The Role of Traditional Discounted Cash Flows in the Tragedy of the Horizon: Another Inconvenient Truth

As the effect of climate change on physical assets and infrastructures become of increased concern, there is growing awareness among owners and investors alike that traditional valuation methods based on discounted cash flows cannot properly account for climate-related risks when assessing long-term investments. This paper discusses how traditional valuation methods exacerbate misaligned investment horizons and how this might lead to significant underinvestment in projects that could foster resilience and adaptation. In this regard, the decoupled net present value (DNPV) method is introduced as an alternative approach that can consistently translate technical assessment of physical risks into financial terms by quantifying in monetary terms the potential exposure of assets to climate-related hazards.

Worldwide economic losses from extreme weather events have increased steadily since the 1980s and now sit at a staggering \$150-\$200 billion annually (Tanner et al., 2015), making an ever more compelling case for investments that "build-in" resilience, and help enhance ex-ante disaster reduction management. There is broad consensus among the scientific and regulatory communities that the physical impacts of climate change will increase the risk of losses in coming decades (Field et al., 2012). The impact of climate change on asset values under "business as-usual" scenarios could result in write downs on the order of 16.9% of the global financial assets according to some estimates (Dietz et al, 2016). As such, investment in low-carbon climate resilient (LCR) infrastructure and deployment of capital to develop adaptive capacity and reduce climate risk exposure will be critical to the sustainability of both the private and public sectors. This has been recognized for some time by national and subnational governments interested in better quantifying the vulnerability of key infrastructure to climate change impacts and developing strategies for improving resilience. Multilateral lenders have also increased their focus on promoting environmental sustainability and LCR infrastructure, as exemplified by the Inter-American Development Bank's Emerging and Sustainable Cities Program (Bouskela et al., 2016). Similarly, there is evidence of increasing awareness within the investment community of the potential risks posed by climate change and the need for more sustainable investment practices (e.g., Generation, 2012; Bloomberg, 2016; Thomä et al., 2016). Financing needs are high: Schub et al. (2106), for example, estimate that annual investment in new and retrofitted LCR infrastructure should be on the order of \$6 trillion.

Currently, a large majority of decision makers rely on estimates of discounted cash flows (DCF) to establish the financial viability of a long-term investment. At the heart of DCF techniques is the selection (not the estimation) of a discount rate (α) to calculate the "appropriate" discount factors as a function of time $(1+\alpha)^{-t}$ such that future revenues and costs can be discounted by these factors to express their values in today's currency. The main characteristic of this rather expedient functional relationship between the parameter α and time is that calculated discount factors are extremely sensitive to this parameter and increases rapidly as time increases. The discount rate, typically used as a proxy for risk, commingles the time value of money (represented by the risk-free rate) with project risk. Because of the exponential characteristic of the discount factor function, selecting a constant discount rate based on heuristic arguments and rules of thumb independent of project risks and the investment horizon introduces a time bias effect in the calculated DCF (i.e., short-term revenues and costs are overemphasized whereas long-term assets and liabilities are downplayed). The bigger the selected discount rate, the higher the bias.

In a speech to Lloyd's of London, the Governor of the Bank of England (BoE) Mark Carney warned that the catastrophic impact of climate change will be felt well beyond the typical horizon of investment and political cycles, imposing a cost on future generations that the current generation (community and decision makers alike) has little incentive to avoid (BoE, 2015). He referred to this issue as "The tragedy of the horizon." This problem is accentuated by the use of DCF to evaluate long-term investment opportunities because of the time bias effect described above. Although the deleterious and potentially catastrophic effects of climate change in key sectors of the economy (e.g., energy, water, transportation, agriculture) have further accentuated the need to adopt longer-term investment strategies, stakeholders with shorter investment horizons yet outsized influence (Figure 1) more often than not adopt myopic investment strategies suitable to their horizons and tend to select projects offering faster returns (political and/or financial) over those that would increase long-term stakeholders' value (Lundstrum, 2002; Antia et al., 2010; World Economic Forum, 2011). And they do so without a clear understanding of the embedded, and often accumulating, risks within their investments.

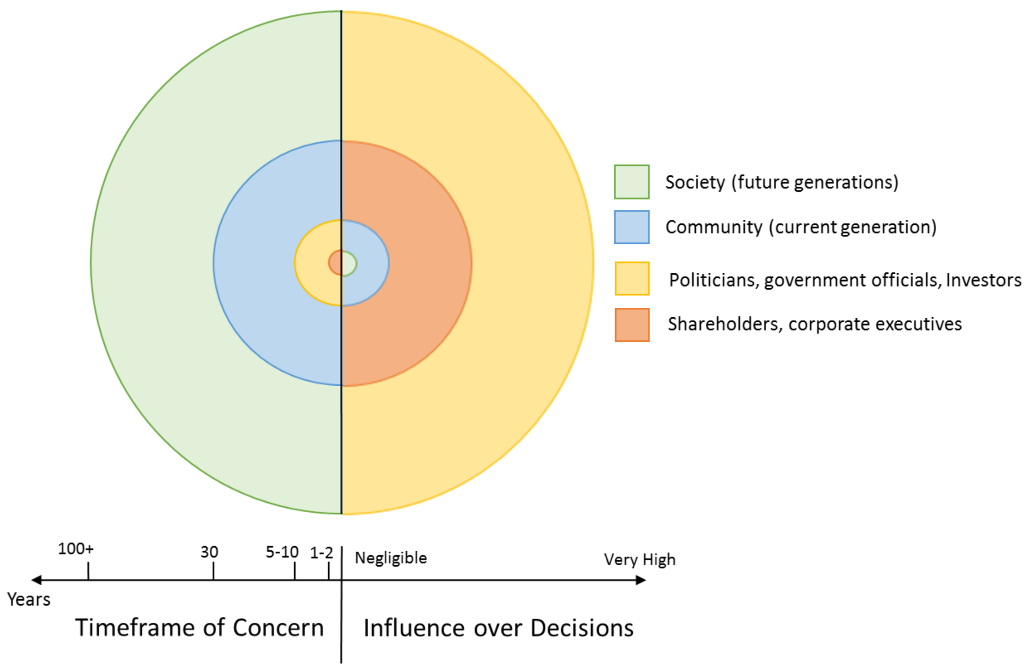

Figure 1: The Tragedy of the Horizon: Stakeholders and Impacts

The widespread practice of accounting for risks in the discount rate masks their effects on investment performance, which makes it difficult for stakeholders to attain a good understanding of the impact of risk management measures on financial performance. As a result, to finance long-term projects, investors may seek large compensation disproportionate to actual project risk, which will either continue to increase income inequality or stifle the flow of capital to much-needed long-term investments to protect existing and future physical assets, including investment in climate change resilience and adaption. This practice can lead to misallocation of risk (and unfair compensation) amongst the existing and future stakeholders. Future generations are most vulnerable because they have no influence over today's investment decisions (Figure 1) yet stand to inherit the impacts thereof.

The economic impact of neglecting climate change may disproportionally affect communities that can least afford it, thereby increasing inequality (Stiglitz and Stern, 2015). Due to the inability of existing financial tools to address the time bias effect introduced by standard DCF models, a different risk quantification framework is needed to evaluate potential suboptimal capital allocations for long-term climate adaptation and resilience measures. However, adopting a long-term investment mentality will require a departure from the practice of using standard DCF methods along with a prescribed constant risk adjusted discount rates (Cifuentes and Espinoza, 2016).

The limitations of DCF has been known for over 60 years (Robichek and Myers, 1966) and several alternatives methods (e.g., Sick, 1988; Carmichael et al 2011; Hawas and Cifuentes, 2016) have been proposed that include certainty equivalent (CE) concepts, real options valuation, and stochastic cash flow analysis, among others. Nevertheless, because of its simplicity, DCF remains at the core of most popular valuation methods. 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 as public policy. In addition, sectors of the economy that currently benefit from the status quo cannot be counted on to support adoption of disruptive ideas. Hence, artful persuasion and well-designed implementation paths will be needed to address typical natural resistance to new ideas and facilitate their acceptance and widespread use (Sinfield and Solis, 2016). Fortunately, due in no small part to the climate change threat, a significant effort has been directed towards addressing the issue of discounting.

Pivot to an Alternative Risk Quantification Framework

<u>Risk Monetization</u>

A better approach to DCF would be to use a valuation method that translate all sources of risks (including climate change risk) into financial terms in a systematic and consistent manner. One such approach is the decoupled net present value (DNPV) method introduced to value long-term infrastructure investments (Espinoza and Morris, 2013; Espinoza 2014). The method separates risk from the time value of money and facilitates the evaluation of the effect of each source of risk (market and non-market) at different times. DNPV introduces the cost of risk concept which considers risks as additional cost items to the project (see Methods). In simple terms, the cost of risk can be thought of as the price to protect an investor against individually identified risks. Considering risks as costs to the project is a natural progression from the conventional business practice of buying insurance (or hedging) products to obtain protection against certain risks. Under DNPV, independent of its source, each risk has a cost which is considered "real" to the project and, if assumed by project investors, represents their compensation bearing for such risks.

The DNPV method is not only simple and intuitive but also flexible, consistent, and robust in that it allows investors and project sponsors to explicitly model and quantify risk in financial terms that can be included in a balance sheet in a manner familiar to those already well versed in DCF methods. On any project, risks are classified within two main groups: **Revenue Risk** (defined as obtaining lower revenues than expected), and/or **Expenditure Risk** (defined as incurring higher costs than originally expected). There may be multiple contributory sources to these risk categories, each of which depend on the particular project under consideration. For example, merchant hydropower plants can be subjected to commodity risk (e.g., energy spot prices), foreign exchange risk, temporary shutdown risk (e.g., labor strike), permanent shutdown risk (e.g., expropriation), or contingency risk affecting energy output (e.g., extreme drought or earthquake-related damage). Illustrative examples of DPNV applications for renewable energy investments are provided by Espinoza and Rojo (2015) and Humpert (2016).

<u>The Advantages of Risk Monetization</u>

The strength of DNPV analysis is that by identifying and monetizing individual components of risk there is no need to prescribe a discount rate (other than the typically quoted risk-free rate). Nonetheless, to convey the results of an analysis in a simple manner using a terminology familiar to decision makers and stakeholders alike, DNPV can be used to back-calculate an equivalent discount rate as a function of investment period and identified risks which can then be compared to investors' hurdle rates. Examples of how equivalent discount rates can be calculated for specific cases are presented below (see Methods).

The primary benefits of quantifying risk in financial terms are threefold. First, investors and project sponsors can profit from technical experts (e.g., engineers and scientists) and adopt appropriate risk management measures (i.e., avoid, reduce, mitigate, transfer, or retain each identified risk). Second, after assigning risks to their "most rightful" owners, project risk profiles can be reassessed. Finally, the effect of resilience and adaptation measures on the return on investments can be assessed in an objective manner (see Methods). Use of a valuation method such as DNPV that requires project-specific risk quantification will, by its nature, also foster better data collection for a variety of risk drivers, thereby improving the accuracy of the method and the development of effective risk management measures over the long term.

<u>Declining Discount Rates</u>

The proposed DNPV can be also used as an alternative to prescribed declining discount rates (DDR) which have been suggested as a simple mechanism to reduce the dramatic effects of exponential discounting (Weitzman, 2001; Groom et al, 2007; Arrow et al., 2013). Several government is developed countries (e.g., the United Kingdom, France, and Norway) have adopted policies that require use of a prescriptive DDR approach to perform long-term cost/benefit analyses (CBA) for public projects, in particular those implemented to reduce greenhouse effects (Cropper et al., 2014). Some DDR examples are provided in Table 1 (see Methods). The United States does not recommend a DDR, although the federal Office of Management and Budget (OMB) acknowledges that CBA of public investments having intergenerational effects cannot be evaluated using only their recommended investment-based 7% discount rate given by the real pre-tax average return on U.S. markets but should also consider the consumption-based 3% discount rate given by the real average rate of return on U.S. treasury bonds (OMB, 2003). The U.S. Environmental Protection Agency (EPA) also recommends the use of the lower discount rate when performing long-term CBA of environmental policies (EPA, 2010). The EPA is reportedly considering the use of a DDR for use in CBA for public investments, although there appears no clear consensus on the appropriate prescriptive term structure (Freeman et al., 2013).

Although the adoption of a DDR approach as national policy could benefit projects fully financed by public funds, the impact of such policies would be limited as capital intensive infrastructure are increasingly funded by private investors through public/private partnerships (PPPs). Moreover, the widespread practice of arbitrarily increasing discount rates to account for additional risk (real or perceived) would make it difficult for DDR to be readily adopted by the private sector. The proposed DNPV method can be used to back-calculate project-specific discount rates for long-term projects and demonstrate how this parameter decreases with time (see Methods).

Beyond Discounting: What about Reserves and Disclosure?

A byproduct of the use of DNPV along with monetization of risks is that its adoption would foster more transparent disclosure of long-term liabilities associated with routine and non-routine natural and man-made hazards. This would ensure sufficient funds are available to provide annual uninterrupted operations and maintenance (O&M) including routine hazards and have sufficient coverage to respond to potential non-routine hazards (i.e., contingent liabilities). Each identified risk could be appropriately described in contract documents and specific responsibilities assigned in case the event takes place, which would represent a tangible improvement over current practices. For example, in accordance with Generally Accepted Accounting Procedures (GAAP) in the United States, only "probable and estimable" environmental liabilities are generally accounted for and reported in the financial statements of publicly-traded companies (Gauthier, 2005). Because individual project risks are not explicitly accounted for in a DCF evaluation, rather than using probability theory to describe the likelihood of future potential events based on industry data and/or expert opinions, loosely defined categories of likelihood (e.g., "probable", "reasonably possible", and "remote") are typically introduced for contingent liabilities. Specific guidance on the precise meaning of these terms is generally lacking: for example, while probable events are commonly considered to have a 50% or higher chance of occurring (Schiff et al., 2012), this description has been applied for financial disclosure purposes to events with a 70-80% chance of occurring (Everett-Garcia, 2013). Similarly, remote or rare events are generally considered to have a less than 10% chance of occurring (Everett-Garcia, 2013). Although the probability of a rare event (e.g., 100-year storm) occurring in any given year may be remote, the probability of such an event taking place increases over the life of an investment. Furthermore, accruals for future liabilities are constrained by the introduction of another hard-to-quantify concept: "reasonably estimable." If it is deemed that a liability cannot be reasonably estimated, then accruals to cover its occurrence are not specifically required. Under this practice, it is not difficult to envision that financial reserves to address difficult-to-define liabilities associated with GAAP's "improbable" or "inestimable" events such as those of climate change will be insufficient, despite the high statistical likelihood of their occurrence sometime in the future when a long time horizon is considered. While proper disclosing and accounting for long-term liabilities is a step in the right direction, this will be insufficient unless appropriate reserves are also set aside. For cases where such events bankrupt the original owner of the liability, future generations within affected communities will be left to bear the burden.

Reasons for Optimism

Fortunately, the investment community is becoming increasingly aware of the risks and opportunities associated with climate change. For instance, a number of Green Investment Banks (GIBs) have been created to finance global LCR infrastructure projects (Schub et al., 2016). Similarly, a coalition of private investors, climate experts, and stakeholders (better known as the Global Adaptation and Resilience Investment Group - GARI) was created after the Paris COP21 conference to focus on how to practically invest in the face of climate adaptation and resilience needs (Koh et al., 2016). Likewise, the Financial Stability Board of the Bank for International Settlements in Basel, Switzerland established a Task Force on Climate-Related Financial Disclosures (TCFD) to provide leadership in investigating efficient ways to voluntarily disclose long-term climate-related risks and promoting better informed investing, lending, and insurance underwriting (Bloomberg, 2016). Furthermore, the Willis-led disaster resilience 1-in-100 Initiative supported by the United Nations seeks to bring together public and private organizations to integrate natural disaster risk into the financial system, as well as stimulate and reward climate resilience investments (United Nations, 2014). The success of these efforts, combined with the availability of DNPV (or other appropriate tools) that can integrate market and non-market risk, may lead to non-financial industries (e.g., energy, mining, oil and gas, or transportation) following suit in including very long-term (climate and non-climate related) liabilities in their investment evaluation process.

The threat posed by climate change on existing and proposed infrastructure investments in developed as well as emerging economies has clearly galvanized the interest of public and private institutions in both the for-profit and non-profit sectors to develop solutions that can improve the resilience of such investments. Such solutions will require a multidisciplinary approach with technical experts from a wide range of disciplines, including climate change, engineering, economics, finance, and social policy. Although the cost to increase resilience and promote adaptation may be significant, the risk of inaction may be devastating and ultimately far more costly for future generations. Fortunately, increasing awareness within the investment community of the potential impacts of climate change on long-term investments, coupled with their efforts to promote voluntary disclosure of liabilities, gives society at large reasons to be optimistic. In that regard, the proposed DNPV method can be used to develop tools that allow investors to assess the effect on return on investment of adopting climate change resilience and adaptation measures. Although pivoting to more appropriate valuation methods along with supporting disclosure practices may take significant time and effort to implement, there appears to be tangible willingness on the part of all involved to begin to take action to tackle the tragedy of the horizon.

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Methods: The Risk-as-a-Cost Concept

The DNPV of cash flows computed over a single period T is simply defined as the riskless revenue (i.e., expected revenues, $\tilde{V}$, minus the cost of the revenue risk, R_v) minus the riskless expenditures (i.e., expected expenditures, $\tilde{X}$, minus the cost of the expenditure risk, R_x) discounted at the risk-free rate (r) as follows:

$$DPNV = \frac{(\tilde{V} - R_v) - (\tilde{X} + R_x)}{(1+r)^T} \quad (1)$$

Because the risks associated with the project are directly accounted for, the riskless cash flows (i.e., expected riskless revenues minus expected riskless expenditures) can then be discounted using term appropriate risk-free rates[1]. It follows from Equation (1) that revenue risk makes riskless revenues smaller whereas expenditure risk makes riskless expenditures higher. The cost of revenue and/or expenditure risks can be derived from information regarding revenue and/or expenditure distributions, respectively (Figure 2). Hence, as in the case of financial options, the cost of risk can be considered as financial derivatives obtained from its parent distribution. In fact, Carmichael (2011) showed that call options can be represented by R_X in Figure 2b.

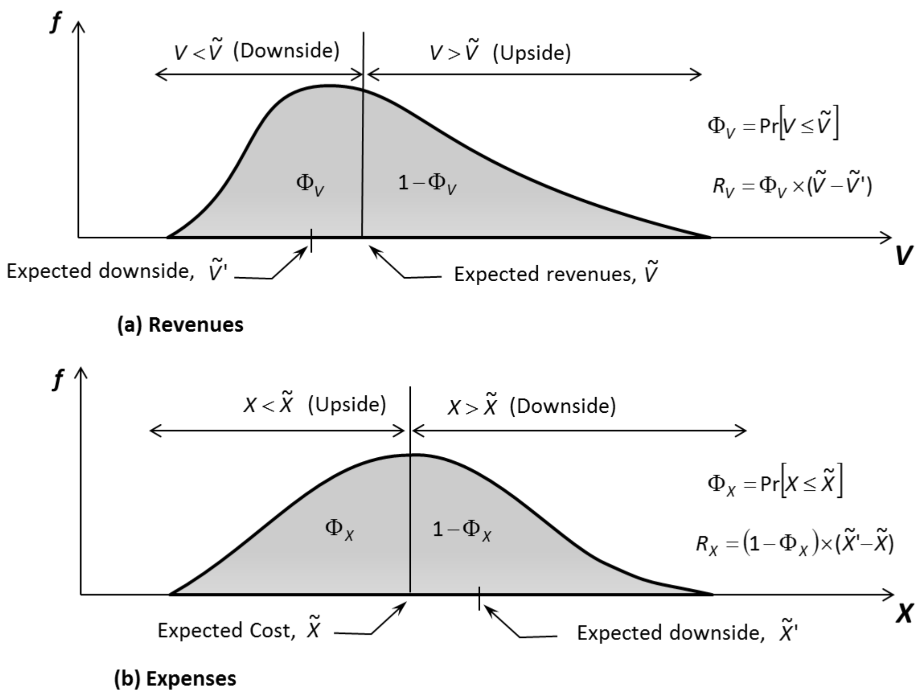


Figure 2 – The Cost of Risk

[1] The magnitude of the risk-free rate depends upon the maturity of government securities. In general, the risk-free rate increases with longer maturities.

The validity of the risk-as-a-cost concept for traded securities is demonstrated by constructing a hypothetical protective put strategy applied to the S&P500 composite price index (SPX). This strategy, referred to as the DNPV500, consists of a long position indexed to the SPX and a short position of monthly at-the-money put options calculated using the volatility index (VIX) published by the Chicago Board Exchange that measures the implied monthly market volatility. The DNPV500 represents the return of the protective put strategy (Figure 3). The values of DNPV500 is calculated as:

$$DPNV500_t = DNPV500_{t-1}\left(1-\frac{P_t}{SPX_t}\right)\left(1+Ln\left[\frac{SPX_t}{SPX_{t-1}}\right]\right)+P_t^f \qquad (2)$$

where P_t is the monthly at-the-money put options calculated using VIX along with Black and Scholes equations; P_t^f is the actual value of the put option at the end of the month. As shown by equation (2), the funds available for purchasing one SPX unit at the beginning of each period are reduced by the amount needed to purchase a put option (i.e., the hedging instrument) to protect the hypothetical investor against a market downside for the selected period. In this case, the put option is viewed as a proxy for the cost of market risk. As shown in Figure 3, this investment strategy, on average, over many trading periods, yields the approximate return of a three-year T bill.

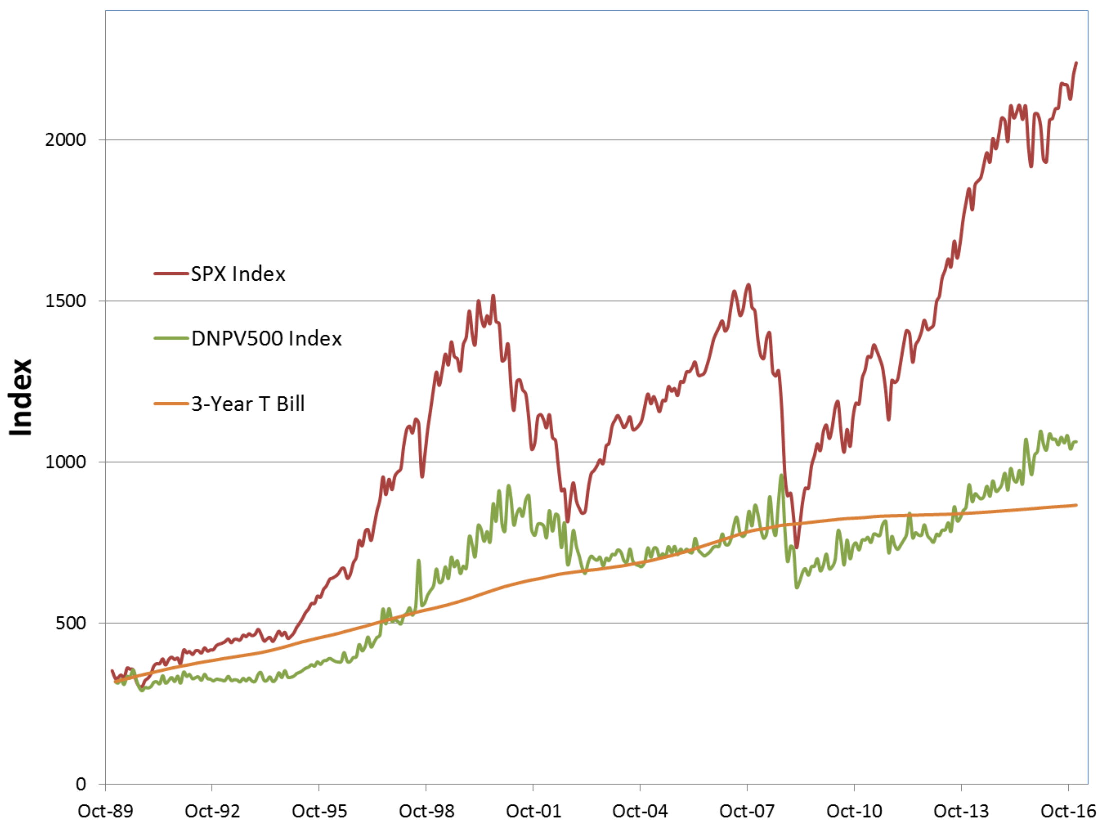


Figure 3: Return on a protective put for SPX

It follows from equation (1) that the future value of a traded security minus its cost of risk discounted at the risk free rate should be equal to the price of the security (X_o). Thus, the value of X_o can be calculated from Equation (3):

$$X_o = \frac{(\tilde{V} - R_V)}{(1+r)^T} \tag{3}$$

Then, the value of the security at the end of the period of investment T should be equal to the future value of the initial investment, $\tilde{X} = X_o(1+r)^T$, plus the future value of the cost of risk (i.e., a European put option with an exercise price equal to $\tilde{X}$ that is that is, $R_V = R_{V/o}(1+r)^T$, where $R_{V/o}$ is the value at of the option at the beginning of the investment period.

$$\tilde{V} = X_o(1+r)^T + R_V = \left(X_o + R_{V/o}\right)(1+r)^T \approx \left(X_o + R_{V/o}\right)e^{rT} \tag{4}$$

The future value $\tilde{V}$ can be expressed as a function of an equivalent risk adjusted discount rate (α) as $\tilde{V} = X_o e^{\alpha T}$. Thus, to maintain equality with the equation above, α would be equal to:

$$\alpha = r + \left(\frac{1}{T}\right)\ln\left(1 + \frac{R_{V/o}}{\tilde{X}_o}\right) \tag{5}$$

Assuming that the stochastic process that describes the US equities follows a geometric Brownian motion (GBM) with the historical annual volatility of 14.9% and an estimated average real short term risk-free interest rate equal to 1.5%, the Black and Scholes equation can be used to estimate at-the-money put options for multiple investment horizons. Using equation (5), values of equivalent risk adjusted discount rates for T = 0.5, 1, 5, 30, 75, 125, 200, and 300 years were calculated as $\alpha =$ 9.7%, 7.3%, 4.0%, 2.4%, 2.0%, 1.9%, 1.8%, and 1.7%, respectively. For interest, these calculated values are interpolated and compared to some DDR recommendations in Table 1.

It follows from above that the back-calculated discount rate decreases with time. Although the decline implies that risk decreases with investment horizon (based on the value of the at-the-money long-term put options) and thus investors with long-term horizons should be satisfied with lower returns, empirical market data indicates that the average real rate of return in the US market is about 7%. This suggests that the average investor in the U.S. market focuses on the immediate (1-2 year) term regardless of their actual investment horizon. However, in order to sustainably invest in long-term projects, returns should not be compared to the average real return on investments in the U.S. market but estimated based on monetization of actual project risk.

Table 1: Potential term structures for long-term investment valuation

<table>
<tr><th rowspan="2">Horizon Range[1] (Years)</th><th rowspan="2">Horizon Label[1]</th><th colspan="3">Recommended Declining Discount Rate (DDR)</th><th rowspan="2">Equivalent DNPV-derived Constant Discount Rate[2,3]</th></tr>
<tr><th>Weitzman (2001)</th><th>France (cit. in Cropper et al., 2014)</th><th>United Kingdom (cit. in Cropper et al., 2014)</th></tr>
<tr><td>0-5</td><td>Immediate</td><td>4%</td><td>4%</td><td>3.5%</td><td>6.5%</td></tr>
<tr><td>5-30</td><td>Near</td><td>3%</td><td>2%</td><td>3.5%</td><td>3.2%</td></tr>
<tr><td>30-75</td><td>Medium</td><td>2%</td><td>2%</td><td>3.0%</td><td>2.2%</td></tr>
<tr><td>75-125</td><td rowspan="3">Distant</td><td rowspan="3">1%</td><td rowspan="3">2%</td><td>2.5%</td><td>1.9%</td></tr>
<tr><td>125-200</td><td>2.0%</td><td>1.8%</td></tr>
<tr><td>200-300</td><td>1.5%</td><td>1.7%</td></tr>
<tr><td>>>300</td><td>Far-Distant</td><td>0%</td><td>2%</td><td>1.0%</td><td>1.5%</td></tr>
</table>

Notes:

1) Horizon ranges and labels derived from Weitzman (2001), wherein the range identified as "distant" spans 75 to 300 years.
2) Back-calculated real discount rate for the average of the defined horizons assuming U.S. market risk only. DNPV-derived discount rates are provided herein for illustration only and are not recommended for application.
3) **These values are included to illustrate how monetized risk could be correlated to an equivalent discount rate using DNPV analysis. This paper does not advocate the adoption of an all-purpose prescriptive risk adjusted discount rate.**

Example

To further illustrate the application of DNPV, a simple hypothetical investment to develop a mine is evaluated. Assume an initial capital expenditure (CAPEX) of $150 million to develop the mine with annual production rate expected to generate $75 million per year over a 10 year period with operating expenses (OPEX) estimated at $33.8 million per year. Assume also that the annual risk-free discount rate (real) is constant at 1.5% and that the mineral price will follow a GBM[2] with an annual volatility of 14.9%. Because mining is a water intensive industry, to simplify the analysis, in addition to market risk (i.e., mineral price volatility), assume that the only physical risk is a 50% production reduction due to severe draught and that the probability of the draught such severe draught is 1 in 100 years (i.e., 1% per year). Under these assumptions, the cost of risk for market risk is simply the put option calculated using the Black and Scholes equation for years 1 through 10. The cost of risk for the physical risk identified (i.e., severe draught), as illustrated in Figure 4, is approximately 1% of revenues. The cash flow (CF) for this simple hypothetical example inclusive of these two risks is presented in Table 2. The DNPV for this investment is calculated by discounting the decoupled CF by the real risk free rate (i.e., 1.5%) and estimated at $185.4 million. For this specific example, the risk adjusted discount rate that would result in a NPV of $185.4 million would be 6.7%. Furthermore, if the risk of a severe draught increases from 1% to 5%, the cost of risk would increase to 4.875% of revenues and the DNPV would decrease by $14.5 million to $170.9 million. The risk adjusted discount rate that would result in a NPV of $170.9 million would be 7.6%. Based on this,

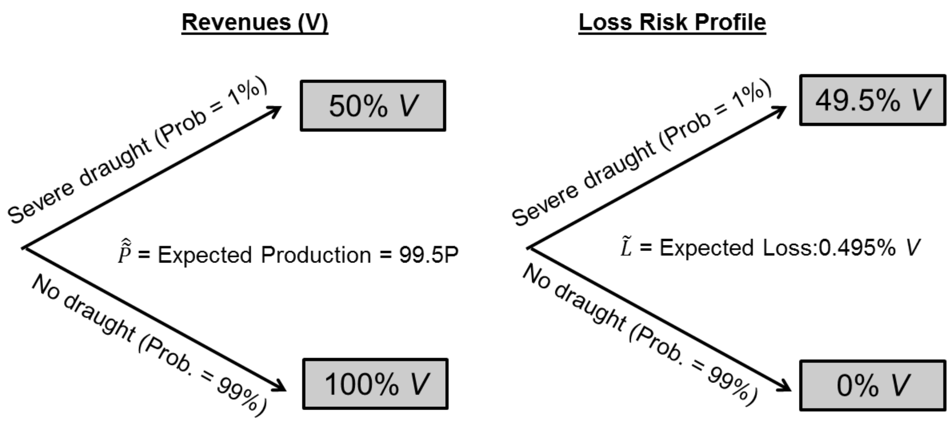
[2] Mineral prices are better represented by mean reverting stochastic processes. A GBM process is assumed for illustration purposes only.

investing in resilience or adaptation measures (e.g., increasing water storage capacity) that would reduce the risk of severe draught to the original 1% in lost productivity at a cost less than $14.5 million would be sensible.

This simple example illustrates how climate change risk can be incorporated in an investment analysis, how different risks can be integrated, and – more importantly – how investment in resilience could be incorporated in the decision making process. The example illustrated only two specific risks whereas in actuality multiple risks could impact productivity. Depending on the source of each of these risks and the availability of data to evaluate them, the cost of risk could be individually estimated for each using probabilistic/stochastic methods. These are based on probability density functions (PDFs) constructed from available data (e.g., weather data, empirical correlations), subjective industry-specific information obtained from technical experts, and/or option pricing techniques developed in the financial industry to estimate the risk of traded securities and commodities. By identifying individual components of risk that affect either revenues or costs, data can be compiled in a repository database in a manner more conducive to analysis using data analytics techniques. The data can later serve to improve estimates of the cost of similar risks.

Table 2 – Hypothetical Mining Example ($ millions)

Year	0	1	2	3	4	5	6	7	8	9	10
Revenues		$76.1	$77.3	$78.4	$79.6	$80.8	$82.0	$83.2	$84.5	$85.8	$87.0
OPEX		$33.8	$33.8	$33.8	$33.8	$33.8	$33.8	$33.8	$33.8	$33.8	$33.8
CAPEX	$150	-	-	-	-	-	-	-	-	-	-
Cash Flows	-$150	$42.4	$43.5	$44.7	$45.9	$47.0	$48.3	$49.5	$50.7	$52.0	$53.3
Cost of Risk											
Market		$4.5	$6.5	$8.1	$9.4	$10.7	$11.9	$13.0	$14.1	$15.2	$16.2
Production		$0.38	$0.38	$0.39	$0.40	$0.40	$0.41	$0.41	$0.42	$0.43	$0.43
Decoupled CF	-$150	$37.5	$36.7	$36.2	$36.0	$36.0	$35.0	$36.1	$36.2	$36.4	$36.7



R_V = Cost of risk = $\left(V - \tilde{V}\right) + \tilde{L} =$ 0.5%V+0.495%V = 0.995% V

Figure 4 – Cost of Physical Risk