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Cinema Industry: Usefulness of the Real Options Approach for Valuation Purpose

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ABSTRACT

The discounted cash flow (DCF) valuation method is used by the practitioners. However, the net debt which is deducted from the enterprise value to obtain the equity value is the book value. It should be based on its economic value. Indeed, it enable to take into account its maturity and the bankruptcy risk of the firm especially within sector where it is difficult to establish reliable business plans because of the historical volatility of the revenues and the free cash flows. The reference to the options literature (mainly Black & Scholes (1973), Merton (1973), Hull, Nelken, and White (2004)) enables to propose a new breakdown of enterprise value between equity and net debt economic values. This study proposes to apply the option model in the cinema and broadcasting industry in order to compare statistically the results with the brokers' forecasts based on DCF method.

JEL Classifications: *G13, G32*

Keywords: *real option; growth; DCF*

I. USEFULNESS OF REAL OPTIONS IN THE CINEMA AND BROADCASTING INDUSTRY

Traditionally, firms' valuation is based on the discounted cash flow (DCF) approach. In that context, the enterprise value (EV) is the sum of present values of future free cash flows to perpetuity. Then, the equity value is derived from the EV thanks to the deduction of the net financial debt. The book value of the net debt is generally taken into account. Using such an approach assumes the capacity to deal with 3 main issues:

- Availability of a business plan, at least on a 3-year period which can then be mechanically extended. Generally, an additional 5 year period is taken into account in order to have a soft landing of the business plan. This period enables to introduce a linear phasing of the growth rate of the revenues towards the perpetuity growth rate.
- Calculation of an accurate weighted average cost of capital (wacc).
- Matching of the book value of the net financial debt with its economic value.

In the case of the cinema and broadcasting industries, the DCF approach does not seem appropriate for the following reasons:

- Difficulty to elaborate a reliable business plan, given the historical volatility of the revenues and therefore of the future cash flows. A central case with sensitivities is always a possibility but the determination of a probability to each scenario is a highly theoretical exercise which is unlikely to be consistent with the reality.
- Subjectivity of the WACC. Indeed, according to the data provider which is chosen (Bloomberg, Factset, Datastream), the beta of the firm (or the betas of the listed peers) can vary significantly. Various sources (Bloomberg, Damodaran, Detroyat) can also provide high discrepancies at the market risk premium level. Moreover, several weightings of the respective costs of resources can be accounted for: it can be a normative debt to EV based either on industry references or on past achievements. It can also be the output of a loop on the model itself. In that case. The enterprise and equity values of the weighting coefficients are the output of the model.
- According to the financial theory, the resources, including the debt, have to be accounted for their economic values. The book value of the debt has no reason to correspond to its economic value for several reasons: on the one hand, assuming a fixed interest rate, the economic value depends on the evolution of the reference rate; on the other hand, its sensitivity depends on the Macaulay duration ($S=-D/(1+i)$) and therefore on the time to expiration. Without entering into technical details, assuming the EV is lower than the nominal value of the debt; its value is worth zero if it is maturing tomorrow. But, if it is maturing later, its economic value is strictly positive as the market considers the volatility of the revenues enables to expect higher cash flows in the future which will be consistent with an increase in the EV beyond the debt's nominal value.

The real options enable to cope with these various issues. Such an approach was implicitly advised by Black and Scholes (1973) in their founding paper. According to them, the equity value corresponds to a call premium on the assets. Then, the spot price of the underlying assets is the EV, the volatility is that of the assets, the strike price is the nominal value of the debt and the time to expiration is that of the debt. As usual, the reference rate is the risk free rate the maturity of which being consistent with the debts.

This proves that a business plan is not necessary; the discount rate is not subjective as it is the risk free rate and the debt's economic value is not required. Moreover, the

Black & Scholes formula enables to get the economic value of debt (B) the economic value of equity (E) being provided by the market. Indeed:

$$E = EV.\Phi(d_1) - D.e^{-rt}.\Phi(d_2) \quad (1)$$

Finally:

$$B = EV - E = E = EV.\Phi(-d_1) - D.e^{-rt}.\Phi(d_2) \quad (2)$$

More importantly, the volatility of revenues and therefore the cash flows is factored in the option's approach. Then the full risk is embedded is the equity valuation.

The relatively high volatilities of a sample of 17 cinema and broadcasting firms justify the real options approach. As evidenced in the table below, the average volatility on the sample is 31.01%. This means that there is only a 5% risk to say that the volatility of the whole industry is in a [24.78% ~ 37.24%] range.

This level of volatility is likely to increase given the current evolution of the industry's business model, following that of the music industry which has been deeply affected by the disruptive digital technology. The lunching by Netflix of House of Cards in 2013, with the possibility to see all the films on the first day, meant the disappearance of the managed dissatisfaction, often enhanced by a cliffhanger at the end of each film. This evidenced the end of the organized chronology of media allocation for each production (cinema then video then downloading) and the decrease in recurring revenues.

Table 1
Volatility's confidence interval

Name		Equity's volatility
21st Century fox		21.52%
AMC		28.11%
Carmike		31.32%
CIDM		53.81%
Cinemark		19.60%
Cineplex		15.74%
Cineworld		24.09%
Dreamworks		45.30%
Eros		41.28%
EuropaCorp		40.16%
Lions Gate		36.30%
Mediaset		44.49%
RealDInc		45.46%
Regal		18.63%
TimeWarner		24.09%
Viacom		19.27%
Walt Disney		17.99%
	Average volatility	31.01%
	Variance	1.47%
	Standard deviation	12.12%
	t	2.12
	Lower limit	24.78%
	Higher limit	37.24%

II. LITERATURE REVIEW

The usefulness of real options to value assets has been many times underlined for high volatility industries whose revenues depend on raw materials' prices which are the output of trading activities on capital markets. This is mainly the case of oil and mining. Such a methodology is useful in the background of open bids by states for concessions. The value of an oil reserve can be looked upon as that of a portfolio of options to open the tap. The number of options corresponds to the frequency of the decision to open or close the tap. The spot price of the underlying asset is that of oil, the volatility of the underlying asset is that of oil, the strike price is the full cost per barrel and the time to expiration is that of each option. The first option's time to expiration is 0. Indeed, once the buyer of an oil concession becomes its owner, he has to decide immediately to open the tap or not. If the duration of the concession is 10 years and if the decision to open or close the tap can be undertaken once a year, there are 9 additional options with 1, 2,... 9 years corresponding to their respective times to expirations. Lots of variations around the valuation of oil reserves have been proposed.

Furthermore, no reference paper has been prepared on the usefulness of real options to get accurate firms' valuations in the cinema and broadcasting industry. The Black and Scholes approach (1973) assumes the debt is a zero coupon. This does not correspond to the reality as installments on the one hand, interests on the other hand are paid at least once a year. Then to get the assets, the ownership of the firm's assets is dependent on the repayment capacity of the whole future installments and interests.

Merton (1973) also considers the equity value as a call premium on the company's assets in the background of the pricing of corporate liabilities. The dynamics for the enterprise value, over time, is described by a diffusion-type stochastic motion with the following stochastic differential equation:

$$dV = (\alpha V - C)dt + \sigma V.dz \tag{3}$$

where α is the instantaneous expected rate of return on the firm per unit time, C is the total payouts by the firm per unit time to either shareholders or liabilities-holders (e.g., dividends or interest payments) if positive and the cash received by the firm from new financing if negative, σ^2 is the instantaneous variance of the return on the firm per unit time, dz is a standard Wiener process. Moreover, F is the economic value of debt and D is the par value of the debt, i.e., the amount the firm has promised to pay to the bondholders on a specified calendar date.

In the event the payment of D is not met, the bondholders take over the company and the shareholders receive nothing. If there are no coupons, the PDE applied to D is:

$$\frac{1}{2}\sigma^2 V^2 \frac{\partial^2 F}{\partial V^2} + r.V.\frac{\partial F}{\partial V} - r.F + \frac{\partial F}{\partial t} = 0 \tag{4}$$

Let F(V, τ) be the economic value of debt when the length of time until maturity is τ and then F(V,0) = min(V,D). Let f(V, τ) be the economic value of equity when the length of time until maturity is τ and then f(V,0) = max(0;V-D) and: f(V, τ)= V. Φ (d_1) – De^{-rt}. Φ (d_2). As F = V – f:

$$F = D.e^{-rt}\left[\Phi(d_2) + \frac{V}{D.e^{-rt}}.\Phi(-d_1)\right] \tag{5}$$

Let

$$d = \frac{D.e^{-rt}}{EV} \text{ or } \frac{1}{d} = \frac{EV}{D.e^{-rt}} \tag{6}$$

Then

$$F = D.e^{-rt}\left[\Phi(d_2) + \frac{1}{d}.\Phi(-d_1)\right] \tag{7}$$

This formula enables to express the spread on the risky debt. In that context, let R be the yield to maturity. Then:

$$F = D.e^{-Rt} \text{ or } \frac{F}{D} = e^{-Rt} \tag{8}$$

and

$$R = \frac{1}{\tau}.\ln\frac{F}{D} \tag{9}$$

Finally,

$$R - r = \text{spread} = -\frac{1}{\tau}\ln\left[\Phi(d_2) + \frac{1}{d}.\Phi(-d_1)\right] \tag{10}$$

Merton (1973)'s pricing of corporate debt does not include any enhancement of the enterprise value by the tax shield which is generated by the tax deductibility of the financial expenses on debt. Such a principle was pioneered by Modigliani and Miller (1963) who established that the enterprise value of the leveraged firm is equal to that of the unleveraged one increased by a tax shield. In that context, the maximisation of the enterprise value can result from the maximisation of the level of corporate debt. But, as reminded by Brennan and Schwartz (1978) such a conclusion leads to the inconsistency between the premise that management has to maximise the wealth of shareholders and the empirical observation that most firms do not maximise their indebtness. This discrepancy is justified by Modigliani and Miller (1963) themselves who remind that retained earnings is a cheaper source of financing than debt and insist on the need for preserving flexibility.

Hull, Nelken, and White (2004) proposed a methodology based on Ito's lemma and used by Moody's rating agency in order to estimate the EV and its volatility:

$$dF(x,t)=\left[\frac{\partial F}{\partial t}+a(x,t)\frac{\partial F}{\partial x}+\frac{1}{2}b^2(x,t)\frac{\partial^2 F}{\partial x^2}\right].dt+b(x,t).\frac{\partial F}{\partial x}.dz \tag{11}$$

with F = E (for equity), x=V (for enterprise value), a(x,t) = m.V, and b(x,t) = $\sigma_V V$

$$dE(V,t)=\left[\frac{\partial E}{\partial t}+m.V\frac{\partial E}{\partial V}+\frac{1}{2}\sigma_V^2 V^2\frac{\partial^2 E}{\partial V^2}\right].dt+\sigma_V V.\frac{\partial E}{\partial V}.dz \tag{12}$$

Then:

$$\sigma_V V.\frac{\partial E}{\partial V}.dz=\sigma_E E.dz \text{ and } \sigma_V V.\frac{\partial E}{\partial V}=\sigma_E E \tag{13}$$

Finally:

$$\sigma_E E=\sigma_V V.\Phi(d_1) \tag{14}$$

Moreover, thanks to the Merton's formula:

$$E=V.\Phi(d_1)-De^{-rt}.\Phi(d_2) \tag{15}$$

The values of V and σ_V can be obtained thanks to Excel's solver applied to the following nonlinear system:

$$V.\Phi\left[\frac{\ln\left(\frac{V}{D}\right)+\left(r+\frac{\sigma_V^2}{2}\right).\tau}{\sigma_V\sqrt{\tau}}\right]-De^{-rt}.\Phi\left[\frac{\ln\left(\frac{V}{D}\right)+\left(r-\frac{\sigma_V^2}{2}\right).\tau}{\sigma_V\sqrt{\tau}}\right]=E \tag{16}$$

$$\frac{\sigma_V V.\Phi\left[\frac{\ln\left(\frac{V}{D}\right)+\left(r+\frac{\sigma_V^2}{2}\right).\tau}{\sigma_V\sqrt{\tau}}\right]}{E}=\sigma_E \tag{17}$$

III. EMPIRICAL TESTS

A. Database

For each firm of the cinema and broadcasting sample, the market capitalization, the brokers' consensus on EV (output of a DCF valuation) and the brokers' consensus on the target price have been extracted from the Factset financial data base as at 03/02/2015. Then, the shares volatility which corresponds to the standard deviation of the return has been calculated. Each daily volatility over two years has been multiplied by $\sqrt{258}$ in order to turn it into a yearly one. In order to establish a homogeneous chart, the data of Cineplex, Cineworld, Europacorp and Mediaset have been changed in dollar. The exchange parities between currencies are the following as at 03/02/2015: EUR = 1.1129 USD (data changed for Europacorp and Mediaset); USD = 1.2519 CAD (data changed for Cineplex) and GBP = 1,534 USD (data changed for Cineworld). For lack of information about broker's consensus, five firms – BAC Majestic, Gaumont SA, IMAX Corporation, Reading International Inc and Xilam Animation SA – have been excluded to the sample. The empirical study is based on 17 firms.

Table 2
Firms' features

Name	Market Cap. (in millions $)	Target equity value (in millions $)	Broker EV consensus (in millions $)	Broker growth potential
21st Century fox	76,033	86,326	103,993	14%
AMC	3,044	3,119	4,801	2%
Carmike	828	1,039	1,039	26%
CIDM	140	319	546	128%
Cinemark	5,262	5,497	6,840	4%
Cineplex	2,430	2,442	2,691	0%
Cineworld	1,777	1,750	1,721	-2%
Dreamworks	1,803	1,758	2,346	-3%
Eros	1,014	1,301	1,464	28%
EuropaCorp	136	178	287	31%
Lions Gate	4,926	6,120	7,415	24%
Mediaset	4,780	4,475	5,129	-6%
RealDInc	704	856	864	22%
Regal	3,446	3,426	5,936	-1%
TimeWarner	77,359	87,125	109,666	13%
Viacom	27,512	31,296	44,919	14%
Walt Disney	195,950	201,142	217,743	3%

Based on the Black and Scholes approach, the equity valuation of the 17 above mentioned firms has been prepared. The French risk free rate, paid on 10-year T-Bonds, is 0.58% which corresponds to 0.58% in continuous time. The strike price corresponds to the amount of the debt in the accounts. So, in each firm's 2013 annual report, the financial debt has been found. In order to apply the option pricing models, two other parameters have to be required: the time to expiration and the underlying asset's volatility. In the Black and Scholes and Merton's seminal papers, the debt is a zero coupon. Then, the option's time to expiration corresponds to the residual maturity of the bond. For most firms, the debt is made of bonds with coupons and financial borrowings from banks. From a theoretical point of view, a compound option with several maturities should be taken into account. However, in order to apply the Black-Scholes-Merton's pricing model, an average residual maturity of each company's debt has been calculated as a proxy of the time to expiration τ. Moreover, to get each firm's enterprise value (i.e., the spot price) of the underlying asset and its volatility, the Hull methodology has been put in practice. Thanks to the Ito's lemma, the following two equations with two unknown parameters (EV and s(EV)) are:

$$E = EV.\Phi(d_1) - De^{-rt}.\Phi(d_2) \quad (18)$$

$$s(E) = \frac{s(EV).EV.\Phi(d_1)}{E} \quad (19)$$

with

$$d_1 = \frac{\ln(\frac{EV}{D}) + (r + \frac{s(EV)^2}{2}).\tau}{s(EV)\sqrt{\tau}} \text{ and } d_2 = d_1 - s(EV)\sqrt{\tau} \quad (20)$$

These equations are solved using the Excel solver.

Table 3
Black and Scholes parameters

Name	Market Cap. (in millions $)	EVconsensus (solveur) (in millions $)	risk free rate	Assets' volatility	Debt in accounts
21st Century fox	76,033	85,218	0.58%	19.35%	16,458
AMC	3,044	4,664	0.58%	20.11%	2,195
Carmike	828	1,135	0.58%	24.08%	455
CIDM	140	356	0.58%	26.85%	263
Cinemark	5,262	6,620	0.58%	16.23%	2,049
Cineplex	2,430	2,581	0.58%	14.85%	190
Cineworld	1,777	1,941	0.58%	22.16%	198
Dreamworks	1,803	2,010	0.58%	40.65%	300
Eros	1,014	1,148	0.58%	36.76%	246
EuropaCorp	136	258	0.58%	26.97%	192
Lions Gate	4,926	5,705	0.58%	31.80%	858
Mediaset	4,780	6,398	0.58%	35.22%	1,840
RealDInc	704	720	0.58%	44.42%	48
Regal	3,446	5,395	0.58%	13.79%	2,311
TimeWarner	77,359	94,528	0.58%	20.16%	20,165
Viacom	27,512	37,306	0.58%	15.17%	11,885
Walt Disney	195,950	187,613	0.58%	16.50%	14,288

Table 4
Valuation according to Black and Scholes Merton approach (in millions $)

Name	EV consensus (solveur)	Debt in accounts	Cash and equivalent	Net debt in accounts	Merton Net debt eco value	EV – Debt eco Equity eco value	B&S M growth potential
21st Century fox	85,218	16,458	6,659	9,799	8,726	76,492	0.60%
AMC	4,664	2,195	546	1,649	1,378	3,286	7.92%
Carmike	1,135	455	144	311	263	872	5.33%
CIDM	356	263	57	206	162	195	39.62%
Cinemark	6,620	2,049	600	1,449	1,304	5,316	1.02%
Cineplex	2,581	190	35	154	150	2,431	0.02%
Cineworld	1,941	198	29	169	163	1,778	0.02%
Dreamworks	2,010	300	95	205	149	1,861	3.21%
Eros	1,148	246	110	136	129	1,018	0.46%
EuropaCorp	258	192	70	122	116	142	4.29%
Lions Gate	5,705	858	62	796	776	4,929	0.05%
Mediaset	6,398	1,840	220	1,620	1,571	4,827	0.98%
RealDInc	720	48	31	16	16	704	0.09%
Regal	5,395	2,311	281	2,030	1,926	3,469	0.66%
TimeWarner	94,528	20,165	1,862	18,303	16,526	78,003	0.83%

B. Empirical Models

The empirical study is focused on the growth potential of the stock price of listed firms which belong to the cinema and broadcasting sector. Such a growth potential can be based on brokers' target prices which can be compared to the listed prices of stocks. In that case, the target price is the enterprise value, which corresponds to the present value of future free cash flows, as determined by brokers, reduced by the net debt that can be found in the accounts. But such a net debt, which is based on its face value without taking its maturity into account and therefore the probability of bankruptcy, may be overestimated. The growth potential of the stock price may increase, should the equity value be based on Black & Scholes-Merton in order to include the bankruptcy risk which depends on the debt's face value but also on its maturity and the assets' volatility. The Black & Scholes-Merton approach provides a new breakdown of the DCF enterprise value (EV) between equity and net debt economic values. In that case:

$$E = \text{Brokers' EV} - \left\lfloor EV.\Phi(-d_1) + De^{-rt}.\Phi(d_2) - \text{cash and equivalent s} \right\rfloor \tag{21}$$

The comparison between both growth potentials may be explained by the corresponding leverage ratios. For that reason, the net debt to EV is calculated based on the net debt which is in the accounts on the one hand, on the economic value of the net debt which is given by the Black and Scholes-Merton's model on the other hand. These ratios are respectively noted D/EV and B/EV. An alternative to Merton's debt economic value, B, is the following breakdown:

$$B = EV.\Phi(-d_1) + De^{-rt}.\Phi(-d_2) - De^{-rt} + De^{-rt}$$
$$B = De^{-rt} + EV.\Phi(-d_1) + De^{-rt}\left[\Phi(-d_2) - 1\right] \quad (22)$$
$$B = De^{-rt} + EV.\Phi(-d_1) - De^{-rt}\Phi(-d_2)$$

and

$$B = D.e^{-rt} - \Phi(-d_2)\left[D.e^{-rt} - \frac{\Phi(-d_1)}{\Phi(-d_2)}.EV\right] \quad (23)$$

where $\frac{\Phi(-d_1)}{\Phi(-d_2)}.EV$ is the amount of debt which will be recovered by the bondholders should the firm file for bankruptcy.

Then $\frac{\Phi(-d_1)}{\Phi(-d_2)}$ is the recovery rate and $D.e^{-rt} - \frac{\Phi(-d_1)}{\Phi(-d_2)}.EV$ is the expected discounted loss which will be borne by the bondholders given the assumed default of the firm. As $\Phi(-d2)$ is the probability of bankruptcy, $\Phi(-d_2)\left[D.e^{-rt} - \frac{\Phi(-d_1)}{\Phi(-d_2)}.EV\right]$ is the expected discounted shortfall. Finally, as used by Moody's KMV and the risk departments of banks in the background of risk weighted assets calculations:

$$\text{Value of debt} = \text{par value of debt} - \text{probability of default x expected discounted LGD} \quad (24)$$

where LGD means "Loss Given Default".

The 3 main parameters of the economic value of the net debt seem to be its maturity (τ), the recovery rate given default $\left(\frac{\Phi(-d_1)}{\Phi(-d_2)}\right)$, which includes the probability of default and the weight of its face value which be expressed as a percentage of the enterprise value (D/EV). In that context, a multiple regression is tested in order to explain the growth potential based on the Black & Scholes Merton's equity value.

C. Empirical Results

1. Equality test of assets' and equities' volatilities

The means of the stocks and assets volatilities are respectively 31% and 25%. The significance of the 6% discrepancy can be tested using the data provided in the following tables. The table is dedicated to the equality test of variances.

Table 5
Equality test of variances (F-test)

	Equity's volatility	Assets' volatility
Mean	31.0%	25.0%
Variance	1.5%	0.9%
Observations	17	17
Degrees of freedom	16	16
F	1.59	
P(F<=f) unilateral	0.18	
Critical value for F (unilateral)	2.33	

If variances are equal, the ratio of the standard variances obeys a Fisher-Snedecor's distribution:

$$\frac{S_X{}^2}{S_Y{}^2} \rightarrow F(n_P - 1; n_Q - 1) \quad (25)$$

where n_P=17 and n_Q=17. Hence:

$$T = \frac{S_X{}^2}{S_Y{}^2} \rightarrow F(16;16) \quad (26)$$

The Fischer-Snedecor's table provides: P[T > 2.33] = 5%. In other words, if the variances are equal, T has a 5% probability to be higher than 2.33. By experimentation, $t_0^* = 1.59 < 2.33$. Hence, with a 5% error risk, the variances of the volatilities of the stocks on the one hand, of the assets on the other hand, are equal. Then a Student's test enables to know whether the stocks' and assets' volatilities are significantly different. The table below is dedicated to such a test:

Table 6
Equality test of means: 2 observations with equal varian*ces*

	Equity's volatility	Assets' volatility
Mean	31.0%	25.0%
Variance	1.5%	0.9%
Observations	17	17
Weighted Variance	1.2%	
Hypothetical means difference	0	
Degrees of freedom	32	
Stat t	1.60	
P(T<=t) bilateral	0.12	
Critical value for F (bilateral)	2.04	

If the means are equal, the following ratio obeys a Student's distribution:

$$T = \frac{\overline{X} - \overline{Y}}{\sqrt{\frac{(n_P - 1)S_X^2 + (n_Q - 1)S_Y^2}{n_P + n_Q - 2}} \cdot \sqrt{\frac{1}{n_P} + \frac{1}{n_Q}}} \quad (27)$$

where n_P=17 and n_Q=17. Hence, $T \rightarrow S(32)$. The Student's table provides: P[-2.04 < T < 2.04] = 95%. In other words, if the means are equal, T has a 95% probability to be in a [-2.04; 2.04] range. By experimentation, $t_0^* = 1.6 < 2.04$. Then, with a 5% error risk, the means of the volatilities of the stocks on the one hand, of the assets on the other hand, are equal. Such a conclusion means the assets' and equities' volatilities are noticeably same.

2. Equality test of stock prices' potential growth based on brokers' and Black and Scholes-Merton's approach

The means of the growth potential based on brokers' target prices and Black & Scholes-Merton's approach of equity valuation are respectively 17.5% and 3.5%. The significance of the 14% discrepancy can be tested thanks to data provided in the following tables. The table bellows is dedicated to the equality test of variances.

Table 7
Equality test of variances (F-test)

	g brokers'	g B&SM
Mean	17.5%	3.5%
Variance	9.6%	1.0%
Observations	17	17
Degrees of freedom	16	16
F	9.66	
P(F<=f) unilateral	0.00	
Critical value for F (unilateral)	2.33	

As in the former equality test of variances, if the variances of growth potentials are equal, $T=\frac{S_X^2}{S_Y^2}$ has a 5% probability to be higher than 2.33.

By experimentation, $t_0^* = 9.66 > 2.33$. Hence, with a 5% error risk, the variances of the potential growth based on brokers on the one hand, on the Black and Scholes-Merton's approach on the other hand, are different. Then an Aspin Welch's test enables to know whether the average growth potentials are significantly different. The table below is dedicated to such a test.

Table 8
Equality test of means: 2 observations with different variances

	g brokers'	g B&SM
Mean	17.5%	3.5%
Variance	9.6%	1.0%
Observations	17	17
Hypothetical means difference	0	
Degrees of freedom	19	
Stat t	1.78	
P(T<=t) bilateral	0.09	
Critical value for F (bilateral)	2.09	

If the means are equal, the following ratio obeys a Student's distribution: $T \rightarrow S(19)$ as in the former equality test of means. The Student's table provides: P[-2.09 < T < 2.09]=95%. By experimentation, $t_0^* = 1.78$. Then t_0^* is obviously in the [-2.00; 2.00] range. Hence, with a 5% error risk, the means of the potential growth based on brokers on the one hand, on the Black and Scholes-Merton's approach on the other hand, are equal. Even if the means of the standard deviation are different, statistically it is not meaningful. In other words, in this sector, brokers' forecasts are reliable. The Black & Scholes Merton's approach doesn't bring a better valuation for the firms belonging to the cinema and broadcasting industry. Hypothesis criticisms about the traditional implementation of DCF when the Black and Scholes Merton's method seems to be used are groundless in this context.

The explanation of the equality of growth potentials can be completed by a statistical test of equality of leverage ratios which correspond to net debt / enterprise value.

3. Equality test of leverage ratios based on the net debts in the firms' accounts and on recalculated net debts including Black and Scholes-Merton's approach

The means of the leverage ratios based on brokers' target prices and Black & Scholes-Merton's approach of equity valuation are respectively 21.6% and 19.3%. The significance of the 2.3% discrepancy can be tested thanks to data provided in the following tables. The table bellows is dedicated to the equality test of variances.

Table 9
Equality test of variances (F-test)

	D/EV	B/EV
Mean	21.6%	19.3%
Variance	2.4%	1.8%
Observations	17	17
Degrees of freedom	16	16
F	1.36	
P(F<=f) unilateral	0.27	
Critical value for F (unilateral)	2.33	

As in the former equality tests of variances, if variances of the leverage ratios are equal, T= $\frac{S_X^2}{S_Y^2}$ has a 5% probability to be higher than 2.33. By experimentation, $t_0^* =$ 1.36 < 3.33. Hence, with a 5% error risk, the variances of the potential growth based on brokers on the one hand, on the Black & Scholes-Merton approach on the other hand, are equal. Then a Student's test enables to know whether the average leverage ratios are significantly different. Table 9 is dedicated to such a test.

Table 10
Equality test of means: 2 observations with equal variances

	D/EV	B/EV
Mean	21.6%	19.3%
Variance	2.4%	1.8%
Observations	17	17
Weighted Variance	2.1%	
Hypothetical means difference	0	
Degrees of freedom	32	
Stat t	0.46	
P(T<=t) bilateral	0.65	
Critical value for F (bilateral)	2.04	

If the means are equal, the following ratio obeys a Student's distribution:

$$T = \frac{\overline{X} - \overline{Y}}{\sqrt{\frac{S_X^2}{n_P} + \sqrt{\frac{S_Y^2}{n_Q}}}} \rightarrow S(32) \qquad (28)$$

The Student's table provides: P[-2.04<T<2.04]=95%. By experimentation, $t_0^* =$ 0.46. Then t_0^* is obviously in the [-2.01; 2.01] range. Hence, with a 5% error risk, the means of the leverage ratios based on brokers on the one hand, on the Black & Scholes-Merton approach on the other hand, are equal.

4. Confidence interval of the spread

As shown in Table 11, the average spread on the sample is 1.68%. This means that there is a 5% risk to say that the volatility of the whole industry is in a [0%; - 3.36%] range.

Table 11
Spread's confidence interval

Name		Spread
21st Century fox		0.09%
AMC		1.71%
Carmike		1.91%
CIDM		7.05%
Cinemark		0.21%
Cineplex		0.00%
Cineworld		0.00%
Dreamworks		2.35%
Eros		0.87%
EuropaCorp		12.41%
Lions Gate		0.07%
Mediaset		1.34%
RealDInc		0.01%
Regal		0.18%
TimeWarner		0.28%
Viacom		0.09%
Walt Disney		0.00%
	Average spread	1.68%
	Variance	0.11%
	Standard deviation	3.26%
	t	2.00
	Lower limit	0.00%
	Higher limit	3.36%

IV. CONCLUSION

In absolute terms, the real options approach enables to correct the valuation of the stock prices than the Discounted Cash Flow Method to the extent that the net debt's amount, which is deducted from the enterprise value, is based on its economic value. However, despite appearances, for cinema and broadcasting firms, the growth potential based on a DCF on the one hand, based on the Black and Scholes-Merton approach on the other hand is, from a statistical point of view, meaningfully equal. The economic value of the net debt, which is embedded in the Black and Scholes-Merton's model, enables to take the probability of default, the maturity of the debt and the assets' volatility into account. But, the risk calculated by the brokers is sufficient and therefore, their assumptions are acceptable. The comparison of the leverage ratios confirms this reality. They are not meaningfully different when based on the net debt in the accounts and on the economic value of the net debt. The relatively low volatility of this cinema and broadcasting industry's stocks, 24~35% range with a 5% risk of error, is consistent with such a situation. Our analysis provides a basis for future research and can be used in other financial markets or sectors.

ENDNOTE

1. For detailed information, please contact the authors.

REFERENCES

Black, F., and M. Scholes, 1973, "The Pricing of Options and Corporate Liabilities." *Journal of Political Economy*, 81(3), 637-654.

Brennan, J., and E.S. Schwartz, 1978, "Corporate Income Taxes, Valuation and the Problem of Optimal Capital Structure." *Journal of Business*, 51(1), 103-114.

Geske, R., 1977, "The Valuation of Corporate Liabilities." *Journal of Financial and Quantitative Analysis*, November, 541-552.

Geske, R., 1979, "The Valuation of Compound Options." *Journal of Financial Economics*, 7, 63-81.

Hull, J., I. Nelken, and A. White, 2004, "Merton's Model, Credit Risk and Volatility Skews." *Journal of Credit Risk*, 1(1), 3-28.

Levyne, O., and J. Sahut, 2008, "Options Réelles." *Dunod*.

Macaulay F., 1938, *The Movements of Interest Rates. Bond Yields and Stock Prices in the United States since 1856*. New York: National Bureau of Economic Research.

Modigliani, F., and M.H. Miller, 1963, "Taxes and the Cost of Capital: A Correction." *American Economic Review*, 53(1), 433-443.