Systemic Risk, Financial Stability And The Choice Between A Merger/Acquisition And A Strategic-Alliance/Joint-Venture.

Michael C. Nwogugu
P. O. Box 11104
Enugu 400007, Enugu State, Nigeria
Emails: mcn2225@aol.com; or mcn2225@gmail.com
Skype: mcn1112

Abstract[1].
       The annual volumes of M&A transactions and cross-border M&A transactions around the world are significant and often have *Multiplier Effects* and *Spillover Effects* on national economies and households, and a wide range of financial/economic indicators. Similarly, the volumes of Strategic Alliances and Joint Ventures around the world are significant (worth more than US$15 trillion annually) and have *Multiplier Effects* and *Cross-Border Spillover Effects*. As noted in Nwogugu (2015), "Synthetic M&As" can be executed using Strategic Alliances or joint Ventures. Conversely Strategic Alliances or Joint Ventures can be structured to provide all the benefits of M&A transactions. This article analyzes critical Dynamical Systems, Nonlinearity, Networks and behavioral issues pertaining to the choice between a Strategic Alliance or joint venture on one hand, and an M&A transaction; and also introduces new decision models.

Keywords: Networks; Knowledge Representation & Reasoning (KR&R); Inverse Problems; Complexity; Game Theory; Evolutionary Computing; Nonlinear Large-Scale Systems; Mergers/Acquisitions; Financial Stability.

1. Introduction.

       The choice between a Merger/acquisition on one hand, and a strategic alliance or Joint Venture (JV) (the "*Transaction Choice*") has been substantially debated in the management literature, although very few mathematical or Game Theoretic models have been developed. The problem is compounded by weaknesses inherent in traditional modelling methods – some of those weaknesses are explained in Granger, King & White (1995), Bromiley & Papenhausen (2003), Bromiley, Govekar & Markus (1989), Dellnitz & Junge (1999), Goeree & Holt (2001), Harrison, Oler & Allen (2005), Hoetker (2007), Hosmer, Taber & Lemeshow (1991), Hu, Zhang & Chen (2004), MacKinley (1997), McWilliams & Siegel (1999), Moss, Wellman & Cotsonis (2003), Roberts & Pashler (2000), and Tu, Kellett, Clerehugh & Gilthorpe (2002). This article introduces new models of the Transaction Choice that combine Game Theory, Evolutionary Computation and Dynamical Systems.
       The series of M&A transactions during 1995-2000 by Encompass Services Inc. (industry consolidation by mergers and acquisitions), illustrate some of the relevant issues - as explained in Nwogugu (2003) and Nwogugu (2007), BOSS and GMAC (predecessors to Encompass) could have achieved the same objectives of increasing geographical coverage and product coverage by entering into strategic alliances with regional and local competitors (compare Cushman & Wakefield and NAI Global, two US-based international real estate brokerage companies). Such strategic alliances and joint ventures would have enabled BOSS and GMAC to obtain the same or maybe more market power while avoiding existing US antitrust laws. Because alliance/JV agreements typically change the firms' cost structure, required investment, return profiles and employee incentives, the firm's cost of capital is

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[1] This article is a substantially revised version of the following article: Nwogugu, M. (2009), *"On The Choice Between A Strategic Alliance And An M&A Transaction"*, *International Journal Of Mathematics, Game Theory & Algebra*, 17(5/6), 269-278. Nova Publishers has granted permission for me to republish the article in other journals or books.

typically lower in alliances/JVs than for the firm as a whole. The use of strategic alliances would have prevented substantial leverage and the resulting increase in firm risk and loss of shareholder value that occurred after BOSS and GMAC merged.

Its noteworthy that stock-financed M&A transactions can provide a company with the same post-transaction risk profile as strategic alliances and joint ventures – the main difference is in allocation of costs which can be changed using alliances/JVs. From a legal perspective, anti-trust laws should be applied to strategic alliances and joint ventures. The difficulty in regulating such transactions is that the underlying agreements can be structured to preclude any allegations or semblance of the usual basis for antitrust prosecution (such product tie-ins, exclusive contracts, etc.).

2. Existing Literature.

The existing literature on the choice between a strategic alliance and an M&A transaction is extensive[2], but doesn't directly or sufficiently include or address *Game Theory strategies* or Evolutionary Computation. As noted in Nwogugu (2009), the existing literature has the following weaknesses and omissions:

1. Quantification of the choice between a strategic alliance and an M&A. Characterization of conditions under which Strategic alliance will be preferred to M&A.

2. Analysis of behavioral/psychological factors in the choice between a strategic alliance and an M&A.

3. The impact of a strategic alliance or an M&A on the probabilities of bankruptcy of the company and its prospective partners.

4. The effect of the magnitude of correlation (changes in assets; operating cash flow; etc.) between the two companies, on the success of an M&A or strategic alliance.

5. The effect of Antitrust laws on the proposed transactions.

6. Most of the empirical studies in the literature are deficient/inaccurate because they suffer from the methodological problems described in Trafimow (2003); Roberts & Pashler (2000); Bromiley, Govekar & Markus (1989); MacKinley (1997); McWilliams & Siegel (1999); Moss, Wellman & Cotsonis (2006); Hosmer, Taber & Lemeshow (1991); Tu, Kellett, Clerehugh & Gilthorpe (2002); Liu (1988); Neely (2005); Bromiley & Papenhausen (2003). The results of most of the empirical studies are valid only for specific time periods; and for specific industry structures (ie. oligopoly vs. monopoly vs. duopoly).

7. Most of the theoretical studies are based on limited and unrealistic "markets" and unique industries, such that there can't be any meaningful generalization - eg. analysis of an airline industry with three companies as in Barla & Constantatos (2006).

8. The effects of regulation and penalties. Some studies omitted many effects of sunk costs.

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[2] *See*: Beden & McGahan (2005), Kogut (1991), Villalonga & McGahan (2005), Williams, Esper & Ozment (2002), Granger, King & White (1995), Goeree & Holt (2001), Dessein (2005), Grant & Baden-Fuller (2004), Harrison, Oler & Allen (Feb. 2005), Yiu & Makino (2002), Harzing (2002), Muller (2007), Mahoney & Lajili (2006), Wang & Zajac (2007), Duarte & Garcia-Canal (2004), Arend & Seale (2005), Ayman & Abbass & Barlow (2007), Hoetker (2007), Bromiley & Papenhausen (2003), Porrini (2004), Hitt & Ahlstrom et al (2004), Hagedoorn & Sadowski (1999), Hagedoorn & Duysters (2002), Duan & Juma (2007), Barla & Constantatos (2006), Okeahialam (2005), Lee (2004), Sinha (2008), Dasgupta & Tao (1998), Li, Quiying & Liu (2006), Garvey (1995), Nye (1992), Ling & Feiqui (2007), Baumol (2001), Lin (2005), Tower, Hewett & Saboo (2020), Genç, Alayoğlu & İyigün (2012), Chaturvedijohn & Prescott (2020), and Tziva, Negro & Hekkert (2021)..

In this paper, Strategic Alliances and Joint Ventures are treated as similar transaction with the main difference being that in Joint Ventures, a new corporate entity is created in which the participants own some equity or other interest.

On Game-Theoretic or mathematical modelling of organizations, Mergers/Acquisitions, JVs and strategic alliances in Operations Research and Management, see: Deman (1999), Aloysius (2002), Belenky (2002), Huang, Tzeng & Ong (2006), Hu, Zhang & Chen (2004), Lin & Chen (2004), Ling & Feiqui (2007), Lukas (2006), Parkhe (1993), Phelan, Arend & Seale (2005). On Development Economics implications, see: Muller (2007), Hu, Zhang & Chen (2004), Hitt, Ahlstrom, et. al. (2004), and Harzing (2002).

On relevant issues in *Dynamical Systems* and *Game Theory*, see: Antonio & Coello (2018), Chica, Chiong, et. al. (2018), Deb, Zhu & Kulkarni (2018), Baltas & Yannacopoulos (2016), Petrohilos-Andrianos & Xepapadeas (2016), Sánchez-Sánchez & Vargas-Valencia (2018), Kuehn, Malavolta & Rasmussen (2018), Yeo & Melny (2019), Chu (2008), and Dellnitz & Junge (1999).

3. Operational Contagion And Bubbles.

Mergers/Acquisitions (M&A) and LBOs/MBOs waves or bubbles are a type of *Operational Contagion* (among private equity firms and acquisitive companies in industry) that is facilitated by easy access to credit, and can increase Systemic Risk and Contagion in the following ways. First, many of such corporate transactions are financed with syndicated-debt and corporate bonds, and thus any financial distress of, or default by a borrower-company will likely affect several banks and insurance companies in addition to the borrower's competitors. Second, the historical and current compensation structure of bankers that arrange these transactions provides significant incentives for banks to take excessive risk by providing sub-optimal loans without adequate monitoring and or to knowingly/un-knowingly misprice risk (all of which raises interbank rates and overall lending rates). Similarly, the historical and current compensation structures of corporate development officers (in industry) that arrange these transactions may compel non-bank companies to take excessive risk or to knowingly/un-knowingly misprice risk via sub-optimal transactions and loans (which raises perceived default risk; and overall lending rates). Third, the buyer and seller companies that are involved in such corporate transactions often provide trade credit to, and also obtain credit from other companies, thus creating "*Credit Chains*" that are susceptible to *Domino Effects*. Fourth, the executive compensation of the senior managers of, and the corporate governance policies of the Buyer and Seller companies can cause such companies to make sub-optimal decisions about financing and operations – which in turn can amplify Systemic Risk. Fifth, such transactions sometimes increase *Managerial Entrenchment*, Group-think in the industry (and within banks/lenders), *Industry Concentration* (both in industry and in the banking sector) and the *Inter-connectedness of companies*, which in turn amplify Systemic Risk and financial/non-financial Contagion (non-financial Contagion refers to increasing adoption of the same non-financial operating policies; Corporate Governance; compensation systems; etc., by many companies). Sixth, waves of corporate transactions sometimes result in substantial layoffs of staff, which can reduce Consumer Confidence, Consumer-Spending, tax revenues, and Corporate Expenditures, all of which can trigger Systemic Risk and "*Operational Contagion*" (wherein companies in an industry copy competitors' strategic moves, operational policies and cost structures). Seventh, some investors and lenders in such corporate transactions are foreign investors; and some buyer and seller companies have substantial foreign/international operations. Eighth, Systemic Risk and Contagion can increase when an M&A/LBO cycle/bubble occurs out of synch with the traditional business cycle. For example when (as in 2007-2009 in the US)[3] an M&A/LBO bubble that is financed with mostly debt occurs at the same time as an economic recession and a relatively low or declining interest rate environment; such M&A/LBO wave/bubble is very likely to increase operational and financial Contagion and the aggregate probability of corporate bankruptcy. Ninth, some M&A/LBO transactions that involve large exchange-traded companies are financed with stock/shares and that can increase the probability of market-crashes, contagion or significant declines in stock market values; and also increase the volumes of harmful arbitrage trading by speculators. Tenth, M&A/LBO bubbles can cause private equity firms to execute value-eroding and sub-optimal acquisitions that under normal circumstances would not be done. Tenth, the most recent gross notional CDS amount reported (by DTCC, and as of December 31, 2010) was US$25.5 trillion and the net notional amount was US$2.3 trillion.

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[3] *See*: Roubini N. (Feb. 22, 2008). *The Bust Of The Private Equity And LBO Bubble......Or the End of Schmalpha*. Available at:
http://www.economonitor.com/nouriel/2008/02/22/the-bust-of-the-private-equity-and-lbo-bubbleor-the-end-of-schmalpha/.

M&A/LBO bubbles can distort pricing in the CDS markets and amplify Systemic Risk in the following ways: **i)** true corporate risks can be hidden or overlooked (by banks; PE firms; buyer/seller companies, government regulators and market participants) due to the profit/growth/stability expectations, potential tax revenues, Commitments and compensation inherent in M&A/LBO transactions; **ii)** illiquidity of bank-debt used in M&A/LBOs compounds the relative pricing of CDS; **iii)** banks/lenders that provide loans and bonds for M&A/LBOs have significant incentives to undervalue the CDS contracts for such debt (the reputational, stock-market and credit-risk penalties that can be imposed on banks/lenders for perceived or actual financial distress of such borrowers are substantial). Unfortunately, the literature on M&A/LBOs does not fully address the critical relationships and substitutability among Mergers, Acquisitions, Strategic Alliances and Joint Ventures and the associated effects on operational risk and accounting disclosure – some of which are addressed in Nwogugu (2015d; *European Journal Of Law Reform*) and Nwogugu (2009).

In the US, the *Dodd Frank Act* attempts to address the inefficiency of corporate bankruptcy statutes primarily through the US FSOC's financial/non-financial SIFI criteria (and the associated governmental power to take over companies). Unfortunately, those rules apply to only very large publicly-traded companies, whereas there are many medium, small and private (not listed on exchanges) companies, mutual funds and asset management companies that are systemically very important. The consequences of such inefficient bankruptcy statutes include *Inefficient Continuance*; increased latent and explicit Systemic Risk; information asymmetry, *Costly Uncertainty*; high interest rates; dormant (rather than proactive) corporate bankruptcy statutes; and very high thresholds for bankruptcy and designation of financial distress; all of which reduce *Social Welfare*.

4. Financial Instability And Systemic Risk.

The choice between an M&A transaction and a strategic alliance substantially affects systemic risk and financial stability in several ways including but not limited to the following:

i) In many instances, large mergers and acquisition that are financed with debt (from banks, insurance companies and pension funds) are not necessary because the same benefits can be achieved through strategic alliances. A classic example is the case of Encompass Services Inc., in the US – see Nwogugu (2004) which analyzes Encompass's transactions in more detail. These acquisition loans are often syndicated among various banks, pension funds, insurance companies, mutual funds and family offices. Post-acquisition integration risk remains a reality in most industries. Thus, the failure of any one of such M&A transactions can substantially affect many banks and financial institutions, and increases systemic risk and financial instability.

ii) Most M&A transactions involve and exchange or purchase of equity. The public announcement of the M&A transaction often affects the acquiror's and the target's share prices and in the case of exchange traded companies, often sets of harmful arbitrage by traders. Such announcement sometimes adversely affects the shares of companies in the same and related industries, and increases systemic risk and financial instability.

iii) Most M&A transactions often involve cost cutting, employee layoffs and fire-sales of assets; dis-engagement of suppliers and contractors; et.. Often, some of the more un-popular side effects are increased un-employment, reduced corporate expenditures and declining real economic growth, all of which increases systemic risk and financial instability.

iv) In many M&A transactions, the target company or acquirer are often members of "credit chains", and the transaction often causes their suppliers and customers to re-evaluate their relationships and contracts, and thus increases systemic risk and financial instability.

v) Around the world, the dollar volume and number of strategic alliances grew exponentially during the last twenty years, and alliances are the "core" of business models of many companies and government agencies. From a Game Theory perspective, strategic alliances are also the "core" of relationships among firms and government agencies in most countries. Just like swaps/derivatives, strategic alliances have created a global network that connects companies and government agencies, increases inter-connectedness and thus

increases systemic risk and financial instability.

5. The Models.

This section introduces new models of the choice between an M&A transaction and a strategic alliance transaction (which can be characterized as a dynamical system). Its conjectured here that in technology industries and service industries, strategic alliances will be more beneficial than M&A financed with leverage where:

- The cost structure has a substantial fixed cost component.
- Costs and hence return profiles can be shifted using alliances and JVs.
- There are labor problems and the jobs involve use of onsite labor.
- There are substantial transportation problems.
- The knowledge base in the industry is somewhat similar – acquisitions will not necessarily provide substantial increased in knowledge which will result in payments of premiums by customers.
- The marginal cost of providing the product/service as a combined entity must be greater than the marginal cost of providing the service/product via an alliance/JV.
- The alliance/JV partner provides certain substantial cost advantages that cannot be replicated in-house at the same or lower cost.
- Employees of both partners can be easily trained, and technology standards are generally accepted in the industry.
- The company's marginal cost of capital is substantially higher than its current cost of capital.

Let:

J_m = multiplier that reflects the projected Synergies in operating costs gained in the proposed M&A transaction. $J_m \in (-1, 1)$.

E_m = estimated index of employee effort reflecting success of motivational efforts after M&A transaction. $E_m \in (-1, 1)$.

E_s = estimated index of employee effort reflecting success of motivational efforts after strategic alliance. $E_s \in (-1, 1)$.

E_{mm} = estimated monetary magnitude of employee effort reflecting success of motivational efforts after M&A transaction. $E_{mm} \in (-\infty, \infty)$.

E_{ms} = estimated monetary magnitude of employee effort reflecting success of motivational efforts after strategic alliance. $E_{ms} \in (-\infty, \infty)$.

I_m = estimated multiplier that reflects the success of post M&A integration efforts 6-9 months after the merger. $I_m \in (-1, 1)$.

I_s = multiplier reflecting the estimated success of post strategic alliance integration efforts 6-9 months after the merger. $I_s \in (-1, 1)$.

Φ_m = estimated transaction costs for proposed M& A – ie. due diligence, advisors, etc.. $\Phi_m \in (-\infty, \infty)$.

Φ_s = estimated transaction costs for proposed strategic alliance. ie. due diligence, advisors, fees, etc... $\Phi_s \in (-\infty, \infty)$.

BD_m = Multiplier that reflects the presence of another bidder in a proposed M &A transaction. $BD_m \in (-1, 1)$. $BD_m \rightarrow 1$ as the other bidder(s) is/are less likely to merge with or acquire the target; and as the prospective acquiree's equity value remains more stable.

T_m = forecasted amount of tax shields that will be produced solely by the proposed M&A transaction. $T_m \in (-\infty, \infty)$.

T_s = forecasted amount if tax shields that will be produced solely by the proposed strategic alliance transaction. $T_s \in (-\infty, \infty)$.

ξ_m = multiplier that reflects the projected monetary change in the Company's operating cash flow arising solely from a change in its cost structure after the M&A transaction. $\xi_m \in (-1, 1)$. $\xi_m \rightarrow -1$, as proportion of fixed costs per unit of product/service declines and as final costs of product/service declines.

ξ_s = multiplier that reflects the projected monetary change in the Company's Operating Cash flow arising solely from change in the Company's cost structure after the proposed strategic alliance. $\xi_s \in (-1, 1)$. $\xi_s \to -1$, as proportion of fixed costs per unit of product/service declines and as final costs of product/service declines.

β_m = the firm's estimated increase/decrease in borrowing costs per dollar of capital borrowed, as a result of the proposed merger. $\beta_m \in (-\infty, \infty)$.

β_s = the firm's estimated increase/decrease in borrowing costs per dollar of capital borrowed, as a result of the proposed strategic alliance. $\beta_s \in (-\infty, \infty)$.

Π = the Company's total debt before either transaction. $\Pi \in (0, \infty)$.

Π_m = the company's incremental/additional debt solely attributable to the merger/acquisition transaction. $\Pi_m \in (0, \infty)$.

Π_s = the company's incremental/additional debt solely attributable to the strategic alliance transaction. $\Pi_s \in (0, \infty)$.

G_m = the time-geography index – this measures the success of the proposed M&A transaction in providing a certain level of market coverage within time t – this refers to the possibility of achievement of certain post-transaction minimum market share in a pre-specified number of regional or local markets. $G_m \in (-1, 1)$. $G_m \to 1$, as it becomes more likely that the post-transaction coverage targets will be achieved within time *t*.

G_s = the time-geography index – this measures the success of the proposed strategic alliance transaction in providing a certain level of market coverage within time *t* – this refers to the possibility of achievement of certain post-transaction minimum market share in a pre-specified number of regional or local markets. $G_s \in (-1, 1)$. $G_s \to 1$, as it becomes more likely that the post-transaction coverage targets will be achieved within time *t*.

$\acute{a}_m$ = estimated/projected impact of the proposed M&A transaction on the Company's brand image. $\acute{a}_m \in (-1, 1)$. $\acute{a}_m \to -1$, as the projected monetary impact becomes more positive.

$\acute{a}_s$ = estimated monetary impact of the proposed strategic alliance transaction on the firm's brand image. $\acute{a}_s \in (-1, 1)$. $\acute{a}_s \to -1$, as the projected monetary impact becomes more positive.

p_s = the 'composite' correlation between both firms (between the company and the proposed strategic alliance partner) – in terms of risk, equity value, sales, size, clients, geographic coverage, etc. $p_s \in (-1, 1)$. 'Composite' refers to correlation that is calculated based on several factors, instead of just one factor.

p_m = the 'composite' correlation between both firms (between the company and the proposed M&A counterparty) – in terms of risk, sales, clients, size, geographic coverage, etc. $p_m \in (-1,1)$. 'Composite' refers to correlation that is calculated based on several factors, instead of just one factor.

V = the value of the Company. $V \in (0, \infty)$.

R_m = estimated monetary impact of regulatory barriers if proposed M&A transaction is completed. $R_m \in (-\infty, \infty)$.

R_s = forecasted monetary impact of regulatory barriers if proposed strategic alliance is completed. $R_s \in (-\infty, \infty)$.

ψ_m = the Company's forecasted total-capital after the proposed merger/acquisition transaction. $\psi_m \in (0, \infty)$.

ψ_s = the Company's forecasted total-capital after the proposed strategic alliance transaction. $\psi_s \in (0, \infty)$.

S_m = the Company's total post-merger/acquisition sales. $S_m \in (0, \infty)$.

S_s = the Company's total post-strategic alliance sales. $S_s \in (0, \infty)$.

Ω_m = the estimated Marginal rate of substitution (of the company's products for other firms' products) after the proposed merger/acquisition. $\Omega_m \in (-\infty, \infty)$.

Ω_s = the estimated Marginal rate of substitution (of the company's products for other firms' products) after the proposed strategic alliance. $\Omega_s \in (-\infty, \infty)$.

Then the firm's objective function for doing the M&A transaction will be multi-criteria:

$$\text{Max}[\text{Max}[\{T_m + {}_0\!\int^t (E_{mm}) \partial t - \Phi_m - R_m + (\beta_m*(\Pi+\Pi_m)) + ((\xi_m+J_m)*S_m)\},0]];$$
$$\text{Max}[\text{Max}[\{(\psi_m)*(1+I_m)*(1+G_m)*(1+\acute{a}_m)*(1+E_m)*(1+BD_m)*(1+\Omega_m)\},0]];$$

s. t. the above-mentioned boundaries for each variable.

Then the firm's payoff and objective function for doing the strategic alliance transaction will be:

Max [Max[{$T_s + {}_0\int^t(E_{ms})\partial t - \Phi_s - R_s + (\beta_s*(\Pi+\Pi_s)) + (\xi_s*S_s)$},0]]

Min[Max[{$(\psi_s)*(1+I_s)*(1+ G_s)*(1+ \acute{a}_s)*(1+E_s)*(1+ \Omega_s)$},0]]

s. t. the above-mentioned boundaries for each variable.

For the firm to profitably choose a strategic alliance instead of a merger/acquisition transaction, the following conditions must exist:

1. [{$T_s - \Phi_s - R_s + (\beta_s*(\Pi+\Pi_s)) + ((\xi_s*S_s))$}] > Max [({$T_m - \Phi_m - R_m + (\beta_m*(\Pi+\Pi_m)) + ((\xi_m+J_m)*S_m)$}), 0]

2. [{$(\partial^3\psi_s/\partial S_s\partial\beta_s\partial\xi_s)*(1+I_s)*(1+ G_s)*(1+ \acute{a}_s)*(1+E_s)*(1+ \Omega_s)$}] > Max[{$(\partial^3\psi_m/\partial S_m\partial\beta_m\partial\xi_m)*(1+I_m)*(1+ G_m)*(1+ \acute{a}_m)*(1+E_m)*(1+ \Omega_m)$}, 0]

3. [${}_0\int^t {}_0\int^{Ss}${$(\psi_s)*(1+I_s)*(1+ G_s)*(1+ \acute{a}_s)*(1+E_s)*(1+ \Omega_s)*(1+p_s)$ }$\partial t\partial S_s$] > Max [(${}_0\int^t {}_0\int^{Sm}${$(\psi_m)*(1+I_m)*(1+ G_m)*(1+ \acute{a}_m)*(1+E_m)*(1+ \Omega_m)*(1+p_m)$ } $\partial t\partial S_m$), 0]

4. $\partial^2 E_s/\partial G_s\partial\acute{a}_s$ > Max [($\partial^2 E_m/\partial G_m\partial\acute{a}_m$), 0]

5. $\partial\acute{a}_s/\partial R_s$ > Max[($\partial\acute{a}_s/\partial R_m$), 1]

6. $\partial^2\xi_s/\partial\beta_s^2$ > Max[($\partial^2\xi_m/\partial\beta_m^2$), 0] $\cap$ [($\psi_m - T_m$) > ($\psi_s - T_s$)]

8. $\partial\beta_s/\partial\xi_s$ > Max[($\partial\beta_m/\partial\xi_m$), 0] $\cap$ [($\Phi_m - T_m$) > ($\Phi_s - T_s$)]

9. $\partial^2\acute{a}_s/\partial G_s^2$ > Max[($\partial^2\acute{a}_m/\partial G_m^2$), 0]

10. $\partial^2 S_s/\partial E_s^2$) > Max[($\partial^2 S_m/\partial E_m^2$), 0]

11. $\partial\acute{a}_s/\partial S_s$ > Max[($\partial\acute{a}_m/\partial S_m$), 1]

12. $\partial V_s/\partial\Phi_s$ > Max[($\partial V_m/\partial\Phi_m$), 1]

13. $\partial V_s/\partial\psi_s$ > Max[($\partial V_m/\partial\psi_m$), 1]

14. $\partial^2 V_s/\partial\Phi_s\partial\acute{a}_s$ > Max[($\partial^2 V_m/\partial\Phi_m\partial\acute{a}_m$), 0]

15. Max[($\partial^2\beta_m/\partial\Phi_m\partial\xi_m$),0] > $\partial^2\beta_s/\partial\Phi_s\partial\xi_s$

16. $\partial\beta_s/\partial\acute{a}_s$ < Min[0, ($\partial\beta_m/\partial\acute{a}_m$)]

17. $\partial^2\beta_s/\partial\acute{a}_s\partial G_s$ < Min[0, ($\partial^2\beta_m/\partial\acute{a}_m\partial G_m$)]

18. $\partial\beta_s/\partial\Phi_s$ > Min[$\partial\beta_s/\partial\Phi_s$, 0]; and ($\partial\Omega_s/\partial\Phi_s$) > Max[$\partial\Omega_m/\partial\Phi_m$, 1]

19. ($\partial^2 E_s/\partial I_s\partial\xi_s$) > Max[($\partial^2 E_m/\partial I_m\partial\xi_m$), 0]

20. ($\partial^2 E_s/\partial G_s\partial\Omega_s$) > Max[($\partial^2 E_m/\partial G_m\partial\Omega_m$), 0]

21. ($\partial^2\Omega_s/\partial\psi_s\partial S_s$) < Min[($\partial^2\Omega_s/\partial\psi_s\partial S_s$), 0]

22. ($\partial^3\Omega_s/\partial p_s\partial\acute{a}_s\partial\beta_s$) < Min[($\partial^3\Omega_m/\partial p_m\partial\acute{a}_m\partial\beta_m$), 0]

For the firm to profitably choose a merger/acquisition instead of a strategic alliance transaction, the following conditions must exist:

1. [{$T_s - \Phi_s - R_s + (\beta_s*(\Pi+\Pi_s)) + ((\xi_s*S_s))$}] < Max [({$T_m - \Phi_m - R_m + (\beta_m*(\Pi+\Pi_m)) + ((\xi_m+J_m)*S_m)$}), 0]

2. [{$(\partial^3\psi_s/\partial S_s\partial\beta_s\partial\xi_s)*(1+I_s)*(1+ G_s)*(1+ \acute{a}_s)*(1+E_s)*(1+ \Omega_s)$}] < Max[{$(\partial^3\psi_m/\partial S_m\partial\beta_m\partial\xi_m)*(1+I_m)*(1+ G_m)*(1+ \acute{a}_m)*(1+E_m)*(1+ \Omega_m)$}, 0]

3. [${}_0\int^t {}_0\int^{Ss}${$(\psi_s)*(1+I_s)*(1+ G_s)*(1+ \acute{a}_s)*(1+E_s)*(1+ \Omega_s)*(1+p_s)$ }$\partial t\partial S_s$] < Max [(${}_0\int^t {}_0\int^{Sm}${$(\psi_m)*(1+I_m)*(1+ G_m)*(1+ \acute{a}_m)*(1+E_m)*(1+ \Omega_m)*(1+p_m)$ } $\partial t\partial S_m$), 0]

4. $\partial^2 E_s/\partial G_s\partial\acute{a}_s$ < Max [($\partial^2 E_m/\partial G_m\partial\acute{a}_m$), 0]

6. $\partial\acute{a}_s/\partial R_s$ < Max[($\partial\acute{a}_s/\partial R_m$), 1]

7. $\partial^2\xi_s/\partial\beta_s^2$ < Max[($\partial^2\xi_m/\partial\beta_m^2$), 0] $\cap$ [($\psi_m - T_m$) < ($\psi_s - T_s$)]

8. $\partial\beta_s/\partial\xi_s$ < Max[($\partial\beta_m/\partial\xi_m$), 0] $\cap$ [($\Phi_m - T_m$) < ($\Phi_s - T_s$)]

9. $\partial^2\acute{a}_s/\partial G_s^2$ < Max[($\partial^2\acute{a}_m/\partial G_m^2$), 0]

10. $\partial\acute{a}_s/\partial S_s$ < Max[($\partial\acute{a}_m/\partial S_m$), 1]

11. $\partial V_s/\partial\Phi_s$ < Max[($\partial V_m/\partial\Phi_m$), 1]

12. $\partial V_s/\partial\psi_s$ < Max[($\partial V_m/\partial\psi_m$), 1]

13. $\partial^2 V_s/\partial\psi_s\partial\acute{a}_s$ < Max[($\partial^2 V_m/\partial\psi_m\partial\acute{a}_m$), 0]

14. Max[($\partial^2\beta_m/\partial\Phi_m\partial\xi_m$),0] < $\partial^2\beta_s/\partial\Phi_s\partial\xi_s$

15. $\partial\beta_s/\partial\acute{\alpha}_s > \mathrm{Min}[0, (\partial\beta_m/\partial\acute{\alpha}_m)]$
16. $\partial^2\beta_s/\partial\acute{\alpha}_s\partial G_s > \mathrm{Min}[0, (\partial^2\beta_m/\partial\acute{\alpha}_m\partial G_m)]$
17. $\partial\acute{\alpha}_m/\partial E_m > \mathrm{Max}[\partial\acute{\alpha}_s/\partial E_s, 1]$
18. $R_m < R_s$
19. $\partial V/\partial R_m < \mathrm{Min}[\partial V/\partial R_s, 0]$
20. $(\partial^3 S_m/\partial\acute{\alpha}_m\partial\psi_m\partial\xi_m) > \mathrm{Max}[(\partial^3 S_s/\partial\acute{\alpha}_s\partial\psi_s\partial\xi_s), 0]$
21. $\partial\xi_m/\partial\beta_m > \mathrm{Min}[\partial\xi_s/\partial\beta_s, 0]$

   While there are relatively very few articles on the choice between M&A and Strategic Alliances as *Games* (see: Nwogugu (2009)), the literatures on Multi-Stage Network Games[4], Dynamic-Games[5], Differential Games[6] and Values-Of-Games[7] are significant, and the following are notable:
   i) Each of the foregoing inequalities are "conditions" that can be construed as quasi-valuations of individual Sub-Game-strategies.
   ii) Each of the foregoing inequalities/conditions define Differential Game Sub-Game strategies because they contain differential equations or quasi differential equations.
   iii) Each of the foregoing inequalities/conditions define Dynamic-Game Sub-Game strategies because they define strategies in which two or more players can simultaneously take actions.
   iv) Within each group of inequalities/conditions, each inequality can be converted into a "*score*" with a "*Weighting*", and a "*Composite-Decision-Score*" is derived by adding all of the weighted Scores.

6. Conclusion.
The choice between an M&A transaction and a strategic alliance (or joint venture) remains a key decision for companies of all sizes in most countries; and also has implications for Financial Stability and Systemic Risk. Such corporate transactions raise key economic, accounting and policy issues that have certainly not been considered at all, or fully analyzed in the existing literature. This article has introduced new models of strategic decision-making that can also be used in designing antitrust laws, Merger & Acquisition regulations and other government policies.

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[4] *See*: Petrosyan & Sedakov (2014), and Petrosyan, Sedakov & Bochkarev (2016).
[5] *See*: Yeung & Petrosyan (2011), Yeung & Petrosyan (2018), and Petrosyan & Ayoshin (2000).
[6] *See*: Petrosyan & Zaccour (2018), and Martin-Heran & Zaccour (2005).
[7] *See*: Petrosyan & Ayoshin (2000), De Clippel (2005), Hart & Mas-Colell (1995), and Milnor & Shapley (1978).

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