ESTIMATING THE COST OF CAPITAL FOR PPP CONTRACTS IN EMERGING MARKETS

Mark Hellowell, University of Edinburgh; and Veronica Vecchi, SDA Bocconi School of Management[1]

Introduction

This report outlines and explains a method for estimating the rate of return that is required by equity investors in PPP contracts in emerging markets. It is designed for policymakers, practitioners, and others involved in quantitative financial analysis (including budget appraisals, value for money analyses, and the negotiation of contract prices) in these markets. Our method is informed by a review of the theoretical and empirical literature on rate of return estimation. However we have sought to ensure that the method is consistent with the theoretical frameworks and practices that are *actually used* by firms active in relevant markets. For this reason, our method is informed by a survey of, and interviews with, experienced infrastructure investment professionals.

The funds used to invest in infrastructure projects have other potential uses in the economy. Therefore, holders of such funds will invest in a given project only if the return they expect to earn from doing so exceeds the market price of the risk involved (Sharpe 1964; Lintner 1965). Therefore, how the market perceives risk, and how it prices that risk, are fundamental issues that we must address is generating an estimate of the cost of capital.

Infrastructure PPPs are undertaken by Special Purpose Vehicles (henceforth, SPVs) that are financed with a mixture of debt and equity. The most uncertain element of the cost of capital, up to the point of financial close, is the cost of equity. We have, through our literature review and original research, sought to understand:

(i) how equity investors perceive the risk characteristics of PPPs, in terms of the probability and severity of the risks that they, as investors, are exposed to, and

[1] Research Assistant: Francesca Casalini, SDA Bocconi sSchool of Management

(ii) how these risks influence (or do not) the rate of return that investors require.

Our objective is to provide an approach to cost of capital estimation that is acceptable to all stakeholders whose interests may be affected by such estimates. In doing so, we intend to complement existing World Bank knowledge products and resources, which consistently point to the importance of quantitative financial analysis in the appraisal, procurement and regulation of PPP contracts (e.g. Farquharson et al. 2011; Shendy et al, 2015).

Our report is structured as follows. In section 1, we present the findings of our literature review and qualitative research, and explain how these have informed our theoretical framework. In Part 2, we present the framework in more detail, and set out the proposed method, variable by variable, and finally as a step-by-step guide to estimation. We also illustrate the method via a series of case studies, estimating key variables in specific markets, and covering economic and social infrastructure.

Part 1: Our theoretical approach

1.1 Data collection

Our starting point is a previous study by the current authors, in which corporate finance theories were applied to evaluate rates of return in three different ways, labelled the 'orthodox', 'opportunistic' and 'realist' approaches (Hellowell and Vecchi, 2012a). The previous study, and related works (e.g. Hellowell and Vecchi 2012b, Vecchi et al, 2010, Vecchi et al, 2013, Colla et al, 2015), focused on the expected return on the basis of different assumptions about the ways in which investors perceive and price risks.

In the current study, we revisit these assumptions by drawing on three key data sources – previous research on cost of capital estimation methods, a survey of the PPP investment industry, and interviews with key investment professionals in this market. Our results are triangulated across these sources in deriving the theoretical framework, methodology and case studies presented in section 2.

To inform the design of our research, we undertook two, linked, searches for relevant literature, focusing on:

(i) research on the application of formal mathematical models used by financial professionals in deriving appropriate rates of return in capital markets *in general*; and

(ii) research on the application of formal mathematical models used by financial professionals in deriving appropriate rates of return in *PPP markets in particular*.

Our survey of the industry was hosted on the website of the *Partnerships Bulletin*, a subscription-only trade journal that covers the international PPP market, and responses were received between April 3rd and April 14th 2017. We sought responses were sought from various parts of the infrastructure investment industry (including private equity firms, pension funds, infrastructure funds, commercial banks, multilateral/ national development banks, financial advisers, and operational investors). We also contacted relevant staff at specific firms, drawing on information held by *the Bulletin*, and asked them to participate in the survey.

In addition, using contact information held by the *Bulletin,* and the journal's data on the activities of individual firms in emerging markets, we identified a list of potential interviewees. The interviews took place, by skype and by phone, under the ethical guidance of the University of Edinburgh, and we guaranteed all respondents total anonymity.[2] Formal consent was sought in writing from each of the interviewees. The interviews were recorded and transcribed, or notes were taken, and the data was coded and analysed by the authors.

1.2 Our conceptual framework

The degree of risk involved in an investment is a key determinant of the cost of capital. When considering risk, finance theory refers to two main categories, which require distinct analysis: these are specific (or idiosyncratic) risk; and systematic (or market) risk. Specific risks are associated with events that affect the cash flows of the individual project being considered, but do not affect the cash flows of other assets in the portfolio. Most of the technical risks associated with PPPs are specific risks, including:

- the risk that design or engineering processes will fail to perform as expected;
- the risk that faulty building techniques or poor project management lead to cost escalation during construction;
- the risk that operations and maintenance costs will be higher than projected; and
- the risk that performance will not be at the standard expected at financial close, giving rise to deductions or penalties, and reduced income for the private sector operator.

In contrast, systematic risks are those that are correlated with the performance of the stock market, or the general economy, and therefore affect many assets and the portfolio returns. Risks in this category include: the costs of inputs (especially those sold on international markets), regional or global political instability, demand risk, and various types of financing risk.

The theoretical literature dictates that the cost of equity in unaffected by specific risks. These have impacts on individual investments, but these impacts are offset, and reduced to a value of zero, across a perfectly diversified portfolio. Standard theory acknowledges that specific

[2] Consistent with the basis of consent, we have not published a list of the interviewed individuals, or their employer.

risks can impact on the project, and must be carefully taken into account by investors, but requires that these are modelled in the expected cash flows, not as a premium on the return.[3]

In contrast, systematic risks cannot be eliminated by diversification, since they affect all investments to some degree. This view of the risk is reflected in much of the previous theoretical literature on PPPs (e.g. Klein, 1997; Grout, 1997; Currie, 2000; Grout 2003; Boyer *et al*, 2013) and is known to be widely understood and applied in real-life capital markets (Graham an Harvey, 2002).

This view is formalised in the Capital Asset Pricing Model (CAPM), of Sharpe (1964) and Lintner (1965), much the most common theoretical framework used by investors in equity markets globally. It and has been found to be the most frequently used model in estimating an appropriate rate of return for infrastructure projects in emerging markets, including Africa (PricewaterhouseCoopers, 2015). The CAPM determines that the return required on any given project - i.e. the return that it must generate in order to attract capital from the markets - is a function of the return available on a risk-free investment (the risk-free rate) plus a premium for the amount of systematic risk in the investment being considered (the equity risk premium).

In corporate finance, the risk free rate is normally referenced to the return on fixed income securities issued by governments. This is taken to be a benchmark for the return required by the market on a riskless asset. In principle, a risk-free security involves no uncertainty about the solvency of the sovereign counterparty and its willingness to make scheduled debt payments (Damodaran, 2009). Thus, bonds issued by corporations are not risk-free, as even the largest firm may declare bankruptcy and fail to meet its debt obligations. In contrast, securities issued by a government in a jurisdiction with its own currency and central bank are considered to involve zero default risk. As governments have the power to print money to pay off debt, holders of these securities can be confident they will receive the expected return on their investment (at least in nominal terms).

[3] The expected value of a periodic cash-flow is the ex ante mean of all possible ex post values of that cash flow, weighted by probability (Brealey et al 2008). Because of risk, the values of future cash flows are uncertain, and this uncertainty must be modelled in terms of a probability distribution, which summarises an investor's degree of belief about the likelihood of possible outcomes. This distribution is often based on the past historical performance of investments, modified to reflect the investors' knowledge of the current project or market conditions. On the basis of the distribution, the mean value of costs, revenues and returns is measured.

Under the CAPM, the equity risk premium is arrived at by multiplying:

• the Beta (β) of the investment – i.e. the weighted covariance of the projected excess return on the investment with the average excess return on the market as a whole; by

• the Equity Market Risk Premium (EMRP) – i.e. the average excess return on the equity market, reflecting the market's view of the risk inherent in the equity market as a whole.

To clarify, if the variance (i.e. risk) of a given investment is perfectly correlated with that of market portfolio (e.g. the FTSE 500), Beta is 1 and the required return on an asset valued using the CAPM is equal to the required return on the equity market as a whole (the market portfolio). Conversely, if there is no correlation between the risk of an investment and that of the market portfolio, Beta is 0 and the required return is the observed market rate on a risk-free security. It should be noted that an investment with a Beta of 0 may still involve a substantial magnitude of project-specific risk (i.e. actual returns may vary significantly from those projected at the time of the investment analysis). However, as long as the expected variance is uncorrelated with the expected variance of the market portfolio, the probability of such variation will not (or should not) attract a premium under CAPM (Brealey et al, 2008).

As the CAPM is the most popular method for estimating the cost of equity (and due to its common usage among regulators and investors, including in the infrastructure sector), it forms a basis for the analysis of the cost of capital here. However, the method needs to take account of a number of key issues and complexities, on which the evidence is limited, and for which we have sought the input of the market to better understand dominant perceptions and practices.

These include:

(1). Estimating the risk-free rate. In emerging markets, the assumption that the Internal Rate of Return on fixed income securities issued by government can be regarded as risk-free is questionable. The market may, for instance, perceive such securities (where they exist) to have exposure to a non-negligible amount of risk, including currency volatility and sovereign risk.

(2). Estimating the EMRP. Estimates of the EMRP are not uniform across global equity markets, as they depend on: (a) the period over which returns are calculated; (b) the method chosen for computing the average rates of return; and (c) whether they are designed to reflect current or expected market conditions (Damodaran, 2015; Vivian 2007). A further complication relates

to emerging markets specifically, in which historical data is either non-existent or is perceived to be unreliable, and where a few large companies (many of them unlisted) may be dominant.

(3). Deriving β. Equity on a PPP project is provided by the owners of the SPV. This is usually a completely new business that has been established with the sole remit of delivering the contracted infrastructure and related services (and earn an income from doing so). As a result, there are no historical data regarding dividends or share price movements and, therefore, no directly observable market data on which to base Beta. Adapting the CAPM to cope with businesses with no historical performance data is a complex process, and requires data from industries or companies that undertake activities generating a similar level of risk to those of PPP projects.

(4). Identifying the degree of portfolio diversification. The CAPM assumes that the investor has a well-diversified portfolio, such that variation in the return on individual assets has a negligible impact on returns. However, where markets are segmented and investors have small or concentrated portfolios, an additional premium for specific risk may be required (see Merton, 1987)

Given these areas of uncertainty, it is apparent that the application of the CAPM is not straightforward in the context of infrastructure PPP projects. A simple application of the CAPM approach may not be feasible on many projects, and even where it is, may lead to estimates of the cost of capital that vary considerably from those considered reasonable in the market. A method for estimating the cost of capital that can command broad support among stakeholders must take account of actual market perceptions and behaviours in relation to these areas of uncertainty. It is to these perceptions and behaviours that we now turn.

1.3 Findings from our qualitative research

In this report, we are focused on estimates of the cost of equity capital for the *direct investor of primary equity* in the SPV. In other words, we are interested in the expected rate of return that directly affects the bid price, and the price ultimately be paid by governments and/or service users. This is an important variable in financial appraisals, value for money analyses,

negotiations during the procurement process and, where applicable (e.g. in concessions), economic regulation.

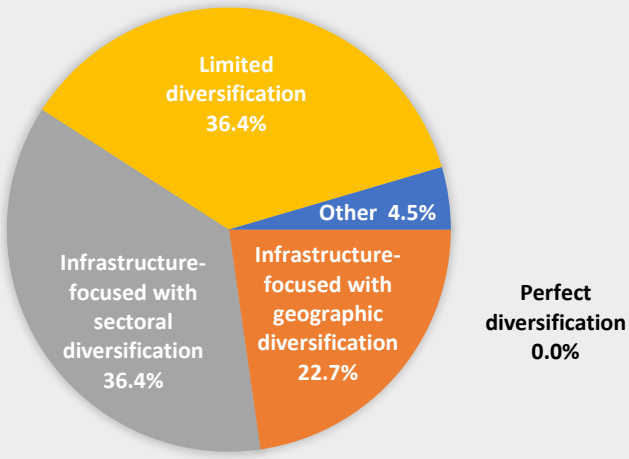
Of course, investors that allocate capital to third-party asset managers, such as infrastructure funds, or in companies that build and operate infrastructure, also have an expected return. While these expected returns have an indirect impact on bid and contract prices, since they influence direct investors' thresholds or Weighted Average Cost of Capital (henceforth: WACC), they are not our primary concern. There are also investors that invest during the operational phase – but again, these are not our main focus because the returns they require do not exert a direct impact on the price to be paid by governments and/or service users.

A consistent finding, across our survey and interview data, is that direct investors of primary equity in SPVs *do not consider themselves to be well-diversified* (Figure 1, overleaf). Over 95% of the respondents to the survey reported that they had achieved limited diversification, or had portfolios that were weighted towards infrastructure, with some geographical or sectoral diversification (see Figure 1, overleaf). Participants noted that investors in PPPs are, commonly, *operational investors* – e.g. construction groups, civil engineering firms, and concession companies that invest equity but also deliver the operational components of the contract. For these entities, portfolios are naturally concentrated in the infrastructure sector.

Even those that have been successful in large mature markets, such as Australia, Canada and the United Kingdom, are unlikely to have portfolios of more than 25-50 investments, resulting in limitedly diversified portfolios, which and may also include very concentrated exposures (i.e. a small number of very large deals).

Many purely *financial investors* also have concentrated portfolios –often as a matter of design. There are, for instance, a growing number of infrastructure funds in the international PPP market that are established as specialised investors, with a mandate to target particular sectors and particular geographies, and set up teams of specialists that understand those assets and attempt to diversify risk across them. While there are investors in the market that have portfolios that approximate the level of diversification assumed in the orthodox CAPM approach (especially large institutional investors, such as pension funds), they rarely act as direct investors of primary equity in any market, and almost never do so in emerging markets.

Figure 1. Which of these best describes the degree of diversification in your investment portfolio?



Perhaps reflecting a distinction between indirect and direct investors, there is some heterogeneity in the views of investors concerning how *specific* versus *systematic* risk should be accounted for in the expected rate of return (Figure 2).

Close to 60% of respondents to the survey agreed that only risks that are correlated across assets (in other words, systematic risks) should command a premium, while the remainder disagreed. However, interviewees from organisations that undertake direct investments in primary equity consistently expressed the view that specific risks *are* considered in several aspects of the analysis, including the cash-flows and, in some cases, the equity risk premium itself.

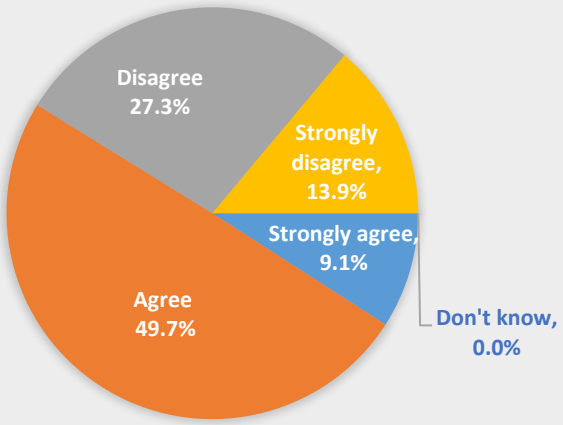
Many interview respondents perceived that while there were diversification benefits from investing in emerging market infrastructure, as these should exhibit low return covariance with other asset classes, these benefits were captured by indirect investors, and would not exert a direct influence on the prices in the market for primary equity (and thus bid and contract prices). Reflecting this, respondents from several direct investors perceived that such projects involved a *higher* degree of risk than their own corporate portfolios, such that a return above their own corporate WACC was seen as necessary to ensure that the investment would be accretive to the value of the business.

Even in the case of well-diversified investors (a small minority of those in the primary market), many respondents felt that agency problems would play a role in ensuring that specific risks were carefully considered and priced in the analysis. It is widely understood that a management team responsible for allocating capital may be rewarded if the project exceeds expectations, but more than proportionally penalised if it falls short. Thus, returns on specific

investments, and the risks that relate to them, may matter greatly for an individual's career and income. As one respondent, an employee at a large diversified investor told us:

> *"As a business, yes, we've got hugely diversified portfolio, and viewing risk to overall portfolio returns is relevant at the corporate level. But as an individual, I'm dealing with the infrastructure business, and so I care deeply about the particular project and the specific risk and return features of that project. The fact that someone on another desk is dealing with other assets and we can diversify across them - I don't care."*

Figure 2. 'The only risks that command a premium are those that are correlated across assets'



Our respondents told us that the specifics of the pricing method vary according to type of investor – i.e. whether they take an operational interest in the deal (e.g. construction firms), or are purely *financial* investors (e.g. infrastructure funds). In the former case, company boards will typically set minimum rates of return for projects which reflect the WACC of the business, including a cost of equity determined by the degree of systematic risk faced by the business, and consider specific premiums for individual risk factors, adding these according to a 'building blocks' approach.

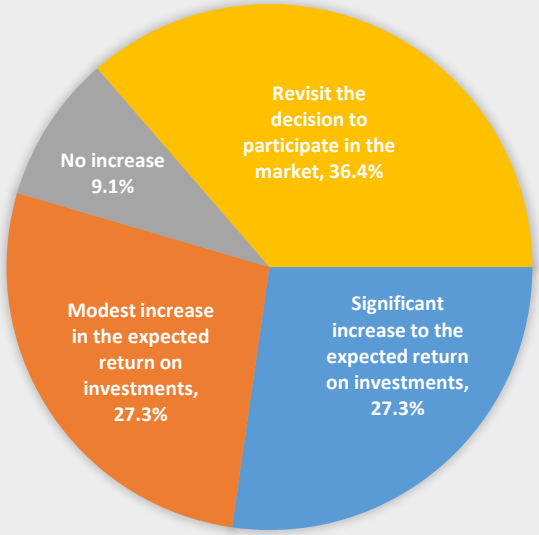
For purely financial investors, the equivalent of the corporate WACC is the cost of funds – i.e. the yield the institution must achieve for it to retain investment. This ratio sets the minimum threshold that the expected rate of return on each project must surpass for investment to be approved. Again, specific premiums for individual risk factors may be added on a case-by-case basis.

Alternatively, some financial investors adopt a comparative approach, where returns are priced according to equivalent projects in mature markets (where markets norms in terms of

pricing are relatively stable and well-known (see Colla et al, 2014)) before taking account of the higher probability of public policy reversals and the enforceability of contractual claims in some emerging markets. For direct investors focusing on emerging markets, these risks are already built into the cost of funds threshold, and the magnitude of any additional adjustment may be modest. Indeed, several financial investors reported the existence of a standard *range*, of approximately 5-8%, in the spread above the threshold, and claimed this is relatively consistent across countries.

The existence of an international *norm*, across what are very different market contexts and risk settings, in which political and regulatory risks are likely to be higher than in mature markets, may seem counter-intuitive. However, both the plurality of survey respondents, and the majority of interview participants, reported that a qualitative approach would be applied, reflected in a binary decision about whether to invest in a given country and project for the market return, rather than via a significant adjustment to the premium (Figure 3).

Figure 3. How would you expect to react to an increase in political and regulatory risk?



From our qualitative research, we conclude that investors in the PPP market are only moderately diversified. In the case of operational investors, expected returns are derived using corporate WACCs, based on the level of systematic risk faced by the firm across all areas of its business activities, adjusted according to a building blocks approach that takes into consideration the risks of the project under consideration. As the magnitude and potential impact of such risks are, in general, perceived to surpass those borne on the corporate portfolio, this approach will generally lead to an expected rate of return that is *higher* than the corporate WACC.

In the case of 'pure' financial investors, the starting point is the cost of funds, and there are, similar to the above, adjustments to reflect risks. In most cases, operational and financial investors will bid together as part of a consortium, and establish a jointly owned SPV to undertake the project at the point of financial close. As the corporate WACC approach is likely in most cases to generate a higher expected return than the cost of funds approach, the former sets a floor on the return that a project must be expected to generate in order for it to receive investment.

2: A method for estimating the cost of equity

2.1 Applying the CAPM to PPPs in the emerging market context

In this section, we explain how the CAPM can be revised to address the issues described in section 1.2, taking account of our findings on investor perceptions and behaviours outlined in section 1.3. We outline the approach according to the three main variables - the risk-free rate, Beta and the Equity Market Risk Premium – and then summarise the approach according to a series of logical steps.

2.1.1 Estimating the risk-free interest rate for PPPs in emerging markets

As already noted, the risk-free rate is the return on an investment with no variance around the expected return. It is standard practice to use the interest rate on government securities as a proxy for a risk-free security, and the selection of the appropriate maturity is a function of the expected holding period for the investment to which the discount rate is to be applied (Damodaran, 2008). In PPP contracts, because of their long-time horizon, the weighted average yield on long-dated government bonds – e.g. 15-year, 20-year or 25-year bonds issued in the relevant year– may be used.

The geographical location of the project does not determine the choice of the risk free interest rate. Rather, this is determined by the currency in which the cash flows are to be estimated (Damodaran 2008). Thus, if cash flows are estimated in nominal US dollar terms, the risk-free rate is referenced to the appropriate US Treasury bond rate. While this may be counter-intuitive, given the higher risk in emerging market countries, it is consistent with standard theory (and our survey and interview findings) since the risk-free rate is not the appropriate variable for considering the pricing of risks.

In emerging markets, local currency bond rates include a credit default spread and do not, therefore, express a 'pure' risk- free rate. Therefore, if the investor chooses to use local

currency bond rates, the default spread of the country is subtracted from the market interest rate on the local bond to determine the risk-free rate in the local currency.

Box 1. The risk-free interest rate: an illustration

Using the Turkish Lira bond as an illustration, we subtract the credit default spread of Turkey (based on Moody's rating, Ba1 in 2017) from the 10y Government bond yield as shown in the formula below.

riskfree rate in Turkish Liras = 10y rate on Liras bond – default spread$_{Turkey}$

= 10.22% - 2.89%

= 7.33%

Source: Bloomberg and Moody's, 2017

2.1.2. Estimating Beta

As noted in Part 1, Beta is the key measure of systematic risk. It gauges the tendency of the return of a financial security to move in parallel with the return of the stock market as a whole. Betas are available for listed companies. However, equity capital on a PPP project is provided by the owners of the SPV, which is a non-listed company, with no historical data regarding dividends or share price movements, since it is a brand new business that has been established with the sole remit of delivering infrastructure and services and earn an income from doing so. As a result, there are no data on which to base the Beta estimates.

However, it is generally believed that CAPM can be adapted to cope with unlisted businesses (Mitenko and Okleshen 1998; Bowman and Bush 2007). In such cases, Beta can be derived from industries or firms with similar activities to those undertaken in the PPP project and are thus exposed to the similar risks (see Box 2). However, in emerging markets, data comparable industries or firms may be limited or non-existent, it is possible to use sectoral beta calculated with reference to wider geographical areas, the most inclusive of which is to use the sectoral beta of the emerging markets as a whole.

For example, relevant sectoral betas may be those relating to (depending on the sectoral location of the individual project being considered) may include: construction, healthcare support services, utilities, and transportation. To better mirror the sectoral composition in the project Beta, it is also possible to weight the sectoral Betas, by referring to the relative dimensions of each sector against the overall economic value of the project.

To get a reliable Beta, data should be sourced from a past period of at least 10-15 years. This data can be sourced from a range of commercial databases, such as *Bloomberg*, *Thomson Datastream* and *OneBanker*. It should be noted that the form of Beta available on such databases is the Equity Beta. This form of Beta reflects the level of systematic risk that company shareholders face in addition to the risks related to the firm's financial leverage (which will be different to the leverage of the specific project under consideration), implying a different level of risk borne by equity.

Therefore, an adjustment needs to be made. To calculate the average Asset Beta for a specific PPP project, the equity Beta is deleveraged, according to the following formula:

$$\text{Asset Beta} = \text{Equity Beta} \div [1 + (1\text{-tax rate}) \times (\text{amount of debt} \div \text{amount of equity})].$$

Box 2. Estimating asset betas: an illustration

The table below shows average asset *Beta* for five comparable industries in emerging market countries over the period 2007-2017.

Industry	Number of listed companies	Equity beta	D/E Ratio	Average sector tax rate	Asset beta
Construction	694	1.15	84.42%	14.92%	0.67
Healthcare Support Services	109	1.22	21.78%	18.14%	1.04
Transportation	141	1.14	65.66%	18.74%	0.74
Utility (General)	13	0.81	215.44%	16.52%	0.29
Utility (Water)	56	1.29	44.17%	17.37%	0.94

Source: Bloomberg 2017

For example, in the case of a hospital PPP project, the beta can be calculated with reference to the beta of the construction and healthcare support sectors in emerging markets. To weight the betas, the value of supporting services compared to value of the investment (construction component) must be calculated. The value of supporting services is the discount value of the revenues for the SPV related to supporting services.

If the value of healthcare supporting services is 50% and the value of the investment is 50%, the average beta is 0.85.

The average asset beta is then re-leveraged by referring to the average project's financial leverage. Finally, beta should be also adjusted according to Blume theory (Blume 1971), which reflects the fact that estimated betas have a tendency to revert to the market mean (i.e. 1) over time.[4]

[4] The effect of the Blume adjustment is to reduce the difference between the Beta and the market average (i.e. 1). Blume (1971) found that adjusting estimated *Equity Betas* toward unity improved their ability to forecast subsequent period stock returns. The most widely held explanation for this is that unusually low or high *Betas* are subject to measurement error. Blume adjustment is standard in the calculation of *Equity Betas* by regulators in respect of UK, US and Australian utilities in determining the appropriate rate of return to investors, and is recommended in the most prominent corporate finance textbooks (e.g. Brealey et al 2010). Blume-adjusted

Box 3. Estimating re-levered betas: an illustration

Using, again, the case of Turkey and a PPP in the healthcare sector, we assume an average project D/E of 60%. We calculate levered beta, and then the adjusted Beta, as follows.

Re-levered beta (Turkey) =	Asset beta x [1 + (1 – tax rate$_{Turkey}$) x (D/E$_{Project}$)]
=	0.85 x [1 + (1 – 20.00%) x 60.00%]
=	1.258
(Bloome) Adjusted beta (Turkey) =	(1.258 x 0.67) + (1 x 0.33)
=	1.173

Source: Bloomberg 2017

Damodaran (2015) suggests that, if Betas are missing for the relevant businesses and sectors in a specific country, which will often be the case for the emerging market context, it is possible to utilise data from advanced economies, adjusting them by adding a factor to compute the country risk.

Betas measure systematic risk – i.e. the risk added by an investment to a perfectly diversified portfolio. However, direct investors of primary equity do not consider themselves to be well-diversified, as we have seen. Most market players that participated in our research perceived the risks faced by primary equity to exceed those faced on their corporate portfolios. Therefore, it is likely that betas derived in a conventional way will understate the investor's exposure to risk.

In this case, a fairly simple adjustment should allow this non-diversifiable risk to be factored into the Beta computation, at least where relevant data exists (Damodaran 2009). This

Betas are available from most commercial databases, such as Bloomberg and the London Business School Risk Management Service. The formula is: Blume-adjusted *Equity Beta* = (0.67)* βOLS + (0.33)*1.

adjustment is based on the calculation of the standard deviation in a private firm's equity value and the standard deviation in the market index, where the standard deviation of the firm's equity value is scaled against the market index's standard deviation to yield what is called *total beta*. However, this approach can't be applied to PPP transactions as SPVs are new companies for which no historical data related to the equity value is available. Therefore, as reflected in our qualitative research findings, additional risks must be added in the estimate of the risk premium, according to a 'building blocks' approach.

2.1.3. Estimating the Equity Market Risk Premium

As stated in Part 1, estimates of the formal EMRP are not uniform across global equity markets, as they depend on: the period over which returns are calculated; the method chosen for computing the average rates of return; and whether they are set to reflect current or expected market conditions (Damodaran 2016a; Vivian 2007). Nevertheless, the most widely used methodology to estimate the EMRP is the so-called *historical risk premium approach* (Damodaran, 2016a), in which the average return earned on equities over a long time period is estimated and compared to the average return on a risk-free security. The difference, on an annual basis, between the two returns is computed, using the arithmetic or geometric mean. This difference represents the historical risk premium.

This is a relatively straightforward process for mature markets, but presents a number of challenges when the focus is an emerging market, in which historical data is either non-existent or unreliable, and where a few large companies (many of them unlisted) are usually dominant. Therefore, the *historical premium plus* is generally applied (Damodaran, 2016b).

More generally, over the last three decades several studies have cast some doubt on the efficacy of the CAPM model, finding that it understates the expected returns of stocks with specific characteristics. As normally calculated, the equity risk premium is referred to the risk for all stocks within a market, regardless of their differences in terms of market capitalization and growth potential. In effect, it is assumed that Betas capture differences in risk across companies (Damodaran, 2016b).

According to Graham and Harvey (2002), the most important additional risk factors to the EMRP that are considered by investors are: exchange rate risk, business cycle risk, interest rate risk and inflation risk. In a PPP contract, the last three risks are less relevant, as returns on infrastructure are relatively insensitive to the economic cycle, interest rates are either fixed or hedged against, and revenues are usually adjusted for inflation. Where that adjustment creates risks to the nominal return, those risks are normally hedged in the derivatives markets, via inflation swaps. However, our qualitative findings suggest currency risk is carefully considered in pricing decisions.[5]

The magnitude of country risk, especially when portfolios are not diversified across geographies, may be underestimated in the standard EMRP approach. Especially when estimated using local indices, Betas do not adequately capture differences in country risks. This risk is difficult to assess in the adjustment of the cash flow and therefore the risk premium is generally adjusted (Damodaran 2016).

There are two approaches to calculate the country specific EMRP (Damodaran 2016b) and they are based on the "Mature Market Plus" approach, which adds to the base premium for mature equity market a country risk premium, defined on the basis of the following two approaches:

- Default spread
- The relative equity market standard deviation

According to the first approach, the default spread that investors charge for buying bonds is used as a proxy to calculate the country specific risk premium. The premium calculated must be added to the expected return on equity for a mature market. However, this approach takes into consideration only the risk of default and is unaffected by other risks. According to the second approach, the equity risk premium of markets should reflect the differences in equity risk, as measured by the volatilities of these markets. As a conventional measure of equity risk

[5] In addition, our interviews and survey data suggest liquidity risk is carefully considered an adjustment of the EMRP for the market capitalization is a common approach, and is done by adding a premium to the expected return (from the CAPM) of small cap stocks (Damodaran, 2016b). For example, to take into consideration illiquidity, an extra premium of 3-3.5% is added, reflecting the excess returns earned by smaller cap companies over very long periods (Damodaran 2016b).

is the standard deviation in stock prices, higher standard deviations are associated with more risk (Damodaran, 2016b). Therefore, the relative standard deviation for a $country_x$ is:

$$\text{Relative standard deviation}_{\text{country x}} = \sigma_{\text{country x}} / \sigma_{\text{US}}$$

This enables the equity risk premium and the risk premium for $country_x$ to be calculated, as follows:

$$\text{Equity risk premium}_{\text{country x}} = (\text{Risk premium}_{\text{US}} * \text{Relative standard deviation}_{\text{country x}})$$

$$\text{Country}_X \text{ Risk premium} = \text{Risk premium}_{\text{US}} * (\sigma_{\text{country x}} / \sigma_{\text{US}}) - \text{Equity risk premium}_{\text{US}}$$

There is also a third, combined approach. As the country risk premiums are larger than those captured by the country default risk spread, the volatility of the equity market relative to the volatility of the bond market used to estimate the spread can be taken into consideration, according to the following formula:

$$\text{Country}_x \text{ Risk premium} = \text{Country}_x \text{ Default spread} * (\sigma_{\text{equity}} / \sigma_{\text{country bond}})$$

A complication is that many emerging market countries do not have a sovereign rating, which does not allow the calculation of a credit default spread in this way. However, Damodaran (2015) and Harvey (2005) found that the country risk score from the Political Risk Services (PRS) group[6] is correlated with the cost of the capital for emerging market companies. Therefore, when an emerging country does not have a sovereign rating but is rated by the PRS group, data for countries that are have a similar PRS score can be used to assign the default spreads that these countries face.

In addition, inflation must be taken into consideration in the estimation of the EMRP. The risk-free rate in a currency should, in theory, incorporate both the expected inflation and the real

[6] The PRS group considers political, financial and economic risk indicators to come up with a composite measure of risk for each country that ranks from 0 to 100, with 0 being highest risk and 100 being the lowest risk. http://www.prsgroup.com

return for investors. Using the free-risk rate of a certain government may be the solution, but in an emerging market the government bond market (where it exists) may be illiquid and volatile. Therefore, an alternative approach is to use the differential inflation with the US market, according to the following formula:

$$\text{Cost of capital in a country}_x = (1+ \text{Cost of capital in USD}) + ((1+\text{expected inflation rate in country}_x \text{ currency})/(1+\text{expected inflation rate in USD})) -1$$

Finally, a point noted in our interviews by several respondents is that, when country risk is well computed in the estimation of the cost of the equity, there is no need to compute the currency risk, which is correlated to the country risk (Damodaran 2016a).

In the following table, we provide some examples about how to calculate the EMRP for some emerging countries, by using the third melted approach.

Box 4. The EMRP for a selection of emerging markets, by applying the melted approach

Factors	Algeria	Turkey	Indonesia	Colombia	India
Base risk premium (US ERPM)	5.69%	5.69%	5.69%	5.69%	5.69%
Country sovereign rating (Moody's)	N/A	Ba1	Baa3	Baa2	Baa3
Country default spread	3.12%*	2.89%	2.54%	2.20%	2.54%
Relative volatility (equity/bond)	1.3	1.3	1.3	1.3	1.3
Country risk premium	4.06%	3.75%	3.31%	2.86%	3.31%
Total ERPM	9.75%	9.44%	9.00%	8.55%	9.00%

*Algeria does not have a sovereign rating, so we calculated the country default spread using the PRS score of the country. Algeria is rated 63.00 by PRS group, thus we applied the average default spread of countries falling in the range 62.00-64.00 according to PRS score.

Source: Bloomberg, PRS Group and Damodaran 2017

Box 5. The cost of equity for a PPP project in the healthcare sector for a selection of emerging markets

By using all the factors calculated above, we calculated the cost of the equity, with and without the illiquidity premium.

Factors	Algeria	Turkey	Indonesia	Colombia	India
10y Governement bond yield	4.75%	10.22%	6.83%	6.21%	6.49%
Country default spread	3.12%	2.89%	2.54%	2.20%	2.54%
Risk free rate	1.63%	7.33%	4.29%	4.01%	3.95%
Asset beta	0.85	0.85	0.85	0.85	0.85
Tax rate	26.00%	20.00%	25.00%	25.00%	34.61%
Average project D/E	60.00%	60.00%	60.00%	60.00%	60.00%
Re-levered beta	1.23	1.26	1.23	1.23	1.18
Ajusted beta	1.15	1.17	1.16	1.16	1.12
EMRP	9.75%	9.44%	9.00%	8.55%	9.00%
Total cost of equity	**12.85%**	**18.40%**	**14.68%**	**13.88%**	**14.05%**
Total cost of equity with illiquidity premium (3%)	**15.85%**	**21.40%**	**17.68%**	**16.88%**	**17.05%**

* Algeria does not have a sovereign rating, so we calculated the country default spread using the PRS score of the country. Algeria is rated 63.00 by PRS group; therefore, we applied the average default spread of countries falling in the range 62.00-64.00 according to PRS score.

Source: Bloomberg, PRS Group and Damodaran 2017

Box 6. The cost of equity for a PPP project in the transportation sector for a selection of emerging markets

By using all the factors calculated above, we calculated the cost of the equity, with and without the illiquidity premium. The Beta has been calculated as the simple average between the beta of the construction and transportation sector-

Factors	Algeria	Turkey	Indonesia	Colombia	India
10y Governement bond yield	4.75%	10.22%	6.83%	6.21%	6.49%
Country default spread	3.12%	2.89%	2.54%	2.20%	2.54%
Risk free rate	1.63%	7.33%	4.29%	4.01%	3.95%
Asset beta	0.70	0.70	0.70	0.70	0.70
Tax rate	26.00%	20.00%	25.00%	25.00%	34.61%
Average project D/E	60.00%	60.00%	60.00%	60.00%	60.00%
Re-levered beta	1.01	1.04	1.02	1.02	0.97
Ajusted beta	1.01	1.02	1.01	1.01	0.98
EMRP	9.75%	9.44%	9.00%	8.55%	9.00%
Total cost of equity	**11.45%**	**17.00%**	**13.38%**	**12.64%**	**12.79%**
Total cost of equity with illiquidity premium (3%)	**14.45%**	**20.00%**	**16.38%**	**15.64%**	**15.79%**

* Algeria does not have a sovereign rating, therefore we calculated the country default spread using the PRS score of the country. Algeria is rated 63.00 by PRS group, thus we applied the average default spread of countries falling in the range 62.00-64.00 according to PRS score.

Source: Bloomberg, PRS Group and Damodaran 2017

2.2 Risks in PPP transactions and determining the cost of equity

As primary equity investors are generally not diversified, it is crucial to understand what risks are retained by the investor in each transaction and how these should be priced. The methodology suggested below is based on the understanding of the risks retained by equity investors through a tool that, our qualitative research findings suggest, is well-used in the market - the risk matrix.

Once risks retained by equity investors have been identified, a second step must be conducted in order to understand how to price them according to the adjusted CAPM methodology, as explained in section 2.2. In current section, our method is explained, by referring, initially, to a general risk allocation in an illustrative PPP transaction. Then, we consider how these risks are allocated among the contracting parties and, for those that remain on equity, how they should (or should not) be factored into the cash flows or expected rate of return.

Risks in PPP transactions can be classified on the basis of their nature in three categories (Vecchi et al., 2017): political and regulatory; market or external; technical.

- Political and regulatory risks depend on the activities of the state at various levels of governance. Often, political risk relates to the government at the central or regional levels. In some cases, risk emerges from the behaviour of the public authority itself.
- Macroeconomic and market risks arise from the possibility that the market and/or economic environment is subject to variation.
- Technical risks are determined by the knowhow of the operators and the features of the project and technology.

Table 2 shows an illustrative classification of the main project risks, grouped according to the project development phases, according to three categories conceived. This classification is useful to understand the nature of the project specific risks and therefore the subjects that generally retain them in a PPP transaction.

Table 2 - Project specific risks: classification by nature

Risks	*Political and regulatory*	*Macroeconomic and market*	*Technical*
Development phase			
Project feasibility and inclusion in investments plan	x		
Quality of project development			x
Longer bidding phase and consequent change of market conditions	x		
Construction phase			
Land availability	x		
Social acceptance	x		
Archaeological	x		x
Environmental	x		x
Technology availability and consistency			x
Reliability of forecasts for construction costs and delivery time			x
Operation phase			
Change in service tariff, defined by the regulator/authority	x		
Volatility of demand		x	
Changes in tariff regulation	x		
Underperformance of the infrastructure, which may cause increase of life cycle costs or further investments			x
Authority doesn't comply with payment obligations	x		
Funding			
Availability of affordable funding		x	
Refinancing risk		x	
Other risks, across the whole life cycle			
Inflation		x	
Exchange rate fluctuation		x	
Force majeure		x	
Change in taxation	x		
Change in law	x		

Stability of business and legal environment	x	x	
Default of operators/SPV		x	
Termination value different from expected	x	x	

Project specific political risks are generally retained by the public authority and are therefore not borne by primary equity investors. Consequently, they should not be priced in cash flows or the cost of equity. However, by applying the adjusted CAPM approach we recommend above, the country risk can be taken into consideration as a proxy of the risk (legal and political) of doing business in a certain country.

Technical risks are allocated to the SPV and are generally passed to specialized subcontractors, through separate EPC (engineering, procurement and construction) and O&M (Operation & Maintenance) contracts. Therefore, they should not command a risk premium on the equity. Even in cases where some element of this risk is retained by the equity investor, it is unlikely that an additional premium is unwarranted: as these technical risks are generally sector specific, they are generally incorporated in the beta.

The Beta of the project is calculated by using the "comparable approach", as explained in section 2.2, paying attention in the selection of the most appropriate comparable sectors.
In some cases, for instance, where it is believed that the SPV's retained technical risks are non-negligible, further steps may be taken, i.e.

- they may be separately priced and added, through a "bottom-up" approach (added to the equity risk premium as separate factors) to the cost of equity capital,
- they may be considered in the cash flows; e.g. if part of the archeological risk is retained by the SPV, this may (and should, in theory) be captured in the expected values of capex cash-flows.

Since investors in this market are not well-diversified, they retain many market-related risks. Many of these are, however, systematic, and should be substantially captured in the Beta of the project, derived via the comparable approach, as outlined above. Among these risks as shown in table 3, there are: demand, inflation, currency, availability of funds, and failure of

subcontractors. Some of these are also mirrored in the country risk, which can be estimated by following the approaches explained in section 2.2.

The assessment of these risks and how they can be considered in the evaluation of the cost of the equity is explained in Table 3. Further, in the application of the CAPM methodology by considering the risks listed in the risk matrix. We would also suggest that an illiquidity premium should be considered and eventually priced as per subsection 2.1.3.

Table 3, drawing the list of risks included in table 2, shows the allocation of risks among the procuring authority and the SPV, by presenting, for each of the risk that the SPV may retain, and the way in which they can be priced.

Table 3. Project specific risks: classification by allocation

Risks	*Procuring authority*	*SPV*	*If allocated to the SPV*
Development phase			
Project feasibility and inclusion in investments plan	x		
Quality of project development		x	Transferred to subcontractors
Longer bidding phase and consequent change of market conditions	x	x	Partially retained by equity investors, generally captured in the sector Beta and in the Country risk premium
Construction phase			
Land availability	x		
Social acceptance	x	x	Partially retained by equity investors, generally captured in the Country risk premium
Archaeological	x	x	Transferred to subcontractors; or if partially retained it can be captured by Beta, or, if the severity is high, considered through an adjustment of cash flows (CAPEX adjustment)
Environmental	x	x	
Technology availability and consistency		x	Transferred to subcontractors; or if partially retained it can be captured by Beta, or, if the severity is high, considered through an adjustment of cash flows (refreshment value adjustment)
Reliability of forecasts for construction costs and delivery time		x	Transferred to subcontractors
Operation phase			
Change in service tariff, defined by the regulator/authority	x		
Volatility of demand	x	x	Especially after the economic crisis, many projects are now availability-based. If the demand is retained by equity investors, it is capture through the Beta
Changes in tariff regulation	x		
Underperformance/Unavailability of the infrastructure, which may cause increase of life cycle costs or further investments		x	Transferred to subcontractors
Authority doesn't comply with payment obligations		x	Retained by the equity investors, it can be captured by Beta and EMRP, or, if the severity is high, considered through an adjustment of cash flows or

			through an additional factor by adjusting the CAPM formula (bottom-up approach)
Funding			
Availability of affordable funding		x	Retained by the equity investors, it can be captured by Beta, or, if the severity is high, considered through an adjustment of cash flows
Refinancing risk		x	Retained by the equity investors, it can be captured by Beta, or, if the severity is high, considered through an adjustment of cash flows
Other risks, across the whole life cycle			
Inflation		x	Retained by the equity investors, it is captured in the EMRP; it can command an extra country risk
Exchange rate fluctuation		x	
Force majeure	x	x	If partially retained by the equity investors, it can be captured by Beta, or, if the severity is high, considered through an adjustment of cash flows
Change in taxation	x	x	If partially retained by the equity investors, it is captured in the EMRP
Change in law	x	x	
Stability of business and legal environment	x	x	
Default of subcontractors		x	Retained by the equity investors, it can be captured by Beta, or, if the severity is high, considered through an adjustment of cash flows
Termination value different from expected		x	Generally in PPP the straight line depreciation is applied and this risk is not relevant. If retained by the equity investors, it can be captured by Beta

2.3 Estimating the cost of equity: a step-by-step description

Following the above, it is possible to outline the key steps, in logical order, that must be undertaken in order to estimate the appropriate cost of equity:

Step 1: Identify the risks via the risk matrix.

Step 2: Identify the allocation of risks to primary equity investors in the SPV.

Step 3: Identify those that are retained by equity investors after transfer to subcontractors or providers of insurance/hedging instruments.

Step 4: By following the matrix in table 3, identify those risks that can be captured in the Beta and those that can be captured in the EMRP.

Step 5: To calculate Beta, choose comparable industries in which equity providers are exposed to similar risks, and calculate t the project Beta, as per boxes 2and 3.

Step 6: Calculate the EMRP, as per the example reported in box 4.

Step 7: Consider if there are any other retained risks that are not adequately captured in the Equity Risk Premium (Beta and EMRP), e.g. a liquidity premium, to be added to the EMRP.

Step 8: consider if there are any other residual risks, including specific risks that are not adequately captured in the Beta and EMRP, and make appropriate adjustments to cash flows.

Step 9: Calculate the risk free rate, as per the examples reported in box 1

Step 10: Apply the CAPM formula to derive the appropriate rate of return on primary equity.

References

Blume, M.E (1971), 'On the assessment of risk' The Journal of Finance, March, pp.1-10.

Bowman, R. G. and Bush, S. R. (2006) Using Comparable Companies to Estimate the Betas of Private Companies. Journal of Applied Finance (Winter/Fall), 71&81.

Boyer, M., Gravel, E. and Mokbel, S. (2013), The Valuation of Public Projects: Risks, Cost of Financing and Cost of Capital. Commentary 388 (Howe Institute Toronto: C.D.)

Brealey, R., S Myers, and F. Allen (2008), Principles of Corporate Finance (McGraw-Hill, New York).

Colla, P., Hellowell, M., Vecchi, V. and Gatti, S. (2015), Determinants of the cost of capital for privately financed hospital projects in the UK. Health Policy, 119(11), pp. 1442–1449.

Currie, D (2000), Funding the London Underground, Regulation Initiative Discussion Paper 35. (London Business School, London).

Damodaran, A (2008), What is the Riskfree Rate? A Search for the Basic Building Block. Available at http://dx.doi.org/10.2139/ssrn.1317436

Damoradan, A (2009), Valuing Young, Start-Up and Growth Companies: Estimation Issues and Valuation Challenges (June 12, 2009). Available at http://dx.doi.org/10.2139/ssrn.1418687

Damodaran, A (2016a), Country Risk: Determinants, Measures and Implications – The 2016 Edition (July 14, 2016).

Damodaran, A (2016b), Equity Risk Premiums (ERP): Determinants, Estimation and Implications – The 2016 Edition (March 5, 2016). Available at: http://dx.doi.org/10.2139/ssrn.2742186

Farquharson, F., de Mastle, C.T., and Yescombe, E., 2011, How to Engage with the Private Sector in Public-Private Partnerships in Emerging Markets (World Bank Group, Washington DC).

Graham, J. and C. Harvey (2002), 'The theory and practice of corporate finance: Evidence from the field'. Journal of Financial Economics, Vol. 60, pp. 60-78.

Grout, P (1997), 'The economics of the private finance initiative.' Oxford Review of Economic Policy. Vol. 13 (4): 53-66.

Grout, P. (2003), Public and private sector discount rates in public-private partnerships. Economic Journal, 113, pp. C63–C68.

Harvey, C.R. (2005), Country Risk Components, the Cost of Capital, and Returns in Emerging Markets, Working paper: Duke University.

Hellowell, M and Vecchi, V (2012a), 'What return for Risk? The Price of Equity Capital in Public-Private Partnerships'. In Greve, C and Hodge, G (editors), Rethinking Public-Private Partnerships: Strategies for Turbulent Times, pp. 57-77 (Routledge: London).

Hellowell, M and Vecchi, V (2012b), 'An evaluation of the projected returns to investors on 10 PFI projects commissioned by the National Health Service', Financial Accountability and Management, Vol.28, No.1, pp. 77-100.

Klein, M (1997), 'The risk premium for evaluating public projects', Oxford Review of Economic Policy, 13 (4), 29–42.

Lintner, J. (1965), "The Valuation of Risk Assets and the Selection of Risky Investments in Stock Portfolios and Capital Budgets," Review of Economics and Statistics, No. 47, pp. 226-37.

Merton, R (1987), 'A Simple Model of Capital Market Equilibrium with Incomplete Information', Journal of Finance, Vol. 42, No. 3, pp. 483-510

Mitenko, G and Okleshen, H (1998), Valuing a Non-Publicly-Traded Business: A Review and Update, 8 J. Legal Econ. 33.

PricewaterhouseCoopers (2015), Africa: A closer look at value: Valuation methodology survey, 2014/15 (PricewaterhouseCoopers, Johannesburg).

Sharpe, W. F (1964), "Capital Asset Prices: A Theory of Market Equilibrium under Conditions of Risk," Journal of Finance, 19, pp. 4254-42.

Shendy, R., Monteiro, R., Mousley, P., Martin, H., Gassner, K. (2015). Implementing a framework for managing fiscal commitments from public private partnerships: operational note (World Bank Group, Washington, DC).

Vecchi, V, Hellowell, M and Longo, F (2010), 'Are Italian healthcare organisations paying too much for their public private partnerships?', Public Money and Management. Vol. 30(2), pp. 125-132.

Vecchi, V, Hellowell, M, Gatti, S. (2013), 'Does the private sector receive an excessive return from investments in health care infrastructure projects? Evidence from the UK', Health Policy. Vol. 110, issue 2, pp. 243-270.

Vecchi, V, Hellowell, M, della Croce, R, Gatti, S (2017), 'Government policies to enhance access to credit for infrastructure-based PPPs: an approach to classification and appraisal', Public Money & Management, Vol. 37 (2), pp. 133-140.

Vivian, A. (2007), 'The UK Equity Premium: 1901-2004,' Journal of Business Finance and Accounting, Vol. 34, 9&10, pp. 1496-1527.