**Risk fundamental analysis: our way of computing cost of equity and cost of capital for A2A.**

In this part we will analyse how to determine a consistent way of measuring risk for A2A.

***‣ A piece of theory***

In this contest risk refers to the likelihood investors will receive a return on a given financial asset that is different from their expected one.

In terms of equity valuation, according to DCF approach, cost of equity (and cost of capital) are key ingredient, but implicit costs which can vary across different investors.

We will focus on the most used risk and return model: the CAPM.

**‣ Steps involved in our analysis**

1) We will define risk in terms of actual returns’ distribution around an expected one. The difference represents the risk (measured using *variance or std*)

2) We make a diversification between diversifiable and non-diversifiable risk.

As well-known there is firm specific risk which affects only a subset of entire firms and *market risk* that affects all investments. Expanding our investment portfolio allows us to diversify it, to reduce the exposure of firm specific risk.   
In contrast, the effects of market wide movements are likely to be in the same directions.

3) Capital Asset Pricing Model looks at risk through the eyes of the marginal investor: a well-diversified agent; the only risk he cares is the risk added on to a diversified portfolio, the market risk.

‣ Under CAPM strict assumptions the risk of any asset becomes the risk that it adds to the market portfolio: if an asset tends to be correlated with market portfolio it will add risk to it.

Statistically, we can measure the risk added by an asset by its covariance with that portfolio. This value standardized by market portfolio variance represents the asset **beta**.

it represents, in one figure, the exposure of an asset to all market risk

According to CAPM the cost of equity is given by the following formula:

Our analysis starts by finding all these three inputs: 1) Risk free rate, 2) Equity risk premium and 3) CAPM Beta for A2A.

**‣ 1) First component of risk: risk free rate**

We can define it as the asset of which the investor knows the expected return with certainty.

For an investment to be risk free, two conditions have to be met:

* There has to be no default risk
* There can be no uncertainty about reinvestment rates: no intermediate cash flows.

Therefore, we must orient towards a government bond (default risk free) not paying cash flows (zero coupon bond).

**Our assumptions**

1) According to the fact we try to estimate cash flows in nominal terms we will use nominal risk-free rates as well.

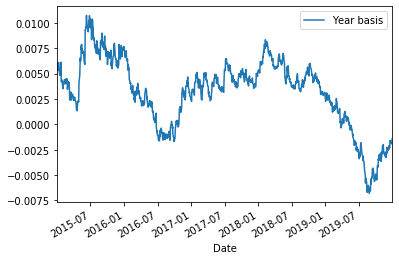
2) We make our computations according to spot rates provided by ECB on AAA government bonds. Precisely, we will use AAA 10 years spot rates: same currency, no default risk.

3) We will assume as a risk-free proxy the geometric average of daily provided returns (in a year basis) over latest 5 years (from 2015-01-01 to 2020-01-01) neglecting coronavirus effect.   
The main consequence of this crisis in terms of rates is the aim of ECB to reduce interest rates in order to make it easier borrowing money for private and public sector. After coronavirus outbreak spot rates trend was decreasing.   
Anyway, we have decided to not consider this effect looking for a possible risk-free rate useful also in the future (in fact, it won’t be changed during valuation)-

4) Last but not least important: we have developed all our computations on Python using Jupiter Notebooks: for more details just check the attached file.

**Results**

We obtained a series over past five years of yearly based spot rates:

It can be appreciated a negative trend in most recent times.

Computing a geometric mean over the series of returns we got the following result which will be used as a proxy for risk free rate: .

**‣ 2) Second component of risk: market risk premium**

**What is it?**

The risk premium measures the extra return that would be demanded by investors for shifting from riskless investments to an average risk investment.

It is a function of:

1) Risk aversion of investors: the higher aversion the higher should be the premium.  
2) Risk of average risk investment.

**How did we measure it? By using historical premiums**

Indeed, focusing on historical data, is the most common approach to estimate risk premium.   
In CAPM it's computed to be the difference between average returns on stocks and average returns on risk free securities (remark: 𝛽 is assumed to be 1).

**Country risk premium, a component to be included**

Italian stock market is a mature market we have a relevant historical background and lots of trades day by day. Anyway, the country has a huge public debt which, over the years, has pushed the Country Rating toward BBB (according to S&P rating agency).

This element must be included: in fact, with respect to a no-default risk government (in our case, according to risk free rate from AAA bond) the risk premium must be enlarged by this spread; it must capture this additional component of risk.

**Our assumptions**

1) Due to the fact we have considered European AAA spot rates and Germany represents a candidate, by consistency we will compute the equity premium in German stock market and then add it the Italian country risk component.

2) The German risk premium will be computed not with an implied approach but using a time series of "Dax" index over last 5 years (weekly returns then converted into annual nominal returns).

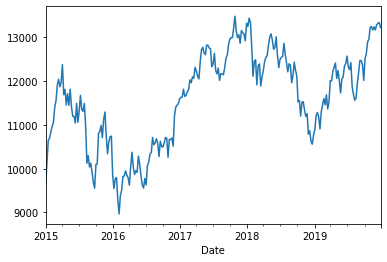
3) We will use *country default spread* for Italy for 170 Basis Points .  
Then, in order to get the country risk premium we will rescale it using as scale factor volatility of Italian market (FTSE MIB in past years) over volatility in Italian bond market (as proxy a BTP with time to maturity 10 years)

4) Finally, to encapsulate coronavirus impact we will add a further risk component we have decided to differentiate in our individual forecasts.

**Analytics: step-by-step**

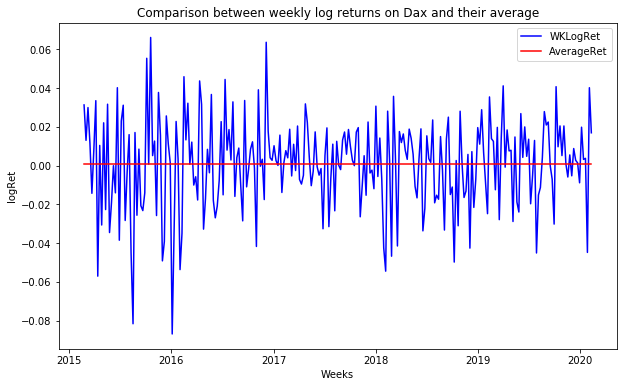
Again, for further information follow Python Notebook. Here will be presented main results.

We downloaded Dax daily prices over last past 5 years before Coronavirus outbreak: from 2015-01-01 to 2020-01-01.

This plot represents Dax price over sample period.

We deliberately excluded latest prices to not consider the drop which would have biased our result.

Due to the fact Dax was priced according to business days, after some arrangements we computed weekly log returns over time and the average weekly log return.



As we can see from the two plot there are outliers in our computation which reduces the average value for a bit.

Finally, in order to get German market risk-premium we converted this rate into annual and then subtracted risk free rate according to the following inverse formula:

, where expected return is given by log return on Dax, risk free rate the rate previously computed and Beta, the market Beta which is 1.

This yields to a proxy for German (stable) market risk premium equal to 4,54%

It remains to adjust this result with Italian country risk premium.

We used the following formula to retrieve a proper market risk premium for Italy: . We have used a CDS of 170 BP and computed standard deviation respectively over FTSE MIB log returns and log returns of an Italian BTP with time to maturity of 10 years (BTP May-31).

At the end we got as Country risk premium the following one: approximately 3,25%.

Adding it to the previous stable market risk premium we obtain an equity risk premium of approximately 7.79% against a 10% estimated by Damodaran (this after Covid-19, furthermore he used US T-Bonds and so a different CRP).

**‣ 3) Third component of risk: CAPM Beta**

We focused on regression Beta due to the fact A2A’s balance sheet was not enough clear in order to compute a nice enough bottom-up beta. Anyway, we tried in a sophisticated way to compute it, results at the end.

**‣ Regression Beta work-around**

For publicly traded firms it's straightforward to estimate returns an investor would have made on its equity over a given period. These returns can be related to a proxy for the market portfolio to get a beta approximation.

* Standard procedure: regress stock returns (A2A's performance in our case) against market returns (FTSE MIB returns).
* Regression method: OLS linear regression of the form

The slope of regression line is the beta of the stock and measures its risk. Obviously is an estimate which comes with a standard error representing how it is noisy.

**‣ Our decisions in estimating**

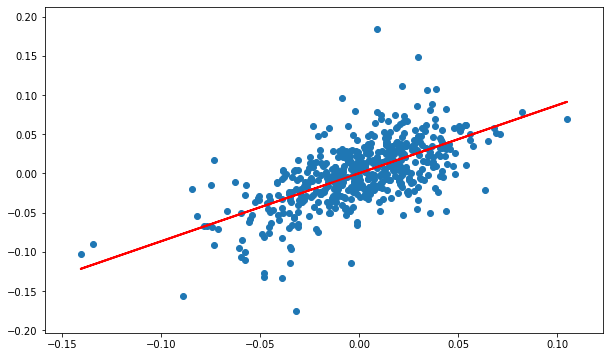
*a) Length of estimation period*: we have decided to use latest 10 years as length, excluding the coronavirus outbreak period.

*b) Return interval:* due to trade-off between bias in estimations and lack of enough observations we have decided to use weekly returns.

c*) Market index proxy*: we continue with *FTSE MIB 40* index as proxy of portfolio market.   
We also have tried to regress it against a European index which includes A2A in its composition: *EUROSTOXX 50.*

From Investing.com we downloaded data time-series for A2A and FTSE MIB100 and in the same way we computed their log returns over the period on a weekly basis.

Then we ran a regression (again, using Python packages) getting the following results.



*Alpha (intercept of the model) = 0.0003*

*Beta: regression beta and slope = 0,868*

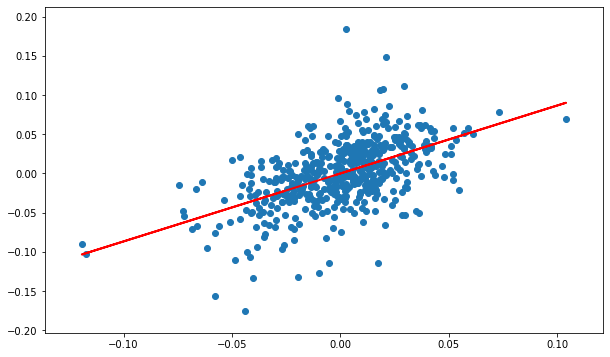
*Regression representation of A2A (on y-axis) against Italian FTSE MIB (on x-axis)*

**Another regression: against European stock market**

We also tried to regress A2A weekly log returns against Eurostoxx 50, a good proxy for European stock market.   
Why should we use this approach? According to the assumption that we should regress against a likely set of assets we could imagine that our (marginal) average investor is well diversified and active in the European stock market.

This is a good argument to use a proxy representing the average European performance: in fact, the index is composed by most appetible shares over European scene.

Here the results over the same time period of observations:



*Alpha = -0,00007*

*Regression Beta = 0.867*

*Regression representation of A2A (on y-axis) against Italian EUROSTOXX50 (on x-axis)*

It’s interesting to notice that Beta provided by Reuters is 0.89, whereas our respectively 0.868 and 0.867.

**‣ Bottom up Beta for A2A**

**How to break down betas into fundamentals**

Breaking down betas into their business, operating leverage and financial leverage components provides us with an alternative way of estimating betas without using historical returns of that asset.

According to the following lemma beta of two assets put together is a weighted average of the individual asset betas with weights their market values. Therefore, the beta for a firm is a weighted average of betas of all different businesses it operates in.

**Bottom up beta workaround and assumptions:**

**1)** According to A2A discloses, it operates in several Business Units (see BS pag.50): most of A2A's results came from: Generation and Trading (inter-sector), Market, Waste and Networks which refers to (with large approximations) energy, water and heat distribution and waste allocation.

2) We used sector averages for unlevered betas adjusted for cash from Damodaran’s dataset: another, big assumption we made was to refer only to 4 main industries relating to utility sector where A2A operates in: Green and renewable energies, environment and waste, utilities (general and water) and gas distribution.   
Therefore, we used 5 different unlevered betas from Damodaran.

3) Strict assumptions with respect to revenues’ splitting: we considered 25 % of all energy from renewable production, we considered revenues values less inter-contribution and associate respectively Waste unit to waste sector and divide revenues from Market, Trading and Networks among remaining industries (25% of energy production is devoted to renewable sector).

4) Then we decided to use market debt to equity ratios (this allowed us to reduce Bottom up beta towards regression beta we have computed: our result it’s clearly biased by our assumptions).



This scheme tries to resume it, anyway most consistent values are Levered Betas at 31/12 using debt to equity ratio at book and market value.   
We can say however that due to difficulties with getting a proper business distinction we should follow regression beta result.

‣**Cost of equity and cost of capital computations (analytical approach)**

Once we have obtained all inputs needed to get the CAPM output we can obtain easily a proxy for cost of equity.

Furthermore, we can compute (net) cost of debt in two ways:

1) Using risk-free rate and add a given default spread provided by rating agencies (S&P) for bond ratings: in our case A2A received a BBB rating for its bond issues. Damodaran provides a spread of 1.50% to add.

2) Using latest A2A emissions, compute a weighted average of their gross internal rate of return (simply provided by A2A itself) with weights number of coupons to be paid times nominal value of outstanding bond.

The latter, preferred, provide a most updated cost of debt: in fact, A2A declared to reduce its cost of debt allowing for less expensive issues.

Finally, according to WACC we can obtain a weighted average of net cost of debt (using a marginal rate of 27.9%) and cost of equity with weights debt to capital and equity to capital.

Table below shows three possible approaches, approach number 3 which uses a regression Beta and a cost of debt in line with latest A2A debenture report is the one which will be followed in valuation (4,340 % according to Book Values).



The details about cost of debt computation in approach 3 and capital ratios are presented in the excel file (Sheet: WACC).

‣**Cost of equity and cost of capital computations (“lean” approach)**