Feature

Time is not Money, Risk is!

A step towards a sustainable and equitable financial analysis practice

by David Espinoza, Jeremy Morris & Alice Hill

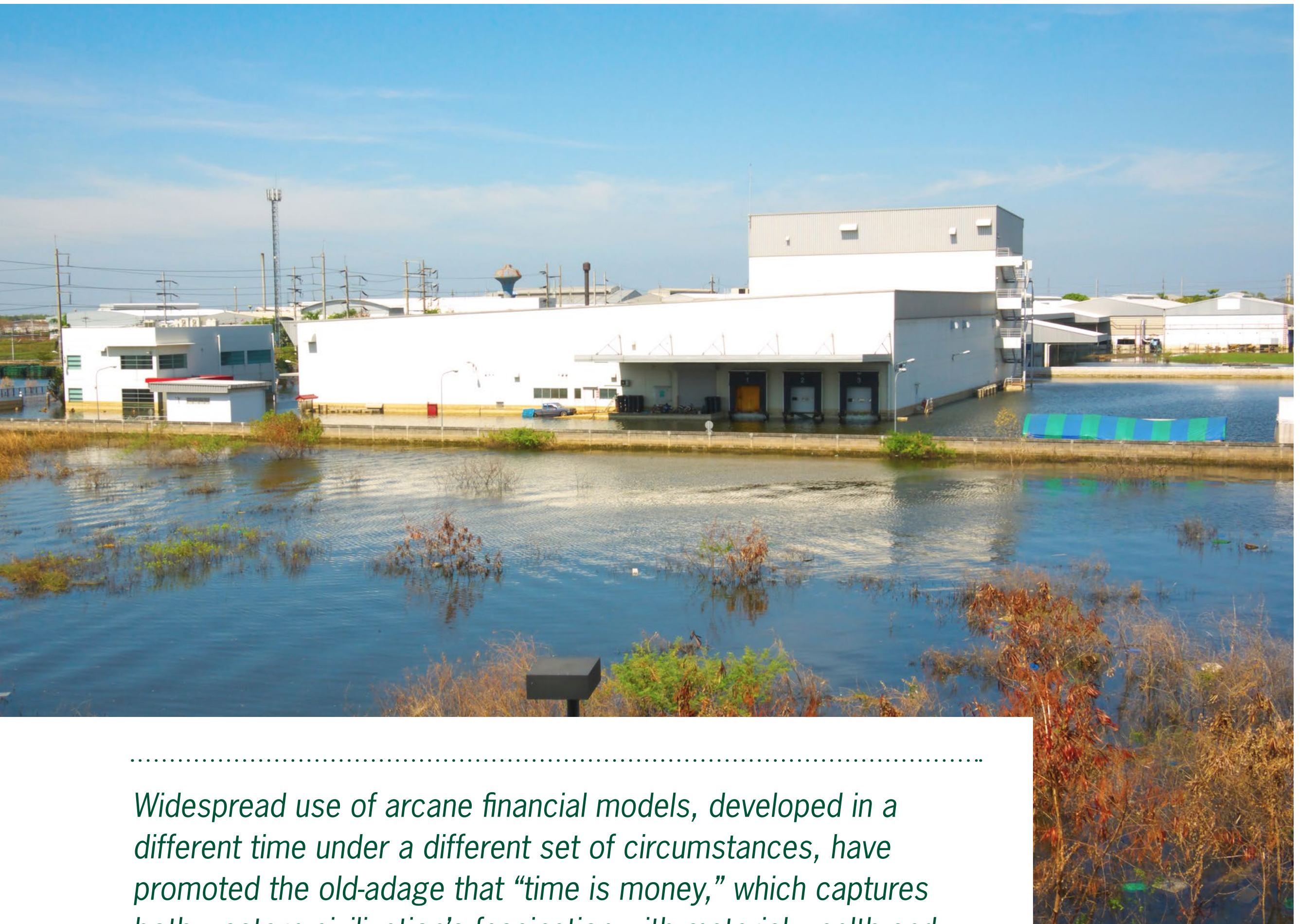
Abstract

Despite our technological achievements, decisions that affect future generations are still based on arcane financial models that artificially downplay future global risks such as climate change and pandemics and fail to appropriately value collective actions that we could take today to alleviate such risks. The current COVID-19 pandemic provides grim evidence of this. By grossly underestimating future global risks, such financial models understate the long-term effects of today's actions, effectively imposing a cost on future generations that the current one has little incentive to fix. Although history shows there is no limit to human ingenuity for technological innovation; sadly, it will not be technical limitations that inhibits society's response to the great challenges posed by global risks, but rather flaws in the financial models used to make long-term consequential decisions. These models, developed in a different time under a different set of circumstances, have promoted the old-adage that "time is money," which captures both western civilization's fascination with material wealth and its current short-term decision-making mindset. Continued reliance on these outdated models hampers our ability to fund projects with long-term benefits that reduce the risk of impacts. We need to start acknowledging that time is not money, risk is! A practical financial model that captures precisely that is described herein: the decoupled net present value (DNPV).

As financial markets blossomed in the early 20^{th} century, the need to compare simple investment instruments such as bonds with different maturities and default risks arose, sparking the development of the discounted cash flow (DCF) concept. DCF relies on discount rates to set cash streams that take place at different times on equal temporal footing.

To compare investment instruments, the DCF analysis commingled payment risk (i.e., default) with the time value of money to determine discount rates. Higher discount rates were used to account for higher default risks. When later extended to perform cost benefit analysis of more complex investment opportunities, DCF models failed to accommodate detailed cash flow risk profiles. However, DCF kept the idea of commingling risk and time value of money. As a result, the mechanics of DCF analyses breed the incorrect perception that short-term benefits are always more valuable (or liabilities more harmful) than long-term ones reinforcing the "time is money" concept. This implicitly and effectively transfers costs and risks from current to future generations while siphoning wealth from those generations to the present. In the context of managing global risks such as climate change, this hampers our ability to finance promising resilience and adaptation ideas within appropriate time frames. The impact of the distortion introduced by discounting future revenues/liabilities on economic policy development and/or public investments in the energy sector have been clearly exposed since the early 1980s[1]. Four decades later, the issue of how to adapt discounting techniques to better represent project development risks is still widely debated among practitioners and academics alike, as clearly illustrated in a recent article on climate risks to global financial assets[2] that recommends using as discount rates the opportunity cost of capital of private investors when valuing a portfolio of privately held financial assets.

Climate change is a global risk that provides a stark example of this adaptation logjam. There is broad consensus among the scientific and regulatory communities that the physical impacts of climate change resulting from unchecked anthropogenic activity will not only increase the risk of losses in coming decades but also the magnitude of the effect[2,3].



Water flood in industrial estate

Widespread use of arcane financial models, developed in a different time under a different set of circumstances, have promoted the old-adage that "time is money," which captures both western civilization's fascination with material wealth and its current mindset for short-term decision making.

However, the inability of DCF to consistently and transparently monetize the effects of physical risks on long-term asset value discourages investments in the scientific and engineering advances that could provide more sustainable solutions to our most challenging problems at a fraction of the cost. In a nutshell, for typical discount rates used in standard financial analysis, DCF promotes the idea that $1 saved today is far more valuable than $6 in avoided future costs, making it difficult to convince society at large that we would be well served investing today in resilience and adaptation measures to mitigate future impacts[4].

2.0 Short-termism and the Tragedy of the Horizon

Promoting and adopting sustainable solutions requires all stakeholders, including non-profit and for-profit executives and shareholders, elected officials, and the community in general, to adopt a long-term mindset so that investments in sustainability or resilience are not perceived as a gamble that only pays off in the event of a disaster. Although nobody would label wasteful an individual buying health or life insurance while hoping at the same time to never use it, the same cannot be said when evaluating the well-being of a community. Unfortunately, acting against the need to implement longer-term investment strategies is the mismatch between the horizons of those typically charged with executing the ideas (e.g., executives who typically have short-term horizons and reduced exposure to long-term impacts) and those affected by them (e.g., communities who suffer most from long-term impacts yet often have little influence over decisions). This misalignment invariably results in myopic investment strategies that favor projects offering faster returns over those that would increase long-term shareholder and

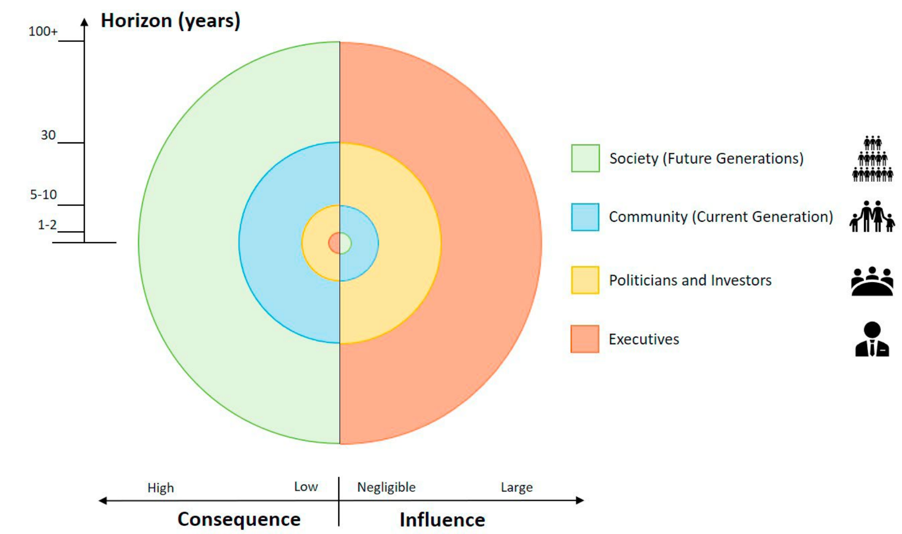


Figure 1: The Tragedy of the Horizon: Stakeholders and Impacts

social value[5,6]. This widespread bias favoring short-term investment decisions has led to a phenomenon known as the Tragedy of the Horizon[7] in which the consequences of decisions are felt well beyond the short-term horizons of business/political cycles and often impose a significant burden on current and future generations (Figure 1). Although the term was originally introduced to describe the concerns associated with climate change risk, it holds true for other major global risks facing society.

The Tragedy of the Horizon is exacerbated by the widespread use of DCF techniques to perform cost benefit analysis of long-term investments, since this results in severe economic distortions and promotion of perverse incentives in which future value is underemphasized[8]. As a result, although society can save $6 in future disasters costs for every dollar spent today on hazard mitigation, more often than not such investments are difficult to justify financially and therefore postponed. Worse still, supported by the artifact of discounting, available funds may be invested in less-promising technologies. At the heart of DCF techniques is the process of exponentially reducing the value of future cash flows to express their net present value (NPV) in today's currency so that revenues/costs taking place at different times can be easily, albeit incorrectly, compared. Future values become exponentially smaller as increasingly higher discount rates are selected further favoring short-termism. Private investors may obtain an unfair compensation for risks that have been cleverly negotiated and transferred to future generations through increases in the discount rates.

Consider a 7% discount rate net of inflation (the rate recommended by the Office of Management and Budget to be used by U.S. federal agencies[9]) applied to a 60-year period (two generations). Application of a 7% discount rate renders the present value of final revenues/expenses at less than 2% (i.e., $104/$6000) of their original (undiscounted) value, while a 12% discount rate (typically used by multilateral international lenders such as the World Bank) yields a paltry NPV of 0.1% (see Table 1) of the original estimate! Private investors and even non-profit institutions may use higher discount rates. So, how do the mechanics of DCF affect the value of $6 of future savings against $1 spent today on hazard mitigation? Well, for starters, DCF is not designed to accommodate contingent liabilities, so it does not account for them. Spending $1 today is simply viewed as an added expense that has no impact on the project cash flow risk profile. At best, decision makers may consider investing in risk reduction rationally by assessing the likelihood of a given event taking place in the near future. For instance, for a 12% discount rate, the present value of $6,000 would be higher than $1,000 for years 1-15 (see Table 1). Hence, a rational decision maker would not consider investing in risk mitigation unless the hazard is expected to take place in the next 15 years. After that, based on standard DCF, the discounted value of the $6 in future savings is lower than a $1 dollar spent today.

Since investment risks and discount rates are loosely connected, if at all, there is no standard systematic approach describing how discount rates should be calculated to account for different risks. As a result, rates are largely prescribed rather than calculated. The practice of using discount rates as a proxy for risk and comparing the return on investment to the risk-free

TIME (T)	DISCOUNT RATES (NET OF INFLATION)			
	5%	7%	12%	15%
1.0	5,714	5,607	5,357	5,217
5.0	4,701	4,278	3,405	2,983
10.0	3,683	3,050	1,932	1,483
12.8	3,208	2,519	1,402	999
15.0	2,886	2,175	1,096	737
15.8	2,773	2,057	999	658
20.0	2,261	1,551	622	367
25.0	1,772	1,105	353	182
26.5	1,647	999	298	148
30.0	1,388	788	200	91
36.7	999	500	93	35
50.0	523	204	21	6
60.0	321	104	7	1
80.0	121	27	1	0
90.0	74	14	0	0
100.0	46	7	0	0

return on safe investments such as U.S. Treasury bonds has the unfortunate effect of commingling two very distinct parameters: the time value of money and risk[10]. This practice has reinforced the widely popular concept known as "time is money," which has been used to evaluate not only the performance of private investments but also non-profit institutions exhorting foundations to distribute their assets at a faster rate[11].

By arbitrarily increasing discount rates to account for additional risk (real or perceived), the widespread use of discounting masks the effect of risk on investment performance, which makes it difficult for stakeholders to attain a good understanding of the impact of risk management measures on financial performance and often leads to misallocation of compensation to different stakeholders for their assumed risk. To finance long-term projects under these terms, investors thus often demand (and obtain) disproportionately large compensation incompatible with their actual risk exposure, which either increases income inequality among project partners or stifles the flow of capital to much-needed long-term investments that could help improve sustainability and resilience. The main victims of this unsustainable practice tend to be the project's host communities, who are often too poorly funded and equipped to handle the risks they have unwittingly accepted at inadequate compensation levels. Future generations are most vulnerable because they have no influence over decisions and generally benefit very little from today's investment practices yet may inherit substantial environmental and other liabilities.

The catastrophic impact of COVID-19 on all sectors of the world economy has exposed the fragility of our current system to global risks and the perils of short-termism. Looming on the horizon is the potential devastating impact of another global risk that does not respect national boundaries: climate change. Minimizing the negative impacts of climate change on society will require not only massive investments in resilience, adaptation, and mitigation but also worldwide cooperation among the scientific as well as the investment community. Institutional investors (e.g., pension funds, retirement funds, university endowments) represent a huge and largely untapped pool of capital that could be used to fund such projects in both developed and developing countries. However, to promote meaningful and sustainable capital flows from this investor class, their fund managers will need to understand how non-market risks could directly affect financial performance. Although there is a recent concerted private sector effort to understand how climate change could affect infrastructure performance and liabilities[12, 13], unfortunately the current focus is mostly on developing easy-to-use tools at the macro level (i.e., ranking systems and indices) leaving the root of the problem largely untouched.

Since risk is treated as a cost, DNPV removes the guess work associated with assigning discount rates to account for risk.

3.0 A Sustainable Alternative: Decoupled Net Present Value (DNPV)

Despite the significant progress made in the disciplines of finance and economics, reliance on DCF has largely gone unexamined as one of the weaker and more questionable elements in the financial landscape. This is unfortunate, because although devising sound technical solutions to address sustainability issues is vital[14], more effort is needed to prevent these ideas from being wasted due to lack of funding. Such effort includes developing and disseminating accurate, consistent, and transparent valuation techniques that explicitly incorporate physical (and other) risk sources[15,16]. As a first step, there is much to be gained

Box 1: Decoupled Net Present Value (DNPV)

The DNPV method (www.dnpv.org) is a valuation framework consistent with Prospect Theory that uses certainty equivalent concepts to decouple the time value of money from risk. DNPV introduces the risk-as-a-cost concept to account for the loss-aversion attitude of rational investors. The cost of risk is related to the downside potential of an investment and is included in the cash flows as a project cost as the effective price to protect an investor against individually identified risks. Because identified project risks are quantified in monetary terms and treated as real costs to the project, the need to massage the discount rate to account for actual and perceived risks is no longer necessary. Future cash flows reduced by the identified costs of risks can simply be discounted using quoted risk-free rates.

from revisiting old concepts[17], including many that might have been previously discarded as impractical due to computational power limitations, and coupling them with new ideas from diverse disciplines including engineering, behavioral economics, mathematics, and data analytics. One such example is the decoupled net present value (DNPV) method (see Box 1) proposed as an alternative to NPV for valuation of long-term infrastructure investments[18]. The DNPV approach consistently translates technical assessment of physical and other risks into financial terms by quantifying in monetary terms the potential exposure of an asset to identified hazards including climate change[19].

The benefits of quantifying individual risks in monetary terms and treating them as costs to the project are numerous. (1) It is more natural to describe risk in monetary terms as it reflects our everyday experience filled with examples of cost of risk (e.g., car insurance premiums, health care premiums, home insurance, life insurance). (2) Contingent liabilities can be taken into account systematically in the cost benefit analysis process. Investors and project sponsors can profit from multidisciplinary technical experts (e.g., engineers, scientists, sociologists, epidemiologists) to assess the magnitude of the contingent liabilities identified. (3) Because risks are quantified, risk managers can adopt appropriate measures to reduce exposure including assigning risks to their "most rightful" owners, and thus project risk profiles can be reassessed. (4) The effect of risk management (i.e., avoid, reduce, mitigate, transfer, or retain identified risks) on return of investment can be assessed in an objective and consistent manner. (5) Project specific risk quantification would foster better data collection for key risk drivers and promote exchange of information across industries, which iteratively will improve our ability to develop accurate and effective risk management measure over time. (6) DNPV removes the guesswork associated with the discount rate. Since risk has been accounted for in the cash flows, the discount rate is simply quoted in risk-free rates.

4.0 Applying the DNPV Method

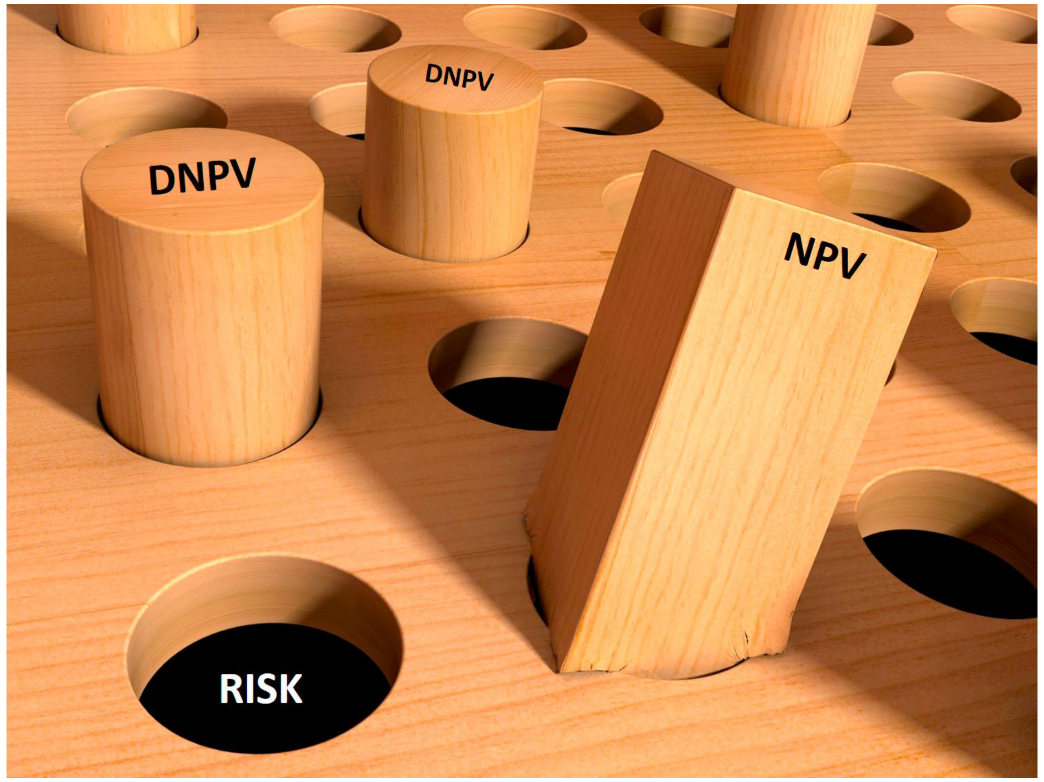
To illustrate the concept, an example application is presented in Table 3 in both NPV and DNPV terms. The example represents an initial capital expenditure (CAPEX) of $110M at a coastal industrial facility that would generate $25M of annual revenues with an annual operating expenditure (OPEX) of $10M (in today's dollars), resulting in a net $15M of annual revenues for a period of 40 years. Without losing generality, it is assumed that climate change induced flooding is the only risk that may affect this investment with an estimated annual probability of occurrence of 4%. For this investment, it is assumed that the opportunity cost of capital is 5%. The corresponding NPV for the cash flows is $147.4M (Line F). Let's assume that the manager has the option to make the facility more resilient by investing an additional CAPEX of $10M (increasing CAPEX in Line D to $120M) to avoid potential $60M losses due to asset damages and production loss in the event of a flood. As indicated above, traditional DCF cannot account for the contingent liability. Thus, making the additional investment of $10M would reduce the NPV to $137.4M. Under DNPV, the $60M contingent liability can be taken into account as an annual cost of risk of $2.4M (4%x60M) which is included in the cash flow as a cost (Line G). Because risk is taken into account in this manner, the

YEAR	0	1	2	3	4	10	20	40
A. Revenue (millions)		$25	$25	$25	$25	$25	$25	$25
B. OpEx (millions)		$10	$10	$10	$10	$10	$10	$10
C. Net revenues (millions)		$15	$15	$15	$15	$15	$15	$15
D. CapEx (millions)	$110.0							
E. Cash Flows (millions)	-$110.0	$15	$15	$15	$15	$15	$15	$15
F. NPV (5%)	$147.39							
G. Climate Risk		$2.4	$2.4	$2.4	$2.4	$2.4	$2.4	$2.4
H. Decoupled Cash Flows	-$110.0	$12.6	$12.6	$12.6	$12.6	$12.6	$12.6	$12.6
I. DNPV (1%)	$302.2							

resulting cash flows (Line H) can be discounted using a risk-free rate. The risk-free rate was selected from the information obtained for 30-yr treasuries (quoted at 2.4%). Because cash flows are in real terms (today's dollars), the real discount (i.e., net of inflation) is approximately 1%. The DNPV for the facility without climate change resilient features is $302.2. If the $10M is invested, the annual $2.4M liability (Line G) can be removed from the cash flows resulting in a DNPV of $370.7. As shown in this simple example, the mechanics of the DNPV method is relatively straight forward and easy to implement.

5.0 Discussion

Unfortunately, because DCF is deceptively simple, it remains popular. For instance, very recent methodologies put forward to assess carbon emission savings and monetize the social benefits (and costs) across time are based upon DCF techniques[20]. Hence, artful persuasion and well-designed implementation paths will be needed to address expected resistance to new ideas such as DNPV and facilitate their acceptance and widespread use by private, public, and non-profit institutions[21]. Moving away from well-established practices takes significant time and effort, particularly when existing methodologies are simpler and expedient, easy to communicate to decision makers, and so deeply rooted as to be included in public policy. In addition, when the very sectors of the economy who would need to lead the drive to change benefit from the status-quo, they cannot be counted on to champion the adoption of disruptive ideas. However, due in no small part to global risks threat, a significant effort must be directed towards addressing the issue of discounting at least to evaluate public investments.



The benefits of adopting DNPV are listed below.

1. DNPV can consistently correlate investments in resilience with reductions in climate change risk and assess the effect of adopting such measures.
2. The adoption of DNPV as a valuation framework to perform cost benefit analysis would foster data collection, standardization of risk quantification, and analysis of the effect of physical risks on investment performance.
3. Because DNPV requires explicit quantification of physical risks in monetary terms, its adoption can facilitate disclosure transparency of long-term liabilities (e.g., climate change) by publicly traded companies.
4. Performing cost benefit analysis of long-term multigenerational projects funded with public monies using government-mandated discount rates would no longer be required.
5. Projects partially/fully funded by private capital through public-private-partnerships would be compensated for risks actually taken.

6.0 Conclusion

Continued use of standard financial analysis such as DCF that is predicated on discounting the future tends to portray investments in sustainability, which typically offer long-term payback periods, as a philanthropic endeavor performed to enhance corporate social responsibility rather than as a strategic investment. By pivoting to a robust valuation method such as DNPV that can handle ever-changing risks and integrate them into financial analysis in a consistent and transparent manner, long-term projects with far-sighted objectives could finally be evaluated on an equal footing with short-term opportunities. Benefits abound, including enabling project developers and planners to promote desperately needed investments in resilience, adaptation , and mitigation measures to safeguard essential public and private assets. This could go a long way toward offering future generations the chance of inheriting a livable planet.

Because DNPV requires explicit quantification of physical risks in monetary terms, its adoption by publicly traded companies could facilitate more transparent disclosure of long-term liabilities such as climate change impact vulnerability.

References:

1. Lind R (1982). A primer on the major issues relating to the discount rate for evaluating national energy options. In: Lind R, Arrow K, Corey GR (eds) Discounting for time and risk in energy policy. John Hopkins University Press, Baltimore.
2. Dietz S., Bowen A., Dixon C., Gradwell, P. (2016). Climate value at risk of global financial assets. Nature Climate Change, 6, 676-679
3. Field C.B., Barros V., Stocker T.F., Dahe, Q. (Eds.) (2012). Managing the risks of extreme events and disasters to advance climate change adaptation. Special report of the Intergovernmental Panel on Climate Change. Cambridge University Press, UK
4. NIBS (2017). Mitigation Saves. National Institute for Building Sciences.
5. Antia M., Pantzalis C., Park J.C. (2010). CEO decision horizon and firm performance: An empirical investigation. Corporate Finance, 16, 288-301
6. World Economic Forum (2011). The future of long term investing (http://bit.ly/2axhxf4)
7. Bank of England (2015). Breaking the tragedy of the horizon – climate change and financial stability. Speech given by Mark Carney, Governor of the Bank of England to Lloyd's of London, UK, 29 September. Video available at: http://bit.ly/2aaFiXV
8. Cifuentes A., Espinoza D. (2016). Infrastructure investment and the peril of discounted cash flow. Financial Times, 3 November
9. USEPA (1996). The role of cost in the superfund remedy selection process. Publication EPA 540/F-96/018, pp. 1-8
10. eckhauser R.J. and Viscusi, W.K. (2008). "Discounting Dilemmas: Editors' Introduction." Journal of Risk and Uncertainty, 37(2-3), 95-106
11. Klausner M. (2003). When time isn't money. Stanford Social Innovative Review, 1, 1, 50-59.
12. Thomä J., Weber C., Dupré S, and Navqi M. (2015). The long-term risk signal valley of death: Exploring the tragedy of the horizon. Project briefing note – November 2015, 2° Investing Initiative and Generation Foundation, New York NY, USA (http://bit.ly/2awMDF5)
13. Bloomberg, M. (2016). Phase I Report of the Task Force on Climate-Related Disclosures. Financial Stability Board, Bank for International Settlement, Basel, Switzerland (http://bit.ly/2g9AHgn)
14. Irwin E.G., Culligan P.J., Fischer-Kowalski M., Law K.L., Murtugudde M., Pfirman S. (2018). Bridging barriers to advance global sustainability. Nature Sustainability, 1, 324-326
15. Kirk S. (2018). Transparency vital in assessing the risk posed by climate change. Financial Times, 27 Jun
16. Hill AC, Mason D, Potter JR, Hellmuth M, Ayyub BM, Baker JW (2019). Ready for Tomorrow: Seven Strategies for Climate-Resilient Infrastructure. Hoover Institution.
17. Peters O. (2019). The ergodicity problem in Economics. Nature Physics: Perspective. Vol 15, 1216-1221
18. Espinoza D., Morris J.W.F. (2013) Decoupled NPV: A simple, improved method to value infrastructure investments. Construction Management and Economics, 31, 471–496
19. Espinoza D., Morris J., Baroud H., Bisogno M., Cifuentes A., Gentzoglanis A., Luccioni L., Rojo J., Vahedifard F. (2019). The Role of Traditional Discounted Cash Flows in the Tragedy of the Horizon: Another Inconvenient Truth. Mitigation and Adaptation Strategies for Global Change. https://doi.org/10.1007/s11027-019-09884-3

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