

Institution: Loughborough University		
Unit of Assessment: C17 – Business and Management Studies		
Title of case study: Using Social Discount Rates to Inform Public Investment Decisions in Long-Term Projects		
Period when the underpinning research was undertaken: 2012 to 2016		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s):	Role(s) (e.g. job title):	Period(s) employed by submitting HEI:
Mark Freeman	Professor of Finance	February 2012 to September 2016
Period when the claimed impact occurred: January 2014 to December 2020		
Is this case study continued from a case study submitted in 2014? No		
1. Summary of the impact (indicative maximum 100 words)		
<p>Public sector bodies need effective methods to evaluate long-term returns on spending in areas such as environmental protection. National and international bodies have used Professor Mark Freeman's research on intergenerational social discount rates (SDRs) to underpin their valuation of long-term assets. The methods and recommendations arising from this work have been adopted by HM Treasury in its <i>Green Book</i> instructions to all UK government departments; by the Dutch government's <i>Green Book</i> equivalent; by the UK's Office for National Statistics for valuation of long-term assets in the national accounts; and by the New York State Government's Department of Environmental Conservation for estimating the value of reducing carbon and other greenhouse gas (GHG) emissions. Freeman's work has also been widely cited in policy documents of governments and national and international agencies.</p>		
2. Underpinning research (indicative maximum 500 words)		
<p>HM Treasury's <i>Green Book</i> notes that "society as a whole... prefers to receive goods and services sooner rather than later". This is why a government will place a lower value on a future benefit for each year that it expects to wait to receive it.</p> <p>Social discount rates (SDRs) quantify the magnitude of this effect. Because of the compounding effects of interest, the economic values that governments place today on long-term projects are extremely sensitive to the precise choice of SDR. For example, if the SDR is 1% then a government will place a value of GBP60.80 today on a project that will deliver GBP100 of benefits in 50 years' time (calculated as $100/1.01^{50}$); yet if the SDR increases only slightly, to 3%, the value placed today on the same project is much lower, at GBP22.81 (calculated as $100/1.03^{50}$).</p> <p>This sensitivity of valuation to the choice of SDR is of significant concern to governmental bodies, because many of the pressing problems facing society today – including climate-change mitigation – have very long-term consequences. For these reasons, determining the intergenerational SDR has been described as "one of the most critical problems in all of economics" (Weitzman, 2001).</p> <p>One of the two broad approaches to determining the SDR, the 'positivist' method, states that it should reflect rates of return offered by other investments, particularly government bonds. This approach requires an understanding of asset pricing theory, and it is primarily from this financial angle that Freeman has contributed to the literature in his research conducted at</p>		

Loughborough. Freeman works with co-authors – most notably Groom (LSE/Exeter) – who mainly specialise in the alternative ‘normative’ approach, which states that the SDR should be determined by considering more philosophically the ethics of intergenerational equity.

The ‘term structure’ of SDRs plots the relationship between the SDR and the maturity of the project being appraised. The Freeman/Groom team has contributed extensively to the ‘declining discount rates’ (DDRs) literature, which argues that this term structure should be downward-sloping, with lower discount rates applied to longer-lived assets.

The team’s econometric estimation of the real interest rate process, with particular emphasis on the inflation component, constructed a new positivist declining term structure of SDRs. Previous research had mixed real (inflation-adjusted) and nominal data, and this work was the first to resolve this inconsistency [R1].

Further research across a number of different theoretical frameworks proved that in practice it is essentially impossible to empirically estimate with precision the rate at which the term structure of SDRs should decline. This work established the hypersensitivity of intergenerational SDRs to small changes in econometric assumptions [R2]. Freeman also applied DDRs for the first time in a full-cost accounting framework to the valuation of environmental assets [R3].

In addition, Freeman co-authored what is primarily a review paper on DDRs, with a clear focus on potential policy applications [R4]. The paper formed part of one of the very few 2014 American Economic Association conference sessions to be webcast and then placed on the AEA website; the session was chaired by Lord Stern and discussed by Nobel laureate Kenneth Arrow.

Freeman’s research at Loughborough also resulted in a 2018 *American Economic Journal: Economic Policy* article that is extensively used as the go-to survey of expert opinion on intergenerational SDRs [R5]. As well as describing the range of views held by experts, the article provides a conceptual understanding of why there is such strong disagreement on this issue. Reconciling differences in expert opinions into ‘consensus’ SDRs, Freeman’s work has also shown that the speed with which the term structure declines depends crucially on whether experts are taking a positive or normative position on social discounting [R6] – providing a key critique of one of the main papers in this field.

3. References to the research (indicative maximum of six references)

R1 Freeman, MC, Groom, B, Panopoulou, E, and Pantelidis, T (2015): ‘Declining discount rates and the Fisher Effect: inflated past, discounted future?’, *Journal of Environmental Economics and Management*, volume 71, pages 32-49
<https://doi.org/10.1016/j.jeem.2015.06.003>

R2 Freeman, MC, and Groom, B (2016): ‘How certain are we about the certainty-equivalent long-term social discount rate?’, *Journal of Environmental Economics and Management*, volume 79, pages 152-168
<https://doi.org/10.1016/j.jeem.2016.06.004>

R3 Freeman, MC, and Groom, B (2013): ‘Biodiversity valuation and the discount rate problem’, *Accounting, Auditing and Accountability Journal*, volume 26, pages 715-745
<https://doi.org/10.1108/AAAJ-02-2013-1226>

R4 Cropper, ML, Freeman, MC, Groom, B, and Pizer, WA (2014): ‘Declining discount rates’, *American Economic Review (Papers and Proceedings)*, volume 104, issue 5, pages 538-543
<http://dx.doi.org/10.1257/aer.104.5.538>

R5 Drupp, MA, Freeman, MC, Groom, B, and Nesje, F (2018): 'Discounting disentangled', *American Economic Journal: Economic Policy*, volume 10, issue 4, pages 109-134
<https://doi.org/10.1257/pol.20160240>

R6 Freeman, MC, and Groom, B (2015): 'Positively gamma discounting: combining the opinions of experts on the social discount rate', *The Economic Journal*, volume 125, pages 1015-1024
<https://doi.org/10.1111/eoj.12129>

All except R4 are separate and distinct pieces of empirical work. R4 is a review piece arising from a presentation at an eminent US conference. All outputs are published in academic journals with rigorous peer-review and editorial processes, overseen by well-established and internationally respected academics in the field of economics and its application to contemporary problems. R5 was published after Freeman left Loughborough, but the research was carried out during his time there. It is closely based on a November 2015 working paper available at the Centre for Climate Change Economics and Policy website.

4. Details of the impact (indicative maximum 750 words)

Freeman's research on long-term discount rates applicable to environmental and other policies has been cited in documents produced by governmental and other agencies around the world between 2014 and 2020. This is due partly to his participation in conferences with policymakers and to reports based on research that he has authored or co-authored for national and international organisations [S1].

In the US Freeman's work has contributed to a report by the prestigious National Academies of Science, Engineering & Medicine, a Council of Economic Advisers briefing to the Obama Administration and an Institute of Policy Integrity report on emissions standards. His research has also been cited in economic and environmental policy documents of the German, Irish, New Zealand and Rwandan governments, by the European Commission and by the OECD. Freeman presented twice in 2016 to the Home Office Counter-terrorism team on the cost-benefit case for long-term de-radicalisation programmes. The Home Office Head of Counter-Terrorism Strategy and Performance later stated: "The points you made about different approaches to cost-benefit analysis and counter-terrorism helped us with our own thinking on the matter." [S1]

As well as this reach, full details of which can be accessed via the links listed in S1, the significance of the impact of Freeman's work is demonstrated by the examples below.

• **Setting of the discount rates used in cost-benefit analysis methods prescribed by the UK Treasury's Green Book in 2018 and 2020**

In 2018 HM Treasury reissued its *Green Book*, the guidance that covers a huge range and volume of public sector investment decisions and prioritisation. The guidance "applies to all proposals that concern public spending, taxation, changes to regulations and changes to the use of existing public assets and resources... [and] all government departments, arm's-length public bodies with responsibility derived from central government for public funds and regulatory authorities" (2018 *Green Book* foreword). As part of the update, HM Treasury undertook a detailed review of whether the discount rates used in the previous edition remained appropriate, including its use of DDRs.

Following two workshops with HM Treasury, Freeman, with Groom and Spackman, authored a detailed report on this topic [S2]. This was the only academic supplementary guidance to the *Green Book* published online by HM Treasury. It cited and used all the underpinning research except R3, and provided the academic support to the discounting recommendations given in the *Green Book*. In 2020 the lead author of the *Green Book* at HM Treasury stated: "Mark Freeman's contribution has been central to this important area of

public concern, and his advice, backed up by his research, has been important in informing how we set and apply public sector discounting in the challenging times from the 2008 financial crisis right up until the present.” [S3]

The Chancellor announced in his 2020 Budget statement a further review of the *Green Book*, on which Freeman was consulted. The lead author of the *Green Book* at HM Treasury stated: “Current considerations concerning uneven development within the UK make research in the area of social discounting doubly important, and we expect to be consulting Mark Freeman again this year” [S3]. In the 2020 edition of the *Green Book*, Freeman’s work was again prominent, and the 2018 report with Groom and Spackman formed a key part of the justification for the discount rate (S4, see especially Section 14).

• *Setting of the discount rates used in cost-benefit analysis methods prescribed by the Netherlands government in 2015 and 2020*

In 2015 Freeman gave expert advice on long-term social discounting to a working group of the Ministry of Finance, Netherlands. The government subsequently stated (translated): “The Cabinet accepts all the recommendations of the working group... [and] has as its starting point that this advice is followed in all policy areas where discounting is involved.”

The Ministry’s response was further updated in 2020 and it again extensively used Freeman’s research, including reproducing some of R5’s Figures [S5], as well as the detailed report used by HM Treasury [S2], in justification of the long-term discount rate now widely and compulsorily used across the Netherlands government. In December 2020 the Programme Leader stated: “The Dutch government has accepted all recommendations of the advice on the discount rate. As a result, the advised discount rate is now mandatory in all government cost-benefit analyses and other policy assessment where discounting plays a role. Cost-benefit analysis is widely used to inform policy decisions in the Netherlands.” [S6]

• *Setting of the discount rate applied by the UK Office for National Statistics in the valuation of long-lived assets in the UK national accounts*

In 2016 the Office for National Statistics (ONS) began a review of the values used for different types of long-term liabilities and assets in the UK national accounts. The aim was to ensure that appropriate discount rates were set within a common framework and that they could be easily explained and justified. To this end, the ONS commissioned two reports from Freeman and colleagues.

With Groom, Freeman authored a 2016 report on the valuation of environmental assets. This was cited in the *UK natural capital accounts methodology guide: October 2019* (page 5): “Based on an extensive review by external consultants, the ONS and Defra use the social discount rate set out in the HM Treasury *Green Book*.” In 2017 Freeman and colleagues conducted an external review of the discount rates that the ONS should use in the production of its outputs, resulting in a report that covered a wide range of long-lived assets. The Deputy Director and Deputy Chief Economist at the ONS commented in 2019: “By providing transparency on the options available and how historic decisions have been taken, this work has helped validate the discount rates used in the national accounts in 2019, delivering a key support to maintaining and implementing the current methodologies.” [S7]

• *Informing the New York State Department of Environmental Conservation’s guidance on estimating the value of reducing carbon and other GHG emissions*

New York State has a population of more than 19 million. In 2020 its Department of Environmental Conservation issued a guidance document to all New York government agencies about calculating the social cost of carbon and other GHG emissions [S8].

Endorsed by Governor Cuomo, the guidance argued that the discount rates used by the Federal Inter-agency Working Group underestimated the value of avoided damages from GHG emissions. A new monetary value was therefore established for avoided emissions of carbon dioxide, methane and nitrous oxide. Freeman's work (especially **R5**) was cited as the primary justification for its policy that the social cost of carbon should be calculated at a discount rate of 1-3% instead of the Federal range of 2.5-5% [**S8**]. In 2020 the Economics Director at the Institute for Policy Integrity at New York University noted that Freeman's work would "directly lead to New York taking more aggressive climate action." [**S9**]

• **Other engagement with decision-making bodies**

In 2020, with Freeman, with Groom and Turk, delivered a report commissioned by the International Seabed Authority (ISA) on appropriate social discount rates. This was to inform decisions on a financial model for the system of payments of deep seabed mining contracts to the ISA. **R4**, **R5** and **S2** contributed heavily to the analysis. ISA, an autonomous organisation established under the United Nations Convention on the Law of the Sea, views the report as a key input to its policy decision-making [**S10**].

Freeman continues to be consulted by national and international government bodies on the basis of his Loughborough research. Instances during 2020 include an invitation to participate in a review of environmental discounting by HM Treasury; a commissioned think piece (with Groom) for the UK Department for Transport; and a request from the US Environmental Protection Agency for advice on estimating the social cost of carbon.

5. Sources to corroborate the impact (indicative maximum of 10 references)

All material at web-links below is also provided to REF as PDFs.

S1 Document listing links to reports from government and other agencies citing Freeman's research

S2 *Social Discount Rates for Cost-Benefit Analysis: A Report for HM Treasury*, February 2018 <https://tinyurl.com/p9mfabry>

S3 Testimonial from lead author of *Green Book* at HM Treasury, March 2020

S4 HM Treasury *Green Book*, 2020 edition (see annex 6)
<https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-government/the-green-book-2020>

S5 *Rapport werkgroep discontovoet 2020*, Dutch Ministry of Finance, 2020 (see pages 54-58 and 80) <https://www.rwseconomie.nl/documenten/rapporten/2020/december/21/rapport-werkgroep-discontovoet>

S6 Testimonial from Programme Leader, Netherlands government, December 2020

S7 Testimonial from Deputy Director and Deputy Chief Economist, ONS, November 2019

S8 *Establishing a Value of Carbon: Guidelines for Use by State Agencies*, New York State Department of Environmental Conservation, 2020 (see page 35)
https://www.dec.ny.gov/docs/administration_pdf/vocfguid.pdf

S9 Testimonial from Economics Director, Institute for Policy Integrity, New York University School of Law, November 2020

S10 Testimonial from Legal Officer, International Seabed Authority, January 2021