Global Arbitration Review

The Guide to Damages in International Arbitration

Editor
John A Trenor

Third Edition

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Editor

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Contents

Part II: Procedural Issues and the Use of Damages Experts

Part III: Approaches and Methods for the Assessment and Quantification of Damages

Part IV: Industry-Specific Damages Issues

Preface

This third edition of Global Arbitration Review's *The Guide to Damages in International Arbitration* builds upon the successful reception of the first two editions. As explained in the introduction, this book is designed to help all participants in the international arbitration community understand damages issues more clearly and communicate those issues more effectively to tribunals to further the common objective of assisting arbitrators in rendering more accurate and well-reasoned awards on damages.

The book is a work in progress, with new and updated material being added to each successive edition. In particular, this third edition incorporates updated chapters from various authors and features several new chapters addressing such issues as best practices and issues in discounted cash flow models, full compensation and total reparation, and estimation of harm in antitrust damages actions.

We hope that this revised edition advances the objective of the first two editions to make the subject of damages in international arbitration more understandable and less intimidating for arbitrators and other participants in the field, and to help participants present these issues more effectively to tribunals. We continue to welcome comments from readers on how the next edition might be further improved.

John A Trenor
Wilmer Cutler Pickering Hale and Dorr LLP

Part III

Approaches and Methods for the Assessment and Quantification of Damages

16

Best Practices and Issues that Arise in DCF Models

Gervase MacGregor, Andrew Maclay and Michael Smith[1]

Introduction

As has been discussed in other chapters of this book, the discounted cash flow (DCF) model has become an established tool in calculating damages claims in international arbitrations. This is because it can be used to calculate a claim for damages in many scenarios for any company that has reliable projections of future income. It also enables the tribunal to base any damages amount on what would most likely have happened to a claimant. Whether or not sufficient evidence exists for the tribunal to put its confidence in the output of the DCF model is hotly debated, but that is beyond the scope of this chapter.

Given this extensive use of DCF models and their importance to damages, it is important that arbitrators, lawyers and experts have a good understanding of model construction, the assumptions that generally underlie such models and the circumstances under which it is appropriate to use them. There are many badly constructed and badly explained models, but often it is left to the other side's expert to try to understand the model and to explain to the tribunal its problems. In our view, reliance entirely on the experts is inadequate, and it is necessary for the tribunal to understand the model if it is going to rely on it for an award of damages, which in many cases can potentially be worth millions of dollars.

This chapter seeks to provide a guide for arbitrators to the key questions they should be asking when considering damages based on a DCF model. We look at the basics of DCF models, the construction of DCF models and finally at key issues that often arise in damages models.

1 Gervase MacGregor is head of forensic services, Andrew Maclay is a forensic accountant and Michael Smith is a forensic senior manager at BDO LLP.

The basics of DCF models

The DCF approach involves estimating the future cash flows of a company (or project), and then discounting these back to the net present value as at the valuation date (typically the date of the alleged breach) by applying a suitable discount rate.

The big challenges in applying the DCF approach are calculating the company's future cash flows and calculating the appropriate discount rate.

Components of future cash flows

Within a DCF model, a company's future cash flows will typically comprise the following components:

- sales revenue earned from operations;
- less operating costs – direct and indirect costs of making the good or providing the service;
- less taxes – the corporation tax due on the operating profits (sales revenue less the operating costs) of the company;
- less investments in assets – for example, the cost of buying buildings, land, machinery, equipment, vehicles, etc.;
- plus non-cash items – including amortisation and depreciation, which are costs to reflect the decrease in value of intangible and tangible assets over their expected useful life. As these costs are charged to the profit and loss account, they will have been included within the 'operating costs' figure above (which is deducted from 'sales revenue earned from operations'). By adding them in this removes these non-cash items from the cash flows; and
- less change in working capital – working capital is the cash a company needs for day-to-day operations, and is calculated as current assets[2] less current liabilities.[3] If the change in working capital between periods is positive (i.e., working capital has increased), this is treated as a cost in the cash flow as it shows that more cash is tied up in working capital than in the previous period.

The first three components of the cash flow (sales revenue, operating costs and taxes) are essentially the net profit of a company, and will be based on figures included in the company's profit and loss account.

The discount rate

The discount rate is applied to reduce the value of the future cash flows back to the present value as at the valuation date.

Future cash flows need to be reduced because of the concept that a dollar today is worth more in economic terms that a dollar in a year's time, which is because of two factors:

- the time value of money – if you receive $1 today and place it in an interest-bearing bank account, in a year's time you will have the $1 plus interest, which is therefore worth more than just receiving the $1 in a year's time; and

2 Examples of current assets include short-term assets, such as debtors (money due from customers) and stock.
3 Examples of current liabilities include short-term liabilities, such as creditors (money due to suppliers).

- the risk and uncertainty attached to future cash flows – this means you would be prepared to accept a guaranteed lower lump sum today (e.g., $0.90) rather than being subjected to the future risk and uncertainty of possibly receiving $1 in a year's time.

The discount rate is often one of the biggest factors affecting a damages claim. In the world of international arbitration, the general methodology underlying the calculation of the discount rate has become reasonably settled and generally agreed among arbitrators; however, there are many major arguments over the parameters and assumptions applied to calculate it. For the purposes of this chapter, we will not go into the details of how a discount rate is calculated.

The arbitrators should understand how sensitive the present value of the forecast cash flows are to changes in the discount rate for each particular case. To this end, some key concepts to be aware of include:

- a higher discount rate will result in a lower present value for the forecast future cash flows and vice versa; and
- the further into the future a cash flow is, the more it will be discounted. For example, say the discount rate is 10 per cent, a forecast cash flow that was to occur two years into the future would be multiplied by 83 per cent[4] to calculate its net present value, whereas a forecast cash flow that was to occur five years into the future would be multiplied by 62 per cent.[5]

This means that the greater the proportion of cash flows that are forecast to occur far into the future, the greater the impact on the damages figure owing to a change in the discount rate.

The DCF approach

The DCF approach can be used in a variety of circumstances, including the valuation of an entire company (for example, in quantifying damages in investment treaty expropriation cases), as well as the valuation of the loss of profits for a specific contract (for example, in quantifying damages because of an early termination of a contract).

The calculation of damages will entail comparing the net present cash flows with and without the alleged breach; i.e., comparing the 'but-for' scenario (the hypothetical situation the company would have been in if it had not been for the alleged breach) and the 'actual' scenario (the actual situation of the company following the alleged breach).

The valuation period is the date from alleged breach up until the alleged breach no longer has a financial impact on the company, and can therefore either be:

- a definite time period – whereby it is assumed that in the future the company will return to its pre-breach levels of performance (i.e., its previous levels of sales or profits). For example, a temporary factory closure or the early termination of a contract; or

4 1/(1+10%)^2 years.

5 1/(1+10%)^5 years.

- an indefinite time period – whereby it is assumed that the value of the company is lost forever and will never be increased back to the pre-breach levels. For example, the expropriation of a company.

With an indefinite time period, it is necessary to calculate a terminal value for the company, as forecasting cash flows beyond a certain period is impractical.

The terminal value represents the sum of all future cash flows beyond the explicit forecast period. The explicit forecast period is typically until the forecast cash flows are in a steady state whereby no major changes to the company are expected that could have any impact on the future cash flows.

The terminal value is important as it can often represent the majority of the value or loss calculated in the DCF model.

Construction of DCF models and spreadsheet

DCF models are typically constructed using a spreadsheet. It is easy to overlook this basic tool and, indeed, tribunals probably rarely see the underlying native copy of the DCF spreadsheet model. And for this reason the next subsection discusses the principles of good spreadsheet design.

Spreadsheets

Spreadsheets are ubiquitous in calculating damages in international arbitrations. They are easy to use and represent a common language among finance people – although some speak that language better than others.

The flexible nature of Microsoft Excel – by far the most popular spreadsheet software program – means that a user can develop a highly complicated model very quickly, which is not necessarily well designed.

Importantly, badly designed spreadsheets are very difficult to review. Intuitively, such spreadsheets are more likely to contain errors, which is a cause for concern given all spreadsheets are inherently prone to errors – a great many errors. Raymond Panko of the University of Hawaii's Shidler Business School carried out extensive research into spreadsheet error and presented his findings in a paper entitled 'What we know about spreadsheet errors'.

There were three important conclusions:

- spreadsheet errors are rare on a per cell basis, but in large spreadsheets at least one incorrect bottom line value is likely to be present;
- errors are extremely difficult to detect and correct; and
- spreadsheet developers are over-confident in the accuracy of their spreadsheets.[6]

Other research cited by Panko indicates that over 90 per cent of spreadsheets contain errors, and that 5 per cent of cells reviewed have errors, including 'mechanical errors' (e.g., typos),

6 Paper entitled 'What we know about spreadsheet errors' by Raymond Panko, January 2005. Published in the *Journal of End User Computing*'s special issue on 'Scaling Up End User Development', Volume 10, No. 2. Spring 1998, pp. 15–21, revised January 2005.

logic errors (e.g., incorrect formulas) and omission errors (e.g., leaving something out of the spreadsheet that should be there).[7] One occasionally sees damages awards making reference to errors in spreadsheet models – the *Yukos* award is a good example.[8]

DCF spreadsheet models for damages claims can range significantly in their complexity, from basic models (e.g., with only a few worksheets, simple formulas and relatively few inputs), to highly complex models (e.g., with numerous worksheets, complicated formulas and lots of inputs).

While it is difficult to guarantee that a complex DCF model is 100 per cent free from errors, if best practice is followed in terms of the model design and quality control and testing of the model, this minimises the risk of material errors and inconsistencies being included in the model. We have set out below the best practice in relation to the design and review of DCF models, with the key principles applicable to both basic and complex models.

Design of the model

If a DCF model is well formatted and labelled (e.g., notes are included explaining how figures have been calculated, it is clear which figures are inputs and which are calculations, the source of any inputs are clear), the model should be fully understandable, even from PDF prints of each worksheet, and even for complex spreadsheets that could run to hundreds of pages in a printed copy.

If a DCF model is well designed (and thus easy to use and understand) and shared with the other side in plenty of time for a model review to be undertaken, it should be possible for both experts to agree that the model is arithmetically accurate given the inputs and calculations included in the model. The experts and the tribunal can then be free to concentrate its enquiry, challenge and debate on the key issues with regard to the model, such as whether the commercial assumptions are reasonable, whether alternative inputs should be used (the common example is which discount rate or interest rate should be applied), and the overall methodology used.

If a DCF model is poorly designed, the task of reviewing the model or trying to make changes to assumptions can be very difficult, as it becomes difficult even to understand how the model and the calculations within it are working, and thus whether the model is accurate. For example, if the sources of the inputs are not clearly labelled within the model, it becomes difficult to agree the input figures contained in the model back to the source data.

The first responsibility for preparing a robust model lies with the preparer of the model. We suggest that preparers follow a number of basic principles around design. There are a number of guides that can be followed, for example, the Institute of Chartered Accountants in England and Wales publishes a list of 20 principles for good spreadsheet practice. The list that our own firm uses contains the following.

7 ibid.

8 *Yukos Universal Limited (Isle of Man) v. The Russian Federation*, Final Award dated 18 July 2014, paras. 1744–1745.

Explicit layout

A well-designed model will have a clear and easy-to-follow structure, with separate worksheets for:

- inputs – the hard-coded inputs and assumptions required for the calculation. For example, the assumed percentage change in sales revenue each year over the forecast time period;
- calculations – the detailed calculations required to assess loss. For example, the calculation of the cash flow for the company in the but-for scenario over the time period; and
- outputs – this will generally only be a single worksheet and can be thought of as the 'summary' worksheet that provides the final output of the model based on the figures contained in the calculations worksheets (i.e., the overall loss incurred by the company as a result of the alleged breach).

Best practice in relation to layout includes:

- inputs worksheets – these should only include hard-coded input data and assumptions, and should not include calculations (other than potentially a sum or average calculation, e.g., summing the revenue earned for each month to calculate the revenue for the year). The inputs will then flow into the calculations worksheets;
- calculations worksheets – these should only include calculations. They should not include any hard-coded input data, but instead any input data required in the calculations worksheet should be linked by a formula to the relevant input cell within the inputs worksheets. The calculations will then flow into the output worksheet; and
- output worksheet – this should not include any hard-coded input data or calculations, but rather should link to the relevant cells within the calculations worksheets.

The more complex models will usually contain numerous inputs and calculations worksheets. If this is the case, all the worksheets for each category should be grouped together within the spreadsheet. Typically, inputs worksheets will grouped together on the right of the tabbed worksheets, which then flow into the calculations worksheets in the middle, with the output worksheet on the left. In a well-designed spreadsheet with many worksheets, data will then flow through a model in one direction, from right to left across the tabbed worksheets.

Finally, each worksheet should be clearly labelled to explain its purpose. If a model has numerous worksheets, it can be helpful to also have a contents page as the first worksheet that sets out the title and purpose for each worksheet and the structure of the calculation.

Consistency

Spreadsheets should have consistent design features, for example:

- left–right consistency – each row should contain one formula copied across each row; and
- column consistency – the same time period should be in the same column on each worksheet.

Clarity

We all recognise that spreadsheets can be complex – but this does not mean they should lack clarity. In particular, calculations should not be more complex than necessary, as the more complex a calculation becomes, the more difficult and time consuming it is to understand the calculation and to verify that it is correct.

Best practice is therefore to use the shortest and simplest formula possible for each calculation, with complex multi-step formulas broken down into a series of steps on separate rows or columns.

Documentation

Documentation is key to understanding any model.

Within each worksheet, the basis of each figure should be clearly labelled. For example:

- inputs – references should be provided to the source document or an explanation setting out how the assumption was arrived at;
- links – cross-references should be provided between the different worksheets within the spreadsheet; and
- calculations – these should either be clear from the face of the spreadsheet (i.e., without looking at the formula, such as the total of the rows immediately above), or explained in a note within the spreadsheet.

For more complex models, a user guide to the model should be included that sets out:

- the structure of the model;
- the flow of information through the calculation (i.e., how the different worksheets within the model link to each other);
- whether any inputs are variable inputs and can be flexed (e.g., drop-down boxes that allow different interest rates to be selected for an interest rate calculation); and
- explanations of any complex formulas, macros[9] or non-standard program add-ins[10] contained within the model.

Quality control and testing

The model should contain quality control features such as adequate and explicit cross-checks, for example, a formula that checks that a balance sheet does balance, or a formula that flags where a calculated number that should always be positive is negative. In more complex models that contain a lot of error checks, it can be helpful to summarise all these checks in a single worksheet within the spreadsheet.

In addition, given spreadsheets are inherently prone to errors, it is best practice for all DCF models used in international arbitration to be verified by a team independent of the team that prepared them. This independent team should verify the model by confirming

9 Macros are a set of programming instructions that the model preparer writes using computing code (known as VBA code). Macros can be used in Excel to perform calculations.

10 Program add-ins can be installed into Excel in order to perform particular calculations. For example, the Monte Carlo add-in can be used to run multiple simulations of a calculation where an input is based on a random number.

that the inputs agree to the source documents and that the formulas within the model are correct (for example, are all the relevant years included within a formula calculating the total).

While some experts have company rules that require the verification of a firm work product (and some have specialised teams who focus only on verifying models), this is not the case for all experts.

The role of the experts and the tribunal

Having established best practice in terms of the model design, and quality control and testing of the model, we now examine the role of the experts and the tribunal in examining the model.

The respondent's expert

The respondent's expert clearly needs to be able to respond to the contents of the DCF model, with some key questions being:

- Do the assumptions make sense?
- Are the inputs properly sourced?
- Are the formulas (i.e., the arithmetic) correct?

It is difficult and may be virtually impossible to perform this work without a native copy of the model (i.e., one that includes all the formulas used). In the absence of the model, the respondent's expert is left trying to reconstruct the model to work out what the claimant's expert has done, something that is less than optimal and can entail substantial costs.

Assuming that a native copy is supplied (and on the basis that the model is well designed and follows best practice as set out above), the respondent's expert should then be in the position of being able to understand the matters noted above (i.e., understand if the assumptions make sense, trace the inputs back to source documentation, confirm or refute if the arithmetic and formulas are correct), and where necessary amend the model to allow for different commercial assumptions.

Having reviewed the claimant's model, the respondent's expert will then need to decide whether or not to produce its own model, or whether it can use the claimant's model and merely amend elements of the model as it feels is required (for example, amending assumptions or calculations). This decision will ultimately depend on whether the respondent's expert considers the claimant's model is overall 'fit for purpose', which will depend on a variety of considerations, including (but not limited to):

- Is the model well designed?
- Are the formulas correct, or if there are errors can these easily be rectified?
- Does it have sufficient flexibility to amend assumptions or inputs if multiple scenarios are required?
- If there are multiple elements to the claim (some of which there may be disagreement between the claimant and the respondent over whether they should be included in the claim as a matter of law), are these split out in the model or can the model be adjusted to exclude certain elements of the claim as required?
- Does it have an appropriate level of complexity?

If the respondent's expert considers it can use the claimant's model (with any required amendments), this can be helpful for the tribunal (compared to the situation where it is confronted by two wholly separate models), as the tribunal does not then have to decide which model to start with for the purposes of its award.

If the respondent's expert does use the claimant's model, it can be helpful to include a 'bridge' for the tribunal that shows how the damages figure as calculated by the claimant changes if the respondent's alternative input assumptions or calculations are used.

However, it could be the case that the claimant's expert's model is not fit for purpose, and the respondent's expert may have little choice but to construct their own model or say that the model, as presented, is just not supportive of any claim. For example, in cases where a model has large numbers of errors or suffers from major design faults, it may be virtually impossible to use it and the respondent's expert may want to produce its own model.

The experts together

One method to narrow differences on a model is by the experts meeting and coming up with areas of agreement and disagreement (if appropriate for the size of the case).

Areas of disagreement between experts in relation to the model can involve a variety of different issues. Some common areas of disagreement include:

- different instructions;
- legal issues;
- commercial assumptions;
- sources for the data;
- design of the model; and
- complexity of the model.

Even if the experts do not agree on a common model, it is still very helpful for the tribunal to understand where the disagreements between the experts lie with regard to the models. In addition, it is helpful if the experts can agree that each other's model is arithmetically accurate (given the inputs and assumptions contained within each model).

Overall, it is important that arbitrators question whether the models being used in the arbitration have been thoroughly verified by the expert on the other side, and whether both sides agree that the other side's model is arithmetically correct.

However, it is very difficult to assess a model when an expert refrains from providing its model, often on the grounds of a proprietary right. This situation raises serious issues about the ability of the other side's expert to assess and verify the model.

The tribunal

Working on the assumption that the claimant is entitled to an award of damages, our recommended approach for the tribunal to approach quantum is as follows:

- the tribunal decides which model to rely upon (if a common model is not being used by the two experts);
- the tribunal makes its determinations of the issues in dispute in relation to the model (for example, which discount rate should be applied, which growth rate of revenue should be used). In order to make its determinations, the tribunal may request that the experts run a number of variations through the model to understand the impact

of different assumptions on the overall loss (if the model is of sufficient flexibility to allow this);

- the experts (or the expert appointed to the tribunal if there is one) can then input the determinations into the model, with the resulting output equalling the amount of damages to be awarded.

Depending on the case, arbitrators should also consider whether they should get an independent model verification performed before relying on the model for their award.

In the absence of their own tribunal-appointed expert, unless the quantum calculations are very simple, tribunals should be wary of undertaking their own calculations of damages, as they will potentially suffer from three overall problems.

First, the damages calculated may be based on a methodology that is flawed because of complexities in the models that the tribunal has not fully taken account of.

Second, in coming up with something novel or hybrid, the tribunal may be adopting something that the parties will argue they have not been able to make adequate submissions on.

Finally, it amplifies the risk that the award itself may contain arithmetic errors, which can open up the opportunity of challenge or discontent with the whole arbitration process. For example, in one of our cases, the tribunal copied and pasted profit figures from one spreadsheet into another – but this did not take account of the tax or inflation impact.

Particular issues that arise in DCF models

In the remainder of this chapter, we look at key commercial issues that arise in DCF models in relation to the forecasted cash flows and the growth of those cash flows, and how this links to the investment rate, changes in working capital and the terminal value.

Forecasted cash flows

The overall problem one faces with forecasted cash flows is that they are, by their nature, forecasts, and therefore composed of inherently uncertain items.

Revenues are traditionally the most difficult item within the cash flow to forecast. Cost of sales are generally easier to forecast than revenues, and may in some cases even be based on revenues (e.g., where cost of sales is calculated as a set percentage of sales volume). Overheads are normally the easiest to forecast, particularly fixed overheads that do not change as production changes – for example, the rent paid on a factory is the same whether 1 unit or 500 units of product are made.

The overall commercial assumptions underpinning each element of the cash flow forecast (as set out above) needs to be looked at sceptically with a view to answering the following two questions: (1) What supports them? (2) Do they make sense?

In particular, the growth of the cash flows can often be a big area of debate between the parties.

Growth of the cash flows

One of the biggest areas of contention in a DCF valuation is likely to be the growth of the cash flows built into them, whereby the growth includes:

- the assumed year-on-year growth of the cash flows over the forecast period (which is driven by the growth in the individual components of the cash flow; i.e., sales revenues, costs, etc.); and
- the assumed stable growth rate applied in the terminal value (for those cases where a terminal value is required).

On a simplistic basis, the main causes of the growth of a company's cash flows include:

- an increase in the volume of goods or services produced and sold, through increasing its capacity by investment in assets or investment in labour (for example, a cake manufacturer could increase its production by hiring more labour or buying additional equipment);
- an increase in the volume of goods or services produced and sold, through increasing productivity (using the same example, the cake manufacturer could increase its production by increasing the productivity of its existing machinery or workforce);
- an increase in the price charged for the good or services sold (the cake manufacturer could charge its customers more for each cake); or
- an increase in efficiency such that the same level of production or sales can be achieved for a decreased cost (the cake manufacturer could reduce wastage of flour and butter such that raw material costs decrease).

When assessing the level of growth assumed within a DCF model, it is important to understand the causes of the growth and determine whether these are reasonable.

For example, while a company can cut its costs (either as a one-off or over a period of a few years) in order to grow its cash flows, a company cannot continually cut costs year on year forever, otherwise eventually costs would reduce to zero.

In practice, companies do not generally experience consistent growth rates year on year. While a consistent growth rate across the forecast period makes modelling easier, it may be unrealistic to achieve over a sustained period of time.

Whatever the level of growth that the expert assumes (whether that is no growth, negative growth, or small or large positive growth), the tribunal and the other side's expert should question whether the assumed level of growth is consistent with:

- the historical performance of the company;
- the growth of the market in which the company operates;
- the size of the company – the bigger the size of the company, the more difficult it becomes for a company to generate the same percentage growth it realised when it was smaller;
- the level of investment that is assumed in the model; and
- the level of working capital that is assumed in the model.

Overall, growth assumptions should always be looked at thoughtfully and the reasons for the growth fully understood.

Growth of the market

It is important to be aware that no company can grow at a rate above that of the market in which it operates for a sustained period of time. High-growth companies will always see growth fall off eventually, as the market is always looking for returns, and any industry or sector enjoying high or above average returns will see competitors entering the market, which in turn drives down growth.

Chasing more growth and more returns often means companies needing to enter new markets, which can then expose the company to increased competition and make it more complex. Increased competition and increased complexity of the company can both limit the growth that can be achieved by expanding into new markets.

Size of the company

In terms of size, the bigger the company, the more difficult it becomes for it to generate the same percentage growth it realised when it was smaller. For example, a small company that had been selling 100 units can grow by 10 per cent by selling an additional 10 units (10 per cent × 100 units), whereas a large company that had been selling 100,000 units will have to sell an additional 10,000 units to also grow by 10 per cent. Selling an additional 10 units is clearly much easier than selling an additional 10,000 units.

A potential cross-check can be to compare the growth of similar sized companies in the same market to the growth forecast in the DCF model.

Investment

As noted above, to support the growth of cash flows, a company can invest in assets (also known as capital). Examples could include a company:

- purchasing machinery in order to add a new production line;
- investing in a new IT system to improve efficiency and productivity; or
- purchasing new premises in order to sell in new regions.

It is important to assess whether the level of investment assumed in the DCF model is reasonable based on the assumed level of growth of the cash flows.

A key consideration will be to understand what is the cause of the growth in the cash flows. It logically follows that the more the growth in the cash flows is driven by making investments in capital (rather than through making investments in labour, increasing productivity, increasing the sales price or increasing efficiency), the higher the level of investment in capital that should be included in the DCF model.

Another consideration is the industry that the company operates in. All other things being equal, in order to achieve the same level of growth, a company operating in a capital-intensive industry[11] will need to invest in more capital than a company operating in a labour-intensive industry.[12]

11 Capital-intensive industries require high levels of capital in order to produce their goods or services. Examples include oil production, telecommunication and transportation (e.g., railways and airlines).

12 Labour-intensive industries require high levels of labour in order to produce their goods or services. Examples include hospitality and professional services (e.g., lawyers and accountants).

The other side's expert and the tribunal should also consider what the implied return on investment is, given the assumed level of investment and growth within the DCF model.

Say a company is forecasting a growth rate in cash flows of 20 per cent per year over a five-year period and that over this same five-year period the company is investing 10 per cent of those cash flows per year. This implies massive returns on the new capital invested, and could indicate that either the investment rate is understated or the growth rate is overstated, or a combination of both. Either an increase in the investment rate or a decrease in the growth rate would lead to a reduction in the forecast cash flows. Well-constructed models will include calculations of ratios, such as the return on investment, as part of the quality control and testing undertaken, which can be easily reviewed to identify any unexpected results arising from the combination of assumptions made.

It is worth bearing in mind that the level of investment used in a DCF model should allow not only for investment in new capital to improve growth, but also investment to maintain the company's existing capital base. The investment required to maintain the company's existing capital base will in part depend on the industry that the company operates in (i.e., whether it is a capital-intensive industry).

Working capital needs

Any assumptions about growth further require the following question to be asked and answered: what is the financial impact on working capital?

As noted above, working capital is the cash a company needs for day-to-day operations, as is calculated as current assets (such as stock, debtors) less current liabilities (such as creditors).

Most growth of a company requires greater amounts of working capital, which must therefore be factored into the forecast cash flows. It is therefore important to consider whether the level of working capital assumed in the forecast cash flows is consistent with the assumed level of growth of the cash flows.

As a general rule, if the value of sales are growing then the company's working capital needs will also grow. This is because if the value of sales increase, this will usually lead to an increase in debtors (money due from customers) and this causes the working capital requirement to increase. For example, if sales increase by 5 per cent, a reasonable assumption is usually that debtors also increase by 5 per cent, which (assuming no other changes) then increases the working capital requirement by 5 per cent.

If the DCF model forecast an increase in sales revenue but no increase in working capital, while there may be reasons that explain this, the other side's expert and the tribunal should understand these reasons and challenge whether they are reasonable.

Terminal value

All companies mature (unless they truncate). In valuation terms, this is referred to as having a stable or constant growth rate and is reflected by the calculation of the terminal value – essentially the value of the future cash flows on the day the company reaches maturity.

Growth rates in the terminal value is another area where modelling mistakes can be made. If a terminal value calculation assumes a 5 per cent stable growth rate, the expert is assuming that the company's cash flow will grow at 5 per cent per annum into perpetuity.

To assess at a high level if the stable growth rate used in the terminal value calculation is reasonable, there are two key points tribunals should consider.

First, stable growth rates for a company cannot be more than the long-term growth rate in the economy in which the company operates. The reason is simple – such an assumption would mean the company eventually grows larger than the economy in which it operates.

Second, the stable growth rate is in fact likely to be lower than the growth in the economy. An economy is made up of high-growth and stable-growth companies, with the growth rate of the economy an average of all of these individual companies' growth rates. This means that stable growth companies will have growth rates lower than the growth rate of the economy, and high-growth companies will have growth rates higher than the growth rate of the economy.

Conclusion

We believe that well-constructed DCF models that have undergone adequate review, and that are sufficiently explained and documented, are key to effective awards in arbitration where damages are likely to be complex, such as the expropriation of a company. They are also likely to lead to a more efficient arbitral process.

In addition, a properly constructed DCF is more likely to result in the key drivers of value and the commercial assumptions underlying them being properly analysed and challenged more effectively.

Conversely, poorly constructed models that have not been quality control tested lead to inefficiencies in arbitration with resources devoted to arguments over model design and corrections of errors.

As a fundamental point, it is very important that DCF models in arbitrations are well designed and properly reviewed if they are to be used by a tribunal. If they are not, then any figure they produce may be subject to doubt.

Appendix 1

About the Authors

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Gervase MacGregor is head of forensic services at BDO. He has a bachelor's degree in geology from the University of Liverpool and a master's degree from HEC in Paris.

He is a chartered accountant and a certified fraud examiner.

He joined BDO in 1982, qualified in 1986, was made a partner in BDO in 1991 and became head of the London-based litigation support and forensic accounting department in 1994.

His first forensic investigation, in 1985, was into a contested takeover by a client of his firm, Caparo Plc. His work into accounting irregularities gave rise to the *Caparo* case on auditors' liability. Since then, he has undertaken a great many investigations and acted as expert in disputes on a large number of occasions.

He has particular expertise in valuation and damages disputes, and share purchase agreement disputes in the natural resources sector.

He has given evidence in the High Court, in international arbitrations and before select committees of the UK Parliament.

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Andrew Maclay is a forensic accountant who has worked on many different types of investigations and disputes since 1996. He has an MA in economics from the University of Cambridge.

He is a chartered accountant, a certified fraud examiner and an accredited accountant expert witness.

He specialises in the quantification of damages in international arbitration, and has worked on disputes in many jurisdictions, particularly France and Switzerland, and in west and east Europe, Africa and the Middle East. Between 1991 and 1994, he worked in Burundi, Africa and is fluent in French.

He has given evidence in international arbitration tribunals, the High Court, a criminal court and by way of deposition in US proceedings.

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Michael is a Chartered Accountant with over 10 years of accountancy experience and has specialised in forensic accounting since 2011. Prior to joining BDO, Michael worked in the forensic accounting department at a Big Four accountancy firm. Before specialising in forensic accounting, Michael gained three years of audit experience within the oil and gas industry at a Big Four accountancy firm. His forensic accounting experience has included international arbitrations; contractual disputes; breach of warranty claims; loss of profit claims (including business interruption claims); fraud, bribery and corruption investigations; completion accounts disputes; and expert determinations.

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