Ending Accidental Time Bias

A new approach to evaluating risk/return trade-offs | April 2016

Pottinger

Synopsis

- Traditional discounted cash flow methods add a risk premium for risk and uncertainty. This emphasises the short term, leading to "accidental time bias", and accentuates perceptions of unacceptable risk/return trade-offs
- Pottinger's approach utilises advanced statistical techniques to quantify explicitly the effects of risk and uncertainties on all project outcomes, and allowing a full range of realistically likely outcomes to be assessed
- Explicit risk modelling allows us to use significantly lower discount rates (as used in conventional optional pricing techniques). Our approach thus avoids accidental time bias and provides a more complete risk/return picture
- This approach thus allows project proponents and investors to attribute proper value to the longer run impact of proposed investments, as well as to take proper account of long run downside risks
- As a result, more informed decisions can be made regarding overall project design, as well as in relation to optimisation of project funding and financing, and associated capital structures
- These methods also provide a more effective framework for assessing social impact, as projects that are beneficial for society frequently translate into economic and financial benefits over longer time horizons

1. Green finance: catalysing the transition to sustainability

Various B20/G20 processes have highlighted the importance of financing initiatives that will support long term growth. At the most fundamental level, these projects are enablers of long term restructuring of economies and industry sectors. Green finance, ie investment to support a transition to sustainability across all aspects of human endeavour, is just one example. Analogous challenges arise in other areas where short term investment is required to achieve long term outcomes. These include the funding, financing and delivery of large scale, long term infrastructure to support ongoing improvements in social prosperity and economic wellbeing.

Most green finance projects have one common feature. Typically the long run outcomes of the projects in question will be both economically and socially attractive, but the short to medium term economics (eg over the first 10 to 20 years) are unattractive. This is especially true for ultra-long run infrastructure, with a likely working life in excess of 100 years. The greater the proportion of up-front capital investment required for any particular project, the greater the likelihood that the risk/return trade-will be perceived as unattractive when judged through a traditional financial decision-making lens. This is a direct, albeit accidental, result of the mechanics of conventional financial decision-making methodologies, resulting in accidental time bias.

The fundamental challenge is thus to bridge the gap between perceived risks and longer run outcomes.

Many stakeholders cite "risk" as a key barrier to accessing private sector capital on sufficiently attractive terms to allow projects to proceed without some form of fiscal or financial intervention. Frequently stakeholders suggest some form of government guarantee as a solution to this problem. However this merely transfers risks from project proponents to society at large. From a government perspective, this is not a funding solution. It's simply a free ride. If properly accounted for, such guarantees will be recorded as liabilities on government balance sheets, demonstrating that this approach taken as a whole is a zero sum game.

Some stakeholders have called for changes in regulation to allow banks to commit long term funding to long term projects. However this would introduce substantial new risk into the banking system, as the large majority of bank funding is short term in nature. This risk would likely be

borne by governments, whether explicitly through national deposit insurance schemes, or indirectly, through implicit guarantees of banks “too big to fail”. Alternatively, the risk would be borne by depositors and would be crystallised in the event of a second bank sector crisis. Once again, this is thus not a solution to the risk/return trade-off problem, but is rather a transference of risk. More appropriate sources of long term capital include life insurers and pension schemes, where there is a better match between long term assets and liabilities. But these still faces challenges in assessing the appropriate balance between risk and return, particularly for green field projects.

2. Weak financial epistemology inhibits capital flows

To address these challenges properly, we need an “eyes open” approach to risk, rather than seeking to transfer risks to another stakeholder or to another time. Specifically, we need to address the root causes of perceived imbalances in risk/return trade-offs. This would result in a much more robust epistemology for financial decision-making – it is precisely the current weak epistemology which inhibits capital flows in relation to long term projects. In other words, we need to reframe how risk and return are assessed and judged.

Despite dramatic increases in financial decision-making sophistication and financial market regulation over the last thirty years, the last decade has seen dramatic economic and financial market disruption. So it is clear that current decision-making methodologies have inherent weaknesses. Meanwhile, disruptive innovators have been able to build extremely influential and profitable global businesses in the face of exceptionally powerful incumbents who had almost unlimited financial and human resources at their disposal. These are increasingly not exceptions: they prove that traditional financial decision-making methodologies and associated approaches to capital allocation are not working effectively (at least not when applied by incumbents).

This paper makes the case that current decision-making methodologies over-inflate perceptions of near term risk, and under-emphasise longer run outcomes. This accidental time bias results from flaws in current decision-making methodologies. It results in inefficient capital allocation, including capital structures that accentuate risk, as well as a requirement for disproportionately large risk premiums. Increasingly rapid change means that the financial impacts of these decisions are felt by investors relatively rapidly (within five to ten year time frames). Thus there are severe disadvantages for young people and future generations, with at best only limited benefits for older people. A complete analysis of these issues will be published later in 2016.

3. Deeper analysis can change perceptions of risk

One fundamental challenge with “green finance” is the perceived risk/return trade-off. Conventional project evaluation methodologies utilise discounted cash flow (“DCF”) valuations. Project assessment typically centres on a base case scenario, with a range of upside and downside scenarios considered. Frequently base case assumptions are cautious, in order to limit down-side risk. Overall project risk is taken into account through the application of a risk premium. As a result, nominal discount rates applied to green field projects are commonly 10% or higher.

This method places a high level of emphasis on the near term, typically the first ten years. The higher the perceived risks inherent in the project as a whole, the higher the discount rate applied. Hence a greater weighting is placed on near term cash flows (including up-front capital costs) and much less weighting is placed on long term financial outcomes.

As a result, medium term upside and downside option value is obscured. Longer term impacts (50 to 100 years hence) are often discounted entirely. We refer to this as accidental time bias. This is a direct result of how discounted cash flow valuations are computed, and in particular the amalgamation of all project risks into a single figure that is intended to represent an “appropriate premium for risk”.

A number of organisations have argued for much lower discount rates to be utilised, particularly in relation to projects that will have a very long life span. Infrastructure examples include hydro-electricity and heavy rail projects, and similar logic applies to initiatives such as re-configuration of energy networks and whole of industry restructuring.

An alternative approach is to extend conventional option valuation methods to infrastructure projects. These methods utilise cash discount rates (thus avoiding accidental time bias), and assess all possible outcomes

in a statistically robust manner. We provide a practical example of the benefits of this approach later in this paper. First, however, consider the intuitive social case for this approach.

4. Social perspective: Would you discount your family?

Green field infrastructure projects are commonly evaluated with nominal discount rates of 10% to 15% in developed economies, and even higher rates in higher growth countries. The human implications of this approach are hard to visualise. So consider nine generations – from your grandparents' grandparents through to your grandchildren's grandchildren. Even if life expectancies do not increase beyond 100 years, the last of these will live to around the year 2200. These are relatively close family members – you will know these people first or second hand. Between them the nine generations will span most of four centuries.

For nearly all of us, the first two generations will already have passed away. With some typical assumptions for longevity, the collective life expectancy of one representative from each of the remaining seven generations will be just under 400 person years. For a typical generation X-er, your own life might contribute roughly 10% of this total, and the subsequent four generations would account for roughly 20% each, ie a total of 80%. A parent and grandparent make up the remaining 10%.

Thus if each person's life was treated equally, there would be a significant emphasis on the longer term and on future generations. But what happens if you place a reducing emphasis on future years using the "rigour" of discounting? With a discount rate of 15%, the 400 years above are reduced to just 22 years and 7 months. Roughly two thirds of this total is accounted for by you and a child, and nearly all the rest represents the parent and grandparent. Thus virtually all the emphasis is placed on current generations, and over 80% of the "value" of these lives is attributed to the next ten years.

Great grandchildren and great great grandchildren don't get a look-in – if you are born after 2075, you just don't matter. Of course, when your own grand-parents were born, you yourself may have been one of these valueless descendants, a person to be born in a year more than 60 years from today who simply "has no value". This is the human impact of the accidental time bias that is baked into the conventional valuation methodologies that have driven most financial decision-making over the last thirty years.

5. Practical applications of this methodology

Conceptual solutions to this problem already exist. Option valuation methodologies are based on explicit evaluation of risk, and the use of cash discount rates. The use of much lower discount rates avoids accidental time bias. This is particularly true in the current environment, where interest rates are at 100 to 1,000+ year lows in a number of major economies. Meanwhile, explicit assessment of risks allows much more informed decisions to be taken in relation to how best to optimise project funding and financing, including implications for the capital structures to be employed.

There are, however, a number of particular challenges that must be addressed if this approach is to be applied effectively to major infrastructure projects:

- **A whole of life time approach:** It is essential for project outcomes to be assessed across the entire lifetime of the project, including outcomes over very long run (100 year plus) time horizons;
- **Objective risk evaluation:** Statistically robust approaches must be applied to identify and assess risk. Whilst the techniques to do this are long established, use of an empirical approach is directly contradictory to the common preference to rely on "judgement and experience". Such an approach can, however, help to address the systematic biases that are encountered in project estimates, including in relation to potential over-runs in initial capital costs[1];
- **Embracing uncertainty:** Comprehensive assessment of risk requires acceptance that there will be inherent uncertainty in the outcomes that are achieved. For each key project assumption, an appropriate distribution of outcomes will need to be identified, replacing reliance on an assessed base case assumption. This typically results in much wider ranges of potential outcomes being projected. Whilst much more realistic, this approach runs contrary to the preference of boards and cabinets for "certainty";
- **Systems thinking considerations:** In addition, there will frequently be second-order or knock-on effects of projects that will have a material impact on outcomes over the longer term. These may offset other assumptions thus delaying change, or alternatively may create inflection points which lead to accelerated change. Systems factors must be taken into account if project assessments are to be based on a realistic understanding of long run effects[2];
- **Matching risk and return:** The capital asset pricing model depends on matching project risks to benchmark listed companies, and using empirical methods to measure the correlation between the

[1] See for example Megaprojects and Risk: An Anatomy of Ambition, Flyvbjerg, Bruzelius and Rothengatter (2003) and The Long Term Starts Tomorrow, Nigel Lake (2013). [2]See for example All Models are Wrong: Reflections on Becoming A Systems Scientist, John D Sterman, Jay Wright Forrester Prize Lecture, 2002

returns achieved by peers and market returns. In practice, however, there are dramatic differences between observed returns over different time scales, making it hard to identify the appropriate implied risk premium with any confidence. This includes decade-long periods for which observed risk premiums are negative. More broadly, this approach does not necessarily allow objective differentiation between projects with materially different return profiles, particularly where project returns are largely or completely uncorrelated with the market and hence a beta of close to zero is applicable (ie very little risk premium is built in);

- **Allowing for residual risks:** Whilst the objective is to identify and assess all risks, residual risks are likely to remain, such as the potential for societal breakdown. One approach is to utilise a social time preference discount rate, which makes allowance for both pure time preference (resulting from ongoing increases in productivity) and catastrophe risk[3], although we note that this still results in relatively high real discount rates of around 3.5% (for the UK).

Pottinger has undertaken substantial research and development in this field over the last decade, leading to the development of solutions to the challenges identified above. These methods enable the explicit and detailed assessment of project risks, and apply granular option valuation methodologies to major projects.

We have developed a wide range of practical applications of these methods, including in relation to areas of particular relevance to this task force, such as major government-sponsored infrastructure projects, investment in the energy value chain (including both traditional and renewable power sources), the natural and mineral resources sectors and financial services.

For example, consider the assessment of major hydro-electricity projects. These offer access to zero-emission base-load renewable power over ultra long term time horizons, with extremely low ongoing marginal costs, but require substantial up front capital investment. The economics of such projects are often questionable, when judged via a conventional discounted cash flow evaluation, particularly if target rates of return of 10% or more are required. Nevertheless a number of major projects are under active consideration around the world. How can such projects be objectively compared to alternative energy sources such as solar PV, which may offer greater certainty during the expected life of the initial solar installation, but have a much shorter expected working life?

We have evaluated a number of such projects, and have observed that major hydro-electricity projects are subject to a variety of substantial, but quantifiable, risks:

- **Construction costs:** There is "overwhelming evidence that budgets are systematically biased below actual costs of large hydropower dams — excluding inflation, substantial debt servicing, environmental, and social costs"[4]. Nevertheless the extent and nature of such biases has been quantified, and explicit allowance can be made by building in construction cost distributions that reflect a realistic assessment of risk (eg with allowance for potential cost over-runs of up to approximately 600%);
- **Long term power price and demand outcomes:** Management teams are typically focussed on near to medium term energy price dynamics. Nevertheless long run data is available in relation to the cost of competing technologies, such as solar PV and battery storage. This shows costs are following reasonably well-defined Moore's Law curves, which can thus be used as base-lines for maximum likely long run power prices. Appropriate allowance must be made for floor effects, including maximum theoretical panel efficiency, the cost of input materials and potential resource supply constraints. Price downside risks must also be built in, for

[3]*See HM Treasury's The Green Book: Appraisal and Evaluation in Central Government, Appendix 6 – Discount Rate*
[4]*See Should We Build More Large Dams? The Actual Costs of Hydropower Megaproject Development, Ansar, Flyvbjerg, Budzier and Lunn, University of Oxford*

example from the advent of commercially viable new technologies, which must by definition result in further downward reductions in the cost of energy;
- **Long term operational risks:** Care is required in assessing potential long run risks, including both basis risks related to operational cost drivers (ie differences between cost inflators for operational costs and cost inflators for the cost of competing power sources), as well as capital risks (eg geological factors which may cause material damage to physical infrastructure, such as seismic activity and/or large scale floods). Empirical approaches will be possible where there is sufficient long run data; and
- **Systems considerations:** Long run price curves for renewable energy sources such as solar PV imply that power prices are likely to decline in real terms for a significant period. There are likely to be offsetting effects, however, as reduced power costs stimulate increased demand. One major example includes the likely material increase in the use of electricity to power consumer vehicles.

In the cases we have examined, the confluence of the above factors results in a significant majority of scenarios where the returns achieved are materially lower than the rates of return that would be required to compensate for such risks if a conventional discounted cash flow methodology was used. As a result, such projects would not proceed. Once all risks have been explicitly taken into account, however, projects should properly be assessed using lower cash discount rates. This materially reduces the perceived gap between project risk and likely project returns, and hence increases the chance that short term investment decisions will align with the most attractive long term outcomes.

In theory, the scenario identified as the statistical median by our methodology should correspond with the base case scenario in a traditional discounted cash flow methodology. Our approach is thus mathematically likely to result in a higher overall valuation for the project, effectively reflecting the benefits of quantifying uncertainty.

Importantly, the analysis typically demonstrates that a substantial element of downside risk can be mitigated through the capital structure adopted. In simple terms, utilising a high level of equity in the capital structure at the outset dramatically reduces the risk of project failure (and hence total loss of equity), at a cost of diluting median expected initial returns to equity. If early stage risks do not eventuate, the project can be progressively leveraged. Thus the overall negative impact on expected returns to equity of this approach is modest in upside cases, but downside risk is substantially reduced. This is highly relevant to projects where early revenues are hard to predict, such as major green field road or rail projects.

As noted above, there are practical challenges with both the quantification of risk and in how that riskiness is translated into decision-making information for governments and boards. This requires a complete mindset shift on the part of decision-makers. From a practical perspective, however, we have found that relevant stakeholders, including equity investors, debt providers and rating agencies have warmly welcomed this approach. In short, explicit evaluation of risk reduces project uncertainty, and hence reduces the rates of return that investors are prepared to accept.

In addition, comprehensive assessment of risks related to revenue sources allows low risk revenue streams to be identified. These can thus be separated out and utilised to underwrite private sector investment, dramatically reducing associated financing costs, including through better matching of risks with the stakeholders best able to manage such risks. As a result, the sum of the risk parts is thus typically worth more than the whole. In contrast, if all risks are lumped together, lowest common denominator effects apply. Investors seek higher overall returns that might otherwise be required, preventing otherwise viable projects from progressing.

6. Conclusions and recommendations

Traditional financial decision-making methodologies have significant inherent weaknesses. This includes accidental time bias, which obscures both upside and downside option value, and hence inhibits investment in projects that would otherwise deliver significant economic and benefits over the medium to long run. In addition, oversimplification of risk profiles, by reliance on a base case and a small number of often arbitrary upside and downside scenarios, impedes the identification of optimal capital structures, thus adding to risk.

Consequently, both corporate and government investors tend to favour projects that deliver attractive short to medium run outcomes, but which may lead to unattractive results over longer term time horizons compared to other projects. This is particularly true in relation to investments required to facilitate long term societal transition to new industrial paradigms. These challenges are further exacerbated by those stakeholders who are likely to resist change, ie the powerful and well-funded representatives of the status quo. One recent example is over-investment in fossil-fuel infrastructure and exploration and development of coal resources.

Both Government and private sector investors will benefit from adopting new project assessment methodologies that take proper account of upside and downside risks over longer time horizons. This includes utilising statistical methods to ensure more robust approach for measuring inherent risk over all time frames, and for making explicit allowance for such risks in financial decision-making. This represents a material enhancement to the "capital asset pricing model" – essentially 1950s financial technology that has remained in use with minimal refinement since it was first adopted in financial decision-making in the late 1980s and early 1990s.

In many cases, such an approach will also provide a mechanism to take into account factors typically considered "non financial", as often there are clear financial effects of positive social impact when measured over longer time frames. Thus such initiatives would not only promote financial inclusion by embracing technological innovation – they would also promote technological inclusion by embracing financial innovation. This will have direct, short term beneficial impacts for infrastructure development in general, and green finance in particular. P

About the author

Nigel Lake is co-founder and CEO of global advisory firm Pottinger and predictive analytics supply chain start-up Atomli. He is also a Senior Associate of the Cambridge University Institute for Sustainability Leadership. Nigel has a long background in the development and application of financial decision-making methodologies across most industry sectors. Early in his career, he led the development of specialist techniques for applying discounted cash flow methodologies to industries such as financial services and infrastructure at Barings, then the leading European investment bank. Nigel has advised hundreds of major companies and governments on M&A transactions worth several hundred billion dollars, as well as strategic transformations, large infrastructure projects and the application of big data analytics to boardroom decisions.