Additional System-Properties Of The Network- And Cognition- Based Financial Products In Nwogugu (2012).

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Abstract.

Nwogugu (2012) introduced a Network-based and Cognition-Based cyberphysical fuzzy-system within which complex self-adjusting "semi-autonomous" financial products are originated, purchased and sold. The participants of the system are diverse and include adults, companies, brokers, banks, lawyers, insurance companies and real estate companies. This theoretical article explains the key additional characteristics, system-architecture, fuzzy-attributes and *Reasoning*/Logic of some cost-reducing and energy-reducing AI/ML Network/Modular Products (ie. Mortgage-Alternatives Products, Retirement/Savings products and Insurance products) that were introduced in Nwogugu (2012), and also other cost-saving financial products that he developed (collectively, the "*Products*"). Through the products' fuzzy features, AI and network, the cyber-system architecture implicitly incorporates "Learning" and also can use Blockchain for record-keeping. The semi-autonomous and "self-adjustment" characteristics of these Modular Products can drastically reduce system-participants' costs and energy-use while increasing their revenues/profits through better and more efficient CRM, "matching", transaction-processing and "state-updating".

Keywords: Energy & Sustainability; Systems Architecture; Networks & Algorithms; Systems-of-Systems; *Super-Modularity* & *Strategic Complementarity*; Cognitive Computing; Mechanism Design; Dynamic-Pricing; Nonlinearity; Fuzzy-Logic.

1. Introduction.

These network-based and cognition-based Products automatically create and function within Networks, ecosystems and systems-of-ecosystems. The AI/ML Network/Modular Products developed in Nwogugu (2012) are AI/ML/blockchain/dynamic-pricing fintech/retail products in the form of savings products, mortgage-alternatives, annuities and retirement products. Blockchains is used to maintain records of transactions. The Modular-Features of Network-Products constitute a Dynamic-pricing system. ML and data are used to provide recommendations to buyers/sellers and to optimize their decisions within the Network/ecosystem.

The Modular-Features of Network-Products constitute a Fuzzy-Logic system because they capture (states/conditions, cognition, opportunities; etc.) and implement the preferences, and decisions of buyers and sellers using interacting "non-numerical" and fuzzy elements. Separately, Fuzzy Logic can be used to develop calibrations of each Modular-Feature.

The *Products* were developed by using *Set Theory*, *Boundary-value Conditions*, Artificial Intelligence and some elements of both Game Theory and *Mechanism Design* - ie. the structure of each Product and *Public-Good* is a set of specific characteristics (many of which have boundary-values) within "*Product-Characteristics Spaces*". This is in contrast to most empirical and theoretical studies of Complex Systems and optimal design of financial contracts.

These Network/Modular Products constitute (are elements of) and function within an international "ecosystem"/"quasi-auction platform"/Network and "decision/negotiation space" wherein:

i) Buyers (individuals; households, companies), sellers (banks, insurance companies, finance companies, individuals, companies) and brokers bid/negotiate for Network/Modular Products (housing finance

contracts; financial products, insurance products, savings/retirement products, etc.). Their bidding/negotiations are enhanced by AI/ML and data gathered from various sources.

ii) Lenders and insurers on one hand, and brokers and borrowers negotiate terms for Network/Modular Products. ML (buyer/seller data, buyer/seller decisions, economic/financial data, local living conditions, etc.) will be used to provide "*recommendations*" and "*Mandatory Beneficial Changes*" (MBCs) to buyers/sellers and to optimize their decisions within the Network/ecosystem. Examples of MBCs are as follows:

1) The applicable interest rates decline such that a housing mortgagee can reduce the monthly P&I payments by at least $250 but doesn't do so, and the Network System will automatically make the necessary contract changes and reduce the monthly payments without any action by the borrower or lender;

2) Property values have risen and mortgage risks have also risen but the lender hasn't changed the property insurance or mortgage insurance which can be procured at about the same cost – the Network System can be programmed to automatically change the insurance policies to provide appropriate risk coverage.

MBCs help reduce or eliminate problems or biases such as *Lethargy*, Fear, *Procastination*, Phobias, addictions, Misunderstanding, *Negligence*, *Fraud*, *Anxiety*, *False-Expectations*, Laziness, Cognitive-Deficits, etc.; each of which can significantly harm buyers/borrowers and sellers/lenders and can reduce the transmission of monetary/fiscal policies (of governments and financial institutions) and thus, are "*Network Systemic Leakages*". Each MBC-participant must affirmatively agree to participate at the inception of the contract.

iii) The structure and evolution of the Networks (and associated Nodes) is defined by the *Modular-Features* of the Network-Products discussed below and in Nwogugu (2012) (and similar products developed by Michael C. Nwogugu) and the associated Cognition-affected decisions embedded in each *Modular-Features*. Some of the "*Modular-Features*" are "*Decision-Factors*" for the buyer and or seller. The Networks and *Modular-Features* introduced herein and in Nwogugu (2012) function to measure, interpret, adapt and use information about human preferences and Cognition. Some of the "*Modular-Features*" create large-scale Networks within which sensitive decisions are made. Thus, there are at least two over-lapping Networks in the system which are:

1) the Cyber-Physical and Cognition-based Network created by customers/buyers and sellers and their decisions (that are made through various physical electronic devices); and

2) the Cyber-Physical and Cognition-based Network created solely by the *Modular-Features* of the Network/Modular Products (the Products are Network-Nodes).

The combination of the Network Structure, the *Modular-Features* and users' decisions (as a group and by itself) constitutes a cognition-based AI system. The Network system uses AI/ML (and data about buyers, sellers, markets, regulations; economic conditions; constraints; contract terms; etc.) to optimize decisions made in the Network, such that the "*Modular-Features*" change/evolve over time to suit buyers and sellers (and incur very low modification-costs).

iv) A decision by one Network-Member (buyer, seller, broker, advisor) about a "*Modular-Features*" can affect the Payoffs, Opportunity-Set, Risk-Perception, Information-Processing-Capacity and decisions of at least one other Network-Member, depending on his/her cognition and information-processing, and the efficiency of the Cyber-physical System. Thus each such decision can have a *rippling effect* throughout the Network (with varying impact on Network-Members).

v) A substantial percentage of the negotiations that occur within the Network are *multi-sided auctions* because its highly probable that:

1) At any time *t*, and for any seller (banks, insurance companies, finance companies) or buyer (customers), several auctions are occurring, and

2) The payoff functions of any buyer-seller pair in any negotiation/auction partly or wholly depends on the negotiation/bidding done by at least another buyer-seller pair either at the same time, or at a different time (this "*Related-Memory*" effect of buyers and sellers is new in the literature);

3) A seller can simultaneously bid in different auctions for different contracts; and a buyer simultaneously bid for similar contracts.

vi) The Network/Modular System introduced in Nwogugu (2012) and discussed below reduce the probability of violations of antitrust statutes (eg. price fixing; price discrimination; etc.); they reduce or eliminate *Regret* and *Deadweight Losses*; and can improve social welfare.
vii) The new implicit dynamic-pricing systems introduced herein differ from both LUBA and LUPI in the following ways:

1) for each financial/insurance product, at origination and during the life of the product, customers can bid on each "Modular-Feature" and other contract terms;
2) the bid used doesn't have to be a unique-bid;
3) for each new Network-Modular Product that is offered, where two customers/buyers bid the same lowest "amount", the System/App will select the bidder with other "*Most Desirable" qualities* (such as age, wealth, location, etc.);
4) the buyers and sellers don't have to pay any fee to participate in the bidding for new Network-Modular Products, but may pay a fee if they don't enter into contracts when selected or matched with a counterparty; 5) the auction/negotiation is two-sided;
6) the auction/negotiation is "*cross-contingent*" because for each asset, the seller' bids are or can be affected by other available auctions for other assets/products in the same network, and the buyer/customers' bid is also affected by other customers' bids in the network;
7) the negotiation bidding processes is part of a *matching process*;
8) the negotiation/bidding process can reduce deadweight losses.

Thus, the auctions introduced herein are two new classes of negotiations which are as follows:

1) The "*two-sided cross-contingent auctions/negotiation*".
2) The "*double-bid two-sided auction/negotiation*" – wherein both sides of a two-sided auction simultaneously bid.

viii) The Network allows for geographic mobility (participants can switch to other financial products or housing-units without materially changing their contracts or physically signing any documents).
ix) Each of the Network/Modular Products discussed herein are a new type of *dynamic pricing system* (based on Evolutionary Computation) henceforth referred to as "*Two-sided State-Contingent dynamic pricing*". The *Modular-Features* of each Network/Modular Product automatically creates a flexible Network-based dynamic pricing system that can be used to amend the Network/Modular Product over its lifetime. The dynamic-pricing system is two-sided because both sides of the transaction (the buyers and sellers; and each can be represented by brokers) can participate in the price-setting or terms-setting process; and at any time, more than one buyer/customer can use the system, and a buyer/customer's bidding and affects or can affect other customers' prices and bidding. The customers in each country/jurisdiction essentially compete for a finite number of Network-Modular Products; while sellers compete for a finite number of customers. The system is *state-contingent* because each party in both sides of the transaction (buyers and sellers) can choose more than one "*state*". Each *state* is defined by:

1) the combination of *Modular-Features* used in the Network-Modular Product, and the "states" allowed in each *Modular-Feature*;
2) the personal characteristics and unique circumstances of the buyer or seller; and
3) other factors.

The pricing scheme can also include both an implied or an express "*Fulfillment Guarantee*" wherein the contracted customer and or seller must comply with specific terms, and if they default, he/she will pay a fee to the system and to the other party. Where the *Fulfillment Guarantee* is expressly included in the dynamic pricing scheme, each of the Network/Modular Products are a new type of dynamic pricing henceforth referred to as "*Two-sided State-Contingent Time-Contingent dynamic pricing*". The system is time-contingent because at least one party on each side of the transaction (buyer or seller) has a time-based obligation that directly affects the pricing mechanism.
x)

The Network/Modular Products can:

i) Reduce the *Regret* and energy costs of banks, insurance companies and finance companies – ie. 1) the significant energy used in various processes in the systems such as the issuance, recording/data-storage, monitoring, restructuring and settlement of financial/insurance instruments and administrative/regulatory

costs; 2) the *Regret* that arises from transaction costs, errors, recovery costs, monitoring costs, default/restructuring costs, labor-intensive processing, etc..
ii) Reduce operating costs, transaction costs, reinsurance costs, recovery/default costs, compliance costs and monitoring costs of banks, insurance companies and finance companies.
iii) Increase revenues of banks and insurance companies by increasing customer-acquisition and customer-retention, and replacing traditional services/products with newer higher-margin services/products.
iv) Reduce households' and companys' *Regret*, operating costs, search-costs, transaction costs, insurance costs, mobility costs, compliance costs and monitoring costs.
v) Increase households savings-rates, transferable-wealth and retirement assets.
vi) Reduce or eliminate most of the psychological/psychiatry problems inherent in savings products[1], home mortgages[2], and retirement products[3].

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[1] *See*: "High debt levels debunk myths about Asians as savers, says Manulife survey - High levels of personal debt among investors in Asia debunk the conventional wisdom that Asians are prudent savers, according to new research from Manulife. The research findings support wider trends that suggest household debt levels in Asia are approaching – or even surpassing – US household debt levels". Feb. 22, 2016. *The Asset*. https://www.theasset.com/article/30849/for-app-deeplink-mobile.
See: Bell, C. (2016). "*Survey Finds Most Americans Have Financial Regrets*". https://www.bankrate.com/finance/consumer-index/financialsecurity-charts-0516.aspx.
See: Pevalin (2009); Searle, Smith & Cook (2006); Börsch-Supan, Bucher-Koenen, et. al. (Nov. 2018) and Morrison & Roese (2011).

[2] *See*: Fitch, Chaplin, Trend & Collard (2007); Bennett, Scharoun-Lee & Tucker-Seeley (2009); Colic-Peisker & Johnson (2010); Keys, Pope & Pope (2016), Moulton, Loibl & Haurin (2017), Niamir, Filatova, Voinov & Bressers (2018), Nitz (2018), Campbell, Clara & Cocco (2018) and Piskorski & Seru (2018).
See: "*Survey: Americans' biggest coronavirus financial regret is not having enough emergency savings*". By James Royal. June 18, 2020. https://www.bankrate.com/surveys/coronavirus-and-financial-regrets/.
See: Wichter, Z. (May 17, 2021). *Nearly two-thirds of millennials have new homebuyer regrets, survey finds*. https://www.bankrate.com/real-estate/homebuyer-regret-survey-may-2021/.
See: "*Mortgage rates: Despite low-interest rates, not all homeowners are refinancing. Should you refinance now*?" Swapna Venugopal Ramaswamy, USA TODAY. June 11, 2021. This article stated in part: "……..From April 2020 through the end of March 2021 around 10.7 million – or 20% of homeowners with mortgages – have refinanced their loans. At the same time, 14.1 million homeowners, or one-quarter of all borrowers who are strong candidates for refinancing, are currently not taking advantage of the low-interest rates, which hit 2.86% this week, according to an analysis provided to USA TODAY by Black Knight Inc., a mortgage data and technology company Black Knight defines these borrowers as 30-year mortgage holders who are current on payments, have good credit (720 plus) and have at least 20% equity in the home. These 14.1 million borrowers could save an average of $286 per month, the analysis found. There are another 22.7 million borrowers who are considered "in the money" (meaning they have mortgage rates at least 0.75% above the prevailing rate, but do not meet all of Black Knight's broad eligibility criteria)……...The reasons cited by homeowners for not refinancing included a belief that they wouldn't save enough money (33%); high closing costs (23%); too much paperwork and hassle (22%) and low credit score (10%)……..".
See: *"Nearly two-thirds of millennials have homebuyer regrets, new survey says*". Sudiksha Kochi, *USA TODAY*. June 11, 2021. This article stated in part: "……According to a recent Bankrate survey, 64% of millennials aged 25 to 40 are facing regrets after buying a home compared with 33% of baby boomers aged 57 to 75. The survey found that the older the buyer, the less likely they were to have homebuyer regret. One factor that may explain this divide is desperation; younger homebuyers are more likely to rush into a purchase which can lead them to settle for properties that might not be to their liking. Factoring in the pandemic, the survey found that homebuyer regrets among millennials mainly fell into two categories: financial and physical. …… About 21% of homebuyers listed high maintenance costs as their biggest regret, and that number jumped to 26% among younger millennials aged 25 to 31. Maintenance refers to anything in the house that breaks and needs to be fixed or replaced. …… "The No. 1 financial regret among Americans is that they wish they had emergency savings," Hamrick said. "You know, you look around the house and it's just a series of things waiting to break." ……..… About 13% of homebuyers listed high mortgage payments as another concern, and 12% of homebuyers were unhappy with mortgage costs. ……

Unlike most other financial products, the Network Products and their properties create Public-Goods including but not limited to the following: improved public health; consumer knowledge; reduced mass-anxiety; stabilized economy; reduced waste and environmental pollution; reduced fossil-based energy consumption; national defense; etc..

Nwogugu (2019b) noted that Evolutionary Computation has traditionally been defined by mimickry of evolution only in the *process* of using the algorithm (eg. genetic algorithms); but other classes of evolutionary Algorithms and "*Machine-Learning*" (which are used in the Network/Modular Products Ecosystem) are as follows:

i) algorithms which embed/represent evolutionary processes in the underlying phenomena or market or field - distinct from and not including the *process* of using the algorithm - see: Martyn, Kuhn, et. al. (2012); and Nwogugu (2013).

ii) algorithms that are indices and measure *states-of-evolution* and or conditions – see Martyn, Kuhn, et. al. (2012), Jacob, Koschutzki, et. al. (2013), and Nwogugu (2013).

iii) the evolutionary algorithms that are implicit in *Regret Minimization* – see Klos, Van Ahee & Tuyls (2010).

iv) groups of algorithms that constitute one solution, and combine to create evolutionary processes – that is, the results or output indicates/represents states-of-evolution or evolutionary processes. See Nwogugu (2007a;c).

2. Existing Literature.

On the optimal design of mortgages, see: Guren, Krishnamurthy & McQuade (2018), Piskorski & Tchistyi (2010), Olszowy (2006), Bar-Gill (2009), Shiller (2009), Shiller, Wojakowski, Ebrahim & Shackleton (2011); Fei & Yongheng (2011), Passmore & Von Hafften (2018), Passmore (2016), Oliner, Peter & Pinto (2018), Benetton (2018), Yanotti (2015), Piskorski & Seru (2018), Campbell, Clara & Cocco (2018), Nejadmalayeri (2011), Buckley, Lipman & Persaud (1993), Eberly & Krishnamurthy (2014), Beraja, et. al. (2017), Eberly & Krishnamurthy (2014), and Piskorski & Tchistyi (2017). On *Optimal Financial Contracting*, see: Sundaresan & Anderson (1996), Sundaresan & Zapatero (1999), Bradley & Roberts (2015), Denis & Wang (2014), Falato & Liang (2016), Garleanu & Zwiebel (2009), Kjenstad, Su & Tian (2013) and Matvos (2013). However, these foregoing studies completely omitted the many psychological, social, Network-dynamics, *Systems-of-Systems*, political issues, "*Internal Corporate Markets*", and household-allocation problems inherent in the use of mortgages, loans and Annuities, some of which are explained in Nwogugu (2012). On *Alternative Mortgages*, see: Erol & Patel

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Finally, about 13% of homebuyers listed overpaying as one of their concerns, and 9% of homebuyers did not think their home was a good investment…… According to the survey, about 15% of homeowners listed a bad location as one of their regrets for buying a house. …….. The survey also found that 14% of millennials said that their house was too big, and the same percentage said that their house was too small. According to Hamrick, people were not entirely happy with being in multifamily units during the pandemic. ……".

[3] *See:* Borsch-Supan, A., Hartl, K. & Leite, D. (2017). *Who Cares About The Day After Tomorrow? Pension Issues When Households Are Myopic Or Time Inconsistent*. ADB Working Paper. https://www.adb.org/sites/default/files/publication/238226/adbi-wp708.pdf.
See: Swiss Re Institute (July 2020). *Closing Asia's Mortality Protection Gap*. https://www.theasset.com/article/30849/for-app-deeplink-mobile.
See: Prudential PLC (2020). *Attitudes to retirement in East Asia: "From Challenge to Opportunity" calls on governments and businesses to close the growing gap in financial security for current and future retirees*. https://www.prudentialplc.com/en/news-and-insights/insights/attitudes-to-retirement-in-east-asia.
See: Miranda, H. (2019). *Spotlight on Retirement: Latin America*. http://atuarios.org.br/uploads/documentos/latin-america-retirement-summary-english.pdf.
See: "*More than half in Asia regret not saving earlier for retirement*". By AAN team. May 16, 2018. https://www.asiaadvisersnetwork.com/article/aid/42858/More-than-half-in-Asia-regret-not-saving-earlier-for-retirement.
See: Bezruchka (2009); Jenkins, Bhugra, Bebbington, et al. (2008); Niamir, Filatova, Voinov & Bressers (2018), Andrews & Oberoi (2015), Bogataj, Battini, et.al. (2018), Calvo & Williamson (2008), Dolls, Doerrenberg, et. al. (2018), Dowd (2018), Feng, He & Sato (2011), Freudenberg, Laub & Sutor (2018) and Carswell, Seay & Polanowski (2013).

(2005), LaCour-Little & Yang (2010), Lea (2010a), Nejadmalayeri (2011), Shiller, Wojakowski, Ebrahim & Shackleton (2011), Passmore & Von Hafften (2018), Oliner, Peter & Pinto (2018), Yanotti (2015), Ambrose & Buttimer (2009).

Haahtela (2012) studied the differences between financial options and real options –also see Demir, Çilden & Polat (2019). On financial innovation, see: Henderson & Pearson (2011).

On *Preference-Elicitation* and examples of associated *Elicitation-Mechanisms*, see: Zohar & Rosenschein (2008), Stein, Gerding, et. al. (2011), Madureira, Pereira, Pereira & Abraham (2014), and Hong, Wernz & Stillinger (2016). On *Supermodularity* and *Preferences*, see: Chambers & Echenique (2009).

The term "*Preferences+Reasoning*" in Artificial Intelligence (AI) and Decision Theory was introduced in Nwogugu (2019) and its defined as the interactions and joint evolution of the *Preferences* and *Reasoning* of both Human Agents and Automated Agents in specific contexts, and constrained by regulations and mechanisms. In this context, the Preferences and Reasoning of Agents about the efficiency and classification of financial instruments has had significant effects on market dynamics, trading patterns and risk management and associated *Multiplier Effects*. See Zohar & Rosenschein (2008), Fang & Yuan (2018), Hong, Wernz & Stillinger (2016), Madureira, Pereira, et. al. (2014), Meneguzzi, Modgil, et. al. (2012), Stein, Gerding, et. al. (2011), Wu, Zhao & Tang (2014), Wei, Wang, et. al. (2018), Terán, Aguilar & Cerrada (2017), Domshlak, Hullermeier, Kaci & Prade (2011) and Niederhoff & Kouvelis (2019), all of which didn't address *Preferences+Reasoning*. However, *Preferences+Reasoning* and the Inefficient Design of Financial Contracts nullify (or reduce the applicability/relevance of) most Utility Preferences in the Computer Science, Economics and Applied Math literatures – such as those discussed in Farahmand, (2017), Boutilier, Caragiannis, et. al. (2012), and Abramowitz & Anshelevich (2018). This also partly because of the assumptions underlying such Preferences – such as Rationality, Complete Information, etc..

The term "*Preferences+Beliefs*" in Artificial Intelligence" (AI) was introduced in Nwogugu (2019) and it refers to the interactions and joint evolution of the *Preferences* and *Beliefs* of both Human Agents and Automated Agent in specific contexts, and constrained by regulations and mechanisms. See Zohar & Rosenschein (2008), Fang & Yuan (2018), Hong, Wernz & Stillinger (2016), Madureira, Pereira, et. al. (2014), Meneguzzi, Modgil, et. al. (2012), Stein, Gerding, et. al. (2011), Wu, Zhao & Tang (2014), Wei, Wang, et. al. (2018), Terán, Aguilar & Cerrada (2017) and Niederhoff & Kouvelis (2019), all of which didn't address *Preferences+Beliefs*. However, *Preferences+Beliefs* and the Inefficient Design of Financial Contracts nullify (or reduce the applicability/relevance of) most Utility Preferences in the Computer Science, Economics and Applied Math literatures – such as those discussed in Farahmand, (2017), Boutilier, Caragiannis, et. al. (2012), and Abramowitz & Anshelevich (2018). Some of the *Preferences* introduced in this document differ from, and may contradict the utility preferences in the Economics, Computer Science and Applied Mathematics literatures – such as those in Farahmand, (2017), Boutilier, Caragiannis, et. al. (2012), Abramowitz & Anshelevich (2018).

On *Qualitative Reasoning* in Artificial Intelligence, see: Forbus (2019), Halpern (2003) and Bredeweg & Struss (Winter 2003). On *Price Complexity*, see: Carlin (2009), Kocamaz, Taşkın, et. al. (2016), Qiu-Xiang, Yu-Hao & Yi-Min (2018), and Li, Chen & Huang (2018).

On Retail Structured Products, see: Baule & Tallau (2011), Benet, Giannetti & Pissaris (2006), Bergstresser (2009), Bernard & Boyle (2011), Breuer & Perst (2007), Farooq (2009), Grunbichler & Wohlwend (2005), Henderson & Pearson (2011), Stoimenov & Wilkens (2005) and Andrews & Oberoi (2015). On real estate derivatives, see: Case & Shiller (1996). On the design of retirement plans, see: Dvorak (2010), Benetton (2018), Warshawsky (2017), Kurtbegu (2018), Staveley-O'Carroll & Staveley-O'Carroll (2017), Bogataj, Battini, et.al. (2018), Cigno (2016), MacDonald & Cairns (2011).

On the efficiency of financial institutions, see: Feng & Apostolos (2010), Hughes, Loretta & Moon (2001), Klein & Saidenberg (2010), An, Yongheng & Clapp (2010).

On *Complex Systems*, *Complexity Theory* and Networks, see: Ivanova, Strand & Leydesdorff (2019), Walters, Van Zyl & Beyers (2019), Lorenz & Neumann (2018), Dragicevic (2018), Xin & Liang (2018), Huet & Mathias (2018), Kurz (2018), Tu & Yan (2018), Kelman, Manes, et. al. (2018), Butler, Pigozzi & Rouchier (2019), Ma, Ren, et. al. (2018), Kocamaz, Taşkın, et. al. (2016), Qiu-Xiang, Yu-Hao & Yi-Min (2018), and Li, Chen & Huang (2018). However, these foregoing articles omitted the issues of *Preferences+Reasoning*, *Preferences+Beliefs* and *Behavioral-Bias Aggregation*. Niamir, Filatova, et. al. (2018), Nakagawa, Oiwa & Takeda (2012), Korniotis & Kumar (1993), Acquier, Daudigeos & Pinkse (2017), Schnellenbach & Schubert (2015), Pennings & Wansink (2004), and Rosenbaum, Billinger, et. al. (2012) concluded or implied that human biases can

affect national economies, although the links they established or theorized were indirect and they didn't discuss the issues of *Preferences+Reasoning*, *Preferences+Beliefs* and *Behavioral Bias Indicators*.

Niamir, Filatova, et. al. (2018) discussed environmental pollution, low-carbon economy and energy issues.

2. IPE Risks.

Some of the main IPE (*International Political Economy*) risks that households, ordinary companies and financial services companies face are as follows: **i**) Currency Risk; **ii**) Interest rate risk; **iii)** Inflation/Deflation; **iv**) Political Risk and Economic Sanctions; **v**) Changes in government subsidies: subsidies/aid grated to households and companies; **vi**) Trade Wars; **vii**) Labor problems; **viii**) Commodities Risk; **ix**) Real Estate Risk; **x**) Tax policy; **xi**) Epidemics; **xii**) Economic/Financial Crisis; **xiii**) Spill-overs of financial/economic/health/political crisis across national borders; xiv) Energy Crisis, xv) Climate Change and Pollution.

3. *Reasoning*", Logic, *Preferences* and "*Preference-Elicitations*": The Modular-Features.

The definitions of the additional Modular-Features of the Network-*Products* and *Public-Goods*, and the "*Reasoning*", Logic, *Preferences* and "*Preference-Elicitations*" underlying the *Products*, are as follows:

1) *Information Neutrality.* This modular attribute was introduced in Nwogugu (2012). The contract origination decision does not rely on consumer credit scores or corporate credit ratings, and the lender/lessee does not report post-origination defaults or late payments to credit bureaus. This reduces dissemination of negative information (that worsens the buyer/borrower/lessee's and neighborhood's actual/perceived economic condition); and also increases *two-sided matching* in Job markets, real estate markets (rentals, purchases and borrowing/lending), Compliance markets and Marriage markets. Using *Qualitative Reasoning*, this characteristic can be scaled/calibrated and adjusted as needed.

2) *Location Neutrality*. This modular attribute was introduced in Nwogugu (2012). "*Lock-in Costs*" refers to the often substantial and negative economic, social and psychological costs incurred by: i) the buyer's inability to sell the property and move to another property or region; or ii) the lessee's inability to cancel its lease contract and re-locate; or iii) a holder's inability to cancel or sell a certificate-of-deposit or Annuity contract, and reinvest in other assets. Many people have bad relationships with neighbors; live in houses that are too small, too big or too far from jobs; etc.. Using *Qualitative Reasoning*, this characteristic can be scaled/calibrated and adjusted as needed.

3) *Default Neutrality.* This modular attribute was introduced in Nwogugu (2012).

4) *Wealth-Neutrality.* This modular attribute was introduced in Nwogugu (2012). Using *Qualitative Reasoning*, this characteristic can be scaled/calibrated and adjusted as needed.

5) *Renegotiation-proofness.* This attribute was introduced in Nwogugu (2012).

6) *Sequential Non-redundancy*. This attribute was introduced in Nwogugu (2012).

7) *Cumulative Non-Separability.* This attribute was introduced in Nwogugu (2012). Using *Qualitative Reasoning*, this characteristic can be scaled/calibrated and adjusted as needed.

8) *Continuous-Payoffs.* This attribute was introduced in Nwogugu (2012).

9) *Decreasing Recursion.* This attribute was introduced in Nwogugu (2012).

10) *Ecosystem/Network Efficient* (*Decreasing Opportunity Cost)* – An earlier version of this attribute was implicitly/impliedly introduced in Nwogugu (2012). some of the *Product's* features (*Location-Neutrality*; *Participant-Substitutability*; *Automation Efficiency; Preference-Matching and Preference-Elicitation; Default Neutrality*; *Non-additive Aggregate Risk*; *Sequential*

Nonredundancy) and the use of the *Product* by many people/companies creates *Intra-firm Product Ecosystems/Exchanges/Networks* (eg. networks of customers, employees and agents within individual banks, finance companies and insurance companies), and *Inter-firm Product Ecosystems/Exchanges/Networks* (ie. national/international/regional Networks among banks/finance-companies/insurers and their customers and agents) and *Virtual Ecosystems*/*Networks* (ie. national/international/regional Networks among banks/finance-companies/insurers, government agencies, non-profit organizations and their customers and agents) that can facilitate and amplify labor-mobility, liquidity, transparency, price-discovery, choice, cost-reduction, *Substitution*, efficiency, transparency and *Matching* in the Labor, Housing/Real-Estate, Compliance, Savings/Investment and Marriage markets. As the number of companies and persons that use the *Product* and its Ecosystem/Network increases, the costs incurred by Network-members generally decrease. That is:

i) $\partial f_c(.)/\partial n < 0$; and $\partial^2 f_c(.)/\partial n^2 > 0$; and in many cases, $\partial^2 f_c(.)/\partial t \partial n < 0$; and in many instances, $\partial^2 r/\partial f_c(.)\partial n < 0$;

ii) $\partial C_n/\partial n > 0$; and $\partial^2 C_n/\partial n^2 > 0$; and in many cases, $\partial^2 C_n/\partial t \partial n > 0$; and in many instances, $\partial^2 r/\partial C_n \partial n < 0$;

where C_n = the absolute dollar amount of annual/quarterly cost reduction in the Ecosystem/Network; cost-function $f_c(.)$ = the absolute dollar amount of annual/quarterly total costs incurred by Network-members in the *Product Ecosystem/Network*; and n = the number of participants in the *Product*'s Ecosystem/Network; and t = the number of equal successive time periods (eg. calendar quarters); r = actual inherent risk of the *Product*. Thus, *Ecosystem/Network Efficiency* differs from "*Network Effects*" in economics. The *Product* achieves such *Ecosystem/Network Efficiency* by implementation of the following "***Efficiency Processes***": i) eliminating redundant processes and choosing process-paths that reduce costs and brokerage-fees and increase profits; ii) transparency and disclosure to Participants involved; iii) increasing the dollar-volume, number, location and "diversity" of assets in the *Product Ecosystem/Network*, which in turn, increases Network-participants' choices and *Opportunity-Sets*; iv) use of "*Binary-state Options*" (options that are simultaneously both *Real Options* and *Financial Options*, or alternate between the two states); v) optimizing decisions and identifying and resolving potential problems (eg. income shocks; default risks; inadequate insurance; healthcare problems in borrower's family; natural disasters; employer's financial distress; etc.); vi) optimal-allocation and informed/data-driven "*Substitution*" (of resources, rights/obligations, persons and assets); vii) eliminating "*Conflict-Points*" and reducing the probability of litigation (actual or potential disagreements and conflicts that increase costs) and tax problems; viii) adopting a "*life-cycle, systems-dynamics and behavioral biases*" approach to the evolving psychological, tax, economic and social needs of customers (households and companies); ix) use of quasi *Liquidated-Damages*; x) identifying and executing mutually beneficial strategies (within the context of both the instance/situation and the *Product Ecosystem/Network*); xi) use of automation, "*Emergence*"-aware processes and *Entropy*-aware processes; xii) *Regret Minimization* (*Regret* distorts current decision-making and can have negative *Multiplier Effects*) and management of customers' *WTAL* (see Nwogugu [2006]); xiii) reducing perceived risk and Uncertainty among Network-participants, which in turn, improves decision making and reduces healthcare costs; xiv) traditional mortgage/real-estate/securities brokerage fees/commissions (and associated costs) are substantially reduced or eliminated because the lender/lessor/bank/seller essentially functions as an uncompensated automated broker (and there are economies-of-scale), and individual buyers/lessees/borrowers and lenders/lessors/banks/sellers in the *Product Ecosystem/Network* can trade and swap assets, contract-rights and lessee-rights directly among themselves without any broker; xv) energy costs and non-energy operating costs are or can be significantly reduced because there are fewer and more efficient processes and transactions, fewer involved-persons, and information is used effectively (compared to traditional financial instruments); xvi) there are *economies-of-scale* and "*Increasing Knowledge Effects*" gained by aggregation of transactions, processes and information by lenders/lessees/sellers in the *Product Ecosystem/Network* (each lender/lessor/seller can have access to the portfolio information of other lenders/sellers/lessors); xvii) the market for *Reputation* and *Social Capital* of lenders/lessors/sellers/banks is better defined

(due to the *Product Ecosystem/Network*) and can serve as a disciplining element; xviii) automation reduces compliance costs and risk. The buyer/borrower/lessee/depositor *Opportunity Cost* decreases as time progresses.

11) *Non-additive Aggregate Risk (Financial Stability And Sustainable Growth).* This attribute was introduced in Nwogugu (2012). This *Product* attribute reduces the probability of occurrence of, and rate of growth of Financial/Economic Crisis.

12) *Time-preference Neutrality*. This attribute was introduced in Nwogugu (2012). Using *Qualitative Reasoning*, this characteristic can be scaled/calibrated and adjusted as needed.

13) *Limited Manipulation And Asset-Volatility*. An earlier version of this attribute was introduced in Nwogugu (2012). The *Product* can reduce harmful asset-volatility (and associated crash-risk, Uncertainty and arbitrage) in the real estate, loan/mortgage, swaps/derivatives and securities markets by implementation of the above-mentioned "***Efficiency Processes***". Similarly the *Product* reduces (or doesn't increase) the actual and perceived risks of depositors/borrowers/buyers/lessees by the same ways.

14) *Preference-Matching and Preference-Elicitation.* An earlier version of this modular attribute was introduced in Nwogugu (2012). The *Product* substantially increases the *matching* of the true (and often un-revealed) preferences of the buyer/borrower/lessee/depositor and the seller/lender/lessor/bank by providing them with alternatives and flexibility of terms.

15) *Participant Substitutability.* This modular attribute was introduced in Nwogugu (2012). The buyer/borrower/lessee/depositor and the seller/lender/lessor/deposit-bank can be substituted simultaneously, sequentially, or randomly at relatively low costs. Using *Qualitative Reasoning*, this characteristic can be scaled/calibrated and adjusted as needed.

16) *Low Ambiguity*. This attribute was introduced in Nwogugu (2012).

17) *Transmission-positive Consistency*. This attribute was introduced in Nwogugu (2012).

18) *Reserve Neutrality.* This attribute was introduced in Nwogugu (2012). The changes in the lessee/buyer/borrower's condition and credit rating and any default have or are likely to have minimal effects on the lessor/seller/lender's capital reserve requirements. Traditional Western mortgages tend to be "*reserve negative*" which means that declines (increases) in the borrower's credit quality increases (reduces) the lender's capital reserve requirements, and thus reduces (increases) lending capacity. Using *Qualitative Reasoning*, this characteristic can be scaled/calibrated and adjusted as needed.

19) *Automation Efficiency* (*Process-Learning* And *Dynamic Algorithms*). An earlier version of this modular attribute was introduced in Nwogugu (2012). The *Product* is more amenable to automation than comparable traditional products (eg. savings accounts, traditional mortgages and the adjustable balance mortgage). The *Product Algorithm* "*learns*" (AI/ML) by analyzing online/offline data about the customer/Lessee/borrower/depositor, the lender/lessor/seller/bank, news and current social/economic/political trends. The *Product* uses such information and Algorithms to make optimal recommendations to all parties involved. For example, the *Product* can recommend: i) that the terms of the contract be accelerated or delayed by mutual consent; or ii) *Strategic Default* by the borrower/lessee; or iii) *substitution* of an asset or "right" by the borrower/lessee/depositor/buyer or lender/lessor/seller/bank; or iv) that the customer/depositor relinquish or forfeit or cancel or exchange the *Product* by mutual consent; or v) that the lender should amend loan terms or reduce its exposure to a borrower. That is, the *Product Algorithm* is dynamic and can adjust to changing circumstances. The Network/Ecosystem and its transactions and data, and data-driven analysis/recommendations serve as a *bankruptcy-prediction* and *social-*

distress prediction model that can predict such trends for both buyers/lessees/borrowers/depositors and lenders/lessors/banks.

20) *Decreasing Monotonicity*. This attribute was introduced in Nwogugu (2012). There is decreasing monotonicity in the relationship between the principal-balance (size) and inherent risk of this type of *Product*, as time progresses.

21) *Self-insurance or no-mortgage-insurance.* This modular attribute was introduced in Nwogugu (2012). For this *Product*, there is no need for third-party *Product Insurance* (and the lender/lessor/seller/bank can self-insure the *Product*), because the lender holds title to the underlying *Principal-Target Asset* (foreclosure/recovery costs are precluded).

22) *Participation Constraints And Litigation-Waivers*. This modular attribute was introduced in Nwogugu (2012), and refers to the following:
(i) The buyer/lessee/borrower cannot participate in the property-values-submarket (cannot obtain home-equity loans or hypothecate the contract or sell the property until he or she makes full payment for the obligation).
(ii) The seller/lessor/lender cannot pledge, encumber or hypothecate the contract or the underlying property until there is default.
iii) The parties to the *Product* contract waive their rights to litigation in courts; and waive their right to litigate about any terms of the contract in any other forum (ie. Unconscionability of contracts; etc.).
iv) Where the *Product* Contract permits eviction, the parties to the *Product* Contract agree on *Non-Judicial Eviction* upon proof of Terminal Default by the borrower/lessee. For example, upon default that is not cured within sixty days, the lender/lessor will notify the local police office about the Product Contract, the default and the impending eviction, and the give the lessee/borrower thirty days to provide evidence of payment of all arrears to both the lender/lessor and the police office. Failure of the borrower/lessee borrower to provide such evidence within the specified time-frame will result in immediate eviction.

23) *Strategic-Complementarity* and *Super-Modularity*. This modular attribute was introduced in Nwogugu (2012). The buyer/borrower/lessee/depositor payoff function is complementary to the seller/lender/lessor/bank payoff function. That is, even upon default or at expiration of the Product-contract, the best strategy implemented by the buyer/borrower/lessee to maximize his or her payoff, also increases the marginal returns of the seller/lender/lessor, and provides substantial incentives for the seller/lender/lessor to comply with the terms of the contract, and vice versa.

24) *Non-nullity.* This attribute was introduced in Nwogugu (2012).

25) *Asset-liability Balance*. This attribute was introduced in Nwogugu (2012). The *Product* reduces or does not cause "*perceived*" asset-liability mismatch and liquidity gaps.

26) *Regret-Positivity.* This attribute was introduced in Nwogugu (2012). The *Product* reduces the *Regret* of both the buyer/borrower/lessee and the seller/lender/lessor.

27) *Bankruptcy-Efficient* – This attribute was introduced in Nwogugu (2012). This *Product* maximizes the Seller/lessor/lender/bank's and Buyer/lessee/depositor/Borrower's payoffs if the Buyer-borrower declares bankruptcy or if an involuntary bankruptcy petition is filed against the Buyer-borrower.

28) *Energy Efficient* – This attribute was impliedly/implicitly introduced in Nwogugu (2012). The *Product* reduces the energy-needs and energy-costs of lenders/lessors/sellers/banks, borrowers/lessees/buyers/depositors, brokers and lawyers. The rate and magnitude of such energy-cost reduction increases as more people use the *Product* and its Ecosystem/Network.

That is: $\partial C_e/\partial n \geq 0$; and $\partial^2 C_e/\partial n^2 \geq 0$; and in many cases, $\partial^2 C_e/\partial t \partial n \geq 0$; and $\partial^2 r/\partial C_e \partial n \leq 0$; where C_e (derived from the cost-function $f_c[.]$)= the absolute dollar amount of periodic/quarterly reduction or energy costs; and n = the number of participants in the *Product*'s Ecosystem/Network; and t = the number of equal successive time periods (eg. calendar quarters); and r = actual inherent risk of the *Product*. The *Energy Costs* include electricity costs, cooling-water costs, bandwidth costs, direct/allocated administrative costs, equipment costs, direct/allocated real estate costs (ie. Data-centers; computer rooms), direct labor/employee costs; compliance costs; fuels/petroleum; waste-disposal costs; other maintenance costs; etc.. Banks, finance companies and insurance companies employ large numbers of loan recovery, transaction processing and customer service staff who consume large amounts of energy, much of which can be eliminated by using the *Product*. The *Product* achieves such energy-cost reduction by the following "***Efficiency Processes***": i) eliminating redundant processes and choosing process-paths that reduce costs and brokerage-fees and increase profits; ii) transparency and disclosure to Participants involved; iii) increasing the dollar-volume, number, location and "diversity" of assets in the *Product Ecosystem/Network*, which in turn, increases Network-participants' choices and *Opportunity-Sets*; iv) use of "*Binary-State Options*" (options that are simultaneously both *Real Options* and *Financial Options*, or alternate between the two states); v) optimizing decisions and identifying and resolving potential problems (eg. income shocks; default risks; inadequate insurance; healthcare problems in borrower's family; natural disasters; employer's financial distress; etc.); vi) optimal-allocation and informed/data-driven "*Substitution*" (of resources, persons and assets); vii) eliminating "*Conflict-Points*" and reducing the probability of litigation (actual or potential disagreements and conflicts that increase costs) and tax problems; viii) adopting a "*life-cycle, systems-of-systems-dynamics and behavioral-biases*" approach to the evolving psychological, tax, economic and social needs of customers (households and companies); ix) use of quasi *Liquidated-Damages*; x) identifying and executing mutually beneficial strategies (within the context of both the instance/situation and the *Product Ecosystem/Network*); xi) use of automation, "*Emergence*"-aware processes and *Entropy*-aware processes; xii) *Regret Minimization* (*Regret* distorts current decision-making and can have negative *Multiplier Effects*) and management of customers' *WTAL* (see Nwogugu [2006]); xiii) reducing perceived risk and *Uncertainty* among Network-participants, which in turn, improves decision making and reduces healthcare costs; xiv) traditional brokerage fees/commissions (and associated energy costs) are substantially reduced or eliminated because the lender/lessee/bank/seller functions as an "uncompensated automated broker", and individual buyers/lessees/borrowers and lenders/lessees/banks/sellers in the *Product Ecosystem/Network* can trade and swap assets and lessee-rights directly among themselves without any broker; xv) energy costs and non-energy operating costs are or can be significantly reduced because there are much fewer and more efficient processes and transactions, fewer involved-persons, and information is used effectively (compared to traditional financial instruments); xvi) there are *economies-of-scale* and "*Increasing Knowledge Effects*" gained by aggregation of transactions and processes by lenders/lessors/sellers/banks in the Product Ecosystem/Network (each lender/lessor/seller/bank can have access to the portfolio information of other lenders/sellers/lessors/banks in the Network) – and duplication of information gathering/processing is substantially reduced; xvii) the market for *Reputation* and *Social Capital* of lenders/lessees/banks is better defined (due to the *Product Ecosystem/Network*) and can serve as a disciplining element; xviii) automation reduces compliance costs and risk. Thus, the *Product* and its *Ecosystem/Network Efficiency* can achieve exponentially greater energy-savings (through *HCI/Activity-Theory*, "*Activity-Engineering*", *Network-Efficiency*; etc.) compared to traditional engineering methods of reducing energy consumption in clusters of buildings.

29) *Hedging-Task Allocation* – This attribute was impliedly/implicitly introduced in Nwogugu (2012). The "*Hedging-Burden*" is responsibility for hedging that is typically contractually or culturally allocated to un-sophisticated and un-informed families/persons/companies that have low information-processing and information-gathering capabilities. Through Separation-of-

Interests and its other attributes, the *Product* and its Ecosystem/Network transfers the *Hedging-Burden* to sophisticated and informed financial institutions that are best positioned to aggregate, manage and hedge such risks.

30) *Allocation/Search Efficiency* – This attribute was impliedly/implicitly introduced in Nwogugu (2012). The *Product* reduces the *Allocation/Search Costs* (allocation of resources, rights, obligations, persons, cash and assets) of lenders/sellers/lessors/banks, borrowers/depositors/lessees/buyers, brokers and lawyers. In many instances, the rate and magnitude of such cost/risk reduction increases as more people use the *Product* and its Ecosystem/Network (ie. *Ecosystem/Network Efficiency*, as explained herein). The *Allocation/Search Costs* include but are not limited to search-costs (eg. research; verification; budgets; transportation/travel; advisors' fees; brokerage fees/commissions; etc.), deliberation costs (eg. committees; human resources processes; family meetings; budgeting; etc.), negotiation/re-negotiation costs (eg. Loan/mortgage restructuring; real estate lease terms; Certificates-of-Deposit terms; etc.), *opportunity costs*, time, cost of arguing with household members (or committee members), divorce costs, fraud costs, bankruptcy/foreclosure costs, eviction costs, *Regret costs*, direct/indirect mental health costs (depression; anxiety/hypertension; phobias; strokes; substance-abuse; obesity; etc.); negative *Multiplier Effects* on co-workers and the general public; loss of employee productivity; etc.. The *Product* achieves such *Allocation/Search Efficiency* and cost-reduction by implementation of the "*Efficiency Processes*" defined herein. Such *Allocation-Cost-Efficiency* enables the lender/bank/lessor to pass on savings to customers in the form of lower "*effective borrowing interest rates*" or higher "*deposit interest rates*" for CDs and savings products (continuing reset of terms), and better customer service. Using *Qualitative Reasoning*, this characteristic can be scaled/calibrated and adjusted as needed.

30) *Transaction-Cost Efficient* - This attribute was impliedly/implicitly introduced in Nwogugu (2012). The *Product* reduces the *Transaction Costs* of lenders/sellers/lessors/banks, borrowers/buyers/lessees/depositors, brokers and lawyers; and the rate and magnitude of such cost-reduction increases as more people use the *Product* and its Ecosystem/Network (ie. *Ecosystem/Network Efficiency* as defined herein and above). That is, $\partial C_t/\partial n \geq 0$; and $\partial^2 C_t/\partial n^2 \geq 0$; and in many cases:

$\partial^2 C_t/\partial t \partial n \geq 0$; and
$\partial^2 r/\partial C_t \partial n \leq 0$; and
$\partial^3 C_t/\partial t \partial n \partial b \geq 0$; and
$\partial^3 r/\partial C_t \partial n \partial b \leq 0$.

Where C_t (which is derived from the cost-function $f_e[.]$) = the absolute dollar amount of periodic/quarterly reduction or energy costs in time t; and n = the number of participants in the *Product*'s Ecosystem/Network; and b = the number of transactions in the *Product*'s Ecosystem/Network in the time period; and t = the number of equal successive time periods (eg. calendar quarters); r = actual inherent risk of the *Product*. Transaction Costs include brokerage fees/commissions, government fees (eg. licensing costs, permits), *Opportunity Costs*, time, travel/lodging costs, *Regret*, legal/accounting fees, compliance costs, filing fees, transfer fees, copying/mailing/shipping costs, margin costs (securities trading), divorce costs and disagreement costs (in households), bankruptcy/foreclosure/eviction costs, fraud costs, direct/indirect mental health costs (depression; anxiety/hypertension; phobias; strokes; substance-abuse; obesity; etc.); negative *Multiplier Effects* on co-workers and the general public; loss of employee productivity; etc.. The *Product* and its Ecosystem/Network achieves such cost-reduction by implementation of the above-mentioned "*Efficiency Processes*". Traditional mortgage/real-estate/securities brokerage fees/commissions (and associated costs) are substantially reduced or eliminated because the lender/lessee/bank/seller essentially functions as an uncompensated automated broker (and there are economies-of-scale), and individual buyers/lessees/borrowers and lenders/lessees/banks/sellers in the *Product Ecosystem/Network* can trade and swap assets, contract-rights and lessee-rights

directly among themselves without any broker.

31) *Operating-Cost Efficient* - This attribute was impliedly/implicitly introduced in Nwogugu (2012). The *Product* reduces the "non-transactional" *Operating Costs* of lenders/sellers/lessors/banks, borrowers/buyers/lessees/depositors, brokers and lawyers; and the rate and magnitude of such cost-reduction increases as more people use the *Product* and its ecosystem (ie. *Ecosystem/Network Efficiency* as defined herein and above). The objective is $\partial C_o/\partial n \geq 0$; and $\partial^2 C_o/\partial n^2 \geq 0$; and in many cases:

$\partial^2 C_o/\partial t \partial n \geq 0$, but $\partial^3 C_o/\partial t \partial n \partial p \geq 0$;
$\partial^2 r/\partial C_o \partial n \leq 0$, but $\partial^3 r/\partial C_o \partial n \partial p \leq 0$;
$\partial C_o/\partial p < 0$;
$\partial r/\partial p \leq 0$, but $\partial^2 r/\partial p \partial n \leq 0$.

Where C_o (derived from the cost-function $f_e[.]$) = the absolute dollar amount of periodic/quarterly reduction of energy costs and other operating costs; and n = the number of participants in the *Product*'s Ecosystem/Network; and p = the number of total *process-units* used by Network-members in the *Product*'s Ecosystem/Network (a single use of a process by a Network-member is a "*process-unit*"; and each process is typically used once or several times by several network-members in each time period); and t = the number of equal successive time periods (eg. calendar quarters); r = actual inherent risk of the *Product*. Operating Costs include but are not limited to direct/allocated administrative costs, fees, transportation costs, bandwidth costs, insurance/reinsurance costs, monitoring costs, software costs, allocated overhead costs, equipment costs, direct labor/employee costs, storage costs, real estate costs, regulatory compliance costs; brokerage fees/commissions; loan recovery costs; customer service costs; *Opportunity Costs*; bankruptcy/foreclosure/eviction costs; direct/indirect mental health costs (depression; anxiety/hypertension; phobias; strokes; substance-abuse; obesity; etc.); public-relations costs, loss of social-capital, fraud costs; negative *Multiplier Effects* on co-workers and the general public; loss of employee productivity; etc.. Banks, government agencies and finance companies maintain huge data centers, loan processing equipment, loan servicing staff, customer services staff, back-office staff and loan-recovery staff, most of which are not necessary where this *Product* is used. By using this product, traditional mortgage/real-estate/securities brokerage fees/commissions (and associated costs) are substantially reduced or eliminated because the lender/lessee/bank/seller functions as a quasi-broker, and individual buyers/lessees/borrowers and lenders/lessees/banks/sellers in the *Product Ecosystem/Network* can trade and swap assets and lessee-rights directly among themselves without any broker. The *Product* and its Ecosystem/Network achieves such cost-reduction by implementation of the above-mentioned "*Efficiency Processes*". Such *Operating Cost Efficiency* enables the lender/bank/lessor to pass on savings to customers in the form of lower "*effective borrowing interest rates*" or higher "*deposit interest rates*" for CDs and savings products (continuing reset of terms), and better customer service.

32) *Risk/Diversification Efficient* (financial/economic risk) – This attribute was impliedly/implicitly introduced in Nwogugu (2012). Insurance Risk often differs from Financial Risk; and in many cases, the *Product* can reduce (or doesn't increase) the perceived/actual financial risks, NPL-Rates and Loan-Recovery Costs of Lenders/Lessors/banks; and can increase the probability that such parties will earn positive returns. The *Product* diversifies the financial risk and portfolios of, and reduces the risk of the buyer/Lessee/buyer/depositor and or the lender/Lessor/bank/seller; and the financial-risk/diversification efficiency increases as the number of people and "assets" in the Products Ecosystem/Network increases (ie. *Ecosystem/Network Efficiency*, as explained herein and above). In contrast to traditional portfolio theory, i) all assets in the Ecosystem/Network are "potential assets" of each Lender/lessor/bank in the Network; ii) sub-state options and Binary-State options are also assets; iii) the mean-variance framework is not applicable; iv) the relationship between risk and return isn't inverse in many cases and is time-varying; v) there is Non-Additive Aggregate Risk (defined herein). The *Product* achieves such financial-risk reduction and diversification by *Wealth Neutrality*, *Location Neutrality*, *Participant-*

Substitution, and implementation of the above-mentioned "*Efficiency Processes*". Such financial *Risk/Diversification Efficiency* enables the lender/bank/lessor to pass on savings to customers in the form of lower "*effective borrowing interest rates*" or higher "*deposit interest rates*" for CDs and savings products (continuing reset of terms), and better customer service.

33) *Savings/Revenue Efficient* – this attribute was impliedly/implicitly introduced in Nwogugu (2012). The *Product* increases (or doesn't reduce) the Household Savings rates and or the absolute savings amounts of depositors/lessees/borrowers/buyers; and in many instances, the rate and magnitude of such increase rises as more people use the *Product* and its Ecosystem/Network (ie. *Ecosystem/Network Efficiency*, as explained herein and above). The *Product* achieves such savings and diversification by: i) creating inherent "savings pools" in the structures of transactions; ii) implementation of the above-mentioned "*Efficiency Processes*"; iii) compounding of interest; iv) increases in the market value of the underlying real estate; v) Participant Substitution; vi) Location Neutrality. Similarly, the Product and its ecosystem can increase revenues (distinct from cost-savings) of the lender/lessor/seller/bank by: i) creating inherent "revenue pools" in the structures of transactions; ii) implementation of the above-mentioned "*Efficiency Processes*"; iii) compounding of interest; iv) increases in the market value of the underlying real estate; v) Participant Substitution; vi) Location Neutrality; vii) Network Effects wherein Network-Members refer non-members to participate in the Network; viii) ancillary revenues from insurance sales; ix) Industry Restructuring (explained herein). Such *Savings/Revenue Efficiency* allows the lender/bank/lessor to pass on savings to customers in the form of lower "*effective borrowing interest rates*" or higher "*deposit interest rates*" for CDs and savings products (continuing reset of terms), and better customer service.

34) *Industry Stability And Industry Restructuring*: This attribute was impliedly/implicitly introduced in Nwogugu (2012). The *Product* can facilitate or achieve *Industry Stability* in the following ways among others:

i) The *Product* and its Ecosystem/Network can reduce overall costs and can increase overall *Industry Profits* in the real estate and financial services industries (given the above-mentioned cost-savings).

ii) The *Product* and its Ecosystem/Network can reduce some types of *Antitrust* misconduct (eg. Collusion; Price-fixing; refusal-to-deal; Price-Discrimination; market-concentration; etc.) and the significant effects of *unfair business practices* (eg. Predatory-Lending; "red-lining" of districts; fraudulent sales practices; etc.).

iii) The *Product* and its Ecosystem/Network democratizes the use of capital by informed/data-driven decisions, *Efficient Allocation*, "*Minimum-Standardization*" of the Product (required for liquidity, choice and transparency), the "*No-broker Regime*"/"Low-Broker Regime" (explained below), *Preference-Elicitation*, and facilitating liquidity, labor-mobility and choice.

iv) The *Product* and its Ecosystem/Network can reduce the "*Lock-in costs*" of Network-members (eg. Fixed contract/loan terms; inability to relocate; inability to sell a mortgage/loan or housing unit; etc.).

v) The use of traditional securities brokers, mortgage brokers and real estate brokers can introduce distortions, Moral Hazard and biases in Incentives and the price-discovery process (which are often sub-optimal and reduce Social Welfare). In the *Product Ecosystem/Network*, such traditional brokerage fees/commissions (and associated costs) are substantially reduced or eliminated because the lender/lessee/bank/seller functions as an uncompensated broker, and individual buyers/lessees/borrowers and lenders/lessees/banks/sellers in the *Product Ecosystem/Network* can trade and swap assets, contract-rights and lessee-rights directly among themselves without any broker.

vi) *Shock-Resistance* – see below.

Given "*Insurance –Efficiency*" (explained herein and below), the *Product* and its Ecosystem/Network can restructure, or can help in restructuring the Global Insurance Industry by:

i) Changing to low-cost distribution channels, and changing the nature and amounts of effective marketing.
ii) Changing the nature of, and basis for competition in the industry.
iii) Automation, and changing pricing and prices; and simplifying pricing by actuaries.
iv) Changing the cost-structure of insurance companies and insurance brokerages, and reducing the number of required workers.
v) Increasing the effect of industry regulations on Non-members of the Network/Ecosystem; while reducing the effect on Network-members.
vi) Reducing *Deadweight Losses*, and increasing transparency and liquidity.
vii) Reducing or eliminating insurance risk and costs.
viii) Creating Ecosystems/Networks, and increasing the efficiency of processes.
ix) Encouraging Innovation in the industry.
x) Reducing or eliminating Antitrust misconduct and unfair business practices.
xi) Where the product is Self-insured (the lender/lessor/seller/bank can self-insure the Product), costs and unnecessary risk-taking can be reduced.
xii) The structure of the *Product* inherently changes the structure of associated insurance contracts.
xiii) Providing incentives for buyers/lessees/borrowers/depositors and lenders/lessors/banks to reduce insurance risk and insurance costs.
xiv) Changing the incentive-structure and payoff-functions of insurers and insurance brokers.
xv) Reducing the *Network Effects* of insurance brokers.
xvi) Changing *Standardization* in the insurance industry.

Similarly, given "*Ecosystem/Network Efficiency*" (explained herein and above), the *Product* and its Ecosystem/Network can restructure, or can help in restructuring the global Mortgage Brokerage, Real Estate Brokerage and Securities Brokerage sectors of the global Financial Services Industry in the following ways:

i) Changing to low-cost sales/distribution channels, and changing the nature and amounts of effective marketing.
ii) Changing the nature of, and basis for competition in these three industry-sectors.
iii) Automation, and changing the basis for pricing and prices and simplifying pricing.
iv) Reducing the number of transactions**,** and amounts of brokerage fees and costs (buyers/lessees/borrowers/depositors and lenders/lessors/banks serve as un-compensated or low-compensated brokers).
v) Creating Ecosystems/Networks, and increasing the efficiency of processes, all of which reduce Insurance Risk, Insurance costs and Financial Risk.
vi) Changing Standardization in the Mortgage/Securities/real-estate sectors.
vii) Reducing or eliminating Antitrust misconduct and unfair business practices.
viii) Changing the cost-structure of Mortgage Brokerages, Real Estate Brokerages and Securities Brokerages, and reducing the number of required workers.
ix) The structure of the *Product* inherently changes the structure of associated "non-system" brokerage contracts (contracts other than the *Product*-Contract).
x) Increasing the effect of industry regulations on Non-members of the of the Network/Ecosystem; while reducing the effect on Network-members.
xi) Reducing *Deadweight Losses*, and increasing transparency and liquidity in Mortgage/Securities/real-estate brokerage.
xii) Changing the incentive-structure and payoff functions of Mortgage/Securities/real-estate brokers.
xiv) Reducing the *Network Effects* of Mortgage/Securities/real-estate brokers; and reducing or eliminating the need for brokers.

The *Industry Restructuring* results in incremental Energy-Cost Savings and reductions of Operating Costs (in addition to the costs-savings mentioned herein and above).

35) *Shock-Resistance* – this attribute was impliedly/implicitly introduced in Nwogugu (2012). The *Product* can adapt to, and or reduce various economic, social, political and psychological shocks in the following ways:

1) *Interest rate shocks* – the Product inherently self-adjusts against interest rate shocks (default options; substitution options; resetting of terms; *Non-Additive Aggregate Risk*; *Default Neutrality*; *Separation-of-Interests*; *Wealth Neutrality*; Interest rate caps; etc.); and implementation of the *Network Efficiency Processes* mentioned herein provides savings/cost-reduction cushions. The lender/lessor/bank can also purchase interest rate swaps/derivatives and real-estate-index products to provide additional hedges. Interest rate shocks include sudden currency devaluations, increases in mortgage interest rates, credit crunches, increases in prices of, and unfavorable/stricter terms for interest rate swaps/derivatives; etc..

2) *Inflation/Deflation* – the Product inherently self-adjusts against inflation/deflation (default options; substitution options; resetting of terms; *Non-Additive Aggregate Risk*; *Default Neutrality*; *Separation-of-Interests*; *Wealth Neutrality*; Interest rate caps; etc.); and the *Product*'s implicit interest rates can be indexed to inflation/deflation, and implementation of the *Network Efficiency Processes* mentioned herein provides savings/cost-reduction cushions. The lender/lessor/bank can also purchase inflation/deflation indexed swaps/derivatives and real-estate-index derivatives products to provide additional hedges and additional subsidies for Network-Members.

3) *Real Estate Shocks* - the Product inherently self-adjusts against real estate rate shocks (default options; substitution options; resetting of terms; *Non-Additive Aggregate Risk*; *Default Neutrality*; *Separation-of-Interests*; *Wealth Neutrality*; Interest rate caps; etc.); and implementation of the *Network Efficiency Processes* mentioned herein provides savings/cost-reduction cushions. The lender/lessor/bank can also purchase real estate swaps/derivatives and real estate index products to provide additional hedges. Real estate shock include sudden declines of property prices; increases in mortgage interest rates; redlining of neighborhoods; credit crunches; etc..

4) *Currency shocks* - the Product inherently self-adjusts for currency shocks (eg. exchange-rate shocks, availability of foreign currency and inflows of FI/FDI) with regards to both the lender/lessor/bank and borrower/lessee/depositor (default options; substitution options; resetting of terms; *Non-Additive Aggregate Risk*; *Default Neutrality*; *Separation-of-Interests*; *Wealth Neutrality*; Interest rate caps; etc.); and implementation of the *Network Efficiency Processes* mentioned herein provides savings/cost-reduction cushions. The lender/lessor/bank can also purchase currency swaps/derivatives and currency-index and real-estate-index products to provide additional hedges. Exchange-rate shocks include sudden exchange-rate devaluations; increases in mortgage interest rates; sudden reductions in inflows of foreign currency denominated FDI/FI; credit crunches; increases in prices of, and unfavorable/stricter terms for OTC currency and interest rate swaps/derivatives; etc..

5) *Commodity Shocks* – the Product inherently self-adjusts against commodity shocks (default options; substitution options; resetting of terms; *Non-Additive Aggregate Risk*; *Default Neutrality*; *Separation-of-Interests*; *Wealth Neutrality*; Interest rate caps; etc.); and implementation of the *Network Efficiency Processes* mentioned herein provides savings/cost-reduction cushions. The lender/lessor/bank can also purchase commodity swaps/derivatives and commodity-index and real-estate-index products to provide additional hedges. Commodity shocks include sudden currency devaluations, increases in prices of commodities used in real estate operations (eg. heating oil; gasoline; etc.); increases in prices of basic agricultural commodities (grains; pork; soybeans; etc.) which in turn, reduces

household's after-tax income that is available for housing-related payments; sudden declines in commodity prices which increases the default risks of the lender/lessor/bank's corporate customers; increases in prices of, and unfavorable/stricter terms for OTC/listed commodity future and OTC interest rate futures contracts which increases the lender/lessor's hedging costs; etc..
6) *Contagion* (*News And Social Networks) Shocks* - the *Product* inherently self-adjusts against the effects of news and Social Network shocks (network contagion) with regards to both the lender/lessor/bank and borrower/lessee/depositor (ie. default options; substitution options; resetting of terms; *Separation-of-Interests*; *Non-Additive Aggregate Risk*; *Default Neutrality*; Wealth *Neutrality*; Interest rate caps; etc.), and implementation of the *Network Efficiency Processes* mentioned herein provides savings/cost-reduction cushions. The lender/lessor/bank can also purchase swaps/derivatives, currency-index products and real-estate-index products to provide additional hedges.
7) *Political Risk* – such as coups; changes of government; changes in government policies; Unilateral Economic Sanctions imposed by the USA and the EU on various countries; etc.. The *Product* inherently self-adjusts against the effects of Political Risk and Economic Sanctions with regards to both the lender/lessor/bank and borrower/lessee/depositor (ie. default options; substitution options; resetting of terms; *Non-Additive Aggregate Risk*; *Separation-of-Interests*; *Default Neutrality*; Wealth *Neutrality*; Interest rate caps; etc.); and implementation of the *Network Efficiency Processes* mentioned herein provides savings/cost-reduction cushions. The lender/lessor/bank can also purchase swaps/derivatives, political risk insurance, currency-index products and real-estate-index products to provide additional hedges.
8) *Changes In Government Subsidies* – that refers to subsidies/aid granted to households and companies. The *Product* inherently self-adjusts against the effects of *Subsidy-Changes* with regards to both the lender/lessor/bank and borrower/lessee/depositor (ie. default options; substitution options; resetting of terms; *Non-Additive Aggregate Risk*; *Default Neutrality*; *Separation-of-Interests*; *Separation-of-Interests*; *Wealth Neutrality*; Interest rate caps; etc.); and the *Network Efficiency Processes* mentioned herein provide savings/cost-reduction cushions. The lender/lessor/bank can also purchase swaps/derivatives, currency-index products and real-estate-index products to provide additional hedges.
9) *Trade Wars* – such as the US-China trade war that began in 2018. The *Product* inherently self-adjusts against the effects of Trade-Wars with regards to both the lender/lessor/bank and borrower/lessee/depositor (ie. default options; substitution options; resetting of terms; *Non-Additive Aggregate Risk*; *Default Neutrality*; *Separation-of-Interests*; Wealth *Neutrality*; Interest rate caps; etc.); and implementation of the *Network Efficiency Processes* mentioned herein provides savings/cost-reduction cushions. The lender/lessor/bank can also purchase swaps/derivatives, trade-risk insurance, currency-index products and real-estate-index products to provide additional hedges.
10) *Labor Problems* – such as labor strikes; etc.. The *Product* inherently self-adjusts against the effects of Labor Problems with regards to both the lender/lessor/bank and borrower/lessee/depositor (ie. default options; substitution options; resetting of terms; *Non-Additive Aggregate Risk*; *Default Neutrality*; *Separation-of-Interests*; *Wealth Neutrality*; Interest rate caps; etc.); and implementation of the *Network Efficiency Processes* mentioned herein provides savings/cost-reduction cushions. The lender/lessor/bank can also purchase swaps/derivatives, labor-risk insurance, currency-index products and real-estate-index products to provide additional hedges.
11) *Epidemics*.
12) *Economic/Financial Crisis*.

13) Thus, the *Product* can increase the resistance/resilience of financial institutions and borrowers/lessees/buyers/depositors to both *within-institution* shocks (eg. real estate shocks, interest rate shocks, political economy shocks, commodity shocks and currency shocks within individual banks and insurance companies) and to systemic risk, political risk and Financial Stability shocks by implementation of the *Network Efficiency Processes* mentioned herein.

35) *Waste-Efficient* – This attribute was impliedly/implicitly introduced in Nwogugu (2012). Various types of waste are generated in financial services (eg. potentially toxic e-waste; paper; stable/unstable plastics; leaked heat; leaked gases; steam; corroded composites; fuels and petroleum byproducts; obsolete/corroded batteries; burnt electric wires; dust; random power surges; left-over food; solvents; evaporated cleaning-solvents; un-detected electromagnetic fields; emissions from computers; printing-ink; glass; carbon-heavy materials; etc.). The *Product* and its Ecosystem/Network reduces or eliminates various types of waste by implementation of the above-mentioned "*Efficiency Processes*". That is: $\partial C_w/\partial n \geq 0$; and $\partial^2 C_w/\partial n^2 \geq 0$; and in many cases, $\partial^2 C_w/\partial t \partial n \geq 0$; and $\partial^2 r/\partial C_w \partial n \leq 0$; where C_w (derived from the cost-function $f_w[.]$)= the absolute dollar amount of periodic/quarterly reduction of waste and waste-management costs; and n = the number of participants in the *Product*'s Ecosystem/Network; and t = the number of equal successive time periods (eg. calendar quarters); and r = actual inherent risk of the *Product*.

36) *Interest Negativity* — This *Modular-Feature* was introduced in Nwogugu (2012). The buyer/Lessee/borrower's interest in the underlying property is a future contingent interest, which does not exist until the buyer/lessee/borrower either defaults, or the buyer/lessee/borrower fulfils specific conditions, or the lender-seller defaults or the contract term expires (the "interest positive" state applies when the buyer-borrower's ownership interest is a present on-contingent interest).

37) *Dynamic Contract-Reset Terms*: This attribute was impliedly/implicitly introduced in Nwogugu (2012). The buyer/lessee/borrower/depositor can elect to have dynamic terms wherein semi-annually or annually or bi-annually (the reset period is established at inception of the contract), the lender/lessor/bank will offer revised terms for this Product, and the Buyer/lessee/borrower/depositor can accept or reject such revised terms (contract terms such as implied interest rate, time, rights, substitution, default conditions; etc.) or it can be implemented as an MBC (defined herein and above).

38) *Multi-sided Multi-Adjustable Incentive Mechanisms* – This attribute was impliedly/implicitly introduced in Nwogugu (2012). The *Product* is a *Multi-sided Incentive Mechanism* because it provides or can provide identifiable, significant and separable/non-separable incentives to three or more Network-participants simultaneously or sequentially. The Network-Participants include the borrower/lessee/depositor, the lender/lessor/bank/seller, the government, the general public, the real estate and mortgage brokers, the securities broker, lawyers, insurance companies, reinsurance companies; etc.. That is unlike traditional financial instruments (eg. mortgages, leases, alternative mortgages and Certificates-of-deposits) which typically provide identifiable, significant and *"non-separable" incentives* if any, to only two parties (the borrower/lessee/buyer/depositor and the lender/lessor/seller/bank). In this context, "non-separable incentive" means that the person is motivated/incentivized by the financial instrument if and only if he/she is contractually obligated/affected by, or linked to the financial instrument. In addition, the *Product* has inherent *Multi-Factor Adjustment* because it adjusts to changing conditions, *beliefs* and *Preferences* in three or more dimensions simultaneously (eg. asset-type; time; interest rate; process; substitution; sequence; amounts; term; liquidation-priority; principal-balance; rights; etc.). That is unlike traditional financial instruments (mortgages, leases, alternative mortgages and Certificates-of-deposit), where most adjustments are only two-dimensional (ie. interest rate and principal amounts).

39) *Separation-of-Interests* – This modular-attribute was impliedly/implicitly introduced in Nwogugu (2012). The "*Principal-Target Asset*" is typically real estate or a bond portfolio, or an Annuity contract or a CD (certificate of deposit) and is what the customer/buyer/borrower/lessee will get at the end of the initial term of the contract, or upon *Asset-substitution* or upon exercise of a *Binary-State Option*. The borrower/lessee/buyer/depositor's ownership interest in the underlying *Principal-Target Asset* is separated and deferred until some conditions are achieved (the borrower/lessee/buyer/depositor's ownership interests in the Product-contract and the underlying *Principal-Target Asset* are different and distinct). That facilitates liquidity, choice, cost-reduction, labor-mobility and risk management; and also helps to reduce or eliminate the often harmful psychological attachment that people have to their owned or rented homes (or other assets).

40) *Coordination Positive* – This attribute was impliedly/implicitly introduced in Nwogugu (2012). The *Product* and its Ecosystem/Network reduces *Coordination Failures* in national and regional economies. "*Coordination Negative*" means the opposite.

41) *Blockchain Compliant* – the records of contracts and asset transactions are or can be maintained and updated using Blockchain.

42) *Property Tax, Maintenance And Property Insurance Reserve* – This modular-attribute was impliedly/implicitly introduced in Nwogugu (2012). Where the buyer/lessee/borrower/depositor is contractually obligated to pay property taxes and or property insurance premiums, a portion of the borrower/lessee's monthly payment will be paid into a bankruptcy-remote reserve to cover unpaid property taxes, maintenance and property insurance costs. The un-used portion of such reserve will be returned to borrower/lessee at the end of the contract. Borrower/lessee must provide quarterly evidence of paid property taxes and property insurance. The property will be inspected periodically by lender/lessor's agent to ensure that its well maintained.

43) *System-Invariants* – This attribute was impliedly/implicitly introduced in Nwogugu (2012). The *Product's* Logic/Reasoning and characteristics defined herein and the evolving relationships among them function as System-Invariants.

44) *Insurance Provisions* – The lender/lessor/bank will contract with a third-party insurance company to provide bulk insurance policies; or lender/lessor/bank will create a bankruptcy-remote insurance subsidiary. At buyer's option, a portion of the buyer's monthly payments will be used to provide a combined insurance policy covering healthcare, life, auto and job insurance for the customer. Any missed monthly-premium payment will be paid/deducted from the buyer's equity/savings in the Contract with a pre-stated limit of X percent of the cumulative total savings/equity. This *Insurance Provision* effectively reduces insurance premiums and insurance costs:

i) by consolidating insurance purchases both at the individual/household level and at the Network/Ecosystem level (the equivalent of bundled insurance or Group Insurance) – that results in *economies-of-scale* and *Knowledge Effects* that reduce insurance costs and insurance premiums.
ii) by reducing dependence on, and adverse effects of consumer credit scores and corporate credit ratings on insurer decisions.
iii) because the structure of the *Product* reduces basic insurance risk and insurance costs for various types of insurance policies (eg. property; healthcare; life).
iv) by reducing the costs of reinsurance and associated processes and risk management, which in turn, reduces premiums and costs.
v) by reducing the "healthcare costs" of real estate, mortgages and investments (eg. mental health problems and associated diseases).
vi) because some of the lender/lessee's cost savings (from *Ecosystem/Network Efficiency*) are used to reduce insurance premiums and insurance costs.

vii) by information sharing by the lender and insurer (lender collects information at inception and on an ongoing basis and sends it to the insurer).

Thus the *Product* and its Ecosystem/Network can restructure, or can help in restructuring the Global Insurance Industry.

45) *Insurance-Efficiency* – This attribute was impliedly/implicitly introduced in Nwogugu (2012). Insurance Risk sometimes differs from Financial Risk. The *Product* and its Ecosystem/Network reduces or eliminates various types of waste, premiums, insurance costs and Insurance Risk by implementation of the above-mentioned "*Efficiency Processes*" and in one or more of the following ways:

i) by providing the opportunity to consolidate insurance purchases both at the individual/household level and at the Network/Ecosystem level (the equivalent of Group Insurance) – that results in *economies-of-scale* and *Knowledge Effects* that reduce insurance costs and insurance premiums. That is, the lender/lessor/bank can contract with third-party insurers to provide insurance policies (portfolio insurance or individual-asset insurance or insurance policies for borrowers/lessees/depositors).
ii) by reducing dependence on, and adverse effects of consumer credit scores and corporate credit ratings on insurer decisions.
iii) because the structure/terms of the *Product* reduces basic Insurance Risk and insurance costs for various types of insurance policies (eg. property; healthcare; life). Mental health costs, life-expectancy risk, mortgage-insurance risk and property-insurance risk are all substantially reduced. The *Product* reduces the "healthcare costs" of real estate, mortgages and investments (eg. mental health problems and associated diseases).
iv) by reducing the costs of reinsurance and associated processes and risk management, which in turn, reduces insurance premiums and insurance costs.
v) because some of the lender/lessee's cost savings (from *Ecosystem/Network Efficiency*) are used to reduce insurance premiums and insurance costs.
vi) by making it easier for actuaries to price Insurance Risk.
vii) By coordinating the joint evolution of actual or possible insurance risk and the *Product*.
viii) because some of the lender/lessee's cost savings (from *Ecosystem/Network Efficiency*) are used to reduce insurance premiums and insurance costs.
ix) by information-sharing and effective monitoring by the lender/lessor/bank and insurer (lender/lessor/bank collects information at inception and on an ongoing basis and sends it to the insurer). If the *Product Contract* or the underlying Principal-Target Asset is insured, the lender/lessor/bank will collaborate with the third-party insurer (that insures either asset).
x) Where the product is Self-insured (the lender/lessor/seller/bank can self-insure the Product), costs and unnecessary risk-taking can be reduced.

As presently organized in most countries, the Global Insurance Industry is very inefficient and costly and the reasons include but are not limited to the following:

i) channel/distribution partners add un-necessary costs (overhead costs and commissions) that bloat insurance premiums. On the contrary, members of the *Product Ecosystem/Network* can refer their friends/family for free or in exchange for relatively small incentives.
ii) channel/distribution partners often distort (and have substantial incentives to distort) decision-making by insured persons and beneficiaries.
iii) insurance fraud by both channel/distribution partners and insurance beneficiaries is rampant and adds un-necessary costs.
iv) the structure and terms of insurance contracts doesn't provide sufficient incentives (to insured persons, beneficiaries and insurers) to reduce costs and Insurance Risk.

v) the terms and inherent-incentives of insured financial instruments often conflict with those of associated/covering insurance policies – that is, the joint evolution of the insurance policy and the insured contract-asset are not adequately addressed often because both contracts are prepared separately and by un-coordinated professionals that have different approaches and backgrounds/experience.
vi) there is a *Truth-telling Problem* and information asymmetry, and insurance companies have incomplete-information (while in some cases, banks have more information about the same assets/transaction/persons).
vii) information gathering and processing, and post-transaction/post-agreement monitoring (for the same assets and transactions) is often duplicated by banks and insurance companies at substantial expense, and information sharing between banks and insurance companies is limited and is regulated in some countries.
viii) while they are obligated to make payments to replace damaged/obsolete/affected insured-assets, insurers often don't take-over such affected collateral and are not positioned to implement restructuring/sale/recovery strategies (but banks can do that).
ix) many insurance policies don't contain or require remedial/preventive measures; and don't allow the insurer to intervene to stop losses.
x) Reinsurance processes are highly inefficient. In many instances, Reinsurance merely transfers but doesn't necessarily reduce risk. Insurers have substantial incentives to hide risks from, and make inadequate disclosures to reinsurers. The deficiencies of insurance contracts are transferred to Reinsurers.
xi) Lack of "substitution" of insurers and insured persons increases risk and reduces liquidity.
xii) Existing insurance contracts (and many savings products, mortgages and retirement products) complicate and make it difficult to predict insurers' liabilities.

46) *Array Matching* And *Quantum Computing* – a set of Arrays can be used to match and analyze data about Network-participants. For example, Array1 is [borrower, lessee, buyer, depositor]; and Array2 is [lender, lessor, seller, bank). Because the lender/bank can take on four "states/roles" simultaneously or sequentially (ie. lender, seller, lessor, bank) and the borrower/buyer can take on four "states/roles" simultaneously or sequentially (ie. borrower, buyer, lessee, depositor), and *Binary-State Options* (defined herein) are features of the *Product*, the data and transactions from the *Product Network/Ecosystem* are amenable to *Quantum Computing* (not in terms of hardware, but with respect to software and computing-times).

47) "*External*" *Home-Equity Transfer/Conversion*: This attribute was impliedly/implicitly introduced in Nwogugu (2012). Buyer/borrower/lessee/depositor's existing home-equity can be transferred into, and credited to the *Product Contract* for this *Product* – ie. credited towards payment of the monthly payments for this Product. That is, such home equity reduces the amount and or magnitude of required monthly payments; or increases the balance of "earned" portion of the Principal-Target Asset. The "*Current Lender*" is the bank or insurance company or entity that is the holder of the Note-and-Security-Agreement at the transaction date – thus the chains-of-title of both the Note-and-Security-Agreement and the underlying property will have to be researched and confirmed. If there is no existing mortgage/loan or if lender/lessor is the *Current Lender*, then after both the lender/lessor and borrower/lessee agree on the value of the property and the home equity, then:

1) an appropriate "internal" transfer agreement will be executed within the lender/lessee – and lender/lessor gets a 100% equity interest in the property, and the value of the home-equity is credited towards payment for the new *Product Contract*; or
2) an appropriate internal transfer agreement will be executed within the lender/lessee wherein the Note-And-Security-Agreement is extinguished and exchanged for the new Product Contract– and lender/lessor gets a 100% equity interest in the property, and the value of the home-equity is credited towards payment for the new *Product Contract*;

If there is an existing mortgage/loan and lender/lessor isn't the *Current Lender*, then lender/lessor can agree with the borrower/lessee about the property-value, and:

1) lender/lessor will payoff any mortgage and get an equity interest in the property, and then swap the borrower/lessee's home equity for an interest in the new *Product Contract*; or

2) lender/lessor will purchase the existing mortgage from the *Current Lender* (and pay the purchase price with promissory notes and or cash and or shares of preferred stock or common stock), and then do an internal "asset-exchange" wherein it will extinguish and replace the mortgage with the new *Product Contract*; and then swap the borrower/lessee's home equity for an interest in the new Product Contract; or

3) take assignment of any home equity from borrower/lessee and if necessary, obtain a second mortgage secured by such home equity.

The lender/lessor/bank will typically transfer/convert the home equity at a discount. Thus, the *Product* can provide all the benefits of, and reduces many of the problems associated with Reverse Mortgages and *Equity-Release Mortgages*, while precluding or reducing problems in allocating household portfolios and corporate portfolios.

48) "*External*" *Mortgage-Balance Transfer/Conversion*: This attribute was impliedly/implicitly introduced in Nwogugu (2012). Buyer/lessee/borrower's existing mortgage balance can be transferred to this Product, wherein such mortgage balance replaces part of the present value of the buyers'/lessee's remaining to-be-paid monthly payment obligations. The "*Current Lender*" is the bank or insurance company or entity that is the holder of the Note-and-Security-Agreement at the transaction date – thus chain-of-title of both the Note-and-Security-Agreement and the underlying property will have to be researched and confirmed. If the lender/lessor was the *Current Lender*, then an appropriate internal transfer agreement will be executed after both parties agree on the principal balance of the existing mortgage. If the lender/lessor isn't the *Current Lender*, then lender/lessor can agree with the borrower/lessee about the property-value, and:

1) lender/lessor will payoff the existing mortgage(s) and take an equity interest in the underlying asset/property that is equal/proportional to the paid-off mortgage balance; and the borrower/lessee's home equity will be credited to the new *Product Contract*; or

2) lender/lessor will purchase the existing mortgage from the *Current Lender* (and pay the purchase price with promissory notes and or cash and or shares of preferred stock), and then do an internal "asset-exchange" wherein it will extinguish and replace the mortgage with the new *Product Contract*; and the borrower/lessee's home equity will be credited to the new *Product Contract*; or

3) lender/lessor will take-over all of borrower/lessee's obligations under the Promissory Note but the Mortgage Security Agreement will be cancelled, and a portion of borrower/lessee's monthly payments will be used to pay the loan P&I balance; and the borrower/lessee's home equity will be credited to the new Product Contract; or

4) lender/lessor will contract with the *Current Lender* for a Lock-box Account such that the mortgage security-agreement (for the security-interest) is cancelled and a portion of borrower/lessee's monthly payments will be used to pay the mortgage P&I balance – and in addition, the lender/lessee will guarantee such payments.

If the lender/lessor is the *Current Lender*, then lender/lessor can agree with the borrower/lessee about the property-value, and:

1) lender/lessor will extinguish the existing Note-and-Mortgage(s) and take an equity interest in the underlying asset/property that is equal/proportional to the paid-off mortgage balance; or

2) lender/lessor will do an internal "asset-exchange" wherein it will extinguish and replace the Note-and-mortgage with the new Product Contract.

The lender/lessor/bank will typically charge a built-in fee for the transfer/conversion of the mortgage (convert/transfer the mortgage at a premium). Thus, the *Product* can provide all the benefits of, but reduces many of the problems associated with Reverse Mortgages and Equity-Release Mortgages; while precluding or reducing problems in allocating/re-balancing household portfolios and corporate portfolios.

49) *Intrinsic Shadow-Equity Conversion*: This modular-attribute was impliedly/implicitly introduced in Nwogugu (2012). This *Product* contains a built-in/intrinsic Shadow-Home-Equity (in the underlying property/asset) or Shadow-Equity (in the *Product-Contract*) which is created by any of the following: i) buyer/borrower/lessee/depositor's regular payments and associated compounding of interest, and ii) in some cases, the increase in the market value of the underlying property/real-estate over time; and iii) in some cases, the cost savings that are passed on by the lender/lessor/seller and or generated by the *Product*'s features. The buyer/borrower/lessee/depositor or lender/lessor/bank typically has the implicit option to convert this Shadow-Home-Equity or Shadow-Equity into other Financial Instruments such as CDs (certificates-of-deposit), Annuities or bonds or liquid securities, and in such cases, the *Product* can solve the many problems inherent in: i) Reverse Mortgages (and associated Annuities) and Equity-Release Mortgages; and ii) the rebalancing of household portfolios and corporate portfolios. That is, in both the short—run and the long run, it's more efficient (and Social Welfare is improved more) for a household to use this *Product*, than to use the two-step combination of a traditional mortgage plus a Reverse Mortgage.

50) *Bankruptcy Remote Reserves* – the seller/lessor/lender/bank will create an insured bankruptcy remote reserve to cover future payments for the *Principal-Target Assets*, such that financial distress or bankruptcy of lender/lessee will not affect such assets and associated payments.

51) *Network-Topology Neutral* – This attribute was impliedly/implicitly introduced in Nwogugu (2012). The benefits/cost-savings generated from the Ecosystem/Network structure (created by the *Produc*t) are likely to be independent of, and not to be significantly influenced by the topology of the Ecosystem/Network. That is, the transactions, processes and cost-savings in the Ecosystem/Network are less dependent on (and "dominate") the physical location of Network-Nodes (Network-Members), than they are on the magnitude of the dollar-amounts (asset-values; cost-savings) and the efficiency of processes in the Ecosystem/Network. *Network-Topology Positivity* refers to instances where the benefits/cost-savings generated from the Ecosystem/Network structure (created by the *Product*) are significantly influenced by, and are directly proportional to the size and topology (eg. degree of clustering) of the Ecosystem/Network. *Network-Topology Negativity* refers to instances where the benefits/cost-savings generated from the Ecosystem/Network structure (created by the *Product*) are significantly influenced by, and are inversely proportional to the size and topology (eg. degree of clustering) of the Ecosystem/Network.

52) *Chaos/Bifurcation/Emergence Neutral* – This attribute was impliedly/implicitly introduced in Nwogugu (2012). The likelihood of Chaos, Bifurcation and or Emergence properties existing or appearing in the Ecosystem/Network is greatly reduced and the Product Ecosystem/Network has relatively low sensitivity to the "*Initial-Values*" of Product-Contract parameters because of System-of-Systems adjustments (eg. Default Neutrality; Dynamic Reset Terms; Wealth Neutrality; Substitution options; Binary-State Options; Location Neutrality; floating interest rates; etc.), *Preference-Matching and Preference-Elicitation*, *Shock-Resistance*; etc..

53) *Homomorphic Payoff Functions* – borrower/buyer/lessee/depositor and lender/lessor/seller/bank payoff functions are homomorphic because they preserve or can preserve the order and relative magnitude of system inputs (which reduces shocks or the probability of shocks).

54) *Conditional Increasing-Returns-To-Scale-And-Diversification* – the Product's *System-of-Systems* generates *Conditional Increasing Returns To Scale And Diversification* only if specific conditions exist.

55) *Floating-Scale System-Activity* – the "*scale*" and "*ability-to-scale-up*" of the Product's *System-of-Systems* (Ecosystem/Network) floats and can vary widely regardless of the number of Network-Members. That is, the system can have low-activity operations (eg. Two million transactions and 14 million process-units per week) even when it has more than 100 million Network Members, and conversely it can have high-activity operations even when it has less than 8 million Network Members (eg. fifteen million transactions and sixty-two million process-units per week). The key variables include *Contagion*, News, members' decision-processes, Members' information processing capabilities; the "recommendations" and "MBCs" provided by the *System-of-System*'s (Product Ecosystem/Network) AI-based recommender app; and economic conditions.

56) *Network-Centrality Neutral* – the Network is unlikely to be substantially affected by communications among nodes/members. Most interactions among members are context-specific and asset-specific and pertain to matching. However, if a social network element is added to the system (ie. the ability to communicate with other Network-members in a forum or via chat) then *Network-Centrality* issues may arise, but will still be relatively low (compared to traditional social networks) because of the nature of the *Product Ecosystem/Network*. *Qualitative Reasoning* can be used to scale this feature.

57) *Nonlinear/Unstable Network-Benefits* – the "*Net-Benefits*" gained by buyers/lessees/borrowers/depositors and lenders/lessors/sellers/banks from participating in the Product Ecosystem/Network are Nonlinear, unstable and time-varying and also can result in "*Emergent Properties*" (new and sometimes un-related phenomena) and short-term *Chaos*. This is partly because:

i) the Net-Benefits and some of the *Product'*s attributes (defined herein) interact and may cancel-out, conflict with, or amplify each other.
ii) Network-Topology is dynamic and nonlinear; and usually affects Network-benefits in many types of Networks.
iii) Network-Centrality is dynamic and nonlinear; and usually affects Network-benefits in many types of Networks.
iv) When Product features are changed, the adjusted features can function as "Initial-Values" that can cause Chaos in the short-run.
v) Some of the cost-savings generated by *Ecosystem/Network Efficiency* are nonlinear and time-varying and may distort Network-Benefits.

Thus, the use of nonlinear mathematical functions to represent Network-Benefits is inaccurate and inefficient.

3. Conclusion.

Energy Consumption and operating costs in cyber-physical financial/insurance networks is growing significantly given the expansion of online financial services, social networks and automation. The Networks and Modular-Features introduced herein are largely dependent on measuring, interpreting and using information about human preferences and cognition; and thus, can provide many efficiencies including significant reductions in Energy Consumption in Financial/Insurance Ecosystems and systems-of-systems.

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