Dividend Growth Model Results

Market Risk Premium Estimate

Report for the Consumer Reference Group

10 March 2022

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10 March 2022

Dear Kieran

Dividend Growth Model Results and the MRP estimate

In accordance with our scope of work we are pleased to provide the Consumer Reference Group (CRG) with our report into the use of Dividend Growth Model (DGM) results to estimate the Market Risk Premium (MRP). We would like to thank the CRG for providing support throughout the preparation of this report.

Please contact me on [redacted] should you have any questions relating to this report.

Yours sincerely,

[redacted]

Alex Georgievski

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Executive Summary

The Australian Energy Regulator (AER) is considering three options for determining its position on estimating the MRP in the 2022 Instrument:

1. Place most weight on using the Historical Excess Return (HER) as per the current approach.

2. Use DGM results to directionally inform the point estimate of the MRP.

3. Place weight on DGM results alongside the HER using a mechanical approach.

A progressive shift in position from option 1 to option 3 would indicate an increasingly definitive view on the merits of DGM results to provide a reliable and robust MRP estimate. The 2022 Instrument is to be applied by the AER without exercising any discretion implying the AER will have formed that definitive view if it is to be applied in the 2022 Instrument.

AER two-stage and three-stage DGM results

The AER's three-stage DGM results are more sensitive to variations in key inputs when compared with the two-stage DGM results at October 2021. This appears driven by a positive spread between implied growth from analysts' dividend forecasts and long-term growth rate $\boldsymbol{g}$: the impact of the spread on DGM results appears to have switched since November 2013. Two lines of enquiry extend from this:

- Identify the dynamic drivers of the spread or consider doing away with $\boldsymbol{g}$ using GDP forecast as an input and rely on implied dividend growth from analysts' dividend forecasts entirely.

- The DGM is known to proxy for low Price / Earnings (P/E) ratio stocks in the longer-term: a known irregularity that can reverse at times. Identification and resolution of irregularities such as this will reduce potential for bias in DGM results used to estimate the MRP; to the extent they are considered relevant in the overall market index.

ENA calibrated DGM results and variable growth rate models

The Energy Networks Australia (ENA) calibrated DGM decouples the DGM result from the long-term GDP forecast by adjusting $\boldsymbol{g}$. This is a step in direction bringing the DGM closer to the partial equilibrium asset return realm of the Sharp Lintner (SL) Capital Asset Pricing Model (CAPM): with a caveat surrounding a relationship between the risk-free rate and the estimated MRP (as it links $\boldsymbol{g}$ to expected return on equity $\boldsymbol{k}$). The ENA is furthering work on its DGM. If dilemma surrounding a relationship between the risk-free rate and the estimated MRP cannot be resolved empirically, or on theoretical grounds, it may be best avoided by exploring the potential for implementing variable growth DGMs with constant discount rates that delink $\boldsymbol{g}$ from $\boldsymbol{k}$.

A way forward

Given the indicative findings outlined above we have not found sufficient merit to support a definitive view on the use of DGM results, in their current form, to provide a reliable and robust MRP estimate (option 3) or to inform the MRP point estimate (option 2) in the 2022 Instrument. The long-term interests of consumers are aligned with the expectations of long-term investors seeking long-run returns. The long-term investor holds the market portfolio for the long-term: enabling the MRP to determine the cost of equity for long-lived assets in the one-period SL CAPM.

Further progress on the development and implementation of variable growth rate DGMs, to address the findings in this report and to avoid dilemma surrounding a relationship between risk-free rates and MRP estimates, is anticipated in the lead up to the 2026 Instrument. This progress may inform a more definitive view on the merits of DGMs for estimating the MRP at that time.

1. Introduction

1.1 AER's proposed position: estimating the MRP

The MRP in the SL version of the CAPM is unobservable and must be estimated. The AER is considering three options to estimate the MRP in the 2022 Instrument:

1. Maintain the current approach consistent with the 2018 Instrument: giving most weight to the HER and lesser weight to other relevant evidence.

2. Inform point estimates of the MRP using DGM results in a similar way to the 2013 approach: using DGM results in a directional sense, or alternatively, setting the MRP having considered DGM results and other relevant evidence.

3. Provide more weight to the DGM results alongside the current approach: prescribing a mechanical approach to weight HER and DGM results (and specifying DGM inputs). For this option the AER must also decide whether:

    a. it sets the MRP estimate in the 2022 Instrument; or

    b. it mechanically updates the MRP estimate over the life of the 2022 Instrument.

    Other relevant evidence, including surveys and conditioning variables, is not considered weighable on a stand-alone basis. To this end, the HER and DGM results remain the dominant approaches for estimating the MRP.

A progressive shift in position from option 1 to option 3 would indicate an increasingly definitive view on the merits of DGM results to:

- reliably inform point estimates of the MRP using the HER (shift from option 1 to option 2);

- provide reliable and robust estimates alongside the HER to apply weight to (shift from option 2 to option 3).

The 2022 Instrument will be applied by the AER without exercising any discretion. This implies the AER will have formed the definitive view on DGM results if it is to be applied in the 2022 Instrument.

1.2 Scope of work

Woollahra Partners was engaged to undertake an evaluation of the potential use of DGM results as an input to estimating the MRP in the 2022 Instrument. The evaluation included a review of:

- the AER two-stage and three-stage DGM results.

- the ENA calibrated DGM results.

- the literature on variable growth rate DGMs (stochastic DGMs).

The evaluation took into consideration factors including:

- sensitivity of DGM results to variation in key inputs to assess the plausible ranges of MRP estimates that may arise.

- whether, in practice, a DGM will link MRP estimates to the risk-free rate.[1]

- potential consequences for consumers if DGM results are used as part of a formula to update the MRP estimate during the life of the 2022 Instrument (rather than a fixed MRP estimate).

1.3 Inherent limitations and disclaimer

This document is solely for the purpose outlined herein and is not intended for any other purpose; and Woollahra Partners is not responsible, in any way, for any reliance placed by third parties.[2] The statements made herein are, in our view, accurate and there is no warranty provided of completeness or accuracy in relation to information and documentation provided to us as part of our review. We agree for this document to be provided to the AER.

1.4 Acknowledgement

Woollahra Partners would like to thank CRG members and Energy Consumers Australia (ECA) for supporting this engagement. We would also like to thank the AER for making staff available to discuss its DGMs and to answer our questions; and the ENA, including its advisors Frontier Economics, to discuss its calibrated DGM and to answer our questions.

1.5 Structure of this Report

This report is structured as follows:

- Section 2.1 provides a background to the foundations of DGMs and its extensions.

- Section 2.2 summarises the AER's two - stage and three - stage DGMs and inputs.

- Section 2.3 presents indicative findings from the analysis of the sensitivity of AER's DGM results to variation in key inputs.

- Section 2.4 discusses the ENA calibrated DGM and makes suggestions for refinements to consider as part of further work planned.

- Section 2.5 presents variable growth rate DGMs as a potential way forward for consideration.

Supporting references are provided in the Appendix.

[1] Noting the AER's preferred position to not recognise a relationship between the MRP and the risk-free rate when making the 2022 Instrument.

[2] This report contains general information only and neither Woollahra Partners, nor its related entities, is providing professional advice or services through its publication. To the extent the report contains information on financial products this does not constitute the provision of financial product advice or services. You should seek the advice of a qualified professional advisor before making any financial decisions that may affect you or your business based upon any information contained herein. Neither Woollahra Partners, nor its related entities may be held responsible for any loss by any person relying on information contained in this publication.

2. Dividend Growth Model Results and the MRP estimate

2.1 DGMs: foundations and extensions

Theoretical foundations of the DGM predate those of the CAPM. Various versions of the DGM are extensions of the constant growth rate Gordon Growth Model with refinements made to dividend dynamics: from a deterministic and constant growth rate $\bar{g}$ to variable dividend growth rate $\tilde{g}$ (stochastic DGMs).

DGMs discount expected dividends by a return on equity that equates the cash-flows to their market value. Their resounding appeal derives from an ability to be fitted to prevailing market conditions under minimal and simplistic assumptions relating to ***g***.

2.2 AER two-stage and three-stage DGMs

The AER two-stage and three-stage DGMs are deterministic extensions to the Gordan Constant Growth model that capture expected dividends in a multi-stage setting. Dividends are assumed to transition to the constant long-term dividend growth rate ***g*** in the final stage.

The form of the AER DGMs and its inputs are as follows:[3]

$$P_c = \frac{m \times E(D_c)}{(1+k)^{m/2}} + \sum_{t=1}^{N} \frac{E(D_t)}{(1+k)^{m+t-0.5}} + \frac{\frac{E(D_N)(1+g)}{k-g}}{(1+k)^{m+N-0.5}}$$

where:

Pc is current price of equity;

E(Dc) is expected dividends per share for current financial year;

E(Dt) is expected dividends per share for financial year *t* years after current financial year;

m is the fraction of current financial year remaining expressed as a decimal point;

N is the time after which dividend growth reverts to its long-term rate;

g is expected long-term growth rate in nominal dividends per share;

k is the expected return on equity for the market portfolio.

The DGM is transparent and straightforward to implement with the following assumptions:

- consensus analyst dividend forecasts in the first stage and constant long term dividend growth rate ***g*** in the final stage.
- step-change transition from first to final stage (two-stage DGM) and gradual transition from first to final stage (with linear adjustment in the second stage of the three-stage DGM).
- discount factor with constant expected return on equity ***k***.

[3] This version of the DGM assumes a mid-year convention to adjust for the timing of dividends distributed throughout the year.

The DGM result is the solution to k that equates discounted expected dividends to the value of the market index. The risk-free rate is deducted from k to obtain the MRP estimate.

Table 1 summarises the inputs of the AERs two-stage and three-stage DGMs.

Table 1 Summary of inputs: AER two-stage and three-stage DGMs

Input	Two-stage DGM	Three-stage DGM
Pc: current price of equity.	Proxied by the **S&P/ASX 200** index.	As per two-stage model.
E(Dc): expected dividends per share for current financial year. ***E(Dt):*** expected dividends per share for financial year *t* years after current financial year	The **Bloomberg** AS51 index provides forecast dividends for the current financial year and the next two financial years.[4] Dividend forecasts are adjusted for imputation credit effects assuming 30 pc corporate tax rate, 0.65 utilisation rate and 0.9 distribution rate.	As per two-stage model.
N: time after which dividend growth reverts to long-term rate ***g***.	**2** periods dividends adjust to ***g*** after ***t.***	**9** periods dividends adjust to ***g*** linearly between ***t*** and ***N.***
g: long-term growth rate in nominal dividends per share	**4.6 pc** nominal based on: $4.6 = 100 \times \{(1 + g^r)(1 + \text{inf}) - 1\}$ where: g^r: is the real dividend growth rate of **2 pc** derived from a long-term GDP forecast of **3 pc** minus a deduction of **1 pc** to account for the net creation of shares: new share issuance (net of buybacks) and emergence of new companies.[5] **inf**: is inflation of **2.5 pc** which is the midpoint of the RBA target range of 2 - 3 pc.	As per two-stage model

Inflation plays a role in converting a real growth rate to a nominal growth rate of 4.6 pc (as defined in table 1). It is assumed that expected inflation is given by the midpoint of the RBA target range of 2 to 3 pc. Depending on the inflation transmission mechanism the impact of entering a period of relatively

[4] The Bloomberg AS51 Index sums Dividends Per Share (DPS) estimates for each stock in the index based on a consensus mean of sell side analysts' best DPS estimate, provided to Bloomberg, for each stock. Total dividends are divided by an index divisor which translates them to index points. To the extent there is bias in the dividend analyst forecast (analyst optimism) would be priced in an efficient market (as a discount): which is reflected in the literature.

[5] 1 pc is the midpoint in Lally, The Dividend Growth Model, 4 March, 2013.

volatile inflation will be reflected in a rising nominal risk-free rate and the expected return of equity ***k*** but not in ***g*** (given the fixed inflation assumption). If rising interest costs are fully reflected in the market inputs, there would be theoretical offset; if not this may impact DGM results.

2.3 Sensitivity analysis

The AER publishes sensitivities of DGM results to the key inputs summarised in Table 1. Sensitivities include: long-term growth rate (***g***), averaging period, analyst's dividend forecasts, and a combined sensitivity. Table 2 summarises AER DGM sensitivities at three points in time and the market inputs:[6]

Table 2 Summary of AER DGM sensitivities and market inputs

Sensitivity	Published December 2013	Published December 2018	Published December 2021
1. Long term div. growth (***g***)	Low: 4.0 pc Mid: 4.6 pc High: 5.1 pc	Low: 3.78 pc Mid: 4.6 pc High: 5.1 pc	Low: 3.78 pc Mid: 4.6 pc High: 5.1 pc
2. Averaging Period	N/A	2 months 6 months 12 months	2 months 6 months 12 months
3. Shift in analyst's dividend forecast	N/A	+ 10 pc - 10 pc	+ 10 pc - 10 pc
4. Combined low	N/A	3.78 pc div. growth (***g***) 6 month averaging Analyst div. forecast -10 pc	3.78 pc div. growth (***g***) 2 month averaging Analyst div. forecast -10 pc
Combined high		5.1 pc div. growth (***g***) 12 month averaging Analyst div. forecast +10 pc	5.1 pc div. growth (***g***) 12 month averaging Analyst div. forecast +10 pc
ASX 200 Index[7] **Dividend Yield**[8]	5425 / 5320 4.09 pc / 4.19 pc	6319 / 6208 4.02 pc / 4.08 pc	7332 / 7324 3.47 pc / 3.43 pc
Commonwealth Government Bond Rates:[9]			
2 yr	2.69 pc / 2.71pc	2.00 pc / 2.03 pc	0.01 pc / 0.16 pc
3yr	2.90 pc / 2.95 pc	2.06 pc / 2.06 pc	0.19 pc / 0.58 pc
5yr	3.33 pc / 3.35 pc	2.24 pc / 2.25 pc	0.66 pc / 1.11 pc
10yr	4.00 pc / 3.97 pc	2.59 pc / 2.63 pc	1.28 pc / 1.72 pc

[6] AER, Better Regulation, Explanatory Statement, Rate of Return Guideline (Appendices), December 2013. Page 119. These DGM estimates reflect the growth in real dividends per share of 1.5 pc, 2.0 pc and 2.5 (which correspond to ***g*** of 4.0 pc, 4.6 pc and 5.1 pc respectively). AER, Rate of Return, Overall rate of return, equity and debt omnibus, Final working paper, December 2021. Page 46. AER, Rate of Return, Explanatory Statement, December 2018. Page 268.

[7] https://www2.asx.com.au/about/market-statistics/historical-market-statistics.

[8] https://www marketindex.com.au/statistics. Market Cap Weighted Dividend Yield for All Ordinaries.

[9] https://www.rba.gov.au/statistics/tables/csv/f2.1-data.csv?v=2022-02-15-10-29-54

Sensitivity of DGM results to ***g*** did not materially change between Sep-18 and Oct-21 implying some symmetry exists in ASX200, analyst forecast dividends and Commonwealth Government Bond Rate changes in this time. At both Sep-18 and Oct-21 the two-stage DGM results are higher than the three-stage DGM results. At Nov-13 the reverse is true: likely explained by a higher implied growth from analyst's dividend forecasts relative to ***g*** at Nov-13. Analyst's dividend forecasts endure for longer in the linearly adjusted three-stage DGM requiring a higher discount rate to equate expected dividends to the ASX 200 at Nov-13. The opposite occurs at Sep-18 and Oct-21 and this switches the impact. These observations are highlighted in the shaded entries of table 2.1.

Table 2.1 DGM result sensitivity to long-term growth rate (*g*)
At Oct-21: 0.5 pc increase in ***g*** resulted in 0.48 pc increase in the MRP estimate in the two-stage DGM result (0.43 pc increase in the three-stage DGM result). 0.82 pc decreased in ***g*** resulted in 0.79 pc decrease in the MRP estimate in the two-stage DGM result (0.7 pc decrease in the three-stage DGM result).[10]

	Nov-13		Sep-18		Oct-21	
Long-term div growth (***g***)	Two-stage	Three-stage	Two-stage	Three-stage	Two-stage	Three-stage
High (5.1 pc)	7.1	7.5	8.02	7.64	8.16	7.49
Mid (4.6 pc)	6.7	7.1	7.54	7.23	7.68	7.06
Low (3.78 pc / 4 pc in 2013)	6.1	6.6	6.67	6.52	6.89	6.36
Range (high - mid)	0.4	0.4	0.48	0.41	0.48	0.43
Range (mid - low)	0.6	0.5	0.87	0.71	0.79	0.7
Range (high - low)	1.0	0.9	1.35	1.12	1.27	1.13

Sensitivity of DGM results to decrease in the averaging period showed visible decline in the DGM result for the three-stage DGM at Oct-21 as highlighted in the shaded entries of table 2.2. In the twelve months to Oct-21 the ASX200 increased from 5927 to 7323 and average Commonwealth Government Bond Rates increased from 0.4 pc to 1 pc. This suggests the three-stage DGM result is more downside sensitive, compared with the two-stage DGM result, to a scenario where a higher implied growth from analysts' dividend forecasts is below ***g*** in a rising ASX200 and rising Commonwealth Government Bond Rates (pursuant to the unwind of monetary stimulus): the MRP estimate reduces from 7.78 to 7.06 when decreasing the averaging period 12 m to 2 m.

Table 2.2 DGM result sensitivity to averaging period
At Oct-21: reduction in averaging period from 12 m to 2 m resulted in 0.13 pc decrease in the MRP estimate in the two-stage DGM result (0.72 pc increase in the three-stage DGM result).

	Sep-18		Oct-21	
Averaging Period	Two-stage	Three-stage	Two-stage	Three-stage
2 m	7.54	7.23	7.68	7.06
6 m	7.45	7.18	7.66	7.06
12 m	7.48	7.43	7.81	7.78

Sensitivity of DGM results to a shift in analysts' dividend forecasts shows a narrowing in the range of DGM results between Sep-18 and Oct-21 as highlighted in the shaded entries of table 2.3. On face value this implies a reduction in analysts' dividend forecasts impacting the three-stage DGM result for the same reasons outlined regarding relativity of analysts' dividend forecasts to ***g***. The 10 pc shift up in analyst's dividend forecast sensitivity for two-stage and three-stage DGM results mirrors the Oct-21 DGM results for a 10 pc increase in long-term growth rate ***g*** in table 2.1.

[10] Indicating some slight asymmetry between DGM results: three-stage DGM result slightly less sensitive to decline in ***g***.

Table 2.3 DGM result sensitivity to a shift in analyst's dividend forecasts
At Oct-21: 10 pc + / 10 pc – shift in analysts dividend forecasts resulted in a 0.94 pc range in the MRP estimate in the two-stage DGM (0.83 pc in the three-stage DGM).

	Sep-18		Oct-21	
Shift Analyst Forecasts	Two-stage	Three-stage	Two-stage	Three-stage
10 pc +	8.12	7.78	8.15	7.48
10 pc -	6.97	6.77	7.21	6.65
Range	1.15	1.01	0.94	0.83

The combined sensitivities reflect the additive decompositions of sensitivities highlighted above. For example: the combined high sensitivity uses 12 m averaging and produces a higher DGM result in the three-stage DGM than it does in the two-stage DGM in table 2.2. This is also likely the reason why the range for the three-stage DGM increases between Sep-18 and Oct-21 (while the two-stage DGM result range decreases). This observation is highlighted in the entries of table 2.4.

Table 2.4 DGM result combined sensitivities
At Oct-21: Combined high / combined low sensitivities resulted in a range of 2.34 in the MRP estimate in the two-stage DGM (2.71 pc in the three-stage DGM)

	Sep-18		Oct-21	
	Two-stage	Three-stage	Two-stage	Three-stage
Combined High	8.59	8.28	8.76	8.65
Combined Low	6.1	5.96	6.42	5.94
Range	2.49	2.32	2.34	2.71

To summarise:

The three-stage DGM results are generally more sensitive to variation in key inputs when compared with the two-stage DGM results:

- lower (higher) implied growth from analysts' dividend forecasts (relative to ***g***) result in a lower (higher) three-stage DGM result relative to the two-stage DGM result.
- the three-stage DGM result is sensitive to the averaging period when compared with the two-stage DGM result. For example: the MRP estimate reduces from 7.78 to 7.06 when decreasing the averaging period 12 m to 2 m at Oct-21 (during a period of rising ASX200 and rising Commonwealth Government Bond Rates pursuant to unwinding of monetary stimulus).

DGMs place greater weight on dividends in nearer periods and exponentially less weight on dividends in distant periods. The two-stage DGM and three-stage DGM treat transition to ***g*** differently: transition occurs linearly in the three-stage DGM and over a longer period. This difference in treatments can explain why the three-stage DGM results in a lower estimate of MRP at Sep-18 and Oct-21.

We have not reviewed the implied growth from analysts' dividend forecasts and a review of long-term GDP forecasts and associated adjustments to derive ***g*** is not within our scope of work. Yet it appears to be the case, at least anecdotally from the analysis, that a positive spread exists between implied growth from analysts' dividend forecasts and ***g***. The spread looked negative at Nov-13 but has since switched.

Two areas of enquiry extend from the indicative findings in this section:

- Identify the dynamic drivers of the spread or consider doing away with ***g*** using GDP forecast as an input and rely on implied dividend growth from analysts' dividend forecasts entirely: as

outlined in the variable growth rate DGM literature using constant discount rates (see section 2.5).

- The DGM is known to proxy for low Price / Earnings (P/E) ratio stocks: low P/E ratio (high dividend yield) stocks outperform high P/E ratio (low dividend) stocks over the longer-term (a known empirical irregularity).[11] There are certain periods in the short-term, however, when the irregularity reverses. This potentially impacts DGM results that estimate the MRP at a point in time if the irregularity manifests in the overall market; as has shown to be the case for single stocks and portfolios of stocks. The identification and resolution of irregularities such as this will reduce the potential for bias in DGM results used to estimate the MRP.

2.4 ENA calibrated DGM: further work and refinement

The ENA calibrated DGM solves for ***g*** to equate the average DGM result with the HER. The ENA has proposed the calibrated DGM would be used to estimate the MRP at the time of the 2022 instrument (and used to inform the MRP estimate): it is not proposed that it is re-estimated at the time of each determination.

At a high-level the ENA calibrated DGM is implemented as follows:

- Estimate the HER which becomes the fixed-point target for the calibration process.
- Use the current market index, Bloomberg 3-year dividend forecasts and a constant growth rate ***g*** to solve for the required return ***k*** in each month.
- Adjust ***g*** until the average DGM estimate of the MRP matches the HER over some historical period: adjustment to ***g*** is constant for each year comprising the average DGM estimate.
- The ENA acknowledges the calibrated DGM requires further work in extending the dividend forecasts back to 1988 and updating its regression analysis using a more comprehensive dataset.

The ENA calibrated DGM effectively decouples the DGM result from the long-term GDP forecast (including associated adjustments) through the adjustment to ***g***. This is a step in direction bringing the DGM closer to the partial equilibrium asset return realm of the SL CAPM: with a caveat surrounding the relationship between the risk-free rate and the estimated MRP.

The AER has expressed the view the calibrated DGM is a fixed growth DGM resulting in a negative relationship between the MRP and the risk-free rate. The ENA's view is that any relationship between the two is data driven and not assumed in the calibrated DGM. Initial regression analysis submitted by the ENA (using risk-free data and DGM results of the MRP estimates between January 1996 and June 2021) shows a large and significant negative coefficient on the risk-free rate in the regression equation. At the time of writing the ENA is updating regression analysis to include DGM results and risk-free rate data back to 1988 (a more comprehensive dataset) for the AER and stakeholders to consider.

In anticipation of the updated analysis, we have summarised some considerations relating to accompanying diagnostics for regression results and sensitivities for ongoing model refinement:

- if visual inspection of the regression residual plots indicates they are correlated with the independent variables this may suggest potential for omitted variable bias in the model.
- introducing a lagged dependent term (predetermined variable) is one approach to mitigate the ensuing bias: but this approach is only reliable if it is uncorrelated with current values of the

[11] See the note by Damodaran: http://pages.stern.nyu.edu/~adamodar/pdfiles/valn2ed/ch13d.pdf

independent variables.[12]

- to the extent the ENA calibrated DGM lends itself to sensitivity analysis this should be performed using the AER's sensitivity analysis approach as a guide (including the choice of calibration period to assess its sensitivity upon DGM results).

If dilemma surrounding a relationship between the risk-free rate and the estimated MRP cannot be resolved empirically, or on theoretical grounds, it may be best avoided by exploring the potential for implementing variable growth DGMs with constant discount rates that delink ***g*** from ***k*** (see section 2.5).

To summarise:

- The calibrated DGM decouples the DGM result from the long-term GDP forecast by making adjustment to ***g***. This is a step in direction bringing the DGM closer to the partial equilibrium asset return realm of the SL CAPM: with a caveat surrounding a relationship between the risk-free rate and the estimated MRP (as it links ***g*** to expected return on equity ***k***).

- In making this decoupling the workings of the calibrated DGM are not inconsistent with doing away with long-term GDP forecast as an input.

- The ENA is undertaking further work on the calibrated DGM including updating dividend forecasts back to 1988 and updating regression analysis.

- If dilemma surrounding a relationship between the risk-free rate and the estimated MRP cannot be resolved empirically, or on theoretical grounds, it may be best avoided by exploring the potential for implementing variable growth DGMs with constant discount rates that delink ***g*** from ***k***.

2.5 Variable growth rate DGMs: accommodating dividend reforecasts

The extensions to variable growth rate DGMs (stochastic DGMs) surveyed in the literature:

- assume a constant discount rate.[13]

- relax the constant (fixed) dividend growth rate ***g*** assumption.

Stochastic DGMs are generally used for single stock valuation (or for portfolios of stocks) rather than on the market index itself; but there appears no reason why this extension cannot be made to allow for comparison of results to those of the AER's DGMs and the ENA calibrated DGM. Stochastic DGMs treat dividends or ***g*** as a sequence of discrete random variables rather than deterministic or fixed; as is the case for the AER and ENA calibrated DGMs. As a discrete random variable ***g*** may vary through time by assigning probability to a step up in dividends: some DGMs also assign a probability to a step down in dividends and a probability of bankruptcy.[14] Extending to a larger range of potential outcomes for ***g***, each with unique probability assigned, is achievable although associated with increasing complexity (requiring a balanced approach).

In this DGM set-up assumptions are made on the probability distribution of ***g*** across time and the valuation proceeds by solving a set of defined linear equations. Some DGMs assume ***g*** is independent, identically distributed to obtain a solution irrespective of the state of the dividend: a dividend – price

[12] See the technical references provided in the appendix on endogeneity and how to address it.

[13] Use of a constant discount rate is general practice in finance and consistent with the view long-term investors follow a buy and hold policy.

[14] Geometric versions of these DGMs are shown to converge to the Gordon Dividend Growth model.

ratio is assigned that cannot change over time. Other DGMs relax this assumption to obtain a different dividend – price ration to obtain a solution for each state of the dividend.

If the dividend – price ratio cannot change, the dividend forecast is made once and for all from the outset: there is no mechanism to update the dividend forecast for information to bring change to the dividend – price ratio.[15] If dividend – price ratios are shown to change over time, for instance, given the dynamics of the market index, then dividend forecasts are implicitly updated when transitioning from one state of $\boldsymbol{g}$ to another.[16] This is why a different dividend–price ratio is assigned to each state of $\boldsymbol{g}$ by the resulting DGM where the dividend– price ratios are determined by the solution to a system of linear equations.[17]

A technical description is left to the references in the appendix.

To summarise:

- The calibrated DGM decouples long-term GDP growth $\boldsymbol{g}$ from the DGM result; and links $\boldsymbol{g}$ to $\boldsymbol{k}$. The variable growth rate DGM takes a further step in delinking $\boldsymbol{g}$ from $\boldsymbol{k}$: avoiding dilemma regarding a relationship between the risk-free rate and the MRP estimate.

- Specifications for variable growth rate DGMs that accommodate dividend reforecasts are available in the literature for consideration and implementation. These approaches provide a mechanism to reforecast dividends while keeping $\boldsymbol{k}$ constant: placing more reliance on analysts' dividend forecast.

- As the ENA is extending dividend forecasts back to 1988 this will provide an expanded data set to explore and calibrate with implementations of variable growth rate DGMs in future.

Further progress on the development and implementation of variable growth rate DGMs, to address the findings in this report and to avoid dilemma surrounding a relationship between risk-free rates and MRP estimates, is anticipated in the lead up to the 2026 Instrument. This progress may inform a more definitive view on the merits of DGMs for estimating the MRP at that time.

[15] This would also be true for deterministic DGMs including the Gordan Growth Model, AER DGMs, and the ENA calibrated DGM.
[16] Dividend–price ratio changes can come from dividend reforecasts or changes to required rates of return: in this set-up the focus is on the dividend reforecasting mechanism.
[17] Some DGMs also estimate likelihood of bankruptcy as a check on transition probabilities.

Appendix

A.1 List of references

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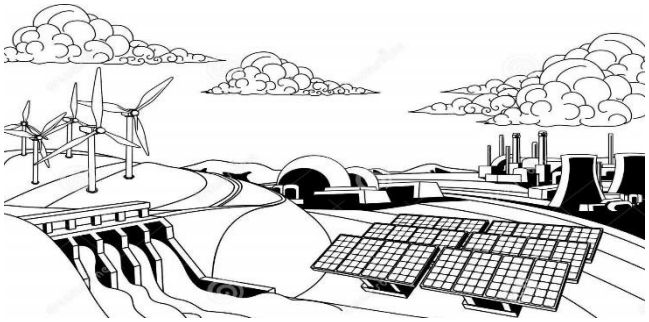

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