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List of Abbreviations

a	Mean Reversion Factor
a$_{Index}$	Forecast Factor
AV	Aggregate Value
b	Long-Term Interest Rate
BRL	Brazilian Real
C	Expenses
CA	Current Assets
CL	Current Liabilities
Co	Consumption
cov	Covariance
CV	Continuing Value
D	Debt
dz	Stochastic Process
E	Equity
e	Exchange Rate
EBITA	Earnings before Interest, Taxes and Amortization
EV	Equity Value
F	Number of Fixed Lines in Brazil
FCF	Free Cash Flow
FTE	Flow to Equity Holders
G	Government Purchases
g	Growth Factor
I	Investing Activities

$I(r)$	Investment Function as a Function of Interest Rates
i_e	Interest Expenses
i_f	Losses due to Foreign-Currency Financing
i_i	Interest Income
inf	Inflation
k_d	Cost of Debt
k_e	Cost of Equity
k_t	Forward Rate Price due at t+1
M	Cash
m	Maturity of Debt Positions
NOPLAT	Net Operating Profit less adjusted Taxes
P_{ij}	Transition Probability from state i to state j
r	Interest Rate
r_{d-f}	Interest Rate Differential
r_f	Risk Free Rate of Return
R_i	Return of Asset
R_p	Return of Market Portfolio
S	Sales
T	Taxes
USD	US Dollar
WACC	Weighted Average Cost of Capital
X	Random Variable
y	Growth of Gross Domestic Product
Y	Gross Domestic Product
β	Beta Factor
σ	Standard Deviation

ω	Path

Indices

CA	Current Assets
CL	Current Liabilities
d	Domestic
Div	Dividends
f	Foreign
FR	Fixed Interest Rate
LT	Long-Term
m	Maturity
n	Number of Path
ST	Short-Term
t	Period
v	Variable
VR	Variable Interest Rate
^	Strategic Value

1   Introduction

The main problem in measuring the value of companies operating in emerging markets is the need to model the risk of the macroeconomic environment. Currently, there are two kind of models to adjust for the risk of emerging market companies. Most of the models either use an additional risk premium to discount the free cash flows or use a limited number of different forecasts to calculate the free cash flow.

This thesis aims to implement a few of the principles taught at the "Institut für Managementwissenschaften" of the Vienna University of Technology. These principles are mainly an uncertainty framework using paths and probabilities, an approach to model, calibrate and validate all financial tools and the approach to model stochastic systems with integrated control strategies.

This thesis proposes a model which closely links the macroeconomic environment and the balance sheet to reproduce the economic reality. At the core stands the Cash Flow Statement and it is derived using a range of variables from GDP-Growth, Exchange Rate to strategic variables determined by the management.

The second chapter analyzes the Brazilian economy, introduces a path environment and finally derives the relations between GDP-Growth and Interest Rate and between Interest Rate and Exchange Rate. The third chapter takes the Corporate View and in the course of this chapter Brasil Telecom will be presented and the financial statements simplified. It also introduces a revenue model and analyzes the debt positions of the company. The fourth chapter introduces two valuation concepts and explains the forecast techniques used to calculate the aggregate value of Brasil Telecom. The last chapter is reserved for the valuation results and a detailed analysis of the impact of different strategies concerning investing activities and debt policy. At the end a few concluding remarks and a proposal for further research will be given.

2   Macroeconomic Environment

2.1   Introduction

In this beginning chapter a short overview of the Brazilian economy and an explanation of the design of the macroeconomic environment for the later valuation will be given. The macroeconomic environment is modeled using the gross domestic product growth as main driver and in a next step the interest rate as a function of GDP growth is derived. Finally, the interest parity theorem is used to develop a model to link the exchange rate to the interest rate. The result will be paths which represent the future development of the economy.

2.2   Brazilian Economy

In this chapter the Brazilian economy will be presented taking a look at the development of the last years and the current economic structure and giving an outlook for the next years.

2.2.1   Brief Economic History

In 1990, the first post-military-regime government was elected and it followed a period of economic reforms including privatization programs and plans to liberalize the economic structures. Initially, the privatization began in the manufacturing sector and spread to the utilities. Although a range of measure was taken, the main problems including a high level of inflation and a paralysis of the economy could not be solved.[1]

In 1994, the Plano Real was introduced to decrease inflationary pressures and enable the transition to a new economic model. This reform approach used the exchange rate as a nominal anchor and involved the opening of the economy, market liberalization and the

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[1] Giambiagi, 2004, p. 3ff

rationalization of the public finances. However, as this disinflation did not happen quickly enough a sharp appreciation of the exchange rate could not be prevented. Combined with a strengthening of domestic demand, it exposed underlying imbalances in the public finances.[2]

At the end of the 90s, a series of financial crises in East Asia and Russia hit the investors' confidence in emerging markets. Due to a rapid fall in foreign currency reserves, the government had to float the Brazilian Real. Although problems with rising inflationary pressures and a recession were expected, the reaction of the economy was extremely positive.[3]

In 2001, a combination of external shocks had negative impacts on the economic growth of the Brazilian economy. These shocks were the Argentinean Crisis, 9/11 and the following slowdown of the American economy. These effects are shown in the following chart.[4] [5] [6]
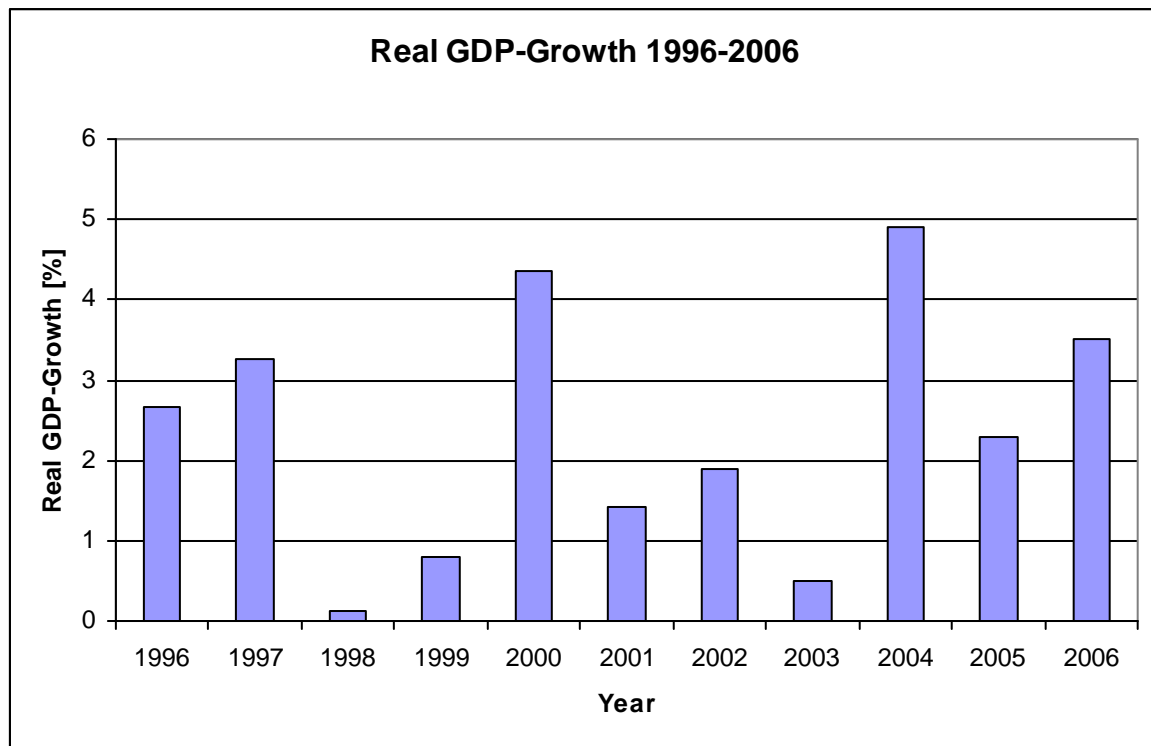
Chart 1 Real GD-Growth in Brazil, 1996-2006

In October 2002, Lula was elected as new president and despite contrary election campaign promises the macroeconomic policies from the previous government were kept unchanged.

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[2] Economist Intelligence Unit, 2006, p. 25

[3] Giambiagi, 2004, p. 3ff

[4] Giambiagi, 2004, p. 59ff

[5] Giambiagi, 2004, p.323

[6] Business Monitor International, 2007, p. 2

These policies include fiscal discipline, a floating exchange rate and inflation targeting[7]. In the next chapter a look at the current economic structure and the main problems will be taken.

2.2.2   Economic structure

Brazil is one of the leading countries in the Americas and possesses many natural advantages. Its ample resources give the country comparative advantages in agriculture and primary goods processing sectors. For a long time the most important goods were sugar, coffee and rubber. The importance of the agricultural sector diminished over the time but still contributes 10% to the national GDP. [8]

Brazil's industrial base was largely built up in response to a policy known as Import-Substituting Industrialization. The industrial base is diversified and ranges from consumer goods to heavy engineering and profits from the huge domestic market, abundant natural resources and a cheap labor market. [9]

In the following table a few of the present characteristics are shown. [10]

Area	8,511,965 sq km
Population	188,078,227
GDP/ capita	$8,600
GDP by sector	agriculture: 8% industry: 38% services: 54%
Unemployment Rate	9,6%

Table 1 Key Numbers

High levels of inflation and a sky-high interest rate have been a problem for the Brazilian economy for a long time. In the following chart inflation and interest rate for the last years are shown. In 1999 an inflation-targeting regime was created and helped to reduce the consumer price inflation towards OECD levels after a period of hyperinflation that slowed down economic growth. This annual inflation target is set by the Conselho Monetário Nacional and

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[7] Economist Intelligence Unit, 2006, p. 23

[8] The Economist, 2007, p. 54

[9] Economist Intelligence Unit, 2006, p. 24

[10] https://www.cia.gov/cia/publications/factbook/geos/br.html

the current target until 2008 is 4.5%. Also, the high level of interest rate which is one of the highest in the world is prohibitive for the economy.[11] [12] [13] [14]

Interest Rate and Inflation 1996-2006
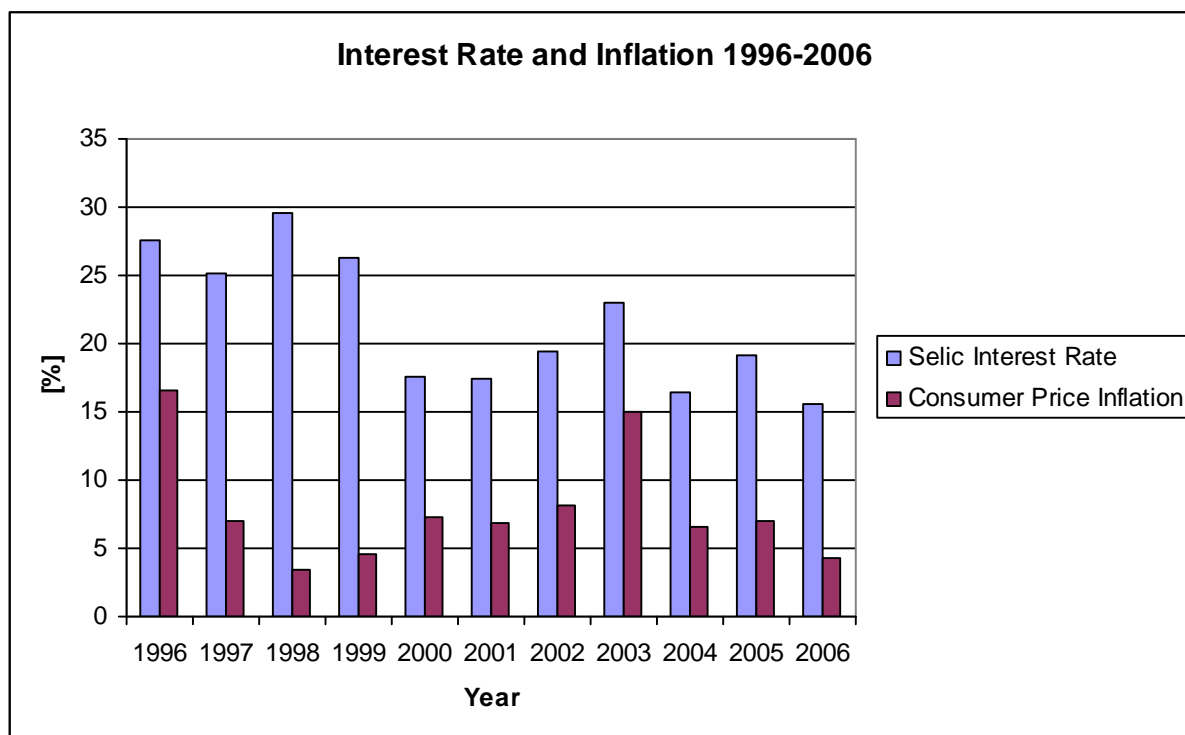
Chart 2 Interest Rate and Inflation in Brazil, 1996-2006

Considering investments in Brazil, the "Custo Brasil" is always a topic. It could be translated as cost of doing business in Brazil. The average ratio of investment to GDP has remained low for the last 20 years and deterred the expansion of industrial capacity and necessary investments in infrastructure investments. This explains why, for example, transport costs consume nearly 13% of Brazil's GDP. [15] The second big issue is the macroeconomic environment and the uncertainty about the future of the economic growth and government policies. Brazil's high real interest rates causes a problem for the financing of corporations and a history of economic volatility with hyper-inflation in the early 90s still weigh heavy on the borrowing costs. The third factor which contributes to the high business costs are caused by an overbearing state and includes restrictive labor laws, a costly and slow judicial system

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[11] Economist Intelligence Unit, 2006, p. 28

[12] http://econstats.com/r/rbra_am1.htm

[13] Business Monitor International, 2007, p. 1

[14] http://www.ibge.gov.br/home/estatistica/indicadores/precos/inpc_ipca/default.shtm

[15] The Economist, 2007, p. 54

and weaknesses in the regulatory system. As an example, opening a business requires 17 procedures and 152 days, putting Brazil in 115th place.[16]

2.2.3 Economic outlook

The economic outlook will be the fundamental factor for the valuation framework presented in the next chapter because the future GDP growth is used as the driver of the model.

In 2003, the investment bank Goldman Sachs published a study which forecasted the future growth of a country group called BRIC. This group includes the countries Brazil, Russia, India and China as the future economic superpowers.

The average Brazilian GDP-growth until 2050 is forecasted at 3.6% and rests on optimistic but consistent and reasonable assumptions. The macroeconomic assumptions consist mainly of the perpetuation of sound policies concerning inflation targeting, market liberalization, education and the efficiency of the state. The study also takes a closer look at the Brazilian challenges to set the conditions for sustainable growth. The main challenges lie in the expansion of international trade, the expansion of the investment ratio and a significant reduction of the government sponsored activities. In the next chart the forecasted GDP-Growth for Brazil, Russia, Indian and China is shown.[17] [18]

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[16] The Economist, 2007, p. 57

[17] Purushothaman, 2003, p. 10

[18] Purushothaman, 2003, p. 19

Real GDP-Growth of BRIC-States 2006-2050
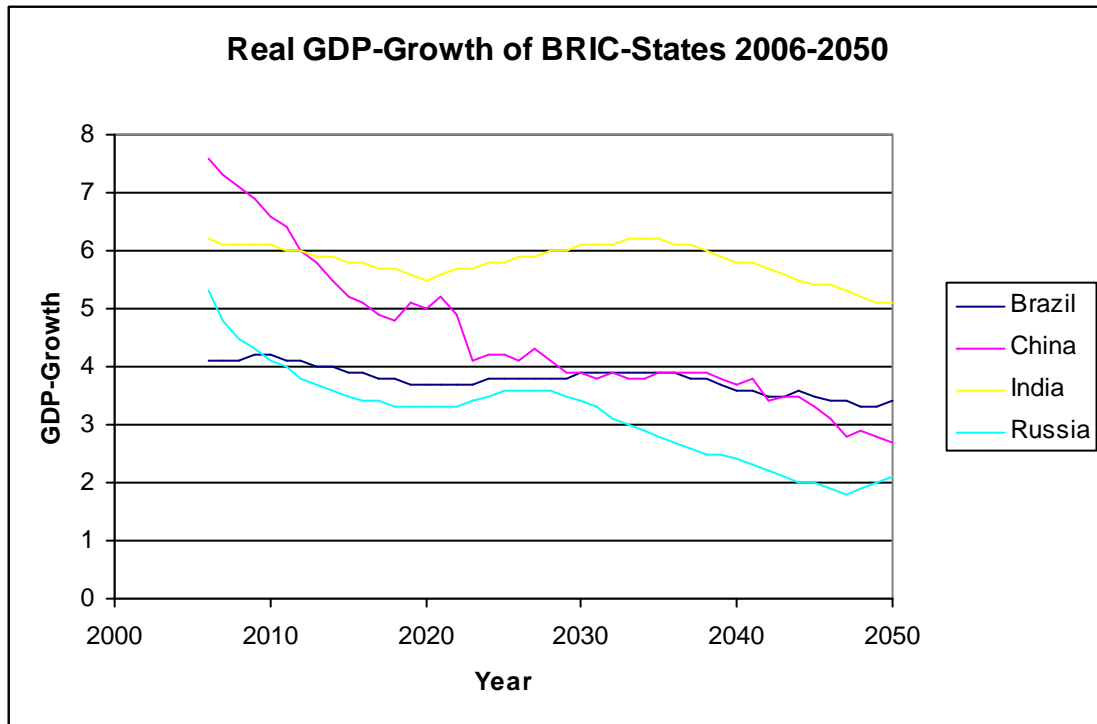
Chart 3 Real GDP-Growth of BRIC-States, 2006-2050

To finish this chapter two further research papers will be shortly highlighted. Deutsche Bank Research recently published a study about the outlook and expected future growth of the Brazilian economy. The analysis is based on four structural factors including demographics, savings and investments, economic openness and human capital. Most of these factors have upside potential and will support further economic growth. In this paper three scenarios are developed with a baseline scenario representing a real GDP growth of 3.3%, an upside scenario with an average real GDP growth of 4% and a downside scenario with an economic growth of 2.5%.[19]

Business Monitor International is a forecasting institute specialized in emerging markets. The forecasts of this institute will also be used for the forecasts on the following pages. The SWOT-Analysis gives some insights and sums up different factors according to the categories strengths, weaknesses, opportunities and threats. According to this analysis, the strengths are the government's commitment to run a primary surplus and to cut the interest rates. The weaknesses are the upside pressures on inflation and deterioration of the export competitiveness following a currency appreciation in the last years. The opportunities are summed up in the fact that the current economic policy should ease private consumption and

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[19] Jaeger, 2006, p. 2 ff

the decreased volatility of the macroeconomic factors should help Brazil to insulate against external shocks. The threats lie mainly in the political system and there is a possibility that the government cannot implement reform programs to modernize the country.[20]

2.3 Modeling of GDP-Growth as Main Driver

The country-specific environment will be modeled as paths and Markov chains will be used as a theoretical base for the model. Following the introduction of the Markov chains the path environment will be filled with information.

2.3.1 Markov Chains

A Markov process is a stochastic process whose past has no influence on the future if its present is specified. A stochastic process is, in a loose sense, a system which evolve probabilistically in time or more precisely, a system in which a certain time-dependent random variable $X(t)$ exists[21]. A Markov process can be given in the following form[22]:

$$P\{X_{t+1} = j | X_t = i, X_{t-1} = i_{t-1},..., X_1 = i_1 = X_0 = i_0\} = P_{ij}$$

Formula 1 Markov Chain

P_{ij} is in this formula the fixed probability that the state will change from state i to state j. This formula may be interpreted as stating that the conditional distribution of any future state X_{t+1} given the past states $X_0, X_1, ... , X_{t-1}$ and the present state X_t, is independent of the past states and depends only on the present state X_t. As all probabilities are non-negative and since the process must make a transition into some state, it can be written that[23]:

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[20] Business Monitor International, 2006, p. 10

[21] Gardiner, 1997, p. 42

[22] Papoulis, 1991, p. 635

[23] Ross, 2003, p. 181 ff

$$P_{ij} \geq 0, \qquad i, j \geq 0, \qquad \sum_{j=0}^{\infty} P_{ij} = 1 \qquad i = 0,1,...$$

Formula 2 Properties of a Markov Chain

In a next step a matrix of transition probabilities should be introduced. *P* should denote this matrix of one-step transition probabilities P_{ij}, so that

$$P = \left\| \begin{array}{cccc} P_{00} & P_{01} & P_{02} & \llcorner \\ P_{10} & P_{11} & P_{12} & \llcorner \\ \mathbb{M} & & & \\ P_{i0} & P_{i1} & P_{i2} & \llcorner \\ \mathbb{M} & \mathbb{M} & \mathbb{M} & \end{array} \right\|$$

Formula 3 One-Step Transition Probabilities

is its determining matrix[24].

In a following step it is necessary to introduce the Chapman-Kolmogorov equations to calculate the n-step transition probabilities P_{ij}^{t} which give the probability that a process in state *i* will be in state *j* in period *t*. That is,

$$P_{ij}^{t} = P\{X_{t+k} = j | X_k = i\}, \qquad t \geq 0 \quad i, j \geq 0$$

Formula 4 n-Step Transition Probabilities

The Chapman-Kolmogorov equations provide a method for computing these n-step transition probabilities. These equations are[25]

$$P_{ij}^{t+u} = \sum_{k=0}^{\infty} P_{ik}^{t} P_{kj}^{u} \qquad \text{for all } t, u \geq 0, \text{ all } i, j$$

Formula 5 Chapman-Kolmogorov Equations

In the literature three general classes of Markov processes are mentioned[26]:

- Discrete time, discrete state

- Continuous time, discrete state

- Continuous time, continuous state

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[24] Romanovsky, 1970, p. 2

[25] Ross, 2003, p. 349 ff

[26] Papoulis, 1991, p. 635ff

For the purposes of this diploma thesis, only discrete-time, discrete-state Markov chains will be considered. After the framework using Markov chains is built it is time to think about a suitable macroeconomic approach.

2.3.2 Path-Environment

In the following chart the paths for the macroeconomic development are shown. In each period three different states can be reached and at the end of the 5 periods 243 different paths can be realized.
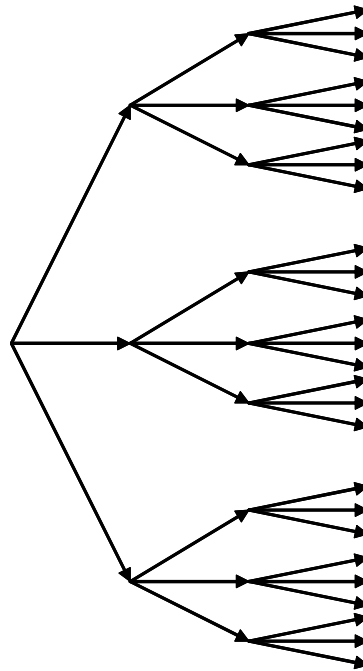
Chart 4 Macroeconomic Paths representing 3 out of 5 periods

Each path consists of 5 periods with specific realization in each period and each path can be given in the following form.

$$\omega_n = \left\{ s_{i,t+1}(n), s_{i,t+2}(n), s_{i,t+3}(n), s_{i,t+4}(n), s_{i,t+5}(n) \right\}$$

with $1 \leq i \leq 3$ and $1 \leq n \leq 243$

Formula 6 Definition of a Path

The path 1 consists of 5 upward movements and this methodology is used to enumerate all paths from 1 o 243. For example, the path 47 consists of the realization 1 in t+1, 2 in t+2, 3 in

t+3, 1 in t+4 and 2 in t+5 and will be used as an illustrative example for the following calculations. 1 represents the upside realization, 2 stands for the base scenario and 3 represent the downside realization in a given period.
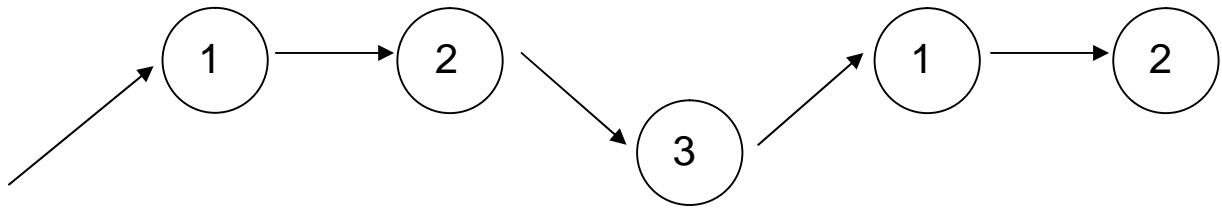
Chart 5 Path 47

2.3.3 Macroeconomic Approach

As the national GDP will be used as the fundamental model driver it is necessary to take a look at the development of the GDP over the last years. Of course, the picture is flawed as Brazil was in the middle of an economic crisis in the 90s.

In the following table, the development of the last years is shown. [27] [28]

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Real GDP Growth	2,662	3,271	0,131	0,787	4,358	1,418	1,900	0,500	4,900	2,300

Table 2 Real GDP Growth in Brazil

In the first two parts Markov chains were introduced and an overview of the Brazilian economy was given. The main idea of this chapter is to apply the idea of the Markov chains with different states to model the future of the Brazilian economy.

Initially, the standard deviation of the real GDP-growth is calculated. Using the following formula to calculate the standard deviation we get a value of 1,523.

$$\sigma_y = \sqrt{\frac{1}{N-1}\sum_{i=1996}^{2005}(y_i - \bar{y})^2}$$

Formula 7 Standard Deviation of GDP-Growth

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[27] Giambiagi, 2004, p. 323

[28] Business Monitor International, 2007, p. 2

In a next step the forecasted growth numbers published by a renowned research institute will be examined. These numbers are shown in the following chart. [29]
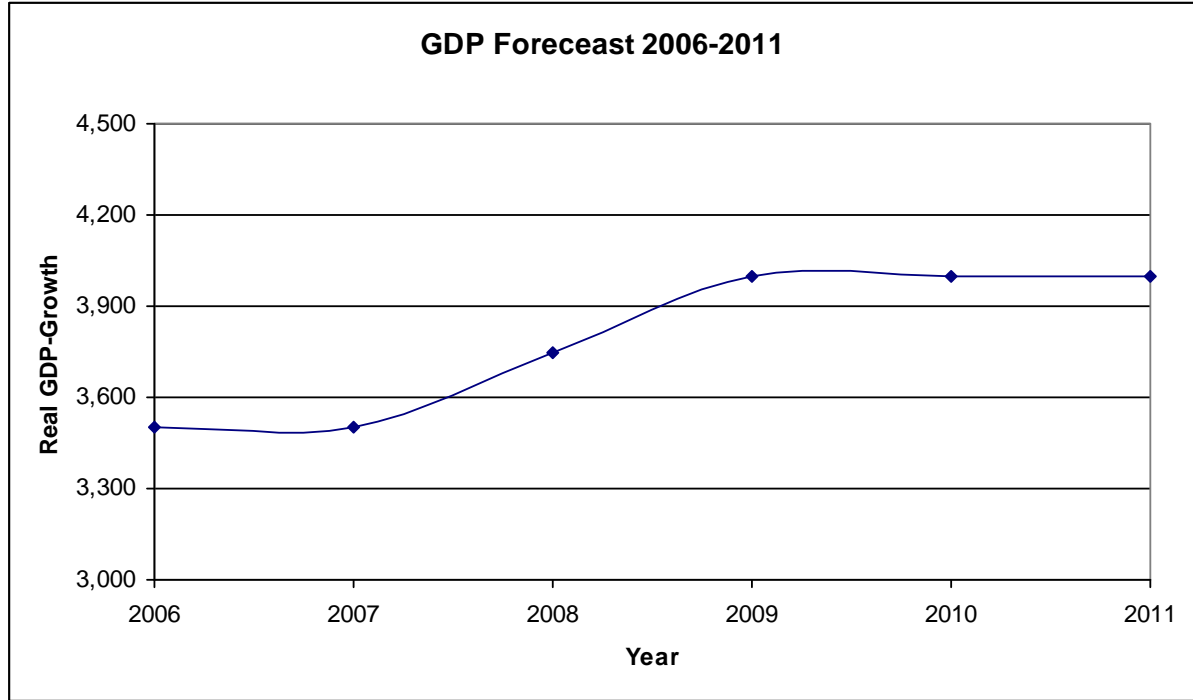
Chart 6 Real GDP-Growth Forecast, 2006-2011

To implement a framework using Markov chains, it will be assumed that in each period three different states can be attained. The second state, the average state, follows the forecast of the published forecasts. As those forecasts do not include upper or lower limits we have to assume that the upper and lower realizations are given by the forecasted GDP growth with an additional negative or positive standard deviation. In a next step it is necessary to introduce a stochastic matrix for the Brazilian economy for a future period of 5 years.

$$A(y_{i,t}) = \begin{pmatrix} y_{1,t+1} & y_{1,t+2} & y_{1,t+3} & y_{1,t+4} & y_{1,t+5} \\ y_{2,t+1} & y_{2,t+2} & y_{2,t+3} & y_{2,t+4} & y_{2,t+5} \\ y_{3,t+1} & y_{3,t+2} & y_{3,t+3} & y_{3,t+4} & y_{3,t+5} \end{pmatrix}$$

$$A(y_{i,t}) = \begin{pmatrix} 5,02 & 5,02 & 5,27 & 5,52 & 5,52 \\ 3,50 & 3,50 & 3,75 & 4,00 & 4,00 \\ 1,98 & 1,98 & 2,23 & 2,48 & 2,48 \end{pmatrix}$$

Formula 8 Stochastic Matrices of the GDP-Growth

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[29] Business Monitor International, 2007, p. 2

Finally, transition probabilities as an important part of the model need to be introduced. As there is no literature about the distribution of this probability function, the assumptions were made that the forecasted value will be realized with a probability with 67% and the up and down scenario are equally possible. This is shown in the following formula.

$$P = \begin{pmatrix} P_{1,t+1} & P_{1,t+2} & P_{1,t+3} & P_{1,t+4} & P_{1,t+5} \\ P_{2,t+1} & P_{2,t+2} & P_{2,t+3} & P_{2,t+4} & P_{2,t+5} \\ P_{3,t+1} & P_{3,t+2} & P_{3,t+3} & P_{3,t+4} & P_{3,t+5} \end{pmatrix}$$

$$P = \begin{pmatrix} \dfrac{1}{6} & \dfrac{1}{6} & \dfrac{1}{6} & \dfrac{1}{6} & \dfrac{1}{6} \\ \dfrac{2}{3} & \dfrac{2}{3} & \dfrac{2}{3} & \dfrac{2}{3} & \dfrac{2}{3} \\ \dfrac{1}{6} & \dfrac{1}{6} & \dfrac{1}{6} & \dfrac{1}{6} & \dfrac{1}{6} \end{pmatrix}$$

Formula 9 Transition Probabilities of the GDP-Growth

In a next step the probability of a given path will be derived multiplying the possibility of the realized state in each period along the path. This aspect is given in the following formula.

$$P(\omega_n) = \prod_{m=1}^{5} P_{i,t+m,n}$$

Formula 10 Probability of a given Path

Calculating the probability of the path 47 (s_1, s_2, s_3, s_4, s_5) and applying the formula results in

$P(\omega_{47}) = 1/6 * 2/3 * 1/6 * 1/6 * 2/3 = 0{,}206\%$.

To give a better understanding the density function is shown for all 243 paths in the next chart. In the middle the probability is highest with peaks equally spread to left and to the right.
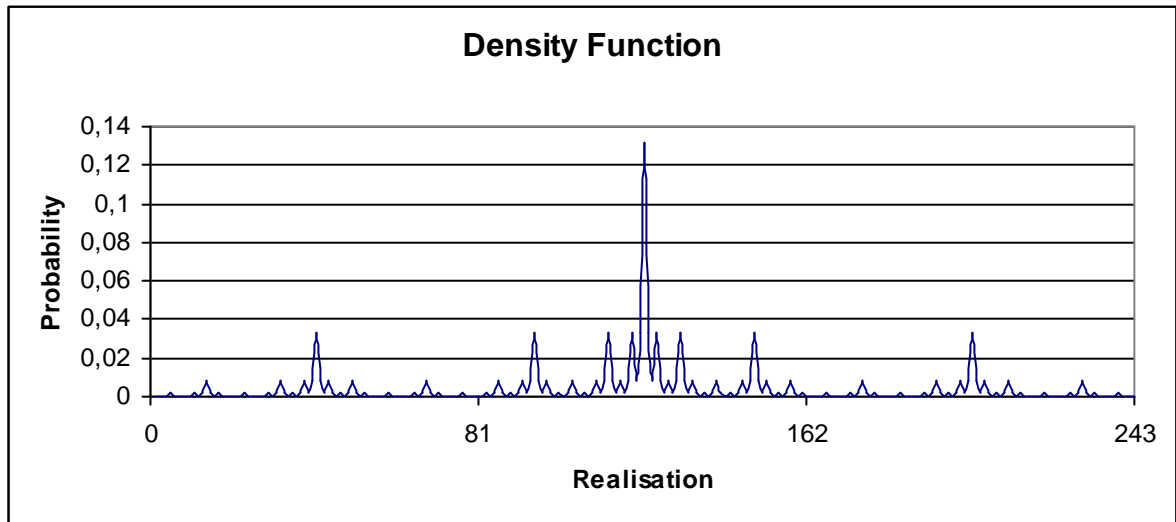
Chart 7 Density Function

It is also possible to calculate the average GDP-Growth per path of the Brazilian Economy over the next years using the following formula.

$$\bar{y}_n = \sum_{i=t}^{T} \sqrt[T]{(1 + y_{i,n,t})}$$

where $y_{i,n,t} = f(\omega_n, t)$

Formula 11 Average GDP-Growth

In the following chart the average GDP-growth per path is given and the different average growth rates can be seen.
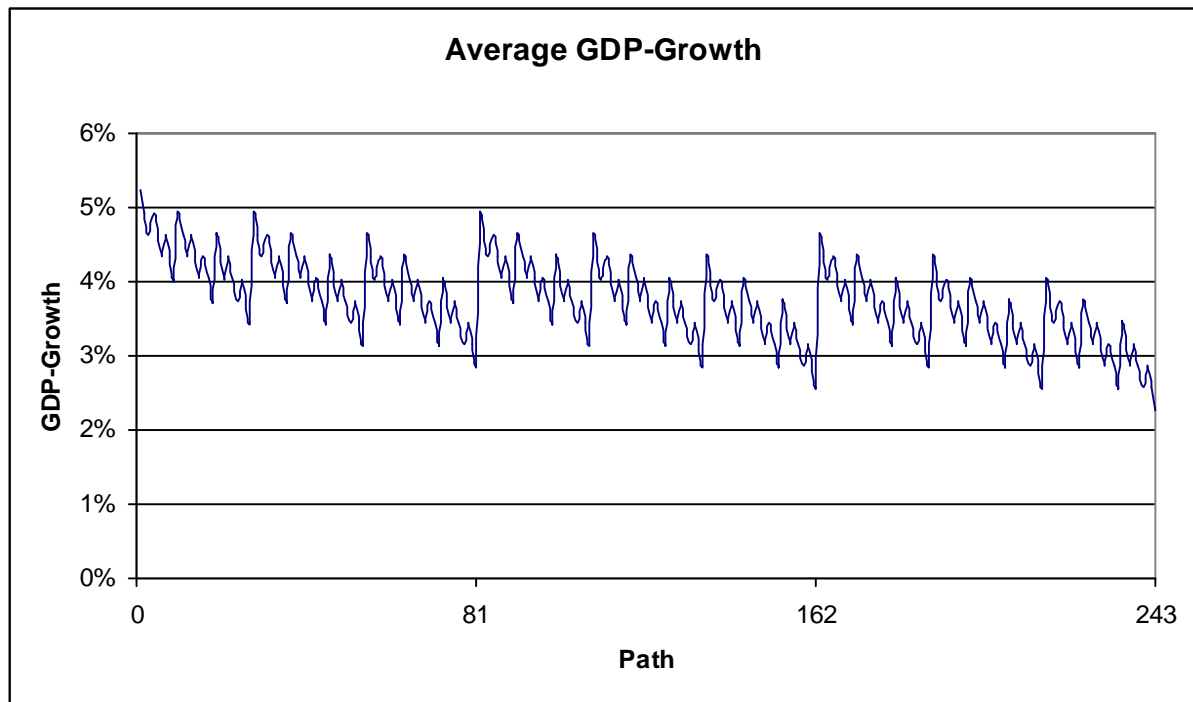
Chart 8 Average GDP-Growth per Path

In the chart "GDP-Growth for the Path 47" the different realizations for each period in the specific case of Path 47 are shown. This path is used to show the numbers in an exemplary form.
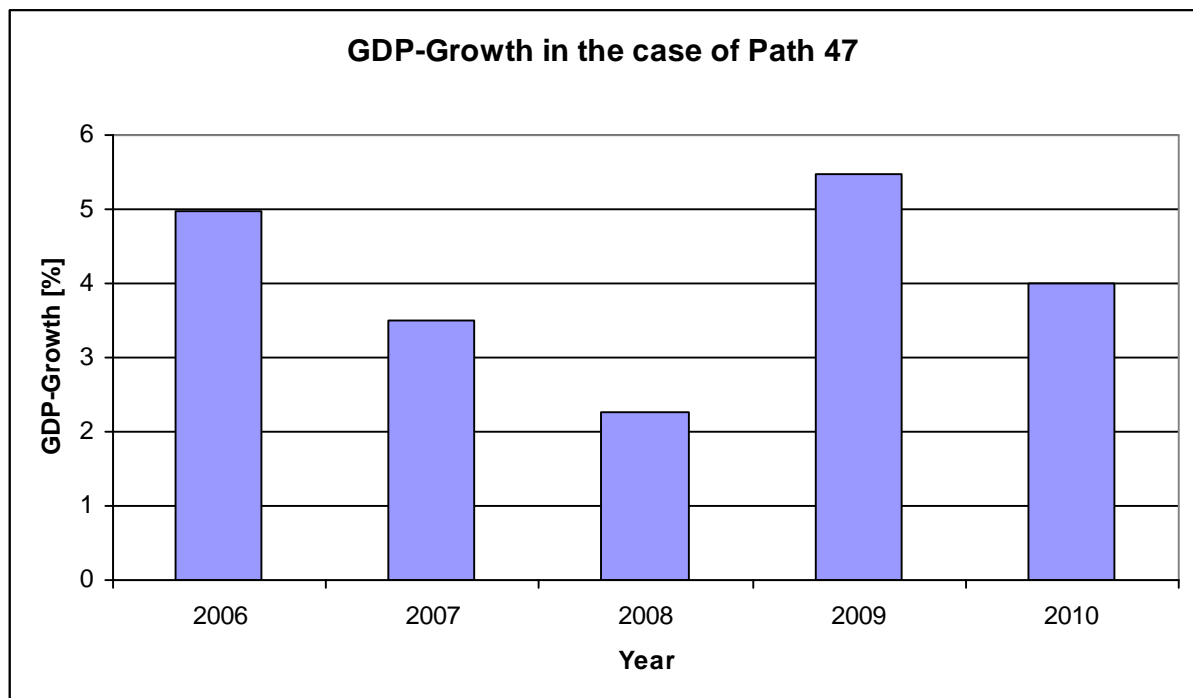
Chart 9 GDP-Growth for the Path 47 (y_1, y_2, y_3, y_1, y_2)

In the next chapters these macroeconomic states of the economy characterized by the GDP growth are linked to the interest rate and subsequently to the Dollar/ Real-exchange rate to use these inputs in the valuation model of the company.

2.4   Interest Rate and GDP-Growth

As explained in the previous chapter, GDP growth serves as model driver and in the next step the relation between GDP growth and the interest rate level has to be found. Most of the literature covers models which focus on the term structure like the Cox-Ingersoll-Ross, Vasicek or Ho-Lee-Model. In a later chapter the Vasicek-Model will be introduced to calculate the expected term structure using variations of the short-term interest rate.

One approach is the IS-Curve as a part of the IS-LM model which is the leading interpretation of Keynes's Theory. According to Mankiw, the IS-LM model can be viewed to show what causes income to change in the short run when the price level is fixed. In another sense the IS-LM model can be used to show what causes the aggregate demand curve to shift. Deriving this curve is quite easy as the main idea is that an increase in the interest rate lowers planned investment. Obviously, this lower level of investment lowers the national income and this relation is reflected in the IS-Curve. The function which describes this relation is shown in the following expression. [30]

$$Y_t - Co(Y_t - T) - G_t = I(r_t)$$

Formula 12 IS Curve

In this formula, *Y* stands for national income, *Co* for consumption as a function of national income less taxes, *G* for government purchases and *I(r)* for the investment function depending on the interest rate. [31]

This curve holds as long as there is no change in fiscal policy. Taxes or government spending will cause the IS curve to shift to the left or to the right. For example, a tax increase will

[30] Mankiw, 1997, p. 260

[31] Mankiw, 1997, p. 248ff

decrease the disposable income for consumption and decreases at the same time the demand for goods. This tax increase would shift the IS curve to the left. [32]

In the following chart the relation between interest rate and real GDP growth is drawn and it looks as if this relation is viable for Brazil. The calibration period is from 2000 to 2004 and the shape of the curve is convex and downwards as described in all macroeconomics textbooks. After the turbulent 90s with sky-high inflation rates and the introduction of the Plano Real the fiscal policy followed a steady path and with Lula in office for the next years the fiscal policy is not likely to change. [33] [34] [35]
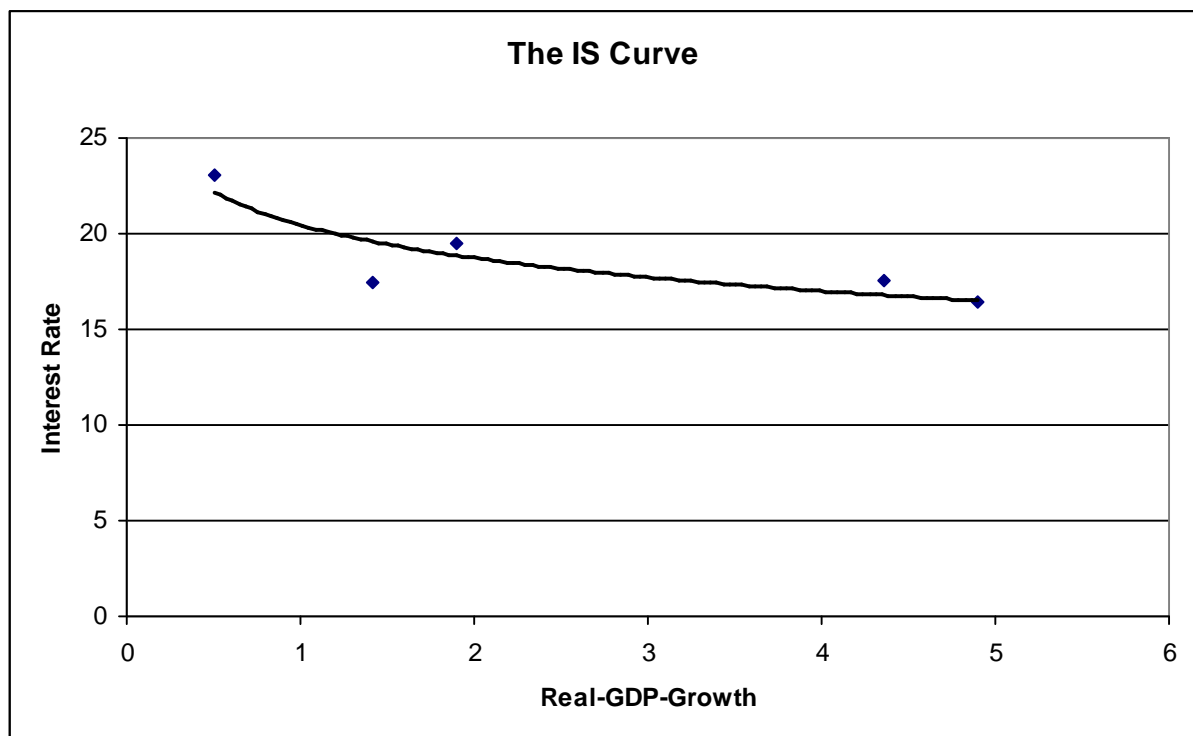
Chart 10 IS Curve, 2000-2004

Using a logarithmic regression the relation for the real interest rate level and the real GDP-Growth of Brazil can be derived.

$$r(y_t) = -2,4983 * \ln(y_t) + 20,461$$

Formula 13 Calibration of the IS curve

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[32] Blanchard, 2003, p. 45ff

[33] Giambiagi, 2004, p. 323

[34] econstats.com/r/rbra_am1.htm

[35] Business Monitor International, 2007, p. 2

As usual, this formula will be validated for the following year. It seems to be a viable relation as the forecasted value of 18.38% is in an acceptable range of 19.15% which is the value for the year 2005. This formula will be applied to define the information of each path knot and using the GDP growth number the interest rate level will be calculated.

2.5   Interest Rate and Exchange Rate

The last part considers the relationship between interest rate and exchange rate. Macroeconomic textbooks always use the same line of argument. Investors have the choice to invest in different currency areas and if the real interest rate in one currency area is higher people will seek to invest their money in this currency. At the same time the demand for this currency increases and drives the return of this investment lower due to currency appreciation.[36] This loss is represented as "loss of foreign-currency financing and monetary variations" in the income statement of the financial model.

In the early 1930s Fisher published papers on the relationship between domestic and foreign exchange rates. Those concepts are known as parity theorems which consist of the

- Fisher-Effect,

- Interest Rate Parity,

- International Fisher-Effect,

- Purchasing Power Parity and

- Expectation Thesis. [37]

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[36] Krugman, 2005, p. 266ff

[37] Spremann, 2005, p. 89ff
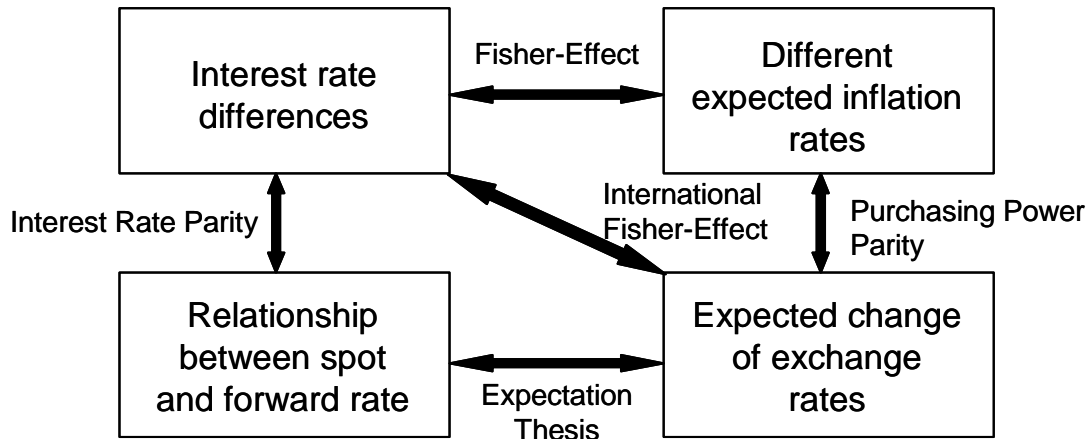
Chart 11 The five Parity Theorems

First, the interest rate parity will be analyzed. This theorem says that the forward rate of the exchange rate is related with the current exchange rate using the following formula.

$$\frac{1+r_{d,t}}{1+r_{f,t}} = \frac{k_t}{e_t}$$

Formula 14 Interest Rate Parity

In this formula r_d stands for the domestic interest rate and r_f for the foreign interest rate. k_t stands for the forward rate agreement price due at the end of the period and e_t is the spot price at time t. This formula intuitively makes sense as it is easy to replicate and uses the no-arbitrage-argument.[38]

The Fisher-Effect can be written in the following form:

$$\frac{1+r_{d,t}}{1+r_f,t} = \frac{1+r_{real,t}+\inf_{d,t}}{1+r_{real,t}+\inf_{f,t}} \approx \frac{1+\inf_{d,t}}{1+\inf_{f,t}}$$

Formula 15 Fisher Effect

The first part is straightforward stating that the nominal interest rate consists of a general real interest rate r_{real} and the inflation rate *inf*. According to this Fisher-Effect the only source of possible discrepancies are different inflation rates. Nevertheless, it cannot be verified with the no-arbitrage-argument but empirical studies show that the Fisher-Effect has some importance in the currency markets.[39]

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[38] Spremann, 2005, p. 89ff

[39] Spreemann, 2005, p. 89ff

The next theorem is the purchasing power parity which links different expected rates of inflation to different expected changes of exchange rates. This argument says that all goods should cost the same if the currencies are exchanged according to the ruling parities. The purchasing power parity assumes that all goods are transportable and international trade will force the currencies to increase or decrease according to this theorem. Obviously, this effect cannot be verified empirically. Therefore a weak form of this theorem was introduced which states that the currencies are changing according to differences concerning the inflation. This argument can be written in the following form.

$$\frac{1+\inf_{d,t}}{1+\inf_{f,t}} = \frac{E[\tilde{e}_{t+1}]}{e_t}$$

Formula 16 Purchasing Power Parity

$E[\tilde{e}_{t+1}]$ stands for the expected spot price at the end of the period and could also be stated as

$E[\tilde{e}_{t+1}] - s_t \approx \inf_{d,t} - \inf_{f,t}$.[40]

The next theorem is the expectation thesis which is a relation between the forward price and the expected future spot price. The main idea is that to avoid arbitrage possibilities the expected spot price at a given date should be the same as the forward price for this date. Consequently, the formula can be given in the following form.[41]

$$\frac{k_t}{e_t} = \frac{E[\tilde{e}_{t+1}]}{e_t}$$

Formula 17 Expectation Thesis

Rewriting the right side of this equation finds the International Fisher-Effect which is given by the following formula.

$$\frac{1+r_{d,t}}{1+r_{f,t}} = \frac{E[\tilde{e}_{t+1}]}{e_t}$$

Formula 18 International Fisher-Effect

The International Fisher-Effect is important for the management of bond portfolios and says that the differences of the nominal interest rates are related with the expected changes of the

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[40] Spreemann, 2005, p.89ff

[41] Spreemann, 2005, p.89ff

currency parities. Therefore, investors have to expect a relative depreciation of the currency if the interest rates are relatively higher in this currency. [42]

This effect is also used to model the exchange rate level for the valuation model. The GDP growth is the main driving factor and using this input factor the interest rate and the exchange rate are derived in a consistent way.

In the following chart the daily changes of the exchange rate between the Brazilian Real and the American Dollar are shown and two major events can be seen. The first shock happened in 1998 and was due to the East Asian financial crisis and the Russian bond default crisis. The second shock in 2002 was mainly caused by problems in neighbouring Argentina and by the financial markets' fear that the newly elected president Lula would not pursue the economic reforms initiated in earlier periods.[43] [44]
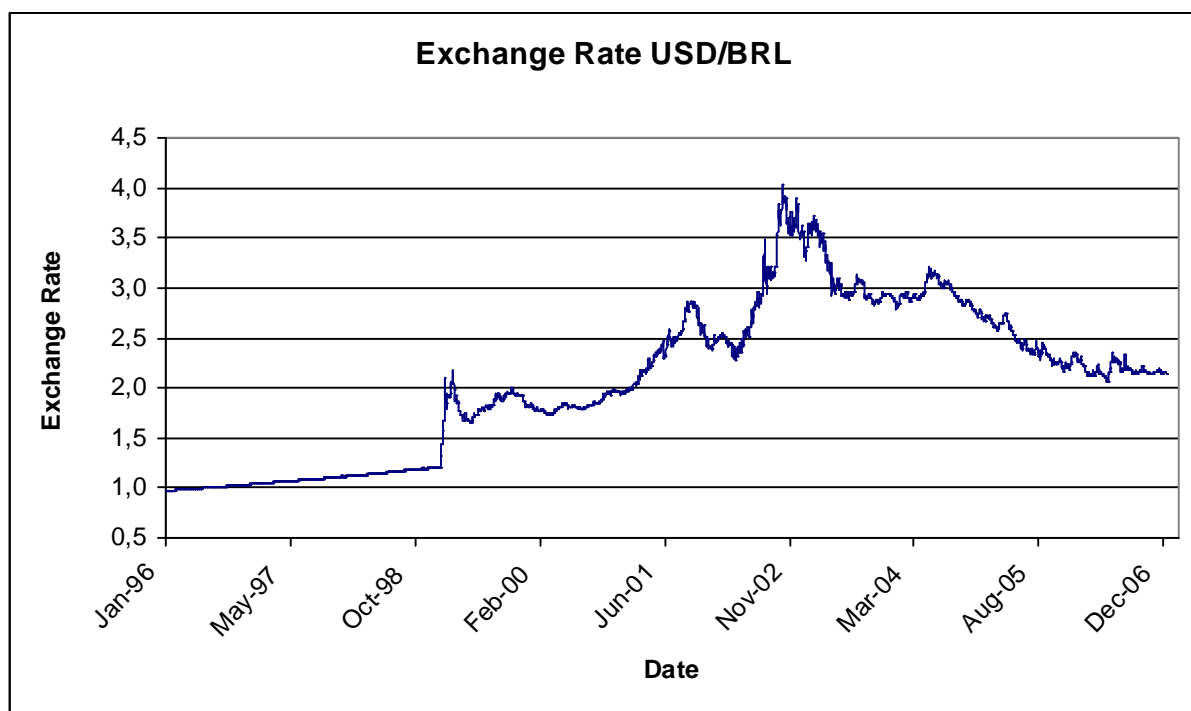
Chart 12 Exchange Rate between US-Dollar and Brazilian Real, 1996-2006

In the following chart the interest rate differential and the exchange rate to derive the interest rate parity are given. The purple line shows the difference between the nominal interest rates

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[42] Spremann, 2005, p.89ff

[43] Giambiagi, 2004, p3.ff

[44] www.oanda.com

in the United States and Brazil and the blue line shows the exchange rate of the two currencies. Economically interpreted, this chart means that an increase of the Brazilian interest rate compared to the American interest rate will end in a depreciation of the currency.[45] In this chart only the development of the last year does not reflect the intuitive expectation but it is frequently observed that interest rate differential and exchange rate do not always move in line with each other as it was recently seen with the carry trades of the Japanese Yen. [46] [47] [48]
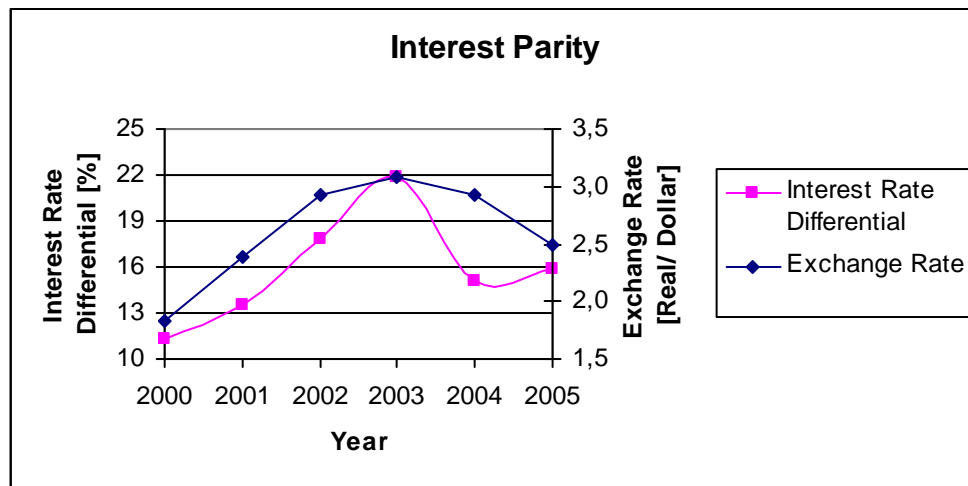
Chart 13 Interest Rate Parity, 2000-2005

In a next step a mathematic relation between the two curves has to be derived. It can be seen that a change in the interest rate differential causes a proportional change in the exchange rate. This factor will be found by minimizing the following expression to find the parameter *a*.

[45] Spremann, 2005, p. 89

[46] www.oanda.com

[47] http://www.federalreserve.gov/RELEASES/h15/data/Annual/H15_FF_O.txt

[48] econstats.com/r/rbra_am1.htm

$$Year(t): \left(\frac{r_{d-f,t}}{r_{d-f,t-1}} - 1 \right) * a = \left(\frac{e_t}{e_{t-1}} - 1 \right)$$

$$a = \arg\min\left(\sum_{t=2003}^{2005} \left(\frac{r_{d-f,t}}{r_{d-f,t-1}} - 1 \right) * a - \left(\frac{e_t}{e_{t-1}} - 1 \right) \right)^2$$

Formula 19 Equations for solving the Interest Rate Parity

Solving this system results in a solution for *a* which is found to be 0,134. Using this value the Exchange Rate Formula can be given in the following form.

$$e_t = \left\{ \left[\left(\frac{r_{d-f,t}}{r_{d-f,t-1}} - 1 \right) * 0,134 \right] + 1 \right\} * e_{t-1}$$

Formula 20 Interest Rate Parity Formula for Brazil

e_t stands for the exchange rate and r_{d-f} signifies the interest rate differential at any given date. This is not the strong form of the interest rate parity but it is common that interest rate changes do not correlate perfectly with exchange rate fluctuations as there are many other disturbing factors.

3 Corporate View

3.1 Introduction

In the second chapter the macroeconomic environment was introduced and on the following pages the corporate view will be established. At the beginning an overview of the Brazilian telecommunication market and a presentation of Brasil Telecom will be given. Especially, the financial statements of Brasil Telecom will be highlighted to give an understanding of the valuation.

3.2 Brazilian Telecommunication Market

Brazil's government has pursued a comprehensive privatization and economic liberalization agenda in recent years which changed the competitive landscape of the Brazilian telecommunication market. Fixed line communication companies are currently trying to expand their services into the more profitable and growing wireless communication sector as they are under increasing pressure.[49]

In the first table an overview of the Brazilian Telecommunication Market is given and two of the three segments show clear growth trends. The number of internet users and also the number of mobile phone subscribers is constantly growing. Only the number of fixed telephone lines is declining and forces the companies to expand into these profitable areas. Brasil Telecom also began to expand its services into the more profitable mobile communication sector. [50]

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[49] Datamonitor, 2006, p. 14

[50] Business Monitor International, 2007, p. 62

	2003	2004	2005	2006	2007	2008	2009	2010
No of Main Telephone Lines in Service	39.295	39.270	39.160	38.180	37.800	37.350	36.900	36.700
No of Main Telephone Lines/ 100 Inhabitants	22,2	21,6	21,3	20,4	20,0	19,4	18,9	18,6
No of Internet Users	17.600	22.000	30.000	33.000	36.000	39.000	43.000	45.000
No of Internet Users/ 100 Inhabitants	6,7	12,1	16,3	17,7	19,0	20,3	22,1	22,8
No of Broadband Internet Subscribers	983	2.074	3.437	4.555	5.920	7.150	8.460	9.500
No of Broadband Internet Subscribers/ 100 Inhabitants	0,5	1,1	1,9	2,4	3,1	3,7	4,4	4,8
No of Mobile Phone Subscribers	46.373	65.606	86.210	100.850	112.300	123.500	132.100	143.500
No of Mobile Phone Subscribers/ 100 Inhabitants	26,2	36,1	46,8	54,0	59,3	64,3	67,8	72,7
No of Mobile Phone Subscribers/ 100 Fixed Line Subscribers	118,0	167,1	220,1	264,1	297,1	330,7	358,0	391,0

Table 3 Key Numbers of Brazilian Telecommunications Market

In the next table different multiples for the main Brazilian telecommunication companies are shown and significant differences in the management of the corporations can be seen. All of these values were taken out of the annual reports published at the Securities and Exchange Commission (SEC). These multiples give a good understanding of their balance sheet strength and the differences of the companies.

For example, Telesp only holds a low cash stock compared to TIM. Also these companies have different levels of profitability ranging from an EBITDA of 15% of revenues to a level of 45% of revenues. One of the most important valuation multiple is the AV/ EBITDA-Multiple. Aggregate value includes the stock market capitalization, pension liabilities, interest-bearing debt and minority interests.[51] Most of these multiples are in the range of 4-5. Only Vivo represents an outlier with an AV/ EBITDA-Multiple of 8.38. Another meaningful multiple is the ratio of Debt to Aggregate Value. TIM has a ratio of 0.03 whereas Brasil Telecom has 0.42. Nevertheless, this ratio has to be viewed with some caution as some companies have controlling shareholders which consolidate these companies on their balance sheet. [52] [53] [54] [55] [56]

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[51] Koller, 2005, p. 116

[52] Form 20-F Embratel Participações S.A., 2006

[53] Form 20-F, Telecommunicações de São Paulo S.A., 2006

[54] Form 20-F, TIM Participações S.A., 2006

[55] Form 20-F, VIVO Participações S.A., 2006

[56] Form 20-F, Brasil Telecom S.A., 2006

	Embratel	Telesp	TIM	Vivo	Brasil Telecom	Peer Group
AV/ EBITDA	4,98	3,92	4,66	8,38	4,97	5,38
Cash and Cash Equivalents/ Revenues	6,0%	3,2%	40,5%	13,7%	17,1%	16,1%
Debt/ AV	0,22	0,09	0,03	0,37	0,42	0,23
Selling Expenses/ Revenues	8,6%	12,6%	25,2%	35,1%	16,3%	19,6%
Administrative Exp/ Revenues	9,5%	6,0%	5,9%	8,8%	12,5%	8,5%
Revenues/ PP&E	1,40	1,16	1,76	1,25	1,17	1,35
PP&E/ Total Assets	0,59	0,66	0,41	0,43	0,52	0,52
EBITDA/ Revenues	14,8%	45,2%	30,4%	22,2%	23,1%	27,2%
CoGS/ Revenues	24,8%	53,6%	43,5%	44,9%	64,4%	46,2%
PP&E/ EBITDA	4,80	1,90	1,87	3,61	3,71	3,18

Table 4 Multiples for Brazilian Telecom Companies

3.3   Brasil Telecom

Prior to 1998, only one public telecommunication company, Telebrás, existed in Brazil. Telebrás was broke up and eight cellular service providers, three regional fixed-line service providers and Embratel providing long-distance telephone services and international telephone service were created. In the following map the regional split of the three regional fixed line companies is shown. [57]

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[57] Form 20-F, Brasil Telecom S.A., 2006
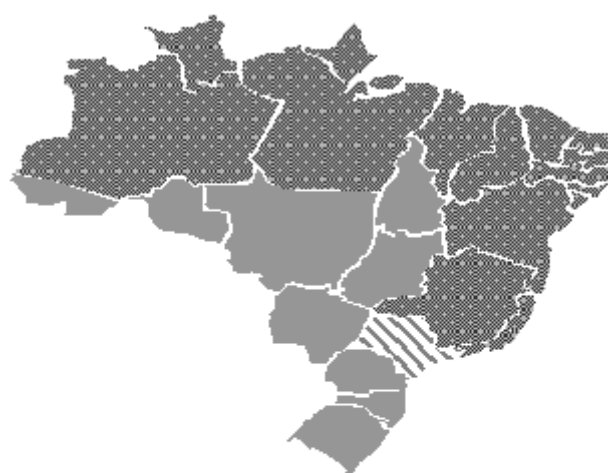
Holding Companies–Regional Fixed Line

- Tele Norte Leste Participações S.A. (Region I)
- Brasil Telecom Participações S.A. (Region II)
- Telesp Participações S.A. (Region III)
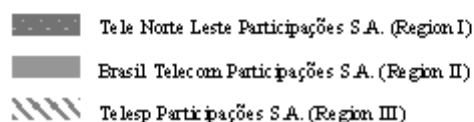
Chart 14 Distribution of Regional Fixed-Line Service Providers

The Brazilian regulator of the telecommunication industry, Anatel, pursued a policy to promote competition and allowed private competitors to enter the market. Nevertheless, the existing public concession service providers had to meet universalization and quality targets before they could expand in other segments and regions. Brasil Telecom reached these targets in 2004 and consequently began to offer mobile telephone services.[58]

In the next chart the stock price movement of Brasil Telecom is shown. The stock trades on the New York Stock Exchange and on the São Paulo Stock Exchange. As there are no public information available on the historical performance the BRL-stock price is just the multiplication of the USD-stock price with the respective exchange rate which also considers the change of the exchange rates during the last years. The USD-stock price is on the right axis and the BRL-stock price on the left axis. [59] [60]

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[58] Form 20-F, Brasil Telecom S.A., 2006

[59] finance.yahoo.com, historical data

[60] www.oanda.com
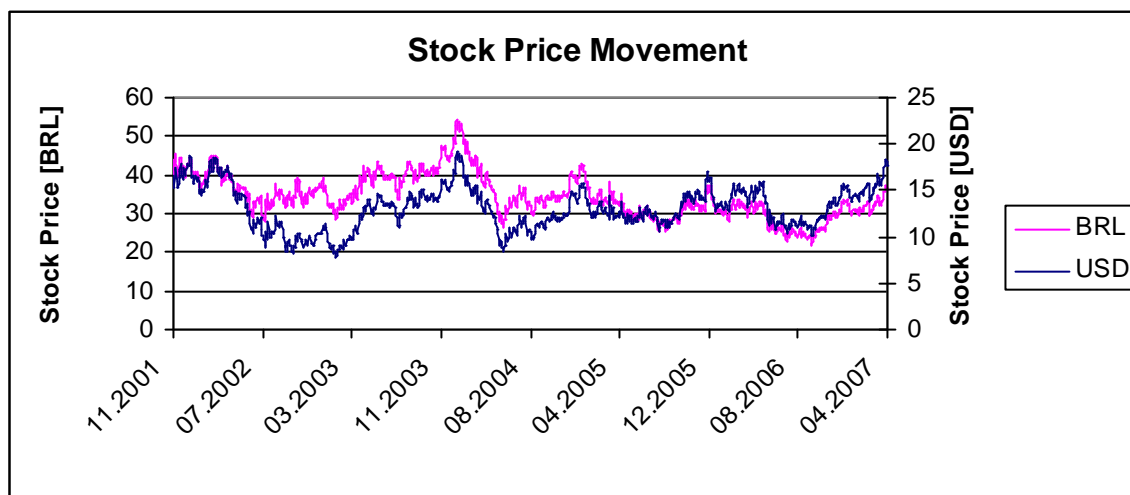
Chart 15 Stock Price Movement – BRL and USD-Basis

3.4   Reorganization of the Financial Statements

In this chapter the financial statements of Brasil Telecom will be reorganized and simplified to use this input for financial modeling. The original statements given in the appendix would contain too much information to give a valuable insight into the company. The balance sheet and the income statement will be reorganized and the cash flow statement is a combination of these statements and does not need to be reorganized separately.

3.4.1 Balance Sheet

In a first step the balance sheet numbers were gathered in detailed tables shown in the appendix. The tables show the statements of current assets, non-current assets, current liabilities and non-current liabilities. The first table in the appendix shows the current assets of Brasil Telecom. Especially the trade accounts receivable have a high value probably due to bad payment behavior in Brazil. The second table shows the non-current assets and most of these assets are concentrated in property, plant and equipment. We also see an increase in 2004 due to the expansion in the mobile services sector.

The next two tables show the liabilities and according to accounting standards there is always a split between current and non-current liabilities. The main liabilities are taxes, provision for contingencies and accounts payable. Provisions for contingencies are recorded in the

segments tax, civil suits and labor. The non-current liabilities include the interest-bearing liabilities and the shareholder's equity. As it can be seen in the table with the multiples the ratio between debt and aggregated value is 0.23.

Using all this information would result in a model with more than 100 balance sheet lines and therefore the next table is a reasonable simplification of the balance sheet organization. Cash could also be included in the item current assets but it is necessary to model it in a separate line to keep the balance sheet and the income statement consistent with the cash flow statement. Working capital includes all balance sheet positions of the current assets and permanent assets are equivalent to the position non-current assets. The liabilities are equally split. Working capital includes most of the current assets like accounts payable, payroll and related accruals. Debt includes all interest-bearing liabilities and equity is the shareholders' equity as given in the balance sheet.

	2001	2002	2003	2004	2005
Assets					
Cash	24	2	5	2.052	5.106
Current Assets	2.597.026	4.000.702	4.590.216	6.146.764	6.309.004
					62,2%
Total cost	30.676.093	31.976.806	30.087.446	32.212.409	33.948.618
Accumulated depreciation	-18.435.823	-20.716.181	-20.520.203	-22.842.318	-25.261.011
Net PP&E	12.240.270	11.260.625	9.567.243	9.370.091	8.687.607
Other assets	936.231	1.170.869	1.449.539	1.883.596	1.726.372
Permanent assets	13.176.501	12.431.494	11.016.782	11.253.687	10.413.979
Total assets	15.773.551	16.432.198	15.607.003	17.402.503	16.728.089
Liabilities					
Current Liabilities	3.481.201	3.376.976	3.833.949	5.137.293	5.865.581
	56,5%	47,8%	48,4%	56,7%	57,9%
Debt	4.035.150	5.081.807	4.635.837	5.281.498	4.908.225
Equity	8.257.200	7.973.415	7.137.217	6.983.712	5.954.283
Total liabilities	15.773.551	16.432.198	15.607.003	17.402.503	16.728.089

Table 5 Reorganization of Balance Sheet, Brasil Telecom 2001-2005

3.4.2 Income Statement

The income statement also has to be simplified as there is not enough public information available to forecast detailed positions of the revenues or of the non-operating expenses. Therefore, it was also necessary to simplify the income statement to reach meaningful results at the end.

The table "Net operating revenues" shows the detailed split of the revenues. Local services contribute most to the net operating revenues and there are two main sources of revenues. These two revenue streams are the monthly charges and the measured service charges. The other areas contributing to the revenues are long distance services, mobile telephone services and other services including network services and data transmissions. At the end the sum is reduced by taxes and discounts given to the customers.

The next table shows the operating structure of Brasil Telecom. The cost of services is split mainly into depreciation and service costs to operate the network. The other two parts are the operating expenses and other operating expenses. The operating expenses are mainly selling expenses and administrative expenses and other operating expenses include positions as different as provisions, taxes and infrastructure rentals and can be seen in the appendix of this thesis. At the end of the appendix the financial expenses, non-operating expenses, taxes and dividends which are the last lines of the simplified income statements are shown.

	2001	2002	2003	2004	2005
Revenues	6.158.408	7.071.368	7.915.194	9.064.855	10.138.684
Fixed Costs (Depreciation)	-2.630.001	-2.635.014	-2.535.001	-2.498.734	-2.278.510
	-21,5%	-23,4%	-26,5%	-26,7%	-26,2%
Variable Costs	-3.554.662	-3.834.786	-4.820.824	-5.790.647	-7.794.677
EBIT	-26.255	601.568	559.369	775.474	65.497
Interest expenses	-287.747	-667.743	-1.050.918	-860.746	-822.754
Losses on foreign currency financing and monetary variations	-126.730	-152.788	-96.447	-212.066	-438.184
Interest income	178.120	201.632	302.563	493.298	664.699
Non-operating expenses	-93.071	-64.497	-541.691	-112.073	-149.024
EBT	-355.683	-81.828	-827.124	83.887	-679.766
Taxes	199.039	111.596	320.751	75.012	389.066
Dividends	-50.834	-41.387	-1.062	-60.059	-12.971
Net Income	-207.478	-11.619	-507.435	98.840	-303.671

Table 6 Reorganization of the Income Statement, Brasil Telecom, 2001-2005

The three years from 2002 to 2005 will be used to calibrate and the values of 2005 will be used to validate the model. Of course, a validation for only one year cannot offer very meaningful results but generates an understanding of the properties of the system.

3.4.3 Cash Flow Statement

The last component of the financial model is the cash flow statement to calculate the free cash flow to value the company in the framework of discounted cash flows. The main result will be the free cash flow generated during one accounting year. It starts with the Earning before interest, taxes and amortization and calculates the taxes on this base. In a next step the depreciation is added and the change of the working capital and capital expenditures are taken into consideration. The sum of these positions is the free cash flow which will be later used to value the company.

	2002	2003	2004	2005
EBITA	601.568	559.369	775.474	65.497
- Taxes on EBITA	-150.392	-139.842	-193.869	-16.374
NOPLAT	451.176	419.527	581.606	49.123
NOPLAT	451.176	419.527	581.606	49.123
+ Depreciation	2.635.014	2.535.001	2.498.734	2.278.510
Gross Cash Flow	3.086.190	2.954.528	3.080.340	2.327.633
+/- Change of Current Assets	-1.403.676	-589.514	-1.556.548	-162.240
+/- Change of Current Liabilities	-104.225	456.973	1.303.344	728.288
- Capital Expenditure	-1.300.713	1.889.360	-2.124.963	-1.736.209
Gross Investment	-2.808.614	1.756.819	-2.378.167	-1.170.161
Gross Cash Flow	3.086.190	2.954.528	3.080.340	2.327.633
- Gross Investment	-2.808.614	1.756.819	-2.378.167	-1.170.161
Free Cash Flow	277.576	4.711.347	702.173	1.157.472

Table 7 Cash Flow Statement, Brasil Telecom, 2001-2005

It is interesting to see that the free cash flow is substantially higher in 2003 as the company sold part of its net property, plant and equipment.

3.5   Revenue Drivers

In this chapter a model to forecast future revenues will be introduced. The first idea was to calculate the sensitivity of the gross operating revenues to the marketing expenses which means how much additional revenue generates one additional unit of marketing expenses. Some academics introduce concepts like price elasticity or a revenue model as a function of marketing expenses.[61]

Unfortunately, Brasil Telecom does not supply the necessary information publicly and therefore other balance sheet positions and income statement positions had to serve as proxies for the following calculations. [62]

The main idea is to find three variables which could reasonably explain the revenue stream of the company. The first term which will be included is the precedent revenue number multiplied by the real GDP growth.

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[61] Bauer, 2006, p.85

[62] 20-F Brasil Telecom, www.sec.gov/egar.shtml

The second term is the position "Investing Activities" of the income statement. As the assets (network, cables, etc.) generate the revenues it seems to be reasonable to add a term which represents the change of these assets during a given period.

The third variable is a non-financial number and is the number of fixed phone lines in Brazil. The number of fixed phone lines is the only operational number forecasted for the next five years in this segment. That means that the first growth factor is given by the macroeconomic environment, the second growth factor can be determined by the company's management and the third growth factor is an external factor with a deterministic growth trend.

The revenue function was derived using the following equation and then applied to the years 2002 to 2004. There are 3 equations and 3 unknown variables and the results for the variables are shown in the table below.

$$S_t = a_S * S_{t-1} * (1 + y_t) + b_S * I_t + c_S * F_t$$

Formula 21 Revenue Model

This table shows the solution for the previous formula and gives the values for a_S, b_S and c_S.

	2001	2002	2003	2004	2005
Revenues	6.158.408	7.071.368	7.915.194	9.064.855	10.138.684
Revenues (Model)		7.071.368	7.915.194	9.064.855	9.845.629
Revenues (t-1) * (1 + Real GDP-Growth		6.275.418	7.106.725	8.303.039	9.273.347
Investing Activities		1.300.713	-1.889.360	2.124.963	1.736.209
No of Fixed Phone Lines		34.000	39.295	39.270	39.160
a_S		0,83	0,83	0,83	0,83
b_S		0,04	0,04	0,04	0,04
c_S		53,82	53,82	53,82	53,82

Table 8 Revenue Model

Trying to interpret this table economically, it means that most of the revenues are auto-regressive. Nevertheless, an additional unit of investing activities generates 0.04 additional units of revenues.

3.6 Debt Level and International Financing

The next area where a strategy will be applied is the financing strategy. The management can pursue different strategies concerning the sourcing of new debt. In the case of Brasil Telecom

the company can finance its operation in domestic or foreign currency debt and choose between fixed and variable rate debt. In the next table a historic view of the financing is shown and we see that the only source of domestic debt is the floating rate debt. Concerning foreign debt, the split between floating rate and fixed rate debt is more or less equally distributed. [63]

	2001	2002	2003	2004	2005
Floating Rate Debt					
Brazilian Reais	3.698.954	4.747.146	4.369.806	3.818.489	3.465.196
Foreign Debt	336.196	175.721	153.686	663.587	492.385
Total	*4.035.150*	*4.922.867*	*4.523.492*	*4.482.076*	*3.957.581*
Fixed Rate Debt					
Brazilian Reais	0	29	20.439	16.007	29.841
Foreign Debt	0	158.912	91.906	657.247	571.704
Total	*0*	*158.941*	*112.345*	*673.254*	*601.545*
Hedge adjustments		0	0	126.168	349.099
Total	4.035.150	5.081.808	4.635.837	5.281.498	4.908.225

Table 9 Floating vs. Fixed Rate Debt and Split between Domestic and Foreign Debt

In a next step the liabilities with the respective maturities, interest rate specifications and the currency will be analyzed. It can be seen that the fixed rate debt is only used for the financing in foreign currencies and foreign-currency debt has a proportion of 23% of the overall debt. The following table shows the distribution of the different debt tranches. [64]

	2006	2007	2008	2009	2010	2011	After 2011
Debt in Dollar							
Fixed rate debt	7,4	7,4	7,4	7,2	7,0	7,0	509,0
Variable rate debt	59,2	96,8	96,5	96,2	94,3	45,1	0,7
Debt in Brazilian reais							
Fixed rate debt	5,0	5,0	0,4	0,0	0,0	0,0	19,0
Variable rate debt	1.360,4	736,4	343,6	750,1	250,1	47,9	0,0

Table 10 Debt maturity table

To model the future path-dependent debt interest expenses it is necessary to find a management strategy for the debt financing. However, the management can pursue different strategies but also faces some constraints. The company cannot cancel their debt positions before the end of the respective maturity and it is also supposed that there is a cap on foreign-

[63] 20-F Brasil Telecom, www.sec.gov/edgar.shtml

[64] 20-F Brasil Telecom, www.sec.gov/edgar.shtml

currency debt. Fixed rate debt in Brazil will only represent a small share of the overall debt. These aspects are extensively covered in the fifth chapter of this thesis.

4   Valuation Methods and Framework

4.1   Introduction

The objective of this chapter is to introduce a valuation framework, simulate different financial strategies and analyze how they affect the company's value. The main focus of this chapter will be to establish a strategy-based framework to analyze decisions in the operating and financing sector. The framework is designed to be either used by external analysts looking at the company or for the company itself to analyze decisions concerning these two segments.

4.2   Valuation Methods

In the following chart the three main approaches are displayed. Those three approaches are the cost approach, the income approach and the market approach. In this thesis only the discounted cash flow valuation as part of the income approach will be used but the main characteristics of the other approaches will also be shortly described. [65]

Cost Approach	→	Replacement cost		Liquidation Value
Income Approach	→	Residual Income Valuation		Discounted Cash Flow Valuation
Market Approach	→		Stock Market Multiples	
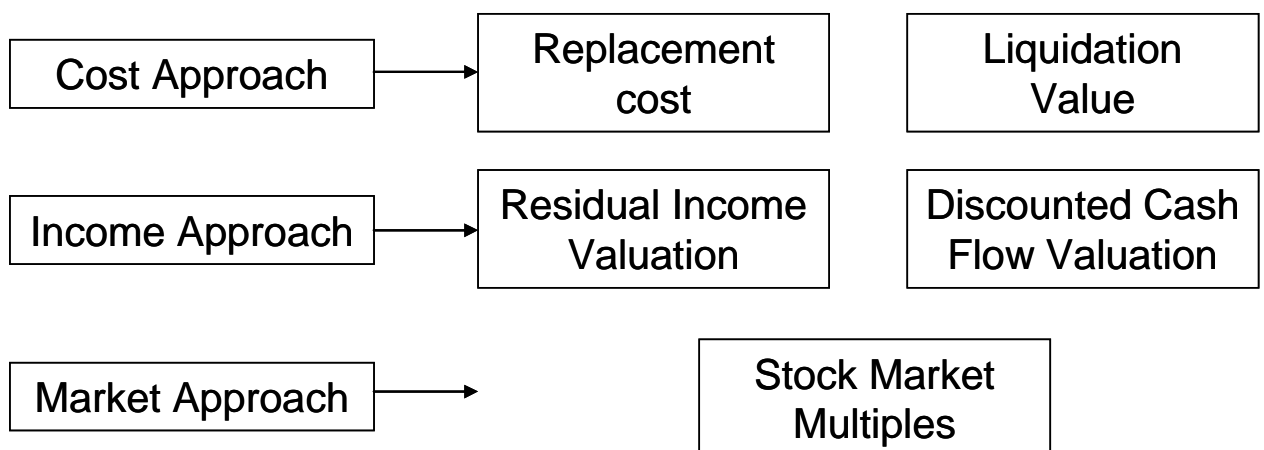
Chart 16 Valuation Methods

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[65] Fux, 2006, p. 15

At the beginning, the two methods of the cost approach will be presented. The first method is the valuation considering replacement costs. This method analyses the market value of all items which contribute to the earnings but do not consider intangible items and for example fails to value synergies of different assets. The second method is the liquidation value approach. Assuming that the company discontinues its operations the liquidation value is determined. Only in this special case it is a reasonable approach. Otherwise the valuation using liquidation value fails to connect to economic reality. Both approaches represent a lower limit of the valuation and can give a first idea of the company's value.[66]

The income approach includes two popular valuation methods which are the residual income valuation method and the discounted cash flow method. The latter will be extensively covered in the course of this chapter and used as a base for the valuation framework. The key concepts of the residual income valuation are, just to mention two, the Economic Value Added Concept and the Ohlson-Feltham Model. Both models are a measure of surplus value created on an investment. It is a powerful concept but in reality limited because of inconsistencies within accounting principles.[67] [68]

The third approach is the market approach and one of the most widely used. In the section "Brazilian Telecommunication Industry" a few multiples were used to show differences in the valuation of the companies. The main idea is that the same company should have the same valuation on the stock market and therefore it is a concept of relative prices. There exist a wide range of multiples but two widely used multiples are the P/E-Multiple and the AV/EBITDA-Multiple. The price-to-earnings ratio gives the relation between earnings and price on the stock market but has some flaws as it commingles operating and non-operating items. Therefore the AV/EBITDA-Multiple is a more reliable key figure as it shows the relation between operating earnings before interest, taxes, depreciation and amortization and relates it to the aggregate value of the company. [69] [70]

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[66] Stellbrink, 2005, p. 64

[67] Fernandez, 2003, p.3

[68] Ohlson, 2000, p. 1

[69] Koller, 2005, 371ff

[70] Richter, 2005, p. 174

4.3 Discounted Cash Flow Method

The Discounted Cash Flow (DCF) Method is probably the most accepted valuation method in the financial sector. The discounted cash flow method is convenient to use and offers meaningful insights into the company.

The first step is to determine the free cash flow which is calculated as part of the cash flow statement and is the sum of operating and investing cash flows. Following this procedure the forecasts of the different balance sheet and income statement positions have to be made. In the case of this valuation framework it depends on the respective strategy or is simply assumed to equal an average value.

4.3.1 Entity Approach

Using this approach the company is valued without considering the capital structure and focusing solely on the operating earnings. Therefore this approach is used to compare different companies with different leverage levels.

At the beginning of the valuation the free cash flow has to be determined and most textbooks favor slightly different methods. The reference used for the calculations will be McKinsey's "Valuation" which is one of the standard text books concerning valuation. Free Cash Flows will be determined following the next formula. [71]

---

[71] Koller, 2005, p. 109ff

Revenues	$S_{t,n}$	=	$a_S * S_{t-1,n} * (1+y_{t,n}) + b_S * I_{t,n} + c_S * F_t$
- Variable Costs	$C_{V,n,t}$	=	$\hat{a}_{CV} * S_{t,n}$
- Fixed Costs	$C_{F,n,t}$	=	$a_{CF} * NPPE_{t-1,n}$
EBITA			

EBITA			
- Taxes on EBITA	T	=	$EBITA * (1-T)$
NOPLAT			

NOPLAT			
+ Depreciation	$C_{F,t,n}$	=	$a_{CF} * NPPE_{t-1}$
Gross Cash Flow			

+/- Change of Current Assets	$CA_{t,n}$	=	$CA_{t-1,n} - CL_{t,n} = \hat{a}_{CA} * S_{t-1,n} - \hat{a}_{CA} * S_{t,n}$
+/- Change of Current Liabilities	$CL_{t,n}$	=	$CL_{t,n} - CL_{t-1,n} = \hat{a}_{CL} * S_{t,n} - \hat{a}_{CL} * S_{t-1,n}$
- Capital Expenditure	$I_{t,n}$	=	$\hat{a}_I * S_{t-1,n}$
Gross Investment			

Gross Cash Flow			
- Gross Investment			
Free Cash Flow	$FCF_{t,n}$		

Formula 22 Free Cash Flow

EBITA are the earnings before interest, taxes and amortization and can be found in the income statement of the company. The taxes are calculated on this basis and the assumption will be made that the taxes are 25% of this amount. Analyzing the company from the outside there is no possibility to make a detailed forecast of the actual tax payment. Although we do not consider the tax shield value at this moment, the *WACC* is designed to integrate this tax shield by reducing the real rate of debt.

Any increase in the working capital lowers the free cash flow as additional working capital ties cash. On the other side an increase in current liabilities has a positive effect on free cash flow. Economically interpreted, it means that suppliers are partly financing the assets of the company.[72] The last item is capital expenditures and is mainly made up of investments in property, plant and equipment. At the end the difference of gross cash flow and gross investment results in the free cash flow.

In one of the following chapters the forecasting techniques will be explained. At the end the free cash flows have to be discounted to calculate the present value of these cash flows. Therefore, a discount factor like the weighted average cost of equity is needed as the company is partly financed with equity.

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[72] Lee, 2004, p. 109ff

The weighted average cost of equity blends the required rates of return for debt k_d and the equity k_e based on their market-based values in a single formula. The marginal tax rate T_m reduces the cost of capital as the tax shield is not deducted from the free cash flow to assure comparability between companies with different debt levels.[73]

$$WACC = \frac{D}{D+E}k_d(1-T) + \frac{E}{D+E}k_e$$

$$\text{with } k_d = \frac{IE_t}{D} \text{ and } k_e = r_f + (E[R_M] - r_f)*\beta$$

Formula 23 Weighted Average Cost of Capital

All of these variables are known. D is the debt given in the balance sheet, E the market value of equity, k_d the return for debt and k_e the return for equity. The Market Premium which is given through $(E[R_M] - r_f)$ will be expected to be 6% which is a common assumption. The CAPM-Model which will be explained later is a tool to calculate the market rate of return for equity.

At the moment the discount factor and the cash flows are known so that the formula can be applied to calculate the aggregate value of the company. The next formula is a tool to calculate the aggregate value of the company as a function of the realized path. [74]

$$AV_{t=0,n} = \sum_{t=1}^{\infty} \frac{FCF_{t,n}}{(1+WACC)^t}$$

Formula 24 Aggregate Value – WACC Approach

4.3.2 Equity Approach

The equity approach is closely linked to the entity approach but only considers cash flows to the equity holders of the company. Therefore, it is a good model to value different debt policies and will be used to value different possibilities for the debt financing.

At the beginning, the cash flow to the equity holders has to be calculated. [75]

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[73] Koller, 2005, p. 297ff

[74] Stellbrink, 2005, p. 139

Revenues	$S_{t,n}$	$=$	$a_S * S_{t-1,n} * (1+y_{t,n}) + b_S * I_{t,n} + c_S * F_t$
- Variable Costs	$C_{V,t,n}$	$=$	$â_{CV} * S_{t,n}$
- Fixed Costs	$C_{F,t,n}$	$=$	$a_{CF} * NPPE_{t-1,n}$
EBIT			

EBIT			
-Interest Expenses	$i_{e,t,n}$	$=$	$r_{d,t,n} * D_{d,t} + r_{f,t,n} * D_{f,t} = \Sigma(r_{d,t,n,m} * D_{d,t,m})+ \Sigma(r_{f,t,n,m} * D_{f,t,m})$
- Losses on Foreign Currency Financ	$i_{f,t,n}$	$=$	$D_{f,t} * (e_{t-1,n} - e_{t,n})$
+ Interest Income	$i_{i,t,n}$	$=$	$r_{d,n} * CA_{t,n} * 0,2$
EBT			

EBT			
-Taxes	T	$=$	$EBT_{t,n} * (1 - T)$
- Dividends	$Div_{t,n}$	$=$	$â_{Div} * M_{t-1,n} = â_{Div} * (M_{t-2,n} + FTE_{t-1,n} - DIV_{t-1,n})$
Net Income			

Net Income			
+ Depreciation	$C_{F,t,n}$	$=$	$â_{CF} * NPPE_{t-1,n}$
Gross Cash Flow			

+/- Change of Current Assets	$CA_{t,n}$	$=$	$CA_{t-1,n} - CL_{t,n} = â_{CA} * S_{t-1,n} - â_{CA} * S_{t,n}$
+/- Change of Current Liabilities	$CL_{t,n}$	$=$	$CL_{t,n} - CL_{t-1,n} = â_{CL} * S_{t,n} - â_{CL} * S_{t-1,n}$
- Capital Expenditure	$I_{t,n}$	$=$	$â_I * S_{t-1,n}$
Gross Investment			

Change of Debt	D_t	$=$	$D_t - D_{t-1}$

Dividends	$Div_{t,n}$	$=$	$â_{Div} * M_{t-1,n} = â_{Div} * (M_{t-2,n} + FTE_{t-1,n} - DIV_{t-1,n})$

Gross Cash Flow		
+Gross Investment		
+/- Change of Debt		
+ Dividends		
Flows to equity holders	$FTE_{t,n}$	

Formula 25 Flows to Equity Holders

The following procedures are closely related to the calculations for the entity approach. In this case the discount factor must be different as there is no effect of debt financing and creditors do not have to be considered. The discount factor in this case is the market return for equity.[76] Below the formula for the equity value is given

$$EV_{t=0,n} = \sum_{t=1}^{\infty} \frac{FTE_{t,n}}{(1+k_e)^t}$$

Formula 26 Equity Value for the Equity Approach

---

[75] Koller, 2005, p. 209ff

[76] Fux, 2006, p. 52

FTE_t is the Flow to Equity in any given year t and k_e is the cost of equity for this company. Adding the formula for the Continuing Value gives us

$$EV_{t=0,n} = \sum_{t=1}^{T} \frac{FTE_{t,n}}{(1+k_e)^t} + \frac{FTE_{T,n}}{(k_e - g) * (1+k_e)^T}$$

Formula 27 Equity Value using Continuing Value

This cost of equity k_e will also be determined by applying the CAPM-Model.

4.4   Additional Issues

In this chapter a few additional issues will be discussed. These issues are the capital asset pricing model to find the cost of equity and the continuing value to analyze the company as an ongoing concern.

4.4.1 Capital Asset Pricing Model

The CAPM is one of the most famous models in finance. It simply states that the expected return of an asset is the sum of the risk free rate of return and the *β-factor* multiplied with the market premium. The *β-factor* is the covariance of the return of the asset and the market return divided by the variance of the market return. The *β-factor* reflects the sensitivity of the return of a single share to the return of the market portfolio and the formula is given in the followinf form.[77]

$$\beta_{i,M} = \frac{\mathrm{cov}(R_i, R_M)}{\sigma_M^{\,2}}$$

Formula 28 Beta Factor

Given the *β-factor* the formula for CAPM can be written as[78]:

---

[77] Perridon, 2007, p. 250ff
[78] Perridon, 2007, p. 250ff

$$E(R_i) = r_f + [E(R_m) - r_f]\beta_i$$

Formula 29 Capital Asset Pricing Model

This formula states that the expected return for any asset is the sum of the risk free return and a risk-adjusted share of the market return. In the case of a risky asset this share will be higher and in the case of a more secure asset this share will be lower.

The market portfolio is in this case the Dow Jones Index. Of course it is not the best market portfolio but it can be argued that is the relevant portfolio from the perspective of an international investor. [79]
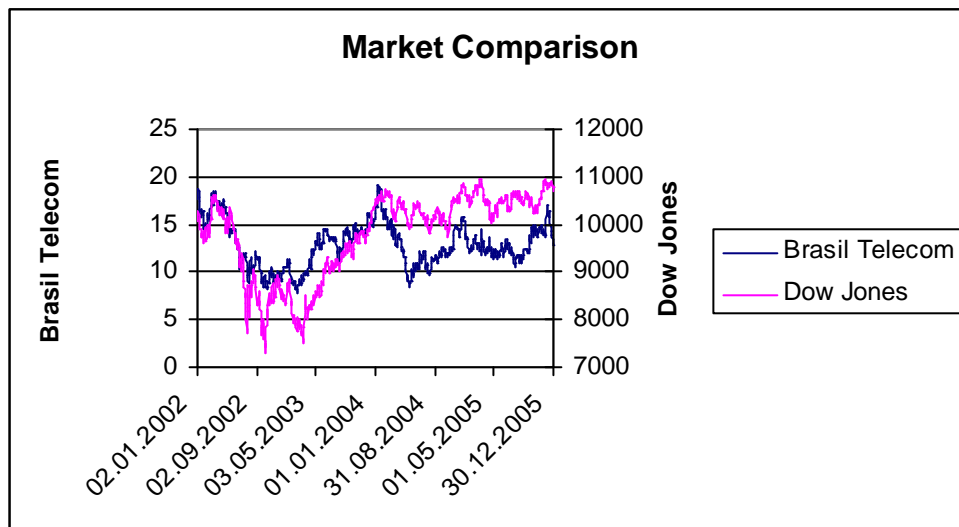
Chart 17 Market Comparison

4.4.2 Continuing Value

Nevertheless, the company is seen on an ongoing basis and as the free cash flows cannot be discounted forever there must be a formula to calculate the continuing value of the company. In most cases this continuing value represents a large share of the enterprise value. In this framework a version will be used which also allows including a future growth value for the company. The formula is given in the following form.

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[79] finance.yahoo.com

$$CV_{t,n} = \frac{FCF_{t,n}}{WACC - g}$$

Formula 30 Continuing Value

This formula can be used to simplify the discounting of the free cash flows and adding this formula to the discounted cash flow model results in a formula for the aggregate value.

$$AV_{t=0,n} = \sum_{t=1}^{T-1} \frac{FCF_{t,n}}{(1+WACC)^t} + \frac{FCF_{T,n}}{(WACC - g) * (1+WACC)^T}$$

Formula 31 Aggregate Value using Continuing Value

To conclude this chapter the main parameters for the valuation of Brasil Telecom have to be calibrated. Therefore, the free cash flows from 2002 to 2005 are used to value the company and this discounted cash flow value should equal the enterprise value which consists of interest-bearing debt, pension liabilities, minority interest and the market capitalization shown in the next table. [80] [81] [82]

Interest-bearing debt	4.035.150
Pension liabilities	-136.835
Minority interests	0
Stock Price	14,237
Shares	530.383.166
Aggregate Value	11.449.526

Table 11 Market Capitalization on December 31, 2002

Finally, the free cash flows of the next years are discounted and the parameters are calibrated to the given enterprise value. The free cash flow is given in the following table.

	2002	2003	2004	2005
Free Cash Flow	277.576	4.711.347	702.173	1.157.472

Table 12 Historic Free Cash Flows

Most of the parameters to value the company are given. The cost of debt k_d is given as ratio of interest expenses to debt and the cost of equity k_e is calculated using the Capital Asset Pricing Model. Debt and market value of equity are also given and the only parameter to calibrate is the growth rate g used for the continuing value formula. These parameters are given in the next table.

---

[80] Form 20-F, Brasil Telecom, 2002

[81] www.oanda.com

[82] finance.yahoo.com

Cost of debt	16,76%
Tax rate	25,00%
Risk Free Rate of Return	3,88%
Market return	6,00%
Beta	1,52
Debt	4.035.150
Equity	7.551.211
Growth-Rate	4,20%
WACC	12,86%

Table 13 Parameters for Calibration

4.5   Forecasting

Forecasting remains one of the most sensible areas as little differences can result in significant deviations. In the course of this chapter the main assumptions, techniques and value drivers will be presented.

4.5.1 Balance Sheet

The forecast of the balance sheet will be split in the positions detailed in the following subchapters. This split enables a better modeling and better results

4.5.1.1   Cash

Financial reports consist of the cash flow statement, the balance sheet and the income statement. In the following chart the mechanics behind the cash item are shown. [83]

---

[83] Lee, 2004, p. 34

Cash Flow	
Cash from operations	200
Cash from investing	-150
Cash from financing	-45
Increase in cash	5

Balance Sheet 01.01.06	
Fixed assets	100
Inventory	25
Cash	10
	135
Share capital	35
Retained Earnings	100
	135

Balance Sheet 31.12.06	
Fixed assets	105
Inventory	90
Cash	15
	210
Share capital	35
Retained Earnings	175
	210

Income Statement 01.01.2006 - 31.12.2006	
Revenues	1000
- Cost of Goods Sold	-800
Gross Profit	200
Selling, General & Administrativ Expenses	-50
	150
- Tax	-50
	100
- Dividends	-25
	75

Chart 18 Cash Linkage between Cash Flow Statement and Cash Flow Statement

The sum of the operating cash flow, the investing cash flow and the financing cash flow represents the increase in cash which will increase or decrease the balance sheet position at the end of the accounting year.

4.5.1.2 Current Assets

The current assets include, for example, inventory or trade accounts receivable and are thought to be assets held for the short term. It is recommended to forecast current assets as percentage of revenues although other drivers like cost of goods sold would also be possible.[84]

In the following chart the historic relation between those figures is shown. This ratio is increasing and for the forecast period the average ratio between current assets and revenues which is 62.7% of revenues will be taken.

---

[84] Koller, 2005, p. 247ff
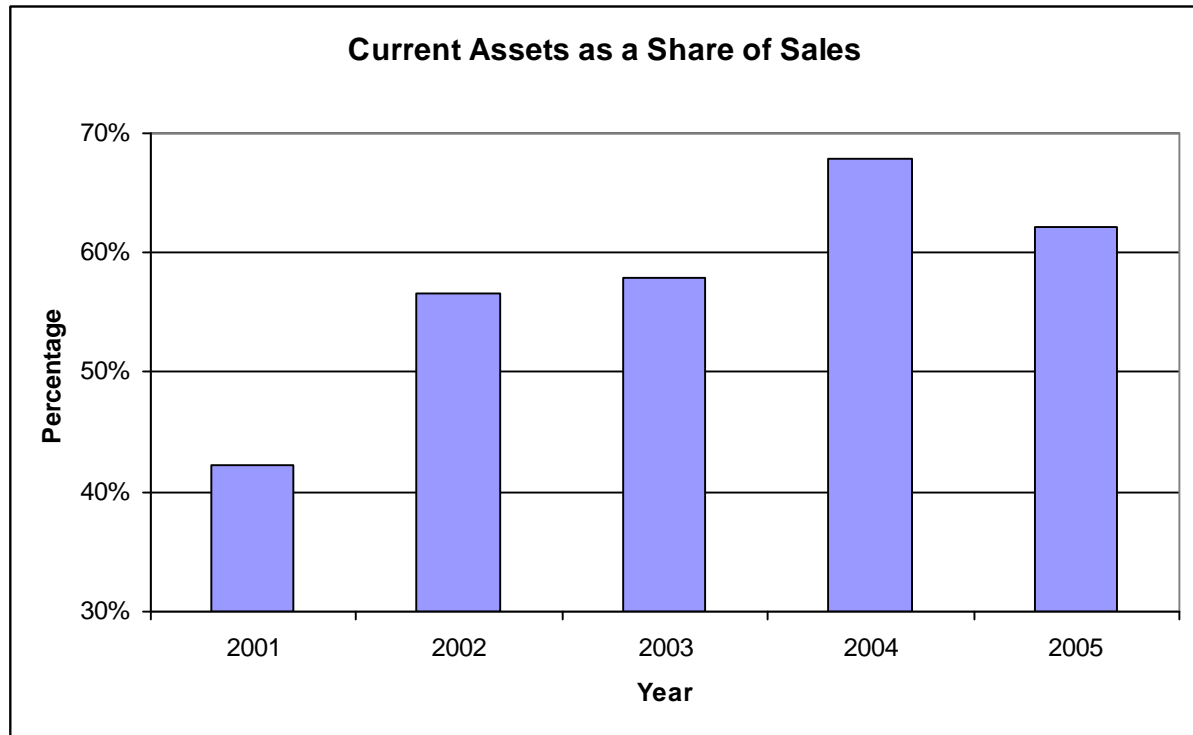
Chart 19 Current Assets as Percentage of Revenues

The ratio will be calculated using the following formula.

$$\hat{a}_{CA} = \sum_{i=1}^{3} \frac{CA_{t-i}}{S_{t-i}} * \frac{1}{3}$$

Formula 32 Current Assets as a Share of Sales

The ratio is set to 62.7% but the management has a tool to evaluate how a change of this ratio would affect free cash flow and therefore the aggregate value. Also for the sake of simplification it will be assumed that 20% of these assets are hold in temporary bank accounts and contribute to the interest income shown in the income statement.

4.5.1.3 Property, Plant and Equipment

There are two possibilities to calculate the future amount of property, plant and equipment. Either the capital expenditure is linked to the revenue stream or the net property, plant or equipment is linked to the level of revenues. For the valuation framework developed in this thesis it will be assumed that capital expenditures are a share of revenues as presented in the next chart.
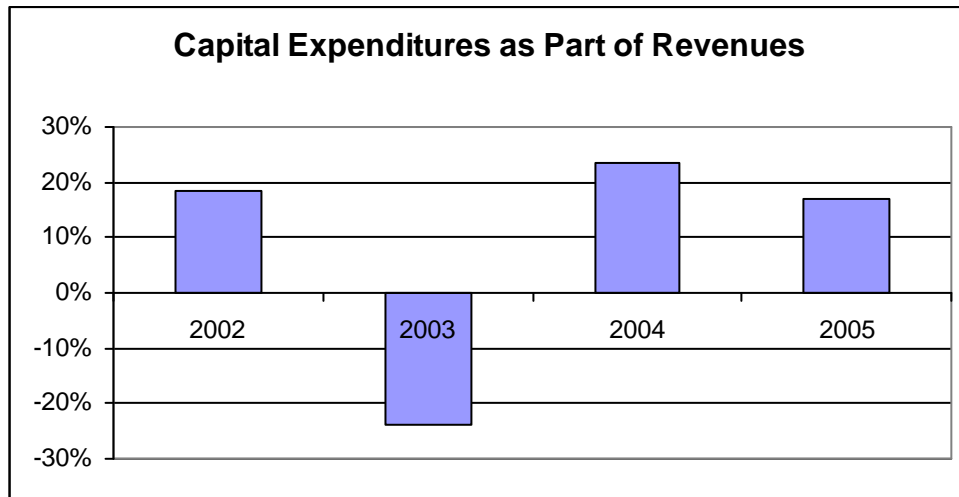
Chart 20 Capital Expenditures as Part of Revenues

Taking a look it is necessary to determine a level for the future capital expenditures as a part of revenues. This level will be calculated with the following formula.

$$\hat{a}_I = \sum_{i=1}^{3} \frac{I_{t-i}}{S_{t-i}} * \frac{1}{3}$$

Formula 33 Determination of Investing Activities as a Share of Sales

As this time series is volatile it makes sense to calculate the average which has a value of 8.8%. As the investing activities drive the revenues of the respective year it is unavoidable to link this ratio to the previous year's revenues. This ratio will be used to forecast capital expenditures and consequently forecast property, plant and equipment.

4.5.1.4 Other assets

This position includes investments, intangibles and other assets as given in the annual report. As there is no detailed information available it will be assumed that this position will be constant during the forecast period not taking depreciation for these assets into account.

4.5.1.5   Current Liabilities

As the current assets, the current liabilities will also be calculated as part of revenues.[85] The historic development of this share is shown in the next chart.

Current Liaibilities as Percentage of Revenues
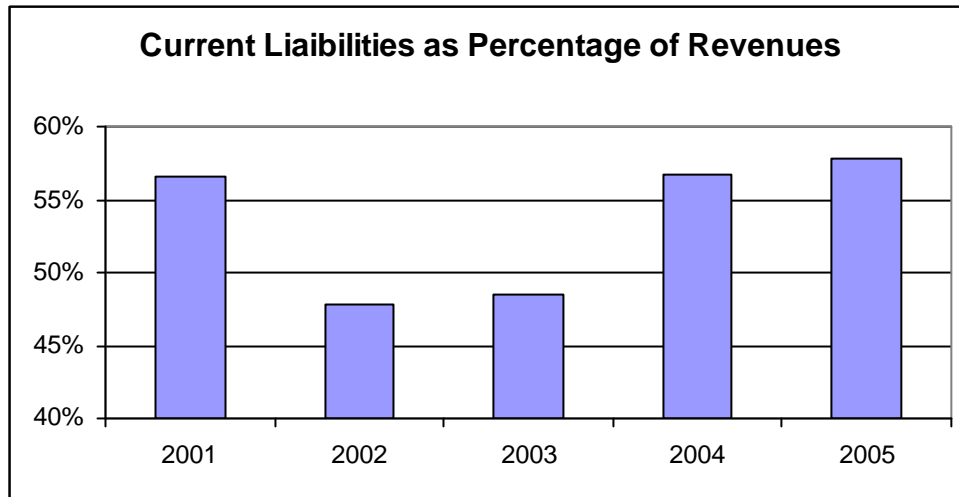
Chart 21 Current Liabilities as Percentage of Revenues

It will also be considered that the management can set a level for the current liabilities as a strategic tool and this level will be calculated using the following formula.

$$\hat{a}_{CL} = \sum_{i=1}^{3} \frac{CL_{t-i}}{S_{t-i}} * \frac{1}{3}$$

Formula 34 Determination of Current Liabilities as a Share of Sales

Taking a look at these historic figures it can be seen that these current liabilities are increasing but nevertheless the average of the last three years will be used as a ratio. The ratio is 54.3%.

4.5.1.6   Debt

The question of the optimal capital structure is still not solved and at the moment there exist different schools of thought. Some follow the approach of Miller and Modigliani which says that both capital structure and dividend policy are largely irrelevant as they have no significant, predictable effect on corporate market values. Another line of argument states that

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[85] Koller, 2005, p. 207ff

corporate managers are mainly concerned with the signaling effects of those decisions as stock prices have the tendency to fall in response to common stock offerings and to rise in response to leverage-increasing recapitalizations. These results lead to the pecking order theory saying that managers have different preferences for their financial decisions. They prefer retained earnings to outside financing, and debt is preferred to equity in the case of outside financing. These facts imply that the debt level is just a result of financial decisions following the path of least resistance. The last school of thought says that financial managers just balance the tax shield of greater debt against the increased probability and costs of financial distress. [86]

In the next chart the described need for the balancing between increased tax savings and increased cost of business erosions is shown. [87]
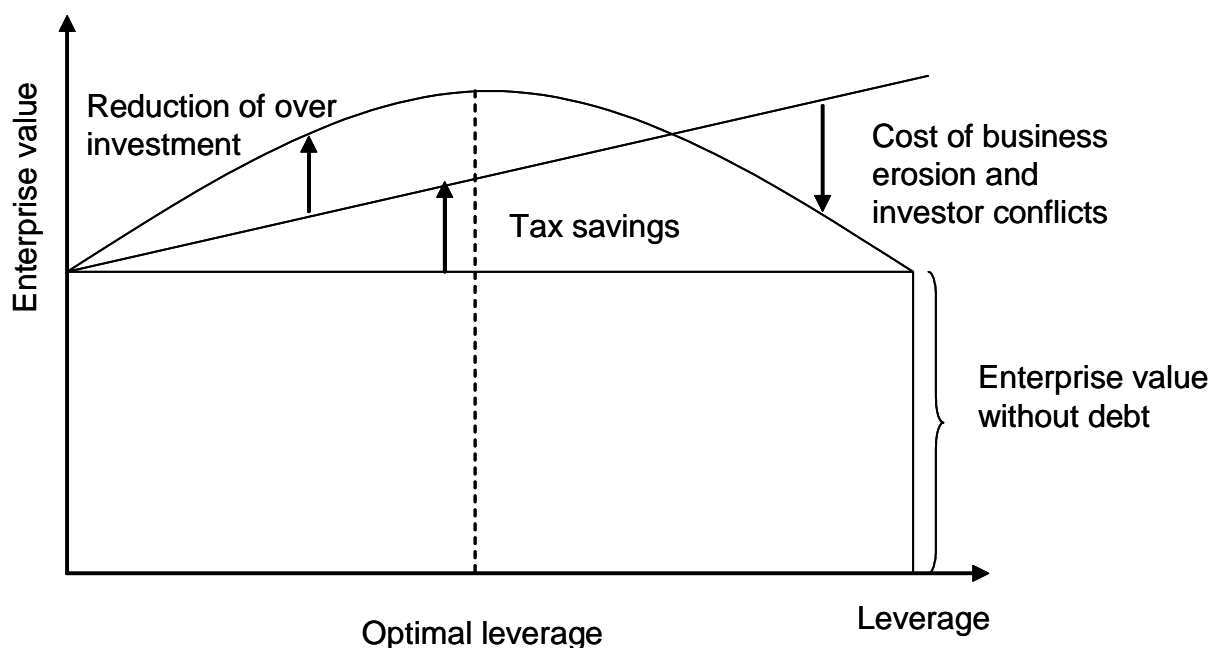
Chart 22 Capital Structure Value Trade-Offs

In the case of Brasil Telecom there is no possibility to estimate the different effects of leverage on the costs of doing business. The only choice is to either leave this ratio at the same level or take a look at the key competitors and setting leverage similar to the peer group. In this peer group-based case the company has no disadvantages but also no advantages compared with their competitors. Taking a closer look at the industry structure it can be seen

[86] Barclay, 1999, p. 1

[87] Koller, 2005, p. 488ff

that all competitors are subsidiaries of international telecommunication companies as stated in the respective annual reports. For the later valuation the absolute debt level will be left unchanged.

4.5.1.7 Equity

The financial model consists of the balance sheet, the income statement and the cash flow statement. As in the case of cash, equity also links the balance sheet and the income statement. This relation is given in the next chart and will also be used to model this balance sheet position. [88]

Cash Flow	
Cash from operations	200
Cash from investing	-150
Cash from financing	-45
Increase in cash	5

Balance Sheet 01.01.06	
Fixed assets	100
Inventory	25
Cash	10
	135
Share capital	35
Retained Earnings	100
	135

Balance Sheet 31.12.06	
Fixed assets	105
Inventory	90
Cash	15
	210
Share capital	35
Retained Earnings	175
	210

Income Statement 01.01.2006 - 31.12.2006	
Revenues	1000
- Cost of Goods Sold	-800
Gross Profit	200
Selling, General & Administrativ Expenses	-50
	150
- Tax	-50
	100
- Dividends	-25
	75

Chart 23 Equity Link between Balance Sheet and Income Statement

---

[88] Lee, 2004, p. 34

4.5.1.8 Forecasted Balance Sheet

These forecasts results in a balance sheet according to the described methodology and will be presented in the following table. The forecasts will be shown for the path 47.

	2006	2007	2008	2009	2010
Assets					
Cash	1.106.317	2.316.270	3.251.940	4.029.020	4.624.378
Current Assets	6.673.872	6.929.541	7.145.283	7.328.092	7.476.975
Total cost	34.840.822	35.777.506	36.750.073	37.752.920	38.781.424
Accumulated depreciation	-27.563.227	-29.491.790	-31.157.504	-32.639.535	-33.994.582
Net PP&E	7.277.595	6.285.716	5.592.569	5.113.385	4.786.842
Other assets	1.726.372	1.726.372	1.726.372	1.726.372	1.726.372
Permanent assets	9.003.967	8.012.088	7.318.941	6.839.757	6.513.214
Total assets	*16.784.157*	*17.257.899*	*17.716.163*	*18.196.869*	*18.614.566*
Liabilities					
Current Liabilities	5.779.765	6.001.181	6.188.020	6.346.338	6.475.275
Debt	4.908.225	4.908.225	4.908.225	4.908.225	4.908.225
Equity	6.096.167	6.348.493	6.619.918	6.942.305	7.231.066
Total liabilities	*16.784.157*	*17.257.899*	*17.716.163*	*18.196.869*	*18.614.566*

Table 14 Forecasted Balance Sheet – Path 47

4.5.2 Income Statement

As it was done for the items of the balance sheet also the positions of the income statement will be separately forecasted. Those forecasts allow to model different strategies and give additional insight which impact they would have on the bottom line.

4.5.2.1 Revenues

In the third chapter the relationship between Revenues and its drivers investing activities, last year revenues adjusted for GDP growth and the number of fixed lines in service was given.

This relationship will also be used to forecast the revenues for the future. This relation was calibrated in the third chapter and can be written in the following form.

$$S_{t,n} = a_S * S_{t-1,n} * (1 + y_{t,n}) + b_S * I_{t,n} + c_S * F_t$$

Formula 35 Revenue Forecast Formula

Datamonitor is one of the companies publishing forecasts for the Brazilian telecom industry and in the following chart these forecasts are shown. As there are no forecasts available for the number of Fixed Lines in Service after 2010 this number will be assumed to be the long-term realization value. [89]
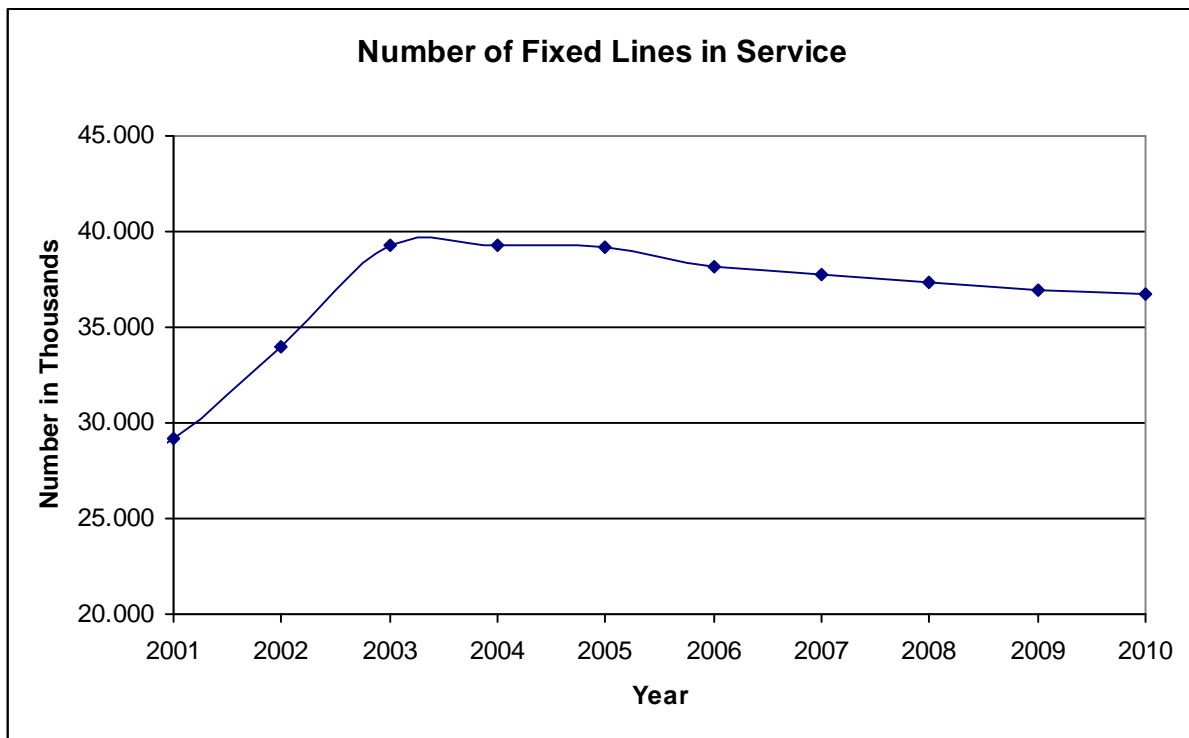
Chart 24 Number of Fixed Lines in Service

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[89] Datamonitor, 2006, p. 62

4.5.2.2 Fixed Costs

In the case of this valuation framework the fixed costs include only depreciation as the reasoning goes that all other costs are in the short-term to mid-term variable costs. Following the literature, depreciation is linked to Net Property, Plant and Equipment.[90]

Depreciation as a Percentage of Net Property, Plant and Equipment
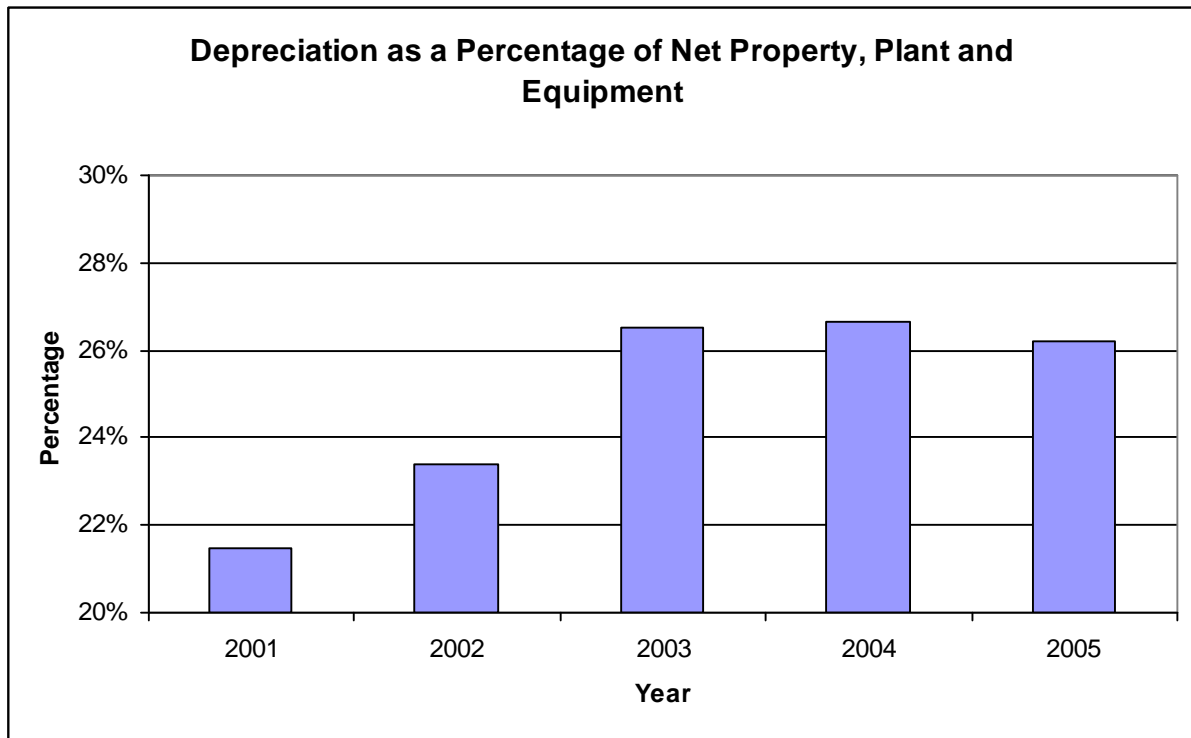
Chart 25 Depreciation as a Percentage of Net PP&E

For the forecast period of Brasil Telecom it will be assumed that the depreciation rate to Net Property, Plant and Equipment is equal to the arithmetic average of the last three years given in the following year.

$$a_{CF} = \sum_{i=1}^{3} \frac{C_{F\,t-i}}{NPPE_{t-1-i}} * \frac{1}{3}$$

Formula 36 Depreciation as a Share of Net PP&E

The ratio will be 26.5% and for the forecast period the Continuing Value will be applied to the previous year's result.

---

[90] Koller, 2005, p. 242ff

4.5.2.3   Variable Costs

Also following the literature, these variable costs are linked to revenues as they only do occur when revenues are generated.[91]

Variable Costs as Percentage of Revenues
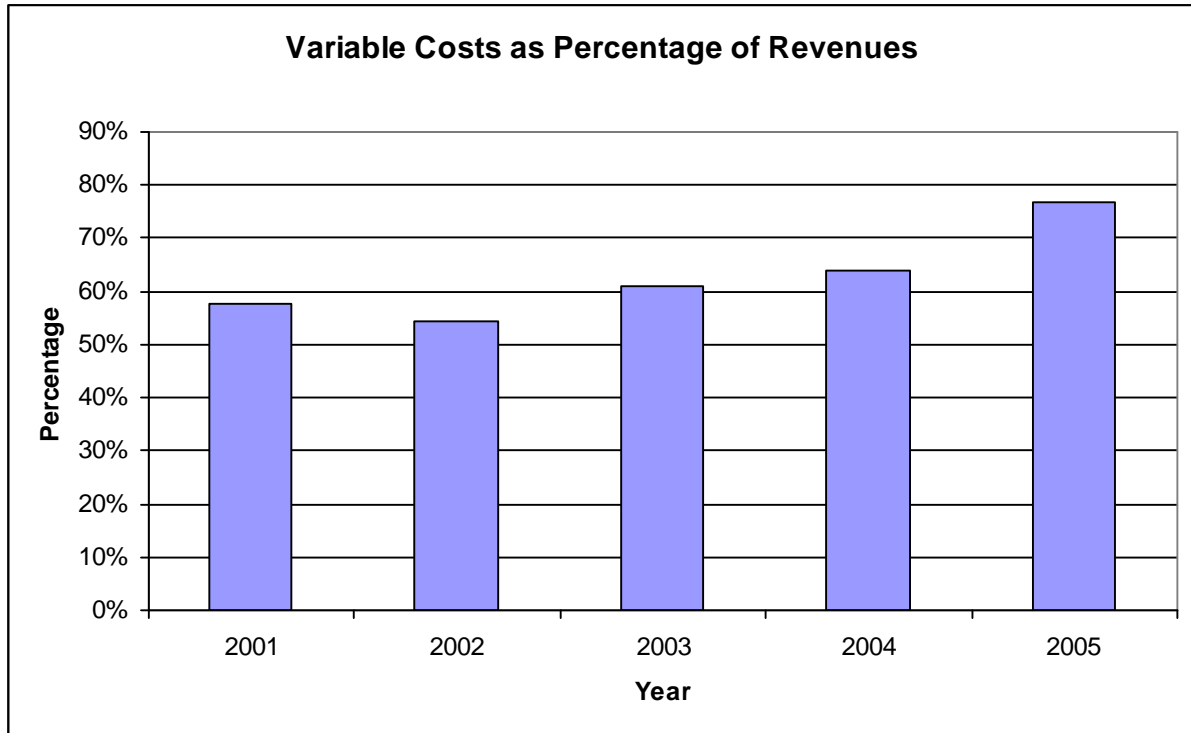
Chart 26 Variable Costs as Percentage of Revenues

This ratio was constantly increasing over the last years as it seems that competition is increasing. As it cannot be assumed that the ratio will decline, the ratio $\hat{a}_{CV}$ will be set to 75%.

4.5.2.4   Net Financial Expenses

The Net Financial Expenses consists of three items which are interest expenses, losses due to monetary variations and interest income. Those three positions are detailed in the following subchapters.

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[91] Koller, 2005, p. 236ff

4.5.2.4.1 Interest Expenses

Interest Expenses will be the main issue in the following chapter analyzing different financing strategies. The company has four different classes of debt and these classes are:

- Domestic Debt – Variable Rate Debt

- Domestic Debt – Fixed Rate Debt

- Foreign-Currency Debt – Variable Rate Debt

- Foreign-Currency Debt – Fixed Rate Debt

All of these debt positions have a respective interest rate and multiplying this interest rate with the debt position results in the interest expenses. The domestic debt is multiplied with the interest rate calculated as part of the macroeconomic environment. The foreign-currency debt positions have two different interest rates. The variable rate debt is multiplied with the current short-term interest rate given in the respective path. The fixed rate debt is calculated using the Vasicek-Model as term structure model. The short term interest rate is used as the driver to determine the yield term curve. This is given in the following formula.

$$i_{e,t,n} = r_{d,t,n} * \hat{D}_{c,t} + r_{f,t,n} * \hat{D}_{f,t} = \sum_{m=1}^{5} r_{d,t,m,n} * \hat{D}_{d,t,m} + \sum_{m=1}^{5} r_{f,t,m,n} * \hat{D}_{f,t,m}$$

Formula 37 Interest Expenses

i_e represents the interest expenses and r is the interest rate for the respective maturity, currency and path as given in the indices and D is the share of domestic and foreign-currency debt.

4.5.2.4.2 Losses due to foreign currency variations

The company sources a portion of its debt in foreign currency and faces the risk of currency depreciation. The theory states that an increase in the foreign currency causes a decrease of the currency. The interest rate parity of the second chapter will be used as framework to calculate these monetary variations.

$$i_{f,t,n} = \hat{D}_{f,t} * (e_{t-1,n} - e_{t,n})$$

Formula 38 Losses due to Foreign Currency Financing

i_f stands for the losses due to foreign-currency financing caused by monetary variations. An increase of the exchange rate relative to the Brazilian Real makes the debt more expensive and therefore causes a loss in the income statement.

4.5.2.4.3 Interest Income

In the historic financial statements it can be seen that the company generates significant interest income i_i. The interest generating assets are part of the current assets and it will be assumed that 20% of the working capital is generating interest income.

$$i_{i,n} = r_{d,t,n} * CA_{t,n} * 0{,}2$$

Formula 39 Interest Income

4.5.2.5 Non-operating Costs

This item includes losses on disposal of permanent assets, write-off of permanent assets of CRT, losses on goodwill on merger of CRT, amortization of goodwill on merger of CRT and other non-operating expenses.[92] Most of these positions are not recurring and therefore non-operating costs will be set to 0.

4.5.2.6 Taxes

The Brazilian tax rules are very complex and especially as an external analyst there is no possibility to detail tax liabilities. In the course of the valuation a flat tax rate of 25% will be assumed.

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[92] Form 20-F, Brasil Telecom, 2006

4.5.2.7   Dividends

For the financial model it will be assumed that 25% of the previous year's cash amount will be paid out to investors as a dividend. *Div* stands for the paid out dividends and M is an abbreviation for the cash position in the balance sheet.

$$Div_{t,n} = \hat{a}_{Div} * M_{t-1,n} = \hat{a}_{Div} * (M_{t-2,n} + FTE_{t-1,n} - Div_{t-1,n})$$

Formula 40 Dividends

4.5.2.8   Forecasted Income Statement

In the following table the forecasted income statement using the rules outlined in the previous pages will be presented.

	2006	2007	2008	2009	2010
Revenues	10.891.608	11.394.483	11.686.930	12.220.501	12.527.863
Fixed Costs (Depreciation)	-2.302.216	-1.928.563	-1.671.486	-1.494.261	-1.370.821
Variable Costs	-8.168.706	-8.545.862	-8.765.197	-9.165.376	-9.395.898
EBIT	420.686	920.058	1.250.247	1.560.864	1.761.144
Interest expenses	-688.079	-699.241	-711.482	-714.604	-761.663
Losses on foreign currency financing and monetary variations	28.511	-12.917	-11.712	12.660	-4.470
Interest income	284.026	299.201	317.798	279.897	293.442
Non-operating expenses	0	0	0	0	0
EBT	45.145	507.102	844.850	1.138.817	1.288.453
Taxes	-11.286	-126.775	-211.212	-284.704	-322.113
	25,0%	25,0%	25,0%	25,0%	25,0%
Dividends	-1.277	-244.057	-510.089	-702.028	-845.297
Net Income	32.582	136.269	123.548	152.085	121.043

Table 15 Forecasted Income Statement – Path 47

5   Valuation and Strategies

5.1   Introduction

Few questions are more fundamental in finance than asking how a corporation should be managed. There are two types of investment decisions: capital budgeting and strategic investment. In capital budgeting, corporate managers have the responsibilities of ensuring that profitable projects are undertaken and in strategic investment the company's management is responsible for exploiting potential growth in different market segments.[93]

In this chapter two valuation methods will be applied and different strategies concerning investments or the financing structure will be analyzed with these tools.

5.2   WACC-Approach

In this chapter the main parameters and a valuation depending on the paths of the macroeconomic environment will be presented. Following this valuation using the forecasted balance sheet and income statement, the effects of additional spending on capital expenditure will be analyzed.

5.2.1 Valuation

At the beginning of the fifth chapter the main results of the valuation will be presented. In the first table the main parameters for the valuation are shown. Beta is the historic value for the last 12 months.

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[93] Ho, 2004, p. 493

Cost of debt	16,76%
Tax rate	25,00%
Risk Free Rate of Return	3,22%
Market return	6,00%
Beta	1,46
Cost of equity	12,00%
Debt	4.908.225
Stock Price	10,09
Shares	541.619
Equity	5.463.084
Growth-Rate	4,20%
WACC	12,27%

Table 16 Parameters for Valuation

Having forecasted all balance sheet lines and income statement items it is possible to calculate the free cash flow. In the following table the forecasted cash flow statement is given.

	2006	2007	2008	2009	2010
EBITA	358.818	834.412	1.183.282	1.439.856	1.626.203
- Taxes on EBITA	-89.704	-208.603	-295.820	-359.964	-406.551
	25,0%	25,0%	25,0%	25,0%	25,0%
NOPLAT	269.113	625.809	887.461	1.079.892	1.219.652
NOPLAT	269.113	625.809	887.461	1.079.892	1.219.652
+ Depreciation	2.302.216	1.928.563	1.665.715	1.482.031	1.355.047
Gross Cash Flow	2.571.329	2.554.372	2.553.176	2.561.923	2.574.699
+/- Change of Current Assets	-364.868	-255.669	-215.742	-182.809	-148.882
+/- Change of Current Liabilities	-85.816	221.416	186.839	158.318	128.936
- Capital Expenditure	-892.204	-936.684	-972.567	-1.002.847	-1.028.504
	8,8%	8,8%	8,8%	8,8%	8,8%
Gross Investment	-1.342.888	-970.936	-1.001.470	-1.027.338	-1.048.450
Gross Cash Flow	2.571.329	2.554.372	2.553.176	2.561.923	2.574.699
- Gross Investment	-1.342.888	-970.936	-1.001.470	-1.027.338	-1.048.450
Free Cash Flow	1.228.441	1.583.436	1.551.706	1.534.585	1.526.249

Table 17 Forecasted Free Cash Flow – Path 47

In the next chart the path-dependent enterprise value as a function of the taken path is shown. The other line shows the probability per path and multiplied they give the probability-weighted enterprise value.

Path-Dependent Aggregate Value
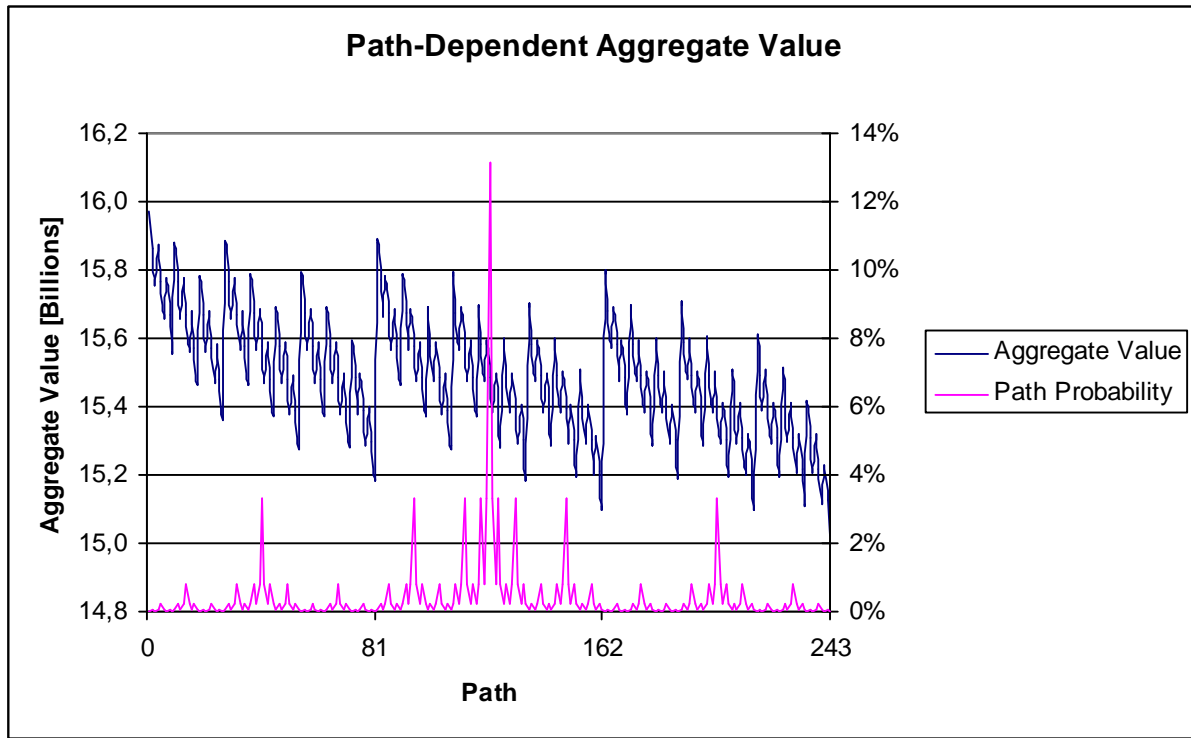
Chart 27 Path-Dependent Value with Probabilities

A multiplication of the realization of the different paths with the respective path probability results in a value of 15,486 billion Brazilian Reais. The formula used to calculate this value is given in the following formula.

$$E[AV] = \sum_{n=1}^{243} AV(FCF(\omega_n)) * P(\omega_n)$$

Formula 41 Expected Aggregate Value

The next formula gives the method to calculate the standard deviation of the different path-dependent strategies.

$$\sigma_y = \sqrt{\frac{1}{243-1} \sum_{n=1}^{243} (AV(FCF(\omega_n)) - E(AV))^2}$$

Formula 42 Standard Deviation of the Path-Dependent Aggregate Values

This framework allows simulating different management decisions and analyzing their impact on the aggregate value. Calculating the standard deviation the result is 174 million Brazilian Reais.

5.2.2 Investment Strategy

One of the key advantages of this model is the easy extensibility which allows to model different scenarios. In the first scenario it will be assumed that investing activities are increased over the initially assumed level of 8.8% of revenues and analyzed which effect on valuation and standard deviation this measure has.

As it was already discussed, investing activities have a positive effect on revenues but it makes sense to additionally assume that an increased level of investing activities also lowers the variable costs as a percentage of revenues.

It will be assumed that the following formula can be applied to measure this effect.

$$a_{CV}(\hat{a}_I) = \hat{a}_{CV} - \sqrt[2]{(\hat{a}_I - 0{,}088)*100}$$

Formula 43 Impact of Additional Investing Activities on Variable Costs

This relation is shown in the following chart. The marginal cost savings is higher at the beginning, declines until 1% and after 1% additional investing activities becomes negative.
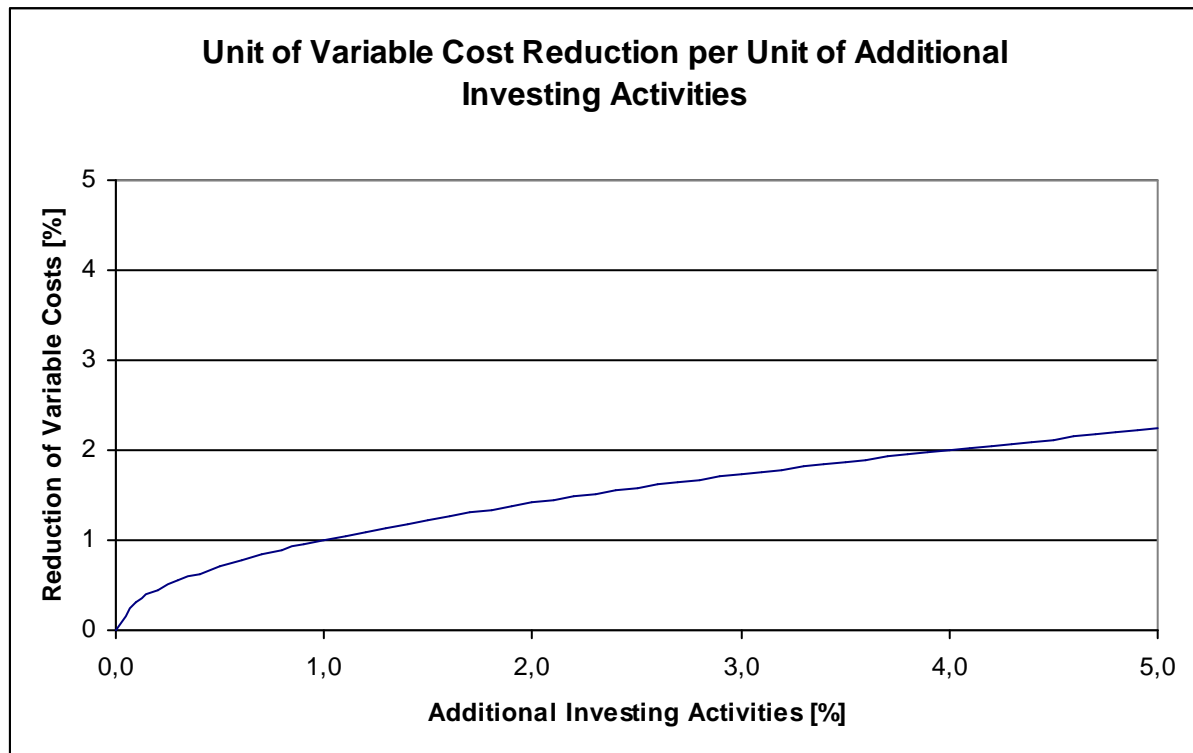
Chart 28 Unit of Variable Cost Reduction per Unit of Additional Investing Activities

In the following chart the results of this simulation are shown and both lines are plotted. The method is as explained previously. All 243 paths are separately calculated and the aggregated

value is nothing else than the probability-weighted enterprise value. The standard deviation is the measure of all 243 realized enterprise values. These values are shown in the following chart.
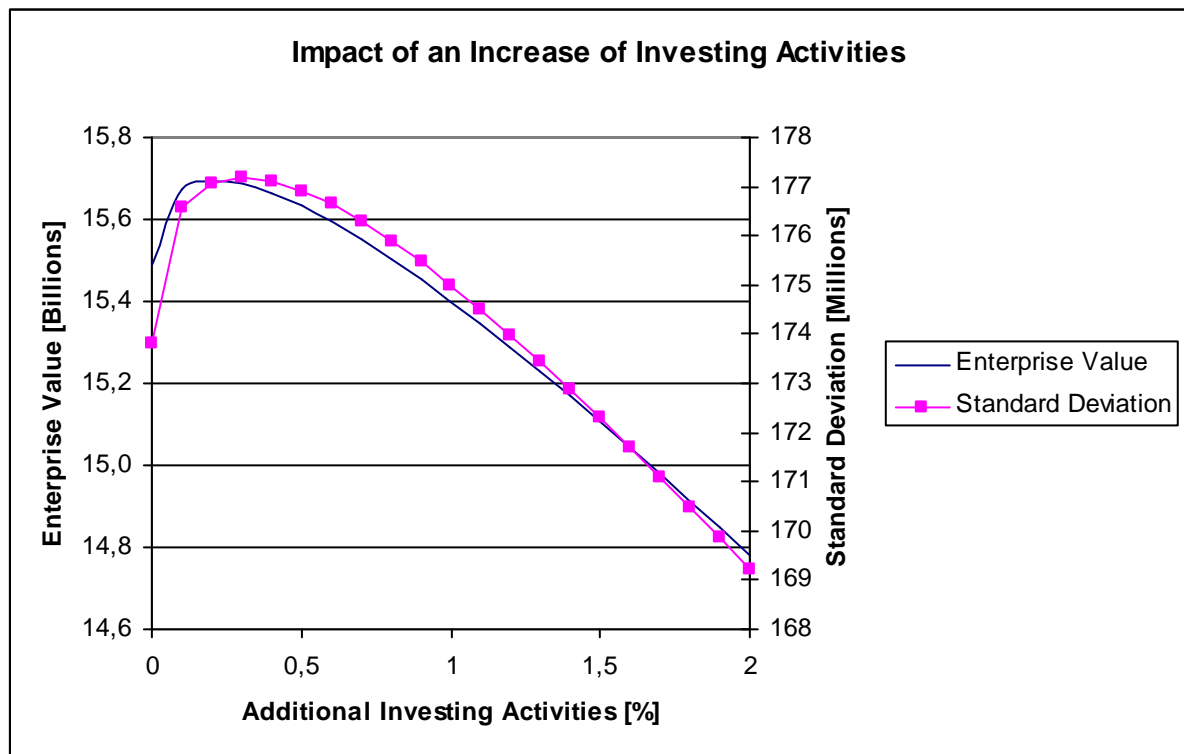
Chart 29 Impact of an Increase of Investing Activities

This chart is significant for the whole thesis and shows the possibilities to analyze the company. It can be seen that the company's enterprise value could be maximized by investing 0.3% more of revenues than set in the main valuation sheet.

5.3 Financing Strategies

For the valuation it will be assumed that the company can control how they shift or rearrange their debt positions. Each year the company has to repay a certain portion of its debt and the debt maturities are shown in the next table. [94]

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[94] 20-F Brasil Telecom, 2006

	2006	2007	2008	2009	2010	2011
Debt in Dollar						
Fixed rate debt	7,4	7,4	7,4	7,2	7,0	7,0
Variable rate debt	59,2	96,8	96,5	96,2	94,3	45,1
Debt in Brazilian reais						
Fixed rate debt	5,0	5,0	0,4	0,0	0,0	0,0
Variable rate debt	1.360,4	736,4	343,6	750,1	250,1	47,9

Table 18 Debt Maturity Table

As the debt level is given the company has to source new debt each year and the management can set the target level for the debt position. Given that all debt positions with a maturity of one year in the previous period need to be sourced, the following equation can be written.

$$D_{N,t} = D_{ST,t-1}$$

Formula 44 Financing Need

D_N stands for the annual financing need and is the difference between the previous year's debt and the current year debt without sourcing new debt. According to these targets the funds will be sourced and the target level will gradually be reached. Our forecast period will be until 2010 and so the final state will not be attained as there are debt positions at the beginning with a maturity longer than the forecast period.

However, the parameters to set are:

- Short-Term Debt and Long-Term Debt

$$D_{N,t} = D_{N,ST,t} + D_{N,LT,t} = \hat{a}_{N,ST,t} * D_{N,t} + \hat{a}_{N,LT,t} * D_{N,t}$$

$$\text{with } \hat{a}_{N,ST,t} + \hat{a}_{N,LT,t} = 1$$

Formula 45 Share of Short and Long-Term Debt

$\hat{a}_{N,ST,t}$ stands for the ratio of new funds sourced in short-term debt. The index LT signifies the ratio for the longt-term debt.

- Domestic Debt and Foreign-Currency Debt

$$D_{N,t} = D_{N,d,t} + D_{N,f,t} = \hat{a}_{N,d,t} * D_{N,t} + \hat{a}_{N,f,t} * D_{N,t}$$

$$\text{with } \hat{a}_{N,d,t} + \hat{a}_{N,f,t} = 1$$

Formula 46 Share of Domestic and Foreign-Currency Debt

$\hat{a}_{N,d,t}$ is the ratio of new funds sourced in the domestic debt as contrary to the foreign-currency debt.

- Fixed Rate Debt and Variable Rate Debt

$$D_{N,t} = D_{N,FR,t} + D_{N,VR,t} = \hat{a}_{N,FR,t} * D_{N,t} + \hat{a}_{N,VR,t} * D_{N,t}$$

$$\text{with } \hat{a}_{N,FR,t} + \hat{a}_{N,VR,t} = 1$$

Formula 47 Share of Fixed Rate and Variable Rate Debt

$\hat{a}_{N,FR,t}$ is the strategic ratio to state how much of the new funds will be sourced as fixed rate debt.

- Maturity

$$D_{N,t} = \sum_{m=1}^{5} \hat{a}_{FR,d,m,t} * D_{N,t} + \sum_{m=1}^{5} \hat{a}_{VR,d,m,t} * D_{N,t} + \sum_{m=1}^{5} \hat{a}_{FR,f,m,t} * D_{N,t} + \sum_{m=1}^{5} \hat{a}_{VR,f,m,t} * D_{N,t}$$

$$\text{with } \sum_{m=1}^{5} \hat{a}_{FR,d,m,t} + \sum_{m=1}^{5} \hat{a}_{VR,d,m,t} + \sum_{m=1}^{5} \hat{a}_{FR,f,m,t} + \sum_{m=1}^{5} \hat{a}_{VR,f,m,t} = 1$$

Formula 48 Maturity of Different Debt Positions

This formula gives the maturity distribution of the different debt positions. $\hat{a}_{FR.d.m,t}$ exemplary stands for the share of fixed rate debt in the domestic currency with a maturity of m years at time t.

In a first step the company has to decide which split of Short-Term Debt and Long-Term Debt the company wants to have for their liabilities structure. Successively, a split between domestic and foreign-currency debt has to be determined and the level of fixed rate debt and variable rate debt determined. Only the fixed rate debt in the domestic currency will be restricted to a maximum of 3% and consequently not considered for the purposes of this valuation.

Finally, the preferred maturity has to be determined and the company can choose between 4 different possibilities given in the following table as a percentage of long-term debt.

	2 years	3 years	4 years	5 years
Constant Maturity	25%	25%	25%	25%
Low Maturity	50%	50%	0%	0%
High Maturity	0%	0%	50%	50%
Decreasing Maturity	40%	30%	20%	10%
Increasing Maturity	10%	20%	30%	40%

Table 19 Maturity Strategies

This table implies that the company can choose to source their funding in the short term rotating their debt positions every 3 years or in the longer term trying to source their debt for longer time periods.

Obviously, it is impossible to find an optimal solution. Therefore simulations have to be run and the optimal solution has to be found with considerations of the restrictions given by the management. It is probably not advisable to source all of the company's financing needs in foreign-currency denominated debt. Another factor is that the company probably does not take the risk to have only variable rate debt on their balance sheet as these positions make the company vulnerable to interest rate changes.

5.4   Forecast of the Foreign Interest Rates

At the moment we do not have the information which interest rate curve to use for the forecasts. It cannot be assumed that the yield term structure will remain constant during the forecast period and the Vasicek model is an excellent tool to overcome this problem and models the interest rate curve depending on changes of the short term interest rate. The Vasicek model uses the Ornstein-Uhlenbeck process and can be written as

$$dr = a(b - r)dt + \sigma dz$$

Formula 49 Vasicek Model

The variable b stands for the long-term mean spot interest which has to be calibrated using the current term structure. *a* stands for the pressure to revert to the mean and prevents the interest rates to drift permanently upward for example. It depends on the value of this variable if the average level of the interest is faster or slower reached.

The standard deviation is given by σ which is calculated on the basis of the Fed interest rate decisions which are the short term interest rates and dz is defined as a standard Wiener Process. The partial differential equation can be solved with the following formula. [95]

$$P(t,T) = A(t,T)e^{-B(t,T)r}$$

$$\text{with } B(t,T) = \frac{1-e^{-a(T-t)}}{a}$$

$$\text{and with } A(t,T) = \exp\left[\frac{B(t,T)-(T-t)(a^2 b - \frac{\sigma^2}{2})}{a^2} - \frac{\sigma^2 B(t,T)}{4a}\right]$$

Formula 50 Vasicek Model Pricing Formula

In the next step the model has to be calibrated using the information of the term structure given at this date. To calibrate the variables, the sum of the squared residuals between the given market price and the calculated Vasicek model price has to be minimized varying the long-term interest rate level b and variable a which states the pressure to revert to the middle. In the table with the Vasicek model prices the market price, the Vasicek-model price and the squared residual value are given.

Maturities	Market Price	Vasicek Model Price	A(t,T)	B(t,T)	Squared Residual
0,08	0,9965	0,9965	0,9994	0,0688	6,9239E-10
0,25	0,9900	0,9894	0,9956	0,1464	3,9349E-07
0,5	0,9798	0,9787	0,9867	0,1911	1,1791E-06
1	0,9572	0,9576	0,9661	0,2089	1,1648E-07
2	0,9161	0,9166	0,9249	0,2107	2,3019E-07
3	0,8761	0,8774	0,8853	0,2107	1,7003E-06
5	0,8037	0,8039	0,8111	0,2107	2,9767E-08
7	0,7375	0,7366	0,7432	0,2107	8,5966E-07
10	0,6460	0,6460	0,6518	0,2107	4,5571E-10

Table 20 Vasicek Model Prices

The parameters given in the next table show the main parameters of the Vasicek Model. a and b are used to calibrate the model and r_0 and σ are either known or calculated like the standard deviation of the short term interest rate.

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[95] Benninga, 1998, p. 8

r$_0$	4,25%
b	4,37%
a	4,746
σ	1,77%

Table 21 Parameter to calibrate for the Vasicek Model

In the next chart the market price is given in the blue colour and the Vasicek model gives us the smoother curve in the purple colour. It seems to be a viable approximation of the real interest rate. [96]
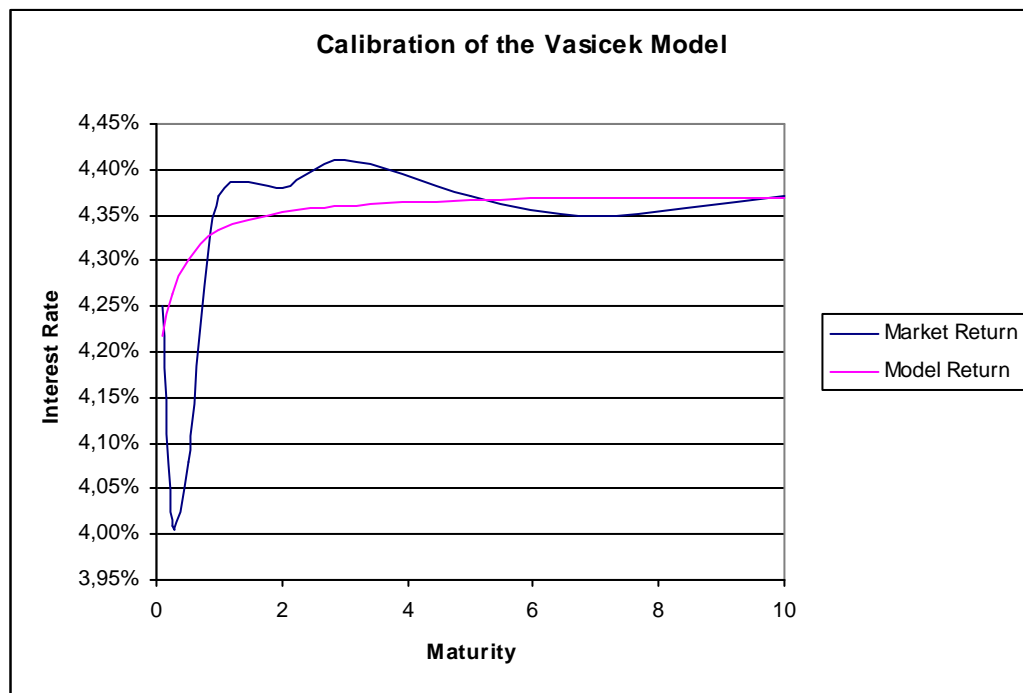
Chart 30 Comparison of the Market Prices and the Model Prices

In the next chart the Fed interest rate decisions are shown and are used to calculate the standard deviation of this variable. Later in this chapter we will see that forecasts for the Fed interest rate are not existent and it is only possible to analyze the results for a range of different scenarios. [97]

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[96] www.federalreserve.gov/RELEASES/h15/data/Annual/H15_FF_O.txt

[97] http://www.bankenverband.de/index.asp?channel=121110&art=200
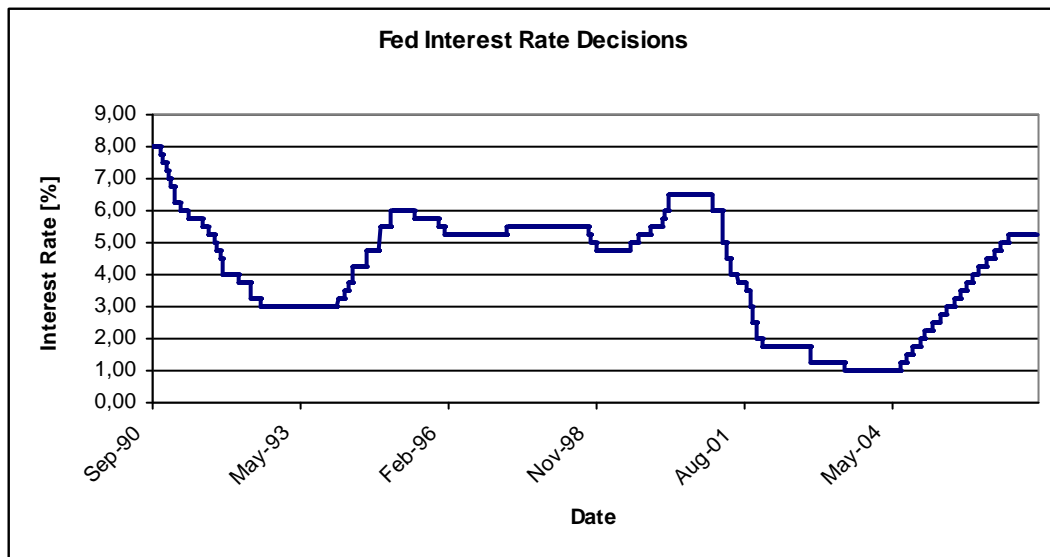
Chart 31 Fed Interest Rate Decisions

Having all these calibrated parameters the Vasicek model can finally be simulated. The only factor is the change of the short-term interest rate and in the next chart it can be seen what happens if the short term interest rate moves downwards to 0% or upwards to 10%. As the parameter *a* which represents the speed of mean reversion is quite high the interest rate curve quickly reaches the level of the average long-term interest rate. The difference term structures will be used to calculate the interest rate curve and the respective net financial expenses in the income statement.
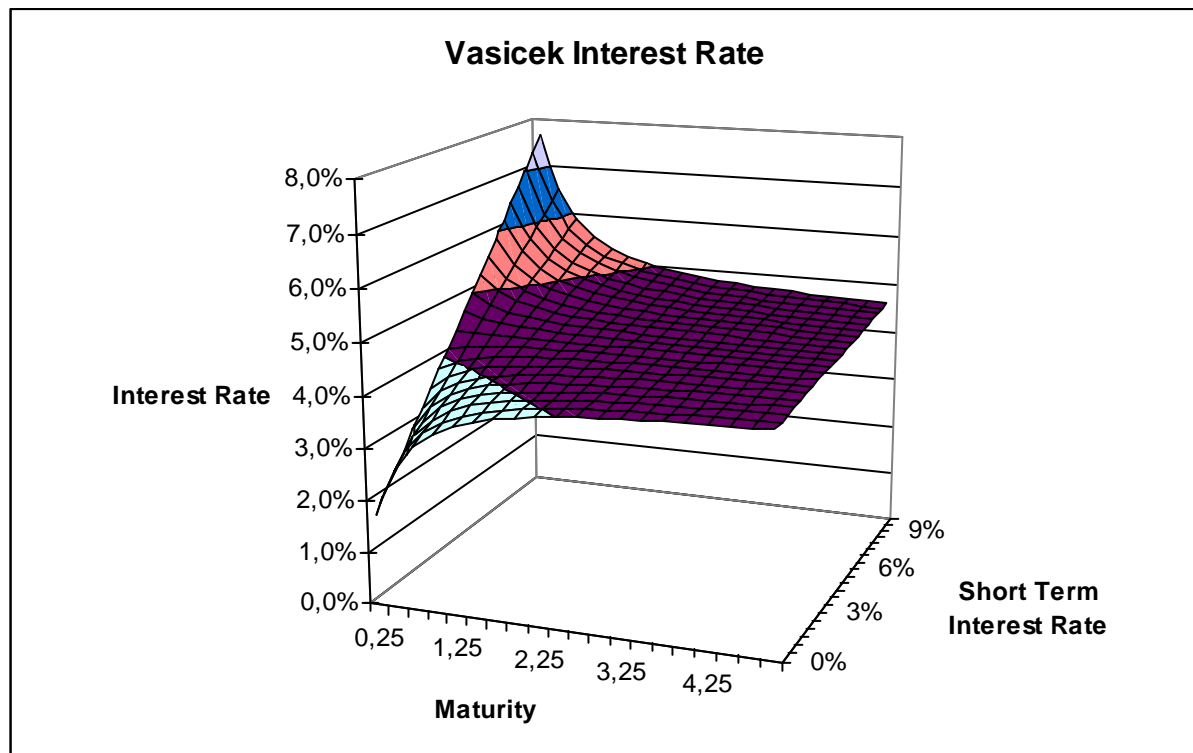
Chart 32 Vasicek Interest Rate

5.5   Equity Value as a Function of Financing Structure

In this chapter the impact of different financing structures will be analyzed. A key issue will be the influence of maturities and foreign-currency financing on the equity value.

5.5.1 Parameters and Scenarios

In this chapter the different financing structures concerning the main parameters will be analyzed. It is obviously possible to find an optimal structure for these two variables but the analysis will be restricted to showing the effects of changes in the capital structure.

Initially, three scenarios for the short term interest rate will be outlined which will be later used to analyze the different options. In the following chart these three charts are shown.
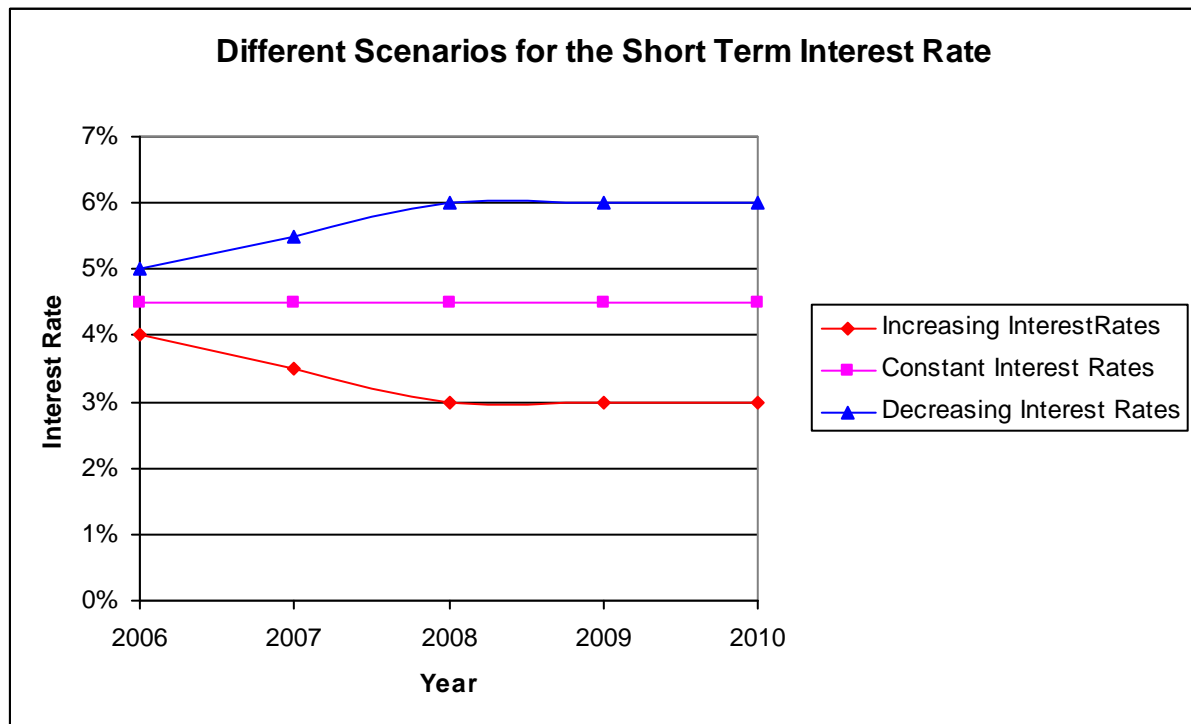
Chart 33 Different Scenarios for the Short Term Interest Rate

5.5.2 Impact of Foreign-Currency and Variable Rate Debt

The first analysis will take a look at the impact of funding in a foreign-currency and variable rate debt. Only these variables are varied and all other parameters are set constant. The ratio of new funding as short-term debt is 20%, the short term interest rate is supposed to be declining and the maturity is set to the increasing scenario meaning that more of the funding has a longer maturity period. The results are shown in the following chart.
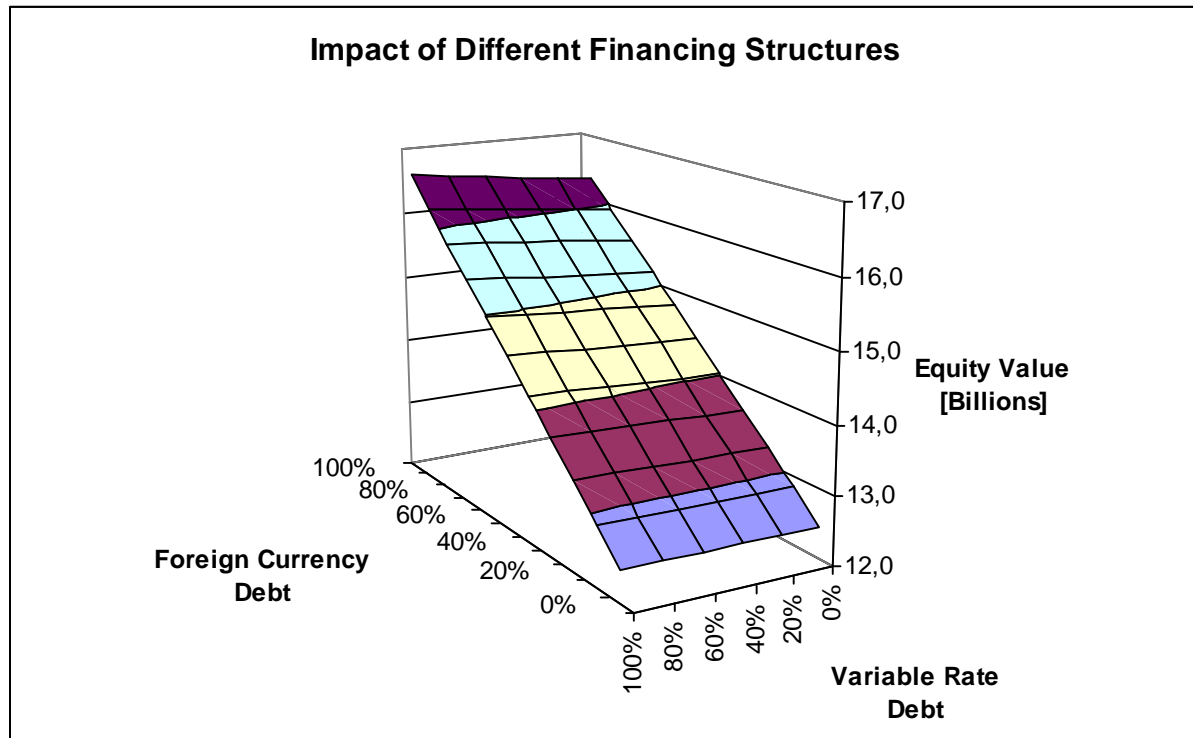
Chart 34 Impact of Different Financing Structures

The formula to calculate the expected equity value is given in the next formula as the sum of all probability-weighted results.

$$E[EV] = \sum_{n=1}^{243} EV(FTE(\omega_n)) * P(\omega_n)$$

Formula 51 Expected Enterprise Value

The results are straightforward. It can be seen that an increase of foreign-currency debt causes an increase of equity value which can be explained by lower interest expenses. An increase of the variable rate debt as percentage of the foreign-currency debt also increases the equity value as the assumption was made that the short term interest rates are declining and therefore the yield curve has a positive inclination making short-term borrowing financially more attractive. Nevertheless, the company has to set limits and these limits will restrict the solution area. The impact on the standard deviation has also to be measured. This standard deviation is the measure of the variance and gives an idea how the expected variance of the solution will behave. The following formula was applied to calculate this measure.

$$\sigma_{EV} = \sqrt{\frac{1}{243-1} \sum_{n=1}^{243} (EV(FTE(\omega_n)) - E(EV))^2}$$

Formula 52 Standard Deviation of the Equity Value

The following chart shows the standard deviation as a function of foreign-currency debt and variable rate debt.
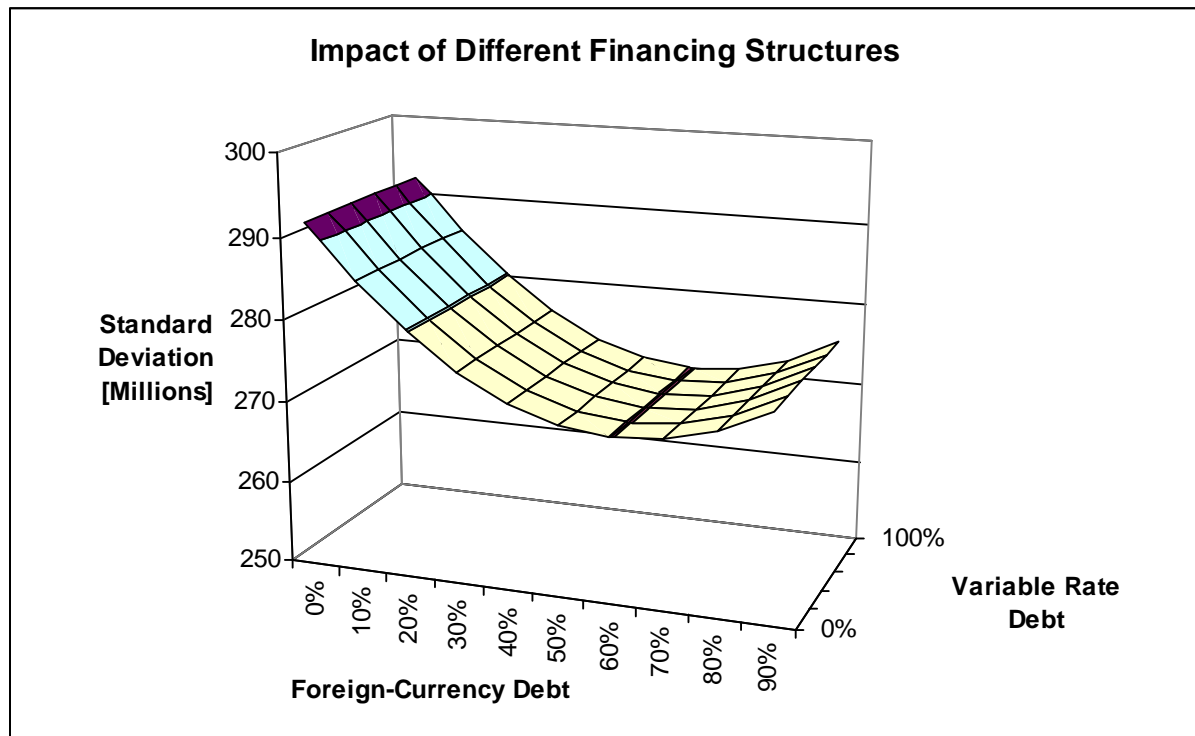
Chart 35 Impact of Foreign-Currency and Variable Rate Debt on Standard Deviation

It is more complicated to analyze why the standard deviation behaves in this form. It can be seen that the standard deviation is a function of the foreign-currency debt and the level of the foreign-currency debt only influences two positions in the income statement. These two positions are the interest expenses and the losses in foreign-currency financing due to monetary variations. If both positions are analyzed it can be seen that the average value as well as the standard deviation of the path-dependent interest expenses are decreasing. Contrary, the losses due to foreign financing are increasing in both measures in a rapid pace. At the end, the sum of these two functions shows the standard deviation as a function of the level of foreign-currency debt in this form.

At the end, it is necessary to analyze how a change of interest rates would affect the equity value. In the next chart, the difference of the equity value for the different foreign short-term interest rate scenarios is shown.
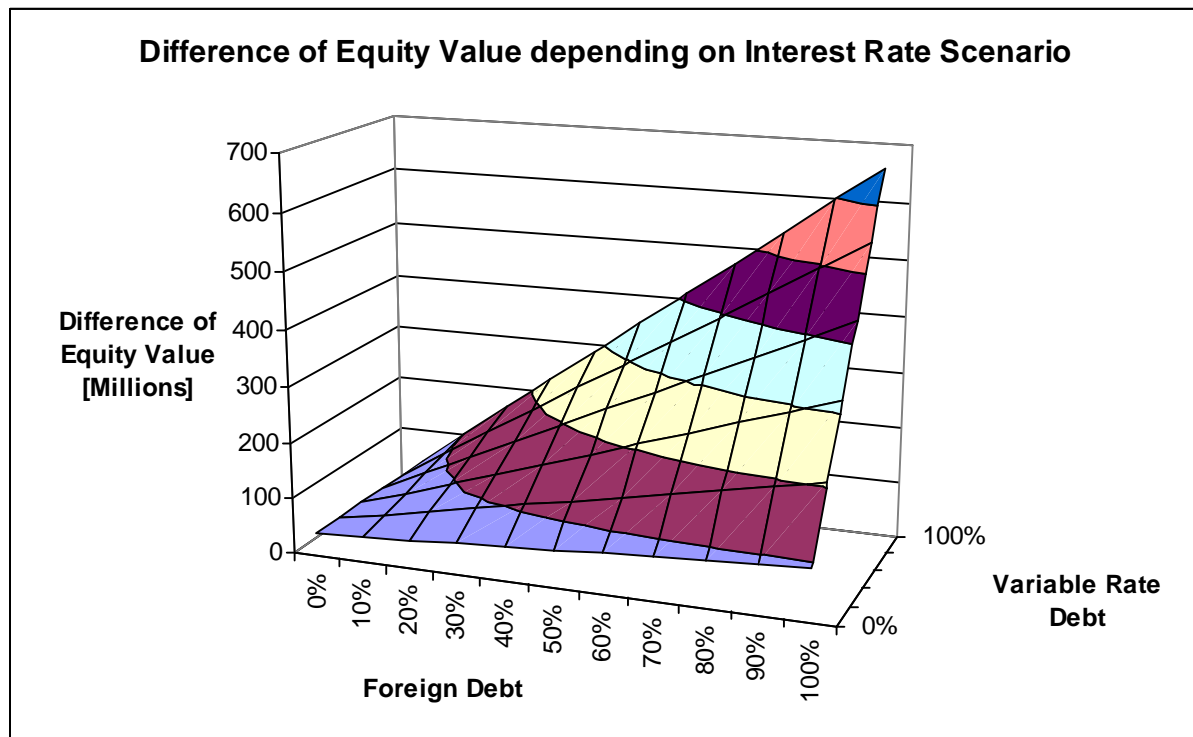
Chart 36 Difference of Equity Value depending on Interest Rate Scenario

This chart clearly shows that if the company chooses to increase its share of variable interest rate in foreign-currency debt it also faces an increased risk of a significant change of equity value.

5.5.3 Impact of Foreign-Currency Debt and Maturity

For the last analysis the maturity choice will be analyzed and optimized. The interest rate is supposed to follow an declining path and 100% of the foreign-currency debt is put into fixed rate debt positions to get the full effect of these changes.

In the following chart these effects are shown. The first chart just shows the main trend of the equity value. As it was expected the equity value increases with a higher share of foreign-currency debt as the interest expense will be lower than in the domestic currency.

Impact of Different Financing Structures

Equity Value [Billions]

17,0
16,0
15,0
14,0
13,0
12,0

Foreign Currency Debt

100% 80% 60% 40% 20% 0%

5 4 3 2 1

Maturity [Years]
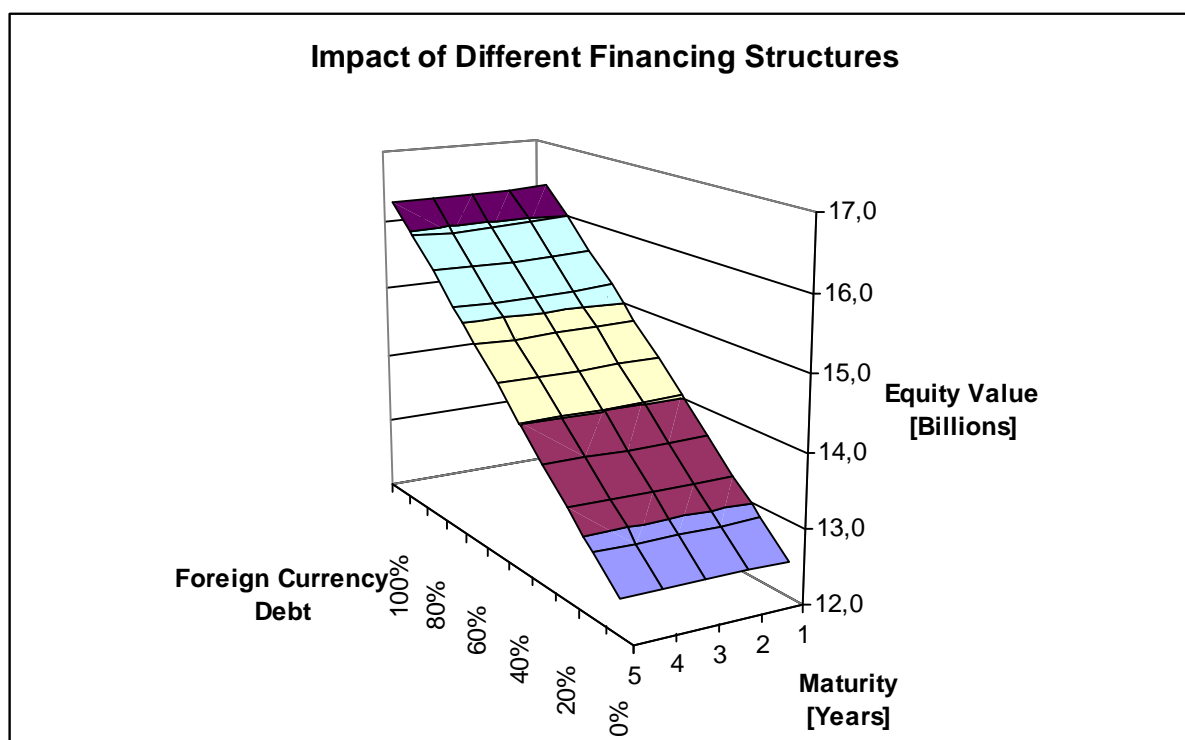
Chart 37 Impact of Changing Maturity and Foreign-Currency Debt

The last chart shows the interesting properties of the standard deviation of this valuation. The minimum lies around 80% of total debt positions denominated in foreign currencies. However, the company also sees that an increase in foreign-currency funding will also lower the standard deviations of the expected value.
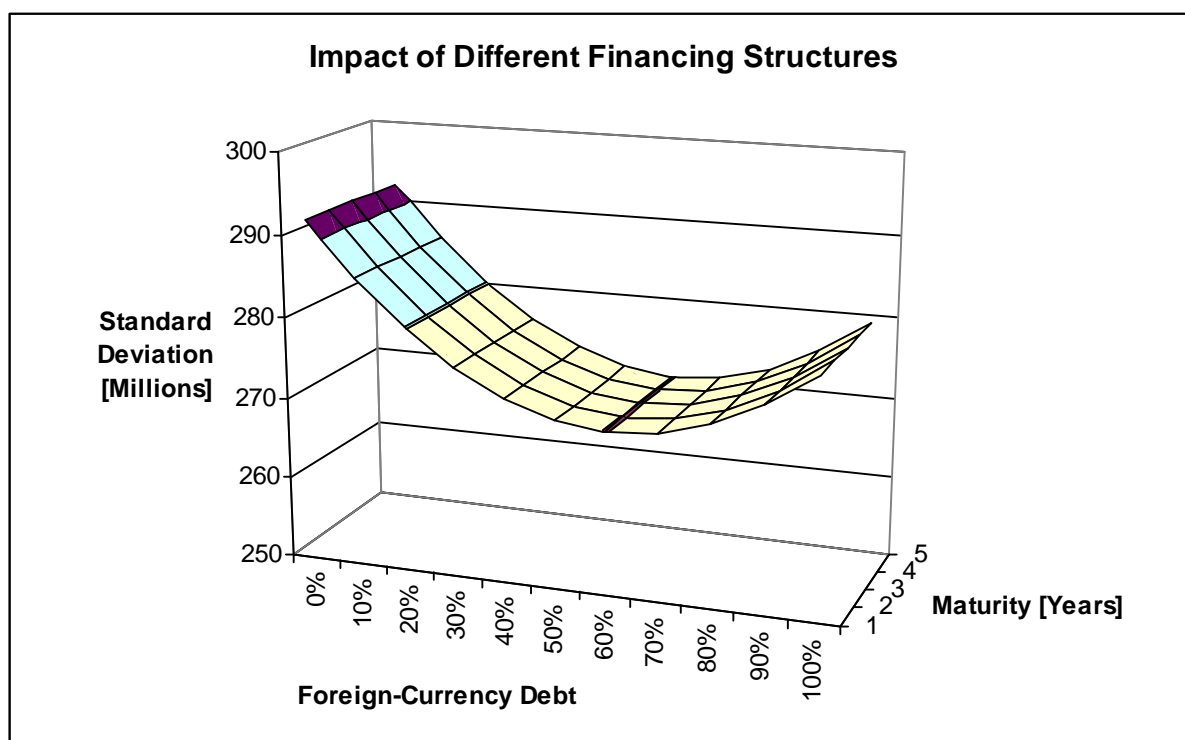
Chart 38 Impact of Changing Maturity and Foreign-Currency Debt on Standard Deviation

Using this information the company can find an optimal solution for its financing structure according to its abilities to source foreign-currency debt and its risk appetite. The explanation for this effect is similar to the previous explanation as the standard deviation behaves like a function of foreign-currency debt.

6   Concluding Remarks

This thesis aimed to introduce a model to value companies operating in emerging markets along the concepts used at the "Institut für Finanzwissenschaften" of the Vienna University of Technology. All these concepts were used in a reasonable framework and offered additional insights into this topic. As an example, the dynamics of the Brazilian economy and its influence on the bottom line of the company could be well modeled.

Nevertheless, the model in its current version is just a basic version and it is easily extensible. An extension could be a more dynamic modeling of the Brazilian economy as the current version does not include the possibility of an "Emerging Market Crisis" is it was seen regularly in the past. Moreover, the thesis only analyzed one company and it would be interesting to see if the model could be as well applied to other companies and to see where the strengths and weaknesses of this approach lie.

Appendix

	2001	2002	2003	2004	2005
Current assets					
Cash	24	2	5	2.052	5.106
Bank accounts	25.438	62.666	150.664	69.260	57.968
Temporary cash investments	305.901	1.360.231	1.315.096	2.326.497	1.667.009
Cash and cash equivalents	**331.363**	**1.422.899**	**1.465.765**	**2.397.809**	**1.730.083**
Unbilled amounts	474.626	572.453	707.130	911.655	961.060
Billed amounts	899.876	1.124.166	1.335.606	1.363.406	1.432.862
Sale of goods	0	0	0	79.699	120.337
Allowance for doubtful accounts					
Services	-143.565	-153.768	-183.023	-241.022	-353.078
Sale of goods	0	0	0	-2.159	-8.368
Trade accounts receivable, net	**1.230.937**	**1.542.851**	**1.859.713**	**2.111.579**	**2.152.813**
Maintenance inventories	58.927	63.171	27.095	15.679	12.497
Mobile phones and accessories	0	0	0	209.024	114.340
Provision for losses - realization value	0	0	0	-43.814	-37.036
Provision for losses - obsolete items	0	0	0	-6.856	-6.766
Inventories, net	**58.927**	**63.171**	**27.095**	**174.033**	**83.035**
Recoverable social contribution tax	10.017	1.448	20.998	21.660	80.114
Recoverable income tax	17.602	14.249	80.446	88.812	343.272
Provision for contingencies	125.532	132.097	236.754	235.126	333.798
Provision for actuarial deficiency	162.362	170.626	172.071	170.492	247.550
Goodwill amortization	246.598	187.749	123.378	59.006	0
Allowance for doubtful accounts	48.812	52.281	62.224	82.209	122.694
Tax loss carryforwards	0	0	0	71.648	406.531
ICMS - 69/88 Agreement	0	0	0	50.761	68.601
Provisions for COFINS/CPMF Suspended Collection	0	0	0	16.110	13.864
Other	70.800	71.635	101.980	37.294	131.113
Deferred tax assets	**654.104**	**614.388**	**696.407**	**722.646**	**1.324.151**
Sales and other taxes	294.100	341.698	439.797	632.277	600.642
Deferred and recoverable taxes	**975.823**	**971.783**	**1.237.648**	**1.465.395**	**2.348.179**
Total current assets	**2.597.050**	**4.000.704**	**4.590.221**	**6.148.816**	**6.314.110**

Table 22 Current Assets, Brasil Telecom [98]

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[98] 20-F Brasil Telecom, 2006

	2001	2002	2003	2004	2005
Non-current assets					
Prepayments	36.072	48.841	36.954	89.865	90.697
Accounts receivable from telecommunications companie	27.519	47.515	103.338	100.330	8.018
Accounts receivable from asset disposals and others	3.823	7.032	5.527	336	0
Recoverable advances	75.262	78.333	33.204	66.538	78.142
Court deposits	256.713	332.088	457.977	620.998	789.736
Escrow agreements	15.787	15.787	69.251	34.181	1.299
Assets available for sale	10.753	2.412	9.269	276	9.175
Tax incentives	14.473	14.473	18.315	14.473	14.473
Loans and financing assets	0	0	0	10.744	9.173
Other	39.703	28.913	8.731	14.932	15.799
Other assets	**480.105**	**575.394**	**742.566**	**952.673**	**1.016.512**
Total non-current assets	**480.105**	**575.394**	**742.566**	**952.673**	**1.016.512**
Permanent assets					
Investments	**82.589**	**124.931**	**175.417**	**66.993**	**59.911**
Construction-in-progress	*2.727.655*	*1.209.507*	*493.961*	*656.698*	*636.246*
Automatic switching equipment	*7.377.110*	*7.703.242*	*6.533.143*	*6.612.080*	*6.675.563*
Transmission and other equipment	*13.775.417*	*15.571.974*	*15.017.188*	*15.802.337*	*16.821.119*
Buildings	*4.845.086*	*5.250.618*	*5.329.572*	*5.421.277*	*5.572.414*
Other assets	*1.950.825*	*2.241.465*	*2.713.582*	*3.720.017*	*4.243.276*
Total cost	**30.676.093**	**31.976.806**	**30.087.446**	**32.212.409**	**33.948.618**
Accumulated depreciation	*-18.435.823*	*-20.716.181*	*-20.520.203*	*-22.842.318*	*-25.261.011*
Property, plant and equipment, net	**12.240.270**	**11.260.625**	**9.567.243**	**9.370.091**	**8.687.607**
Goodwill on merger of CRT	*373.537*	*276.404*	*180.266*	*113.681*	*0*
Goodwill on acquisition of iBest	*0*	*0*	*117.216*	*74.076*	*49.102*
Mobile personal service licenses	*0*	*194.140*	*228.398*	*303.176*	*307.685*
Other licenses	*0*	*0*	*0*	*11.713*	*11.713*
Goodwill on acquisition of GlobeNet	*0*	*0*	*5.676*	*6.584*	*4.703*
Goodwill on acquisition of BrT Multimidia	*0*	*0*	*0*	*95.651*	*73.578*
Goodwill on acquisition of iG	*0*	*0*	*0*	*234.302*	*203.168*
Others	*0*	*0*	*0*	*24.747*	*0*
Intangibles	**373.537**	**470.544**	**531.556**	**863.930**	**649.949**
Total permanent assets	**12.696.396**	**11.856.100**	**10.274.216**	**10.301.014**	**9.397.467**
Total assets	**15.773.551**	**16.432.198**	**15.607.003**	**17.402.503**	**16.728.089**

Table 23 Non-Current and Permanent Assets, Brasil Telecom, 2000-2005[99]

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[99] 20-F Brasil Telecom, 2006

	2001	2002	2003	2004	2005
Current liabilities					
Salaries and wages	2.828	3.055	243	4.553	3.995
Accrued social security charges	48.504	37.830	56.496	63.097	67.836
Accrued benefits	7.312	3.205	4.811	5.588	6.383
Accrued liability for voluntary terminations	33.096	0	0	0	0
Payroll and related accruals	**58.644**	**44.090**	**61.550**	**73.238**	**78.214**
Suppliers	1.294.515	997.670	987.403	1.787.302	1.786.535
Third-Party Consignments	0	0	0	96.397	154.696
Accounts payable and accrued expenses	**1.294.515**	**997.670**	**987.403**	**1.883.699**	**1.941.231**
ICMS (Value-added tax)	388.642	607.318	859.023	1.192.853	1.124.874
Other tax on operating revenues	65.854	89.039	163.386	162.848	211.729
Taxes other than income taxes	**454.496**	**696.357**	**1.022.409**	**1.355.701**	**1.336.603**
Controlling shareholder	129.511	181.362	138.062	250.236	220.708
Minority shareholder	100.972	128.936	109.180	160.966	155.871
Employees' profit sharing	50.415	39.327	49.006	60.869	64.445
Dividends and employees' profit sharing	**280.898**	**349.625**	**296.248**	**472.071**	**441.024**
Federal income tax payable	5.840	20.825	35.367	71.931	198.580
Deferred tax liabilities	623.643	402.189	132.985	11.239	9.960
Income taxes	**629.483**	**423.014**	**168.352**	**83.170**	**208.540**
Labor	320.337	316.334	424.097	414.221	567.273
Tax	7.871	11.905	65.970	109.936	161.068
Civil	50.270	60.985	206.678	214.688	276.018
Provisions for contingencies	**378.478**	**389.224**	**696.745**	**738.845**	**1.004.359**
Other liabilities	**174.841**	**324.781**	**391.400**	**501.194**	**568.545**
Total current liabilites	**3.271.355**	**3.224.761**	**3.624.107**	**5.107.918**	**5.578.516**

Table 24 Current Liabilities, Brasil Telecom, 2000-2005[100]

[100] 20-F Brasil Telecom, 2006

	2001	2002	2003	2004	2005
Non-current liabilities					
Financial Institutions	2.404.438	2.424.901	1.886.605	3.205.114	3.007.477
Loans from suppliers and others	56.635	17.600	4.574	29.627	25.474
Public debentures	0	900.000	900.000	500.000	500.000
Hedge	-2.358	-19.338	54.704	126.168	349.099
Accrued interest	182.125	339.421	400.942	436.600	447.797
Loans and financing	**2.640.840**	**3.662.584**	**3.246.825**	**4.297.509**	**4.329.847**
Loans from Controlling Shareholder	*85.105*	*119.223*	*89.012*	73.989	58.378
Debentures issued to Controlling Shareholder	*1.309.205*	*1.300.000*	*1.300.000*	910.000	520.000
Loans and financing - controlling shareholder	**1.394.310**	**1.419.223**	**1.389.012**	**983.989**	**578.378**
Provision for pensions	**490.744**	**501.840**	**506.090**	**501.446**	**728.089**
Total non-current liabilities	**4.525.894**	**5.583.647**	**5.141.927**	**5.782.944**	**5.636.314**
Minority interest	**0**	**0**	**7**	**30.277**	**16.652**
Shareholders' equity					
Share capital	4.878.336	4.917.927	4.955.254	4.983.402	5.017.945
Capital reserves	2.405.382	2.371.398	2.337.916	2.310.218	2.275.675
Income reserves	357.923	379.929	379.929	394.357	394.357
Retained earnings (accumulated losses)	394.785	15.365	-756.489	-1.114.163	-2.036.648
Treasury shares	-60.124	-60.829	-75.648	-92.450	-154.722
Total shareholders' equity	**7.976.302**	**7.623.790**	**6.840.962**	**6.481.364**	**5.496.607**
Total liabilites and shareholders' equity	**15.773.551**	**16.432.198**	**15.607.003**	**17.402.503**	**16.728.089**

Table 25 Non-Current Liabilities and Shareholders' Equity, Brasil Telecom, 2000-2005 [101]

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[101] 20-F Brasil Telecom, 2006

	2001	2002	2003	2004	2005
Local services					
Monthly charges	2.218.784	2.656.631	2.867.244	3.110.050	3.529.066
Measured service charges	2.863.073	3.106.544	3.490.010	3.655.450	3.480.161
Public telephones	274.218	341.766	394.525	478.805	496.766
Other	191.679	149.643	148.035	126.260	96.529
Total	*5.547.754*	*6.254.584*	*6.899.814*	*7.370.565*	*7.602.522*
Long distance services					
Intraregional	1.341.288	1.748.190	1.923.094	2.393.997	2.626.464
Interregional and International	718	594	562	248.909	364.098
Total	*1.342.006*	*1.748.784*	*1.923.656*	*2.642.906*	*2.990.562*
Mobile telephone services					
Telephony	0	0	0	18.219	432.977
Sales of goods	0	0	0	69.685	299.362
Total	*0*	*0*	*0*	*87.904*	*732.339*
Data transmission	324.690	504.979	764.059	1.068.779	1.530.985
Network services	994.343	1.021.308	1.050.821	970.422	941.464
Other	249.703	310.025	439.031	622.866	889.367
Gross operating revenues	**8.458.496**	**9.839.680**	**11.077.381**	**12.763.442**	**14.687.239**
Value added and other taxes on revenues	-2.200.580	-2.670.871	-3.042.487	-3.579.541	-4.219.054
Discounts	-99.508	-97.441	-119.700	-119.046	-329.501
Net operating revenues	**6.158.408**	**7.071.368**	**7.915.194**	**9.064.855**	**10.138.684**

Table 26 Net Operating Revenues, Brasil Telecom, 2000-2005[102]

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[102] 20-F Brasil Telecom, 2006

	2001	2002	2003	2004	2005
Depreciation and amortization	-2.630.001	-2.635.014	-2.535.001	-2.498.734	-2.278.510
Personnel	-185.843	-144.581	-129.404	-120.172	-160.721
Mobile handsets and accessories	0	0	0	-113.642	-357.680
Materials	-91.746	-78.759	-84.262	-66.613	-73.871
Services	-1.689.287	-2.057.838	-2.370.454	-2.959.656	-3.102.827
Other	-201.557	-247.669	-353.021	-383.828	-552.289
Cost of Services	-4.798.434	-5.163.861	-5.472.142	-6.142.645	-6.525.898
Gross profit	**1.359.974**	**1.907.507**	**2.443.052**	**2.922.210**	**3.612.786**
Operating expenses:					
Selling expenses	-724.570	-763.375	-821.656	-1.086.946	-1.656.242
General and administrative expenses	-604.890	-661.060	-847.074	-998.592	-1.264.741
Taxes other than income taxes	-16.394	-22.496	-31.869	-126.809	-120.017
Provision for actuarial liabilities of pension fund	-98.173	-3.295	-8.434	-31.132	-266.195
Technical and administrative services	31.037	34.630	41.998	60.192	53.589
Provision for contingencies, net of reversal	-8.015	-29.159	-359.713	-252.200	-481.456
Fines and expenses recovered	76.969	95.184	114.587	182.161	149.694
Settlement of dispute with Telcoms	0	0	0	124.501	63.937
Infrastructure rentals	27.006	36.146	44.033	48.384	67.937
Forfeiture dividends	19.162	6.468	10.544	0	0
Amortization of goodwill on acquisition of investment	0	0	0	-61.039	-94.458
Other	-88.361	1.018	-26.099	-5.256	663
Other net operating expenses	-56.769	118.496	-214.953	-61.198	-626.306
Operating income before net financial expenses	**-26.255**	**601.568**	**559.369**	**775.474**	**65.497**

Table 27 Operating Cost Structure, Brasil Telecom, 2000-2005[103]

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[103] 20-F Brasil Telecom, 2006

	2001	2002	2003	2004	2005
Interest income	178.120	201.632	302.563	493.298	664.699
Losses on foreign currency financing and monetary varia	-126.730	-152.788	-96.447	-212.066	-438.184
Interet expense	-287.747	-667.743	-1.050.918	-860.746	-822.754
Net financial expenses	-236.357	-618.899	-844.802	-579.514	-596.239
Operating income (loss)	-262.612	-17.331	-285.433	195.960	-530.742
Losses (gain) on disposal of permanent assets	7.293	28.733	-67.953	18.205	-47.122
Write-off of permanent assets CRT	0	0	-386.977	0	0
Losses on goodwill on merger of CRT	0	0	0	-51.594	0
Amortization of goodwill on merger of CRT	-96.133	-96.133	-96.133	-66.590	-102.716
Other	-4.231	2.903	9.372	-12.094	814
Net non-operating expenses	-93.071	-64.497	-541.691	-112.073	-149.024
Employees' profit share	-50.834	-41.387	-1.076	-53.783	0
Income (loss) before taxes and minority interest	-406.517	-123.215	-828.200	30.104	-679.766
Social contribution tax	-22.176	-7.592	-2.573	-13.312	-51.977
Income tax	-67.831	-53.048	-23.868	-59.209	-161.743
Deferred taxes	289.046	172.236	347.192	147.533	602.786
Income and social contribution taxes benefit	199.039	111.596	320.751	75.012	389.066
Income (loss) before minority interest	-207.478	-11.619	-507.449	105.116	-290.700
Minority interests		0	14	-6.276	-12.971
Net income (loss)	**-207.478**	**-11.619**	**-507.435**	**98.840**	**-303.671**
Shares outstanding at the balance sheet date	530.383.166	535.584.460	539.447.369	541.608.463	541.618.899

Table 28 Financial Expenses, Brasil Telecom, 2000-2005[104]

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[104] 20-F Brasil Telecom, 2006

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