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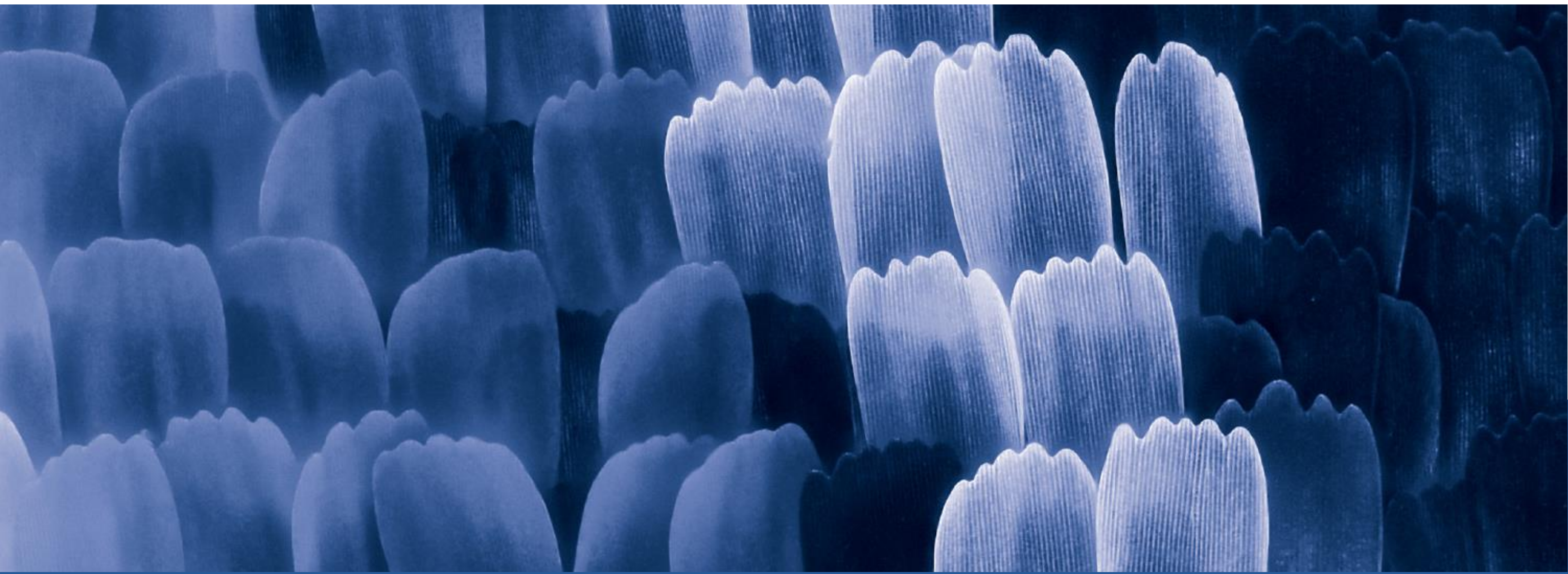

Why are investment hurdle rates so high? Risk or market power?

Staff working paper

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1. Introduction[1]

Stagnating investment remains one of the major puzzles of the period between the Global Financial Crisis (GFC) and the COVID-19 pandemic. Capital investment and corporate risk-taking were subdued, even when interest rates were at historically low levels (Edwards and Lane 2021).

Research by the Reserve Bank of Australia concluded that hurdle rates on investment projects (the required rate of return before a firm is willing to invest) remained high even while interest rates and the cost of capital were at unprecedentedly low levels (Edwards and Lane 2021). As a result, the wedge between the return on private capital and the risk-free rate grew considerably. If hurdle rates underwent a structural shift after the GFC, permanently increasing the wedge between the risk-free rate and the hurdle rate, then investment has been lower than it would otherwise be since the GFC, and investment is likely to decline in the current environment of high interest rates. Lower investment has serious negative consequences for productivity growth and income growth, because most technological change is embodied in investment.

A larger wedge between the return on private capital and risk-free returns could be driven by a rising risk premium. A basic tenet of investor behaviour is that investors require compensation for bearing risk. The compensation is typically referred to as a 'risk premium', measured as the additional return above the risk-free rate. (The *market* risk premium is the difference between the returns on a fully diversified portfolio of equities and the risk-free rate.) If investors perceived the business environment to be riskier since the GFC, or if their risk aversion increased, they would require higher compensation to invest.

However, Farhi and Gourio (2019) point out that the larger wedge could be driven by increases in market power instead. They argue that firms experiencing high profits from their existing market power will not invest to expand output and lower profits and prices. Implicitly firms behave as if they face a high hurdle rate.[2]

Farhi and Gourio present a novel methodology for identifying how much of the larger wedge between private capital returns and risk-free returns is attributable to a rising risk premium, and how much is attributable to rising market power. Their unifying framework can account for broad trends in gross profitability, the gross capital share, the investment-capital ratio, the price-dividend ratio, and the wedge between the return to private capital and the risk-free rate. And given that (with some simplifying assumptions) they obtain closed-form expressions for these variables, the link between the risk premium and market power and these variables is made explicit. They find that in the United States, the increased wedge between the return on private capital and the risk-free rate is partly due to a rising risk premium, but it is also due to rising market power.

We reproduce the Farhi and Gourio estimation for Australia. We find that a rising market risk premium explains the high hurdle rate since the GFC. Interestingly, however, our estimation suggests that increased market power played **no** role in Australia, unlike in the United States. These results are intriguing, given a

[1] An earlier version of this paper was presented at the 2022 Australian Conference of Economists. We thank our colleagues at the Productivity Commission for helpful comments, especially Rosalyn Bell, Michael Brennan and Stephen King. We thank Christian Valence, Michael Kouparitsas, Riki Polygenis, Rebecca Cassells, Damien Dunn, Sam Hurley, Michelle Le, and especially Damoon Sadeghian from the Department of Treasury for extremely useful feedback. All errors remain our own.

[2] It should be noted that there is an extensive literature on whether firms with more market power are more or less likely to invest than firms in more competitive markets. Much of that literature has concentrated on firms' incentives to invest in innovation; see (Cohen 2010). There are theoretical arguments and empirical evidence in favour of both more and less investment, and so the Farhi and Gourio proposition that market power means less investment is not self-evident.

growing literature focused on the role of market power in Australia (Day et al. 2022; Hambur 2021). This literature argues that increased market power is responsible for some of the slowdown in investment in Australia (Hambur and Andrews 2023; see King 2023 for a dissenting view). That empirical literature may need to allow for changing risk premia as well as potentially rising market power.

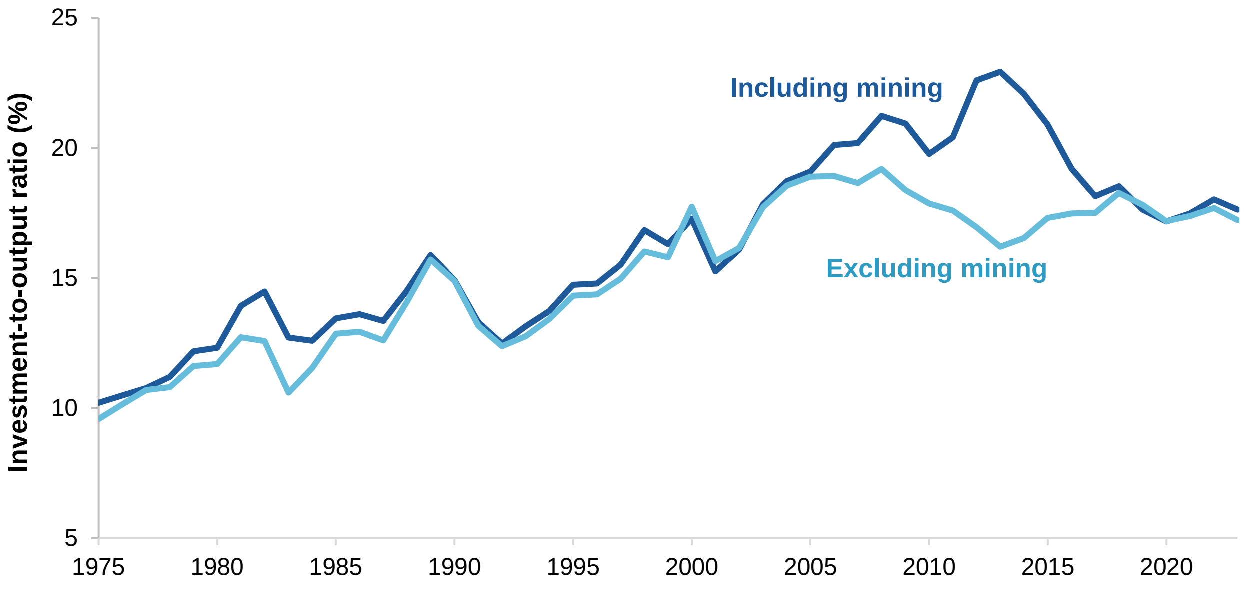
The rest of the paper proceeds as follows. Chapter 2 briefly presents the trends in key variables such as investment and hurdle rates for Australia, showing that there are fewer indicators of excess market power in Australian data than in the US data. Chapter 3 reproduces the Farhi and Gourio estimation for Australia and presents the results, showing that estimated market power has not changed. Chapter 4 discusses the findings in light of the broader literature on hurdle rates. There is an ongoing debate as to whether hurdle rates have indeed undergone a structural shift (due to risk or market power), permanently increasing the wedge between the risk-free rate and the hurdle rate, or whether hurdle rates are simply 'sticky' (as argued by Edwards and Lane 2021 for instance). If the risk-free rate falls in riskier environments, because more investors seek safe assets at the risk-free rate, the hurdle rate could appear sticky. The next few years will provide interesting evidence in that debate, because interest rates have risen sharply but the riskiness of investment has not lessened noticeably.

2. Selected trends in Australia

Key financial and economic variables in Australia have exhibited a number of concerning (and potentially interrelated) trends between the GFC and the COVID-19 pandemic. The trend that has captured the most attention is the stagnation in investment rates. Figure 1 shows that non-mining investment remained roughly constant as a share of output since the GFC.

Figure 1 – Declining investment

Private investment-to-output ratio, with and without mining[a]



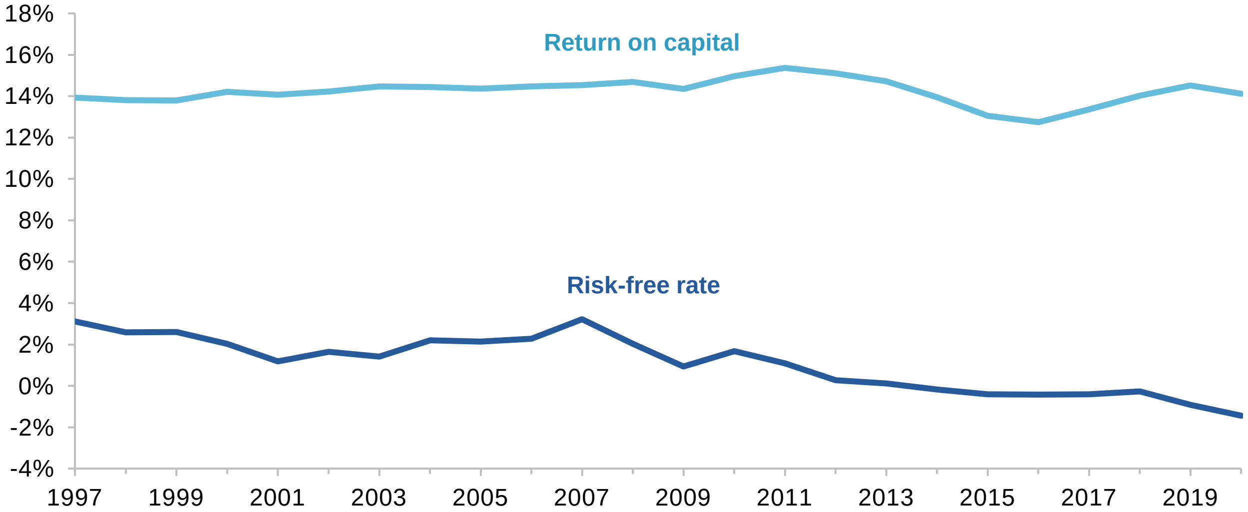
a. Data are volume chain measures. Including mining = gross fixed private investment/gross domestic product (GDP). Excluding mining = (gross fixed private investment – mining investment)/(GDP – mining value add to GDP).

Source: ABS (*Australian National Accounts: National Income, Expenditure and Product*, October 2023, Cat. no. 506, Table 2, 5 and 58).

Puzzlingly, this stagnation in investment occurred at the same time as real interest rates fell, lowering the cost of investment. The implication appears to be that investors required higher expected returns before they were prepared to invest. Figure 2 shows a growing wedge between the risk-free rate and the hurdle rate, the minimum expected rate of return that an investor is willing to accept before investing in a project.

Figure 2 – Return on capital and the risk-free rate[a]

The return on capital has not fallen commensurately with the risk free rate



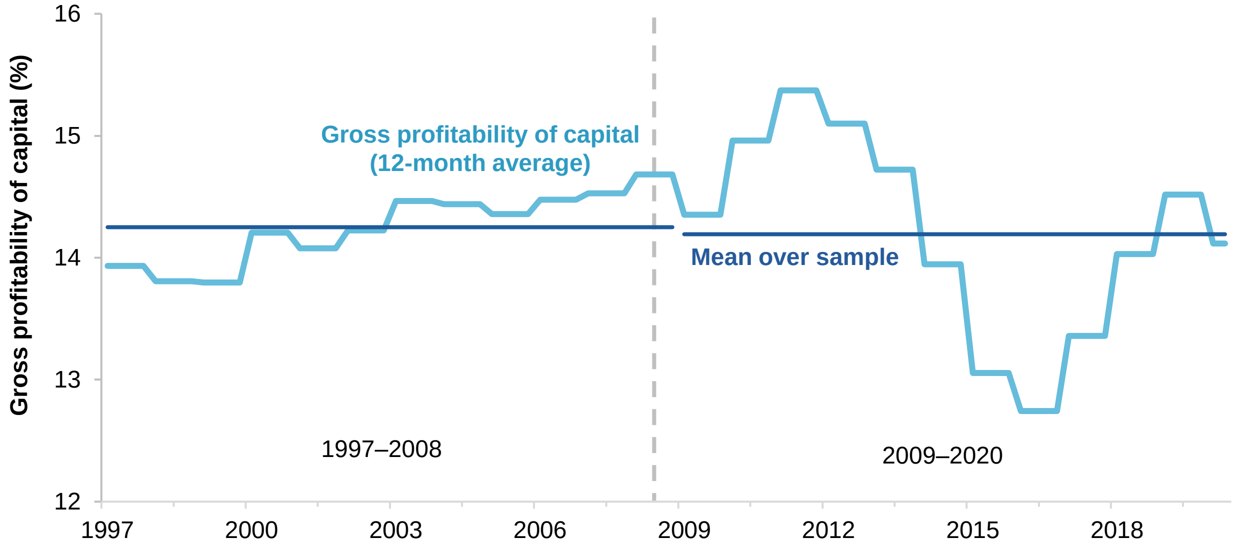
a. Return on capital is defined as capital income divided by the end of year net capital stock (current prices). Risk-free rate is estimated as the average quarterly two-year government bond yield less quarterly two-year inflation expectations. Estimates of how the results would change under different estimations of the risk-free rate are provided in appendix A.2.

Source: Commission estimates, based on ABS and RBA data.

A priori, one would expect the profitability of capital to increase over this period, if interest rate costs fell and hurdle rates remained roughly constant. But interestingly, the average profitability of capital appeared to be roughly the same before and after the GFC, as shown in figure 3. There was a great deal of variability from one year to the next, however, and so there is some uncertainty in this conclusion. The greater variability would seem to imply that investment grew more risky (and hence less profitable) after the GFC, which would account for the greater margins demanded by investors.

Figure 3 – Gross profitability of capital

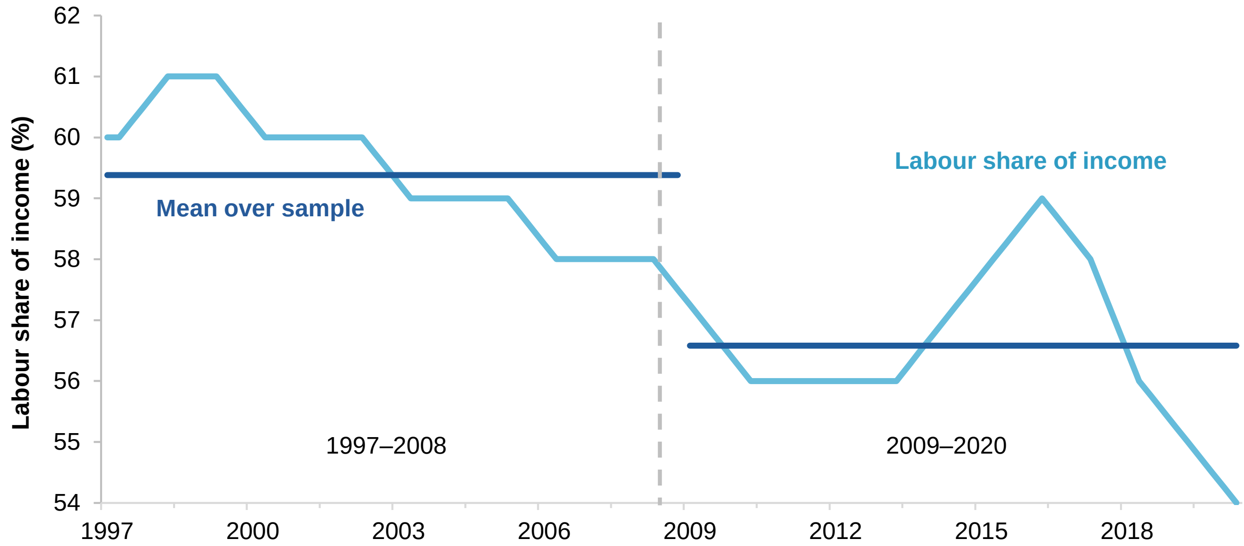
The gross profitability of capital has not declined since the GFC



Source: Commission estimates, based on ABS and RBA data.

Significantly, this result is quite different to the result that Farhi and Gourio (2019) obtained from US data, where gross profitability increased significantly since the GFC, and where the authors found that increased market power played a significant role in the increase in market premiums. No improvement in gross profitability in Australia seems to imply that market power did not increase a great deal over this period. However, other trends such as the declining labour share of income (figure 4) may provide contradictory evidence, and may suggest that market power could be playing more of a role. (In a separate paper, the Productivity Commission has undertaken some analysis of the declining labour share of income and found that the trend may be overstated: much of the observed decline may be driven by fluctuations in commodity prices; PC 2023.) As we will see in the next Section, the Farhi and Gourio model infers changes in market power from three indicators: the gross profitability of capital, the labour share of income, and expected equity returns.

Figure 4 – Labour share of income has declined

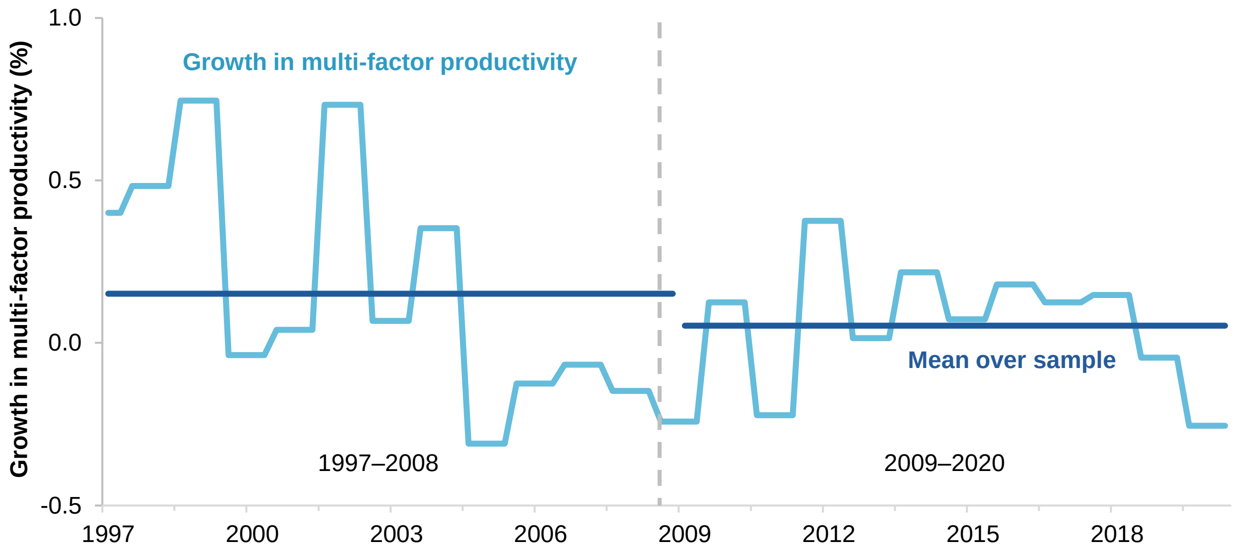


Source: Commission estimates, based on ABS and RBA data.

An empirical strategy to measure the role of a rising risk premium and the role of market power also needs to measure other possible forces. Declining productivity and demographic change could explain some of the decline in investment: there could be less investment simply because there are fewer opportunities to invest. Figure 5 confirms that productivity is stagnating in Australia, similarly to the United States and most OECD countries; and Australia is undergoing a similar demographic transition to other OECD countries, as its population ages.

Figure 5 – Productivity

Growth in multi-factor productivity has slowed since the GFC



Source: Commission estimates, based on ABS and RBA data.

3. Evolution of the market risk premium

This section presents the model briefly, with some intuition provided for the relationships between variables in their model. The reader is referred to their paper for the full derivation of the results. We explain how the model parameters are calibrated from the moments of publicly sourced data, outlined in table 1.

Table 1 – The ten key moments from publicly sourced data

Moment	Description	Symbol
M1	measured gross profitability	$\frac{\pi}{K}$
M2	measured gross capital share of output	$\frac{\pi}{Y}$
M3	investment-capital ratio	$\frac{I}{K}$
M4	risk-free rate	r_f
M5	price-dividend ratio	P/D
M6	growth rate of population	g_L
M7	growth rate of total factor productivity	g_Z
M8	negative of growth rate of investment prices	g_Q
M9	employment-population ratio	E/P
M10	supply of labour	N

3.1 Model outline

The model is a fairly standard representative-agent economy, with an assumption of constant rates of growth in population, TFP and investment-specific progress, and a technology-neutral productivity shock. Model assumptions are indicated by an asterisk (*). The building block equations that allow the main parameters to be estimated are indicated by numbers.

Consumers are assumed to have an Epstein-Zin utility function:

$$V_t = \left((1-\beta) L_t c_{pc,t}^{1-\sigma} + \beta E_t \left(V_{t+1}^{1-\theta} \right)^{\frac{1-\sigma}{1-\theta}} \right)^{\frac{1}{1-\sigma}} \qquad (*)$$

where L_t is population size and $c_{pc,t}$ is per-capita consumption in period t.

Goods are produced using a Cobb-Douglas production function: in aggregate, output is

$$Y_t = Z_t K_t^{\alpha} (S_t N_t)^{1-\alpha} \qquad (*)$$

where N_t is labour and S_t is a martingale productivity process: $S_{t+1} = S_t e^{\chi_{t+1}}$. And there is constant elasticity of substitution μ between goods from the point of view of the consumer. As a result, each good producer charges a constant markup over its cost, equal to the elasticity of substitution, μ; a larger μ implies greater market power. The markup also affects labour's share of gross value added:

$$s_L = 1 - \frac{\pi}{Y} = \frac{w_t N_t}{Y_t} = \frac{1-\alpha}{\mu} \qquad (1)$$

And the markup affects the first-order condition for the rental of capital and hiring of labour:

$$\alpha \frac{Y_t}{K_t} = \mu R_t$$

Capital is assumed to accumulate in line with depreciation, investment X_t, and investment-specific technical progress Q_t:

$$K_{t+1} = \big((1-\delta)K_t + Q_t X_t\big)e^{\chi_{t+1}} \qquad (*)$$

Farhi and Gourio (2019) assume that population L, total factor productivity Z, and investment-specific technical progress Q have constant rates of growth g_L, g_Z, and g_Q, so that $Q_t = Q^*\big(1+g_Q\big)^t$, for example. Their strongest assumption is that the shock to investment productivity and the shock to labour productivity are the same $e^{\chi_{t+1}}$; this assumption ensures that the shock is technology neutral. They further assume that $e^{\chi_{t+1}}$ is independently and identically distributed, with $E(e^{\chi_{t+1}}) = 1$. Then investment, output and consumption grow at the same rate:

$$X_t = T_t S_t x^*$$

$$Y_t = T_t S_t y^*$$

where $T_t = L_t Z_t^{\frac{1}{1-\alpha}} Q_t^{\frac{\alpha}{1-\alpha}}$, hence $1 + g_T = (1+g_L)(1+g_Z)^{\frac{1}{1-\alpha}}(1+g_Q)^{\frac{\alpha}{1-\alpha}}$.

Noting that K_t/Q_t is the capital stock at current cost, the investment-capital ratio then reflects balanced growth:[3]

$$\frac{I}{K} = \frac{X_t}{K_t/Q_t} \approx \delta + g_Q + g_T \qquad (2)$$

The estimation proceeds as follows: First, from (2) we obtain an estimate of the depreciation rate δ.

Next, the price-dividend ratio reflects the Gordon growth formula:

$$\frac{P}{D} \approx \frac{1+g_T}{r^* - g_T} \qquad (3)$$

where $r^* = \frac{1}{\beta}\left(\frac{1+g_T}{1+g_L}\right)^{\sigma} \times E\left(e^{(1-\theta)\chi_{t+1}}\right)^{\frac{\sigma-1}{1-\theta}}$.

Expected equity returns, defined as $E(R_{t+1}) = E\left(\frac{P_{t+1}+D_{t+1}}{P_t}\right)$, can be shown using (3) to be equal to $E(R_{t+1}) \approx (r^*+1)E(e^{\chi_{t+1}}) = r^* + 1$. Thus r^* is the expected return on risky assets and can be derived from the observed price-dividend ratio using equation (3).

The investment level is determined by the Euler equation $E_t[M_{t+1}R_{t+1}^K] = 1$, where R_{t+1}^K is the return on capital that incorporates the rental rate of capital but also depreciation: $R_{t+1}^K = \left(\frac{\alpha Y_{t+1}}{\mu K_{t+1}} + \frac{1-\delta}{Q_{t+1}}\right) Q_t e^{\chi_{t+1}}$.

M_{t+1} is the real stochastic discount factor derived from the utility function:

$$M_{t+1} = \beta\left(\frac{c_{pc,t+1}}{c_{pc,t}}\right)^{-\sigma}\left(\frac{V_{t+1}L_{t+1}^{1/(\sigma-1)}}{E_t\left(V_{t+1}^{1-\theta}L_{t+1}^{1-\theta/(\sigma-1)}\right)}\right)^{\sigma-\theta}$$

Using the constant growth assumptions:

$$M_{t+1} = \beta\left(1 + \frac{1+g_T}{1+g_L}\right)^{-\sigma} e^{-\theta\chi_{t+1}} E\left(e^{(1-\theta)\chi_{t+1}}\right)^{\frac{\theta-\sigma}{1-\theta}} \qquad (4)$$

[3] The approximate equality signs here and further on reflect the approximation that $\log(1+x) \approx x \approx 1/(1-x)$.

Then the Euler equation can be rewritten as equating the user cost of capital with its marginal revenue:

$$\frac{1}{Q^*}\left(r^* + \delta + g_Q\right) \approx \frac{\alpha}{\mu}\left(\frac{Y_t}{K_t}\right)$$

Rewriting we obtain:

$$MPK = \frac{\pi}{K/Q} = \frac{\alpha + \mu - 1}{\alpha}\left(r^* + \delta + g_Q\right) \tag{5}$$

Given that r^*has been estimated using (3), equations (1) and (5) together allow one to solve for α and μ, using the observed labour share of value added and measured gross profitability, $\frac{\pi}{K/Q}$.

Finally, the wedge between r^* and the risk-free rate r_f (where the risk-free rate can be derived from observables) provides information on the distribution of risk. The risk-free rate in this model is equal to the real stochastic discount factor:

$$r_f + 1 = \frac{1}{E(M_{t+1})} = \frac{(r^* + 1)E\left(e^{(1-\theta)\chi_{t+1}}\right)}{E\left(e^{-\theta\chi_{t+1}}\right)} \tag{6}$$

Re-arranging, we obtain:

$$r^* - r_f \approx logE\left(e^{-\theta\chi_{t+1}}\right) - logE\left(e^{(1-\theta)\chi_{t+1}}\right) \tag{7}$$

With assumptions on θ (the coefficient of risk aversion) and selected parameters of distribution of χ, the remaining parameter of χ can be identified using (7). Farhi and Gourio assume that $\theta = 12$ and that χ_t follows a “disaster risk” three-point distribution, i.e.

$$\begin{cases} \chi_{t+1} = 0 \;\; with\, prob\; 1 - 2p \\ \chi_{t+1} = \log(1 - b)\, with\, prob\; p \\ \chi_{t+1} = \log(1 + b_H)\, with\, prob\; p \end{cases} \tag{*}$$

They fix b (and therefore b_H, given that $E(e^{\chi_{t+1}}) = 1$ by assumption) at 0.15 and use (7) to estimate p. (However, other distributions could easily be estimated.)

Thus, the ten moments from publicly sourced data (table 1) are used to solve sequentially for the five key parameters in the framework (table 2), and these parameters are used to identify the contribution of the market risk premium and of market power to hurdle rates.

Table 2 – The five key parameters

Parameter	Description	Symbol
P1	Depreciation rate of capital	δ
P2	Expected return on risky assets	r^*
P3	Markup on prices due to firms’ market power	μ
P4	Cobb-Douglas parameter for labour share of output	α
P5	Risk, modelled as the probability of an economic crisis or disaster	p

3.2 Results

Appendix A.1 describes the exact data series that were used to identify the ten moments in table 1. The one point of difficulty lies in determining the appropriate risk-free interest rate. The results presented in this section use the two-year Australian government bond rate (as government bonds in high-income countries are considered nearly risk free). Appendix A.2 explores how the results change depending on whether the one-year, two-year or ten-year bond rate is used. Appendix A.2 also explores how the results change when capital price growth is used instead of investment price growth (as these differ in practice, but not in the model).

Table 3 indicates how the moments from public data have evolved over the period from 1997 to 2020. Following Farhi and Gourio, we break the data into two broad periods, from 1997 to 2008 and from 2009 to 2020.

Table 4 outlines the calculation of the key parameters over those two periods, using equations (1)(2)(3)(5)(7).

Table 3 – Evolution of the public moments over two periods

Moments	Symbol	1997–2008	2009–2020	Difference
Gross profitability	$\frac{\pi}{K/Q}$	14.249	14.193	-0.057
Capital share	$\frac{\pi}{Y}$	40.620	43.418	2.799
Risk free rate	r_F	2.205	0.069	-2.136
Price-dividend ratio	$\frac{P}{D}$	29.487	24.040	-5.447
Investment-capital ratio	$\frac{I}{K}$	7.588	6.727	-0.862
Growth rate of TFP	g_Z	0.604	0.213	-0.390
Growth rate of investment prices	$-g_Q$	-0.882	-0.570	0.312
Growth rate of population	g_N	1.322	1.562	0.240
Employment-population ratio	N/Pop	59.973	61.607	1.634

Table 4 – The five key parameters calculated over two periods

Parameters	Symbol	1997–2008	2009–2020	Difference
Depreciation of capital	δ	3.7356	3.7657	0.0301
Risk premium	r^*	6.463	6.650	0.187
Mark-up	μ	1.0993	1.1088	0.0095
Cobb-Douglas parameter for labour	α	0.3472	0.3726	0.0254
Probability of economic crisis	p	0.03915	0.0692	0.0301

The role of risk and the role of market power

The results of the estimation allow us to identify how much each factor has contributed to the growing wedge between the return on private capital and risk free returns. There are several possible explanations for the increased wedge:

- An increased risk premium, either because of greater perceived risk or greater risk aversion on the part of investors.
- Greater market power of firms, which causes them to restrict output and investment.
- Increased depreciation or increased investment-specific technical progress, which increases the effective cost of capital (a less likely explanation).

These contributing factors can be decomposed using equation (4), which defines the marginal product of capital, also known as the return on private capital. Equation (4) can be rewritten as:

$$MPK - r_f = \underbrace{\delta + g_Q}_{depreciation} + \underbrace{\frac{\mu - 1}{\alpha}\left(r^* + g_Q + \delta\right)}_{rents\ due\ to\ market\ power} + \underbrace{r^* - r_f}_{market\ risk\ premium} \quad (9)$$

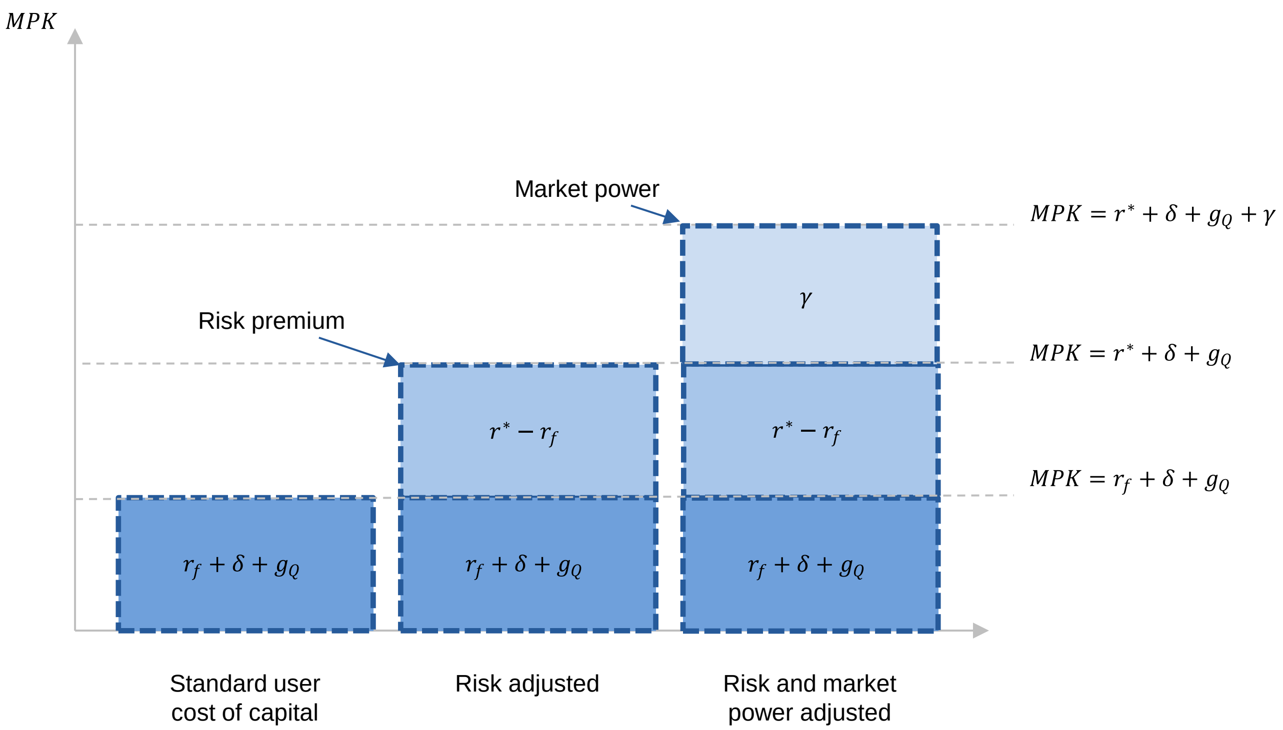
This equation decomposes the equity premium into three components:

- depreciation, represented by: $\delta + g_Q$;
- economic rents due to market power, represented by: $\frac{\mu-1}{\alpha}\left(r^* + g_Q + \delta\right) \equiv \gamma$; this is loosely related to market power because μ is firms' markup;
- a market risk premium, represented by $r^* - r_f$.

Figure 6 illustrates how each component adds to the marginal product of capital, and hence to the user cost of capital (the cost of borrowing additional capital for investment). In a world with no risk and no market power, the cost of capital would simply reflect time preferences (r_f), the depreciation of the capital while in use (δ), and technological progress which increases its productivity in the future, g_Q. But in a world of risk, there is additionally a risk premium that the owners of capital require, to compensate them for the risk that they may not recover their capital. And if firms have market power and charge a markup, the hurdle rate before they choose to invest will be higher, as they will choose to have lower output and higher prices.

Figure 6 – The user cost of capital is affected by risk and market power[a]

Components of the wedge between the return on private capital (which equals user cost) and the risk free rate



a. Notation in the figure: r_f is the risk-free interest rate; δ is the rate of physical depreciation on capital; g_Q is the change in price of capital; r^* is the return on private equity; and γ is the pure profit from capital.

The components of the spread between private capital returns and the risk-free rate are reported across the two distinct time periods, divided by the Global Financial Crisis.

The average spread was 14.1% over the period 2009-2020 after the crisis; up from 12.0% over the prior period 1997-2008. In other words, the spread rose by 2.1 percentage points after the crisis, an increase which is largely attributable to a rising market risk premium (table 5).

Table 5 – The spread between private capital returns and the risk free rate has increased significantly due to the risk premium

Comparison of spread pre- and post- Global Financial Crisis

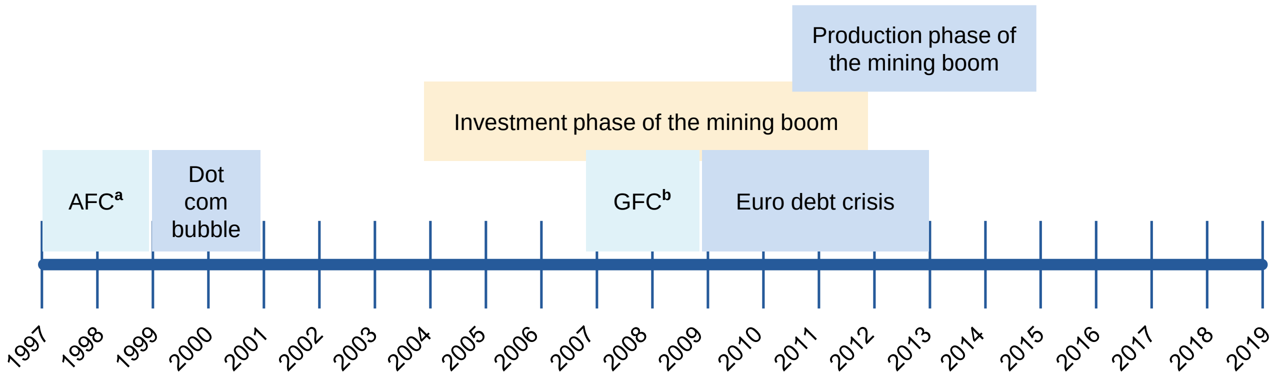
MPK-RF spread	1997–2008	2009–2020	Difference
Total spread	12.04	14.12	2.08
Depreciation $\delta + g_Q$	4.62	4.34	-0.28
Market power γ	3.17	3.21	0.04
Risk premium $r^* - r_f$	4.26	6.58	2.32

Source: Commission estimates based on ABS, RBA and Market Index data.

As risk premiums rise, firm managers – acting on behalf of their shareholders – were deterred from investing (despite cheap capital) as fewer projects had a large enough return to cover the risk-adjusted user cost of capital.

In Australia, as in the United States, a number of risks increased the risk premium required by investors in the period between the GFC and the COVID-19 pandemic, including technological disruptions, geopolitical uncertainty, and domestic political uncertainty (The Australian Government and Heads of Treasury 2017, pp. 18–19). These are illustrated in Figure 7. There was a growing demand among investors for safety and certainty following the global financial crisis, affecting firms' ability to take on risky investments (Ellis 2021; Jones 2021).

Figure 7 – Macroeconomic events

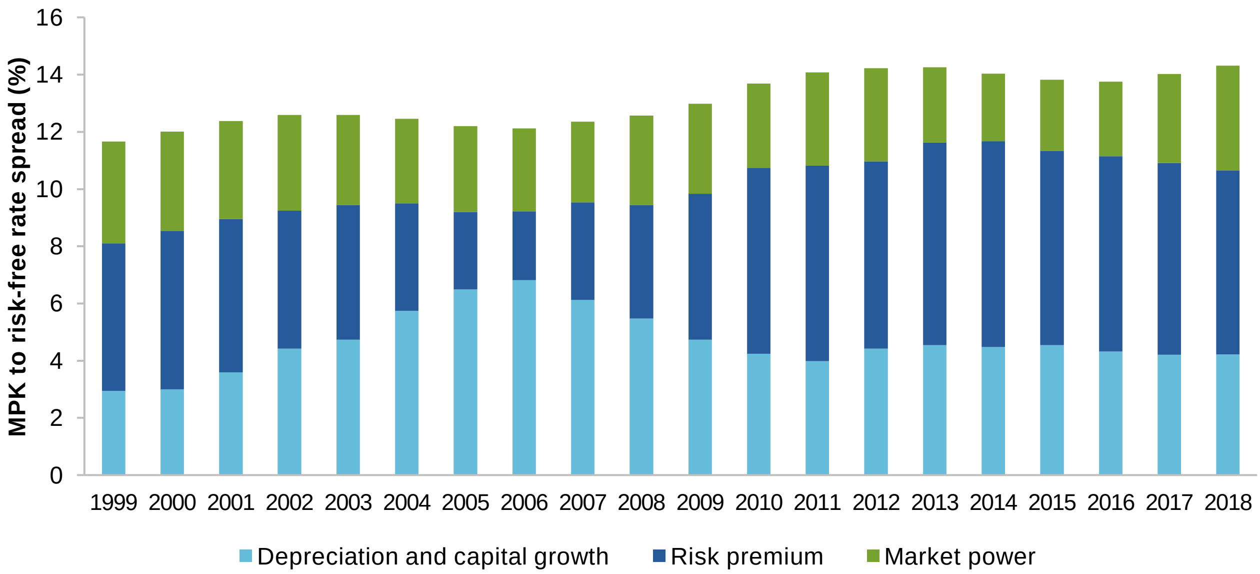


a. Asian Financial Crisis **b.** Global Financial Crisis.

The evolution of the market risk premium as a component of the wedge between the return on capital and the risk-free rate is best illustrated using a five-year moving average (figure 8). This approach is appealing as it allows for a visualisation of how the market risk premium – and its underlying components – have evolved over time. (It does, however, do violence to the model, which assumes that the economy is on a steady state growth path.) The evolution of the estimated market risk premium seems to broadly align with world events as outlined in Figure 7. It seems likely that over the period under investigation (1997 to 2020), the market risk-premium was higher shortly after the Asian Financial Crisis in 1997, then decreased in the lead-up to the Global Financial Crisis in 2008 before increasing significantly in 2008. The subsequent European debt crisis is likely to have caused the market risk premium to remain high.

Figure 8 – Components of investment to risk-free rate spread

Five year moving average



Source: Commission estimates based on ABS (Australian National Accounts: National Income, Expenditure and Product, September 2021, Cat. no. 5206, table 2, 4, 6 and 58), ABS (Australian System of National Accounts, June 2021, Cat. no. 5204, table 1, 6, 56 and 58), ABS (National, state and territory population, March 2021, Cat. no. 3101, table 1), ABS (Estimates of Industry Multifactor Productivity, Australia, 30 November 2020, Cat. no. 5260.0.55.002, table 6), RBA (Capital Market Yields – Government Bonds, 2021), RBA (Inflation expectations, 2021) and Market Index (2021).

4. Discussion of the results

4.1 Risk

Possible determinants of the market risk premium

While the model can identify an increase in the market risk premium, there are limits to the interpretation of that result. Changes in the market risk premium can result from either:

- a change in the probability of macroeconomic shocks
- a change in the size of macroeconomic shocks
- a change in the *attitude to risk*, as measured by the implied coefficient of risk aversion.

Unfortunately these cannot be disentangled from the available data. As is clear from equation (7), each contributes to the market risk premium, and they are not separately identified.

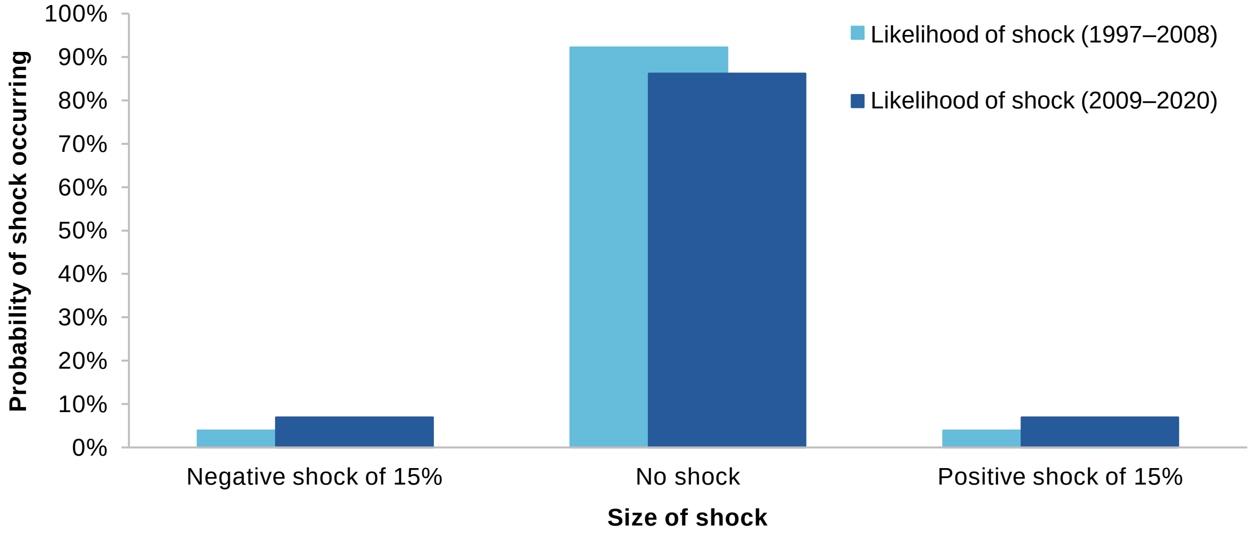
In figures 9 and 10 we illustrate what the estimated change in the market premium would imply for any one of these three factors, holding the other two constant; this provides some idea of the maximum possible change in each variable.

We maintain the assumption of a three point disaster distribution: a negative shock of size *b* (held fixed at 0.15) with probability p; a positive shock of size b_H (also 0.15) with probability p; and no shock, with probability

$1 - 2p$. We ask what increase in p at the time of the GFC would explain the higher post-GFC risk premium, if the size of shocks and the level of risk aversion were held constant; it is in some sense the maximum increase in p. Figure 9 indicates that the probability of a shock would have to increase from 4% to 7%.

Figure 9 – If the increase in risk premium were due to higher likelihood of a shock

Probability distribution of a shock

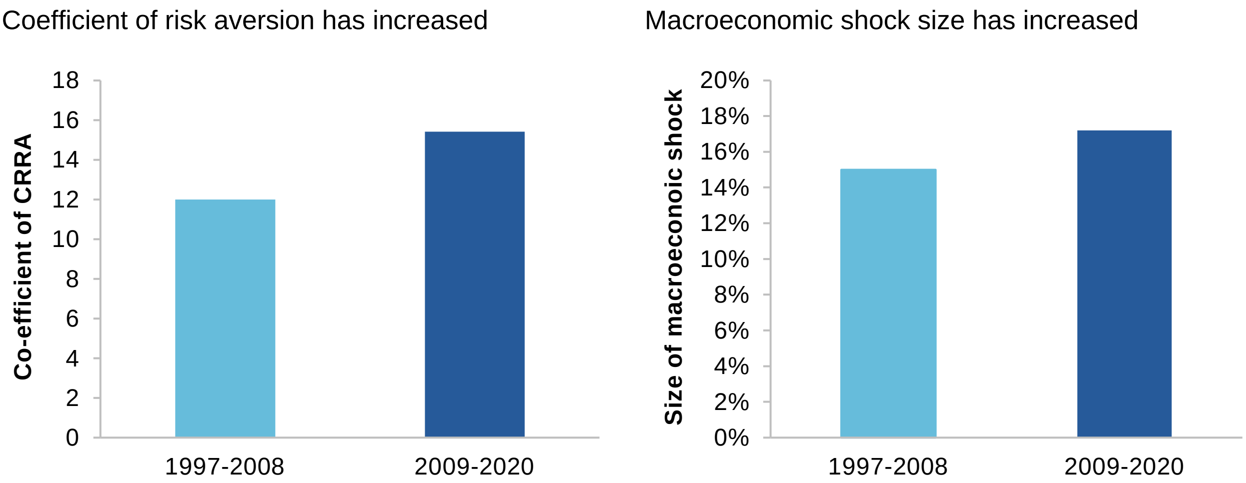


In the second instance, the co-efficient of risk aversion and *probability* of shock is assumed to remain constant over time. The co-efficient of risk aversion is held fixed at $\theta = 12$, and the probability of the shock held constant at 5.4% (the average probability of a shock estimated in the 1997-2008 window). The estimated size of the macroeconomic shock would have to increase by 2 percentage points (from 15% to 17%) to account for the increase in the risk premium (figure 10, first panel).

Lastly, we ask how much the coefficient of risk aversion would have to increase to account for the increase in the risk premium. The value of the risk aversion coefficient was initially set at 12, well above empirical microeconomic estimates, but set in order to generate a reasonable equity premium.[4] Applying this to the comparison of two distinct time periods, the coefficient of risk aversion would have to increase from $\theta = 12$ to $\theta = 15.4$ to explain the increase in the equity risk premium (figure 10, second panel).

[4] There is a degree of conjecture in the literature as to an appropriate coefficient of risk aversion. This has, in part, given rise to the equity premium puzzle, proposed by Mehra and Prescott (1985). Under Mehra and Prescott's framework, to explain the return on equities in the Unites States, the coefficient of risk aversion needs to be 'large' – much higher than what is commonly documented in the microeconomic literature (which Mehra and Prescott document to be between 1 and 10). In an Australian context, estimates the coefficient of risk aversion are between 1.08 and 2.47 (Freestone and Breunig 2020).

Figure 10 – If the increase in the risk premium were due to greater risk aversion, or greater shock size



Other measures of risk

The Farhi and Gouri model considers only one type of risk in financial markets: the risk of price volatility. However, many models with more of a focus on financial variables would include other forms of risk, and there may have been changes to those risks during the period in question. Liquidity risk, for instance, played an important risk during the global financial crisis, when many institutions limited withdrawals at the peak of the crisis (Allen 2012). And there are a number of information risks that could be relevant to the growth and then collapse of the Collateralised Debt Obligation (CDO) market. However, we consider it unlikely that the inclusion of these more detailed types of risk in the model would lead to major changes to the model's predictions.

4.2 The role of market power

As illustrated in figure 8, the spread between the private return on capital and the risk free rate can be decomposed into several contributing factors: the risk premium, market power, and depreciation. Strikingly, the contribution of market power does not appear to change at all over the period of interest. This is in clear contrast to results for the United States, where there is a significant increase in market power from the period up to the year 2000 to the period afterwards. Farhi and Gourio estimate that US markups increased by 6.2%; in contrast, undertaking the same exercise with Australian data shows an increase in markups in Australia of less than 1%.

This finding adds another piece of evidence in the broader discussion over the role of market power in Australia. An important literature focused on the United States has attributed stagnating business investment and growth and the decline of the labour share of income to the increased exercise of market power in many industries. (The rise in market power may be due to relatively lax antitrust enforcement, and/or to the emergence of superstar firms that earn outsize profits.) However, Farhi and Gourio (2019) point out that this literature does not attempt to account for risk in explaining these trends. They find that the high hurdle rate for investment (which explains slow investment) is attributable in part to an increased risk premium (equation 6 and table 1). Their paper finds an important role for market power in explaining slowing investment in the U.S., but a smaller role than in a framework that ignored risk.

Some researchers have argued that Australia's stagnating investment and declining labour share of income must also be attributable to increased market power (Hambur 2021; Hambur and Andrews 2023). However, the empirical evidence is not conclusive (King 2023). While this particular estimation framework needs further validation (see next section), it is very interesting that Australian data do not show the same role for market power as US data.

4.3 Mismeasured capital

One issue that we have not explored in detail is the role of intangible capital. The measurement of capital has traditionally focused on tangible capital assets, but intangible capital is rising in importance, and thus there is a risk of underestimation of intangible capital assets. If mismeasurement were growing over time (and it is not clear that it is) then that could explain some of the increasing spread between the measured marginal product of capital and the risk free rate.

However, Farhi and Gouri undertake simulations and conclude that increasing mismeasurement of intangible capital would reduce the estimated impact of market power, but it would have no effect on the estimated risk premium. Given that we find no role for increased market power, we did not explore the role of intangible capital in detail.

4.4 The risk free rate

The Farhi and Gourio estimation treats the risk-free rate as an exogenous variable, estimated from public data. Yet interestingly the model also yields an explicit formula for the real rate of time preference, and hence the risk-free rate, r_f, using equations (4) and (6). Equation (4) defines the real rate of time preference M_{t+1}, and Equation (6) defines the risk-free rate as its inverse.

Changes in risk aversion and changes in the likelihood and size of shocks will all lead to changes in the risk-free rate, according to equations (4) and (6), because they affect the real rate of time preference. Under the current model assumptions, for many parameter values, if the probability of shocks increases, then the risk-free rate will rise.

How does this result compare to the rest of the macro-finance literature (see for example Constantinides and Duffie (1996), or Rietz (1988))? That literature tends to assume that the real risk-free rate is relatively constant, while the real rate of return on risky assets is likely to vary with macroeconomic factors. (The macro-finance literature also generally assumes that the weighted average cost of capital rises when the risk premium rises, because it assumes a constant risk-free rate and a higher risk premium for risky capital. Farhi and Gourio instead find that the weighted average cost of capital falls.)

What evidence exists on the risk-free rate? Jordà et al. (2019) undertake an analysis of the rate of return on a number of important asset classes from 1870 to 2015, in 16 advanced economies, drawing together important sources of data for the first time. Surprisingly, Jordà et al. find that over these extremely long time horizons, the real rate of return on risky assets does not vary much, while the real risk free rate appears to have very persistent swings up and down. This is consistent with the RBA's observation that hurdle rates in Australia are sticky (Edwards and Lane 2021).

On reflection, it seems likely that the risk-free rate will fall if risk or risk aversion increases after a shock. An increase in risk or risk aversion would lead to a flight to safe assets (such as government bonds) by investors, and hence a decrease in the interest rate on those safe assets. If the fluctuations that Jordà et al. (2019) identify over the decades are primarily driven by changes in risk, the risk free rate would fluctuate and the hurdle rate would appear sticky.

The Farhi and Gourio model requires slight changes to its assumptions in order to obtain the result that the risk-free rate falls as risk increases. Barro (2023) develops a related theoretical model that might provide some basis for such an amendment. Whereas in Farhi and Gourio, the risk-free rate simply reflects the rate of time preference, by assumption, in the Barro model, agents trade loans at the risk-free rate, and thus these loans serve as an insurance product against output risk for the lender. As a result, Barro's risk-free interest rate falls when risk increases.

5. Conclusion

This paper investigates the high hurdle rates that Australia experienced in the period between the GFC and the COVID-19 pandemic. High hurdle rates are a serious concern because of their negative implications for investment, productivity growth and income growth. It would be particularly concerning if those high hurdle rates were due to greater market power in the Australian economy. Given that market power can be influenced by competition policy and other levers, any negative effects of market power should be treated with concern.

However, when we examine the relative contribution of risk premiums, market power, and depreciation to the larger hurdle rates, we find that market power did not increase, and therefore increasing market power played no role in rising hurdle rates. Rather, the high hurdle rates were due to an increase in the market risk premium.

While a similar decomposition for the United States found a role for both a rising risk premium and increased market power, the Australian decomposition found no role for market power. Markups in Australia (as estimated in the model) increased less than 1% over the period of interest, whereas in the US data (over a slightly longer time period) they had increased 6%. The finding is intriguing, given the current debate on whether increased market power is responsible for a decline in business dynamism in Australia.

While we cannot determine whether the rising risk premium is due to an increase in risk aversion, or an increase in the actual risk faced by investors, there are a number of indicators suggesting that investors perceive the climate to be more risky since the GFC (Ellis 2021). If this is driven by pessimism, it is less clear how policy can have an impact.

Appendix

A.1 Data dictionary

This section details the construction of the nine key moments. In many cases, alternate series were considered, but as the paper focuses on medium-run trends and abstracts from business cycle shocks, changing data specifications has little effect on the target moments. Where relevant, results under alternate specifications are presented in section A.2.

Publicly available data was used to construct the nine key moments (table A.1). Table A.1 summarises the variable names and descriptions, and the data sources used. Quarterly data observations were used in the analysis.

Table A.1 – Framework variables created with public data

Variable name	Description	Data source
Risk-free rate (r_f)	The average quarterly two-year government bond yield less quarterly two-year inflation expectations	RBA (*F2.1 Capital market yields – government bonds*, 2021) RBA (*G3 Inflation expectations*, 2021)
Gross profitability of capital (Π/K)	The ratio of capital income to gross domestic output (GDP) divided by the ratio of end of year net capital stock to GDP (current prices)	ABS (*Estimates of Industry Multifactor Productivity*, Australia, December 2021, Cat. no. 5260.0.55.022, table 2) ABS (*Australian System of National Accounts*, June 2021, Cat. no. 5204, table 56) ABS (*Australian National Accounts: National income, Expenditure and Product*, September 2021, Cat. no. 5206, table 3)
Price-dividend ratio (P/D)	The inverse of the quarterly average market-cap weighted dividend yield for the Australian stock market	Market Index (2021)
Investment-capital ratio (I/K)	The gross private capital accumulation (seasonally adjusted) divided by the total end of year net capital stock (current prices).	ABS (*Australian National Accounts: National income, Expenditure and Product*, September 2021, Cat. no. 5206, table 3) ABS (*Australian System of National Accounts*, June 2021, Cat. no. 5204, table 56)
Labour share of income (s_L)	The ratio of labour income to GDP	ABS (*Estimates of Industry Multifactor Productivity*, Australia, December 2021, Cat. no. 5260.0.55.022, table 2)
Total factor productivity growth (g_Z)	The quality adjusted annual growth rate of the market sector multifactor productivity index	ABS (*Estimates of Industry Multifactor Productivity*, Australia, December 2021, Cat. no. 5260.0.55.022, table 2)
Population growth (g_L)	Quarterly population growth using the estimated residential population of Australia	ABS (*National, state and territory population*, November 2021, Cat. no. 3101.0, table 1)
Employment-to-population ratio (E/P)	The quarterly average number of people aged 15 years and over that are employed as a percentage of the quarterly average civilian population aged 15 years and over	ABS (*Labour Force, Australia, Detailed*, November 2021, Cat. no. 6291.0.55.001, table 1)
Negative investment price growth (g_Q)	Quarterly growth of the ratio of the gross fixed capital formation chain price index to the final consumption expenditure chain price index	ABS (*Australian National Accounts: National income, Expenditure and Product*, September 2021, Cat. no. 5206, table 4)

A.2 Model extensions

As a robustness check, the specification of some data series were altered to examine how they affected the results. Two key data of interest are the measurement of the risk-free rate and investment price growth. This section explains why the data specification may affect results and sets out the results under the alternate specification.

Risk-free rate

To estimate the risk-free rate, chapter 2 used the Australian Government two-year bond yield rate, less two-year inflation expectations published by the RBA. However, as capital investments can be short-, medium- or long-term, different estimates of the risk-free rate could be used to reflect different investment time horizons. This will control for the term premium that is required to compensate investors for the risks associated with time for longer-term investments. For example, if a project has a longer lifespan a ten-year risk-free rate may be more suitable.

Table A.2 shows how different estimates of the risk-free rate (one-year, two-year and ten-year) affect the total spread between the return on capital and the risk-free rate and the aggregate market risk premium.[5] The one-year and two-year risk-free rate had similar results, while the ten-year real risk-free rate resulted in a smaller total spread and risk premium. This is likely due to the term premium associated with long-term bond yields. Long-term bonds will generally have a higher yield to compensate investors for the risks associated with time; therefore, this results in a higher risk-free rate which will decrease the total spread and risk premium (holding all else equal).

Despite this, each risk-free rate selected showed evidence of a rising risk premium.

Table A.2 – Model results using different risk-free rates

MPK-RF spread	1997–2008	2009–2020	Difference
Total spread ($r_f = 1\ year^{a}$)	12.10	14.10	2.05
Depreciation $\delta + g_Q$	4.62	4.34	-0.28
Market power γ	3.17	3.21	0.04
Risk premium $r^* - r_f$	4.30	6.59	2.29
Total spread ($r_f = 2\ years^{b}$)	12.00	14.10	2.08
Depreciation $\delta + g_Q$	4.62	4.34	-0.28
Market power γ	3.17	3.21	0.04
Risk premium $r^* - r_f$	4.26	6.58	2.32
Total spread ($r_f = 10\ years^{c}$)	11.1	13.0	1.98
Depreciation $\delta + g_Q$	4.62	4.34	-0.28
Market power γ	3.17	3.21	0.04
Risk premium $r^* - r_f$	3.28	5.50	2.22

a. 1 year risk-free rate = 1 year RBA zero coupon rate – 1 year inflation expectations. **b.** 2 year risk-free rate = 2 year government bond yields – 2 year inflation expectations. **c.** 10 year risk-free rate = 10 year government bond yields – 10 year inflation expectations.

Source: Commission estimates based on RBA, ABS and Market Index data.

[5] The one-year risk-free rate was constructed using the RBA's one year zero coupon rate data, which is a theoretical measure and not government bond yield data.

Investment price growth

Farhi and Gourio's (2019) model assumes that an increase in investment price growth will reduce capital accumulation and economic growth by reducing investment in capital.

While this assumption is intuitive, standard user cost of capital theory uses capital price growth rather than investment price growth. Capital and investment prices have diverged in Australia – ABS data show that capital prices have grown about six times faster than investment prices from 1997 to 2021. Given this difference, capital price growth was substituted into the model for investment price growth (i.e. g_Q became a larger negative value in the model) (table A.3).

Introducing capital price growth into the framework decreased the absolute value of the risk premium and increased the absolute value of depreciation; the market power component remained relatively constant. Using capital prices still resulted in a rising risk premium.

The large increase in the depreciation spread reflects that the higher capital prices (larger negative g_Q) would reduce investment in new capital stock and the trend growth rate (g_T), thereby resulting in a larger magnitude of depreciation (δ). This increase in depreciation offsets the larger negative value of g_Q, resulting in a higher overall depreciation spread.

The lower risk premium reflects that higher capital prices would reduce capital accumulation, and therefore the trend growth of GDP; a lower trend growth in GDP would reduce the required rate of return according to the Gordon growth model, and therefore the risk premium.

Table A.3 – Substituting capital price growth into the model

MPK-RF spread	1997–2008	2009–2020	Difference
Total spread ($g_Q = investment\ price\ growth$)[a]	12.00	14.10	2.08
Depreciation $\delta + g_Q$	4.62	4.34	-0.28
Market power γ	3.17	3.21	0.04
Risk premium $r^* - r_f$	4.26	6.58	2.32
Total spread ($g_Q = capital\ price\ growth$)[b]	12.00	14.10	2.08
Depreciation $\delta + g_Q$	8.51	7.18	-1.33
Market power γ	3.30	3.32	0.02
Risk premium $r^* - r_f$	0.23	3.62	3.39

a. g_Q is the negative quarterly growth of (gross fixed private capital accumulation chain price index)/(final consumption chain price index). **b.** g_Q is the negative quarterly growth rate of (capital price index)/(final consumption chain price index). The capital price index was constructed by subtracting the growth rate of the quantity of the capital stock by the growth rate of the value (price and quantity) of the capital stock. This gives a growth rate for capital stock prices.

Source: Commission estimates based on RBA, ABS and Market Index data.

References

Allen, W 2012, *International liquidity and the financial crisis*, Cambridge University Press.

Barro, R 2023, 'r Minus g', *Review of Economic Dynamics*, vol. 48, pp. 1–17.

Cohen, W 2010, 'Fifty years of empirical studies of innovation activity and performance', in Hall, B and Rosenberg, N (eds), Handbook of the economics of innovation, vol 1, Elsevier, North-Holland, pp. 129–213.

Constantinides, GM and Duffie, D 1996, 'Asset Pricing with Heterogeneous Consumers', *Journal of Political Economy*, vol. 104, no. 2, pp. 219–240.

Day, I, Duretto, Z, Hartigan, P and Hambur, J 2022, *Competition in Australia and its impact on productivity growth*, October, Treasury round-up, October 2022.

Edwards, H and Lane, K 2021, 'Why are investment hurdle rates so sticky?', RBA Bulletin.

Ellis, L 2021, *Innovation and Dynamism in the Post-pandemic World*, Reserve Bank of Australia, www.rba.gov.au/speeches/2021/sp-ag-2021-11-18.html (accessed 11 January 2022).

Farhi, E and Gourio, F 2019, *Accounting for Macro-Finance Trends: Market Power, Intangibles, and Risk Premia*, 25283, National Bureau of Economic Research.

Freestone, O and Breunig, R 2020, 'Risk Aversion and the Elasticity of Intertemporal Substitution among Australian Households', *Economic Record*, vol. 96, no. 313, pp. 121–139.

Hambur, J 2021, *Product market power and its implications for the Australian economy*, Treasury Working Paper 2021-03.

—— and Andrews, D 2023, *Doing less, with less: Capital misallocation, investment, and the productivity slowdown in Australia*, Research Discussion Paper, Reserve Bank of Australia.

Jones, B 2021*, Uncertainty and risk aversion - before and after the pandemic*, Reserve Bank of Australia, https://www.rba.gov.au/speeches/2021/sp-so-2021-06-02.html (accessed 6 December 2021).

Jordà, Ò, Knoll, K, Kuvshinov, D, Schularick, M and Taylor, A 2019, 'The Rate of Return on Everything, 1870–2015', The *Quarterly Journal of Economics*, vol. 134, no. 3, pp. 1225–1298.

King, S 2023, 'Productivity, Economic Dynamism and the "Failure of Competition" Narrative', *Economic papers*, vol. 42, no. 3, pp. 213–228.

PC (Productivity Commission) 2023, *Productivity growth and wages: a forensic look*, PC Productivity Insights, Canberra.

Rietz, T 1988, 'The Equity Risk Premium', *Journal of Monetary Economics*, vol. 22, no. 1, pp. 117–131.

The Australian Government and Heads of Treasury 2017, *Intergovernmental Review of Business Investment*, Commonwealth of Australia, https://research.treasury.gov.au/external-paper/intergovernmental-review-of-business-investment (accessed 6 December 2021).