Alexander Chepakovich

VALUATION OF STOCKS

The Quest for Intrinsic Value

1st edition, August 2016

X-FIN.COM

Contents

Introduction

Valuation is not an exact science. In fact, it is regarded by most valuation practitioners to be more art than science, because valuations can be done by different methods (with very different results), and even if only one method is used, the valuation result varies from one valuator to the other. Valuation of a company without reference to values of similar companies requires projections and assumptions about the company's future performance - all this is very tentative, as nobody really knows what will happen in the future. Real world does not allow for controlled experiments with real companies. There are just too many factors that could influence a business - most of them of inherently unpredictable nature (such as innovation, changes in social behavior and government regulation - just to name a few).

There is such a discipline as valuation, nonetheless. It introduces specific principles, that, if applied consistently to different companies, at least make possible determination of their relative values (whether one company is more valuable than the other and approximately by how much).

Even though the end results of the valuation process may be a number or a range, it should be treated with a certain degree of healthy skepticism: the valuation process vastly oversimplifies the real world and totally omits factors that cannot be estimated or forecasted. In a way, it is not that much different from trying to predict what future awaits a person. By the way, the younger the person or the company is, the higher the degree of uncertainty. For a newly-born it is an absolute mystery.

Nonetheless, it is better to have at least some crude measuring instrument than no instrument at all.

The concept of valuation

How much is a company worth?

The main question in investing is "If I buy something today, how much will I realize after selling it at some time in the future?" In other words, the investor wants to know what his expected return on investment adjusted for all kinds of risks will be. A rational human being would not invest without getting (or at least guessing) an answer to this question.

Clearly, the objective of estimating future gain can be split into two parts: 1) what is the expected (or promised) amount one will get and 2) what is the likelihood that the party that is obliged (as in the case of bonds, for example) to furnish the said amount in the future will, for whatever reason, renege on its obligation.

When investing in bonds and other fixed-income instruments, the process of valuation is rather straightforward, as the amount(s) of money the investor will receive and the date(s) when he will receive them are known. All what is needed to value a bond is to estimate the probability of default of the issuer, adjust future cash flows by that amount, and discount the risk-adjusted future cash flows to the present day using current interest rates (or - which in theory should amount to the same thing – use the nominal future cash flows but increase the discount factor in accordance with the level of risk of default).

For equities, however, the task is much more challenging, as stocks in general have indefinite life and the issuer is under no obligation to repurchase them at some point in the future at a predetermined price.

The company's stock price is reflective of the value of the company. Therefore, the recipe for a successful investment in stocks is to find companies whose market value will increase in the future. The task is daunting, as stock prices literally reflect everything and are set by the market forces. In a well-functioning market at any given moment the stock trades at the price at which the demand for the stock is equal to the supply, i.e. number of shares sought to be purchased at that price is equal to the number of shares sought to be sold.

Market forces aside, fundamentally, the company is worth its future cash flows that can be distributed to shareholders. This is the basic premise for equity valuation used by so-called 'value investors'. If an investor knows how much cash will be generated by a company or business, he can quite easily calculate the value of this company or business to him.

What is a company?

Generally, the main purpose of any for-profit business is to generate income for its owners. Of course, it would be nice if such income is generated ethically (not to mention legally) and the process of its generation (i.e. operations of the company) contributes to some noble course. In the latter case companies usually exploit this for marketing and position themselves almost as world saviors. When in fact, "saving the world" or, as it is more commonly put "making it a better place to live in" is just a byproduct of their main activity - generating money. There is nothing wrong with craving for money - for better or for worse, that's the foundation on which our modern capitalist society is built on.

We might have gone deeper into the discussion on merits and drawbacks of different society arrangements, but this is a subject for a different discussion and, probably, a different audience. So, let's stick to analyzing how businesses make money and how we as investors can profit from this.

Before we delve into the nitty-gritty of specific company analysis, let's conceptualize what we are dealing with here.

Categorization of production inputs

To generate revenue, the company needs to sell a product or service. But before it can be sold, the object of sale needs to be produced. Production and sale (and all related processes) require all kinds of resources (or production inputs), that could be categorized as follows:

- Material assets:
  - capital assets (property, plant and equipment)
  - materials and parts (inventory)
- Utilities (electricity, water, etc.)
- Intellectual assets - procedures, know-how, patents, etc
- Manpower (or labor)
- Financial resources:
  - to realize long-term capital intensive investment projects

- to provide working capital (to cover cash deficiency periods during the production cycle - until the receipt of funds for products/services sold)

Luckily for us, all of the above resources could be represented in monetary form, i.e. by amount of money needed to acquire and maintain them. So, in our analysis we will be dealing not with physical quantities and non-material substances, but rather with their monetary equivalents. This conversion of everything into their money equivalents is justified by our objective: we want to determine the monetary equivalent of the company itself, i.e. find out what amount of hard cash in hand is equivalent to owning the company. This process is called valuation.

Determinants of value

Revenue and revenue growth

It all starts with the "top line" - the first line of the income statement, which shows revenue or, as it is more commonly known, sales. In reality, though, the first line does not always shows all revenue, or the revenue we need for investment valuation purposes. Sometimes it shows "gross revenue", of which the actual revenue to the company could be just a small portion. Often the revenue part of the income statement consists of two or more lines, showing a split of revenue by category. At the end, we are usually interested in total revenue, which is always present on the income statement, though not necessarily at the top line.

The revenue number is not of that much interest to us on its own: what we are after is the pair "revenue - revenue growth". These are, by far, the most important input factors in any valuation model based on forecasting future cash flows. Therefore, an extreme care should be taken in selecting and adjusting (if needed) both the revenue and revenue growth numbers to be used in the company valuation.

Sometimes the company management goes to great lengths to embellish the company's condition and to hide any unfavorable developments. Normally, this is done within the framework of generally accepted accounting principles (GAAP) or other accounting methodology permitted by law in the country of the company's residence, but shear legality of this does not make it acceptable for the purposes of valuation.

There are two major caveats that an analyst should take into account when selecting or calculating the magnitude of the revenue he should use in valuation.

First, we are primarily interested in organic revenue growth. The analyst should determine how much of the company's stated revenue growth rate came from organic growth and how much of it resulted from acquisitions. Quite often, especially in cases when investing community pays large premiums for growth, achieving and maintaining such growth becomes an overriding obsession of the company management - as they know only too well that if the growth expectations fail to materialize, the stock price of such company will crash - literally crash, not just correct.

The easiest way to achieve high growth is through acquisition of other companies - very often at inflated prices. When this happens, the analyst should value the company on the pre-acquisition basis and make separate valuations of each of the acquired companies. This is much easier said than done as the analyst has to take a set of consolidated financial statements of the company and make from it at least two sets (one for the acquirer and one for each of the acquisition targets) - as if the acquisition did not happen.

Second, we need to make sure that the revenue numbers were not artificially inflated or deflated (though the latter case is not a common practice, theoretically, it is also possible). The two most common examples of inflation are:

- putting gross sales in revenue (e.g. when the company acts as an intermediary or broker in a sales transaction and books the nominal value of the transaction as its revenue – instead of booking only its commission), and
- recognizing revenue prior to actual completion of the sale transaction in its economic sense (delivery of product or service against payment); this results in accelerated buildup of accounts payable and accounts receivable on the company's balance sheet, which means that the product or service has not been quite delivered yet.

There are many more potential reasons for adjustment of the revenue and revenue growth rate the analysts should be aware of. They are not always apparent even for a trained eye and quite often require a detailed study of the complete set of financial statements and accompanying notes to them. At the end, the true picture should be discernible from the company's official reporting - unless it is fraudulent, of course.

Variable costs

Total operating costs could be split into variable and fixed costs. By definition, variable costs depend on the production volume and constitute more or less fixed proportion of the revenue. These are supplies, labor and utilities needed for production of product or performance of service. Fixed costs are non-volume related.

The variable-fixed costs split looks quite obvious in theory, but it is not that straightforward in practice. Let's take a closer look at variable costs (we will be dealing with fixed costs in the next chapter).

First, there is always a lag between a change in production volume and a corresponding change in variable costs. And such a lag is different for different components of variable costs. It takes time to adapt production facilities, supply chain and labor for a given production volume.

Take materials and parts, for example. Yes, you cannot use more or less of them for a particular production item, but as the level of productions declines or accelerates, the volume of inventories of materials and parts changes accordingly, even if only for a short period of time - before the company adjusts the rate of their supply to the rate of consumption. A change in inventories means change in the costs of keeping these inventories. An even bigger change in costs could be caused by changes in the price of materials and parts - they are usually quite sensitive to changes in supply and demand and the company is affecting the demand side of the balance.

The most inflexible part of the variable costs, not surprisingly, is labor. It is not that easy and fast to fire workers or to hire and train them. And any change in the number of the workforce has its "unit cost" implications, I.e. it affects the amount of variable costs needed for production of one unit of product, thus increasing the risk of under- or overestimating them in our projections.

Second, as already mentioned above, variable costs are more variable than what is implied by their definition: their proportion in total unit costs changes with any significant change in the production volume. It is the role of a good analyst to estimate how variable unit costs will change in the future - and forecasting future commodity prices is only part of the puzzle. For example, in a stable macroeconomic environment what will happen to unit variable costs if production doubles? The task of determining this is almost insurmountable to an outsider.

With all this in mind, the best alternative might be, surprisingly, an easy "way out" solution to assume that future variable costs will be the same (or increase at the rate of inflation) for a unit of production as they are now. This assumption, if applied universally to all companies we are valuing, at least will cause a similar error for each one of them and will not affect much relative valuation of the companies, which, at the end, in many cases is more important than "absolute" valuation of a company. By the way, there is nothing absolute in this world - everything is measured in relation to something else.

Fixed costs

Fixed costs, by definition, are costs that do not depend on the level of production. However, just like in the case of variable costs, this is not that simple. Yes, a company may pay year over year about the same for its corporate headquarters and its staff, but if production (and revenue) grows fast, such outlays tend to become larger.

So, in effect, fixed costs are not that fixed after all. What is important to know is that they are not as adaptable to the level of production as variable costs are, and that if they change substantially, they tend to change in a step-up (or step-down) manner, i.e. not gradually. Their change, though affected by changes in the production volume, which tend to change gradually (together with demand), is really set by a corporate decision, and as such is not that predictable.

You, our reader, might be puzzled by now: why are we talking about variable and fixed costs if the company itself might not keep track of them and they are definitely not shown as such on any company income statement? Well, if we want to make a reasonably good prediction about the company's future cash flows (and this is usually the objective for financial statements analysis done with the purpose of business or investment valuation), we'd better know how total costs change with a change in revenue. If we can split, even approximately, total operating costs into variable and fixed costs, our prediction capability increases dramatically. This also helps in understanding the business and key factors affecting its profitability.

Though splitting of total operating costs into variable and fixed costs is a mandatory feature of any microeconomic textbook, its not a common practice at all in financial analysis, as the splitting of expenses into variable and fixed is not that straightforward.

Well, as it was already said, investment valuation is more of an art than science. Everybody practices it in a slightly (or sometimes totally) different way. Our approach is decidedly different from others, though. And one of its distinguishing features is a separate forecasting of fixed and variable expenses.

So, how do we go about splitting total operating expenses into fixed and variable? For this we analyze how total expenses changed in relation to revenue in the past and use a simple formula to calculate the split. The formula and the process how it was derived is described in the chapter “Chepakovich valuation model” below.

Our cost splitting methodology relies on regular financial statements produced by the company and, therefore, does not always yields a meaningful result (financial statements just do not explicitly contain the information we are after). Nonetheless, just like in many other areas, having an instrument that works at least half of the time is better than having no instrument at all.

Once you are finished with forecasting revenue and expenses, half of the work of building a cash flow model is done. The rest is a lot easier and straightforward, and, we might add, more rigorous.

Production assets

As mentioned earlier (see the chapter "The concept of valuation"), to conduct business (manufacture a product or provide a service), the company, among other things, uses material assets (or capital assets), which are denoted on the balance sheet as "Property, plant and equipment". In our analysis we determine which capital assets are actually used in production and call them "production assets" or "production base".

For the purposes of valuation, we calculate average monetary value of production assets historically needed for generation of a unit of revenue. This number is used to calculate the amount of capital expenditure (CAPEX) needed to support increased revenue - that is if we forecast it to increase. We call this expenditure "new CAPEX".

At the same time, we need to calculate the amount of capital expenditure needed to maintain the existing production assets that support the current level of production - we call it "maintenance and replacement CAPEX". This expenditure is best estimated (though not always accurately) by the current amount of amortization, depreciation and depletion - another line from the company's financials (this time the cash flow statement).

There is a constraint, however, on how much a company could spend on CAPEX. This constraint is of a financial nature: the CAPEX should not exceed the sum of the amount of cash generated by the company's operations and the maximum amount of debt increase and equity issuance (sale of shares to investors) the company can afford in any given year without jeopardizing its financial standing.

There are a number of financial ratios closely monitored by the company itself and its lenders that are used to gage the company's financial health. In combination with historical data for other companies in a particular industry, these ratios are also used is estimating a probability of the company defaulting on its obligations to pay its debt. Usually a company operates within very well defined ranges for key financial ratios which limit its ability to borrow.

Returning back to our valuation model: if the company hits the "ceiling" we set for it on how much outside new financing it could safely obtain, we limit the revenue growth by the number that can be supported by production assets corresponding to the maximum amount of CAPEX (both new and maintenance/replacement) the company can afford.

Chepakovich valuation model

Unlike other models, the Chepakovich valuation model has almost universal applicability. For intrinsic value estimations it does not require the company to pay dividends or even have positive net income. Nor does it need detailed projections of future cash flows. All is needed is financial statements for the last several years and an estimation of future revenue growth rates. The model employs an original method for splitting total expenses into fixed and variable expenses from the income statement data. This, combined with projected revenue growth rates, makes possible forecasting of the company's future profitability. The model also has a number of other unique features not present in other valuation models: variable period-dependent discount rates; a direct link between the magnitude of revenues and that of production assets needed to sustain a given level of revenues; optimal and maximum levels of financial leverage that allow for an extraordinary divided to be paid out in case of underleverage or limit the revenue growth rate in case of overleverage; estimation of future actual stock-based compensation expenses (as opposed to the accounting ones) and subtraction of them from projected cash flows; assumption of a gradual decay in future revenue growth rates to a predetermined level (it is argued that this level should be equal to the GDP). The Chepakovich valuation model makes possible semi-automation of the valuation process and could be used for screening of large number of companies. All that is required as company-specific input is historical financial statements and stock prices.

Other valuation models

Basically, there are two fundamental valuation models used by investment professionals today: the dividend discount (DD) model and the discounted cash flow (DCF) model. For the first model, one has to estimate or assume future annual dividends, for the second model - future cash flows (either to firm or to equity). In a limiting case, when dividends are equal to cash flow to equity, these modes yield the same results. But generally, valuation outcomes of the DD model and the DCF model are vastly different, though in theory they not necessarily have to be.

There is an implied assumption in the DCF model that the free after-interest cash flow (called here ‘net cash flow’) generated by a company is either distributed to shareholders or reinvested into the business (for organic growth expansion or acquisitions) at the rate of return (on the net cash basis) equal to the discount rate. The DD model implies that cash reinvested into the business produces higher dividends in the future (though the dividend growth rate should not exceed or be close to the discount rate - otherwise the model just does not give a meaningful result).

No doubt, the DCF model is greatly superior to the DD model, and not just because of the limitation on the dividend growth rate, but primarily because of the usually observed disconnect between the net cash flow generated by a company and the magnitude of the dividend.

The main weakness of the DCF model is subjectivity in forecasting future cash flows. Usually, future annual net cash flows are calculated in such a way that they are set to be a fixed proportion of the revenue. This is alright for a well-established firm in a mature industry, but is hardly applicable for a start-up or a fast-growing company, especially if it currently shows negative cash flow (i.e. if the company uses cash instead of generating it). Currently, there are no models that make fundamental valuation of such companies possible. For lack of a better tool, comparative valuation is widely used in such cases. However, because of the non-fundamental (i.e. not relying on intrinsic value characteristics of the company) nature of the comparative valuation, wild market excesses are possible. In fact, comparative valuation lies at the heart of every bubble.

The Chepakovich valuation model described below was developed to address these limitations of other models and to provide valuation practitioners with a universal and simple in application tool. Just like the DCF model is a step forward compared to the DD model, as it makes possible valuation of companies that pay little or no divided at all, the Chepakovich valuation model, which a variation of the DCF model, is a step forward compared to the DCF model currently used, as it makes possible fundamental valuation of loss-making and fast growing companies.

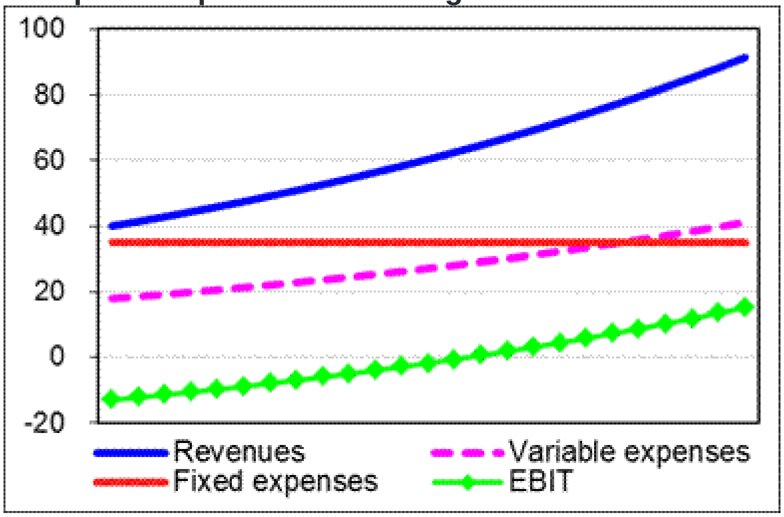
Chepakovich valuation model

The Chepakovich Valuation Model uses the discounted cash flow valuation approach. It was first developed by Alexander Chepakovich in 2000 and perfected in subsequent years. The model was originally designed for valuation of 'growth stocks' (common shares of companies experiencing high revenue growth rates) and has been successfully applied to valuation of high-tech companies, even those that do not generate profit yet. At the same time, it is a general valuation model and can also be applied to no-growth or negative-growth companies. In a limiting case, when there is no growth in revenues, the model yields similar (but not the same) valuation result as a regular discounted cash flow to equity model.

The key distinguishing feature of the Chepakovich Valuation Model is separate forecasting of fixed (or quasi-fixed) and variable expenses for the valuated company. Though intuitively obvious, this approach so far has not been used in valuation models, apparently, due to the custom to use the same line items as in financial statements where variable and fixed expenses are not separated. The model presented here assumes that fixed expenses will only change at the rate of inflation or other predetermined rate of escalation, while variable expenses are set to be a fixed percentage of revenues (subject to efficiency improvement/degradation in the future – when this can be foreseen).

This feature makes possible valuation of start-ups and other high-growth companies on a fundamental basis, i.e. with determination of their intrinsic values. Such companies initially have high fixed costs (relative to revenues) and small or negative net income (as shown in Figure 1, for example). However, high rate of revenue growth insures that gross profit (defined here as revenues minus variable expenses) will grow rapidly in proportion to fixed expenses. This process will eventually lead the company to predictable and measurable profitability in the future: note how earnings before interest and taxes (EBIT) steadily increase in Figure 1 and at one point cross into the positive territory.

Figure 1. Example of separate forecasting of fixed and variable expenses.



Unlike other methods of valuation of loss-making companies, which rely primarily on use of comparable valuation ratios, and, therefore, provide only relative valuation, the Chepakovich Valuation Model estimates intrinsic (i.e. fundamental) value.

The calculation algorithm of splitting historical expenses as they reported in the income statement into fixed and variable expenses is an integral part of the Chepakovich Valuation Model. It is based on the reasoning outlined below.

First, let's write an equation for expenses growth rate:

$$g_{exp} = \frac{e_2}{e_1} - 1 \qquad (1)$$

where e_1 and e_2 are total expenses in two consecutive periods (Year 1 and Year 2, respectively).

Taking into account that total expenses could be split into fixed and variable, and assuming that fixed expenses do not change from year to year while variable expenses change at the rate of revenue growth, Equation (1) could be rewritten as follows:

$$g_{exp} = \frac{e_f + e_{1v}(1 + g_{rev})}{e_f + e_{1v}} - 1 \qquad (2)$$

where e_f and e_{1v} are, respectively, fixed and variable expenses in Year 1 and $g_{rev}$is revenue growth rate.

Equation (2) can be rewritten in the following way:

$$g_{exp} = \frac{e_{1v} * g_{rev}}{e_f + e_{1v}} \qquad (3)$$

Equation (3) can be rearranged:

$$\frac{e_{1v}}{e} = \frac{g_{exp}}{g_{rev}} \qquad (4)$$

where e is the total expenses (a sum of variable and fixed expenses) in Year 1.

From Equation (4) follows, that the ratio of variable expenses to total expenses, or the variable cost factor k_v, as it is denoted below, is equal to the ratio of expenses growth rate to revenue growth rate:

$$k_v = \frac{g_{exp}}{g_{rev}} \qquad (5)$$

both of which are quite easy to calculate using historical financial statements (revenues and expenses should be adjusted first for effects of acquisitions and divestments).

Other distinguishing and original features of the Chepakovich Valuation Model are:

- Variable discount rate (depends on time in the future from which cash flow is discounted to the present) to reflect investor's required rate of return (it is constant for a particular investor) and risk of investment (it is a function of time and riskiness of investment). The base for setting the discount rate is the so-called risk-free rate, i.e. the yield on a corresponding zero-coupon Treasury bond. The riskiness of investment is quantified through use of a risk-rating algorithm, which takes as inputs company-specific (‘funds from operations-to-debt’ and ‘net debt-to-capital’ ratios), which after incorporation of general macroeconomic (inflation, risk-free interest rate and equity risk premium) parameters transforms into the base discount rate (BDR). The BDR set for cash to be received in one year from now. To account for higher risk associated with further-in-future cash flows, a multiplier is applied in each consecutive year to the discount rate.

- Company's investments in means of production, or production assets as they are also referred to at this site (it is the sum of tangible and intangible assets needed for a company to produce a certain amount of output) is set to be a function of the revenue growth (there should be enough production capacity to provide increase in production/revenue). Surprisingly many discounted cash flow (DCF) models used today do not account for additional production capacity need when revenues grow.
- Long-term convergence of company's revenue growth rate to that of GDP. This follows from the fact that combined revenue growth rate of all companies in an economy is equal to the GDP growth rate and from an assumption that over- or underperformance (compared to the GDP) by individual companies will be eliminated in the long run (which is usually the case for the vast majority of companies - so vast, indeed, that the incompliant others could be treated as a statistical error). Valuation is conducted on the premise that change in the company's revenue is attributable only to the company's organic growth rate. This means that historical revenue growth rates are adjusted for effects of acquisitions/divestitures.
- Actual cost of stock-based compensation of company's employees that does not show in the company's income statement is subtracted from the cash flow. It is determined as the difference between the amount the company could have received by selling the shares at market prices and the amount it received from selling the shares to employees (the actual process of stock-based compensation could be much more complicated than the one described here, but its economic consequences are still the same). The actual cost of stock-based compensation (ACSBC) is calculated in the model as follows:

  $$ACSBC = (N_2 - N_1)\, p_{avg} - ICF \qquad (6)$$

  where N_1 and N_2 are the number of shares outstanding at consecutive reporting dates 1 and 2, respectively, p_{avg} is the average price of the company's stock during the period between the two reporting dates, and ICF is the net cash flow from issuance of shares as reported in the company's cash flow statement. This method provides an approximation of the ACSBC. The exact number could be calculated from data provided in the statement of shareholders' equity and notes to financial statements.
- It is assumed that, subject to availability of the necessary free cash flow, the company's capital structure (debt-to-equity ratio) will converge to optimal. This would also have an effect on the risk rating of the company and the discount rate. The optimal capital structure is defined as the one at which the sum of the cost of debt (company's interest payments) and its cost of equity (yield on an alternative investment with the same risk - it is a function of the company's financial leverage) after an adjustment for risk caused

by business cycles is at its minimum. If the company is underleveraged, the model assumes that it will raise debt and payout an extraordinary dividend if this extra cash could not be efficiently deployed (i.e. if it will exceed what is required to achieve organic revenue growth rate targets). If, on the other hand, the company is overleveraged, then revenue growth is curtailed to reduce the level of debt.

Application of the model

To calculate intrinsic value of a company's common stock, the Chepakovich valuation model needs only a limited number of input parameters (see the full list below). Most of them are derived directly from the company's financial statements, some are reflective of the current macroeconomic/market situation and are used for determining an appropriate initial discount rate, while the rest, though labeled below as industry-specific, allow for a certain degree of subjectivity.

Model's input parameters

Company-specific:

- Revenue
- Initial revenue growth rate
- Gross margin (excluding depreciation)
- Fixed operating expenses
- Interest rate on debt
- Corporate tax rate
- Cost of stock options / Revenue
- Dividend payout ratio
- Revenue / Production assets
- Revenue / Working capital
- Cash & short-term investments
- Goodwill
- Gross debt
- Trade receivables
- Equity
- Funds from operations
- Number of shares outstanding

Macroeconomic/market data:

- Risk-free rate
- Inflation rate
- Equity risk premium
- Terminal revenue growth rate(or GDP)

Industry-specific:

- Maximum debt-to-equity ratio

- Optimal debt-to-equity ratio
- Service life of production assets
- Revenue decline factor
- Discount rate multiplier

An online version of the Chepakovich Valuation Model is used on X-FIN.com website for common stock valuation. Its unique valuation method provides a solid foundation for estimating intrinsic value of stocks.

Valuation algorithm

The valuation theory in essence is very simple: you just need to estimate future cash flows and then discount these cash flows to the present day by applying an appropriate (i.e. commensurable with the level of risk) discount rate. The theory was mostly developed when computers were either non-existent or were not readily available for investors. This necessitated development of simple valuation techniques that could be performed using a hand-held calculator. However, simplified techniques require very simplified assumptions that could significantly differ from real life circumstances.

Our valuation model, which is associated with the name of its creator - the Chepakovich valuation model, is built with the possibilities presented by a computer in mind. No doubt, it is much more complicated, but, at the same time, it allows for better modeling of actual company performance.

The model not just builds on the basic concepts of the classic valuation theory, but also introduces new features that make modeling so much more realistic, such as separate forecasting of fixed and variable expenses and variable-by-year discount factor - just to mention the two most prominent features. Unlike previous models, that basically consist of one formula, the Chepakovich valuation model is a calculation algorithm, which we describe here.

Determination of model input parameters

The starting point of the company valuation in our model is forecasting future yearly revenues. It is based on the total revenue of the last year for which financial data is available.

Another parameter that is absolutely crucial for valuation and the one that is especially difficult to forecast is the revenue growth rate. When you are not very familiar with the company or do not have an opinion about its growth prospects, we suggest to use the year-over-year quarterly revenue change for the last quarter reported as the revenue growth rate for the first forecasted period. Unlike the annual revenue data, that changes, by definition, only once a year, it allows for faster (four times per year) factoring in of actual company’s performance.

The revenue growth rate that we’ve just described is only used for the first forecasted period. For each of the all subsequent years, in general, the revenue growth rate should be set individually. This, however, in most of the cases is insurmountable task. For simplicity, we can assume that on average the revenue growth rate for all companies in the long run will approach the long-term revenue growth rate for the national economy (i.e. the GDP).

Thus, we assume that the terminal revenue growth rate is equal to the long-term GDP growth rate. Further, the forecasting is made a lot easier if we just specify that for each year the revenue growth rate will be equal to the previous year's revenue growth rate multiplied by a revenue decline factor, that makes the forecasted year's revenue growth rate to be equal to a fixed fraction of the difference between last year's revenue growth rate and the terminal revenue growth rate.

Data requirements and sources

Data parameter	Abbreviation
balance sheet	
Cash and short term investments	CASH
Total receivables (net)	RECVBLS
Total inventory	INVENTORY
Prepaid expenses	PREPAID
Total current assets	CURASSETS
Property, plant, equipment (gross)	PPE
Accumulated depreciation	ACCDEPR
Goodwill (net)	GOODWILL
Intangibles (net)	INTANGBLS
Long term investments	LTINVEST
Total assets	TTLASSETS
Notes payable & short term debt	STDEBT
Current port. of LT debt & capital leases	CURLTDEBT
Total current liabilities	TTLLIABIL
Total debt	TTLDEBT
Total equity	EQUITY
Number of shares outstanding	SHARES
income statement	
Total revenue	REVENUE
Total operating expenses	OPEXP
cash flow statement	
Depreciation & depletion	DEPREC
Amortization	AMORTIZ
Changes in working capital	WCCHG
Cash from operating activities	OPCF

Cash interest paid	INTPAID
other sources	
Inflation	INFLATION
user-defined parameters	
Terminal revenue growth rate	TERMREVGR
Revenue decline factor	REVDECL
Service life of production assets	SLIFE
Years goodwill amortizes	GWAMORT
Corporate tax rate	TAXRATE
Cash flow adjustment to revenue	CFADJREV
Initial discount rate	DR
Discount rate multiplier	DRMULT
Proportional claim of current shareholders on cash flows	PORTION
Adjusted equity ratio	EQRATIO

Calculated input parameters

Input parameter	Abbreviation	Calculation formula
Net debt	NETDEBT	TTLDEBT - CASH
Funds from operations	FFO	OPCF - WCCHG
Capital	CAPITAL	TTLDEBT + EQUITY
Revenue growth rate	REVGR	REVENUE / REVENUEprev - 1
Total expenses growth rate	EXPGR	OPEXP / OPEXPprev - 1
Adjusted total assets	ADJASSETS	TTLASSETS - CASH
Adjusted total liabilities	ADJLIABIL	ADJASSETS - EQUITY
Production assets	PRASSETS	PPE - ACCDEPR + INTANGBLS
Average production assets	AVGPRASS	(PRASSETSprev + PRASSETS) / 2
Non-financial working capital	NFWC	(CURASSETS - CASH) - (TTLLIABIL - STDEBT - CURLTDEBT)
Interest rate on debt	INTRATE	INTPAID / (0.5 x (TTLDEBTprev + TTLDEBT))
Variable cost factor (variable/total expenses)	VARCOSTF	EXPGR / REVGR

Production assets + Goodwill	PRASSGW	PRASSETS + GOODWILL
Production assets to revenue	PRASSREV	AVGPRASS / REVENUE
Working capital to revenue	WCREV	NFWC / REVENUE
Fixed expenses	FIXEDEXP	OPEXPprev x (1 - VARCOSTF) x (1 + INFLATION)
Average depreciation life of production assets, years	DLIFE	0.5 X (PRASSGWprev + PRASSGW) / (DEPREC + AMORTIZ)
Tangible net worth	TNETWORTH	EQUITY – GOODWILL - INTANGBLS

“prev” – indicates that the value of the parameter is for the previous year.

Calculation loop (year-by-year forecasting)

Though we do not set any assumptions on how long the company we are valuating will be in existence, and, therefore, imply that its operations will continue forever, the calculation loop cannot be indefinite. Thus, merely for practicality considerations, we put some reasonable time horizon (say, 50 years) for our forecast.

The time horizon is also the number of times we go through the calculation algorithms that forecasts key financial data, with each passage through the loop corresponding to a separate year in the future.

Below is a brief description of each step of the calculation and the appropriate formulae.

1. **Revenue growth rate**
   The calculation loop starts with forecasting revenue growth rate for a particular year. For the first forecasted year, it is set to be equal to its input value. For all subsequent years it is calculated using the following formula:
   Revenue growth rate = Terminal revenue growth rate +(Revenue growth rate at previous year -Terminal revenue growth rate) x Revenue decline factor
   REVGR = TERMREVGR + (REVGRprev - TERMREVGR) x REVDECL
2. **Revenue**
   Revenue = Previous year revenue x (1+ Revenue growth rate)
   REVENUE = REVENUEprev x (1 + REVGR)
3. **Variable costs**
   Variable costs = Revenue x Variable cost factor+ Goodwill / Years goodwill amortizes
   Note: the second addend exists only in years when Goodwill is greater than zero (i.e. when it is not fully amortized).
   VARCOSTS = REVENUE x VARCOSTF + GOODWILL / GWAMORT
4. **Production assets or base (average for the year)**
   Production assets = Revenue x Production assets to revenue
   PRASSETS= REVENUE x PRASSREV
5. **New CAPEX**
   Here we calculate the amount of capital expenditures needed to expand the production base to the level commeasurable with the current level of revenue. We assume that all new capital expenditures are made at the very beginning of the year and, therefore, the benefits of this new CAPEX also fully accrue in the current year. Definitely, this is an oversimplification, but the one that greatly reduces complexity of the model.

New CAPEX = Production assets - Previous year production assets
NEWCAPEX = PRASSETS - PRASSETSprev

6. **Maintenance CAPEX**
   Maintenance CAPEX, as it is used here, is different from maintenance expenses. Rather, in accounting terms it could be described as the current-year depreciation expense (estimated here on the straight line basis) on the previous-year production assets. We consciously used the word 'maintenance' to describe these capital expenditures, as, in essence, this is the CAPEX that is needed to keep existing production assets at their current production capacity.
   Maintenance CAPEX = Previous year production assets / Depreciationlife of production assets
   MAINTCAPEX = PRASSETSprev / DLIFE
7. **Depreciation expense of new CAPEX**
   As mentioned above, we assume that all new capital expenditures are made at the very beginning of the current year. Therefore, we must also account for depreciation of the new CAPEX already in the current year. Depreciation is calculated on the straight line basis.
   Depreciation expense on new CAPEX = New CAPEX / Depreciation life of production assets
   DEPRNEWC = NEWCAPEX / DLIFE
8. **Total depreciation**
   Total depreciation = Depreciation expense on new CAPEX + Maintenance CAPEX + Goodwill / Years goodwill amortizes
   Note: the third addend exists only in years when Goodwill is greater than zero (i.e. when it is not fully amortized).
   DEPREC = DEPRNEWC + MAINTCAPEX + GOODWILL / GWAMORT
9. **Fixed operating expenses**
   Fixed operating expenses = Previous year fixed operating expenses x (1+Inflation rate)
   FIXCOSTS = FIXCOSTSprev x (1 + INFLATION)
10. **EBIT(Operating Income)**
    EBIT = Revenue - Variable costs - Fixed operating expenses
    EBIT = REVENUE - VARCOSTS - FIXCOSTS
11. **EBITDA**
    EBITDA = EBIT + Total depreciation
    EBITDA = EBIT + DEPREC
12. **Interest expense (on net debt)**
    Interest expense = Previous year total net debt x Interest rate on debt
    INTCOSTS = NETDEBTprev x INTRATE
13. **Earnings before tax**
    Earnings before tax = EBIT - Interest expense
    EBT = EBIT - INTCOSTS
14. **Tax expense**
    Tax expense = Earnings before tax x Corporate tax rate
    Note: only if Earnings before tax are positive
    TAXES = EBT x TAXRATE
15. **Net income**
    Net income = Earnings before tax - Tax expense
    NETINCOME = EBT - TAXES

16. **Funds from operations (FFO)**
    Funds from operations = Net income + Total depreciation
    FFO = NETINCOME + DEPREC
17. **Working capital**
    Working capital = Revenue x Working capital to revenue
    WC = REVENUE x WCREV
18. **Change in working capital**
    Change in working capital = Working capital - Previous year working capital
    WCCHG = NFWC - NFWCprev
19. **Cash from operations (CFO)**
    Cash from operations = Funds from operations - Change in working capital
    CFO = FFO - WCCHG
20. **Free cash flow (FCF)**
    Free cash flow = Cash from operations - New CAPEX - Maintenance CAPEX
    FCF = CFO - NEWCAPEX - MAINTCAPEX
21. **Adjusted total assets**
    Adjusted total assets = Revenue /Production assets to revenue
    ADJASSETS = REVENUE / PRASSREV
22. **Equity**
    Equity = Adjusted assets * Adjusted equity ratio
    EQUITY = ADJASSETS * EQRATIO
23. **Change in equity**
    Change in equity = Equity - Previousyear equity
    EQUITYCHG = EQUITY - EQUITYprev
24. **Adjusted total liabilities**
    Adjusted total liabilities = Adjusted total assets -Equity
    ADJLIABIL = ADJASSETS - EQUITY
25. **Change in liabilities**
    Change in liabilities = Adjusted total liabilities - Previous year adjusted total liabilities
    LIABILCHG = ADJLIABIL - ADJLIABILprev
26. **Issuance of new debt**
    Issuance of new debt = Change in liabilities
    NEWDEBT = LIABILCHG
27. **Total cash flow**
    Total cash flow = Free cash flow + Issuance of new debt
    TOTALCF = FCF + NEWDEBT
28. **Cash flow adjustment** (for real cost of stock options, for example)
    This is the entry for any cash flow adjustments, such as for the real cost of stock option compensation plan used by the company, for example.
    Cash flow adjustment = Revenue x Cash flow adjustment to revenue
    CFADJ = REVENUE x CFADJREV
29. **Adjusted total cash flow**
    Adjusted total cash flow = Total cash flow + Cash flow adjustment
    ADJTOTALCF = TOTALCF + CFADJ
30. **Cash for distribution 1**
    Before cash could be distributed to shareholders, it is used, if needed, for equity increase - see the change in equity calculation above. Conversely, if the change in equity is negative, such change could be distributed to shareholders, too.

Cash for distribution 1 = Adjusted total cash flow - Change in equity
CFD1 = ADJTOTALCF - EQUITYCHG

31. **Issuance of new equity**
    If Cash for distribution 1 calculated above is negative, then the company needs to issue new equity (i.e. sell its shares to shareholders).
    If CFD1 is negative:
    Issuance of new equity= -CFD1
    NEWEQUITY = -CFD1
    If CFD1 is non-negative:
    Issuance of new equity = 0
    NEWEQUITY = 0
32. **Cash for distribution 2**
    Cash for distribution 2 = Cash for distribution 1 - Issuance of new equity
    CFD2 = CFD1 - NEWEQUITY
33. **Proportional claim of current shareholders on cash flows**
    If new equity is issued (i.e. if new shares are sold by the company to investors), the stake of the current shareholders on the company's assets and cash flows is diluted (assuming that they do not purchase newly-issued shares).
    Proportional claim of current shareholders on cash flows = Previous year proportional claim of current shareholders on cash flows x (Equity - Issuance of new equity) / Equity
    PORTION = PORTIONprev x (EQUITY - NEWEQUITY) / EQUITY
34. **Cash for distribution 3**
    Cash for distribution 3= Cash for distribution 2 x Proportional claim of current shareholders on cash flows
    CFD3 = CFD2 x PORTION
35. **Present value (PV) of cash for distribution**
    PV of cash for distribution = Cash for distribution 3/(1+Discount rate) ^ Year
    PVCFD = CFD3 / (1+ DR) ^ Year
36. **Next year's discount rate**
    Next year's discount rate = Discount rate x Discount rate multiplier
    DRnext = DR x DRMULT

Calculation of intrinsic value

The intrinsic value of the company is calculated by summing up the present values of the cash flows available for distribution in each of the future years that were estimated in the calculation loop. We impose a restriction on the lower magnitude of the intrinsic value: it cannot be less than the company's Tangible net worth.

By dividing the company's intrinsic value by the number of outstanding shares, we find the intrinsic value per share. The latter is compared with the current market share price to estimate the company's stock upside or downside potential.