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Social discounting and the equity premium

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April 2021

Abstract

There has been a forty-year divide in economics on the relevance to public funding of the equity premium (in particular, today, the consumption CAPM). The costs and benefits of public spending are often correlated with income, but conventional neoclassical analysis, applied by many governments, suggests that the cost of this systematic risk in publicly funded activities is usually trivial. On the other hand, it is often asserted that equity market premiums, which are very much higher than would be estimated from neoclassical analysis (the equity premium 'puzzle'), should apply also to public funding. This paper, which aims largely to help government administrations, assembles a picture of the evolving research on and understanding of the premium. Public funding does incur social costs arising from the associated tax burden. There is, however, no evidence to support assertions that the equity risk premium anomaly is relevant to public funding. In any case, the cost of systematic risk in the benefits of public funding does not fall as an annual percentage rate to financiers, but as an absolute cost to public service beneficiaries.

1. Historical background

The importance of fluctuations in costs or benefits that vary systematically with income or consumption became well recognised in both welfare and financial economics in the 1960s.

In welfare economics, the effect was estimated from the rate at which the marginal utility of consumption declines with increasing income. The effect can be significant in some overseas development projects where, for example, agricultural benefits may be correlated with times of poor or abundant food supply. An important influence was work later summarised by its original authors in Little and Mirrlees (1990, 356-357).

In financial economics, the focus was initially on the systematic variation of equity returns with the wider equity market, and developed in the capital asset pricing model (CAPM). Traditional CAPM expresses the expected return to a financial asset, $E(Ri)$, as the sum of a risk free rate, R_f, and a multiple (the 'market beta', β_{mi}) of the risk premium in expected returns in the stock market as a whole, $\{E(R_m) - R_f\}$. The late 1970s saw development of a generalised version, the consumption CAPM, in which the asset's market beta is replaced with its consumption beta, β_{ci}. These models are set out slightly more fully in the Appendix.

Not until the 1980s was it clearly recognised that equity market premiums are higher by several percentage points than a conventional neoclassical estimation, as by Little and Mirrlees, of the cost of systematic variation with income. Mehra and Prescott (1985) exposed the anomaly under the title of 'The Equity Premium: A Puzzle'.

Many experts in financial economics see the rate of return to competitive private financing as a market price of capital that applies to both private *and public* financing (Gollier, 2021, Lucas 2014; Brealey et all, 1997). Many welfare and behavioural economists, in contrast, believe that the equity premium anomaly is specific to equity markets and has little if any relevance to the cost of public funding, as illustrated by default in US Federal guidance (OMB, 1992, 2002) and UK central government guidance (HM Treasury, 1997, 2020), all of which drew on national academic input.

Historically the most common financial economics position (e.g. Brealey et al., 1997; Lucas, 2014) has been that publicly funded activities should be discounted as if they were privately financed. This has features in common with the 'social opportunity cost' (SOC) discounting convention, but is a separate literature, different in origin, rationale and authorship.

In recent years a more sharply focused argument has developed (e.g. Gollier, 2019) for adding project-specific 'consumption CAPM' risk premiums to social discount rates (added to a 'social time preference' (STP) rate or, more closely resembling a privately financed cost of capital, added to a risk free rate). This literature has some support from academics distinguished in CBA as well as finance (Freeman and Groom, 2016, 14). However, although the consumption beta is more relevant to publicly funded projects than the market beta, both betas are multiplied by the anomalously high equity market premium to derive a risk premium.

Section 2 examines what the equity premium literature can demonstrate about the relevance of the premium to public funding.

Section 3 addresses a relevant aspect that falls outside that equity premium literature, which is the different ways in which the costs of systematic risk fall with private and public financing.

2. The equity premium literature

There appears to be no financial economics literature examining, as distinct from asserting, the relevance of the equity premium to public funding.[i] There is, however, a vast literature on potential explanations of the equity premium puzzle. These studies can be examined for plausible explanations that might apply also to public funding.

The most comprehensive review of these studies is the 80-page work by Mehra (2006), written twenty years after Mehra's original paper with Prescott. From the literature since

then the most conspicuous contributions are continuation of work in behavioural finance. There is also work that fits to the historical data a different statistical distribution.

None of this work refers to or appears to support arguments that the equity premium anomaly is relevant to public funding.

Illustrating the diversity of possible contributory factors to the high equity premium, Mehra (2006) includes reviews of five *non-risk based* factors. One addresses borrowing constraints, where in Mehra's view 'Some recent attempts to resolve the puzzle incorporating both borrowing constraints *and* consumer heterogeneity appear promising'. Others address the choice of a riskless asset and (US) government regulations. Mehra comments that 'using the return on a risk-free asset that is used for saving as a proxy for the intertemporal marginal rate of substitution of consumption (instead of a T-bill return) can significantly reduce the equity premium. Adjusting debt returns for government regulations further reduces the premium by 1 percent irrespective of the debt asset used as a benchmark'. These potential, partial explanations of the equity premium would not contribute to any such premium with public funding.

Potential risk-based factors include alternative assumptions about preferences. Mehra and Prescott (1985) assumed conventional preferences in which the coefficient of risk aversion ($1 - \alpha$) is the reciprocal of the elasticity of intertemporal substitution σ. Mehra notes that this implies that 'aversion to variation of consumption across different states *at a particular point of time* is the same as aversion to *consumption variation over time* and there is no a priori reason that this must be so', and reviews two very different approaches to preferences.

One approach, Epstein and Zin (1991), presents a class of preferences that they term "Generalized Expected Utility" (GEU), which defines utility over time recursively and allows $(1 - \alpha)$ and σ to be independent. This is a significant theoretical advance, widely used in monetary and macro analysis (Pariès and Loublier, 2010; Barro, 2015).

However Mehra notes that "testing this preference structure ... depend on variables that are *unobservable*, and this makes calibration tricky". Agents' wealth evolves in the model as the return on *all* invested wealth. For this Epstein and Zin use the 'market portfolio' as a proxy. In Mehra's view 'this proxy overstates the correlation between asset returns and e wealth portfolio and hence [the authors'] claim that their framework offers a solution to the equity premium puzzle'. Mehra also notes that the GEU model 'has the *potential* to resolve the risk-free rate puzzle' (i.e. why is it so low?), but finds that to achieve this it would have to be assumed that σ is large, whereas there is independent evidence that σ is small. Mehra concludes that 'hence this generality is not very useful when the model is accurately calibrated'. The GEU model anyway does not explain how the equity premium might apply to income-correlated risk in the benefits of public funding.

The other approach to preferences applies the behavioural economic concepts of 'loss aversion' and 'narrow framing'. Loss aversion describes the surprisingly consistent ratios of about 2 in the weight that people give to *perceived* financial losses relative to equal gains. This concept was developed Kahneman and Tversky (1979), using the term 'Prospect Theory', which is how it is now usually described. Narrow framing describes, in this case, the assumption that the investor is loss averse over changes in the value of their financial wealth, defined as holdings of T-Bills and stocks, disregarding other components of wealth, notably human capital and housing.

The first application of these concepts to the aggregate stock market was Benartzi and Thaler (1995). This developed a single period model and claimed to show that, if investors reviewed their holdings annually, loss aversion would fully explain the equity premium. Mehra dismisses this work because it looks at equity investment in isolation, commenting that 'without any direct connection to consumption it is impossible to ascertain how their model might describe the joint processes on equilibrium returns and consumption growth, for example'.

Mehra has more time however for the later work of Barberis et al (2001), which claims to 'help explain the high mean, excess volatility, and predictability of stock returns, as well as their low correlation with consumption growth'.[ii] Barberis et al estimated a substantial equity risk premium, but found that this required a multi-period model, where investors' preferences are influenced by the previous period. Mehra comments that "Loss aversion/narrow framing is an appealing idea and Barberis et al (2001) analyze its equilibrium asset pricing implications in a careful and thorough way. There is, however, a sense in which their study is premature. In particular, we as yet lack choice theoretic underpinnings and the aggregation properties are as yet unconfirmed (strict aggregation will not hold)."

There is here a hint of differences between how behavioural and conventional financial economics frame the issues. Barberis et al is not distinguishing between preferences over time and at a point in time, but between risk from equity returns and risk from sources (including public service benefits) that do not expose people to large financial losses of which they are keenly aware. Conventional financial economics does not easily accommodate preferences that vary across people's different perceptions of mathematically similar changes in income or wealth from different sources. Such context-specific framing is however fundamental to behavioural economics, including behavioural finance.

Since the Mehra review, work on behavioural finance and equity return has continued. Barberis (2015) is a long but accessible and informative set of slides under the heading of 'Prospect Theory Applications in Finance'. Introducing Benartzi and Thaler (1995), Barberis notes that the idea of bringing together loss aversion, regular investor review and narrow framing 'is now gaining acceptance'. This is supported by a 2009 quotation of Kenneth

French saying that 'When I think about my own preferences, this [Prospect Theory] argument seems reasonable to me'.

It also includes from the same interview a comment by Eugene Fama similar to the view of the equity premium long held in some, perhaps many government admirations. Fama's response to 'Has the equity premium puzzle gone away?' was 'There never was one. It is easy to show that this argument is silly.... the high volatility of stock returns ... means that getting a positive equity premium (of any size) is highly likely only for holding periods of 35 years (an investment lifetime) or more. Given this result, the historical equity premium does not seem too high'.

Experimental evidence on the perverse effect that reviewing portfolios can have on financial investors' returns (Metcalfe, (2017) adds significant[iii] support for the importance of prospect theory in understanding equity returns.

This behavioural explanation, again, does not apply to the cost of *public* funding, where there are no investors seeking and monitoring personal or institutional financial returns. Beneficiaries of publicly funded projects are often subject to income-correlated fluctuations in the benefits, but it seems implausible that these often generate material loss aversion.

In recent work from another perspective Shirvani, et al (2020), after a wide ranging review of the literature report that, by fitting the data to a distribution with heavy tails "the relative risk aversion coefficient reduced to 8.9626 [sic], a value that is within the range acceptable to economists". [iv] The paper contrasts this with 'explanations for the existence of the puzzle relied on arguments put forth by proponents of behavioural finance'. Time will tell how much traction it gains, but even if it were to prevail it would, again, offer no reason why equity premiums might be relevant to the benefits of public funding.

A discussion of the literature on systematic risk and public funding would be incomplete without a reference to Arrow and Lind (1970). That paper, influential in its day, was almost entirely about *non*-systematic risk. However, it is often presented today (Lucas, 2014; Gollier 2021) as if it has led generations of economists to misunderstand systematic risk. The paper was written many years before the consumption CAPM or the equity premium puzzle and before even traditional CAPM had spread widely. It takes a smoother view of macroeconomic stability than would be taken today. However Arrow and Lind's views on the cost of what is now described as systematic risk in publicly funded benefits will have been based on application of the neoclassical Little and Mirrlees analysis. Their doubts about whether this cost would ever be significant remain valid.

Today's critics agree that neoclassical estimates of the cost of systematic risk are generally extremely small. Gollier and Hammitt (2014, 282, 291) notes that the volatility (standard deviation) of Western world per capita growth rates has historically been about 3% per year;

and that, for an investment with a consumption β of 1, with an a elasticity of marginal utility of 2, the neoclassical estimate of the risk premium, expressed as a rate of return to investors, would be $2x(3\%)^2 = 0.18\%$. The paper adds that 'On a more normative ground, considering such a small systematic risk premium looks very counterintuitive because doing so makes the riskiness of projects nearly irrelevant to their evaluation'.

3. The impact of systematic risk with private and public funding

Section 2 implicitly accepted the fairly common presumption that public funding by taxation can safely be modelled in much the same way as private debt and equity financing.

Many aspects of financial planning and management are the same or similar with public funding and private financing. However, when public funding is providing non-financial benefits the distribution of costs, benefits and risk differs markedly from that with private debt and equity financing.

Private financing is conventionally provided by financiers in exchange for expected financial returns. Its cost is measured as an annual percentage rate of return. The cost of systematic risk in a project's financial return materialises as a premiums on the percentage rate of return required on the financier's investment.

Public funding is different. Public services generally produce no net revenue. The costs of systematic risk fall as absolute reductions in the consumption-value of those benefits that are corrected with income. But, following Little and Mirrlees, these percentage reductions will very rarely be more than be trivial. Moreover they do not accumulated at an exponential rate over time. There is no financial feedback to taxpayers imposing any cost of systematic risk to them, as generally happens to equity financiers.

With public financing the nature of any consumption-equivalent benefits generally has no material relationship with the costs of the funding. The social cost of a marginal dollar of general taxation is a dollar of consumption taken from the economy, plus the marginal excess tax burden imposed by distortionary and other costs of the taxation. This cost is broadly the same for all public spending.[v]

4. Discussion

Mehra (2006), as background to his review of the literature on the equity premium puzzle, commented that "The neoclassical growth model and its stochastic variants are a central construct in contemporary finance, public finance, and business cycle theory. ... The model has had some remarkable successes when confronted with empirical data. Unfortunately, when confronted with financial market data **on stock returns**, tests of these models have led, without exception, to their rejection." (Emphasis added). The equity market premium is thus an unusual anomaly. However, it is also central to the cost of capital revealed by competitive

financial markets. It is thus unsurprising that many experts in that field, when faced with social discounting in government, should presume that the market cost of capital applies, like most other competitive market prices, to the public sector, but it is disappointing that this presumption appears always to be presented as an unqualified assertion.

From a welfare and behavioural economics perspective it is at least plausible that the freedom of equity markets, while essential for their vital function in a market economy, leads to extreme fluctuations and behavioural impacts on investors that have a significant (but unavoidable and acceptable) cost. The concept of competitive markets imposing costs in such a way may not, however, fit easily with the 'efficient markets' spirit of financial economics as it developed from the 1960s.

Both sides of this debate have acquired what they may see as heavy weapons.

On one side, the consumption CAPM, developed in the late 1970s, provides a 'consumption beta' that can sensibly be applied to public service benefits as well as returns to commercial returns to equity. However, while multiplying a consumption beta by the equity market premium makes sense for equity funded activities, it makes no clear sense for activities that are publicly funded.

On the other side, behavioural finance has now looked seriously at the impact of fluctuations in equity returns on financial investors, in theory and to a limited extent empirically. This work provides good evidence that the anomalous high returns to equity are at least largely attributable to the nature of equity markets for reasons that do not apply to public funding.

Less widely recognised, but also quantitatively important, is the very different way in which the cost of systematic risk falls in markets financed by debt and equity as opposed to activities funded by public spending. In the former case the cost falls as a higher required annual rate of return to private financiers. In the latter, public funding case, the cost falls as an absoluter reduction in the value of the benefits to the public service beneficiaries.

5. Conclusion

Many financial experts believe that the costs of financing revealed by competitive financial markets is a social cost that applies equally to public funding of similar activities. However, the differences between financing by investors seeking a financial return and funding by taxation are substantial.

Private financing has crucial, beneficial incentive impacts that are lacking with public funding. However, there is good evidence that the freedom of equity markets that contributes greatly to these benefits also brings significant costs. There is also good evidence that these costs are not relevant to public funding. In any case any cost of systematic risk in the

benefits of public funding does not fall as an annual rate of return, but as a reduction in the value of the benefit's to beneficiaries.

The benefits of publicly funded projects, in developed as well as less developed economies, are sometimes strongly covariant with income, but the cost of virtually any plausible covariance appears to be trivial.

However, given the subtlety of the issues, and the tending for them to be framed very differently by experts with different analytical backgrounds, professional consensus may be a long way off.

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Appendix: Traditional and consumption CAPM

The traditional CAPM is expressed as

$E(Ri) = R_f + \beta_{mi}\{E(R_m) - R_f\}$

where

$E(Ri)$ is the expected rate of return on an asset i

R_f is the risk-free interest rate

$E(R_m)$ is the expected average market rate of return

β_{mi} = market beta for asset $i = \text{cov}(R_i,R_m)/\text{var}R_m$.

The term in curly brackets is the "market premium".

If the return to the asset varies proportionately to the market average return $\beta_{Mi} = 1$ and the estimated asset premium is equal to the market premium.

The Consumption CAPM redefines beta as

β_{ci} = consumption beta for asset $i = \text{cov}(R_i,R_c)/\text{cov}(R_m,R_c)$

where

R_c is the consumption growth rate.

If the return to the asset varies proportionately to consumption $\beta_{Ci} = 1$. As with the traditional CAPM, the estimated asset premium is again equal to the equity market premium.

Thus, while benefits of public spending or regulation are likely to have consumption betas higher than market betas, the question of whether the equity market premium is materially relevant to public funding applies to both forms of CAPM.

References

Arrow, Kenneth and Robert Lind. 1970. Uncertainty and the Evaluation of Public Investment Decisions, *American Economic Review*, 60: 364-78.

Barberis, N., M. Huang, and T. Santos (2001), Prospect theory and asset prices, *The Quarterly Journal of Economics* 116.1: 1–53.

Barberis, Nicholas. 2015. Prospect Theory Applications in Finance, Yale University, https://canvas.harvard.edu/files/392444/download?download_frd=1 (accessed 21 February 2021)

Barro, Robert. 2015. Environmental Protection, Rare Disasters and Discount Rates, *Economica*, 82: 1–23.

Benartzi, Shlomo, and Richard Thaler. 1995. Myopic Loss Aversion and the Equity Premium Puzzle, *Quarterly Journal of Economics*, 110(1): 73–92.

Brealey, Richard, Ian Cooper, and Michel Habib. 1997. Investment Appraisal in the Public Sector, *Oxford Review of Economic Policy*, 13(4): 12–28.

Dietz, Simon, Christian Gollier and Louise Kessler, 2018. The climate beta, *Journal of Environmental Economics and Management*, 87: 258–274/

Epstein, L. G. and S. E. Zin, 1991. Substitution, risk aversion, and the temporal behavior of consumption and asset returns: An empirical analysis, *Journal of Political Economy* 99: 263–286.

Freeman, Mark and Ben Groom, 2016. Discounting for Environmental Accounts', Report for the Office for National Statistics, Chantry Educational Services. https://www.ons.gov.uk/economy/environmentalaccounts/methodologies/naturalcapital (accessed 20 February 2021)

Gollier, Christian (2021) The welfare cost of ignoring the beta, Toulouse School of Economics, University of Toulouse-Capitole https://www.tse-fr.eu/sites/default/files/TSE/documents/doc/by/gollier/forget6.pdf (accessed 20 February 2021)

Gollier, Christian, and Jim Hammitt. 2014. 'The Long-Run Discount Rate Controversy' *Annual Review of Resource Economics*, 6: 273–295.

HM Treasury. 1997. The Green Book. Appraisal and Eventualxx in Central Government, London: The Stationery Office.

HM Treasury. 2020. The Green Book Central Government Guidance on Appraisal and Evaluation, Open Government Licence, https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-governent

Kahneman, Daniel and Amos Tversky. 1979. Prospect Theory: An Analysis of Decision under Risk, *Econometrica,* 47**.**2: 263–291.

Little, I, and J. Mirrlees. 1990. Project Appraisal and Planning Twenty Years On, Proceedings of the World Bank Annual Conference on Development Economics

Lucas, Deborah. 2014. Rebutting Arrow and Lind: Why Governments Should Use Market Rates for Discounting, *Journal of Natural Resources Policy Research*, 6(1): 85–91.

Mehra, Rajnish. 2006. The Equity Premium Puzzle: A Review, *Foundations and Trends in Finance*, 2.1: 1–81.

Mehra, Rajnish and Prescott, Edward. 1985. The Equity Premium: A Puzzle, *Journal of Monetary Economics*, 15: 145-161.

Metcalfe, Robert. 2917. Myopic Loss Aversion: A Behavioral Answer to the Equity Premium Puzzle?, *behavioralxxeconomics.com*
https://www.behavioralxxconomics.com/myopic-loss-aversion-a-behavioral-answer-to-the-equity-premium-puzzle/
(Accessed 30 January, 2021)

Moore, Mark, Anthony Boardman and Aidan Vining. 2017. Risk in Public Sector Project Appraisal: It Mostly Does Not Matter! *Public Works Management & Policy*, 22(4): 301-321.

OMB. 1992, Circular A-94 Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs,
https://www.whitehouse.gov/sites/whitehouse.gov/files/omb/circulars/A94/a094.pdf
(accessed 20 September 2020).

OMB. 2003. Circular A-4, Regulatory Analysis,
https://obamawhitehouse.archives.gov/omb/circulars_a004_a-4/ (accessed 21 January 2021).

Pariès, Matthieu, and Alexis Loublier. 2010. Epstein-Zin Preferences and Their Use in Macro-Finance Models: Implications for Optimal Monetary Policy, Working Paper Series No 1209/June, European Central Bank. Available at Epstein-Zin preferences and their use in macro-finance models: implications for optimal monetary policy (ssrn.com) (accessed 2 February 2021).

Shirvani, Abootaleb, Stoyan Stoyanov, Frank Fabozzi and Svetlozar Rachev. 2020. Equity premium puzzle or faulty economic modelling? *Review of Quantitative Finance and Accounting*, published online 31 August.

[i] Although Moore et al (2017) discuss the issue from a welfare economics perspective, in terms similar to those in this paper.
[ii] Barberis et al also identify a limitation in Benartzi and Thaler, which had presented only a single-period model, by showing that the effects on each successive period of previous gains or losses need to be included to establish that loss aversion can generate a substantial equity premium.
[iii] The Summary at the end of Barberis (2015) illustrates how behavioural finance has developed in general and in its study of the equity risk premium.
[iv] The authors adopted what they describe as a log-normal compound inverse Gaussian distribution.
[v] The marginal opportunity cost of public funding from a specific budget will of course also depend upon how tight the budget is relative to the marginal value of the relevant spending options.