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Improving Resilience to Systemic Crises through Financing Innovations: Lessons and Recommendations from Singapore

Introduction

Any systemic crisis—manmade or otherwise—places undue strain on the economic and financial system and its participants, including ordinary citizens. We know this from two events in recent memory—the Global Financial Crisis of 2008-2009 and the more recent spread of COVID-19. Other less extensive crises, such as the European Debt Crisis, the U.S. trade war with the rest of the world, and the tragic wildfires in California and Australia should also serve as life lessons. Economic agents must be better prepared to respond in the next unfortunate calamity.

In such extreme cases, which usually result from the market being unable to bear unpriced (tail) risks, the state has an important role to play as the insurer of last resort. A case in point is the risks and costs for individuals, businesses, and the economy associated with the current pandemic.

This essay will focus on the lessons learned from the COVID-19 pandemic regarding how economic agents and policy-makers can use financial markets, innovation, government policies, and investment

science to improve and build more resilient ecosystems. Examining three areas in which governments are equipped to intervene—retirement finance, small and medium-sized enterprise (SME) financing, and infrastructure finance—the discussion will cover the role of both the capital markets and the state in difficult times. While the current essay can apply anywhere in the world, our illustrations and examples will focus on Asia, with a particular emphasis on Singapore.

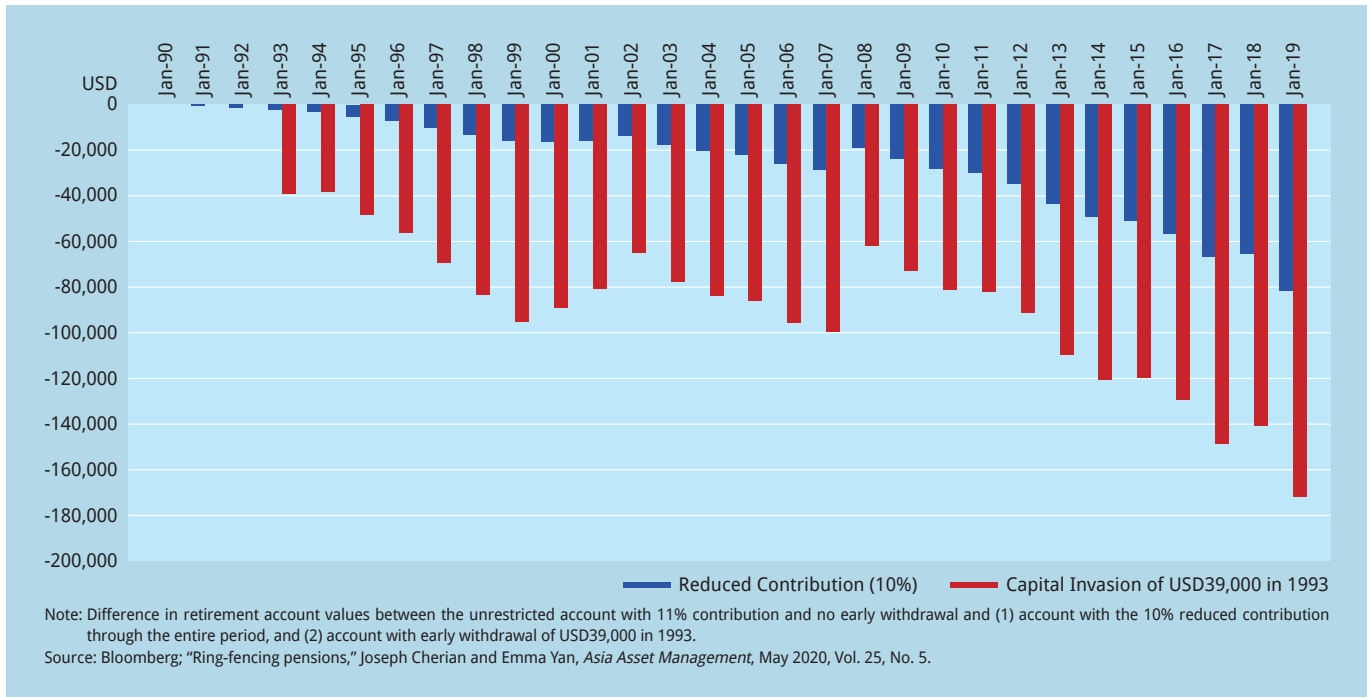
Retirement Finance: Fighting Inadequacy and Standardized Solutions

Among its many other consequences, the pandemic has resulted in sub-optimal behavior by certain governments and retirement plan providers. Facing undue hardship from loss of income, jobs, health or bereavement, members of retirement plans, especially state-managed ones, were allowed to dip into their hard-saved retirement pots to help alleviate the pandemic-induced financial burden. Cases in point include: the Australian government permitting individuals to access up to AUD20,000 (USD15,445) of their superannuation funds by the middle of 2021; India allowing its Employees Provident Fund (EPF) members

to withdraw the lower amount of either 75% of retirement savings or three months of salary equivalent; and Malaysia's EPF announcing in March 2020 that the statutory contribution rate for employees would be cut from 11% to 7% of their salaries, and that members could withdraw a total of RM6,000 (USD1,465) over the following 12 months. Furthermore, the Malaysian government in November 2020 announced a second withdrawal scheme of up to RM60,000—a tenfold increase—to “help EPF members reeling from the economic fallout of the COVID-19 crisis”. Fortunately, national retirement schemes in Singapore and Hong Kong wisely resisted this temptation. Rather, Singapore simply deferred by a year a scheduled increase in the contribution rates for older workers.

Such extreme responses are sure-fire ways to destabilize the retirement plan's long-term mission of safeguarding everyone's financial future, especially in retirement. In a May 2020 essay, I demonstrated that the difference in retirement account values over a 30-year period (1990-2019) due to a reduced contribution rate (10% instead of 11%) or a raid on capital (USD39,000 withdrawn in 1993) against the unrestricted, fully invested case can be quite substantial. In fact, the difference could be up to 18% over the planning horizon (Figure 1). To illustrate this shortfall, a hypothetical 60/40 retirement portfolio invested in the S&P500 and Barclays U.S. Aggregate Bond Index, respectively, was constructed and then subjected to each value-reducing scenario.¹

Figure 1: Difference in Cumulated Values against Full Contribution of 11% and No Capital Invasion



My recommendation then was that these plans should be ringfenced by legislation to avoid the national temptation of many households digging into their retirement nest eggs which tend to be the largest pool of available assets (apart from homeowner's equity). And if households indeed face extenuating financial circumstances due to a healthcare pandemic, it is the state's responsibility to step in and address the hardship. It can do so via targeted cash transfers, by preserving or enhancing job opportunities, deferring interest and principal payments via forbearance programs, etc., just as the governments of Singapore and the U.S. did in the current crisis. If that is not enough, the government could subsidize the monthly contributions that members make to their retirement accounts, at least until the exigency is over.

The second issue is that of conjoining the accumulated knowledge in investment science—in other words, modern portfolio theory—and the disruptive power of technology to provide cost-efficient bespoke retirement solutions that go back to the basics. Just as defined benefit plans once provided sufficient pension income to reasonably sustain a person's lifestyle in retirement, a defined contribution scheme should also take this approach over the member's entire life cycle. That is, it should first develop a target income goal in retirement based on the member's individual circumstances; then it should ensure that

financial engineers and technology devise an investment plan that allows for updating the target income as the individual's life circumstances change due to promotions, marriage, children, the consumption of leisure, and so on, so that the end goal is achieved with maximum likelihood upon retirement.

This is not a new concept. Nobel laureate Robert Merton has authored two articles that illustrate how to achieve this. The first was a seminal piece involving "glidepath strategies," where Merton and his co-authors demonstrated that the tradeoff between labor and consumption, along with the ability to choose the retirement date, can lead to a lifecycle investment choice up to and including retirement that is specific to the individual. The linkage among labor wage income, financial markets, and one's ability to vary labor supply, consumption spending, savings versus dis-savings periods, etc., can result in certain individuals being able to take on greater investment risk during different parts of their life cycle as compared to others.² Merton later articulated his ideas behind life cycle finance in the *Financial Analysts Journal* article, "Thoughts on the Future: Theory and Practice in Investment Management", which was published in 2003.

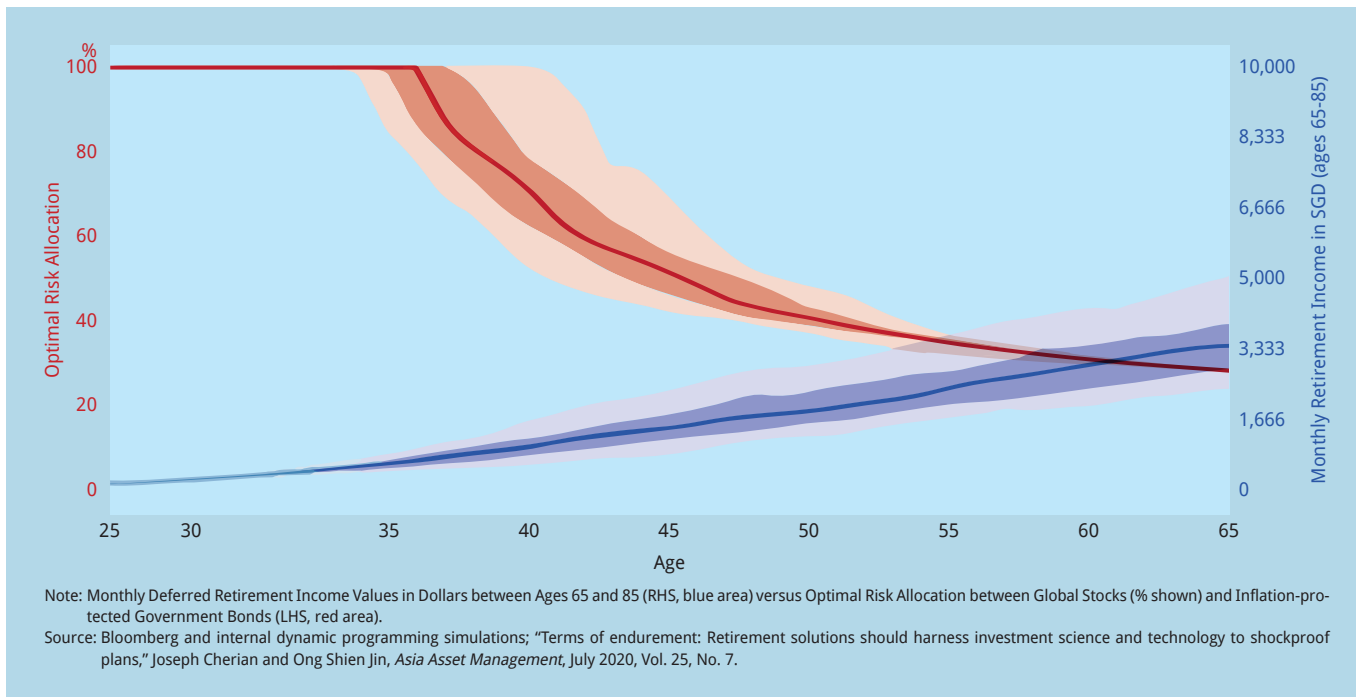
My co-author and I demonstrated that an individualized glidepath investment plan can be developed to maximize monthly (future) target income at the point

of the individual's retirement. This plan must consider the human capital labor income stream's correlation with the investment assets in place and other factors such as financial markets, current retirement savings and invested assets, desired income in retirement, spending profile, and risk aversion. These are combined with a mathematical optimization method called stochastic dynamic programming.³

The blue area in Figure 2 below illustrates the potential range of deferred annuity income values at retirement (at age 65) from one's retirement assets in place. The red area illustrates the retirement portfolio's range of mathematically determined optimal allocations between the 'risky' portfolio of global equities and 'safe' portfolio of Treasury inflation-protected securities, an extension of the standard 60/40 retirement portfolio. The red area is similar to the glidepath strategy depicted in many target date funds offered by asset managers. Our proposal is that asset managers target the individual and not the date.

Technology, Big Data, machine learning and artificial intelligence in financial systems, or 'fintech', have made immense strides to date, as have investment and behavioral science. It is imperative that the asset management industry utilizes these tools to move away from the one-size-fits-all model portfolio approach to life cycle investing. While some progress in this direction has been made on the robo-advi-

Figure 2: Annuity Income Values at Retirement from Retirement Assets in Place



sory front, the industry as a whole should be moving towards the bespoke, dynamic programming approach to finding sound and cost-efficient solutions for the investor.

suffered an overall y-o-y contraction of -5.4% in 2020, with most of the contraction understandably happening in the second quarter of 2020 (-13.3%). Despite estimates that the construction industry will con-

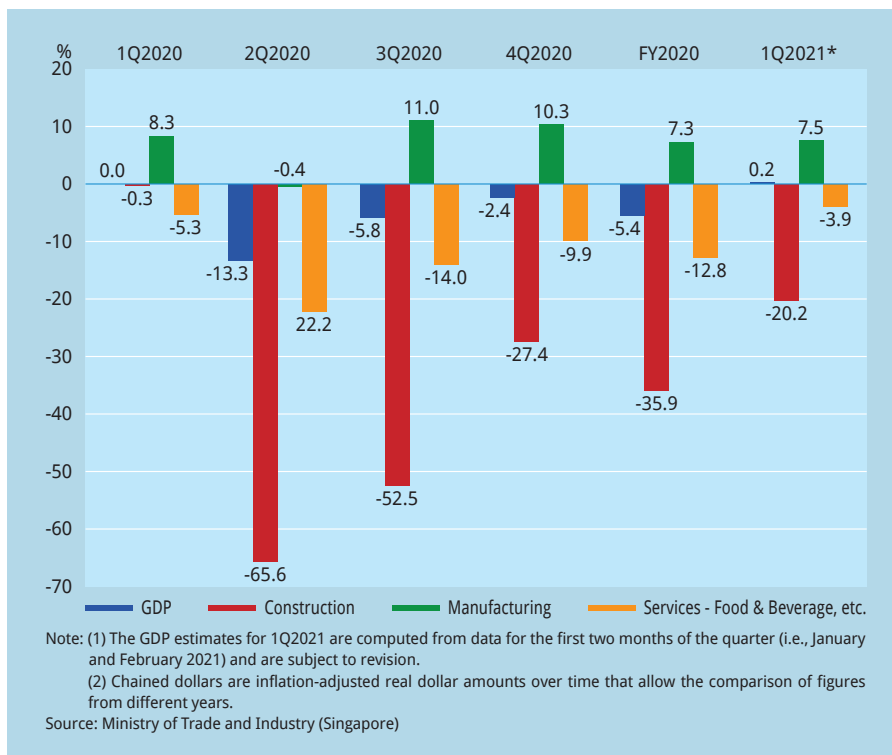
tract by 20.2% in the first quarter of 2021 (-65.6% in 2Q2020), the overall Singapore economy is expected to expand by 0.2% on a y-o-y basis in the first quarter of 2021 (Figure 3).⁴

SME Financing: The Need for Out-of-the-Box Thinking for the Next Systemic Crisis

History has taught us that any pandemic has prodigious human, health, and economic consequences. Even with all the modern advances in health and emergency medical care, the COVID-19 pandemic has taken an extraordinary toll in human lives. As of 1 May 2021, there have been 151 million cases and 3.17 million deaths recorded worldwide. Singapore has at least avoided the worst of the disease's impact; the city-state has witnessed only 61,121 COVID-19 cases and 30 deaths as of 1 May 2021. On the vaccination side, more than 4% of the population has received a second dose of the vaccine.

According to the Ministry of Trade and Industry in Singapore, the country's gross domestic product (GDP) nonetheless

Figure 3: Singapore's GDP in Chained (2015) Dollars



The impact on businesses in Singapore, including SMEs and particularly those in the hospitality, travel, tourism, and entertainment sectors, has been more severe. Singapore, like many other responsible governments around the world, came up with massive financial support packages in 2020 and 2021 to help preserve local SMEs, workforce, households, public health and well-being, and the overall economy. Despite the Singapore government's massive COVID-19 financial support, on the order of SGD100 billion (USD75 billion) in 2020 (close to 20% of GDP) and another planned SGD107 billion in Budget 2021, SGD53.7 billion (USD40.4 billion) of which will be drawn from its reserves, most government support to business is in the form of loans and debt channeled through the private sector at concessional rates, which eventually have to be repaid.

In response to COVID-19, the Singapore government helped over 15,300 SMEs improve their productivity, innovation, and internationalization efforts in 2020; this was 54% more enterprises than the

government assisted in 2019. About SGD18 billion in loans at concessionary rates were disbursed. According to the Department of Statistics of Singapore, SMEs are a key pillar of the island-nation's economy. In 2020 (with 2019 data in parenthesis), SMEs contributed 45% of value-add to Singapore's GDP of SGD480.2 billion (SGD507.6 billion), provided over 70% of the 3.35 million (3.52 million) in total jobs, and constituted 99.5% (99.5%) of all its enterprises, comprising 279,700 (273,100) firms. As mentioned, many SMEs in Singapore do not have access to the local capital markets. Instead, they must rely on government support and grants (which are not ample), and bank financing, or are simply owner-financed. Enterprise Singapore's Year-in-Review 2020 provides an overview of the support provided by the government and the business challenges faced by enterprises (Figure 4).

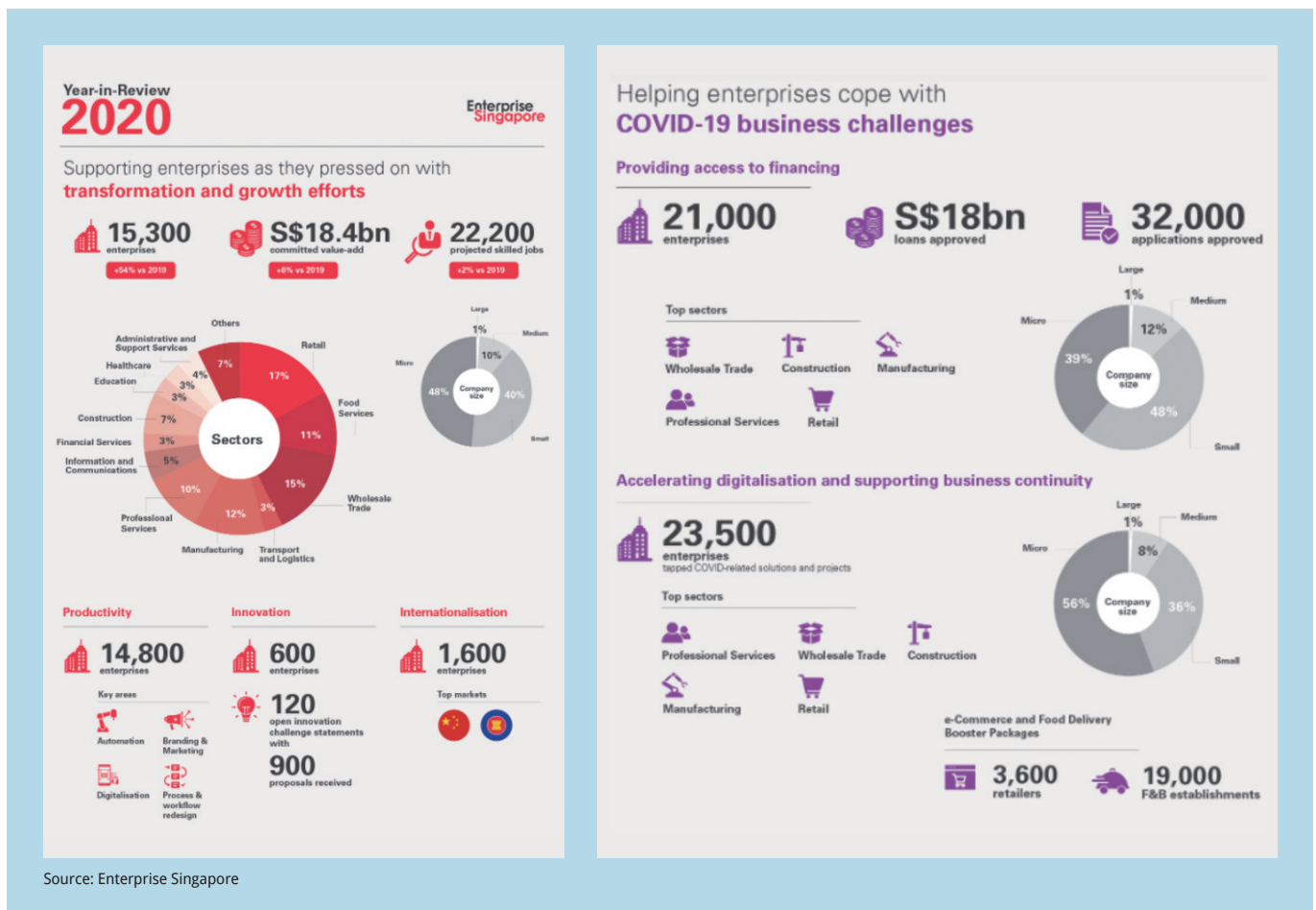
As the infographic shows, the need for a long-term solution for all enterprises in Singapore, especially hard-hit SMEs, cannot be overemphasized. Indeed, it is a

problem faced the world over. While subsidized or concessionary loans may temporarily help ease firms' short-term burdens, they may end up dragging down businesses in the long run, especially if they are SMEs.⁵

For that reason, I recommend that governments explore the possibility of taking on a partial equity stake in SMEs as part of the overall solution to the "going concern" (or the lack thereof) problem of such firms, both large and small. This approach, only applicable during a large-scale, systemic crisis, should be exercised in the case of SMEs and those firms with limited access to bank loans or capital market fundraising mechanisms. For convenience, I refer to the state's direct equity stake in the business as "quasi-equity" (as opposed to preferred equity or convertible equity). How would a quasi-equity program work, taking Singapore's experience as an example?

Firstly, the government has to recognize the need to provide support to SMEs during a systemic crisis such as a health

Figure 4: Enterprise Singapore's Year-in-Review 2020



Source: Enterprise Singapore

pandemic, to keep the economy humming while mitigating negative economic consequences, to save organizational capital, especially organization-specific human capital, and to mitigate negative social consequences.

Secondly, the Singapore government's COVID-19 subsidized term loan scheme, administered by the Monetary Authority of Singapore (MAS) and/or Enterprise Singapore via banks, has greatly helped micro and small enterprises. Very broadly, the *MAS-Enterprise Singapore Enhanced Enterprise Financing Scheme - SME Working Capital Loan* is capped at SGD1 million, with a 0.1% lending rate from MAS to the banks for a 2-year period. The government shares up to 90% of risk on the SME loan, with the bank's final interest rate charged to SMEs determined by the cost of funds, the SME's risk profile, and so on.⁶ It also allows for a 1-year deferral of principal repayment, subject to the bank's risk assessment. The Ministry of Trade and Industry reported that the interest rates ranged between 2% and 4.5% p.a., between 1 March and 30 April 2020, with banks disbursing 2,500 loans worth SGD1.9 billion, for an average of SGD760,000 per loan.

Thirdly, the government is aware that direct handouts of cash can be costly for the following reasons:

- Handing out money to those who do not need it nor deserve it is costly.
- Fair and justified selective handouts may have high administrative costs, e.g., overcoming firm-specific information asymmetry, moral hazard, etc.

The Singapore government's various enhanced credit channel schemes for SMEs appear to be working well. What is missing? Despite the change in administration in the U.S., the trend away from globalization toward regionalism pressed by inward looking policies will continue. Consistent with the (pandemic-related) Declaration on Trade in Essential Goods, and past agreements such as the Closer Economic Partnership (CEP), Strategic Economic Partnership (SEP), and the Free Trade Agreement (FTA), the government announced that SMEs need to "emerge stronger, aspire to be one of the first to recover, seize new business opportunities" post-pandemic.

Regrettably, the world is in transition, with more nationalism and regionalism in evidence. That said, ASEAN nations, particularly Singapore, are seeing more foreign investment coming in to cater to the demands of China, Japan, and the rest of Asia. SMEs in Singapore can be key players in this new phase as the pandemic subsides. However, SMEs with the potential to seize such opportunities in the region and beyond will certainly face financial constraints. Additionally, SMEs will need to redesign, retrain, hire, innovate, upskill, tech-up and transform. To do this, they will need even more financing which is the nature of entrepreneurial financing. Banks and traditional financial institutions may be "trapped" with extant SME loans, deferral and forbearance programs, non-performing or bad loans, etc., so that SMEs are likely to remain cash-constrained even after the pandemic fades.

This is where a hybrid entrepreneurial financing solution option, i.e., credit combined with quasi-equity, will be helpful. A quasi-equity overlay example specif-

ic to Singapore would be instructive. The textbox below depicts the government's original concessionary lending scheme offered via the banks around March 2020 (Option 1) overlaid with state-funded quasi-equity. For convenience, the government Special Purpose Vehicle (g-SPV) referenced below could potentially be set up under the new Singapore Variable Capital Companies Act (2020).⁷

How does state-led quasi-equity financing work? First determine which SMEs qualify for the quasi-equity program via certain quantitative filters—say, the past 3 years' Profits after Tax (PAT), long-term viability/prospects, and the bank's credit loan officers' evaluation, as in Option 1 of the textbox. Then provide an arms-length, quasi-equity "term financing" via the g-SPV. Say for example, y% of 2017-2019 average annual revenues is in equity financing, which is combined with [100-y]% via the MAS-Enterprise Singapore SME term loan. Like preferred equity, the g-SPV holding the quasi-equity shares has no voting rights but has priority over owners' equity; i.e., the SME pays "dividends" in the form of, say, higher corporate taxes. The SME can buy the quasi-equity back from the g-SPV at an appropriate buy-back or forward price post a fixed holding period or duration. The oversight of the SME as a result of the quasi-equity will involve a Board of Overseers.

Conjoining state-led quasi-equity with the SME enhanced loan scheme provides a first-loss protection mechanism for the lenders. It also has other tangible benefits. On the business front, the SME faces lower interest rates (a reduction of x basis points) and hence lower monthly loan payments. On the lender's front, it fully utilizes the bank's ability to assess loans and lowers risk, given the government's equity participation, *ceteris paribus*. Additionally, it frees up capital on the bank's balance sheet for other more productive lending. On the government front, it encourages entrepreneurial risk-taking without overclaiming the fruits of the SMEs' efforts (the forward sell-back price is the SMEs' put option). A simple financial economic model is provided in the Appendix to justify the program economically.

The state-owned g-SPV of the quasi-equity certainly must worry about standard risk management issues, like adverse selection and moral hazard. For example, due to adverse selection, the SME would know more about its true health, condition, and commitment than the g-SPV does, *ex ante*. The solution is appreciation for long-term reputational effects, particu-

MAS-ESG Enhanced Enterprise Financing Scheme - SME Working Capital Loan

The SME needs SGD5 million in financing. Provide 2 options:

Option 1: The SME borrows SGD5 million over 2 years at 4% under extant MAS-Enterprise Singapore Enhanced Enterprise Financing & Temporary Bridging Loan Programme (TBLP) Schemes with 10% risk-share by the bank (=SGD500,000) and 90% risk share by the government (=SGD4.5 million)

Option 2 (proposed): The SME borrows SGD2.5 million over 2 years at (4%-x bps) under MAS-Enterprise Singapore Enhanced Enterprise Financing/TBLP Schemes with 10% risk-share by the FI (=SGD250,000) and 90% risk share by the government (=SGD2.25 million) + SGD2.5 million in state-led pseudo-equity financing. Very much like a public-private partnership program (PPP)

larly in the case of Singapore, which is a small island-nation. If necessary, the g-SPV can apply an adverse selection “haircut” to the loan/equity financing amount. Another example would be moral hazard, which arises when the SME recipient of quasi-equity financing, ex post, siphons off the funds for unauthorized purposes, be they unnecessary risk-taking or consumption of perquisites. The government, however, has punitive authority: any fraud or egregious wrongdoing can be prosecuted, or the SME could be “blacklisted” by the government.

In a well-managed country like Singapore, where tax compliance is good and long-term reputation is paramount, these effects would be smaller than in many other jurisdictions. Apart from the government agencies and regulatory authorities, reputable local business associations can be incorporated into the Board of Overseers in Public Private Partnership (PPP) format to monitor the state-led quasi-equity financing program.

Infrastructure Financing

Without oversimplifying, the appeal of infrastructure assets is the steady, predictable, and long-term nature of their cash flows. These features adequately meet the asset and liability needs of sovereign funds, insurance companies and pension plans which are constantly looking for alternative sources of risk premia (and hence returns) in this low-yield interest rate environment. Over the last five to ten years, the FTSE Global Core Infrastructure Index of infrastructure-related listed securities worldwide returned 6.5% and 6.1% per annum, while the EDHECinfra's most representative index of unlisted infrastructure equity, the infra300 Index, returned 5.03% and 13.5% per annum, respectively. U.S. President Joe Biden has been the latest leader to jump on the infrastructure bandwagon, with a USD2.3 trillion spending plan, around 50% of which is estimated to go towards physical infrastructure, such as rebuilding roads and bridges.⁸

Singapore, too, has been at the forefront of infrastructure financing and de-

velopment through Infrastructure Asia, a government agency which partners with various stakeholders for this purpose in Southeast and South Asia. Additionally, Singapore boasts some of the region's leaders in infrastructure development, particularly in urban planning, design, and build. These include Surbana Jurong and Sembcorp.

I would like to explore three areas as new ways to think about investing in infrastructure. They are: the use of real options analysis (ROA) for project feasibility and due diligence studies; the innovative financing opportunities available in urban infrastructure in this region from the “value-chain solution provider's” point of view, especially focusing on green and sustainability financing initiatives in urban infrastructure; and the potential of digital security token issuance to enable broader participation of non-accredited investors in the real economy. In other words, giving smaller investors the opportunity to invest in infrastructure.

First, ROA, which, unlike traditional capital budgeting using the ubiquitous discounted cash flow (DCF) model, takes uncertainty and flexibility into consideration when evaluating whether projects add value. ROA incorporates the impact of risk and uncertainty in irreversible investment projects, while explicitly valuing the inherent flexibilities in project management along the way, including project deferment, abandonment, or expansion. In a Surbana Jurong Capital test case study conducted in 2020 involving a wind farm within this region, students at the National University of Singapore (NUS) Business School divided the project into the following three irreversible stages (financial stages in parenthesis): feasibility studies (due diligence), project structuring and engineering (deal structuring) and construction (actual financing starts). A critical result from the study is that the difference in net present value of the project using the DCF versus ROA method increases monotonically in ROA's favor as the volatility of the future cash flows to the project increases. The intuition behind this result is that in the ROA approach, the model considers the project manager's ability, or flexibility, to abandon, defer, expand or re-contract. As financial option pricing theory predicts, the higher the volatility (or uncertainty) of the underlying project's future cash flows, the greater is this project's “flexibility” premium.⁹

Second is a new way of thinking about urban infrastructure financing that offers the opportunity to promote green

and sustainable goals. In November 2020, the MAS launched the world's first Green and Sustainability-Linked Loan Grant Scheme for corporates. The financing scheme is such that independent service providers can be engaged by corporates, particularly SMEs, to validate that loan proceeds are used for green and sustainable purposes. So why don't the industry and policymakers allow for green, sustainability and social-linked home mortgage schemes too, especially in the case of affordable housing? Any housing project—and its residents—that supports the Sustainable Development Goals (SDGs), Environment, Social, and Governance (ESG), circular economy, renewable energy and energy efficient activities, biological diversity, or which minimizes the social and environmental footprint as well as promotes sustainable food/farming practices, would qualify for this Green and Social-linked Home Mortgage Scheme. Or, the developer could offer a green-linked rent-to-own scheme, which combines a standard lease agreement with an option to buy before the lease terminates.

Finally, on the digital front, tremendous strides have been taken in Singapore to allow the issuance of digital securities, both traditional bonds and private equity-backed bonds, and digital token securities for the trading and settlement of the same in smaller denominations.

In the former case, HSBC Singapore and Marketnode (a joint Singapore Exchange (SGX) and Temasek digital asset issuance, depository, and servicing platform) have recently completed a digital bond issuance process in conjunction with a traditional bond issue from Singtel. According to HSBC Singapore, digital bond issuance is achieved by creating a “distributed ledger technology electronic platform that connects various parties in bond issuances and uses self-executing smart contracts to automate processes such as issuance flows and coupon payments.” In other words, a blockchain system.

In the latter case, a Temasek portfolio company, Azalea Investment Management, has been issuing listed bonds on a diversified portfolio of private equity funds held by Temasek, commencing in 2016 with Astrea III. The latest in the series of such PE-backed bonds, Astrea VI, is now witnessing local digital asset exchange, iSTOX, issuing tokens on Astrea VI. The tokenized offering of such bonds, down to a minimum size of USD20,000, allows for “fractionalized ownership” of Temasek's PE funds, giving greater access to a broader range of investors, as well as better after-market liquidity

for those who need it.

A similar strong case can also be made for digital issuance and tokenization of infrastructure finance securities, so that a broader swath of investors can participate and benefit from the growth in the real economy through infrastructure investment.

Conclusion

In this essay, I have tried to lay out how business owners, investors, and policy-makers can use financial markets, products, policies, technology, and science to build more resilient ecosystems to counter extreme systemic crises.

In retirement finance, adequacy and customization are paramount to individual lifecycle planning. Indeed, there are various tools and applications already available to do that in a cost-efficient and seamless manner. Additionally, governments should enact legislation to ringfence retirement assets from capital invasion.

In SME financing, state-run quasi-equity funding with unique features can help provide the necessary liquidity to an otherwise healthy firm during exigencies. Quasi-equity financing is meant to tide the SME over a difficult (yet short) liquidity “squeeze period” in exchange for equity to help the firm survive, recover, and potentially thrive in the long run.

I have also shown that the ROA approach in infrastructure finance adds value over and above traditional capital budgeting using DCFs. ROA provides for the necessary tradeoff and opportunity cost analysis that stems from the ability of the decision maker to adapt to changing scenarios in real time, be they economic, environmental, regulatory, social, or political. And what kind of stewards are we if our decision-making in this space is not green and sustainable? Furthermore, innovations in home mortgage financing and leasing can promote green and sustainable goals while innovations in digital securities issuance can promote access to a broader range of participants. Rethinking the roles of financial markets, innovation, and government policy in retirement finance, SME

financing and infrastructure financing in the ways described here will strengthen resilience in the face of future systemic crises, in Singapore and around the world.

Appendix

The Mathematics of SME Financing

A simple economic model to illustrate the economic benefit of state-led quasi-equity is instructive.¹⁰

- There are 2 states of nature: $\Theta \in \{h, l\}$ (h or high = good state w.p. π ; or low = bad state w.p. $(1 - \pi)$)
- One SME which can borrow $D \in \{D_L, D_H\}$ at $r = 0$ (i.e., assume borrowing rate = 0%); and $D_L < D_H$
- SME needs D_H (\$) in total financing, and is risk averse with Von-Neumann Morgenstern utility such that $u'(\cdot) > 0$ and $u''(\cdot) < 0$, where $u(\cdot)$ is the SME's twice continuously differentiable “utility function”
- One good risky investment returning R (in \$) w.p. π and 0 w.p. $(1 - \pi)$
- One riskless investment with certain return S (in USD)
- SME can allocate $a \in [0, 1]$ to “good” risky investment and $(1 - a)$ to riskless investment
 - Scenario 1: All investment financed by debt $\Rightarrow D = D_H$
 - Scenario 2: Investment financed by combo of debt (D_L) + quasi-equity (E) for $x\%$ give-up s.t. $D_L + E = D_H$
- If $\Theta = h$ (good state)
 - Income y from ME's investment in risky & riskless assets: $y^h(a, D) = \{aR + (1 - a)S\} * D_H$
- If $\Theta = l$ (bad state)
 - Income y from ME's investment in risky & riskless assets: $y^l(a, D) = \{(1 - a)S\} * D_H$ (assume $< D_L$)

- The Bank collects: $P \equiv \text{Min}\{D, y\} = \text{Min}\{D, y^i\}$ (i.e., it collects full face value in good state w.p. π , and takes over the firm otherwise)
- The Government ($x\%$) collects: $xy = xy^h$ w.p. π (0 otherwise) (i.e., the government receives dividends per its %equity stake w.p. π)
- SME $(1 - x\%)$ retains: $(1 - x)y^h - P$ w.p. π (0 otherwise) (i.e., the SME receives residual value after first paying the government and bank its dues w.p. π)

The Scenarios:

- **Scenario 1:** $x = 0\%$, $D = D_H$ (Pandemic borrowing situation in Singapore where SMEs are financed by low-interest loans)
ME maximizes $u(\pi * \{aR + (1 - a)S\} * D_H - D_H) \Rightarrow u(\pi * D_H * \{aR + (1 - a)S - 1\})$
- **Scenario 2:** $x = x\%$, $D = D_L$; where $D_L + E = D_H$ (Proposed hybrid solution for Singapore where SMEs are financed by low-interest loans and state-led quasi-equity)
ME maximizes $u(\pi * \{aR + (1 - a)S\} * (1 - x) * D_H - D_L) \Rightarrow u(\pi * D_H * \{aR + (1 - a)S\} * (1 - x) - 1 * (D_L / D_H))$

Scenario 1: Recall, SME maximizes $u(\pi * D_H * \{aR + (1 - a)S - 1\})$, and

Scenario 2: SME maximizes $u(\pi * D_H * \{aR + (1 - a)S\} * \frac{(1 - x)}{<1} - 1 * \frac{(D_L / D_H)}{<1})$

- By inspection, since $u'(\cdot) > 0 \Rightarrow a_{\max}(\text{Scenario 2}) > a_{\max}(\text{Scenario 1})$.
- Due to concavity ($u''(\cdot) < 0$), a in both cases are indeed interior maxima
- Hence the SME will optimally invest more in the “good” risky investment in Scenario 2
- From the bank's point of view, the risk of default in Scenario 2 is lower since:
 $D_L(\text{Scenario 2}) < D_H(\text{Scenario 1})$
- From the government's point of view:
 - ▶ Scenario 2 implies more risk taking by SME and, hence, greater economic activity
 - ▶ The government collects a dividend of: xy^h w.p. $\pi \Rightarrow x * \{aR + (1 - a)S\} * D_H$ w.p. π QED \square

Economic recovery COVID-19



Note

- 1 “Ring-fencing pensions,” Joseph Cherian and Emma Yan, *Asia Asset Management*, May 2020, Vol. 25, No. 5.
URL: <https://www.asiaasset.com/post/23349>
- 2 “Labor supply flexibility and portfolio choice in a life cycle model,” Zvi Bodie, Robert C. Merton, and William F. Samuelson, *Journal of Economic Dynamics and Control*, 16, Issues 3-4 (1992): 427-449.
- 3 “Terms of endurance: Retirement solutions should harness investment science and technology to shockproof plans”, Joseph Cherian and Ong Shien Jin, *Asia Asset Management*, July 2020, Vol. 25, No. 7.
URL: <https://www.asiaasset.com/post/23545>
- 4 Editor’s note: The latest GDP growth estimates provided by the Ministry of Trade and Industry (Singapore) on 14 July 2021 report that Singapore’s economy grew by 14.3% on a y-o-y basis in the second quarter of 2021, while first quarter growth registered 1.3% growth.
- 5 According to Enterprise Singapore, small enterprises are companies with revenues between USD1-10 million, while medium-sized enterprises are companies with revenues between USD10-100 million. Other qualification conditions are listed on the Enterprise Singapore website.
- 6 The Enterprise Singapore’s SME TBLP provides 5-year working capital loans up to SGD5 million with interest rates capped at 5% p.a.

URL:<https://www.enterprisesg.gov.sg/financial-assistance/loans-and-insurance/loans-and-insurance/temporary-bridging-loan-programme/overview>

- 7 See MAS Report (10 September 2018).
URL:https://www.mas.gov.sg/-/media/MAS/News-and-Publications/Consultation-Papers/Response-to-Feedback-on-Proposed-VCC-Framework_10-Sep.pdf
- 8 Editor’s note: Since the writing of this article, the U.S. Senate has introduced a less ambitious USD1 trillion bipartisan infrastructure investment bill.

9 A caveat is in order here. While ROA provides a better returns representation of the project given it reflects the added optionality and risk premium, the corresponding challenge is the accuracy of both the underlying assumptions and ascertainment of the parameters associated with the ROA methodology.

10 The financial economic model used in this SME Financing section is adapted from “Contract Structure, Risk Sharing, and Investment Choice”, Greg Fisher, *Econometrica*, 81, no. 3 (2013): 883-939.

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Joseph Cherian is Practice Professor (Finance) at National University of Singapore (NUS) Business School, where he was Founding Director of the Centre for Asset Management Research & Investments. Prior to joining NUS, he was Managing Director, Global Head and CIO of the Quantitative Strategies Group at Credit Suisse (CS) in New York where he had direct responsibility for over USD67 billion in client assets. While at CS, he served on the Global Executive Committee, and various senior management, investments, and risk committees of the Asset Management division.

Joe joined the financial industry in New York after an academic career, including as Associate

Professor of Finance at Boston University. He currently serves as Advisor to Nipun Capital, Xen Capital, Asia Asset Management, and the Mercer-CFA Institute Global Pensions Index. He has had advisory or board appointments at the Journal of Alternative Investments, Singapore’s Central Provident Fund and National Research Foundation, and was an Independent Non-Executive Director of Bursa Malaysia.

Joe holds a B.Sc. in Electrical Engineering from MIT, and M.Sc. and Ph.D. degrees in finance from Cornell University where he was a two-term member of the Johnson Graduate School of Management’s Dean’s Advisory Council and remains Emeritus Member of the Council.