

The Hidden Value in the "Black Swan" Pandemic Synergistic Externalities Creates Opportunity Value Reversing Application of Black-Scholes Option Pricing Model (BSOPM)

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Abstract: The worldly pandemic crisis creates unprecedented external value effects. These effects result in unexpected economic externalities which generate unexpected synergy value in investment valuation. 2020 global pandemic is an extraordinary example of such synergistic externalities.

We aim to conduct research in the reversing application of the Black-Scholes Option Pricing Model (BSOPM). In the past, BSOPM failed when extreme unexpected events occurred. The normality assumption of the Black-Scholes model does not capture extreme movements. However, the reversed application and empirical testing results demonstrate the greater volatility, the greater the return. It is axiomatic that risk and reward are positively correlated, even when "black swan" events occur. This is unconventional and contradicted with valuation intuition. Technology has greatly advanced. The information travels in nanoseconds hence breaking the "norm". Is it possible the "Black Swan" creates values through the exceedingly high fluctuation?

In this paper, we will evaluate the hidden value in the "Black Swan" — that is, examine the pandemic global impact (synergistic externalities) and how this disaster creates opportunity value. We target to research on the reversing application of Black-Scholes Option Pricing Model (BSOPM) in such an evaluation and recommend how to utilize the BSOPM model-thinking to strategize the organization's agility to anticipate the "unexpected".

Key words: heterodox valuation, economics

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1. Introduction

The worldly pandemic crisis revealed and is revealing the vulnerability of the global economy. It forcefully changed business and social normality. The new "norm" is being established and will continue reshaping conventionalism. The unprecedented vulnerability leads to unanticipated volatility in just about everywhere in the world. This global pandemic is a "black swan". What is value could a "black swan" possibly bring? In doing business, it is less risk the safer the operation will be. However, in investment, it is axiomatic that risk and reward

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are positively correlated: the bigger the risk, the greater the return shall be. This may sound contradicted with valuation intuition, however, is perceived as a common understanding in investors who are looking for high yield investment return (with reasons). 2020 global pandemic is unfortunately an astonishing example of how "black swan" creates value. These effects result in unexpected economic externalities which generated and are generating unexpected synergy value in investment valuation.

In this research, we aim to demonstrate how the "Synergistic Externalities Creates Opportunity Value" and how such opportunity values are reflected in the synergy value in investment valuation. We will be primarily using the Black-Scholes Option Pricing Model (BSOPM), but in a reversed methodology. In the past, BSOPM failed when an extreme unexpected event occurred. The normality assumption of the Black-Scholes model does not capture extreme movements. However, the reversed application and empirical testing results demonstrate the greater volatility, the greater the return. As mentioned in the first paragraph, the "black swan" unveils the hidden value and hence creates opportunity value. The 2020 Pandemic is a gigantic "Black Swan". Is it possible the "Black Swan" creates values through the exceedingly high fluctuation?

We will start by uncovering the "Black Swan" hidden value — that is, examine the pandemic global impact (synergistic externalities) and how this global disaster creates opportunity value. We then illustrate the reversing application of the Black-Scholes Option Pricing Model (BSOPM) in such an evaluation and recommend how to utilize the BSOPM model-thinking to strategize the organization's agility to anticipate the "unexpected".

2. Part I The Black Swan – "Hidden Values"

The coronavirus has impacted many businesses. From small "mom and pop" businesses to global entities, all over the world. Businesses must quickly adapt to the new reality. The global supply chain is temporarily interrupted then assumed only to a certain capacity. Some industries have been almost entirely tanked due to these changes and interruptions. Travel, restaurants, and airlines are just a few examples of industries that have been impacted severely.

On the other hand, some industries have flourished, some have even seen significant growth. Examples are online shopping, e-commerce B2B (business to business), B2C (business to consumers), social media (zoom for example), courier delivery services (door dash, Uber eats, etc), enterprise technology services (cloud web services, google), home entertainment (Netlfix). Not to mention the sad growth in hospitals, medical equipment suppliers, and even sanitary product manufacturing.

The pandemic also forced many social and organizational changes. All of sudden, government offices are closed. The usual procedures have to be skipped. Rules can be and are broken. Business or even governmental decisions are made faster without sitting in the same conference rooms.

And the biggest change, we would say is the employees are allowed to work from home due to the circumstances. It feels like a labor liberation revolution happened. People, the workforce, are freed from having to go into the office and face the supervisors. People spend a lot of time at home with family while working. This reshapes how they think of work and life in general. This is significant in many ways. This is a hidden value no one could predict.

Additionally, the pandemic has coerced globalization even deeper into globalization through more perplexing, enigmatic, and inexplicable online platforms. The growing use of digital technology enables broader and deeper coordination across the borders. This generates a (much) higher productivity at a lower cost. Cross-border

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communication is now easier than ever. Even the United Nations conferences were conducted online. This propels entrepreneurs to exploit and access global market needs. This is evident. During the pandemic, many disruptive innovations and/or ideas have been engendered. Some have been implemented and established (more details see "Global Pandemic Creates New Opportunities, Challenges for International Entrepreneurs, University of Minnesota)

"Black swan" also interrupted the global supply chain. At the same of globalization, regionalization also came into play on a much rapidly developed scale. It is known that countries don't build the entire product, such as Apple, Nike, etc). Now companies are looking to build the product in the "neighborhood countries: again due to the interruption of supply chain and shipping logistics industry bottleneck. This could bring a tremendous opportunity to the domestic manufacturers.

In the United States, the manufacturing groundworks have been lagging behind since the '80s. Many of these edifices are inadequate. Digitization makes it possible to (re)build this deficiency. New industries emerged. "The auto industry is going through a significant transformation".... "It's transitioning from automobile companies to technology companies." (Glenn Stevens, Jr., executive director, MICHauto, and vice president, automotive and mobility initiatives for the Detroit Regional Chamber). The Detroit region isn't relying solely on next-generation mobility for its economic future. When COVID-19 hit, the industry pivoted and started making ventilators within week (Maureen Donohue Krauss, president, and CEO, Detroit Regional Partnership).

Another example is Healthcare. This industry is in the early stages of adopting data science and technology. According to Nawal Roy, Founder & CEO, Holmusk, in his article "Shorten the innovation cycle", he pointed out that "we have been living with an outdated operating model that is not up to the standard of our times. This pandemic has brought forward challenges that we otherwise might not have recognized, giving us an opportunity to rebuild to serve a more diverse community through technology-based solutions. In addition, he deepened this point by adding, "Change can be daunting, but rather than dwelling on current system constraints, we can seize this opportunity to make positive changes through data-driven decision-making in healthcare and refocusing on the social determinants of health that are vital to understanding and improving outcomes".

The food industry has shown significant acceptance of technology and innovation. COVID-19 has exposed the vulnerability of our food supply chain both domestically and internationally. Mr. Ponsi Trivisvavet, CEO, Inari rightly pointed out "the importance of shorter innovation cycles for the life sciences". He emphasized that it is essential to improve that industry improves its "capacity to react to this fast-changing environment" and that "whether that be in agriculture or human health"...that "we must bring new seeds to market — and ensure they fit local needs — much faster and more efficiently than what has been done in the past". What's more, in our view, is his calling of "Have the courage to challenge the status quo and offer the diversity that is lacking in the industry: diversity of technology, diversity of thought, and diversity in the players who will deliver the required innovation to the market". This awaking realization is part of the hidden value this "black swan" revealed.

Most importantly, the pandemic highlighted the power of corporate or organizational infrastructure and culture, and learning and adaptation ability, and modern technology.

2.1 Culture

Collaborative business constructs among departments, divisions, and teams. For a small business, the "sailing through the storm" loyalty between the owners and employees plays a magnificent role in weathering the most difficult period. This is the time that shows the "culture" and "loyal" that is planted and carefully nurtured over the

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years. In international companies' case, coordinative infrastructure among countries' operations. Similar to the small business' cases, this work collaborative ethos is the "secret sauce" for the longevity of any business, the cipher, the code embedded in the business or organization culture. The 2020 Black Swan tests such value. This is a "synergistic externalities" value that is not normally revealed.

2.2 Agility to Learn to Innovate, to Change, and to Adapt

Too often this agility is being talked about, only at the surface level. It is almost a "political right" phrase to put in textbooks, case studies, or annual reports to the investors. However, this is not the top priority for many C-suites decision-makers. While this sounds "trendy", it is hard to break the comfort zones. It is daunting or even intimidating to see the competitors' moves. In some industries, it is also overwhelming to face to face the newer and newer reality in the marketplace.

Pandemic forced businesses and organizations to step out of their "comfort zones" in many ways. Businesses either survive or even thrive through learning, innovating, changing, and adapting or shrinking or even disappearing if choosing an otherwise path.

2.3 Modern Technology and Digital Transformation

this has been an ongoing process driven by a broad range of innovators. However, the pandemic has accelerated this process. From start-ups and entrepreneurs to big corporations, we see tremendous progress towards diversity and creativity in technological innovation. It wouldn't be an exaggeration to call as the "Fourth Industrial Revolution".

To recap, it is awe-inspiring to discover and to excavate the hidden value — Synergistic Externalities Creates Opportunity Value. Now let's move to Part Two the Black-Scholes Option Pricing Model (BSOPM).

3. Part II: Proposed the Reconfiguration of the Black-Scholes Option Pricing Model (BSOPM) to Reveal the "Black Swan Hidden Values"

In 1973, Fischer Black and Myron Scholes devised a formula to value financial options¹, known as the Black Scholes Option Pricing Model. The original formula calculates the theoretical option value - the present value of the expected option payoff — under the assumption that no dividends, taxes, or transaction costs were paid. This model was based on the proposition that options are not correctly priced in the market. If they could be more accurately priced through the use of a financial model, it would become possible to capture riskless profits by creating portfolios of long and short positions in options and stocks (Black F. & Scholes, M.,1973).

Later modified by Robert Merton, the formula incorporates dividends. This dividend variable reduces the value of the share to the option holder by the present value of the forgone dividend and reduces the cost of holding a share by the dividend stream that would be received (Merton R. C., 1973). Since then, the Black Scholes Option Pricing Model with Merton's modification has been widely used to value options in the financial investment sector because the theory proved to be quite accurate. In 1984, Dr. Stewart Myers demonstrated that the rationale behind the valuation of financial options could also be applied in situations where an investor could elect to make or decline to make an investment in a non-financial option. He constructed the "Real Options" (RO) concept upon the foundation of the Black-Scholes Option Pricing Model (BSOPM) by extending it beyond the valuation of

¹ Financial options: for the payment of a specific price, a financial option provide the right (but not the obligation) to buy or sell a specific amount of a stock or other financial asset during a specified time window, for a specified price (the "strike" price). Financial options are generally freely tradable. The underlying financial asset might be common stock, bonds or other financial instruments.

financial options to the valuation of real asset investment opportunities or projects.

In Dr. Robert Merton's 1998 Nobel Laureate speech, he succinctly outlined the development of the option pricing strategy, particularly following the breakthrough introduction of the BSOPM in 1973. Dr. Merton highlighted the many improvements made to option pricing theory and practice by a series of gifted and determined scholars during the decades following its introduction.

Original BSOPM Equations:

$$\boldsymbol{C} = \boldsymbol{S}\boldsymbol{e}^{-\delta t}\{\boldsymbol{N}(\boldsymbol{d}_1)\} - \boldsymbol{X}\boldsymbol{e}^{-rt}\{\boldsymbol{N}(\boldsymbol{D}_2)\}$$
(1)

$$P = Xe^{-rt}\{1 - N(d_2)\} - Se^{-\delta t}\{1 - N(d_1)\}$$
(2)

d1 = $\left\{ ln\left(\frac{s}{x}\right) + \left(r - \delta + \frac{\sigma^2}{2}\right) \right\} / \sigma \sqrt{t}$

d2 = $d_1 - \sigma \sqrt{t}$

C: Call Option Value

P: Put Option Value

(S): Present value of an underlying asset — the present value of cash flows expected from the investment opportunity.

(X): the option strike price — The present value of the total committed investment

 (σ) : Sigma — the standard deviation of the sales growth rate

(t): the period for which the investment opportunity is valid

(r): risk-free rate

(δ): Dividend payouts -when the applicable cost of delay – Annual cost of delay 1/n

N(d) = cumulative normal probability

To utilize the BSOPM in revealing the "Black Swan" hidden values, sources for various components in the formula must be identified and estimated. Table 1 summarizes how this study proposes to implement/estimate the BSOPM variables in the valuation of call options in the actual application. (Note: The "dividend" variable in the table only applies when the scenario might involve a delay of the investment, where some fraction of true value-creating cash flows during the life of the investment might be "lost".

 Table 1
 Proposed Inputs BSOPM adapting to reveal "Hidden Values"

| Components | description | Estimators |
|------------|--|--|
| S | Value of the underlying asset | Present Value of Expected business and social values of the investment (discounted by the industry cost of capital or nation's inflation rate) |
| σ | Std_Dev of rate of the return of under1ying Asset (sigma) | Std_Dev of company's stock price Std_Dev of the major competitor stock prices Std_Dev of the macro-indicators such as industry or countries' voluntitily indicators |
| X | Exercise/strike price on option | Present value of the cost of making thefull investment on the project. (discounted by the risk-free rate if cost is known with certainty. If uncertain discount rate is company-wide cost of capital). |
| t | Expiration of the option | Life of the duration |
| δ | Dividend Yied — which is forgon as an option holder (if appropriate | Proxy: Annual cost of delay = $1/n$ (Each year of delay translates into one less year of value-creating cash flows from the life of the projects) |

3.1 Overview: Reconfiguring BSOPM

Correct reconfiguring the BSOPM's S, X, and Sigma variables extends BSOPM's statistical function (a normal cumulative distribution curve) to derive the investment's value. The crucial task is the identification and

utilization of the variables. BSOPM variables are reconfigured as the following.

3.1.1 The S and X Variables

As mentioned above, the BSOPM S is normally the stock price of the underline asset. In the real options method, it is the present value of the future projected profitability (cash flow for most of the cases, or EBIT). While X is the present value of the current investment. In valuing the "black swan" hidden values, we recommend that S be the Present Value of Expected business and social values of the investment (discounted by the industry cost of capital or nation's inflation rate). This varies according to the nature of the industry and the companies' business models, financial strength, products, consumers, and diversification, etc.

X: Present Value of the cost of making the full investment on the project (discounted by the risk-free rate if cost is known with certainty. If the uncertain, discount rate is the company-wide cost of capital). Reconfiguring these two brings in externalities – the future projection or expectation of the investment's growth. It also changes the ways S and X are used and defined in the BSOPM, where S and X are optional. That is, in our analysis, we regard S and X are both committed investments. These investments are not optional. Pandemic leaves little or no options for businesses and/or organizations to invest in technology or people as a must investment. This differs from the real options methodology. Real options methodology is another variant of the BSOPM that places financial values on various "real options" such as the option to delay and the option to abandon. By contrast, here we treat funds as committed, not optional. In addition, time t is treated as a duration of the period and is different across companies and industries.

3.1.2 The t Variable

t, the time duration variable, is defined as the time for which the brand equity is being evaluated. In the original BSOPM, the time variable t is "discrete". However, in our analysis, t is regarded as having a much longer duration; in fact, it is regarded as having a perpetual duration because we expect the brand to continue to exist even after the expiration of n years.

3.1.3 Sigma

As previously mentioned, sigma represents the degree of uncertainty of the future associated with the investment under consideration. We insert these variables into the BSOPM cumulative normal distribution curve in order to capture the maximal value distribution since, for most industry leaders, the investment return value should be equivalent to the maximal and optimal probability of profitability.

In the BSOPM, sigma represents the degree of uncertainty of the future associated with the investment under consideration. Gui [2011] utilized the BSOPM to conduct Real Option evaluations of various investment opportunities faced by a large multinational sportswear company - Nike. Gui determined that the company's stock price was the appropriate value for sigma. The firm's stock price was widely traded and closely followed by institutional traders and was therefore highly reflective of the market's perception of the company's performance in an uncertain future. Gui further noted that the fluctuation of the stock price was a good representation of the volatility of the uncertain environment within which the company operated. Gui testes the assumption that the stock price data, Gui found the Stock Price (P) = -4.67 + 1.31(S), with R2 = 0.83. The regression fit was robust and the coefficients were significant at the 95% level. This is strong evidence that stock price is a good proxy for sigma and effectively acts as a measure of the degree of uncertainty regarding the future. This is particularly the case for industry leaders, most of whom are public companies.

4. Discussion and Conclusion

The "norm" in investment has been that greater uncertainty, the less return of that investment. To many, this is common sense. Any investment with great uncertainty automatically is regarded as "risky" as the unknown introduces volatility. A negative investment-uncertainty relationship has hence been the "rule". The ROIC (Return On Invested Capital) must be greater than the WACC (Weighted Average Cost of Capital). Recently this rule has been questioned in the "Black Swan" event, the pandemic. Even when ROIC is less than WACC, due to an unusual business environment, the investment still must be made in order to survive and to generate values in the near future.

It is anticipated that as the model is developed it will enable much more effective guidance to decision-makers, particularly on how to connect or correlate the companies' investments with industry or macro-environment, and hence how to best allocate companies' investment in order to maximize and sustain business value.

It is unfortunate that the world had to go through a tragedy to awaken some of the true values that have been hidden. Perhaps the most important contribution of this study is uncovering the counterintuitive inverse relationship between the invisible "soft values" (such as business and organizational culture) and usual "hard values" (earnings profitability as such). It is axiomatic that the "Black Swan" actually brought in hidden values: disruption and interruption into the normal business conduct and the global environment are positively correlated with our future, even at the present, it is evidence of such progress.

References

Black F. and Scholes M. (1973). "The pricing of options and corporate liabilities", Journal of Political Economy, Vol. 81, No. 3.

Gui H. (2011). "Real Options in sportswear strategic investment", Ph.D. dissertation, Dept. Systems Science, Portland State Univ., Portland, OR.

Porter M. (1986). Competitive Advantage, New York City, NY: Free Press.