OPTIMAL PORTFOLIO CHOICE WITH LIMITED HISTORY: APPLICATION TO THE CASABLANCA STOCK EXCHANGE

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Abstract
In the framework of the profound transformation of our economies, stock markets are considered as the ideal place of the financing activities, mainly those at high risk. In this regard, the initial public offering (IPO) is a means, among others, which allows companies to have access to the remarkable financing while minimizing the financial expenses.
This phenomenon raises numerous questions, which are as the following: how to fix a price for these emissions? How these new values are set after introducing them? How to determine the optimal composition of a portfolio containing newly issued security investment with missing data?
The objective of this paper is to apply an ex post weighting approach with the series of past data to a stock portfolio of the Casablanca Stock Exchange, using the optimization model of Konno & Yamazaki (1991) reformulated by Janssen & Hamza (1998). This study seeks to enable us to determine an optimal portfolio of our shares in the presence of the share of the Jorf Lasfar Company (Morocco TAQA), which is a practically new share within the energy sector with no wide history.

Key words: IPO, the company TAQA Morocco, ex-ante approach, ex post weighting approach, Model & Konno Yamazaki reformulated by Hamza & Janssen.

(JEL) Classification: G11, G17, C61

1. Introduction

The financial market has many economic and strategic functions. It is an instrument of the economic liberalization and mobilization of savings. It also promotes the transformation of production structures through the acquisition of assets or takeover of other companies that may be financed by the issuance of securities without using the company cash and through the initial public offering (IPO).
Thus, the IPO is a financial transaction that allows a company to increase and diversify its funding resources by opening up its capital in the form of shares sold to investors on a stock market. This rise of capital enables it to grow by financing its growth, expansion and investments.
In addition to the companies, the attractions representing an IPO also concern shareholders and investors who aim to generate their profits. Indeed, an investor, who has the capital and the opportunity to invest in a number of financial assets including those of the companies that have recently gone public, must make an important decision. ***How would they determine the optimal weighting of their portfolio***? For example, they may choose between several assets such as those that allow the best, minimize the risk for a fixed yield, or maximize the yield for a set level of risk.
In this respect, it is essential to measure returns and risks of their portfolio with the best possible accuracy, i.e. taking into account all information concerning the assets comprising the portfolio and preferences; especially those recently introduced whose data are missing. For this reason, it is recommended to call on the ex-ante and ex-post estimators or to use an alternative model.
To better answer our research question, the rest of this paper is organized as follows. The second section presents a theoretical framework on IPOs, focusing on the different explanations advanced by the

literature. Indeed, this section evaluates the ex ante approach or the scenario-based approach and its limitations. This section presents in addition the ex-post weighted approach as an alternative to the scenario approach. The third section describes the methodology and sample data used in the empirical study and the fourth section presents the results and the discussions of testing and optimization program based on an analysis of testing by the econometric software E-Views 7 and the simulation of the optimization program *Matlab*, and finally concluding with remarks.

2. Review of literature

2.1. The Initial Public Offering (IPO): General Framework

The initial public offering (IPO) has started in the late 1980s to attract the attention of many researchers and practitioners who are interested in the benefits and constraints of such operation (Ritter 1987; Rajan 1992; Holmstrom et Tirole 1993; Chemmanur et Fulghieri 1995, Yosha 1995; Pagano et Roel 1998). Thus, this term is considered in the English terminology as the transformation of a private company to a public company that requires on part of candidate companies, a set of transformations to meet the requirements of the markets authorities. It is a process of legal and financial restructuring that generates direct and indirect costs (Ritter, 1987).

All companies, which decide to put a portion of their capital in the stock market must:

- Either sell the existing shares coming from the former shareholders.
- Or issue new shares or warrants and convertible bonds.

A candidate company for the IPO must master the financial engineering required to the necessary restructuring, know all the agents involved in the financial market and their safeguards, and quite clearly understand the reference texts governing activities along with relationships between transactors in the financial market (Zogning, 2006).

2.1.1. Constraints and reluctance factors

The IPO generates, for the leaders of a company, a certain number of constraints whose importance should not be underestimated and which can even be seen as obstacles to this operation. Among these constraints, we listed the main ones:

- An IPO stands for a capital dilution, meaning that the capital will be in the hands of a large number of shareholders. This leads firstly to a loss of control, and secondly to the risk that some shareholders will invite competitors or potential purchasers for example.
- The listed companies must disclose any particular information on sales, margins, wages, future projects, etc. This means that their competitors, customers, suppliers and employees will have access to information on the inner working of the company.
- In addition, the company whose shares are listed on the stock exchange is obliged to make the company's management completely transparent against the outside, and keep a strict accounting and compliance with the standards defined by the law.
- Again, it is required to publish any commercial, technical or financial information that could have a significant influence on the stock market price of their securities.
- The company must publish its real valuation facing the taxation which can hinder shareholders.
- In addition to the constraint of transparency, the public company is subject to a performance constraint, i.e. the listed company must permanently give the signal of a commercially and financially successful company. Moreover, the public offering is expensive in terms of time and money.

2.1.2. The benefits of an Initial Public Offering IPO.

The IPO opens up many opportunities for companies, shareholders and investors.

Indeed, this phenomenon has not obviously the sole purpose of raising capitals, but also it promotes the expansion of companies. The diversification of funding sources could in most cases, assure it a capital at lower costs, and a long-term financing (Jacquillat 1994).

In addition, the IPO brings indirect benefits such as enhancing reliability and financial legitimacy of the company along with building its reputation. For Jacquillat (1994), Jobard (1996), and Grinblatt and Titman (1998), the current events devoted to a corporate that wants to go public will have the effect of increasing the brand awareness and strengthening its image and bargaining power with business partners. Chemmanur and Yan (2004) have shown that the marketing of the IPO is one of the fundamental tools of a global strategy for the disclosure of information on the quality of products and the company's value.
Similarly, the employees' participation system can be more easily implemented either through an incentive system, or with "stock options".
The IPO has not only the beneficial effects on the company because, in fact, the original shareholders benefit from the IPO in order to ensure the liquidity of their assets, the sustainability of their business and the opportunity to reap substantial capital gains. After having the shares of company listed on the stock market, it is easier for shareholders to divest all or part of their property without formal search for new buyers nor unnecessary regulations and legal formalities (Grinblatt and Titman 1998) and (Zingales 1995).
Apart from businesses and shareholders, the IPO is an operation of great interest to investors because it gives them the inspired return level and ensures their control over the company.
The returns sought by the investors can be in two forms for the equity market. On the one hand, the earned dividends and the other possible capital gains are the expense of sales of securities. Similarly, investors who reach the threshold crossings are no longer interested in one-time return on their investment, but also they want to participate in the company management and contribute to the determination of its strategic directions along with its various policies.
The search for an optimal combination (risk-return) of financial assets portfolio encourages investors to opt for methods for determining the estimators of these two parameters in their investment decision, taking into account the available information. In this regard, they can use ex-ante or ex-post approaches or an alternative approach to assess the value of return and risk.

2.2. Ex-ante approach and scenario planning

The principle of this approach is to assign each 'configuration' the returns observed in the past and the probability, which is regarded as a scenario. Therefore, this limits the imaginary number of scenarios to the number of periods T, which are used in the database. This implies that the probability of occurrence of other scenarios is zero[1].
We can later generalize the model Konno - Yamazaki (1991), which measures the risk by the absolute deviation of the portfolio return compared to its average: $K(x) = E\{|R(x) - \mu(x)|\}$ in order to take into account the scenario approach or what called ex-ante approach.

In this case, we rewrite the model: $\hat{K}(x) = \frac{1}{T\text{-}1}\sum_{t=1}^{T}\left|\sum_{j=1}^{n}(r_{jt} - \hat{r}_j)x_j\right|$ with, $\hat{r}_j = \frac{1}{T}\sum_{t=1}^{T} r_{jt}$ j=1,..., n; replacing the index 't' that designates a given period by another index 's' which would then designate the scenario number. Then, our historical estimator becomes: $\hat{K}(x) = \frac{1}{S}\sum_{s=1}^{S} p_s\left|\sum_{j=1}^{n}(r_{js} - \hat{r}_j)x_j\right|$ and $y_s = \left|\sum_{j=1}^{n}(r_{js} - \hat{r}_j)x_j\right|$

The portfolio optimization program of Konno - Yamazaki obtained by the simplified formulation of Hamza and Janssen (1998), will then be written as follows:

[1] Faris HAMZA & Jacques JANSSEN, '*Choix Optimal des Actifs Financiers et Gestion de Portefeuille'*, Hermes-Lavoisier, 2009.

$$Min \quad \frac{\sum_{t=1}^{T} p_s y_t}{S} \qquad subject\ to$$

$$\begin{cases} y_s + \sum_{1 \le j \le n} \left(r_{js} - \hat{r}_j\right) x_j \ge 0 & s = 1,\ldots..,\ S \\ \sum_{1 \le j \le n} \hat{r}_j x_j \ge \rho & \\ \sum_{1 \le j \le n} x_j = 1 & \\ x_j \ge 0 & 1 \le j \le n \\ y_s \ge 0 & s = 1,\ldots.,S \end{cases}$$

With $\hat{r}_j = \frac{\sum_{s=1}^{S} p_s r_{js}}{\sum_{s=1}^{S} p_s}$

In this case, S (the total number of possible scenarios) is no longer limited to the number of the historical data. The weight p_s is the probability associated with the scenario s for $(s = 1, \ldots, S)$

The interest behind proceeding in this way is when we are limited to the scenarios of the past. For this reason, we can remove some of them if we think they are unlikely to reoccur during the holding period of the portfolio or rather, we add others.

According to Wander Weide and Carleton (1988), the ex-ante approach known as the scenarios approach is considered as a more effective method in comparison with the historical methods used to predict the future prices of the financial assets. However, it remains little used as part of the Value at Risk[2] method which increasingly used to measure and manage financial risks. Nevertheless, we find an example of its utilization in a study of Farrell (1989) whose purpose was to determine the optimum distribution between three categories of the assets: shares, bonds and money market investments.

Although the ex-ante approach and the scenario planning are rich and useful to be adapted to complex situations, they become difficult to be applied in the optimization perspective; especially when we want build portfolios for several reasons:

- Determination of scenarios: One option is to consider a great number of scenarios. Thus, we will confront a computational load problem. If we want very specific scenarios, we will face too many possibilities. For example, if we aspire to consider for each security 10 possible returns, we will have 10 scenarios to study.
- The determination of probabilities: we cannot base our study on the observed frequencies of occurrence of the scenarios in the past, because we would then resort to the ex-post approach. To grasp this idea, we can suppose the case of an investor who considers 10 scenarios are possible for the economy in which he will invest and for the horizon, he has set. In order to estimate the probability associated with each of the scenarios, the investor should resort to the historical data and focus on the occurrence frequency of each scenario. He will therefore develop a forecasting method that can generate probabilities for the future scenarios. Another solution consists in calculating the observed frequencies in the past and slightly changing them, based on the expectations that we have for the future. Similarly, it is difficult (even impossible) for the investor to subjectively associate the probabilities to each scenario. The ex-ante methods are subject to other biases (choice of the model and analysts errors, etc.).

Chopra and Ziemba (1993) studied the relative impact of the estimation errors of the expectations, variances and covariances. In other words, an error in estimating the expected rate of return has dramatic

[2] The VaR of a portfolio of financial assets is the amount of maximum loss over a given time horizon and with a predefined confidence level. This is the baseline hazard measure used in Solvency II.

effects more than an error in the estimation of variance or covariances. Thus, the "ex ante" estimations of the portfolio performance are often biased predictions (that is to say too optimistic) of the actual performance of the portfolios.

2.3. The ex-post approach with weighting of the series of data: an alternative of the scenario approach.

In practice, the application of portfolio allocation methods (mean -variance, mean- absolute deviation-and mean / semi-variance) requires a priori estimations of the return and the assets risks that can be part of the portfolio composition. Until now, it was widely believed that the best possible estimations of returns were their average and their historical risk. This approach, which was initially developed by Markowitz, is systematized by JPMorgan in its RiskMetrics methodology and widely used today in all the institutions of management.

There are also forecasting methods of the yields based on the study of the financial ratios of the companies. Similarly, the yield prediction can be made by using time series.

The autoregressive–moving-average (ARMA) models developed by Box and Jenkins can analyze the return to come as a weighted average of past values and / or the independent random variables. There is also the autoregressive integrated-moving-average (ARIMA) methodology, which is the ARMA model applied to the differences between the yields instead of focusing on the returns directly.

The ex-post approach is the simplest method to use, it assumes that the future will replicate the past without modification. The past average return is rarely linked to the future return, even if the "bad" past performance can provide useful information to estimate the return and future risks. Likewise, this method is insufficient because it does not reveal the randomness of this performance and therefore the portfolio risk.

The Historical data are widely available, we frequently use them in order assess the future risk of the shares. Nothing prevents us to proceed in this way, but we should be aware that those are the future fluctuations of returns that investors are interested. In this respect, the past fluctuations can be quite poor forecasts.

The utilization of the historical standard deviation of a forecast future type can therefore lead to the estimation errors. We will find with Farrell (1989) a discussion of the stability of risk parameters in the US market

It is essential to remember that these estimations are provided through a sample of observations. Therefore, these estimations are considered as the true parameters of the entire population, not as the estimation of the real unknown parameters. Bawa and Klein (1976) had showed that this approximation involves certainly a choice of a suboptimal portfolio.

Shanken and Lewellen (1998), in a market equilibrium context, also found that the uncertainty regarding the estimation of parameters could significantly affect the time series and the correlation structure between the assets' rate of return.

To overcome the difficulty of implementing the ex-ante approach and give a more realistic interpretation of the historical data, we will adopt a historical approach with weighting datasets which satisfy the absolute mean-variance criterion (Konno & Yamazaki), reformulated by Hamza & Janssen. Thus, the return immediately can be interpreted as a scenario, which can be given a measure of risk that will define a weighted average of r. We can then associate a probability of occurrence of this scenario.

The relevance of these ex-post estimations however, is not obvious from the perspective of the investor since it does not take into account the expectations of the agents.

Moreover, it is difficult to take a too long a history because businesses change over time. Their nature follows the changing strategies, amalgamations, acquisitions and other events. Relying on a very long period can inevitably lead to the calculation of the estimators with less predictive value. Thus, the return and the risk function are as follows:

$$\begin{cases} \hat{r}_j = \dfrac{\sum_{t=1}^{T} w_t r_{jt}}{\sum_{t=1}^{T} w_t} \\ \dfrac{1}{\sum_{t=1}^{T} w_t} \sum_{t=1}^{T} w_t y_t \end{cases}$$

The investor who chooses such expression of the expected return rate prefers the securities that have recently issued a good return. To improve the result and better take into account the developments, we can give more importance to the recent years by assigning weights w_t to returns and risk.

Furthermore the introduction of w_t weight into the risk function, allows us to represent the behavior of an investor who has risk aversion for securities that have undergone significant changes in recent times.

To perform this function, we can use the exponential weight $w_t = \delta^t$ to smooth the series returns. This will give more weight to the recent scenarios. We can then measure the δ value according to the reports that exist between the past and the future. We avoid giving too much importance to the past data while integrating them into the system. Therefore, our optimization model will be written as follows:

$$\frac{\sum_{t=1}^{T} w_t y_t}{\sum_{t=1}^{T} w_t} \qquad \textit{subject to}$$

$$\begin{cases} y_t + \sum_{1 \le j \le n} \left(r_{jt} - \hat{r}_j \right) x_j \ge 0 & t = 1,\ldots..,\ T \\ \sum_{1 \le j \le n} \hat{r}_j x_j \ge \rho & \\ \sum_{1 \le j \le n} x_j = 1 & \\ x_j \ge 0 & 1 \le j \le n \\ y_t \ge 0 & t = 1,\ldots..,\ T . \end{cases}$$

Finally, because of the weight, the more or less long periods in the past play a vital role in the selection process, which will consist in identifying the most favorable securities, focusing on the available recent data.

- The application model with an exponential weighting is:

$w_t = \delta^t$ Or $0 \le \delta \le 1$

- And the linear weighting is:

$$w_t = \frac{2t}{T(T+1)} \qquad \sum_{t=1}^{T} w_t = 1$$

3. Methodology and choice of data

In this section, we will deal with our empirical study in details in order to complete the theoretical part already presented.

As far methodology, we selected a sample of 29 shares involving a significant representation of all the securities listed on the Casablanca stock exchange. Consequently, we are going to complete our sample by adding another newly issued share of the energy sector; it is either the share of the Jorf Lasfar Energy Company (TAQA Morocco), which has only seven months of the real history or the share of the Moroccan Anonymous Company for the Refining Industry (SAMIR). If we opt for the share of TAQA, we will be obliged to assimilate the history of our share for the other months in the same sector. Nevertheless, if we opt for the share of SAMIR, we will pay more attention to the recent data.

Furthermore, we worked on the weekly data covering the period of January 1, 2013 to July 8, 2014. The normality tests are performed by using the econometric software E-Views7 but the optimization program resolution is done by using Matlab software.

Morocco is endowed with a modern stock exchange, whose operating regulations meet the best international standards; but it still suffers from its narrowness of the market because of the small number of companies (74 companies in the fourth quarter of 2014).

The various reforms of the financial markets were mainly intended to pave the way for a real modernization of the Casablanca stock exchange. For this reason, the reforms aimed at encouraging measures to attract the flow of money; particularly the corporations to go public.

The Casablanca stock exchange has not witnessed any new initial public offerings in the recent years, but rather several withdrawals were recorded. The only IPO operation, which was conducted late in 2013, was the one of Jorf Lasfar. Meanwhile, the public operator of port operations in Morocco (Marsa Maroc) is expected to go public next year.

-The Jorf Lasfar Energy Company (TAQA MOROCCO) was established in 1997, within the energy sector and subsidiary of Abu Dhabi National Energy Company PJSC (TAQA). It is the largest independent coal thermal power plant in the MENA region and the leading supplier of the National Office of Electricity and Water (ONEE), with a total installed capacity of 1,356 MW.

It has been listed in Casablanca stock exchange in December 24, 2013 at a price MAD 447.5 see (table below). The share of Jorf Lasfar is estimated nowadays to be over MAD 524 and with a Price Earning Ratio (PER) of 19.

Concerning 2014, the current operating income of the JLEC Company (TAQA Morocco) has recorded a decrease by 15% from 838 million dirham to 703 million dirham.

Share Price in MAD	447.50
Amount subscribed in MAD	6, 689, 885,588
Requested Shares	14, 949,465
Granted Shares	2, 234,638
Satisfaction rate of demand	14.95 %
Number of subscribers	30,474
Number of regions having	16
Number of different countries	30
Suscription period	from 10 to 12 December 2013

Table 1: executive overview of results

- The "SAMIR" Company: is a former state company, which went public in 1996 and privatized in 1997 by repurchasing 67% of the capital of the group Corral Morocco Holding. It takes two-thirds of the country's fuel supplies.

Following the example of the TAQA Company, the current operating income of the company SAMIR recorded a considerable decline. Thus, because of the collapse of prices and the depreciation of stocks along with its current operating income amounted to -3,320 billion dirham in 2014 (i.e. 841 million DH in 2013), the negative contribution of the inventory change is -3,029 billion dirham.

The correlation between the returns of the TAQA share and those of SAMIR is 0.18.

In fact, the two securities have evolved in the same direction over the study period.

4. Discussion

The study of normality of returns is checked through the tests which are based on symmetry coefficients (called skewness) noted as S_k and kurtosis noted as K_u.

Accepting the assumption of normality of returns of securities listed on the Casablanca stock exchange is whether the skewness and kurtosis are respectively near to zero and three. Several tests can confirm this; the best known in the financial literature is that of Jarque Berra. The descriptive statistics returns of our model are presented in the (appendix 1).

According to table and the graph (appendix 1 and appendix 2), we can conclude that the distribution of the weekly returns of our portfolio is different from the normal distribution. Indeed, the symmetry assumption is generally rejected for all securities with a coefficient of skewness nonzero. However, 23 shares have a strictly positive skewness (distorting the normal distribution) and 6 shares have a strictly negative skewness indicating that our sample has made abnormal returns. In addition, the leptokurtic character is significant for 23 shares because the coefficient of kurtosis reached the values much higher than 3 and for the 6 remaining shares, the coefficient of kurtosis is significantly lower than three. This explains that our portfolio, which is the subject under discussion, can yield high returns.

It is therefore necessary to find the optimal weightings that minimize the overall variance of the portfolio, taking into account the presence of the share JLEC (TAQA MOROCCO) which has a missing data.

For the IT experience, we have set a minimum expected return of 0.05 for a period one week. In order to give more importance to the recent information, we have set a delta equal to 0.8. The table below informs us about the results related to the adopted ex-post model that is weighted by the series of data of our sample, using the exponential weighting:

$$w_t = \delta^t \qquad \text{or} \qquad 0 \le \delta \le 1$$

Shares	Proportion
BCP	0,38170185
ATTIJARIWAFA BANK	0,104926361
M2M Group	0,095509805
ITISSALAT AL-MAGHRIB	0,092311613
AGMA LAHLOU-TAZI	0,074059177
OULMES	0,066151512
CENTRALE LAITIERE	0,052976068
SMI	0,039976019
JORF LASFAR ENERGY (TAQA Morroco)	**0,033146151**
DELTA HOLDING S.A	0,023075856
STROC INDUSTRIE	0,017331311

CGI	0,013678347
MEDIACO MAROC	0,005100345
Objective Function	**0.0007226**

Table 2: optimal portfolio composition in the case of an ex-post exponential weighting

Based on the table above, our optimal portfolio comprises 13 shares that recorded interesting rates of return over the period analyzed, including that of JLEC (TAQA Morocco) whose optimal composition is in the range of 0.033146.

Similarly, for the IT simulation in the case of using the linear weighting, we set a minimum expected return of 0.05 for one week.

The table below summarizes the results relating to the adoption of the ex-post model weighted by the series of data of our sample, using linear weighting:

$$w_t = \frac{2t}{T(T+1)} \qquad \sum_{t=1}^{T} w_t = 1$$

The optimal portfolio obtained by applying the approach of the ex-post linear weighting is more diverse than the one obtained with the exponential ex-post approach. This portfolio consists of 18 shares, including the one of JLEC (TAQA Morocco) whose optimal composition is in the range of 0.023289

Shares	**Proportion**
BCP	0,331464
AGMA LAHLOU-TAZI	0,087591
CENTRALE LAITIERE	0,079611
SMI	0,07871
AFRIQUIA GAZ	0,063894
ALUMINIUM DU MAROC	0,056745
M2M Group	0,047087
RISMA	0,046791
STROC INDUSTRIE	0,045903
SALAFIN	0,044397
COLORADO	0,041171
JORF LASFAR ENERGY (TAQA Morocco)	**0,023289**
DOUJA PROM ADDOHA	0,016265
OULMES	0,012054
CGI	0,009531
EQDOM	0,008475
AFRIC INDUSTRIES SA	0,005912
INVOLYS	0,001111
Objective Function	**0.002475**

Table 3: optimal portfolio composition in the case of an ex-post linear weighting

We also note that the linear weighting gives chance to a larger number of shares to be represented as the exponential method. Likewise, the composition of our recently registered shares is more important in the optimal portfolio resulting from the approach by the ex-post exponential than the one with linear weighting which meets our objective.

5. Conclusion

Our ultimate goal throughout this study is to assess the contribution of the ex-post approach with weighting of the data series to the management of a portfolio of shares of the Casablanca Stock Exchange, containing the shares of Jorf Lasfar (TAQA Morocco) which belong to the energy sector with a very limited period.
We have also tried to present the different theoretical elements on IPO operations and the ex-post and ex-ante approaches. Again, we have sought to implement the ex post approach with exponential weighting linear series data as an alternative to the ex-ante approach on our portfolio of 29 shares, including the one of Jorf lasfar (TAQA Morocco) which is newly issued and whose history has been likened to that of the refining company SAMIR.
The empirical implication, which is about a representative sample of a number of companies listed on the Casablanca Stock Exchange including the Jorf Lasfar Company (Morocco TAQA), has allowed us to find interesting results. Therefore, it seems worthy to lend importance to the theoretical ex-post approach with exponential weighting of the data series deemed as a n alternative to the ex-ante approach.

Appendix

Appendix: 1 Descriptive statistics of the weekly returns of the analyzed sample

TITRES	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Probability
AFRIC_INDUSTRIES_SA	0.000688	0.000000	0.049905	-0.053571	0.024123	0.070961	2.733763	0.166877	0.919947
AFRIQUIA_GAZ	0.002422	0.000000	0.073620	-0.055215	0.026353	0.055033	3.609076	0.702328	0.703868
AGMA_LAHLOU_TAZI	0.006497	0.000000	0.138311	-0.151899	0.043963	0.015252	7.527869	37.58797	0.000000
ALUMINIUM_DU_MAROC	-0.001144	-0.007964	0.108534	-0.079555	0.042789	0.629613	3.167714	2.958597	0.227797
ATTIJARIWAFA_BANK	0.000580	0.000000	0.062500	-0.044248	0.021137	0.588885	4.165929	5.035310	0.080649
BCP	-0.000390	0.000000	0.046154	-0.088010	0.018598	-1.934716	13.17267	217.1690	0.000000
BMCI	-0.001136	-0.000127	0.115819	-0.100000	0.042694	0.085682	3.592965	0.698450	0.705234
CENTRALE_LAITIERE	0.000536	0.000000	0.091549	-0.113208	0.034347	-0.370840	5.443304	11.95301	0.002538
CGI	0.002736	-0.001839	0.209040	-0.103774	0.055684	1.295734	6.130184	30.27522	0.000000

COLORADO	0.013831	0.000105	0.268800	-0.131532	0.060349	1.579382	9.028928	84.93057	0.000000
CTM	0.013289	0.008422	0.145833	-0.135200	0.053076	0.320707	4.019491	2.659753	0.264510
DELTA_HOLDING_S_A	0.000138	-0.002500	0.135714	-0.092506	0.053887	0.548282	2.931638	2.213068	0.330703
DOUJA_PROM_ADDOHA	0.001301	-0.005951	0.120448	-0.077885	0.048484	0.845421	3.624676	5.956805	0.050874
EQDOM	-0.002460	0.000000	0.121212	-0.115282	0.048479	0.255450	3.653833	1.262283	0.531984
INVOLYS	0.008337	0.000000	0.244737	-0.077419	0.065688	1.600739	6.001287	35.30485	0.000000
ITISSALAT_AL_MAGHRIB	-0.000623	0.001265	0.039770	-0.075564	0.022952	-0.848643	4.328792	8.518528	0.014133
JORF_LASFAR_ENERGY	0.009224	-0.006594	0.571675	-0.141210	0.098748	4.239768	25.28812	1042.548	0.000000
M2M_GROUP	0.003304	-0.003528	0.129412	-0.094213	0.053800	0.277868	2.340897	1.362645	0.505948
MANAGEM	-0.002830	-0.007353	0.096154	-0.103987	0.047879	0.240192	2.547323	0.798756	0.670737
MAROC_LEASING	-0.002569	0.000000	0.210104	-0.146968	0.059304	0.730655	5.869141	19.00689	0.000075
MEDIACO_MAROC	-0.001131	0.000000	0.198297	-0.164765	0.073216	0.442916	3.380762	1.704412	0.426473
OULMES	0.005014	0.000000	0.122989	-0.165476	0.050485	-0.475326	5.829296	16.33254	0.000284
PROMOPHARM_S_A_	0.007754	0.000000	0.297600	-0.161765	0.067800	1.389028	9.372805	88.60544	0.000000
RISMA	0.021948	0.000993	0.180124	-0.058329	0.060173	0.661077	2.814268	3.268075	0.195140
SALAFIN	0.000168	0.000000	0.045370	-0.050847	0.018525	-0.054328	3.792781	1.173898	0.556021
SMI	-0.001515	0.000000	0.082192	-0.102767	0.042956	-0.283302	2.665975	0.793124	0.672628

SONASID	0.005187	-0.014502	0.275195	-0.201178	0.095850	0.685591	3.765859	4.522242	0.104234
STROC_INDUSTRIE	0.006077	-0.005768	0.423750	-0.196315	0.097775	1.758164	9.105409	91.00774	0.000000
TIMAR	-0.001881	0.000000	0.123481	-0.060750	0.043259	0.566966	3.309598	2.533030	0.281812

Appendix 3: The code in Matlab of the ex post Approach with exponential weighting:

```
functionoptimisation_ex_- post exponentielle ()
[S, txt, tab] = xlsread('price GFL.xls');
[T0,N]= size(S);
for j=1:N,
for t=1:T0-1,
      r(t,j)=(S(t+1,j)-S(t,j))/S(t,j);
end,
end;
delta=0.8;
[T,n] = size(r);
for t=1:T
w(t)=delta^(T-t+1);
end
rm=w*r/sum(w);
Y(1:T,1)=w'/sum(w);
Y(T+1:T+n,1)=0;
for t=1:T
for j=1:n,
R(t,j) = r(t,j)-rm(j);
end;
end
A(1:T,1:T)=eye(T);
A(1:T,T+1:T+n)=-R;
A(T+1,:) =0 ;
A(T+1,T+1:T+n)=rm;
aeq(1,1:T)=0;
aeq(1,T+1:T+n)=1;
beq=1;
b(1:T,1)=0;
b(T+1,1) = 0.05;
A=-A;
b=-b;
m = max(size(Y));
L = zeros(m,1);
[x,fval] = LINPROG(Y,A,b,aeq,beq,L);
for j=1:n
xi(j)=x(j+T);
end
ind=find(xi<=10^-4);
```

```
xi(ind)=0;
xlswrite('Rest_GFL.xls',[txt'  num2cell(xi')]);
xlswrite('Value_objective_ex_ante.xls',fval)
```

Appendix 4: The code in Matlab of the ex post Approach with linear weighting:

```
functionoptimisation_ex_post_lin()
[S, txt, tab] = xlsread('price GFL.xls');
[T0,N]= size(S);
for j=1:N,
for t=1:T0-1,
      r(t,j)=(S(t+1,j)-S(t,j))/S(t,j);
end,
end;
 [T,n] = size(r);
for t=1:T
w(t)=2*t/(T*(T+1));
end
rm=w*r/sum(w);
Y(1:T,1)=w'/sum(w);
Y(T+1:T+n,1)=0;
for t=1:T
for j=1:n,
R(t,j) = r(t,j)-rm(j);
end;
end
A(1:T,1:T)=eye(T);
A(1:T,T+1:T+n)=R;
A(T+1,:) =0 ;
A(T+1,T+1:T+n) =rm;
aeq(1,1:T)=0;
aeq(1,T+1:T+n)=1;
beq=1;
b(1:T,1)=0;
b(T+1,1) = 0.05;
A=-A;
b=-b;
m = max(size(Y));
L = zeros(m,1);
[x,fval] = LINPROG(Y,A,b,aeq,beq,L);
for j=1:n
xi(j)=x(j+T);
end
ind=find(xi<=10^-4);
xi(ind)=0;
xlswrite('Rest_GFL_lin.xls',[txt'  num2cell(xi')]);
xlswrite('Value_objective_ex_ante_lin.xls',fval)
```

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