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Original Paper

The Ching Paradox: The Forward-Looking Solution of Value Replacing the Backward-Looking Peer Review Process Demonstrated by Fuzzy Logic with Finite Range of Tolerance Replacing Exact Logic with Zero Range of Tolerance in the Fuzzy Infinite Spreadsheet

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Abstract

The P/E Ratio (Price/Earning) is one of the most popular concepts in stock analysis, yet its exact interpretation is lacking. Most stock investors know the P/E Ratio as a financial indicator with the useful characteristics of being relatively time-invariant. In this paper, a rigorous mathematical derivation of the P/E Ratio is presented. The derivation shows that, in addition to its assumptions, the P/E Ratio can be considered the zeroth order solution to the rate of return on investment. The commonly used concept of the Capitalization Rate (Cap Rate = Net Income / Price) in real estate investment analysis can also be similarly derived as the zeroth order solution of the rate of return on real estate investment. This paper also derives the first order solution to the rate of return (Return = Dividend/Price + Growth) with its assumptions. Both the zeroth and the first order solutions are derived from the exact future accounting equation (Cash Return = Sum of Cash Flow + Cash from Resale). The exact equation has been The Abstract to the patent the derivation of the exact solution of the rate of return. Empirically, as an illustration of an actual case, the rates of return are 3%, 73%, and 115% for a stock with 70% growth rate for, respectively, the zeroth order, the first order, and the exact solution to the rate of return; the stock doubled its price in 2004. This paper concludes that the zero-th, the first order, and the exact solution of the rate of return all can be derived mathematically from the same exact equation, which, thus, forms a rigorous mathematical foundation for investment analysis, and that the low order solutions have the very practical use in

providing the analytically calculated initial conditions for the iterative numerical calculation for the exact solution. The solution of value belongs to recently classified Culture Level Quotient CLQ = 10 and is in the process of being updated by fuzzy logic with its range of tolerance for predicting market crashes to advance to CLQ = 2.

1. Introduction

One day, when Lotfi A. Zadeh, the Father of Fuzzy Logic, was explaining fuzzy logic to a group of international luminaries in his office, Hugh Ching, nicknamed Godfather of Post-Science, and his student Chien Yi Lee, nicknamed Integer Lady, walked into the room, and Zadeh asked them: "How would you handle the future?" Lee replied promptly with justone word: "Recalculate." To recalculate, there must be a deterministic system. This paper deals with the formulation of the deterministic system with the addition of equation for the condition at infinity.

The two pioneers Kenneth Arrow and Gerard Debreu and the Founder Hugh Ching of Mathematical Social Science advances the Free Market of Milton Friedman to Mathematical Economics, dealing with Completely Mathematically Rigorous in economics. More fundamentally, they identify that the purpose of mathematics is for relating rigorously the complex factors in social science, whose solutions are not empirically verifiable and must be accepted based on complete mathematical rigor. The completely mathematical relationships are needed for solving financial crises, which are out of reach of non-mathematical economics.

The solution to the problem of value posed by Gerard Debreu in his book Theory of Value is a completely mathematically rigorous system, which corresponds realistically to the price system. Value is defined as the sum total of future benefit of losses of an investment to the infinite future. Value can be defined either as the price or the rate of return on investment. In fact, the solution of value is the complete mathematically rigorous relationship between the price and the rate of return. The completely mathematically rigorous solution of value is a breakthrough in the applications of mathematics as the method of social science, as empirical verification is the method of science. Social science deals with the whole reality, which extends to infinity. Since infinity, by definition, never arrives and makes the collecting a complete set of deterministic input data impossible, solutions in social science are not subjected to empirical verification. Social science is thus fundamentally different from science in that social science cannot be empirically verified. For example, the price of an ounce of gold cannot be empirically verified, for the price will vary continually to the infinite future. The solutions in social science must be accepted based on complete mathematical rigor.

The solution of value could be considered the foundation of social science. It has achieved a historical breakthrough in demonstrating market prediction. The solution of value has predicted publicly the US Savings and Loan Crisis for Fed Chairman Alan Greenspan as early as 1984 and the Subprime Woe for Fed Chairman Ben S. Bernanke in June of 2006 by detecting the overvaluation of the real estate market. The solution of value has been found, since 1976, to be infallible in predicting the real estate market.

The solution of value is now predicting that the current unlimited Quantitative Easing, which was recommended by Hugh Ching to Bernanke as the solution to the Subprime Woe, has raised the price equilibrium to a dangerously high level, and that any economic instability can bring the world into a global economic crisis. Based on the solution of value, the long-term solution to the current overvalued market price is to balance the low rate of return from Quantitative Easing with the high rate of return of innovative research projects, which, however, must be justified by the solution of value. The solution of value, known commercially as the Infinite Spreadsheet disclosed in the patent "Quantitative Supply and Demand Model Based on Infinite Spreadsheet" (Pat. No. 6,078,901), provides full disclosure of the inputs and the outputs and full accountability to the infinite future. The solution of value is a non-violable law of nature in social science, as gravitation is a non-violable law in science. Non-violable laws of nature in both science and social science could replace all man-made laws in the future.

A rational decision should be made based on the future expectations, not the past data, unless that the data are invariant. The solution of value resolves the Ching Paradox, which states that the peer review process filters out truly original ideas, which are peerless. The Ching Paradox can also be stated that, technically, when a variable can be calculated, it should not be derived by comparing to the past data. For example, one can use comparable data for the price or for the rate of return, but cannot input both, because when the comparable rate of return is used as an input, the price can be calculated by the Infinite Spreadsheet, as for real estate, and when the comparable price, such as a stock quote, is used as an input, the rate of return can be calculate by the infinite Spreadsheet, as for stocks.

Similarly, the Market Comparison Method in real estate appraisal should be replaced by the solution of value, when a deterministic price system in the form of the Infinite Spreadsheet is available, such as demonstrated commercially at http://123is.com/verify.htm. The abstract to the patent is quoted below for the convenience of the reader:

"Calculating devices for non-arbitrary price determination and rational decision making. The historical problem of value has been solved in this invention. The solution represents the first major breakthrough in social science. Value is defined as the sum total of all the future benefits and losses. An infinite spreadsheet establishes a deterministic relationship described by an equal number of equations and unknowns-between the price and all the factors affecting the price in an expected time space extending from now to the infinite future. The infinite spreadsheet expands the current finite spreadsheet to infinity. It does not assume a resale price in the determination of the price. The current finite spreadsheet for planning and decision making should not be allowed because it hides material information, namely, the future beyond the finite time. The scientific method based on empirical verification is not always applicable in social science. In particular, the solution to price cannot be empirically verified because deterministic sets of data can never be collected when the infinite future, which will never arrive, is involved. In order to carry the calculation to infinity, the inputs are expressed as approximate time-invariant variables. Since the present price depends on the future price,

the calculation is done in a time-reversed fashion. The law of supply and demand, or the general economic equilibrium analysis, emphasizes the spatial dependence of the price and has neglected the importance of the temporal consideration, which is investigated in detail in the infinite spreadsheet. A quantitative supply and demand model for multiple commodities with similar functionality and with a uniform price can be constructed by summing over the quantities whose various prices are determined individually by the infinite spreadsheet. In turn, the quantitative model can be used to obtain the inputs for the infinite spreadsheet, with which it forms a new quantitative foundation for economics and ushers in a new age of social science."

Fuzzy Logic should replace Exact Logic as the new foundation of knowledge because a solution should be defined as all the answers lying within the range of tolerance or validity of the solution. In the solution of value, multiple calculations with different inputs expands the range of tolerance of the solution spatially, and recalculation, when the future expectation changes, expands the range of tolerance for the future to cover all the possibilities in an uncertain future. Thus, Fuzzy Infinite Spreadsheet, not just the Infinite Spreadsheet, is the most accurate description describing value.

2. Solution of Value: A Complete Mathematical Rigorous System of Value

Almost all the stock investors know about the P/E Ratio, and most stock analysts, including, particularly, Fed Chairman Alan Greenspan, use the equation return = dividend/price + growth ($r_0 = d_0E_0/P_0 + g_1$). In real estate, P/E ratio is equivalent to the inverse of the capitalization rate, Net Income/Price. Therefore, a rigorous mathematical derivation of these two equations is long overdue. Most importantly, the derivation starts from the same equation based on which the Infinite Spreadsheet is derived. The equation used to derive all three equations, namely, the zeroth order equation of P/E Ratio, the first order equation of $r_0 = d_0E_0/P_0 + g_1$, and the Infinite Spreadsheet is simply the exact realistic forward accounting of cash flow including the cash from resale.

P/E Ratio, instead of P/D Ratio, is used simply because D (Dividend) for many stocks is zero. The inadequacy of the zero-th order equationis obvious. P/E Ratio is unaffected by the growth rate of earning, inaddition to the use of E which is the net income to the stock company, not of D which is the real cash return to the stock investor.

Now with all three equations available and mathematically interpreted, it might be interesting to compare their results. It should be noted that all three equations calculate the rate of return on investment to the stock investor. In this regard, Net Income is the term used in real estate and is, respectively, the earnings and dividend for a company anda stock investor. Similarly, P/E or P/D ratio corresponds to the inverse of the Capitalization Rate in real estate, which is the Net Income divided by the price. The rate of return, especially for the stock market where the price in the form of the quote is given on the second, is really the only remaining unknown to be determined. Using the stock POT as an example, the zero-th equation P/E = 33, which translates into return = E/P = 3%, the first order return $r_0 = d_0E_0/P_0 + g_1 = 73\%$ and, the Infinite Spreadsheet calculates a return based on a 5-years growth rate of

70% to be around 115%. The Infinite Spreadsheet has, thus, calculated P/E Ratio and r_0 exactly. In 2004, POT doubled its price, a 100% increase. However, the rate of return has a short-term one-year investment period and needs to be recalculated any time there is a material change in the future expectation.

The main reason that the three rates of return are all useful is that they are all approximately time-invariant, which can be used as market comparable inputs. However, only the Infinite Spreadsheet can calculate the absolute rate of return, with the other two being only relative indicators. Another practical advantage of the Infinite Spreadsheet is that it is completely mathematically rigorous and, thus, can take over the responsibility of analyst. On the other end, SEC can take the responsibility of the inputs to the Infinite Spreadsheet, leaving the analyst totally free of responsibility. In addition to being mathematically rigorous, the Infinite Spreadsheet discloses all its methodology (in a patent) and equations, and all its inputs to infinity in time, resulting in full future accountability of the analysis.

Formal Classical Expansion:

$f(x) = x^1 + x^2$

$x = \varepsilon^0 x_0 + \varepsilon^1 x_1 + \varepsilon^2 x_2$

Substituting x into f(x),

$f(x) = (x_0 + \varepsilon x_1 + \varepsilon^2 x_2) + (x_0 + \varepsilon x_1 + \varepsilon^2 x_2)^2$

Usually, ε is a very small number, but, generally, ε can be any number. For example, $\varepsilon = 0.01$, $\varepsilon^2 = 0.0001$, $\varepsilon^3 = 0.000001$... In general, order, which is represented by the exponential of e, is related physically to the significance rather than the magnitude. For example, often the zeroth order terms are zero rather than finite, while the first order terms are finite.

$$x_0 + \varepsilon x_1 + \varepsilon^2 x_2$$

$$x_0 + \varepsilon x_1 + \varepsilon^2 x_2$$

$$\varepsilon^2 x_0 x_2 + \varepsilon^3 x_1 x_2 + \varepsilon^4 x_2^2$$

$$\varepsilon x_0 x_1 + \varepsilon^2 x_1^2 + \varepsilon^3 x_1 x_2$$

$$x_0^2 + \varepsilon x_0 x_1 + \varepsilon^2 x_0 x_2$$

$$\varepsilon^0 x_0^2 + 2\varepsilon^1 x_0 x_1 + \varepsilon^2 (2 x_0 x_2 + x_1^2) + 2\varepsilon^3 x_1 x_2 + \varepsilon^4 x_2^2$$

Order	Epsilon(ε)	Collected Terms
0	ε^0	x_0^2
1	ε^1	$2 x_0 x_1$
2	ε^2	$2 x_0 x_2 + x_1^2$
3	ε^3	$2 x_1 x_2$

4 ε^4 x_2^2

$$f(x) = (x_0 + \varepsilon x_1 + \varepsilon^2 x_2) + (x_0 + \varepsilon x_1 + \varepsilon^2 x_2)^2$$
$$= (x_0 + \varepsilon x_1 + \varepsilon^2 x_2) + \varepsilon^0 x_0^2 + 2\varepsilon^1 x_0 x_1 + \varepsilon^2 (2 x_0 x_2 + x_1^2) + 2\varepsilon^3 x_1 x_2 + \varepsilon^4 x_2^2$$

$$f(x) = \varepsilon^0 (x_0 + x_0^2) + \varepsilon^1 (x_1 + 2 x_0 x_1) + \varepsilon^2 (x_2 + 2 x_0 x_2 + x_1^2) + \varepsilon^3 (2 x_1 x_2) + \varepsilon^4 x_2^2$$

Collected terms for f (x)

Order	Epsilon(ε)	Collected Terms
0	ε^0	$x_0 + x_0^2$
1	ε^1	$x_1 + 2 x_0 x_1$
2	ε^2	$x_2 + 2 x_0 x_2 + x_1^2$
3	ε^3	$2 x_1 x_2$
4	ε^4	x_2^2

Exact Equation (Cash flow equation): CashInvestmentReturn = SumOfCashFlow + CashFromResaleor write out in detail

(Price - Loan - BuyerExpense) * (1 + Return)$^{\text{InvestmentPeriod}}$ = (NetIncome -Loan * %Payment - TaxBracket * NetIncome) + (ResalePrice - Loan - SellerExpense)

Write out in symbolic form:

$(P - P * l - P * x) * (1 + r)^T =$ $(N - l * m - b * N) +$

P(Resale) - P * l - P(Resale) * e

where

P = Price or Resale Pricel = loan as % of Price

x = Expense of buyer as % of price

r = Return on investment averaged over investment period TT = Investment period

N = Net income

m = Loan payment as % of Loanb = Tax bracket

g = growth rate of price

e = Expense of seller as % of price

Our goal is to rigorously interpret the familiar concept of P/E Ratio and the commonly used equation for stock valuation

%Return = Dividend/Price + Growth Rate

in terms of their order of approximation. Practically, the resulting approximate equations can be used to calculate analytically the suitable initial conditions for the exact numerical calculation. Using classical expansion with the following substitutions for the zero-th and the first orders,

$P = P_0 + P_1 = P_0 * (1 + g)^T = P_0 + P_0 * (g_1 T + g_2 T^2 + \ldots + g_n T^n + \ldots)$

$l = l_0 + l_1$

$x = x_0 + x_1$

$r = r_0 + r_1$

$N = N_0 + N_1$

$m = m_0 + m_1$

$b = b_0 + b_1$

g = Defined implicitly in P above in a polynomial expansion

$e = e_0 + e_1$

where the zero-th order terms are constant and the first order terms can be time-varying, into the cash flow equation with 1 year investment period (T = 1)

$[P_0 + P_1 -(P_0 + P_1)*(l_0 + l_1) - (P_0 + P_1)*(x_0 + x_1)] * (1+ r_0 + r_1) =N_0 + N_1 - (l_0 + l_1)*(m_0 + m_1) - (b_0 + b_1)*(N_0 + N_1) + P_0 + P_1(\text{Resale}) - (P_0 + P_1)*(l_0 + l_1) - (P_0 + P_1)*(e_0 + e_1)$

Expanded out, we get

$P_0 + P_1 - P_0l_0 - P_0l_1 - P_1l_0 - P_1l_1 - P_0x_0 - P_0x_1 - P_1x_0 - P_1x_1 +P_0r_0 + P_1r_0 - P_0l_0r_0 - P_0l_1r_0 - P_1l_0r_0 - P_1l_1r_0 - P_0x_0r_0 - P_0x_1r_0 - P_1x_0r_0 -P_1x_1r_0 + P_0r_1 + P_1r_1 - P_0l_0r_1 - P_0l_1r_1 - P_1l_0r_1 - P_1l_1r_1 - P_0x_0r_1 - P_0x_1r_1 -P_1x_0r_1 - P_1x_1r_1 = N_0 + N_1 - l_0m_0 - l_0m_1 - l_1m_0 - l_1m_1 - b_0N_0 - b_0N_1 - b_1N_0 - b_1N_1 + P_0 +P_1(\text{Resale}) - P_0l_0 - P_0l_1 - P_1l_0 - P_1l_1 - P_0e_0 - P_0e_1 - P_1e_0 - P_1e_1$

To construct stock P/E Ratio from the above expanded equation, we realize that for stock investment N = Dividend = DividendPayoutRatio *Earning = $d * E = N_0 + N_1 = d_0E_0 + d_0E_1 + d_1E_0 + d_1E_1$. Substituting Dividend for Net Income (N), we get

$P_0 + P_1 - P_0l_0 - P_0l_1 - P_1l_0 - P_1l_1 - P_0x_0 - P_0x_1 - P_1x_0 - P_1x_1 +P_0r_0 + P_1r_0 - P_0l_0r_0 - P_0l_1r_0 - P_1l_0r_0 - P_1l_1r_0 - P_0x_0r_0 - P_0x_1r_0 - P_1x_0r_0 - P_1x_1r_0 + P_0r_1 + P_1r_1 - P_0l_0r_1 - P_0l_1r_1 - P_1l_0r_1 - P_1l_1r_1 - P_0x_0r_1 - P_0x_1r_1 - P_1x_0r_1 - P_1x_1r_1 = d_0E_0 + d_0E_1 + d_1E_0 + d_1E_1 - l_0m_0 - l_0m_1 - l_1m_0 - l_1m_1 - b_0d_0E_0 - b_0d_0E_1 - b_0d_1E_0 - b_0d_1E_1 - b_1d_0E_0 - b_1d_0E_1 - b_1d_1E_0 - b_0d_1E_1 + P_0 + P_1(\text{Resale}) - P_0l_0 - P_0l_1 - P_1l_0 - P_1l_1 - P_0e_0 - P_0e_1 - P_1e_0 - P_1e_1$

To extract P/E or, more exactly, its zero-th order expression P_0/E_0 from the above equation, we need to set to zero all the non-zero order terms:

$P_0 - P_0l_0 - P_0x_0 + P_0r_0 - P_0l_0r_0 - P_0x_0r_0 = d_0E_0 - l_0m_0 - b_0d_0E_0 + P_0 - P_0l_0 - P_0e_0$

or dividing through by E_0, the above equation becomes

$P_0/E_0 - P_0l_0/E_0 - P_0x_0/E_0 + P_0r_0/E_0 - P_0l_0r_0/E_0 - P_0x_0r_0/E_0 = d_0 - l_0m_0/E_0 - b_0d_0 + P_0/E_0 - P_0l_0/E_0 - P_0e_0/E_0$

or

$P_0/E_0 * (1 - l_0 - x_0 + r_0 - l_0r_0 - x_0r_0 - 1 + l_0 + e_0) = d_0 - l_0m_0/E_0 - b_0d_0$ or

$P_0/E_0 = (d_0 - l_0m_0/E_0 - b_0d_0)/(-x_0 + r_0 - l_0r_0 - x_0r_0 + e_0)$ or solving for r_0

$r_0 * (1 - l_0 - x_0) = d_0E_0/P_0 - l_0m_0/P_0 - b_0d_0E_0/P_0 - e_0$

$r_0 = (d_0E_0/P_0 - l_0m_0/P_0 - b_0d_0E_0/P_0 - e_0)/(1 - l_0 - x_0)$,

$r_0 = d_0E_0/P_0$, when l_0, m_0, b_0, e_0, x_0 are zero

The zeroth order equation does not contain the growth rate g, which appears in the first order price, P_1. Therefore, to construct an equation with g, we need to consider the first order equation. For simplicity,

l, x, m, b, and e, which do not appear in the desired equation, are set to zero in the equation for calculating P/E Ratio

$P_0 + P_1 + P_0r_0 + P_1r_0 + P_0r_1 = d_0E_0 + d_0E_1 + d_1E_0 + d_1E_1 + P_0 + P_1(\text{Resale})$

where $P_1(\text{Resale})=P_0*(g_1T + g_2)$. With T=1, the first order equation for the first order rate of return is, neglecting all the smaller terms (P_1,P_1r_0, P_0r_1, d_0E_1, d_1E_0, and d_1E_1),

$r_0 = d_0E_0/P_0 + g_1$

where r_0 is equivalent to equity premium plus riskless interest rate in some derivations. The Infinite Spreadsheet solves the problem exactly.

The solution of value is the first time in history that a completely mathematically rigorous system, which corresponds to the price system, is discovered. It belongs to recently classified Culture Level Quotient CLQ = 10 and is in the process of being updated by fuzzy logic with its range of tolerance for predicting market crashes to advance to CLQ = 2. The range of tolerance applies to all problems, which is fuzzy. The real estate market has a range of tolerance around 35% +/- 5% from the experience from the Savings and Loan Crisis and the Subprime Woe. What the range of tolerance means is that the market has a range of tolerance around 35%, which if exceeded, will cause a market crash. The concept of range of tolerance of fuzzy logic will make the study and prediction of market crash complete, but the study has just begun recently in the 2020s.

Social science deals with the whole reality, which extends to infinity. Since infinity, by definition, never arrives and makes the collecting a complete set of deterministic input data impossible, solutions in social science are not subjected to empirical verification. Social science is thus fundamentally different from science in that social science cannot be empirically verified. For example, the price of an ounce of gold cannot be empirically verified, for the price will vary continually to the infinite future. The solutions in social science must be accepted based on complete mathematical rigor.

The solution of value can determine the rate of return on investment, which is central to setting the interest rate in the logical economic relationship, Rate of Return > Interest Rate. Also, to be studied is the Fisher Identity or the Quantity Theory of Money, namely, PQ = VM (Price x Quantity = Velocity of Circulation of Money x Money Supply), which closely related to the cause and the cure of the current financial crisis.

The Taylor Rule should be replaced by the logic relationship:

Rate of Return > Interest Rate > Inflation

where the Rate of Return can only be calculated with the availability of a deterministic valuation system applied to sales data to determine the Return.

From an overall historical perspective, the failure to carry the success achieved in physical science into social science must rank among the major disappointments of the twentieth century. Empirical verification is the bulwark of physical science, but is possible only when a deterministic event, described by an equal number of equations and unknowns, occurs within a finite time interval; scientific predictions rely on the possibility of fitting deterministic future phenomena onto deterministic

past phenomena. Value, the foundation of social science, can be defined as the sum total of all the future benefits and losses in a semi-infinite time space. Deterministic sets of data can never be collected in value determination when the infinite future is involved. Therefore, empirical verification and predictions based on past data are generally not possible in social science. Thus, while mathematical rigor is desirable, but not absolutely necessary, in science because scientific principles can all be verified empirically, the rigor of mathematics becomes the only means by which the solution of value can be trusted because values, decisions, and plans are not empirically verifiable. Full consideration, which implies full disclosure, of all the factors' affecting value is a mathematical necessity for a deterministic solution of value.

In addition to market predictions, the solution of value exposes one of the most serious defects in judging knowledge. The defect is the peer review process, which is like the Market Comparison Method. The peer review process makes judgements on knowledge by comparing to the past established knowledge, as the Market Comparison Method compares to the past prices. The Market Comparison Method causes market crashes by keeping the prices unchanged, and the peer review process has kept knowledge unchanged. The peer review process is a defender of the establishment, which is dominated by science with CLQ = 11. To advance from CLQ = 11 to CLQ = 10, the solution of value must replace the peer review process. The Ching Paradox states that the peer review process filters out truly original ideas, which are peerless. The solution of value resolves the Ching Paradox. Similarly, the Market Comparison Method in real estate appraisal should be replaced by the solution of value, when a deterministic price system in the form of the Infinite Spreadsheet is available, such as demonstrated commercially at http://123is.com/verify.htm. CLQ = 10 contains the solution of peace, for the solution of value is also the solution of arbitration. In sum, as predicted by Paul Feyerabend in his book Against Method, the method for social science is completely different from the method for science and must consider the infinite future for deterministic solutions.

3. Fuzzy Infinite Spreadsheet

The essence of fuzzy logic is to realize that precision is sacrificed in the process of expanding the Range of Tolerance of a creation to survive and flourish for all the possibilities in an uncertain future. Thus, a solution is defined as all the answers lying within the Range of Tolerance or validity of the solution, whereby fuzzy logic replaces exact logic as the new foundation of knowledge, and Fuzzy Exact Solution replaces Exact Solution as the most accurate description of reality. Zadeh had dedicated almost 60 years of his life to contradict science, which is obsessed with precision, with fuzzy logic based on his unshakable belief that reality is fuzzy, not exact. The breakthrough in understanding fuzzy logic finally came in the final 3 years of his life after his 10-year long collaboration with Ching in extending the concept of "Range of Value" to that of "Range of Tolerance" based on the realization that fuzzy logic is needed to exploit the Range of Tolerance of a creation to survive and flourish all the possibilities in an uncertain future. The old established idea of one exact solution is not only illogical,

but also often impossible,as one can never make an exact 12-inch ruler, for it will take infinite cost to make the ruler precisely 12 inches in length. With this new foundation in knowledge, upon reflection on science, few, if any solution, in science is exact, especially, at the microscopic level, and social and life sciences depend on the Range of Tolerance for market stability and for human free will within the Range of Tolerance provided by nature, respectively. Theoretically, the Range of Tolerance in fuzzy logic resolves the incompleteness in logic, as raised by Kurt Friedrich Gödel in his Two Incompleteness Theorems, Kenneth Arrow in his Impossibility Theorem, and Bertrand Russell in the Russell Paradox.According to Godel, Arrow, and Russell, no solution is complete before fuzzy logic, and according to Zadeh and Ching, all solutions are valid, if their ranges of validity or tolerance are specified. Fuzzy logic deals with expanding the range of tolerance of a creation to cover the range of possibilities, which should be narrowed, for autonomous survival in an uncertain future.

Zadeh had identified all the essential elements of fuzzy logic and jumped directly from science to fuzzy logic. His heir Ching connected all the essential elements and filled in the gap in knowledge progressing from science to social science to life science to robotics to self-creation to fuzzy logic, where science is obsessed with precision, and social and life sciences are clearly fuzzy. Ching summarized the contribution of fuzzy logic in his two 2021 papers "The Fuzzy Completeness Theory" and "Culture Level Quotient."

The scientific way of reasoning by empirical verification depends so much on the faith in the Law of Uniformity that it is completely dismissed by mathematicians and logicians, especially, after the exposure of Thomas Kuhn and Paul Feyerabend that a scientific advancement is akin to a religious conversion. On the other hand, mathematicians and logicians have been working steadily to find the limit of reliable knowledge. In the current state of knowledge, Gödel holds the most advanced view with his Two Incompleteness Theorems, which conclude that the most reliable of human knowledge, logic, is incomplete and can be shown to be self-contradictory, and, thus, not completely reliable. For example, one can never define a word completely because every word needs other words to define, and the process goes on to infinity and can never be completed. Gödel is further supported by the Impossibility Theory of Kenneth Arrow and the Russell Paradox. Zadeh and Ching applied fuzzy logic to reality that fuzzy logic can expand the Range of Tolerance of knowledge so that any incompleteness can be resolved by the Range of Tolerance covering incomplete parts or the infrequent impossibilities to make logic complete again.

The Fuzzy Completeness Theory deals with methods of reason. Before Fuzzy Logic, people use exact reasons as the method to discover truth. And before complete solutions, people arrive at incomplete solutions. For example, the Scientific Method completes reason by introducing the final equation for a deterministic solution, with an equal number of equations and independent variables, from an empirically verified law of nature, which, however, requires the faith in the Law of Uniformity, which states that what happens in the past will happen in the future.

Mathematics is more reliable than empirical verification, and logic is even more reliable than mathematics and is the foundation of mathematics. The solution of value identifies an exact complete mathematically rigorous system, which corresponds to reality. The exact solution of completely automated software identifies a complete logically rigorous system, which satisfies the Requirement of Permanence based on complete automation. However, Gödel and Arrow find that logic cannot be complete that is that no knowledge can be completely reliable, and their incompleteness and impossibility theorems have made all knowledge incomplete or not completely valid.

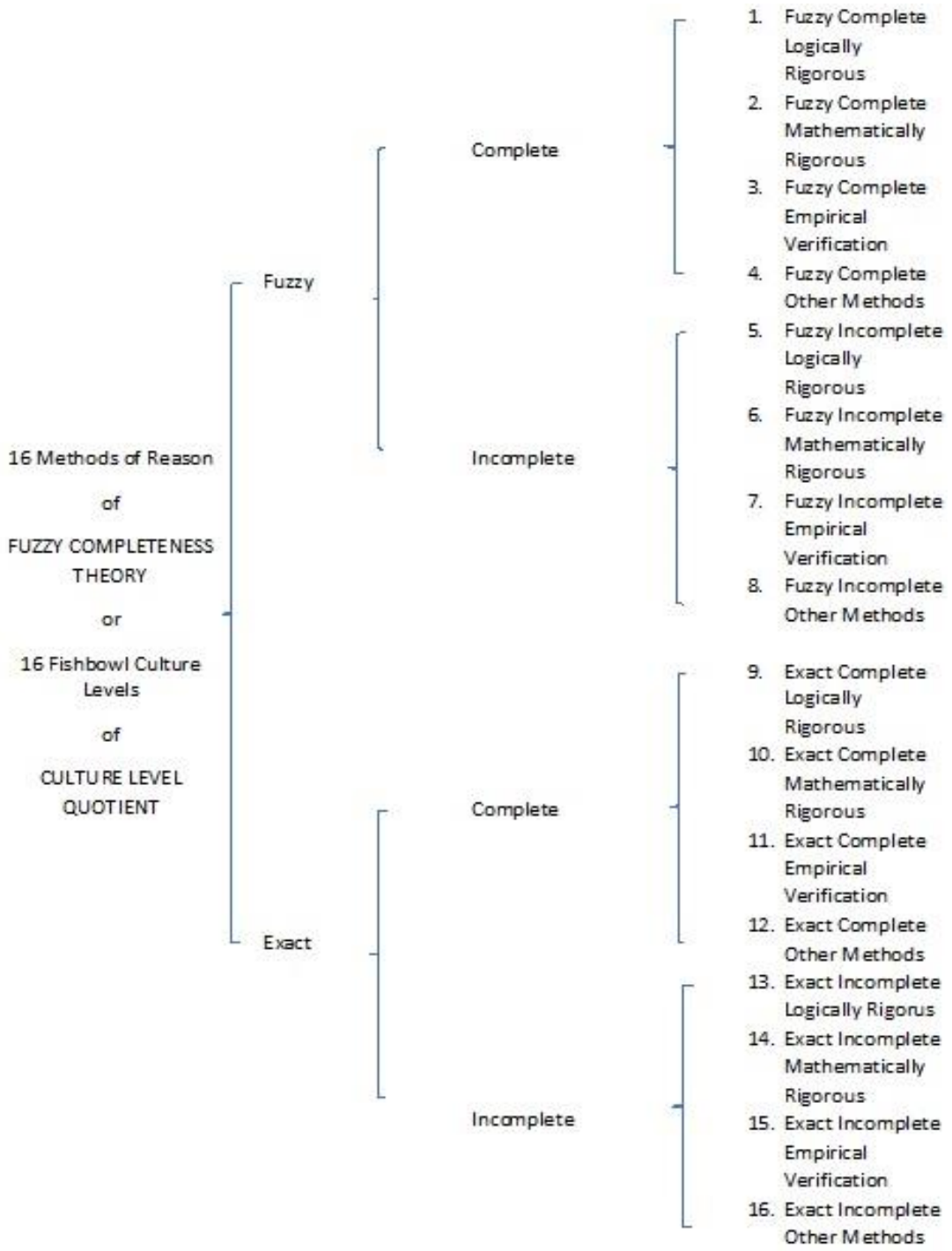
This incompleteness is a real threat to knowledge, and before fuzzy logic of Zadeh, no one can resolve this fundamental defect in knowledge.

Technically, the Fuzzy Completeness Theory classifies methods of reason formally into 16 Methods of Reason, which represent the technical and applicable description of the Fuzzy Completeness Theory. The 16 Methods are the combination of the 4 basic methods of reasoning: 1) Logic, 2) Mathematics, 3) Empirical Verification, and 4) Others, each of which has 2 forms: 1) Incomplete and 2) Complete and two types: 1) Exact and 2) Fuzzy. Thus, the 16 Methods of Reason are in the order of accuracy or reliability, where their

realized and potential applications are enclosed in brackets:

1) Fuzzy Complete Logic (Self-Creation of the Living System)
2) Fuzzy Complete Mathematics (Predictive Fuzzy Social Science)
3) Fuzzy Complete Empirical Verification (Fuzzy Biological Touch Mechanism)
4) Fuzzy Complete Other Method of Reason (Religion of Knowledge)
5) Fuzzy Incomplete Logic (Fuzzy Logic)
6) Fuzzy Incomplete Mathematics (Fuzzy Mathematics)
7) Fuzzy Incomplete Empirical Verification (Fuzzy Jumpulse Mechanism)
8) Fuzzy Incomplete Other Method of Reason (Theoretical Biology)
9) Exact Complete Logic (Solution of Software)
10) Exact Complete Mathematics (Solution of Value)
11) Exact Complete Empirical Verification (Science)
12) Exact Complete Other Method of Reason (Religion of Morality)
13) Exact Incomplete Logic (Logic)
14) Exact Incomplete Mathematics (Mathematics)
15) Exact Incomplete Empirical Verification (Pre-Science Alchemist)
16) Exact Incomplete Other Method of Reason (Morality)

The graph is shown in Figure below:



By extending the concept of Range of Value to that of Range of Tolerance, Ching becomes the heir to Dr. Zadeh, the Father of Fuzzy Logic. Following the footsteps of his mentors Zadeh, Paul Feyerabend, Ta-You Wu, Kenneth Arrow, Gerard Debreu, Milton Friedman, Tosiyasu L. Kunii, Chittor V. Ramamoorthy, Harold Grad, and K. T. Li, Ching has become one of the leading thinkers in the fields of their knowledge. He realizes that social and life sciences involve the infinite future, and, therefore,

solutions in social and life sciences are not subject to empirical verification because infinity, by definition, will never arrive for collecting the complete set of deterministic data. He concludes that solutions in social science must be accepted based on complete mathematical rigor, and that solutions in life science must beaccepted based on complete logic. The complete mathematical rigor is demonstrated in his solution to the problem of value posed by Kenneth Arrow and Gerard Debreu in Debreu's book Theory of Value. The complete logic is demonstrated in his solution to complete automation, which characterizes life science. The solution of completely automated software is disclosed in the patent "Completely Automated and Self-generating Software System" (Pat. No. 5,485,601), of which DNA-protein of the living system is a prime example.

4. Conclusion

The essence of this paper is recalculation versus peer review. The rational way to make a decision is to recalculate whenever the future expectation changes and not compare it to old decisions based on old situations. To illustrate the recalculation process, all the inputs are invariants, which can be obtained by past data, and the price is a variant, which changes continually to infinity in time, must be calculated as the last variable in the system. But recalculation is difficult, for it must consider the infinite future for a deterministic solution. In fact, the condition at infinity provides the last equation needed to make the number of equations equal to the number of unknowns. The peer review process is an easy way for intellectuals collectively to cheat politicians or their non-intellectual bosses for money. Post-science is against the backward-looking peer review process and wants the forward-looking solution of value to replace the peer review process. The reviewer of this paper demonstrates the defect of the peer review process by claiming that this paper has no conclusion, while the truth is exactly the opposite, as the entire paper is the conclusion of the solution of value disclosed in its patent. In combination with the patent, this paper forms a completely rigorous mathematical system which corresponds to the price system. This paper criticizes mathematics being incomplete; the solution of value is the first, and possibly still the only, complete mathematically rigorous system corresponding to reality, particularly, social science. The conclusion of this paper implies that mathematics is for social science. Furthermore, fuzzy logic supplies the range of tolerance to further complete the description of reality. Accordingly, the Fuzzy Infinite Spreadsheet demonstrates that market crash can be quantified, and, thus, can be predicted, by the range of tolerance of fuzzy logic, in the case of real estate, being 35% +/- 5%.

5. Future Research: Economic Instability and Money

Milton Friedman forms the bulk of the discussion in Post-Science Economics with his speech "Chinese Economic Reform." Friedman is for the Free Market, but the market is not free; the market is regulated quantitatively by mathematically rigorous relationships, such as the solution of value or the Infinite Spreadsheet, and qualitatively by the socalled invisible hand. Also, financial crises are caused by market crashes. The solution of value, when used by all sectors of the economy, will establish an

economic equilibrium. Without the constant adjustment by the solution of value, economic instabilities, such as the Finite Spreadsheet Instability, which justifies the price rise by price appreciation, not the cash flow, will drive the price to the highest limit of the range of tolerance of the market to cause a market crash initiating a financial crisis.

Price is measured in money. Friedman's Quantity Theory of Money, Price x Quantity = Velocity of Circulation of Money x Money Supply, shows the importance of money. Post-Science Institute has invented Universal Permanent Money or Integer Gold based on its invention of the Universal Permanent Software. Integer Gold is like gold; both have intrinsic value. But gold is in limited supply and hard to handle. The control of money supply determines the priorities of a society. Resource allocation depends on to whom money is supplied. Social progress depends on who supply the money. Politicians will supply money mainly for military competition. Businessmen will supply money for economic competition. Thinkers will supply money for knowledge cooperation. Human culture advances from Politics-Oriented Society to Money-Oriented Society to Knowledge-Oriented Society. In a Money-Oriented Society, money is invested in projects with short-term and monetary returns with mainly self interests. In a Knowledge-Oriented Society with Integer Gold, in addition to providing Universal Basic Income to the poor, money will be supplied to fund long-term, as well as short-term, unselfish nonmonetary, as well as selfish and monetary, innovative research projects, which are justified by the solution of value with full disclosure and full accountability.

Table 1. Summary of Solution of Value

The following table summarizes the rigorous derivations in this article and relates the results to other popular rate of return calculations.

Name (Other Names)	Formula	Outcome	Explanation
Zero-th Order (P/E Ratio) (Valuation Multiplier)(Earning-Based) (Yield) (Capitalization Rate)	$r_0 = d_0 * E_0/P_0$	3%	r_0 = Rate of Return d_0 = Dividend Payout Ratio E_0 = Earning P_0 = Price (Subscript 0 stands forthe zero-th order)
	$r_0 = \frac{N_0}{P_0}$	(5% Cap Rate)	N_0 = Net Income (r_0 = Cap Rate)

First Order			
(Expected Rate Of Return)		73% with 70% Growth	g_1 = Growth Rate
(Gordon Growth Model)	$r_0 = d_0 * E_0/P_0 + g_1$		
(Equity Premium + Riskless Interest Rate)			
(Dividend-Based)	$r_0 = \frac{N_0}{P_0} + g_1$	(8% with 3% Growth)	
Exact Solution			
(Infinite Spreadsheet)(Cash Flow Model) (Supply Side)	Cash Return =Sum of Cash Flow + Cash From Resale	115% Actual >100%;Price Doubled In the Year (10% Return)	(Price-Loan-BuyerExpense) *[(1+Return) to the power of InvestmentPeriod] = Σ (NetIncome - Loan*%Payment - TaxBracket* NetIncome) + (ResalePrice-Loan-SellerExpense)
Fuzzy Exact Solution Fuzzy Infinite Spreadsheet	Same as Exact Solution	Range of Valid Solutions (e.g., 35% +/- 5%)	Same as Exact Solution

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