ENSURING A RELIABLE APPROACH TO NOTIONAL FINANCEABILITY

A Report for SP Energy Networks

November 2024

Economic Insight

01 Introduction and Executive Summary

Introduction

In line with other economic regulators, Ofgem has a financing (or financeability) duty to have: *"regard to the need for licence holders to be able to finance their licensable activities."*[1] When interpreting and applying financeability duties in practice, regulators typically do so with respect to a notional (hypothetical) firm, rather than an actual company. There are two dimensions to this:

- **Hypothetically efficient.** That is to say, rather than testing to see whether an actual company, which may incur *'too high'* (i.e., inefficient) costs, is financeable, Ofgem tests whether its determinations result in a hypothetically (notionally) efficient company being financeable.

- **Notional capital structure.** Again, rather than testing whether a firm is financeable under its actual capital structure (gearing), Ofgem adopts a hypothetical (notional) capital structure, to reflect that capital structure choices (and the risks associated with them) are a matter for companies.

Consistent with the above, in its Sector Specific Methodology Decision for RIIO-3, Ofgem confirmed that it will: *"assess the financeability of energy networks on the basis of an efficient licensee adopting the notional capital structure"*[2] [emphasis added].

The principles that underpin the need to assess financeability on a notional basis are sound. However, the 'in practice' application of assessing notional financeability raises some important challenges. Chief amongst these is the fact that the results of any such assessment are substantively affected by the assumptions one makes regarding the performance (efficient costs incurred and service quality delivered) and characteristics of the notional company. By way of example, holding all other assumptions constant, if one assumes a notional company has 50% gearing, one is more likely to conclude it is financeable (for debt) than if one assumes notional gearing of 70%. Therefore, there is a risk that, without adequate consideration of these challenges, and an approach to addressing them, financeability assessments may not (in practice) provide a reliable basis for reaching a conclusion on whether the notional firm is, or is not, financeable (nor, therefore, whether statutory financeability duties have been met).

Following from the above, SP Energy Networks commissioned us to take a fresh look at notional financeability and consider: (a) what the appropriate approach should be; and (b) how one might address the challenges arising from applying that approach in practice. The aim of our work is to help encourage further consideration of how regulators, regulated companies, and other stakeholders can ensure notional financeability assessments are robust, so that they provide a reliable guide as to whether related statutory financeability duties are met, under future determinations.

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[1] *'The Energy Act 2023.' Part 1; 1(c).'*

[2] *'RIIO-3 Sector Specific Methodology Decision – Finance Annex.' Ofgem (July 2024); paragraph 5.2.*

Executive summary

Economic regulators in the UK have statutory financeability duties. Whilst regulators have consistently interpreted these as relating to a hypothetically efficient / notional firm, their approach to considering *whether* the notional firm 'is financeable' has evolved over time. In earlier determinations, regulators were explicit that the concept of the notional firm 'being financeable' had two limbs, and incorporated both: (a) setting an appropriate WACC and, through their determinations more broadly, expected equity return (because a firm that is not *expected* to earn a return commensurate with the risks it faces is, by definition, not financeable); and (b) assessing whether credit metrics were consistent with the notional firm being financeable for debt (typically referred to by regulators as financeability testing / assessment). Over time, regulators have tended to focus primarily on financeability testing (i.e., for debt), with limited discussion of what it means for a firm to 'be financeable', as per the two limbs.

We have identified two main challenges in assessing financeability on a notional basis in practice:

- **Challenge 1: accurately identifying the notional firm.** This refers to ensuring that the assumptions one makes about the notional firm are robust in their own right and reflect interdependencies across those assumptions. If this challenge is not adequately addressed, the *expected* returns and cashflows of the notional firm may be over (or under) stated, leading one to erroneously conclude that it is financeable (or not), which would further be inconsistent with meeting the **'fair bet'** principle.[3]

- **Challenge 2: ensuring notional financeability over the long-term.** By this we mean the challenge in avoiding conflating short-term cash constraints with more fundamental issues, so that revenue reprofiling masks the real problem, at the expense of future customers / investors.

Focusing predominantly on Challenge 1, we have reviewed the academic literature relevant to the assumptions that must be made regarding the notional firm, and the interrelationships between them. Table 1 summarises our assessment of the strength of these relationships which, in turn, informs the recommendations we make in this report.

Table 1: Summary of findings

Relationship between assumptions re the notional firm	Strength of evidence for relationship
Efficient (notional) gearing is a function of firm / industry characteristics	
Higher (better) credit ratings are associated with lower levels of gearing (capital structure)	
Higer (better) credit ratings are associated with a lower cost of debt	
Higher productivity is associated with higher equity returns	

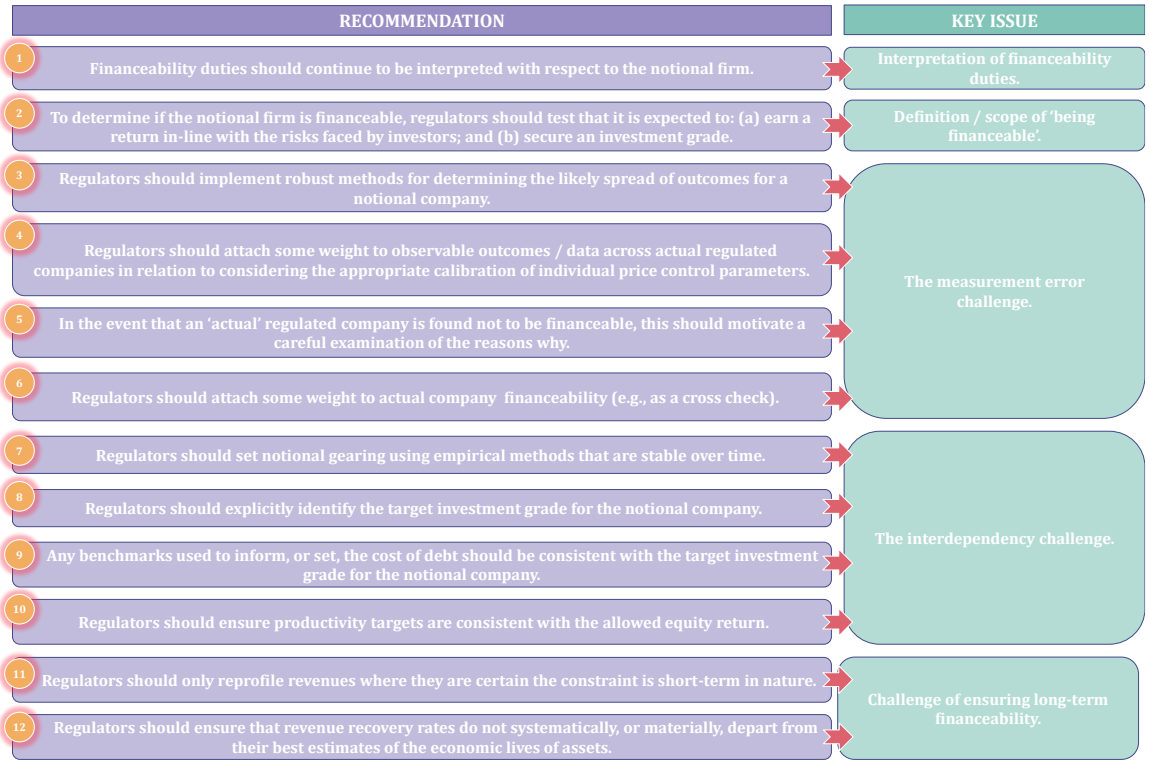
Source: Economic Insight

[3] *The fair bet principle refers to the idea that investors should face an equal chance of out or under-performing, with the expected return being equal to the allowed return.*

Our recommendations

We have identified 12 recommendations regarding the approach to notional financeability. **Figure 1** sets out a high-level summary of these (see purple boxes), and the issues they map to (see green boxes). These recommendations are described more fully, along with their rationale, in Table 3, contained in the concluding chapter of this report.

Figure 1: Summary of our recommendations and the issues they map to



Source: Economic Insight

The remainder of this report is structured as follows:

- Section 2 provides further relevant background information.
- Section 3 discusses the challenges in assessing notional financeability.
- Section 4 assesses potential relationships between assumptions regarding the notional firm, based on a literature review.
- Section 5 sets out our recommendations.

Annexes contain further details of Ofgem's approach to financeability and our literature review.

02 Background context

In the following we set out further background context relevant to the issues addressed in this report. In turn we discuss: (i) the economics principles pertinent to financeability; (ii) some brief observations on how the approach to financeability taken by regulators has evolved over time; and (iii) an overview of Ofgem's approach to financeability at RIIO-3.

Economics principles relevant to financeability

Principle 1: to 'be financeable' a firm must be expected to earn an appropriate return and have adequate cashflows

Before considering the interpretation of *statutory* financeability duties under economic regulation, it is important to recall that the concept of a firm (in any market / industry) being financeable has two components:

- The first is that a firm (investors in a firm) must be *expected* to generate (earn) an overall rate of return that is commensurate with the risks they face, as typically measured by the WACC.
- The second is that a firm must have cash flows that are consistent with it being able to make its debt payments and raise debt finance.

The economics intuition for the above is straightforward. In reference to the first component, in the long-run, to stay in business, a firm *must* be able to recover all of its costs, including its opportunity cost of debt and equity capital. Therefore, if a firm is not expected to do this (on average over time), we can categorically say that it is not financeable. However, even if this first condition is met (i.e., a firm *will* earn its WACC on average over time) it could still be rendered insolvent, or be unable to raise finance, due to mismatches in the timing of cash inflows and outflows. Therefore, intuitively, these two components give rise to a hierarchy, whereby the first is a 'necessary, but not sufficient', condition for a firm to be financeable.

Implications for economic regulation

For a regulator setting price controls, so that *both* conditions above are met, the implications are:

- For the expected return for debt and equity investors to be commensurate with the risks they face, it is necessary that the:
  - regulatory set WACC (and within it, the cost of debt and equity) reflects those risks; and
  - overall price determinations reflect a symmetrical balance of risk for equity investors, such that they neither expect to out, nor under, perform (known as the **'fair bet'** principle).
- To ensure cash flows are sufficient for debt payments to be made, and that debt finance can be raised, it is necessary that the projected cash flows (and related credit metrics) *that arise under regulatory determinations* are consistent with regulated companies being able to:
  - make their projected debt repayments; and
  - secure a reasonable overall investment grade rating, such that they can access debt capital markets at a reasonable cost.

Principle 2: only efficient firms are expected to be financeable in competitive markets

In a competitive market it is *expected* that *efficient* companies *will* earn their opportunity cost of capital. That is to say, any inefficiency will be punished by competitive forces (i.e., resulting in inefficient firms earning returns below their cost of capital, leading them to exit the market). Similarly, 'excessive' profits (profits substantively and persistently above the cost of capital) will also be competed away (by entry and expansion).

Implications for economic regulation

When setting price determinations, regulators should not seek to ensure that the 'actual' firms they regulate are financeable (as defined above); but, rather, should assess financeability with respect to a hypothetically efficient (or notional) company. However, as per the main focus of this report, achieving this in practice requires ensuring that the assumptions one makes about the notional firm are themselves, robust.

Evolution of the regulatory approach to assessing financeability

Statutory duties

All of the main economic regulators in the UK have statutory financeability duties, although the formulation of them varies. Ofgem has a duty to have regard to: *"the need to secure that licence holders are able to finance the activities which are the subject of obligations [imposed upon them]."*[4] Ofwat has a general (or primary) duty *"to secure that companies… are able (in particular, by securing reasonable returns on their capital) to finance the proper carrying out of those functions."*[5] The CAA has a general (primary) duty to have regard to: *"the need to secure that each holder of a licence under this Chapter is able to finance its provision of airport operation services in the area for which the licence is granted."*[6]

Observations on how the regulatory approach to financeability has evolved

In the following we make some observations on changes in the regulatory approach to financeability that have emerged over time. In doing so, we refer to the approaches of both Ofwat and Ofgem, as similar themes emerge for both, which are pertinent to the issues we are considering here.

Shift in focus towards the debt-side of financeability

At earlier price controls, it is notable that, whilst the economic regulators tended to use the term 'financeability' to specifically refer to the testing of debt financeability, there was explicit recognition of the 'two strands' to companies being financeable (in line with our previous discussion of the economics principles). Accordingly, there was therefore also considerable emphasis on whether companies were (on a notional basis) financeable for equity.

As per the above, at PR04, in relation to the cost of capital and financeability, Ofwat set out that: *"we have a duty to secure that companies are able to finance the proper carrying out of their functions as licenced undertakers ('finance functions'). We look at this as having two strands. One is to secure that, if a company is efficiently managed and financed, it is able to earn a return at least equal to the cost of capital. The second is that its revenues, profits and cash flows must allow it to raise finance on*

[4] *See 'The Gas Act' (1986). Part 1; Section 4AA; 2(b).*

[5] *See 'The Water Industry Act' (1991). Part 1; Section 2; 2(A) (c).*

[6] *See 'The Civil Aviation Act' (2012).*

reasonable terms in the capital markets. We refer to this second strand as financeability"[7] [emphasis added].

> *"We look at this [our finance duty] as having two strands. One is to secure that, if a company is efficiently managed and financed, it is able to earn a return at least equal to the cost of capital. The second is that its revenues, profits and cash flows must allow it to raise finance on reasonable terms in the capital markets." Ofwat*

Ofwat also explained that its approach to setting prices was to *"create conditions under which the additional investment required could come from debt or equity sources. We believe that the returns allowed should provide shareholders with sufficient incentives to commit additional funds, either in the form of retained earnings or new equity injections where this is appropriate, to enable companies to make new investment. Efficient companies should be able to retain stable credit quality going forward."*[8]

Twenty years later, Ofwat's final methodology at PR24 does not explicitly refer to the 'two strands' of firms 'being financeable' (for the purpose of fulfilling its finance duty) in the manner above, and the 'financeability' sections of its method are focused on the assessment of credit metrics relevant to the ability to raise debt finance.[9] Ofwat does not, in its PR24 method, discuss that the setting of the WACC; cost of equity (or expected returns) are themselves core to determining whether companies are financeable (as distinct from financeability testing). This is not to say that the regulator does not recognise their importance per se. Rather, we are simply noting a relative shift in positioning over time.[10]

We observe a similar shift in positioning by Ofgem. For example, in its 2010 RPI-X@20 report, Ofgem summarised its approach to 'ensuring that efficient delivery is financeable' as follows: *"we will ensure that efficient delivery of outputs is financeable by committing to published principles for setting a weight[ed] average cost of capital (WACC)-based allowed return to reflect the cash flow risk of the business over the long term. Financeability will be assessed in the round, including a cross-check against relevant equity metrics and credit rating ratios."*[11] That is to say, as per Ofwat in its early price controls, whilst Ofgem used the term 'financeability' to refer to testing on the debt-side, it explicitly recognised that the allowed return (WACC) was a core strand to ensuring the notional firm is *financeable* in practice.

In its RIIO-3 sector specific methodology decision, Ofgem has raised the prospect of introducing (equity) 'investability' as a concept under the next round of energy network price controls. Whilst Ofgem has not finalised how this will be applied in detail, it has explained that it will likely include: (a) cross checks on the CAPM cost of equity; and (b) factoring in additional (equity) risks on a forward-looking basis (or between different segments of the energy industry). Ofgem has also noted that it may need to take account of any differences between 'allowed' and 'expected' equity returns,

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[7] *'Future Water and Sewerage Charges: Final Determinations. 2010-2015.' Ofwat (2004); page 217*

[8] *'Future Water and Sewerage Charges: Final Determinations. 2010-2015.' Ofwat (2004); page 40*

[9] *'Creating tomorrow, together: Our final methodology for PR24 Appendix 10 Aligning risk and return.' Ofwat (2022); page 41.*

[10] *We also recognise that Ofwat's PR24 method retains the use of return on regulatory equity (RoRE) as a framework / analysis for informing equity risk (expected equity returns). However, as we subsequently explain, we have concerns as to the robustness / usefulness of this in practice.*

[11] *'RIIO – a new way to regulate energy networks: final decision.' Ofgem (2010); page 4.*

although in the first instance, its aim will be to address asymmetry 'at source' (meaning allowed and expected returns should coincide).[12]

In summary, although the term 'financeability' has tended to be consistently used by the regulators in relation to the testing of credit metrics for the purpose of assessing the ability to raise debt finance, there appears to have been some change in emphasis over time. This is both in relation to: (i) recognition that the setting of the WACC and equity return is, notwithstanding terminology, *essential* to the concept of ensuring the notional firm is financeable (including for the purpose of meeting statutory duties)[13]; and (ii) the weight placed on ensuring / testing whether regulated companies are, in fact, attractive for equity (both substantively, and in tone). It is possible that the more recent discussions of (equity) *investability* may signal a recognition of this evolution, meaning that this balance will, to a degree, shift back somewhat at the next round of price controls.

Less detailed consideration of risk (particularly equity risk), in the context of increased regulatory incentive mechanisms

Under its GD-1 decisions, Ofgem, made use of Monte Carlo modelling to assess relative totex risk, and incorporated this into its financeability assessment, explaining that it had*: "added a further dimension to our financeability assessment by testing financeability under the simulations produced in our Monte Carlo modelling of relative risk."*[14] Ofgem thus calculated (using Moody's published methodology at that time) projected overall credit ratings under its Monte Carlo simulations. In doing so it: *"looked at the implied credit rating at the 5th per centile (ie in 95 per cent of simulations the implied credit rating was no lower)."*[15]

In contrast to the above, under its RIIO-3 final methodology decision, Ofgem will rely on plausible downside scenario stress tests, rather than any probabilistic modelling (on the basis that Ofgem has concerns about the reliability of the latter).[16]

In the water industry, Ofwat has (going back to its earlier price controls) tended to consider risk through the lens of scenario analysis. Whilst, since PR14, it has (in principle) identified P10 and P90 probabilities in order to define return on regulatory equity (RoRE) downside and upside risks, in practice these have been determined relatively arbitrarily. At PR24, Ofwat has now made some use of Monte Carlo risk modelling (in relation to ODIs, but not in relation to financeability more broadly).[17] However, under both scenario and Monte Carlo methods, there have been challenges and reliability issues regarding Ofwat's underlying assumptions / risk ranges, and the resultant projected distributions of financial outcomes for firms.

In summary, our main observation is that, in both energy networks and water, the overall regulatory approach has become more complex over time, with equity returns being impacted by an increased number of regulatory incentive mechanisms. However, in both sectors, the regulatory approach and tools for robustly identifying and quantifying this risk have, arguably, not fully kept pace with the complexity. In making this observation, we recognise that it is inherently difficult to robustly identify and model risk (and it is important to avoid spurious accuracy in attempting to do so). An additional observation would be that risk analysis has typically been undertaken as an 'after-the-event' exercise, rather than being seen as a central *input* into individual elements of price determinations, used to

[12] 'RIIO-3 Sector Specific Methodology Decision – Finance Annex.' Ofgem (2024).

[13] As distinct from the narrow testing of credit metrics on the debt side, for which the term 'financeability testing' is commonly used..

[14] 'RIIO-GD1: Final Proposals - Finance and uncertainty supporting document.' Ofgem (2012); page 28.

[15] 'RIIO-GD1: Final Proposals - Finance and uncertainty supporting document.' Ofgem (2012); page 31.

[16] 'RIIO-3 Sector Specific Methodology Decision – Finance Annex.' Ofgem (2024); paragraphs 5.38-5.39.

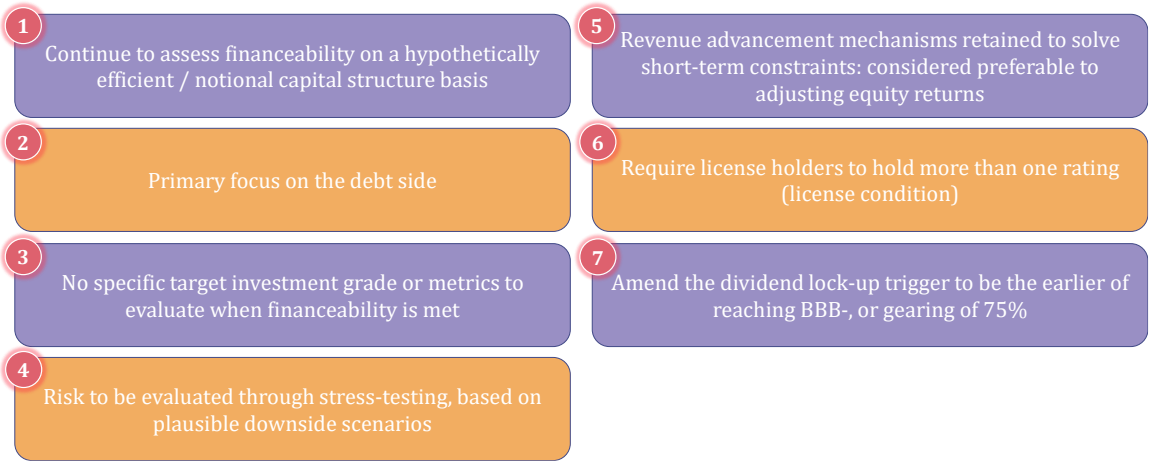
[17] 'PR24 Draft Determinations: Delivering outcomes for customers and the environment.' Ofwat (2024); page 127.

help identify and set the 'most likely' outcome for the notionally efficient firm (which is essential to meeting the 'fair bet' principle). That is to say, regulators have tended to 'set' parameters and then consider possible variations / scenarios around them, rather than seeing risk analysis itself as being a means to appropriately set parameters in the first place.

Ofgem's approach to financeability at RIIO-3

Figure 2 below summarises the main features of Ofgem's approach to financeability at RIIO-3. Annex A provides further details of this.

Figure 2: Key features of Ofgem's approach to financeability at RIIO-3



Source: RIIO-3 Sector Specific Methodology Decision – Finance Annex

Consistent with our observations regarding the evolution of the approach to financeability across the economic regulators over time, we highlight that Ofgem explicitly states that its approach at RIIO-3 will predominantly focus on the debt side of financeability (because it considers there are more likely to be binding constraints in relation to debt than equity).

> *"These issues [potential constraints on debt] lead the financeability assessment to focus primarily on whether the price control package in-the-round puts licensees (at the notional capital structure) in a position where they can service reasonable debt costs." Ofgem*

03 Challenges arising from the current approach to notional financeability

In this section we set out the challenges we identify as arising from the current approach to assessing notional financeability. We discuss two main challenges: (i) accurately identifying the notional firm (which is the main focus of the next main section of our report); and (ii) ensuring notional financeability over the long term.

Challenge 1: accurately identifying the notional firm

Whilst the principle of assessing financeability on a notional basis is sound (for the reasons previously explained), the main challenge this raises in practice is 'how' one identifies / appropriately characterises the notional firm, such that said assessments are reliable. By this, we mean one's assessment of whether the notional firm is financeable turns on the projected financial performance of the notional firm, and (relatedly) the characteristics of the notional firm, under regulatory determinations. Specifically, it turns on the:

- regulatory-set WACC;
- projected expected equity returns, relative to the regulatory set cost of equity (on the equity side);
- projected cash flows and related financial ratios (on the debt side); and
- assumed notional capital structure.

The projected equity returns and cash flows of the notional firm, in turn, crucially depend on what the regulator assumes in relation the 'most likely' estimates of the efficient: (i) costs the notional firm will incur; and (ii) service quality performance the notional firm will deliver.

The current approach to assessing notional financeability carries both a 'measurement error' risk and an 'interdependency' risk regarding the above.

Measurement error risk

Measurement error risk arises from the challenge in accurately calibrating each individual element of a price determination (e.g., allowed totex; ODIs) to reflect the 'most likely' outcome of the efficient firm (which is essential to meeting the 'fair bet' principle). Whilst this difficulty is inherent (one can never perfectly identify efficient costs), there are good reasons to suppose this risk has increased over time. This is because, in the main, regulatory frameworks have become more complex, with an increasing number of incentive mechanisms which, collectively, determine allowed revenues and impact cashflows. At the same time, regulatory tools for stress-testing whether each parameter has, in fact, been calibrated appropriately (which requires being able to accurately forecast the performance spread of the notional firm for each parameter) do not appear to have kept up with this evolution. If each parameter is not appropriately calibrated, the result will be that projected returns and cashflows may either be over (or under) stated, meaning one *erroneously* concludes the notional firm is financeable (or is not).

Interdependency risk

In addition to ensuring that each individual assumption regarding the performance / characteristics of the notional company is robust in its own right, there is also the challenge of how one ensures

those assumptions, when considered together, are cogent. There are a number of assumptions where one might expect there to be a degree of interdependency. For example:

- The efficient (notional) gearing may be dependent on firm / industry level characteristics.
- The overall credit rating may be related to individual credit metrics (including gearing).
- There may be a relationship between overall credit ratings and the cost of debt.
- Productivity may be related to equity returns.

To the extent that such interdependencies arise, in unregulated markets they occur naturally (due to competition and capital market efficiency). However, in regulated industries, such as energy, these relationships are only preserved for the notional company if regulators explicitly factor them into their assumptions, when assessing notional financeability. The evolution of regulatory approaches to notional financeability has perhaps increased the risk of not recognising interdependencies in two ways. Firstly, as the number of incentive mechanisms has increased over time, there is perhaps a greater prospect of each being considered in isolation. Secondly, the decoupling of the assessment of debt-financeability (and focus on it) from expected equity returns likely further increases this risk. If interdependencies are not appropriately captured then, as above, projected returns and cashflows can be over (under) stated, leading to flawed conclusions that the notional firm is (is not) financeable.

Challenge 2: ensuring notional financeability over the long-term

The second challenge relates to ensuring the notional firm is financeable *over the long term.* In theory, if over consecutive price controls, regulators set determinations such that, at each one, the notional firm was financeable (i.e., the notional firm was *expected* to earn a return commensurate with the risks faced; and had adequate cash flows) one might suppose that it *would also be financeable in the long-run.* However, there are two reasons why this may not be the case:

- First, the long-lived nature of assets in regulated networks means there are long lags between changes in expenditure (particularly capex); asset performance; and service quality. Therefore, any given price determination may *appear* to result in the notional firm being financeable *over the duration of that control,* whilst resulting in a sub-optimal level of investment (and asset health and service quality) in the long-run. Accordingly, were the notional firm assessed over a longer time period, where the costs required to maintain asset health and service quality (or correct for any deterioration) are taken into consideration, it may not be financeable.
- Second, regulators can reprofile revenues at any price determination. The in-principle use of reprofiling is sound, in that it can provide an NPV-neutral solution to short-term financeability (advancing revenues) or affordability (deferring revenues) constraints. However, suppose the problem has been misdiagnosed, because what appears to be a short-term cash-flow constraint is actually due to a deeper issue that results in the notional firm being under-funded. In this case, the use of reprofiling might mask a failure to ensure long-term financeability.

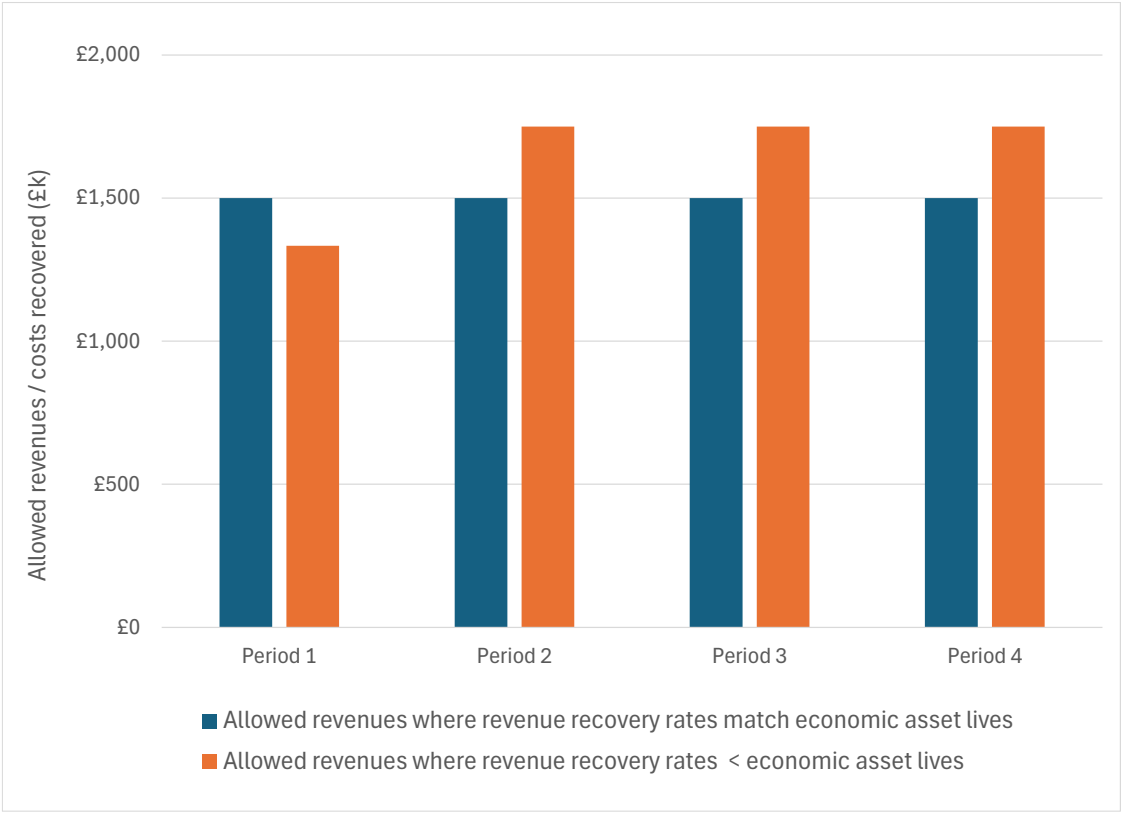
Expanding on the second reason above, whilst all industries that utilise assets to provide a service face choices as to how they recover costs over time, regulated network industries have some unique features that affect how this can be done.

In industries providing non-essential services in competitive markets, how companies balance cost recovery over time typically has *no* implications for the welfare of future customers. For example, consider a holiday car rental company. It may know that, on average, it will own a car for (say) 5 years. During that time, it may expect to make 50 rentals. It will therefore balance its pricing such

that, on average over the 5 years, it has covered the costs of operating and financing *the vehicle in question,* plus a reasonable rate of return. Importantly, however, its pricing decisions over that period have no longer term implications for the welfare of its car rental customers in (say) 10 years' time.[18]

In contrast, in regulated industries (where assets are long-lived; the services are essential; and may be demanded 'in perpetuity') decisions as to the speed of cost recovery over any one price control period *do* have the potential to affect future customer welfare. The following two figures provide illustrative examples of why this occurs. Firstly, **Figure 3** shows the case based on a single hypothetical asset, with a value of £1m and an economic life of 10 years. The blue bars show implied allowed revenues over four successive price controls (each lasting 10 years) where the revenue recovery rate is set equal to the asset life (i.e., costs are fully recovered over the 10 years). The orange bars show the same, but where the revenue recovery rate is set to 15 years. As can be seen, customers in Period 1 benefit from the slower revenue recovery rate. However, in future periods, this implies there are greater costs to be recovered, due to the overlap in unrecovered costs from the previous periods' asset(s) and the costs of new assets. By implication, this means allowed revenues at future periods need to be higher, *in order to achieve financeability.*

Figure 3: Illustration of impact of revenue recovery being slower than economic asset lives



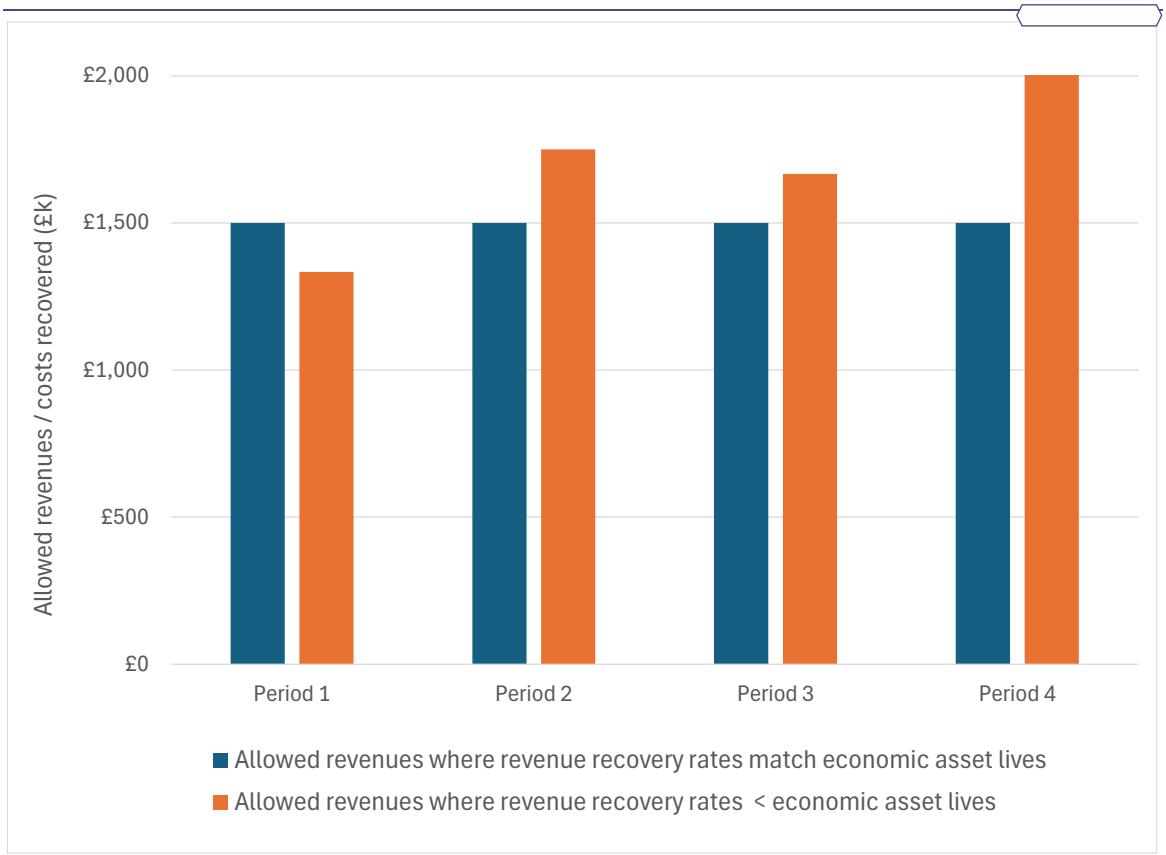
Source: Economic Insight

[18] *Customer willingness to pay for a holiday car rental is a function of vehicle condition. So, beyond a certain age, customers would not be willing to rent the car. Relatedly, the rental company faces demand uncertainty (for car rentals in general; and from its relative competitive position in the market). These factors mean it would likely not be commercially viable to leave some proportion of a vehicle's costs 'unrecovered' over its ownership period in the expectation that these could be recovered from future rentals of other vehicles. Thus, there is a bounded period of time over which the rental company can balance cost recovery for each vehicle. Thus, the costs / benefits arising from the vehicle can be reprofiled over that time period (shared between customers renting it during that time) based on the firm's pricing decisions but have no longer-term implications for customers.*

One could take the view that the above is not necessarily a problem (as, in NPV terms, the total amounts recovered over the periods are unaffected by the recovery rate, including in our example). However, in practice this *cannot be assumed to be the case,* because the decisions regulators and companies take in any one period have no binding implications for future periods. That is to say, whilst mathematically the slowing down of revenue recovery implies that 'in the end' future costs to be recovered increase 'at some point', there is no mechanism to ensure this occurs. Because price controls are set 'in the round', regulators might make other offsetting decisions in future, such as allowing lower costs, or slowing recovery rates further, to avoid the (necessary) increase.

Figure 4 shows the same example again, but where the revenue recovery rate is slowed for a second time, in Period 3. As can be seen, this 'mitigates' the (increased) costs to be recovered in that period, but thus implies allowed revenues must be even higher in Period 4 (and beyond), due to the greater overlap in unrecovered historical asset costs, and new asset costs. In other words, the implied transfer of costs to future customers through adjustments to revenue recovery rates becomes greater, the more such mechanisms are used.

Figure 4: Illustration of impact of revenue recovery being slower than economic asset lives



Source: Economic Insight

In explaining the case for revenue reprofiling mechanisms, Ofgem states: *"these measures can address short-term cashflow shortfalls in a way that is NPV neutral to the consumer. Other measures, specifically increasing allowed returns on equity, would represent a permanent transfer of value from consumers to companies to address a short-term cashflow issue."* We agree with Ofgem's rationale in principle. However, it is also clear that the systematic use of such mechanisms (in a manner that results in recovery rates departing from economic asset lives) risks storing up either financeability or affordability constraints over time. Moreover, the rationale for such mechanisms crucially depends

on the *source* of any cashflow shortfall. One could equally forward the opposite characterisation to that outlined by Ofgem: that 'cashflow shortfalls' can, in fact, be a symptom of a longer-term underfunding problem *requiring* an uplift in overall allowed revenues, and that (in these circumstances) reprofiling revenue masks the problem, by transferring costs over time between generations of customers (and / or investors).

Short-term cashflow shortfalls' might, in fact, be a symptom of a longer-term underfunding problem requiring an uplift in overall allowed revenues, and revenue reprofiling may serve to mask this problem, by transferring costs over time between generations of customers.

Challenge 1 and Challenge 2 are inherently interconnected. If Challenge 1 is not properly addressed, there is a greater prospect that long-term (notional) financeability is not achieved. In other words, addressing Challenge 1 is a prerequisite of meeting Challenge 2, but is not sufficient on its own. Therefore, even if Challenge 1 is adequately addressed (i.e., the notional firm is correctly identified) there might still be cash-flow constraints (which might be addressed by the use of financeability levers, such as revenue reprofiling). However, to meet Challenge 2 in that circumstance, it is important that regulators closely examine the source of any cashflow constraint, and only deploy reprofiling tools:

(i) where they are *certain* that the constraint is short-term in nature, and is not symptomatic of long-term underfunding issues; and
(ii) such that revenue recovery rates do not systematically or materially depart from their best estimates of the economic lives of assets.

04 Key interdependencies relevant to notional financeability

As discussed in the previous section, a critical challenge in ensuring that any assessment of notional financeability is reliable is accurately identifying the performance / characteristics of the notional company. In this section, we discuss the potential relationships relating to the key assumptions regulators must make regarding the notional firm. For each, we: (i) summarise the key intuition and evidence, based on an academic literature review; (ii) discuss the implications for regulators; and (iii) highlight the risks arising from *not* addressing the implications. Further details of our literature review are provided in Annex B.

Firm characteristics and capital structure (gearing)

Summary of intuition from literature overview

Whilst Modigliani-Miller theorem (1958)[19] proposes that firm value may be independent of capital structure (i.e., there is 'no' efficient capital structure for a firm), this requires several strong assumptions that do not hold in practice (e.g., capital market efficiency; zero taxes, and so on). As a result, there are a range of theories as to the determinants of efficient capital structure. Chief amongst these are:

- **Trade-off theory** (Fama and French, 2002).[20] Under this theory, the optimal capital structure is one where the 'tax shield' benefit of increasing debt financing is offset by the 'financing cost' effect of increased equity risk.

- **Signalling theory** (Ross, 1977).[21] This suggests firms use debt as a signalling device, to show confidence in their financial sustainability (i.e., by raising debt finance, they are 'committing' to being able to make the associated repayments in future).

- **Pecking order theory** (Myers, 1984).[22] This theory proposes that optimal capital structure is determined by firms raising finance in an established hierarchy, based on the relative costs of finance sources. Firms therefore first prefer to fund investment through retained earnings; then through external debt finance; then through equity.

Consistent with the above, various empirical studies find a relationship between firm (and / or industry) characteristics and gearing (which we would not expect to be the case, if there were 'no such thing' as efficient capital structures).[23] These empirical studies are broadly supportive of efficient capital structures varying with the following firm / industry characteristics: *capital intensity; tangible asset intensity; firm size; firm age; growth rate; liquidity; profitability; revenue volatility; tax shields on debt; economic shocks; and other potential unobservable factors that vary by industry / firm.*

A simple examination of variation in actual gearing across industries further illustrates the above. **Figure 5** shows the actual average gearing of firms in the UK and Ireland for the period 2013-23 for a selection of industries, based on the Fame financial database. As can be seen, there is significant

[19] *'The cost of capital, corporation finance and the theory of investment'. Miller, M., & Modigliani, F. The American Economic Review (1958); pages 261-297*

[20] *'Testing trade-off and pecking order predictions about dividends and debt.' Fama, E., & French, K. (2002). The Review of Financial Studies, 15(1), (2002); pages 1-33.*

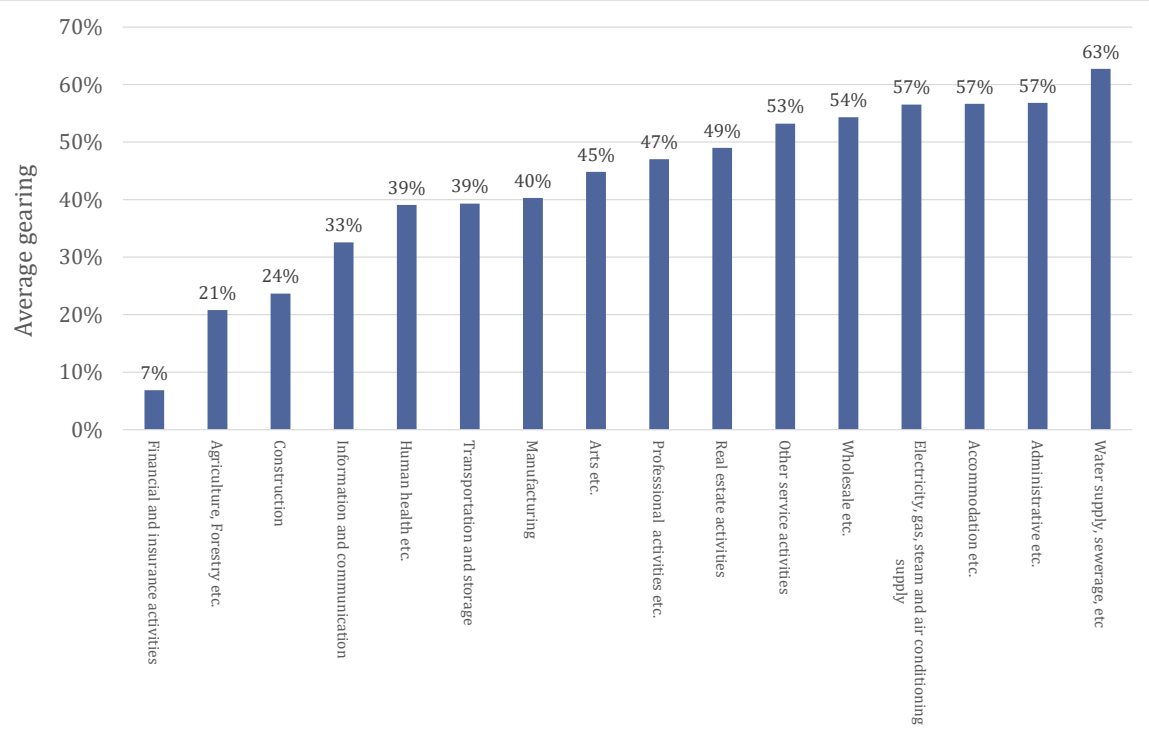
[21] *'The Determination of Financial Structure: The Incentive-Signalling Approach.' Ross, S. A. The Bell Journal of Economics, 8(1), (1970); pages 23-40.*

[22] *'The capital structure puzzle.' Myers, S. The Journal of Finance, 39(3), (1984); pages 574-592.*

[23] *i.e. because if there were no efficient capital structure, capital structure variation across firms / industries should be random.*

variation in average gearing by industry, ranging from 7% to 63% This is not consistent with gearing being random (i.e., it accords with optimal capital structure theory and the related existing empirical studies).

Figure 5: Gearing by industry in the UK (Net debt / capital employed across selected industry sub-divisions)



Source: Economic Insight analysis of Fame data

Note: observations with missing values for any of the variables removed. We truncated relevant variables, and removed outliers by excluding the 2% extremes of financial ratios. The resulting dataset has 104,119 observations across 20,130 companies

Implications for regulators

Whilst it is not possible to *precisely* measure the efficient level of gearing, there is a sufficient theoretical and empirical basis to establish that firm capital choices (and therefore variation in firm and industry gearing) are non-random. Accordingly, regulatory set notional gearing should be estimated from (or directly informed by) firm-level data of regulated companies (industries), reflecting the key characteristics that are shown to drive gearing choices in competitive, unregulated, markets.

There are various options that regulators could explore for identifying (predicting) the efficient (notional) gearing level at price determinations, including; (i) estimating their own econometric models to explain gearing variation, then applying the resultant coefficients to regulated industries[24]; and / or (ii) drawing on existing empirical models under the literature, and applying the associated coefficients to regulated industries.

[24] *For example, as we did in a report for Southern Water – see 'evaluating the case for a gearing incentive mechanism: a report for Southern Water.' Economic Insight (2024).*

Any given approach (econometric model) will be imperfect. Thus, the primary aim should be to:

- determine notional (efficient) gearing in a way that is ***most consistent*** with the main drivers supported by the existing evidence (reflecting industry characteristics identified under the literature as most important, such as capital and tangible asset intensity); and
- ***reduce regulatory discretion,*** such that regulatory set notional gearing should (primarily) only vary over time due to changes in the factors that we would expect to determine efficient capital structures.

Risks of not addressing implications

If regulatory set notional gearing deviates from the 'true' notional level, it risks incentivising inefficient capital structures in regulated industries, which (over time) customers will pay for. That is to say, over time, intuitively this will result in a higher cost of capital for regulated companies.

In addition, if notional gearing is set below the efficient level, debt financeability assessments undertaken at price determinations will be overly optimistic (because they are assuming a higher equity buffer than we would expect, given firm / industry characteristics). Similarly, if notional gearing is set above the efficient level, the opposite will be true, and debt financeability assessments will be overly pessimistic. An error in either direction therefore raises the risk that regulators erroneously conclude that they have met their financeability duties.

Overall credit rating and individual credit metrics (gearing)

Summary of intuition from literature overview

There are good intuitive reasons to suppose that there is an inverse relationship between gearing and overall credit rating (i.e., higher gearing correlates with a reduced credit rating, all else equal). Most obviously, this arises from the fact that the ratings agencies themselves typically use gearing as *one metric* of relevance to assigning overall credit rating grades, whereby credit ratings decline as gearing increases. Moody's assigns gearing a weighting of 12.5% (out of a total of 40% for leverage related metrics) under its scorecard for regulated electric and gas networks.[25] Its scorecard also sets out thresholds for gearing by overall investment grade rating, which we summarise in Table 2.

Table 2: Gearing metrics assigned to investment grades under Moody's methodology

Investment grade	Gearing threshold (net debt / RAB)
Aaa	<30%
Aa	30%-45%
A	45%-60%
Baa	60%-75%
Ba	75%-90%
B	90%-100%
Caa	>100%

Source: Moody's

[25] *See 'Rating Methodology: Regulated Electric and Gas Networks.' Moody's (2022).*

Under the above intuition, there is a causal relationship whereby firms make their gearing choices (independently of ratings – say, based on optimising capital structure) and the ratings agencies subsequently assign ratings such that, as the gearing of firms increases, their credit ratings decline. So, on average, more highly geared firms will have lower credit ratings than more lowly geared firms.

In addition, the literature identifies strong evidence that firms target specific rating grades and thus (due to the material role that gearing may play in the assignment of overall grades) may either: (i) pre-emptively, perhaps prompted by a negative outlook watch, reduce gearing or defer an increase in gearing, to avoid a downgrade; or (ii) following a downgrade, take steps to reduce their gearing. This intuition is discussed by Kisgen (2006)[26], in a paper now widely referenced, who explains that ratings have material cost and benefit implications for companies, which are sufficient to influence their capital structure choice. Key costs identified by the author as relevant include:

- regulations on bond investments means the pool of available investors directly varies with credit ratings;
- ratings act as a signal of firm quality, which affect the cost of capital (we discuss this further subsequently); and
- various 'discrete' costs, such as changes in ratings triggering changes in bond coupon rates, mandatory repurchasing of bonds, or reduced access to the commercial paper market.

Kisgen (2006) argues that instances of firm management behaviour (as regards to capital structure targets) intended as a means to influence credit ratings (i.e., whether to issue more debt) primarily arise for firms that are 'close to' a ratings upgrade or downgrade.

Wojewodzki et al. (2018) highlight the costs associated with different levels of ratings as likely explaining a relationship between them and gearing. They postulate that a rating is a signal of the probability of default. Hence, higher ratings are expected to be associated with a lower cost of debt, and vice-versa[27] (we discuss the ratings cost of debt interdependency issue subsequently).

Krichene and Khoufi (2016) further suggest that ratings may affect a firm's third-party relationships (say, with employees, suppliers and customers), providing a further incentive to target a particular investment grade and, hence, gearing.[28]

Further to the intuition identified above, the literature contains empirical support for there being a relationship between overall credit ratings and gearing.

Kisgen (2006) undertakes an empirical analysis of debt issuance, relative to equity issuance, identifying whether the likelihood of issuance varies for firms 'close to' a ratings upgrade or downgrade, using Compustat data from 1986 to 2001 (and where the credit rating metric used is Standard & Poor's Long-Term Domestic Issuer Credit Rating). The author finds a strong relationship between firm capital structure choices and credit ratings. Specifically, Kisgen reports that firms 'near' a ratings change issue around 1.0% less net debt (relative to equity) as a percentage of their total assets (i.e., size adjusted), compared to firms not near a ratings change.[29]

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[26] 'Credit Ratings and Capital Structure.' D Kisgen. The Journal of Finance (2006).

[27] 'The role of credit ratings on capital structure and its speed of adjustment: an international study.' Michal Wojewodzki, Winnie P.H. Poon & Jianfu Shen To. The European Journal of Finance (2018); page 736.

[28] 'The effects of credit rating grades' changes on capital structure: S&P 500.' Afef Krichene and Walid Khoufi. Afef Feki Krichene, 2Walid Khoufi (2016).

[29] 'Credit Ratings and Capital Structure.' D Kisgen. The Journal of Finance (2006); page 1068.

Wojewodzki et al. (2018) focus on the relationship between credit ratings levels (rather than changes in ratings, as per Kisgen) and gearing. Using 17,102 firm-year observations from 19 economies between 1991 and 2010, the authors test the impact of credit rating levels on capital structure, and the speed of capital structure adjustment. They find an inverse relationship between ratings and gearing, as follows: *"a credit rating upgrade of four notches (e.g. from A to AA+) in year t will lead to a drop of 4×0.41%, i.e. 1.64%, in a company's debt-to-equity ratio one year later, all else being equal."*[30]

Krichene and Khoufi (2016) empirically test the relationship between capital structure and ratings upgrades and downgrades for S&P500 firms. They find that both ratings upgrades and downgrades have significant effects on the ratio of net debt issuance. Specifically, firms downgraded to the speculative grade (at time t-1) will issue, in the next year, (1.94%) less debt than equity.[31]

Implications for regulators

The above has implications for regulators as regards to the consistency between notional gearing and target investment grades for the notional firm; and any regulatory incentive mechanisms relating to capital structure.

In relation to the first issue, evidence in the literature of an empirical relationship between gearing and credit ratings calls into question the extent to which regulators can legitimately decouple the two, on the basis that the target investment grade is an 'in the round' assessment. Whilst the studies we have reviewed within the scope of this report provide an insufficient basis to conclude on the best basis for connecting the assumptions, they do suggest regulators should give this matter further thought. A related consideration is that, to the extent that the ratings agencies themselves may make an 'in the round' assessment, it does not automatically follow from this that regulators should themselves deploy a high degree of discretion in their decision-making in this area. Rather, regulators should be mindful of the benefits of regulatory predictability and credibility, which can help deliver lower financing costs over the longer-term.

In relation to the latter issue, it would seem to imply that (to the extent that the in-principle and in-practice case for any such capital structure incentive mechanisms has been made), the thresholds for them should be set at a point where, based on robust and appropriate evidence, the relative cost-benefits are maximised. With regards to gearing and ratings grades, this may imply identifying whether there are any discontinuities in relation to ratings grades, at which point(s) further downgrades result in large increases in costs to customers; the environment; and / or wider society. The corresponding gearing threshold (under the ratings agency methodology) can then be identified and taken into account as a relevant piece of evidence.

More broadly, we suggest that the existence of a relationship provides a further basis to suppose regulators should be explicit about the target investment grade for the notional firm, rather than adopt a relatively subjective approach under which a 'comfortable' investment grade is the objective.

Risks of not addressing implications

The main risk of not addressing the above is the potential for internal inconsistencies between the target investment grade level; notional gearing (and related gearing incentive mechanisms); and the

[30] *'The role of credit ratings on capital structure and its speed of adjustment: an international study.' Michal Wojewodzki, Winnie P.H. Poon & Jianfu Shen To. The European Journal of Finance (2018); page 745. Results are significant at the 1% level.*

[31] *'The effects of credit rating grades' changes on capital structure: S&P 500.' Afef Krichene and Walid Khoufi. Afef Feki Krichene, 2Walid Khoufi (2016); page 53.*

allowed cost of debt. These inconsistencies could lead to an either 'overly optimistic' or 'overly pessimistic' assessment of notional financeability. For example:

- If a regulator assumed a target investment grade that was 'stronger' than the corresponding level of notional gearing, it might increase the risk of setting the allowed cost of debt 'below' the internally consistent level, leading to an overly optimistic assessment of notional financeability (i.e., erroneously concluding that the notional firm is financeable).

- Conversely, if a regulator assumed a target investment grade that was 'weaker' than the corresponding level of notional gearing, the opposite may occur, leading to an overly pessimistic assessment of notional financeability.

Credit rating and the cost of debt

Summary of intuition from literature overview

From a first principles point of view, there are good reasons to suppose a relationship between credit ratings grades and the cost of debt. Most obviously, the cost of debt for a firm is given by the: risk free rate; the probability of default / loss on default; and the tax advantage of holding debt. As the ratings agencies themselves explicitly calculate probabilities of default (and where said probabilities inform their overall ratings), logically, a relationship should arise. Put another way, firms with a higher *actual* default probability (higher cost of debt) would be expected to have lower credit ratings grades than firms with a lower *actual* default probability (lower cost of debt), all else equal, and assuming credit ratings agencies accurately estimate default probabilities and that this is reflected under their assigned ratings.

The literature also supports the existence of the above relationship and, moreover, postulates causalities whereby credit ratings may themselves affect (rather than merely *reflect*, as explained above) the cost of debt for firms, as summarised below.

Credit ratings might not only reflect differences in the underlying riskiness of debt, but may themselves affect the cost of debt, including by revealing additional information to the market.

Credit ratings may provide additional information to the market about a company's default risk, potentially addressing an information asymmetry. This is because ratings agencies may have specialist capabilities in assessing firm default risk and / or because they have access to non-public information that enhances their ability to accurately ascertain default risk, relative to outside stakeholders. For example, see Han and Pagano (2012)[32] and Ederington et al. (1987).[33] In addition, ratings can impact the 'type' of investors able to hold a firm's bonds, which will also impact yields.

There may also be a credibility effect associated with holding external ratings that is beneficial to a firm's borrowing costs, as postulated by Kisgen and Strahan (2010).[34] These authors also explain

[32] *'Rating Agency Reputation, the Global Financial Crisis, and the Cost of Debt.' Seung Han and Michael Pagano. Financial Management (2012).*

[33] *'The Informational Content of Bonds Ratings.' Louis Ederington, Jess Yawitz and Brian Roberts. Journal of Financial Research (1987).*

[34] *'Do Regulations Based on Credit Ratings Affect a Firm's Cost of Capital?' Darren Kisgen and Philip. Strahan. The Review of Financial Studies; Volume 23, Issue 12, (2010)*

that, intuitively, one might distinguish between a ratings impact on the cost of debt due to changes in information / available sources of debt (as per the two theories above) and impacts not due to these factors, but more linked to reputation and regulation (the latter of which they explore in relation to ratings agencies being appointed 'Nationally Recognised Statistical Ratings Organisations – NRSROs', in the USA). We note that the distinction between reputational effects and the above theories may not always be clear. For example, the reputation of a ratings agency may in part arise from a view that it is especially able to appraise default risk, thus reducing information asymmetry.

The literature also contains empirical analyses, which confirm the existence of the expected relationship.

Kisgen and Strahan (2010) undertake a quasi-natural experiment, examining the impact on bond yields associated with firms in the USA having a rating from DBRS before and after the agency was awarded NRSRO status by the SEC. They find that firms rated favourably by DBRS experienced a fall in bond yields after the SEC's decision to award it NRSRO status (although the affect was asymmetric). Whilst the authors' primary focus is the impact of the regulatory status of ratings on the cost of debt, their study is also consistent with variation in *ratings grades* affecting firm debt costs. Specifically, they find that a one notch better rating from DBRS implies a 39-basis point reduction in firm's debt costs.[35]

Han and Pagano (2012)[36], in an analysis of yen-denominated plain vanilla bonds in Japan, find that bonds rated by at least one global ratings agency can significantly reduce the cost of debt for firms (compared to those only rated by Japanese agencies). The authors postulate that this reflects the reputational status of the global ratings agencies.

Ederington et al. (1987) undertake an analysis of the impact of ratings on yields to maturity, across a cross section of US bonds traded on the NYSE (using dummy variables for Moody's and S&P's ratings). Importantly, the analysis uses individual dummies for each investment grade, in order to identify the grade effect (e.g., SPAA; SPA… SPB, etc). The authors find an inverse, and statistically significant, relationship between ratings grades and the yield to maturity.[37] They also find that market yields vary with ratings independently of financial accounting data, indicating that agency ratings do provide additional information to the market.

Implications for regulators

To the extent that regulators make use of benchmarks (e.g., IBoxx) for informing the cost of debt, they should seek to ensure that these are consistent with the overall target investment grade for the notional company (and similarly for notional gearing, as noted above). Again, this points to it being desirable for regulators to explicitly identify the target investment grade.

Relatedly, if it is considered appropriate to assess / quantify potential out / under performance on the cost of debt (sometimes referred to as the 'halo effect'), relative to any benchmark(s) relied upon, it is important to control for differences in credit rating. Whilst this point relates specifically to the rating *of individual issuances,* the intuition discussed above (that ratings are related to yields more

[35] *'Do Regulations Based on Credit Ratings Affect a Firm's Cost of Capital?' Darren Kisgen and Philip. Strahan. The Review of Financial Studies; Volume 23, Issue 12, (2010; page 18.*

[36] *'Rating Agency Reputation, the Global Financial Crisis, and the Cost of Debt.' Seung Han and Michael Pagano. Financial Management (2012).*

[37] *'The Informational Content of Bonds Ratings.' Louis Ederington, Jess Yawitz and Brian Roberts. Journal of Financial Research (1987); page 219-220, Tables 2 and 3. Results significant at the 5% level.*

broadly) holds. We note that this is also consistent with the CMA's position, under the water PR19 price control redeterminations.[38]

Risks of not addressing implications

The risk of not considering the above implication is as per our discussion of the relationship between credit ratings and gearing. Namely, it risks there being an inconsistency, whereby the allowed cost of debt is out of kilter with the target investment grade, such that regulators may erroneously conclude that the notional firm is financeable (when it is not), or vice-versa.

Productivity and equity returns

Summary of intuition from literature overview

The literature identifies a number of potential intuitive relationships between productivity and equity returns. We broadly summarise these as follows.

As the price of an asset should reflect expectations of future profits, and because improved productivity should increase profit, it follows that there should be a positive relationship between productivity and future equity returns and so also prevailing stock prices. This intuition is summarised in Avouyi-Dovi and Matheron (2006).[39] By extension, one can consider higher stock returns as being a form of compensation for the increased risk associated with higher productivity firms (or investments). This is discussed by Hiroki et al. (2022), who cite higher risks associated with more productive firms relating to: innovation in human capital formation; innovation through R&D; and investment in human and organisational capital.[40] We term this the 'risk-compensation' mechanism.

Related, but distinct, from the above, the literature suggests one might expect a positive relationship between productivity and current and future *profitability,* (as distinct from stock prices) because, by realising productivity gains, firms are able to produce a higher output (quality) for a given cost (or at a lower cost, for a given output). We term this the 'realised-reward' mechanism.

The literature also includes empirical examination of the relationship between firm productivity and equity returns.

- Davis and Madsen (2008) find strong positive linkages between capital productivity and total stock returns in both the short- and long-run in nearly all of the 11 countries investigated in their research. Their approach leverages time series methods to identify long- and short-run relationships between these variables, as well as the direction of causality.[41]

- Chun et al. (2016) find a strong positive relationship between the firm level productivity growth rate and stock returns.[42]

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[38] 'Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations: Final Report.' The CMA (2021); paragraphs 9.752, 9.788 and 9.824.

[39] 'Productivity and stock prices.' Sanvi Anouyi-Dovi and Julien Matheron. Financial Stability Review. No 8 (2006); page 82.

[40] 'Does firm-level data productivity predict stock returns?' Takashi Hiroki, Kentaro Iwatsubo and Clinton Watkins. Pacific-Basin Finance Journal (2022); page 20.

[41] 'Productivity and equity market fundamentals: 80 years of evidence for 11 OECD countries.' E. Philip Davis and Jakob B. Madsen. Journal of International Money and Finance.

[42] 'Productivity growth and stock returns: firm- and aggregate-level analyses.' Hyunbae Chun, Jung-Wook Kim & Randall Morck. Applied Economics.

- Hiroki et al. (2022) investigate the relationship between firm level productivity (TFP) and future stock returns for listed Japanese manufacturing firms from 1999 to 2018. They find that more productive firms attract a significant premium over less productive firms, which compensates investors for risks related to innovation and human and organisational capital formation.[43]

- Avouyi-Dovi and Matheron (2006) find a strong positive correlation between productivity (% growth rate) and stock returns in the USA over the period 1973 to 2002 (correlation coefficient of 0.46). The authors find a similar result in the Euro area, albeit with a less strong positive correlation (0.23).[44]

- Pellegrini et al. (2017) estimated the relationship between stock returns and various drivers (including productivity) cross 256 companies in fast-growing European markets and find a positive relationship.[45]

- Fiordelisi and Molyneux (2010) estimate the relationship between shareholder value and productivity (including a TFP measure) for a sample of listed and non-listed European banks between 1995 and 2002. The authors find a strong positive relationship, for the UK specifically.[46]

- Tang et al. (2024) find a positive relationship between TFP and stock returns at a firm level for Chinese companies for the period 1999-2020. Additionally, the results indicate that firm level productivity is also an indicator of future profitability. However, the authors found that limited investor attention and capability played a role in these results (i.e., mispricing) relative to more developed markets such as the US. This finding indicates that this relationship could potentially be spurious, reflecting stock market inefficiencies, rather than a fundamental relationship between productivity and stock returns.[47]

Not all of the papers we have identified suggest a positive relationship between productivity and stock returns. Two papers present a negative relationship between productivity and stock returns, which we assess in more detail below.

- While Imrohoroglu and Tuzel (2014) find that productivity is positively related to contemporaneous excess returns in the US, they also find a negative relationship between productivity and future stock returns. The latter relationship is interpreted as a risk premium attached to low productivity firms, although the authors do not consider alternative explanations, such as mispricing, as is the case under Ang et al (2020), below.[48]

- Ang et al (2020)[49] also find a negative relationship between productivity and stock returns in the US. However, the authors contend that mispricing is driving this relationship, with investors systematically under-pricing low productivity firms and over-pricing high productivity firms.

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[43] 'Does firm-level data productivity predict stock returns?' Takashi Hiroki, Kentaro Iwatsubo and Clinton Watkins. Pacific-Basin Finance Journal (2022); page 20.

[44] 'Productivity and stock prices.' Sanvi Anouyi-Dovi and Julien Matheron. Financial Stability Review. No 8 (2006); page 88. See Table 2 and related discussion. Correlation coefficients are significant at the 5% level.

[45] 'Stock returns, productivity and corruption in weight European fast-emerging markets.' Carlo Bellavite Pellegrini, Bruno Sergi, Emiliano Sironi. Thunderbird International Business Review Vol 59 (2017); page 19. Results significant at the 1% level.

[46] 'Total factor productivity and shareholder returns in banking.' Franco Fiordelisi and Phil Molyneux. Omega (2010); see Section 5 'conclusions'. Results statistically significant at the 1% level.

[47] 'Firm-level productivity and stock return: new evidence from China.' Ning Ting, Mengyao Gao, Yixun Zhou, Fangzhao Zhou and Jichen Zhu. International Review of Economics and Finance (2024); page 15.

[48] 'Firm Level Productivity, Risk, and Return.' Ayse Imrohoroglu and Selale Tuzel. Management Science.

[49] 'Mispricing firm-level productivity.' Tze Chuan Chewie Ang, F.Y. Eric C. Lam, K.C. John Wei. Journal of Empirical Finance (2020).

This means that, as stock prices correct, low productivity firms may (erroneously) have been observed to outperform high productivity firms, giving rise to a negative relationship. We therefore consider this to be an example of a spurious relationship, as under the mispricing framing proposed, it is arising from market inefficiencies (rather than a genuine lack of positive relationship between productivity and equity returns). The mispricing theory may also explain the results reported above in Imrohoroglu and Tuzel (2014), who did not consider this possible explanation.

Overall, we find broad support for a positive relationship between firm productivity and equity returns. Only two papers diverge from this finding. However, it is unclear whether these papers offer a valid counterpoint that reflects the relationship of interest, rather than being a spurious relationship resulting from market inefficiencies.

Implications for regulators

Regulators should ensure that regulatory determined productivity targets (commonly referred to as ongoing efficiency or frontier shift) are consistent with the regulatory set cost of equity at price determinations. Most obviously, if the regulatory set cost of equity is generally calibrated to reflect a 'low-risk / low-return' environment for regulated industries, then regulatory productivity targets should similarly be calibrated such that they are 'low', relative to other industries (and vice-versa). This is in-line with the 'risk-compensation' rationale identified under the literature.

To the extent that regulators may wish to incentivise the extent of productivity in regulated industries, they may wish to consider that this has implications for the profile of investor (and investments) needed to achieve that. From the literature, one might infer that a higher cost of equity may attract investors more willing to take the risks to achieve higher productivity gains. However, we would caution against overstating this point, as:

- economy-wide factors appear to be important determinants of productivity[50] (such as the stock of the labour market); and
- productivity may be further determined by intrinsic industry features, unrelated to incentives (such as the scope for technological change).

Put another way, minor changes in the allowed cost of equity will likely not translate to material changes in productivity performance in regulated industries (and thus, 'fine tuning' of regulatory productivity targets should not be rationalised on this basis). Rather, the more pertinent implication is the first one we identify above.

Risks of not addressing implications

A lack of consistency between the allowed cost of equity and regulatory productivity targets will lead to the 'true' expected return of the notional company being below the allowed cost of equity (where the productivity target is 'too high', given the cost of equity); and above the allowed cost of equity (where the productivity target is 'too low', given the cost of equity). Under either eventuality, the consequence would be that regulators reach erroneous conclusions when undertaking their assessments of financeability on a notional basis.

[50] *For example, see 'The UK Productivity Puzzle: A Survey of the Literature and Expert Views.' Sam Williams, Anthony J. Glass, Madeleine Matos, Thomas Elder & David Arnett. International Journal of the Economics of Business (2024).*

05 Recommendations

Drawing on the evidence and analysis contained in the previous chapters, Table 3 sets out our recommendations and related rationale. These recommendations have been identified on the basis of our review of regulatory approaches to notional financeability; a review of the academic literature; and our own reflections on financeability assessments under regulatory price controls. Our findings would potentially benefit from: (i) empirical work, targeted at assessing the extent to which the relationships of interest hold (particularly in a UK context); and (ii) further consideration of how the recommendations should be implemented in detail.

Table 3: Our recommendations

Issue	Sub issue	Recommendation	Rationale / notes
Interpretation of financeability duties.	NA	1 Financeability duties should continue to be interpreted with respect to the notional firm.	Customers should not pay for inefficiency.
Definition (scope) of what it means for the notional firm to be 'financeable' for the purpose of meeting regulatory statutory duties (as above).	NA	2 Irrespective of terminology*, to determine whether the notional firm is financeable, regulators should assess whether it is expected to: (a) earn a return in line with its WACC (requiring that the regulatory set WACC itself is commensurate with the risks faced by debt and equity investors, and that the balance of equity risk under any price determination is symmetrical, consistent with the **'fair bet'** principle); and (b) secure an investment grade consistent with being able to raise debt finance on reasonable terms. Regulators should make this definition explicit going forward.	Over time, the in-practice application of 'financeability testing' has increasingly focused on (b). Whilst the more recent discussions of 'investability' may help better ensure (a) is addressed in the future, it has always been core to the concept of a firm being financeable (i.e., if a firm is not expected to earn its WACC on average over time, it will not remain in business). *By 'terminology' we are referring to the use of the terms 'financeability' with respect to debt financeability testing, and 'investability' with respect to equity financeability.
Accurately identifying the notional firm / ensuring assumptions regarding the notional firm are accurate.	The measurement error challenge (limitations of existing regulatory tools).	3 Regulators should implement robust methods for determining the likely spread of outcomes for a notional company (for each material element of their determinations) and endeavour to set each relevant parameter of their determinations at the 'most likely' outcome.	The assessment of notional financeability is only meaningful if the assumptions one makes about the notional firm are accurate. Understanding the spread of performance outcomes for the notional firm is essential to meeting the 'fair bet' principle.
	The measurement error challenge (inherent limitations in ability to accurately identify the notional firm).	4 Regulators should attach some weight to observable outcomes / data across actual regulated companies in relation to considering the appropriate calibration of *individual parameters*.	As above.
		5 In the event that an 'actual' regulated company is found not to be financeable, this should motivate a careful examination of the reasons why. Regulators and companies should thoroughly stress-test the extent to which this result reflects: (a) genuine inefficiency on the part of the actual company; and / or (b) erroneous assumptions regarding the notional firm.	As above.

		6 Regulators should attach 'some weight' to 'actual company' financeability in light of the inherent challenges in accurately appraising notional financeability (perhaps using it as a cross check).	
	The interdependency challenge.	7 Regulators should set notional gearing using an empirical method (either directly, using econometrics that relates optimal gearing to industry / firm characteristics; or drawing on existing models under the literature) and the method should remain stable over time.	Over or under estimating notional gearing harms customers / investors. A stable estimation method over time means notional gearing would only change due to changes in industry characteristics that would logically affect optimal capital structures.
	The interdependency challenge.	8 Regulators should explicitly identify the target investment grade for the notional company. Regulators should also seek to ensure there is consistency between the target investment grade and the notional gearing level, based on published ratings agencies' methodologies.	Evidence suggests interdependencies exist between credit ratings and gearing.
	The interdependency challenge.	9 Any benchmarks used to inform, or set, the cost of debt should be consistent with the target investment grade for the notional company.	Evidence suggests interdependencies exist between credit ratings and the cost of debt.
	The interdependency challenge.	10 Regulators should ensure that the productivity targets they set are consistent with the allowed equity return, in line with the 'risk-compensation' rationale identified in the literature.	Evidence suggests that interdependencies exist between productivity and equity returns.
Ensuring notional financeability is achieved in the long-run.	NA	11 In the event of finding a cash-flow constraint for the notional firm *over the duration of a price control,* regulators should carefully examine the reasons for this, and only deploy revenue reprofiling tools where they are confident it is arising from a short-term issue, rather than reflecting overall allowed revenues being 'too low'.	Inappropriate use of reprofiling levers risks storing up financeability (or affordability) constraints in the long-term.
		12 Regulators should ensure that revenue recovery rates do not systematically, or materially, depart from their best estimates of the economic lives of assets.	

Source: Economic Insight

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06 Annex A: Further details of Ofgem's approach to financeability at RIIO-3

Financeability

At a high level, Ofgem has confirmed its intention to continue assessing financeability on the basis of a hypothetically efficient / notional company, in-line with the economics principles discussed above, stating that it will: *"assess the financeability of energy networks on the basis of an efficient licensee adopting the notional capital structure."*[51] Ofgem has further confirmed that it envisages setting notional gearing at the same levels used at RIIO-2 (namely, 55% for ET and 60% for GT and GD).

Consistent with our observations regarding the evolution of the approach to financeability across the economic regulators over time, Ofgem also recognises that (in practice) its approach will predominantly focus on the debt side of financeability. The regulator's rationale for this appears to be that there are more likely to be binding constraints on the debt-side that require testing: *"these issues [potential constraints on debt] lead the financeability assessment to focus primarily on whether the price control package in-the-round puts licensees (at the notional capital structure) in a position where they can service reasonable debt costs and maintain financial metrics that would be associated with an appropriate credit rating range."*[52]

In terms of the overall investment grade of the notional firm, Ofgem is not seeking to set a particular target in order to deem the notional firm financeable (on the debt side). Rather, its position is that the notional firm should *"broadly"* achieve a *"comfortable"* investment grade.[53] In addition to this, Ofgem is also not proposing to evaluate whether a 'comfortable' investment grade is achieved by ensuring specific credit metrics (e.g., gearing; adjusted interest cover ratio, etc) are in line with associated thresholds either:

- in each individual year of a price control, nor
- over the price control period as a whole.

Ofgem's reasoning for this is that the ratings agencies do not assign overall ratings in a mechanistic manner; and so they will similarly take an 'in the round' approach.[54]

Ofgem proposes to consider risk by stress-testing its notional financeability assessment under 'plausible downside scenarios', and has identified a range of common scenarios to be tested.[55] Ofgem explains that it prefers scenarios over probabilistic modelling, as it cannot accurately implement probability-based approaches at this time.

Revenue advancement options (adjusting capitalisation and / or depreciation rates) will be retained as a means of addressing financeability constraints. Ofgem explains that these help address short-term cashflow shortfalls in a manner that is NPV neutral to companies and consumers. The regulator explains that this is preferable over increasing equity returns, as the latter would represent a permanent transfer of value from consumers to companies.[56] However, the regulator recognises that

[51] *'RIIO-3 Sector Specific Methodology Decision – Finance Annex.' Ofgem (2024); paragraph 5.2.*
[52] *'RIIO-3 Sector Specific Methodology Decision – Finance Annex.' Ofgem (2024); paragraph 5.6.*
[53] *'RIIO-3 Sector Specific Methodology Decision – Finance Annex.' Ofgem (2024); paragraph 5.31. Companies argued for a target overall rating of BBB+ (S&P) and Baa1 (Moody's). Ofgem noted that ratings of BBB/Baa2 would, in its view, be consistent with license requirements.*
[54] *'RIIO-3 Sector Specific Methodology Decision – Finance Annex.' Ofgem (2024); paragraph 5.31-5.32. Ofgem will use Moody's scorecard for determining ratings.*
[55] *'RIIO-3 Sector Specific Methodology Decision – Finance Annex.' Ofgem (2024); paragraph 5.40 and Table 15.*
[56] *'RIIO-3 Sector Specific Methodology Decision – Finance Annex.' Ofgem (2024); paragraph 5.41.*

certain ratings agencies do not include the impact of such adjustments, when determining credit ratings.

Financial resilience

Whilst Ofgem has emphasised that it sees 'financial resilience' as a distinct concept from financeability, in our view this (in part) reflects the somewhat 'carved out' assessment of debt financeability. Accordingly, if one considers financeability more from the perspective of its underlying principles, the issues addressed by Ofgem relating to 'financial resilience' are also pertinent. Accordingly, new financial resilience measures proposed by Ofgem at RIIO-3 (relevant to the issues addressed in this report) include the following:

- Amend license conditions to 'require' license holders to hold more than one credit rating.
- Amend the dividend lock-up trigger to be the earlier of reaching BBB-, or gearing of 75%.
- Amend the availability of resources requirement for board certification, such that it states the company has the financial resources needed to cover the entire price control, or at least three years ahead.[57]

07 Annex B: Literature review

This chapter sets out more detailed results of our literature review into the interrelationships between assumptions regarding the notional firm. In the following subsections, we set out the results of the literature review in relation to each of the four main relationships we are investigating, in the same order as they are set out in the report. These relationships are as follows:

(i) Relationship between firm characteristics and capital structure.
(ii) Relationship between overall credit rating and individual credit metrics (gearing).
(iii) Relationship between credit rating and the cost of debt
(iv) Relationship between firm-level productivity and equity returns

Within these subsections, we summarise the key findings of each paper, presenting the results of each in a separate table.

[57] *'RIIO-3 Sector Specific Methodology Decision – Finance Annex.' Ofgem (2024); paragraph 6.9, table 16. Ofgem confirms it will apply these measures at paragraph 6.17.*

Relationship between firm characteristics and capital structure (gearing)

Table 4: 'The Determination of UK Corporate Capital Gearing', Bank of England (2005). Bank of England publication.

Overview of research	• This article provides a review of existing literature to support relationships between firm characteristics and gearing. • Modigliani and Miller (MM) (1958) assume that the value of a firm is independent of its capital structure, and so there is nothing systematic about capital structures across industries. But MM theory is very simplified and assumes no market imperfections i.e. ignores factors like taxes and bankruptcy costs. • The 'trade-off model' gives an optimal gearing level that balances the tax benefits of debt against the expected financial distress costs (e.g. bankruptcy costs). • The 'pecking order model' includes non-tax factors such as information asymmetries/signalling. The pecking order model suggests that a firm should prefer to finance new investments using internal financing (using retained earnings). Where these are insufficient, firms opt for debt financing, and only use equity financing as a last resort, as this signals to investors that the firm is overvalued, which leads to a fall in the share price. • Unlike the trade-off model, there will not necessarily be any target or optimal level of gearing when using the pecking order model. • 'Agency cost models' consider the principal-agent problem – whereby it is in the managers interest to maximise their own welfare rather than shareholder value, and so in these models, debt is seen as a tool to limit cash available to managers and to discipline them (due to the regular interest payments on debt). • The 'control rights model' focuses on small entrepreneurial firms, in which debt is favoured over equity as managers do not wish to cede control rights to outside investors.
Data used / approach taken	• This paper is largely comprised of a literature review, but also provides supporting empirical evidence using UK company accounts data.
Key findings	• **Company size:** The empirical evidence points to a positive relationship i.e. larger firms have higher levels of debt financing. This effect is small and uncertain in some studies but well-determined in others. • **Profitability:** Empirical evidence tends to support the pecking order model's prediction of a negative relationship between corporate gearing and profitability (as internal financing is preferred). • **Growth opportunities:** Growth opportunities are typically proxied in empirical studies by the ratio of the market value of a company's assets to their book value. Most studies support the theory and find strong evidence of a negative relationship between gearing and market to book ratios. • **Tangibility of assets:** The trade-off theory suggests that firms with a low proportion of tangible assets e.g. machinery and property, are likely to face higher bankruptcy costs, given that they can only offer limited collateral to secure debt finance, and so will tend to have a low 'optimal' gearing level. The empirical evidence from UK company accounts data supports this theory. • **Persistence in gearing:** The authors use UK company accounts data to identify industries with persistently high and low gearing. This persistence in gearing levels in certain industries may reflect common company-level characteristics with systematic links to target gearing levels, for example (as already noted) the ratio of tangible to intangible assets.
Comments on robustness	**Robustness Rating: High** • This article sets out the existing theory and evidence and provides a summary of supportive empirical evidence.

Table 5: 'Capital structure across industries', Talberg et al. (2008). International Journal of the Economics of Business.

Overview of research	• The purpose of this study is to examine the differences in capital structure for US companies across a range of industries. In this paper, the authors present supportive evidence that capital structures do in fact vary across industries.
Data used / approach taken	• The authors analyse companies across different industries that are quoted on a stock exchange and headquartered in the United States (US), at the end of the fiscal year 2005. • Regressions are conducted across different industries to analyse the factors influencing each industry's debt ratio. • The dependent variable is the total long-term debt (TLTD). • Explanatory variables are: (i) the ratio of fixed assets to total assets (ASV); (ii) market value to total equity (MB); (iii) firm profitability; (iv) firm size; and (v) firm age. • The authors run this regression across five industries: Construction, Food and Beverages, Oil and Gas, Chemicals, and Software. • They use hypothesis testing to test the coefficients of their regressions to determine whether there is a difference in coefficients determining the capital structure between different industries.
Key findings	• Asset structure is positively related to the debt ratio; growth, profitability, and age are negatively related to the debt ratio, and the size is both positively and negatively related to the debt ratio depending on the size intervals one is examining. • Hypothesis testing rejected the null that there are no differences in the capital structure between industries. Specific regression takeaways (for the 5 industries studied): • Higher ASV leads to a higher long term debt ratio in all industries (apart from the 'chemicals' industry), and this is most statistically significant for the 'oil and gas' industry. • Higher MB leads to a lower debt ratio in all industries apart from 'Software' – this is in line with the pecking order theory, as growing firms are likely to have more internal funds that can be invested into new projects. • Higher profitability leads to a lower debt ratio in all industries apart from 'Food and beverages', this result is also in line with the pecking order theory as more profitable firms have greater retained earnings that can be invested, and so less of a need for debt financing. • Across all industries, the size of a firm has a positive impact on TLTD i.e. the bigger the firm is, the greater the TLTD. This is in line with the idea that larger firms are lower risk, and thus are able to secure debt financing more easily. • However, when the regression is run only on the 50 largest companies (across industries), the relationship becomes negative, and this is in line with the currency risk hedging effect outlined in Barclay and Smith Jr (1995). • In all industries apart from 'Software', the older a firm is, the less debt they obtain.
Comments on robustness	**Robustness Rating: High** • This is a detailed paper, with a clear motivation, hypothesis, and structure to testing the hypothesis. • No explicit statistical robustness checks are carried out, however, coefficient values largely fit the predictions of the authors based on existing theory and literature. The authors also run pooled regressions, testing whether there are differences in capital structure between industries, and these regressions give the same overall signs of coefficients from the industry specific regressions.

Table 6: 'The impact of firm and industry characteristics on small firms' capital structure', Degryse et al. (2010). Small Business Economics.

Overview of research	• The authors study the impact of firm and industry characteristics on small firms' capital structure. • This is noted to be a crucial relationship to investigate as capital structure choice is one of the most important decisions faced by firm management. • While most empirical work deals with large publicly listed firms, this paper focuses on small unlisted firms, which make up 90% of all existing firms, and are therefore key to economic growth more broadly. • The findings of this paper are linked to the underlying capital structure theories (trade-off theory and pecking order theory).
Data used / approach taken	• Authors use financial statements of Dutch small and medium-sized enterprises (SMEs) from 2003 to 2005. • They use a fixed effects panel data regression model, which regresses the debt level on a vector of explanatory variables.
Key findings	• The firm characteristics suggest that the capital structure decision is consistent with the pecking-order theory: Dutch SMEs use profits to reduce their debt level, and growing firms increase their debt position since they need more funds. • The paper further report that profits reduce short-term debt, whereas growth increases long-term debt. Key regression results: • Larger firms exhibit higher leverage. A one standard deviation change in log size implies a 3.03 percentage point increase in the ratio of total debt to total assets. • The coefficient for size in the long-term debt regression is positive, statistically significant, and economically relevant. • A one standard deviation increase in tangible assets implies a 10.08 percentage point increase in the ratio of total debt to assets (strong evidence for the positive relation between total debt and collateral). • Finally, the impact of firm characteristics for each industry is mostly in line with the pecking-order theory. • The intra-industry results indicate that firms display considerable heterogeneity even after controlling for firm characteristics. This suggests that the degree of industry competition, the degree of agency conflicts, and the heterogeneity in employed technology are also important drivers of capital structure.
Comments on robustness	**Robustness Rating: High** Overall, this paper contributes significantly to the literature by analysing the capital structure decisions of SMEs rather than listed companies, produces results that are for the most part statistically robust, and sensibly explains the drivers of capital structure, both inter-industry and intra-industry. Four statistical robustness checks are carried out: (1) 2005 had 30% fewer observations than the other years and after carrying out a Wald test, the authors conclude their results are robust. (2) Authors check the maturity matching principle, which. If true, inventories should positively relate to short-term debt and have no significant relationship with long-term debt, but this is not found to hold. (3) Authors replace asset growth by sales growth as proxy for growth opportunities; leading to similar results. (4) Finally, to mitigate potential endogeneity issues, the authors run regressions where they compute all explanatory variables using lagged values of total assets – to which the results remain robust.

Table 7: 'Industry Effects on the Determinants of Unquoted SMEs' Capital Structure', Hall et al. (2000). International Journal of the Economics of Business.

Overview of research	• This paper reports a study of 3500 unquoted, UK small and medium sized enterprises (SMEs). • This paper contributes to the literature on unquoted SMEs by considering the stability of the determinants of capital structure across industries. • It particularly considers the extent to which variations in capital structure (between industries) are due to industry effects or variations in the determinants of capital structure, such as firm size. • This research sets out to test various hypotheses concerning the determinants of SME capital structure, and to establish whether and how the relationship of these determinants to long- and short-term debt varies between industries.
Data used / approach taken	• SMEs are defined as those firms having fewer than 200 employees. • A total number of 3500 firms that satisfied the definitional and data requirements for the research were randomly selected. • In an attempt to make the database as representative of the UK small business sector as possible, firms from all the different industries in the economy were selected.
Key findings	• The results show differences between how firm characteristics affect long-term and short-term debt. • Long-term debt was found to be related positively to asset structure and company size and negatively to age. • Short-term debt was related negatively to profitability, asset structure, size and age, and positively to growth. • The effect of growth on short-term debt, however, was consistent across industries, whilst profitability did not have a statistically significant effect on long-term borrowing in any industry. • Significant variation across industries was found in most of the explanatory variables.
Comments on robustness	**Robustness Rating: High** • There is some overlap between the results of this paper and Talberg et al. (2008) in Table 5. • No explicit statistical robustness checks are carried out in this paper. • Overall, the results for age and profitability are consistent with the pecking order theory. • The results are likely to be robust given the array of firm characteristics investigated, and the similarities with findings from other papers in the literature.

Table 8: 'How firm characteristics affect capital structure: an empirical study', Eriotis et al. (2007). Managerial Finance.

Overview of research	• The aim of this study is to isolate the firm characteristics that affect capital structure. The results of this study are consistent with the theories of capital structure, such as the trade-off theory and the agency cost model described above.
Data used / approach taken	• This study uses a panel data procedure for a sample of 129 Greek companies listed on the Athens Stock Exchange from 1997 to 2001. • The number of companies in the sample corresponds to 63% of the listed companies in 1996. • The firm characteristics are analysed as determinants of capital structure according to different explanatory theories. • The hypothesis that is tested in this paper is that the debt ratio depends on the size of the firm, the growth of the firm, its quick ratio (LIQ, a measure of liquidity) and its interest coverage ratio (INCOV). • Authors run firm-level regressions of the debt ratio on size, LIQ, INCOV, growth (the percentage change in earnings between time t and t-1). • The authors specifically distinguish highly levered firms by including a dummy variable for firms with a debt ratio greater than 50%.
Key findings	• The findings of this study justify the hypothesis that there is a negative relationship between the debt ratio of firms and their growth, their quick ratio, and their interest coverage ratio. • Size appears to be positively related to the debt ratio. • There is a negative relationship between the debt ratio of a firm and its liquidity (consistent with the pecking order theory). • According to adjusted R-Squared, the independent variables explain 92% of the variation in a firm's debt ratio. • All variables' coefficients are significant at the 5% level. • The statistical significance of the dummy variable and its positive sign indicate that there is a distinction in the capital structure for firms who have a debt ratio greater than 50%; according to the results, these firms have an additional 19% of debt relative to the market.
Comments on robustness	**Robustness Rating: High** • A detailed paper with results and conclusions that are consistent with the theoretical background. • All variables (apart from growth) are robust to the three models used (total, fixed and random). • In panel data analysis, which combines data from different firms over time, there may be effects specific to each firm or group of firms. Two methods, random effects and fixed effects models, are implemented to identify these firm-specific effects. • The diagnostics from the random effects model suggest that the variable of growth is not statistically significant and does not affect the debt ratio. However, the Hausman test indicates that the fixed effect model is more appropriate, so should supersede the random effects model. • The use of a number of estimation methods and the diagnostic testing between them gives us confidence that these results are robust.

Table 9: 'How firm characteristics affect capital structure: An international comparison', Wald (1999). The Journal of Financial Research.

Overview of research	• In this empirical study, the author examines the firm-level characteristics correlated with capital structure in France, Germany, Japan, the United Kingdom, and the United States. • The author confirms prior findings, but also extends the analysis by examining the effect of additional firm characteristics, such as earnings volatility, sales growth, and nondebt tax shields, on capital structure. • What the author also does differently to prior research is focus on firm characteristics that are not similarly correlated with leverage across countries. • These characteristics include measures of firm size, risk, sales growth, and inventories. • By focusing on these differences, the author obtains a greater understanding of the relation between institutional differences and capital structure.
Data used / approach taken	• The 1993 Worldscope dataset provides information on firms from approximately 40 countries, though analysis is restricted to France, Germany, Japan, UK, and US. • Worldscope provides annual balance sheet information with five to ten years of history, primarily for public companies. • The dataset is restricted to firms that have all the necessary variables, resulting in a sample of 4,404 firms. • Long-term debt to book value of assets is the dependent variable the author uses to measure a firm's capital structure. • Explanatory variables used are: costs of financial distress (proxied by the standard deviation in the first differences in the ratio of EBIT divided by total assets), moral hazard, nondebt tax shields, profitability, growth, and size.
Key findings	Costs of financial distress (i.e. bankruptcy costs): • For the US, a one-standard-deviation increase in risk (volatility of EBIT as a ratio of total assets – an indicator of bankruptcy costs), causes a 3% decrease in the long-term debt/asset ratio. But for the other countries studied, risk has a positive coefficient. Moral hazard (excessive debt causing managers to take on excessive risk): • If a firm has capital entrenched in physical plant, the potential for underinvestment or excessive risk taking by management is reduced. • Thus, measures of physical plant are expected to increase the debt/asset ratio of a firm. • Symmetrically, firms' expenses on intellectual goods, such as R&D, are expected to decrease the debt/asset ratio. • These expected impacts on the debt/asset ratio are found for the US and are statistically significant. Non-debt tax shields: • Firms that have significant non-debt tax deductions, such as depreciation, generally issue less debt since they have less reliance on the tax advantages that come with debt financing. • Regression results show a significant negative correlation between non-debt tax shields and debt/asset ratio. Profitability: • For the US, the author finds that profitability has the largest single effect on debt/asset ratios. A one standard deviation increase in profitability is correlated with a 9.6% decrease in long-term debt/asset ratio. • A negative relationship is also apparent for all 5 countries investigated.

	Growth: • The author finds that US firms with higher growth have lower debt/asset ratios. This is in line with the pecking order theory as internal financing is preferred, to avoid agency costs of transferring wealth from shareholders to debtholders. • However, the US is the only country where high growth is associated with a lower debt/equity ratio. For UK firms, the relationship is reversed, with faster growing firms using more debt. Size: • Germany is the only country where large firms have a smaller long-term debt/asset ratio, and this result holds for total debt, as well. • However, the result for Germany is not significant at the 5% level, so it seems as though it is more likely that larger firms will have larger debt/asset ratios.
Comments on robustness	**Robustness rating:** High • This paper contributes significantly to the literature by analysing characteristics of firms that are not common in other papers. • The sample size of this study is very large and spans a range of countries, which gives us confidence that the results are based on a sample of data that is representative. • A detailed investigation carried out for numerous firm characteristics, confirming existing relationships, whilst also looking at characteristics such as moral hazard.

Table 10: 'How do Firm Characteristics Affect Capital Structure? Some UK Evidence', Akdal (2011). SSRN.

Overview of research	• This study aims to determine the influence of various firm-level characteristics, such as profitability, size, growth opportunities, asset tangibility, non-debt tax shields, volatility and liquidity, on capital structure. • The researcher also investigates what the best proxy for capital structure is.
Data used / approach taken	• Employing the cross-sectional data methodology, the researcher examines the capital structure determinants of 202 companies from FTSE 250 for the time period of 2002 to 2009. • Multiple regression models are used to estimate the influence of firm-level attributes on capital structure, and capital structure is measured simultaneously by the ratios of total debt, long-term debt and short-term debt at both book value and market value of equity.
Key findings	• The results obtained from four of the regression models show that profitability and liquidity are negatively and significantly related to leverage. • Asset tangibility has a positive relationship with leverage, which is significant. • Firm size has a positive relationship with leverage; aligns with static trade-off theory. • Growth opportunities have a negative relationship with leverage. • Non-debt tax shields have a negative relationship with leverage; supports static trade-off theory. • Volatility has a negative relationship with leverage. • The researcher finds that total debt ratio at market value of equity is the most important dependent variable as a proxy of capital structure, followed by long-term debt ratio at market value of equity.
Comments on robustness	**Robustness Rating:** Medium • The study does face some limitations which have been highlighted by the authors, including a restricted sample size due to time constraints, issues with imperfect data leading to a reduced number of companies, limited proxies for variables, affecting reliability, and the potential endogeneity of capital structure which is a shortcoming of the OLS method employed. • Nevertheless, some of the results do seem to agree with other papers, such as Wald (1999).

Relationship between overall credit rating and individual credit metrics (gearing)

Table 11: 'Credit Rating as a Mechanism for Capital Credit Ratings and Capital Structure', Kisgen (2006). The Journal of Finance.

Overview of research	• This paper examines the extent to which credit ratings directly affect capital structure decisions. • The fundamental hypothesis of this paper is that credit ratings are a material consideration for managers in making capital structure decisions due to discrete costs/benefits associated with different ratings levels (henceforth referred to as the Credit Rating Capital Structure Hypothesis or "CR-CS"). This paper sets out three reasons why credit ratings are significant for capital structure decisions: 1. Regulations on Bond Investment. • Regulations on bond investment influence capital structure decisions by tying firms' credit ratings to their ability to raise debt capital. • Because many financial institutions are restricted from investing in lower-rated bonds (e.g., speculative-grade), firms with these lower ratings may face higher borrowing costs and reduced access to capital markets. • This creates a direct financial incentive for firms to maintain or improve their credit ratings to ensure they can access funding at favourable rates. • Consequently, firms may issue less debt to avoid falling into lower rating categories, thereby impacting their overall capital structure. 2. Information Content of Ratings. • Credit ratings offer unique insights beyond public information, grouping firms with similar credit scores together. • Therefore, credit spreads are equalised for all firms within a certain rating. • Firms near a downgrade in rating will then have an incentive to maintain the higher rating (e.g. by reducing debt). If they are downgraded (even though they only have marginally worse credit), they will be pooled into the group of all firms in that lower credit class. • Likewise, firms near an upgrade will have an incentive to obtain that upgrade to be pooled with firms in the higher ratings category, thus impacting the amount of debt they take on. 3. Costs Directly Imposed on the Firm. • Credit ratings are important for capital structure decisions because they affect a firm's costs and access to financing. • A lower credit rating can lead to stricter rules for contracts and higher interest rates, making it harder to borrow money. • Additionally, bond covenants can mean that if a firm's rating drops, it might face sudden financial obligations, such as forced repurchases, which can strain its cash flow.
Data used / approach taken	• The primary testable implication of CR-CS considered in this paper is that credit rating changes directly affect capital structure, with firms near a ratings change issuing less net debt relative to net equity than firms not near a ratings change. • The dependent variable in the regressions is a measure of the amount of net debt and/or net equity issued. • Since the author is concerned with credit ratings, book values of equity and debt are used, as these are the variables credit rating agencies emphasise (Standard and Poor's (2001)). • The book value measures also directly reflect managerial decision making, which is more relevant.

Key findings	• Main result: Firms near a credit rating upgrade or downgrade issue less debt relative to equity than firms not near a change in rating. • Firms with a credit rating designated with a plus or minus (e.g. AA+ or AA–) issue less debt relative to equity than firms that do not have a plus or minus rating (e.g. AA). • Also, when firms are ranked by thirds within each specific rating (e.g. BB–) based on credit quality determinates, the top third and lower third of firms within ratings issue less debt relative to equity than firms that are in the middle of their individual ratings. • The results are both statistically and economically significant, with firms near a ratings change issuing approximately 1.0% less net debt relative to net equity annually as a percentage of total assets than firms not near a ratings change.
Comments on robustness	**Robustness Rating:** High • This is a key paper in the literature that contributes to the theoretical and empirical capital structure decision frameworks. • This paper lays the foundation for many other papers that follow as it describes the hypothesis known as the Credit Rating Capital Structure Hypothesis, making this paper highly cited. • The main results of this paper are robust to using market values as well, although the statistical significance is somewhat reduced. • The results are consistent with discrete costs (benefits) of rating changes but are not explained by traditional capital structure theories. • The results hold when net debt and net equity issuance are tested separately, and the results are robust to several model specifications and econometric approaches.

Table 12: 'Credit Rating as a Mechanism for Capital Structure Optimization: Empirical Evidence from Panel Data Analysis', Sajjad and Zakaria (2018). International Journal of Financial Studies.

Overview of research	• This paper empirically examines the significance of credit ratings for optimal capital structure decisions. • Stakeholders are concerned by credit ratings when making their investment and financing choices. • Studies from numerous surveys revealed that in order to undertake financing decisions, CFOs of listed and privately held companies consider credit ratings highly relevant, and this holds particularly for debt-based financing choices (Graham and Harvey (1999); Boot et al. (2006)). The authors highlight two main areas of previous literature: 1. The importance of rating changes and leverage decisions: • Organisations whose ratings are getting worse, generally decrease their leverage. • Inversely, firms with upgraded ratings generally choose to increase their debts due to the lower cost of capital and better access to external financing. 2. Credit rating categories (investment versus speculative grade): • Credit assessments are categorised into investment and speculative grade. • Firms in the investment grade category receive benefits by bringing down the cost of capital through their high ratings, whereas firms in the speculative grade category generally have a low level of leverage due to the high costs of debt.
Data used / approach taken	• Non-financial Asian listed companies, evaluated by Standard and Poor's (S&P), are selected from 2000 to 2016. • Panel data analysis with pooled ordinary least square (OLS), fixed effects (FE), and generalised method of moments (GMM) estimation techniques are employed to test the effect of each credit rating scale on capital structure choices.
Key findings	• The findings of all of the estimation techniques show that the relationship between credit rating scales and leverage ratio is a non-linear inverted U shape. • High- and low-rated companies have a low level of leverage, whereas mid-rated companies have a high level of leverage. This means that lower rated firms are found to increase their leverage if they achieve a higher rating. However, firms that are rated more highly are likely to reduce their leverage if their rating improves further. • All three of the models indicate that the peak of the inverted U is around the lowest investment grade rating of BBB-, indicating that companies increase their leverage until they achieve an investment grade rating, and reduce their leverage with increases in their credit rating thereafter. • The results indicate that low-rated corporations have restricted entry into debt markets compared to medium-rated corporations, or face a higher cost of borrowing. • Medium-rated corporations have a high level of leverage as they have a relatively lower cost of debt. • High-rated companies also having a low level of leverage indicates the preference of these firms is to take advantage of the high level of credit ratings to raise other types of financing e.g. equity financing.
Comments on robustness	**Robustness Rating: High** • Models appear to be well specified, and the hypothesis of an inverted U shape relationship is grounded in previous literature. • Results are also robust to all three estimation techniques; OLS, FE and GMM.

Table 13: 'The role of credit ratings on capital structure and its speed of adjustment: an international study', Wojewodzki et al. (2018). The European Journal of Finance.

Overview of research	• Using an international dataset, the authors examine the role of issuers' credit ratings in explaining corporate leverage, and the speed at which firms adjust towards their optimal level of leverage. • One potential problem in prior studies exploring the effect of the credit rating level on capital structure is the simultaneity between credit ratings and corporate leverage. • When credit rating agencies assess firms' creditworthiness, they examine the firm's current and past levels of debt. • Because the credit rating can be seen as a proxy for the probability of default, the higher the company's leverage, the higher that probability and the possibility of a lower credit rating. • By contrast, if a firm has a higher credit rating, the firm's cost of debt financing is lower, and thus the managers can borrow at a lower cost and increase their leverage in the future. • Wojewodzki et al. (2018) successfully mitigate this simultaneity issue by employing a two-step system generalized method of moments (GMM) dynamic model, which was found to be the most suitable in previous literature.
Data used / approach taken	The authors test three hypotheses based on existing studies: • **Hypothesis** 1: A better credit rating has a negative effect on a firm's leverage ratio. • **Hypothesis 2**: Firms with a high credit rating (investment grade) adjust to achieve their optimal debt-equity ratio more slowly than firms with a poor credit rating (speculative grade). • **Hypothesis 3**: The effect of a credit rating on a firm's capital structure is more significant in countries with a more market-oriented financial system.
Key findings	• There is a negative relationship between credit ratings and leverage ratios that can be associated with material costs and benefits of credit ratings for firms (in particular with respect to the highest ratings) and asymmetric information. • Companies with a better credit rating may become more conservative about using debt financing and enjoy easier access to equity financing than those with a poor credit rating. Thus, they issue more equity and less debt, which leads to a lower leverage ratio – this contradicts the trade-off theory. • It is found that, in countries with a more market-oriented financial system, the impact of credit ratings on firms' capital structure is more significant and that firms with a poorer credit rating adjust more rapidly. • Furthermore, the results show some striking differences in the speed of adjusting capital structure between firms rated as speculative and investment grade, with the former adjusting much more rapidly.
Comments on robustness	**Robustness Rating: High** • Four different measures of a firm's leverage ratio are used as a robustness check, and they each give similar results. • Results are robust to potential overrepresentation bias. • Many other robustness tests are carried out, including sensitivity analysis, all which still support the three hypotheses mentioned earlier. • There is, however, a limitation with respect to the measurement of firms' leverage and its components – there is no distinction between public and private debt. • Hence, including off-balance sheet debts may shed a different light on the relationship between credit ratings and firms' capital structure in the international context. • Overall, this paper has a credible methodology.

Table 14: 'Role of Credit Rating in determining Capital structure: Evidence from Non-Financial sector of Pakistan', Ali et al. (2020). Studies of Applied Economics.

Overview of research	• Firstly, this study explores whether credit rating affects firm capital structure in Pakistan. • Secondly, this study explores whether the relationship between credit rating and capital structure is linear or not. • Finally, this paper looks at the relationship between firm characteristics and capital structure (as seen above in the first section of Annex B).
Data used / approach taken	• This study uses annual data of 70 non-financial firms from 2012 to 2018. • The final sample consists of 35 rated and 35 non-rated firms. • It uses ordinary least square (OLS) to estimate the impact of credit rating on capital structure. The hypotheses tested in the paper are as follows: • Rated firms are likely to have high levels of leverage in their capital structure, compared to non-rated firms. • Low rated firms are likely to have low levels of leverage in their capital structure. • Other things being equal, high rated firms are likely to have low levels of leverage in their capital structures. • Medium rated firms are likely to have higher levels of leverage compared to low and high rated firms.
Key findings	• The study finds that firms with credit ratings have higher leverage compared to non-rated firms, with a non-linear relationship between credit rating and capital structure; medium rated firms exhibit the highest leverage, while high and low rated firms have lower leverage (consistent with Sajjad and Zakaria (2018), Table 12). • Profitability and tangibility have a significant negative relationship with capital structure, whereas firm size has a significant positive relationship with capital structure.
Comments on robustness	**Robustness Rating: Medium** • There is an overlap between the results of this paper and those from other papers in the literature. • In this paper, there is a thorough review of the literature, which allows the authors to reach their four hypotheses. • A broad range of hypotheses are tested, drawing together the findings from a number of different papers from the literature.

Table 15: 'Credit Rating Change and Capital Structure in Latin America', Rogers et al. (2016). Brazilian Administration Review.

Overview of research	• This paper's hypothesis is that non-financial companies listed in Latin America alter their capital structure when they are subject to imminent reclassification of their credit rating, in an attempt to avoid rating downgrades, or to achieve an upgrade. • The above hypothesis is based on the findings from Kisgen (2006) – i.e. this paper tests whether the results from Kisgen (2006) holds for non-financial companies in Latin America. • The impacts of credit ratings are important to understand as Graham and Harvey (2001) and Bancel and Mittoo (2004), verified that the credit rating is the second most important item analysed by chief financial officers (CFOs) when determining the capital structure of the company. • This is justified as higher ratings allow greater access to international bond markets.
Data used / approach taken	• The historical data of ratings was collected between 2001 and 2010, with a total of 598 observations. • The data set was composed of 87 companies: 8 from Argentina, 39 from Brazil, 14 from Chile, 24 from Mexico, 1 from Peru and 1 from Venezuela. • The database was divided into aggregate and restricted sets, excluding companies with indebtedness variation over 10%. • To measure the companies' debt, the author uses accounting values of debt rather than market values, as there is a lack of liquidity in the bond markets in Latin America. • In the regressions run, debt is the dependent variable, but lagged values of debt are independent variables; this is based on the assumption that current debt tends to perpetuate and/or influence the performance levels of indebtedness in the future.
Key findings	• The main results do not indicate that non-financial corporations listed in Latin America faced with imminent reclassification of ratings adopt less debt than those without an imminent reclassification of their ratings. • These findings suggest that the imminent reclassifications of credit ratings do not present important information for managers when making decisions about capital structure. • These findings contradict Kisgen (2006).
Comments on robustness	**Robustness Rating: Low** • Given that the results of this paper contradict Kisgen (2006), and Kisgen (2006) is such a highly cited paper, there may be arguments here for a lack of robustness. Results differ based on whether the total database is looked at, or the restricted database. • The authors conclude that they reject the research hypothesis as the main results are significant enough to do so. • However, we query the representativeness of these results given that the study focuses solely on Latin America. We cannot rule out that these results may be driven by idiosyncrasies that are specific to this region.

Table 16: 'The effects of credit rating grades' changes on capital structure: S&P 500', Khoufi and Krichene (2016). The International Journal of Engineering and Science.

Overview of research	• This paper examines the effects of real credit rating changes (investment or speculative grade) on capital structure decision making. • The authors look at real credit rating changes due to the fact that regulations are almost specific to the credit rating changes between investment and speculative grades. • The effect of credit ratings on capital structure is of importance, as previous studies have pointed out that achieving a desirable credit rating is frequently incorporated into company goals and represents an integral part of a firm's capital structure policy. • Therefore, this relationship is important as managers may actively target a specific rating, which translates into real capital structure decisions.
Data used / approach taken	• The authors look at 292 American firms listed on the S&P 500 index from 2008 to 2010. • The total number of observations of total credit ratings (AAA~D) throughout the entire period is 860, the average percentage of firms that upgrade from the speculative to the investment grade is 1.49% and the average percentage of firms that downgrade from the investment to the speculative grade is 1.14%. • The dependent variable is Net Debt Issuance, the explanatory variables are the rating dummies, and the control variables are the other leverage determinants. Based on previous studies' findings, the authors form three hypotheses: (1) Firms recently downgraded to the speculative grade will issue less debt than equity. (2) Firms upgraded to the investment grade will not change their debt issuance. (3) The credit rating and capital structure hypothesis has a persistent effect in the context of the trade-off theory and pecking order theory.
Key findings	• The findings suggest that credit ratings are a major factor in determining firms' capital structure or leverage, which is confirmed even in the context of traditional capital structure theories (trade-off and pecking order theory). • The results show that both upgrades and downgrades of credit ratings significantly affect leverage decisions of the following year. • Firms downgraded to the speculative grade will reduce their debt issuance in the following year, in order to regain the investment grade credit rating, which implies that lower leverage leads to higher credit ratings and vice versa. • However, the results also show that once the investment grade is reached following an upgrade, firms will again increase their debt issues. • Firms with strong growth opportunities issue more debt than equity, which is consistent with the prediction of the pecking order theory. • The results are also consistent with the trade-off theory.
Comments on robustness	**Robustness Rating: High** • The empirical evidence aligns with the theoretical frameworks. • This paper is highly relevant as it looks at real changes in credit ratings i.e. investment grade to speculative grade and vice versa. • This is particularly useful as it allows for an understanding of the capital structure of firms that are close to the boundary between investment and speculative grade. • Overall, this paper clearly sets out the relationship between credit grades and capital structure.

Relationship between credit rating and the cost of debt

Table 17: 'Rating Agency Reputation, the Global Financial Crisis, and the Cost of Debt', Han et al. (2012). Financial Management.

Overview of research	• This paper assesses why foreign firms obtain credit ratings from global rating agencies e.g. Moody's and Standard & Poor's (S&P), rather than domestic agencies, even though global rating agencies typically assign lower credit ratings. • Japanese firms obtain ratings from global agencies for yen-denominated bonds despite lower ratings, suggesting that Moody's/S&P ratings may reduce the cost of debt. • The strong reputation of global rating agencies boosts investor trust in foreign companies, leading to lower costs of debt through a "certification effect." i.e. the global rating agencies have greater reputation, so a good rating acts like a stamp of approval, making investors more confident and willing to lend money at a lower cost.
Data used / approach taken	• The authors study this by seeing how a rating from a global agency affects the cost of debt for newly issued, yen-denominated Japanese corporate bonds. • The question is investigated with 3,525 new plain vanilla corporate bonds, issued in yen by non-financial firms in Japan, rated by R&I, JCR (credit rating agencies based in Japan), Moody's, or S&P from April 1998 to March 2009.
Key findings	• The authors find that bonds rated by at least one global agency are associated with a significant reduction in the cost of debt compared to those rated by only domestic Japanese rating agencies. • The magnitude of this effect is estimated to be 11-14bps, though this effect was negated during the 2007 to 2009 financial crisis, indicating that the reputation of these rating agencies may have declined during this period as a result of their failure to identify issues in subprime mortgages. • It is also observed that it is more likely for firms with the following characteristics to seek out ratings from Moody's or S&P rather than domestic Japanese rating agencies: (i) high financial leverage; (ii) greater information asymmetry; (iii) larger levels of foreign equity ownership; (iv) weaker financial performance and; (v) greater systematic risk. • These firms appear to do this in order to reduce the cost of debt by relying on the stronger reputation of the global rating agencies.
Comments on robustness	**Robustness Rating: High** • The authors of this paper look at the impact on the cost of debt from having a credit rating from a global ratings agency, rather than the impact of credit rating levels on the cost of debt. However, it is still a useful result, indicating that the reputation of the rating issuer, has an impact on the cost of debt. • The results are robust even after controlling for possible selection bias (firms with poorer financial quality may be the ones seeking ratings from global agencies in order to benefit from global agencies' reputation). • The result is also robust to the inclusion and exclusion of industry and year dummies.

Table 18: 'Do Regulations Based on Credit Ratings Affect a Firm's Cost of Capital?', Kisgen and Strahan (2010). The Review of Financial Studies.

Overview of research	• Previous studies have examined whether credit ratings affect the yields on a firm's bonds. To the extent that they incorporate non-public information regarding a firm's probability of default, ratings might be expected to have an impact on the bond's yield. • The authors' contribution to the literature is through an empirical design that allows them to identify the regulatory impact of ratings on the cost of debt. This is the first study to document that regulations based on ratings affect a firm's cost of capital.
Data used / approach taken	• Monthly bond ratings and yield data come from Bloomberg from 2001 to 2005. • The authors rely on an exogenous change in the regulatory status of the Dominion Bond Rating Service (DBRS). • In February 2003, the Securities and Exchange Commission (SEC) designated DBRS as the fourth Nationally Recognized Statistical Ratings Organization (NRSRO) (the other three are S&P, Moody's and Fitch). • By using this unexpected change in DBRS's regulatory status as a quasi-natural experiment, the authors check if the regulatory importance of a rating agency (DBRS) itself can influence bond yields, regardless of any new information about the firms' actual creditworthiness. • An example of a regulation tied to credit ratings would be banks' investment restrictions; banks are typically limited to only holding investment grade bonds, thus affecting the demand for bonds, which therefore impacts a bond's yield. • In theory, DBRS's regulatory status change should not impact prior ratings information. Any bond yield changes after the status improvement should be due to regulations, not new information, as existing ratings remain unchanged.
Key findings	• Firms with DBRS ratings better than the other NRSRO's as of January 2003 experience a decline in their cost of debt after February 2003. • By the end of 2003, these firms had experienced a 39-basis-point drop in bond yields compared to firms whose DBRS ratings were the same as the average of the other agencies. • This shows that, because the ratings were held fixed as of January 2003, information-based explanations for the change in yields can be ruled out i.e. the yield change is not due to new information, as ratings stayed constant, therefore it must be driven by DBRS's regulatory status change. • Authors find two reasons why yield falls. First, demand by regulated insurance companies to hold bonds rated better by DBRS seemed to increase. Second, liquidity for the better-rated bonds increased relative to bonds rated the same by DBRS. • The evidence provided by the authors strongly supports the notion that ratings-based regulations affect a firm's cost of capital rather than reputation effects. • Regulatory effects mean that DBRS's ratings now matter for compliance with various rules affecting which bonds investors can buy and hold, leading to changes in borrowing costs. • Reputation effects would imply that DBRS's newfound credibility after SEC certification could have made investors trust its ratings more, leading to changes in bond yields even without regulatory enforcement.
Comments on robustness	**Robustness Rating: High** • The authors conduct falsification tests, incorrectly assuming that a change in regulatory status occurred in February 2004 or February 2005 - conducting the experiment with these dates does not generate similar results. • To avoid potential selection bias, authors consider only bonds rated by DBRS prior to DBRS obtaining NRSRO status. • These tests indicate that the change in regulatory status of DBRS changed the impact of its ratings on a firm's bond yields.

Table 19: 'The Informational Content of Bonds Ratings', Ederington et al. (1987). Journal of Financial Research.

Overview of research	• In this study, the authors seek to determine the 'information content' of credit ratings i.e. whether credit ratings provide extra information over and above the public information of a firm e.g. a firm's financial statistics. • This paper assesses whether yields on bonds indicate that market participants base their evaluations of bond issuers' default risk on publicly available financial statistics (e.g. coverage and leverage) or on agency credit ratings. Specifically, there are four questions the authors seek to answer, as the answers reflect what the informational content of a credit rating actually is: (1) Do market yields on bonds indicate that market participants view ratings as reflecting only readily available information, i.e. as providing no new information? (2) Do market yields indicate that market participants view all relevant information regarding an issuer's creditworthiness as adequately represented by its rating(s)? (3) If the market views ratings as important, do market participants rely relatively more on one rating agency than another? (4) Does the information content of ratings decline over time i.e. do market participants regard recently released ratings as better indicators of credit risk than ratings which have not been reviewed recently?
Data used / approach taken	• Using a non-linear least squares procedure, the authors relate the yield to maturity to Moody's rating, Standard & Poor's (S&P) rating, and accounting measures of creditworthiness such as coverage and leverage. • They regress the yield to maturity of various bond issues both on dummy variables representing Moody's and S&P ratings, and on variables representing readily available information regarding the issuing firm and the bond issue itself.
Key findings	• The authors find that market yields are significantly correlated with both the ratings and with a set of readily available financial accounting statistics. The results reveal the following information in relation to the four questions posed: (1) The ratings bring some information to the market above and beyond that contained in the set of accounting variables. (2) Market participants base their evaluations of a bond issuer's creditworthiness on more than Moody's and Standard and Poor's ratings. Specifically, it is clear that they also consider recent financial statistics. (3) The market views Moody's and S&P ratings as interchangeable and as equally reliable indicators of an issuer's creditworthiness. (4) Though the relationship is weak, the analysis also suggests that the market may pay more attention to the accounting measures and less to the ratings if the rating has not been reviewed recently.
Comments on robustness	**Robustness Rating: Medium** • Reverse causality cannot be completely ruled out, and hence, the relationships found do exist, but there is uncertainty of the direction of causation. • However, from the paper it can still be understood that there is a clear importance of credit ratings, credit ratings are used by market participants to evaluate a bond, and it is understood that the market views Moody's and S&P ratings equally.

Relationship between firm-level productivity and equity returns

Table 20: 'Firm-Level Productivity, Risk, and Return', Imrohoroglu and Tuzel (2014). Management science.

Overview of research	• Previous literature has documented in detail how firm characteristics, other than productivity, affect stock returns, and also that low productivity firms are more vulnerable to business cycles and end up being risker than high productivity firms. • However, in this paper, the authors directly estimate the relationship between firm-level total factor productivity (TFP) and stock returns for publicly traded manufacturing firms in the US. • Previous papers have not investigated the relationships between TFP, firm characteristics, and firm returns directly. • Authors analyse this relationship both empirically, and through a model economy.
Data used / approach taken	• To empirically examine this relationship, the authors run Fama-MacBeth regressions of monthly stock returns on firm-level TFP.
Key findings	**Risk-based explanation for the relationship:** • Authors find that TFP is positively and monotonically related to contemporaneous excess returns and negatively related to future excess returns (i.e. equity returns in excess of the risk-free rate). • They find that low productivity firms have, on average, higher future excess returns than high productivity firms. • The difference between the contemporaneous excess returns of high and low TFP firms is 19.7% for equal-weighted portfolios, and 12.4% for value-weighted portfolios (both spreads are statistically significant). • Regarding future excess returns, for equal-weighted portfolios, low productivity firms on average earn a 7.4% annual premium over high productivity firms in the following year (also statistically significant), but the result becomes 2.6% and insignificant for value-weighted portfolios. • They also find that there is significant variation in the return spread over business cycles. It is roughly five times as high during economic contractions as it is during expansions. The spread in the average returns across these portfolios is interpreted as the risk premia associated with the higher risk of low productivity firms. • The authors explore the negative relationship between TFP and expected returns by examining how low and high TFP firms' profits react to economic shocks. Low-TFP firms' profits are found to be more sensitive, especially during recessions, while high TFP firms are less affected. This shows that low TFP firms are riskier, which the authors suggest explains their higher expected returns to compensate for this greater risk.
Comments on robustness	**Robustness Rating: Low** • The authors interpret the negative relationship between TFP and future excess returns as a risk premium for low productivity firms and present evidence supporting this idea. • The authors do not consider alternative explanations for this result that are explored in other papers, such as mispricing in Ang et al (2020). • A more recent paper, Hiroki et al. (2022), explicitly refers to this paper, and shows that, a similar but more complex model yields a positive relationship between TFP and future returns, albeit using data from a different country. This raises questions over the robustness of this result.

Table 21: 'Does firm-level productivity predict stock returns?', Hiroki et al. (2022). Elsevier; Pacific-Basin Finance Journal.

Overview of research	• This paper looks at the relationship between firm-level total factor productivity (TFP) and future stock returns of Japanese firms in the cross section i.e. not over time. • The authors look into the risk factors that explain the relationship between TFP and future returns. • The results of this paper appear to contradict previous findings applying a similar approach to US data (see Imrohoroglu and Tuzel (2014)). **Motivation for this paper:** • The only study that has previously analysed the productivity of Japanese firms in relation to their stock returns is Ishikawa and Hasegawa (2019), who focus on labour productivity. • Hiroki et al. (2022) extends this literature by examining the relationship between TFP and returns for Japanese firms.
Data used / approach taken	• Listed Japanese manufacturing firms included in the TOPIX index. • 570 firm-level observations per year on average over the 20 fiscal years from 1999 to 2018. • Measure of TFP is estimated using production function estimates.
Key findings	**Risk-based explanation for the relationship:** • TFP of Japanese manufacturers positively predicts future stock returns i.e. there is a productivity premium. • This result is highly statistically significant. • The authors evaluate and reject the mispricing hypothesis with limits-to-arbitrage as an explanation. • They investigate alternative risk-based explanations of our result, examining bankruptcy, macroeconomic, capital and intangibles expenditure risks. • They find that risks related to R&D and personnel expenditure explain the productivity premium the best. • Bankruptcy, macroeconomic and CAPEX risks do not explain the premium.
Comments on robustness	**Robustness Rating: Medium** • The robustness check supports the view that the TFP premium is not due to mispricing, but reflects fundamental characteristics of the firms, including their productivity. • The results suggest that mispricing does not explain the TFP premium, as high TFP firms tend to have lower arbitrage risk, information uncertainty, and transaction costs, and relatively high investor sophistication. • These robustness checks, combined with the use of an updated approach relative to Imrohoroglu and Tuzel (2014) (e.g. more complex risk factor models and more control variables), suggest that this paper should be the more robust of the two. • However, explaining the differences in results is challenging, as the studies examine different countries (Japan and the US).

Table 22: 'Productivity and equity market fundamentals: 80 years of evidence for 11 OECD countries', Davis and Madsen (2008). Elsevier; Journal of International Money and Finance.

Overview of research	• The share market boom in the 1990's is often linked to the acceleration in labour and total factor productivities over the same period. • The problem associated with growth in labour productivity as a measure of earnings is that it is heavily influenced by capital deepening, which lowers earnings per unit of capital due to diminishing returns to capital. • TFP growth influences earnings positively, but because TFP growth is often triggered by capital deepening which embodies new technologies (Wolff, 1991), the relationship between stock returns and TFP growth is distorted. • This paper posits that labour and total factor productivities are inaccurate measures of a firm's earnings, which underlie equity valuations, and that capital productivity is a better measure of earnings.
Data used / approach taken	• The paper uses 80 years of data for 11 OECD countries (the US, Germany, Canada, the UK, France, Italy, Japan, Denmark, Sweden, the Netherlands and Australia). • Gordon's growth model is used for the equity valuations. • The authors first assess bivariate granger causality in the short and long run, before focussing on a multivariate Johansen Vector Error Correction Model (VECM) and multivariate panel estimation. • A VECM is a time series method used to model the short and long run relationships between variables that are closely interrelated over time and have a common long equilibrium relationship between them (cointegrated).
Key findings	• Granger causality tests show that capital productivity is the most strongly related to real total returns than the other measures of productivity (labour and TFP). Results indicate that stock returns are often a leading indicator of capital productivity growth in the short run, consistent with the forward-looking nature of markets, but that in the long run capital productivity and accumulated real returns are cointegrated with productivity driving returns in the longer term. • Impulse responses from the VECM models show that capital productivity has a positive impact on total stock returns in most cases in both the short and long run. • The panel estimation results show that the estimated coefficient on capital productivity is positive and highly statistically significant, in contrast to the coefficients on TFP and labour productivity.
Comments on robustness	**Robustness Rating: High** • This paper investigates both the short and long run linkages between different types of productivity and stock returns using time series methods. This contrasts with other literature which focus on cross sectional approaches and stock returns over shorter periods. • The authors use a range of methods, including granger causality testing, a VECM, and panel data models, all of which yield consistent results.

Table 23: 'Firm-level productivity and stock return: New evidence from China', Tang et al. (2024). Elsevier; International Review of Economics and Finance.

Overview of research	• The authors measure the relationship between firm-level productivity (TFP) and stock market returns. • The results in similar prior studies vary depending on the country in question. • The authors also examine the reason for the relationship, looking at risk compensation (asset pricing theory) and mispricing (behavioural finance theory) as possible explanations.
Data used / approach taken	• Uses data on listed companies in China A-share market, looking at monthly stock returns. • Portfolio analysis includes grouping firms by size and TFP, and then running regressions of expected returns on the relevant systematic risk factors (Fama French 3 and 5 factor models).
Key findings	**Mispricing reasoning for the relationship:** • Significantly positive correlation between productivity (TFP) of Chinese firms and their future stock returns. • This relationship between productivity and equity returns is found to be due to mispricing rather than a risk premium. The market does not adequately assimilate information about firm-level productivity. • Mispricing is found to be caused by overconfidence, investor inattention, and limits to arbitrage. • The greater the level of expectation stickiness (i.e. past profits being used to forecast future profits) is, or, in other words, the more persistent a firm's productivity is, the less likely mispricing will be corrected, resulting in a greater productivity anomaly over time.
Comments on robustness	**Robustness Rating: Low** • The authors first examine the relationship in question, but also take the findings from the previous literature on the reasoning for the relationship (risk-based versus mispricing) and then arrive at a conclusion following detailed tests. • The authors investigate a range of factors individually that could explain the relationship and come to a conclusion based on the empirical evidence. • The relationship they find is robust to two different measures of TFP, and inclusion of controls for Fama-French risk factors. • Bivariate portfolio analysis is also carried out to check for robustness, and the results still hold i.e. results are consistent with univariate analysis. • Results conflict with Ang et al (2020), though we note these studies relate to different countries. • Overall, it is unclear the extent to which this paper captures the fundamental relationship between productivity and equity returns as opposed to a relationship driven by mispricing.

Table 24: 'Productivity growth and stock returns: firm and aggregate-level analyses', Chun et al. (2016). Applied Economics.

Overview of research	• The authors look into the relationship between productivity and returns, distinguishing between the firm-level TFP effect on returns, and the aggregate TFP effect on returns. • This paper helps to explain why we might expect different relationships to arise when using aggregate versus firm-level TFP.
Data used / approach taken	• Annual firm-level productivity growth rates for US firms from 1970 to 2006 let the authors explore the contemporaneous relationships between firm-level and aggregate stock returns and firm-level and aggregate productivity growth rates. • Realised abnormal stock returns are calculated using the CAPM.
Key findings	• A firm's stock return is affected not only by its own productivity growth rate, but also by other firms' productivity growth rates. • Stock returns and productivity growth are positively correlated in firm-level data, but negatively correlated in aggregate data – so an aggregate boost in TFP may not be good for shareholders across the entire market. • These results are consistent with the idea of 'Schumpeterian creative destruction' i.e. even if aggregate productivity increases, there can be more losers than winners from the increase in productivity, and so the returns fall on aggregate. • In other words, most individual firms' stock returns correlate negatively with aggregate productivity growth due to creative destruction arising from increased competition with more productive rivals.
Comments on robustness	**Robustness Rating: High** • This paper explains the relationship between changes in firm-level productivity and stock returns. It also investigates the impact of aggregate-level productivity on returns, though this result is less relevant for our research purpose. • The authors perform a range of robustness checks, including changes to the specification, different approaches to weighting, and different methods of calculating TFP. These results are generally qualitatively similar to the main results.

Table 25: 'Productivity and stock prices', Avouyi-Dovi and Matheron (2006). Banque de France; Financial Stability Review.

Overview of research	• An analysis of the correlation between stock prices and labour productivity. • This paper focusses on the cyclical component of stock prices i.e. the part of the stock price movements that are influenced by the overall business cycle, as opposed to the long-term trend.
Data used / approach taken	• The US and euro area are studied over the period 1973-1985. • Labour productivity is calculated as the ratio of real GDP to employment for the euro area, and the ratio of real GDP to total work hours for the US.
Key findings	• In the US, an increase in the cyclical component of the rate of stock returns is positively correlated with current or future increases in that of the productivity growth rate (vice versa). • In the euro area, this correlation still positive but less strong. • This pattern appears to suggest that the cyclical component of stock prices is in phase with that of productivity.
Comments on robustness	**Robustness rating: High** • The results are corroborated by two complementary methods. They also align with Estrella's (2003) findings for the United States. • However, the paper only measures correlations and cannot be used to make forecasts or provide further economic interpretation. • This paper only focuses on labour productivity, as opposed to other measures, such as TFP.

Table 26: 'Stock Returns, Productivity, and Corruption in Eight European Fast-Emerging Markets', Pellegrini et al. (2017). Wiley; Thunderbird International Business Review.

Overview of research	• This article addresses the impact of productivity (the variable of interest), corruption, and trade openness on firms' stock returns.
Data used / approach taken	• Data on 265 industrial companies listed in eight Eastern European fast-emerging markets, over the 2004-2013 period. • Financial sector companies are dropped from the sample. • Multivariate regressions are based on the Fama French three-factor model approach, augmented with additional variables. • The dependent variable is the annual investment return, and the independent variables include the corporate productivity index (ratio between sales and total assets).
Key findings	• Findings suggest that the most productive firms are associated with higher stock returns. • Corporate productivity does play a statistically significant role in explaining annual investment returns on stocks.
Comments on robustness	**Robustness Rating: High** • Results partially confirm the existing literature, and control for a comprehensive range of variables. Market capitalization, price volatility, country risk premium, and corporate productivity are found to have positive relationships with stock returns, with statistically significant coefficients. Corruption, and trade openness are inversely related, also with statistically significant coefficients. • Results are statistically robust. • The authors believe that their estimates are made more reliable and robust via the introduction two variables that deal with a company's balance sheet (gearing and productivity), which are uncorrelated.

Table 27: 'Total factor productivity and shareholder returns in banking', Fiordelisi and Molyneux (2010). Elsevier; Omega.

Overview of research	• This paper examines shareholder value drivers in European banking, focusing on the efficiency and productivity features of individual banks. • Shareholder value drivers are studied in this paper as only a few previous studies use shareholder value creation indicators as measures of bank performance. • Shareholder value drivers are important to examine given that creating value for owners (i.e. generating returns in excess of the cost of capital) has been the main strategic objective of banks. • This paper breaks TFP into its component parts, which enables more detailed assessment of the drivers of shareholder value.
Data used / approach taken	• This paper focuses on the French, German, Italian and UK banking systems over the period 1995–2002 and includes both listed and non-listed banks. • A panel data regression model is used. • The TFP measure includes technical efficiency change, technological change, pure technical efficiency change and scale efficiency change.
Key findings	• Main result – total factor productivity (TFP) changes best explain variations in shareholder value. • In general, the authors find that improvements in top-performing banks (through technological change) explain value creation better than the progress of other banks trying to catch up to these top performer (i.e. the findings suggests that to enhance value creation in the banking sector, focusing on technological advancements is key, especially those that come from the banks that set the standard for excellence in the industry).
Comments on robustness	**Robustness Rating: Medium** • Robustness tests include running models using one-year cross-section sub-samples for both listed and non-listed banks. Although the overall significance of these models cannot be directly compared to the one using the panel data sample, estimated regression coefficients display consistent signs, magnitude, and statistical significance over the time period analysed, reinforcing the main results. • The authors also observe that the findings for the sample of listed and non-listed banks appear to be strongly consistent with those for the sample of only listed banks. • The paper's focus on the banking sector may limit its applicability to other sectors or the economy more widely.

Table 28: 'Mispricing Firm-level Productivity', Ang et al. (2020). Elsevier; Journal of Empirical Finance.

Overview of research	• This paper provides a mispricing-based explanation for the negative relation between firm-level productivity and stock returns. • Previous empirical studies have shown a negative relation between firm productivity and future stock returns in the USA (the firm productivity effect) and have attributed it to risk i.e. unproductive firms are riskier as they are more likely to face financial distress, and also higher costs to reduce their unproductive assets, therefore investors require higher returns. • In this study, the authors instead explore the role of mispricing (especially in the form of extrapolative errors) and limits to arbitrage in explaining the firm productivity effect.
Data used / approach taken	• The sample consists of all common stocks (share codes 10 and 11) listed on the NYSE, AMEX, and Nasdaq from 1972 to 2015 inclusive. • Two measures of productivity are used: (i) a firm's shortfall from its potential optimal value frontier; and (ii) TFP.
Key findings	**Mispricing reasoning for the relationship:** • The relationship between productivity and returns suggested by the findings is that productive firms tend to be overpriced, leading to lower future returns, while unproductive firms are underpriced, leading to higher future returns (as the mispricing is corrected by the market). • In summary, the overpricing of productive firms results from excessive optimism, while the underpricing of unproductive firms reflects neglect, leading to a situation where productive firms may not perform as well as expected, and unproductive firms can surprise investors positively. The results indicate that this mispricing is driven by: • Investor sentiment: When optimism is high, productive firms get overpriced, worsening the mispricing. • Extrapolation errors: Investors wrongly assume that past productivity growth will continue, even though it often reverses. • Short sale constraints: Investors who recognise overpricing cannot easily short-sell and correct the prices. • Limits to arbitrage: These constraints prevent quick exploitation of mispricing, so price corrections occur slowly, often coinciding with earnings announcements when true performance is revealed. Thus, the mispricing causes underproductive firms to offer higher returns as prices adjust, while productive firms offer lower returns. • Decomposition analysis suggests that extrapolation of past returns / productivity growth and limits to arbitrage explain most of the firm productivity effect.
Comments on robustness	**Robustness Rating: Low** • The results of this paper are statistically robust after controlling for various return predictors and factors not included in earlier studies. • In contrast to Imrohoroglu and Tuzel (2014), the authors find that the negative relation between firm productivity and future stock returns is due to mispricing, rather than risk compensation. • The mispricing effect identified in this paper may obscure the relationship between productivity and equity returns. • Overall, it is unclear the extent to which this paper captures the fundamental relationship between productivity and equity returns, as opposed to a relationship driven by mispricing. • Results also conflict with Tang et al (2024), though we note these studies relate to different countries.

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