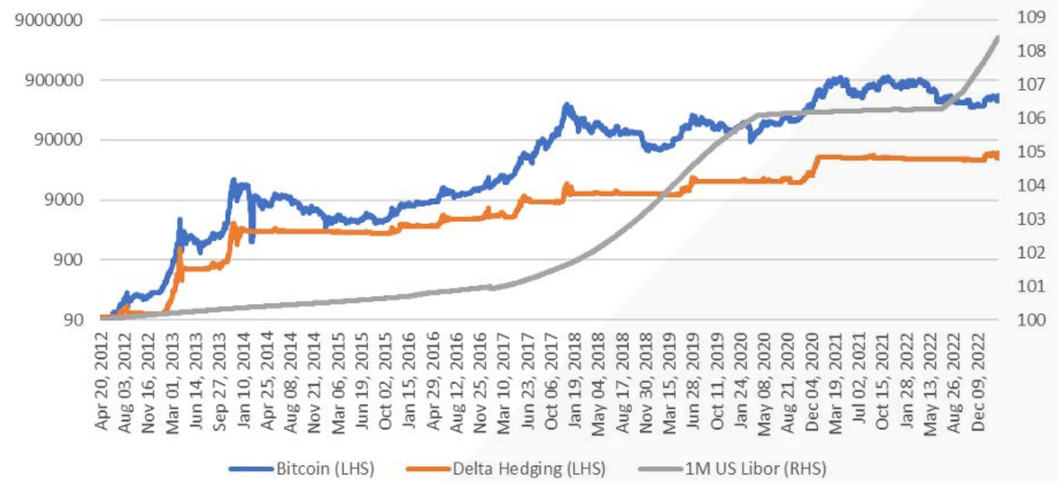

Figure 1 - Bitcoin vs delta hedging model (2012-2023)

The 2019 paper entitled The high frequency multifractal properties of Bitcoin[5] examined the multifractal properties of Bitcoin US$ exchange rates using high frequency data fluctuation analysis to conclude that Bitcoin exhibits a large degree of multifractality in all examined time intervals, similarly displayed in small and emerging markets rather than developed ones, and the main source of multifractality is attributed to the high kurtosis and the fat distributional tails of the series returns, suggesting that Bitcoin holds few diversifier or safe-haven benefits.

4 / Chu, Jeffrey, Saralees Nadarajah, and Stephen Chan. 2015. Statistical analysis of the exchange rate of bitcoin. PLoS ONE 10: e0133678

5 / Stavroyiannis, Stavros, Vassilios Babalos, Stelios Bekiros, Salim Lahmiri, and Gazi Salah Uddin. 2019. The high frequency multifractal properties of Bitcoin. Physica A: Statistical Mechanics and its Applications 1873–2119 520: 62–71

Plotting the Bitcoin delta hedged and fully exposed portfolio, in Figure 2, from January 2018 to March 2023 produces the following relationship between simulated historical returns, demonstrating the model's success in allowing US$ based investors to participate in Bitcoin upside while protecting them against downside risk from their Bitcoin exposure.

Figure 2 - Bitcoin vs delta hedging model (2018-2023)

Similarly, delta hedging can be applied to other cryptocurrencies with a trading strategy that replicates the performance of an option by buying and selling the selected cryptocurrency in proportion to changes in their option's hedge ratio. A logarithmic scale to plot delta hedged Binance coin and fully exposed Binance coin portfolios from August 2018 to March 2023 produces the following relationship between simulated historical returns in Figure 3, demonstrating that delta hedging is as successful in reducing the volatility of Binance coin returns as it was for Bitcoin in Figures 1 and 2.

Figure 3 - Bitcoin vs delta hedging model (2018-2023)

conclusion

Simulated delta hedge trading strategies provide a cost-effective insurance method for portfolios of high volatility cryptocurrencies, without being impacted by illiquidity and capital inefficiencies associated with cryptocurrency derivatives. As delta hedging is based on Black-Scholes, extensions may be included, like the volatility smile and/or fat tails in the underlying asset, but the strategy in turn suffers from known Black-Scholes limitations, such as assuming no arbitrage opportunities and that cryptocurrency returns follow a lognormal pattern, thus ignoring large price swings that are observed more frequently in the real world.

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Synopsis

Model use is widespread despite quizzical looks to the question: “what exactly is a model?” This confusion is especially true outside of the regulated banking industry where model risk is virtually unheard of. Nonetheless, model risk is not rocket science: a ground-level approach can be developed without exorbitant cost to suit an organization’s needs and hopefully save it from the embarrassment and expense of model failure.

model governance for noobs

by **Katrina** Szadek

introduction

There is a misconception that model risk management is only important for banks. In fact, I did not hear about model risk – least of all a model governance program – until 16 years into my career despite working with companies in at least half a dozen industries. It made me wonder how much companies outside the financial services industry understand about model risk.

Unregulated organizations beginning to explore model risk should first ask whether the organization uses models. If *anything* is forecasted – sales, labor hours, losses, interest rates - the answer is yes. The U.S. Federal Reserve Bank defines a model in regulatory standard SR 11-7: Guidance on Model Risk Management[1] as “a quantitative method, system, or approach that applies statistical, economic, financial, or mathematical theories, techniques, and assumptions to process input data into quantitative estimates.” Models comprise three components according to The Actuarial Standards Board:

1. an information input component, which delivers data and assumptions to the model
2. a processing component, which transforms input into output, and
3. a results component, which translates output into useful business information.

Even with this guidance, there can be ambiguity as to what constitutes a model, so every organization should develop an internal definition and understanding.

1 / https://www.federalreserve.gov/supervisionreg/srletters/sr1107.htm

start with the basics: where do models exist within organizations, and how critical are they to the business?

- Model Discovery – identify models used within the organization

  Ideally, front line leaders (in each of the key functions) will need to be consulted. Objectives should be explained and assistance in identifying potential models used within the organization requested. It is important to include all functions in this process rather than assuming the conversation may not apply to everyone. All models have *someone* using the outputs, and users are just as critical to this process as developers and owners.

  Model information to be captured should include the model developer, owner, user(s), purpose of the model, model inputs, model outputs, frequency with which the model is run, any assumptions used in the model, and limitations of the model.

- Risk Assessment – assess the level of inherent risk for each model

  What is the risk to the business if a model stops working tomorrow? An alternative approach is to assess the business criticality of each model. Sometimes it is easier to assess how critical the model is to a business, rather than how much risk model failure poses.

program in proportion to risk

For banks, SR 11-7 is a regulatory requirement and therefore a minimum standard. But for organizations in other industries that may not rely as heavily on models, SR 11-7 may be viewed as the gold standard – something to work towards. Developing a new model risk management program that includes all elements of SR 11-7 will not only be overwhelming but could set the organization up for failure in terms of model governance.

The business criticality or level of inherent risk posed by models should determine the breadth and sophistication of the program. The word “program” is used loosely – implementing a single review control may be sufficient to address the risk posed by models if they are not used for critical business decisions.

As the model risk management program develops, consider these key elements of effective model governance:

- processes installed to allow organizations to track all models being used for decision-making
- comprehensive model documentation for each model to ensure the model purpose and limitations are understood
- regular monitoring of model performance

- periodic, independent review and validation of models to ensure they are fit for purpose and working as expected

The rigor governing the above activities may vary by model and should be appropriately aligned with each model's assessed risk and/or business criticality. It is better to have an elementary program with plans to mature, than no program at all.

maintain and mature

When the model risk management program has been developed and implemented, a resource responsible for model governance – someone to maintain the program and facilitate required activities – must be identified. This is typically a first or second line of defense responsibility, however it could reside anywhere from Operations to Compliance to Risk/ERM to Internal Audit. Depending on the number of models and the sophistication of the program, it could require as little as 1-2 hours per month.

A *Roadmap to Maturity* is a good tool if the plan is to continue to evolve the model risk management program. The roadmap could be used as a multi-year plan to mature processes and implement best practices.

shmoutsource

Developing a model risk management program does not require expertise or even experience with modeling, so there need not be a significant investment to get started. There is an abundance of guidance available on model risk management and model governance best practices. In addition to the resources already mentioned, PRMIA has had several detailed courses and webinars on the topic. Many well-known public accounting and consulting firms have also published white papers and other guidance. Risk professionals are skilled at learning new processes, defining the risks, identifying control gaps, and implementing enhancements: model governance is no different.

accept the risk

In some cases, an organization may determine not to implement additional controls or processes around model risk management. If that is the case, the process by which that decision was reached should be thoroughly documented, including an understanding and quantification of the potential risk posed by the models, and the decision to accept this risk with formal approval from the appropriate company Executive(s). It is better to demonstrate an understanding and acceptance of the risk than to appear to be unaware of it.

the importance of awareness

Ray Panko, a professor at the University of Hawaii, discovered through his research that up to 88% of spreadsheets have 1% or more errors in their formulas. At that magnitude, not having processes in place to ensure models are properly implemented, reviewed, documented, and validated can lead to very costly mistakes! Full Stack Modeller[2] lists these top 5 modeling errors that have made headlines:

1. JP Morgan hit with $6 billion trading loss
2. Fannie Mae restate unrealized gains by $1.2 billion
3. TransAlta Corp loses $24 million
4. Kodak restate due to $11 million error
5. AstraZeneca sees 0.4% drop in share price

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Synopsis

As climate management takes the center stage of public policy and regulatory oversight, banks are working on ways to curb climate risks through enhanced Enterprise Risk Management (ERM) frameworks and sustainable finance. The growth and strengthening of taxonomies and acting on the pointers they provide could be a differentiating tool for banks in better managing climate change risks.

growth of taxonomies and climate risk management: a practitioner's view

by **Saloni** Ramakrishna

introduction

Banks play a critical role in achieving the goal of carbon neutrality. They have the wherewithal to redirect capital flows towards environment friendly activities. The question really is what qualify as "sustainable economic activities?" Taxonomies provide clear indicators in this direction. The primary focus of taxonomies is to have a standard, acceptable explanation of what qualifies as "green" or "brown" investment or financing.

BIS, in its paper "A taxonomy of sustainable finance taxonomies" describes a taxonomy as "a set of criteria which can form the basis for an evaluation of whether and to what extent a financial asset can support given sustainability goals." Regulators, global organizations, and academic institutes are in the process of creating, and refining taxonomies, with regulators being the front runners.

The purpose of this article is to briefly explore how taxonomies can influence and aid climate change risk management. It looks at the pointers that taxonomies provide, which can support better managing climate risks.

climate risk taxonomies

The first set of taxonomies is led by regulators who identify sustainable financing activities. These could be regional level taxonomies like the ones from the European Union (EU) or the ASEAN Taxonomy for Sustainable Finance[1], or country-centric.

1 / https://asean.org/book/asean-taxonomy-for-sustainable-finance/

the importance of awareness

The other class is focused on specifics, like the climate risk taxonomy, and offer an alternative but complement the above taxonomies. Examples of each of the two classes of taxonomy are below:

1. The EU Taxonomy is the front runner in sustainable finance taxonomies. It is a science-based classification system that lists environmentally sustainable economic activities as "green" with the expectation that the financial industry will focus on these activities to boost sustainable investment as a means towards achieving a climate neutral Europe by 2050. As of 1st January 2022, the taxonomy covers two themes of climate mitigation and adaptation.

2. The Climate Risk Taxonomy's focus is on identifying and defining risk categories associated with climate factors. Climate risks constitute a broad set of risks. Granulating them into a standard taxonomy helps users better understand and assess the connected risks.

pointers of risk management from taxonomies

Is there a direct link between the EU Taxonomy, for example, and risk management? Probably not. Sustainability taxonomies stipulate the target and not how the risks can be managed. Climate risk taxonomies go a step further as they identify and assess the potential scope of impact. However, both types provide directional indicators for the various phases of climate risk management.

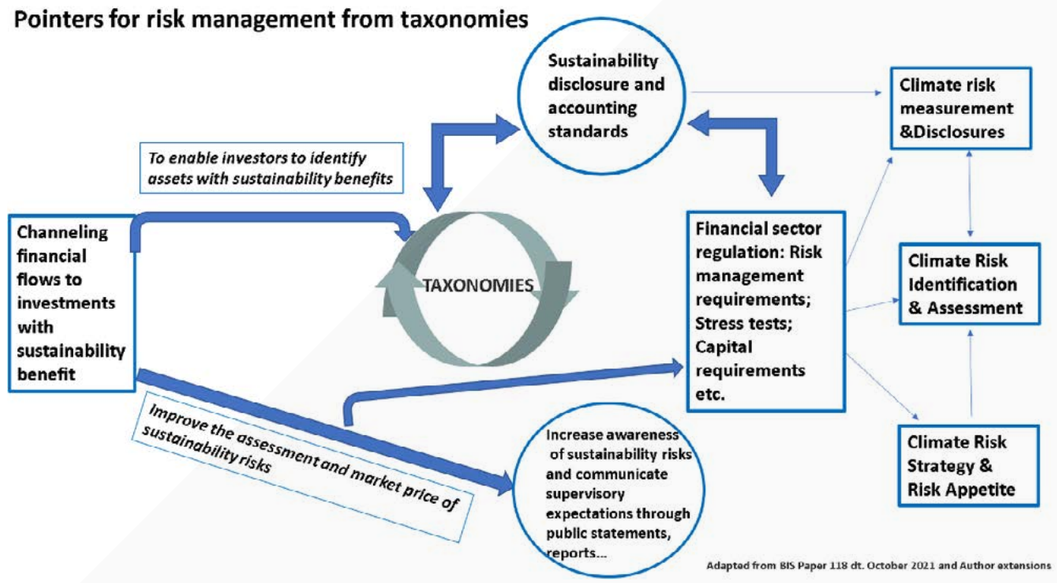

Figure 1 - Pointers to Climate-related Risk Management

Source - Adapted from BIS Paper No 118- A taxonomy of sustainable finance taxonomies – October 2021 with author extensions

Risk appetite and strategy

Banks, globally, have made commitments towards transition to low carbon economy, both for their own operations and for the businesses they finance. It gets reflected in their climate strategy. Risk appetite statement, flowing from the climate strategy, is required to spell out the industries, activities, geographies, product, and services of focus. Taxonomies provide the guidance of what activities qualify as "green" from which banks can choose their preferred portfolio to achieve the climate targets set by them.

Risk identification and assessment

Climate risk taxonomies aid in identifying climate risks inherent in potential projects **before** they cause reduction in asset utilization, create stranded assets, reduced income and margins, or other negative financial impacts. These could result in credit risk and influence a lender's decision in extending finance to entrepreneurs. The transition risks due to adaptation or mitigation are spelt out in taxonomies, which aid banks identify risks and decide whether to filter out or accept the risks. They also provide insights that help an informed assessment of risks by:

a. Indicating activities or industries that are less likely to be impacted by policy changes and therefore lower on transition risk.

b. Indicating the impact on counterparties that need to be factored into assessments.

Risk measurement and disclosures

At a bank level, measurement of "greenness" of its portfolio is required internally as well as expected externally for disclosures. Taxonomies, through the KPIs, help gauge how much of the business is green, thereby assessing individual bank alignment to the net zero goals it has committed to. Comparable key performance indicators like GAR (Green Asset Ratio) and BTAR (Banking Book Taxonomy Alignment Ratio - will apply from June 2024), as conceptualized by the European Banking Authority, help measure the sustainable financing as a percentage of their total portfolio.

At the individual counterparty level, taxonomy alignment will be a key factor in climate blended rating as well as in project evaluation.

conclusion

Taxonomies are here to stay, grow stronger and become a pervasive mechanism that transparently explores, compares, and declares investor and lenders' environmental footprint. It is an evolving discipline, where taxonomy metrics are developing. An example is the identification of "Standardized Transition-risk Exposure Coefficients (TECs) reflecting the transition potential, as well as transition-risk exposure, of each sector."

Risk managers will do well to keep abreast of this space not only for mandatory disclosures but also to leverage the content for embedding nuances of climate risk management into their ERM framework. This not only enables deployment of funds towards creating and maintaining a sustainable ecosystem, but also for better managing climate-related financial risks.

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4 / Enterprise Compliance Risk Management: An Essential Toolkit for Banks and Financial Services, Saloni Ramakrishna, Wiley Corporate F&A, ISBN: 978-1-118-55031-1, http://www.wiley.com/WileyCDA/WileyTitle/productCd-1118550285.html

Synopsis

The discovery of child labour in corporate supply chains at first appears a simple problem to solve: just stop doing it. But, as the author lays out, it's not so simple, especially once you take into consideration the responsibility companies have, the interests of the children, their communities and host governments. Intergovernmental organizations are trying to tackle this thorny issue by encouraging sustainable practices and dealing with root causes.

what to do when you discover Child Labour issues in your supply chain

by **Alan** Franklin

introduction

Companies are exhorted to conduct human rights due diligence whether because of legal requirements, soft laws such as the OECD Guidelines for Multinational Enterprises or concepts of Corporate Social Responsibility (CSR) but rarely is cogent advice offered on the steps to take when child labour is found in the supply chain.

The common corporate response is to require suppliers to fire the child workers so the company can report that the remediation was effective - no child labour in the supply chain. This was the solution adopted by many retailers after the Rana Plaza disaster[1] when human rights issues became a global focus.

The sanguine belief was that these children would go "back" to school and revive their childhood. This was absurd at the highest level, as the reason for the child labour is not that retailers buy the goods from these suppliers, thereby creating child-employment, but rather that the children generally have no option but to work[2].

The children were fired from the garment factories, but the results were quite disastrous for the children. Many went to work for glass factories (very unsafe under extreme heat conditions) or ended up on the streets as beggars, but retailer corporate reputation was enhanced.

1 / On 24 April 2013, the collapse of the Rana Plaza building in Dhaka, Bangladesh, which housed five garment factories, killed at least 1,132 people and injured more than 2,500.

2 / The reality of this issue is encapsulated in the quote from The UNICEF Netflix series Tales by Light "We haven't met a child that hasn't had to work." (referring to children filmed for the series on child labour). In many countries, free education for the poor does not exist or is of such poor quality that no education is provided.

traditional approaches and new questions facing companies

Simplistic solutions are often promoted such as that the company engages in certification systems, audits, SWAT teams, and finding new suppliers that do not use child labour. These are potentially helpful acts to reduce reputational and legal risk but leave the child labourers worse off in many cases. (Shah, 2021)

The questions for the company therefore are whether they feel responsible, legally, or morally, to help those children directly. If so, what can be done for the children if they are removed from the factory? Generally, children work because their families are poor and need the meagre income from that child to put food on the table. Some companies have taken the responsibility to establish classrooms for the children, so that they can learn while they work. Is that a reasonable action on the part of a business which exists to earn profits? Should it now be obligated to take on the responsibility for these children whose problem is primarily related to the government's failure to comply with its human rights obligations to its own citizens?

Moreover, the lack of educational facilities is often a direct result of conscious efforts by the host state government. "The political will to provide universal education may also be absent in undemocratic societies, if ruling elites fear that an educated population will be better equipped to challenge them." (Hillman, 2004) Thus, efforts by the company to provide education opportunities to the poor children may be viewed negatively by the state, thereby jeopardizing the relationship of the company with the host state government.

Another potential action is for the business to arrange for the children to be fired from their work, but the company takes on the economic responsibility for that child for a year, to replace the income that the child would have earned by working. Again, should this be seen as the obligation of private business? For smaller companies, this economic responsibility may be a prohibitive cost.

the role of governments and intergovernmental organizations

The United Nations General Assembly made 2021 its "International Year for the Elimination of Child Labor by 2025," expressly providing businesses with the impetus to partner with governments and communities. Without the assistance of NGOs, international organizations and home state governments, this goal will likely fail. The preferable solution may be to work with NGOs, inter-governmental organizations such as UNICEF, UNDP and the home state government to help the host state government "solve" these problems of child labour in their states.

While business engagement with the local community is often seen as a positive step, it is fraught with potential pitfalls. Often, the community will see any attempts by business to eliminate child labour as inimical to the community itself, as families must rely on their children working to provide sufficient income for survival. Although they may prefer to have their children in school, the loss of the child's income makes it unattainable – it is dependent on their government to provide the budget to achieve this end. Also, companies engaging with the community may spark anger of the government towards the company for "interfering in internal matters of the state."

Apple: a case study

An example from Apple is illustrative of the realities of the issues. They took 3 years to cut ties with a supplier that used underage labour. Apple discovered this issue during audits of the supplier and decided it should act to eliminate the child labour, because its corporate code of conduct said that it would not tolerate child labour in its supply chain. The suggestion from ex-Apple employees was that the company could not cut the supplier off due to child labour until it found alternative suppliers able to provide the quality products. The reality is that if a supplier provides the quality of goods demanded by the purchaser, on time, and on budget, a buyer is not likely to jeopardize its business by removing the supplier "merely" because of child labour. Often there are good business reasons for this lack of action. (Ma, 2020)

steps towards ending child labour

Some suggestions from UNICEF may help to reduce child labour:

> *"Well established, responsible business and purchasing practices can help keep firms afloat and reduce child labour. Examples include long-term supplier contracts, clarity on future contracts, honouring commitments on orders and payments, fair payment schedules, and pricing capturing the true production costs and market values of products and services. Industry-wide and cross-industry collaboration must aim to cut off the roots of child labour at lower tiers of supply chains, since individual companies often have limited leverage. A wide range of voluntary, business-led initiatives have emerged in recent years in recognition of this reality.*
>
> *Sustainability and effectiveness depend largely on integrating company action into existing efforts by governments, social partners, civil society and others active on ending child labour." (Child Labour, 2020, pages 67-68)*

Issues to consider regarding the foregoing advice:

If we reduce opportunities for child labour through these suggestions, will it reduce child labour or move the children to other industries, potentially even more dangerous ones, or leave them to be beggars? Either result will harm children more but reduce the reputational risks for the companies. What is the real goal? Will stable contracts, better payment provisions, and other recommended actions motivate suppliers to reduce child labour?

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