NSF EAGER Proposal

Title: Replacing Backward-Looking Qualitative Peer Review Process with Forward-Looking Quantitative Valuation

By Hugh Ching, Research Advisor, and George Hsieh, President, Northwestern Polytechnic University

September 1, 2010

Project Description

This research proposes a method to fund research based on valuation, not just peer review. The method is designed to promote peerless, independent, unpredictable, original, revolutionary, and even anti-establishment research projects. The research funding will be dependent on quantified merit using valuation and rate of return calculation software systems. The merit will be judged and quantified based on the future expected consequences, not just the past established views, which will be used as inputs to the software systems. All applicants must submit valuations of their proposed projects. The funding amount will be based on the value of the project. The value will be based on the expected future return of the project.

There should also be a transformative change of the funding agency, in view of the ease with which the Internet can search for new discoveries in knowledge and introduces the people of the new discovery. Since the funding agency can do the valuation of a discovery as well as the researcher, it should also search and solicit for research ideas and proposers rather than just let the ideas come to it. Historically, money or funding does not buy revolutionary breakthroughs in knowledge. In fact, history records mostly the persecution of antiestablishment discoveries through a public peer review process.

Awards of a project should depend on the value of the project. The examination process might be similar to that of the US Patent Office for patent approval, with the qualitative requirement of "utility" be replaced by the quantitative calculation of "value" which can be expressed in either the price or the rate of return. The examination will be open, if public fund is requested, and judged by the plausibility of the inputs to the valuation of the research project, in accordance with the process of rational decision-making. As in patent applications, registration fees will be charged, but can be waived for cases with special merits or hardships. The researchers of this proposal plan to work closely with the patent office in referring to it and in funding patentable ideas. It believes that NSF and the Patent Office should function in the same spirit and, thus, follow similar procedures.

An example of valuation software is provided by the Infinite Spreadsheet based on the solution of value. The infinite Spreadsheet can determine a price without knowing a market price.

Valuation vs. Peer Review

In the solution of value, all the inputs are obtained from market comparison, and the price is calculated as the last remaining unknown. The inputs are expressed as approximately time-invariant quantities and, thus, can be approximated by past data and can be expressed to infinity in time. The price is a time-variant quantity, which changes continually to infinity in time, and, thus, should not be determined by comparing to past data, if the current economic condition is different from the past.

The peer review process makes a decision based on the past. The decision, like the price, is a time-variant quantity and should not be made by comparing to past decisions, since generally the current condition is different from the past. Since the condition of the future generally will change continually to infinity in time, decisions should not generally be made by comparison to past decisions.

The solution of value should replace the peer review process in determining the funding of research projects. The peer review process is similar, or even identical in concept, to the market comparison method for appraising the price of real estates. The market comparison method is the main cause of the Savings and Loan Crisis and the Subprime Woe, for it causes the price to remain the same, after the economic condition has changed.

The intuitive notion that peer review should play a part in decision-making really associates with the time-invariant elements in the decision. Also, science works because science deals exclusively with time-invariant laws of nature in science. Knowledge and new discoveries are definitely, or even by definition, not time-invariant. The time-invariant elements are the inputs to the valuation system. And the decision should be based on valuation, which has the added advantage of producing a quantitative result. In practice, the inputs can be time-varying in the initial period for as long as the values of the inputs are known. And when the inputs are expressed as time-invariant variables, such as a percentage of the price or the income, they can be approximated by past data.

The peer review process, as the market comparison method, is the main method used, even though it is incorrect generally, when the solution of value is not available. The peer review process could be considered the greatest obstacle to truly original, peerless, innovations, as the market comparison method could be considered the main cause of past financial crises.

The researcher and the examiner must both provide their inputs for the valuation of the research project. They should debate and justify their values of the inputs, and not to assign the final decision or value of the project based on past cases. This process of valuation of a research project is conceptually identical to the rational process of negotiating a price. Both buyer and the seller of a real estate provide their inputs for the real estate based on comparison to past data. They should not determine the price based on past comparable prices. The price is calculated based on a deterministic relationship between the inputs and the price. What can be calculated should not be determined by other means. A rational justice

system should follow this same valuation process in making a decision, which should be based on value. Valuation should be more stringent than peer review in upholding proposal quality.

In conclusion, this research proposes the replacement of the peer review process, which is similar in concept to the market comparison method, the main cause of the US Savings and Loan Crisis, with valuation, where only the time-invariant inputs, not the price, are obtained from market comparison and are to be debated between the research proposer and the proposal reviewer. The following is an illustration of the process of making a funding decision based on valuation, using the current proposal as an example.

The process of reviewing a proposal, for example, can goes through the following steps:

1. Studying thoroughly the prospective proposed research by either or both the proposer and the funding agency in terms of the technical feasibility and future expected monetary and non-monetary consequences,

2. Quantifying the future consequences in terms of monetary return, which should depend on its socially beneficial non-monetary return, by both the proposer and the funding agency,

3. Providing empirical evidence and justifications to support their quantified inputs of the future consequences by both the proposer and the funding agency,

4. Debating publicly on the evidences and justifications,

5. Arbitrating the final quantified inputs,

6. Inputting the agreed inputs into the valuation system,

7. Comparing the calculated value to the requested budget,

8. Readjusting the inputs within a reasonable range,

9. If value is greater than the budget, the proposal should be considered for funding, and it less, discarded,

10. Basing the funding priority on the rate of return,

11. Calculating the rate of return with the calculated value or price.

For example, this proposal is roughly valued between $10,973$ to $496,710. The lowest value is calculated as a commercial venture with 100% annual rate of return for the first 8 years and 40% annual rate of return for resale period of 8 years to infinity, and the high end is calculated as a socially benefit research with 40% annual rate of return for the first 8 years and 20% for resale returns. The requested $200,000 for EAGER funding is within this range. The valuation is done by the Time-Varying Infinite Spreadsheet, which is a valuation software based on the solution of value, using the estimate of the inputs: $50,000 for the first year ($10 x 1000 users with 50% expenses), increasing 50% per year for 10

years, then increasing at 10% per year to infinity, 100% rate of return for the first 8 years and 40% rate of return for investment period for all the resale to infinity; 0 finance, tax 35% and 15% resale; 100% land for no depreciation, etc.   As a beneficial social research funding and based on the value of $200,000, the calculated rate of return is 56.66%, which should be compared to other proposals to determine the priority of this proposed research.

All future research projects should have valuations which can justify their funding and should provide full disclosure now and full accountability in the future, which will be one of the key elements of consumer protection. The rate of return will gain accuracy with more experience in proposal valuation.

The following is a brief description of the Infinite Spreadsheet Valuation System from the point of view of Discounted Cash Flow Model, the current standard of valuation software.

Understanding Infinite Spreadsheet from Point of View of Discounted Cash Flow Model.

To determine the price Discounted Cash Flow Method calculates the cash flows during the holding period and the cash received when the investment is resold. All the cash flows are discounted back to the present with one or more discount rates.

To determine the price, the Infinite Spreadsheet accounts the cash flows realistically forward, with the cash flows grow with a reinvestment rate. And when the investment is resold, the cash received from the resale is realistically calculated, based on a yet-unknown resale price. All the cash flows and the cash from resale are accounted forward as would be in an accounting system.

DCF Method assumes a resale cap rate, which gives the resale price needed to determine the cash from resale. Also, terminal value calculation can eliminate the need to assume a resale price.

The Infinite Spreadsheet determines the resale price by going through exactly the same process outlined above for determining the price. And the same process for determining the price is used in all the resale prices to infinity in time.

The equation used in the Infinite Spreadsheet is:

Cash Return = Sum of Cash Flows + Cash from Resale

Where, also

 Cash Return = Initial Investment x (1 + %Rate of Return) to the power of holding period

A similar equation for determining the resale price for a future buyer when it is resold is of the exactly the same form, which introduces an additional resale price for the future buyer. Thus, each time an additional equation is introduced, a new resale price is added. Either this process continues to infinity or the investment is completely used up somewhere along the process, in which case considering to

infinity in no longer necessary.

Mathematically, the problem of the Infinite Spreadsheet can be expressed as:

Po = Po(P1(P2(P3(P4(P5(P6…(Pn(Pn+1…(Pinfinity)))…))))))

which simply says that the price Po depends on P1, and P1 depends on P2, so on and so forth to Pinfinity. Another way to say it is that if Pn is known Pn-1 can be determined. For example, if P2 is known, P1 can be determined, and if P1 is known, Po can be determined.

What the above analysis says is that the calculation should start from a resale price in the distant future and work backward in a time-reversed fashion. The distant future can be as far as one wants, within the computing power. Thus, in principle, the entire infinite spreadsheet can be made mathematically rigorous. In practice, most investors are no longer interested or known sufficiently accurately what happens after a certain time in the future, and an equivalent stable financial condition can be assumed for determining the first resale price in the distant future to be calculated. An approximate valid condition $Pi/Pj = Ni/Nj$ where Pi is the resale price in the year i, and Nj is the net income in the year j. The validity of the condition $Pi/Pj = Ni/Nj$ is still under intensive study by the PIs of this proposal.

The equation $Pi/Pj = Ni/Nj$ provides the additional equation needed to make the number of equations and the number of unknown prices equal. However, the first calculated resale price generally has to be calculated by iteration. In the iteration, a trial resale price is picked, and using the trial price, the rate of return is calculated. If the calculated rate of return does not equal to the given rate of return within a pre-assigned accuracy, another trial resale price is picked, and the return is again calculated. This process continues until the calculated rate of return falls within the accuracy required, and the trial resale price is the resale price.

THE ABOVE VALUATION BY THE INFINITE SPREADSHEET IS BASED SOLELY ON EXPECTED FUTURE CASH FLOWS AND IS COMPLETELY INDEPENDENT OF THE MARKET PRICE, WHICH IS NEVER USED OR COMPARED IN THE VALUATION. ALL THE INPUTS OF THE INFINITE SPREADSHEET ARE OBTAINED FROM MARKET COMPARISON.

An Abstract of a Related EAGER funding

The initial description in the first paragraph and the final conclusion in the last paragraph of the following Abstract applies equally well to the present proposed research. The "open-source simulation software" can also be implemented with the current proposed valuation methods, which also runs on the web.

Award Abstract #1042164

EAGER: Accelerating the Pace of Discovery by Changing the Peer Review Algorithm

ABSTRACT

Peer review is the main tool for scrutinizing scholarly publications, grant proposals and career advancements in science. However, the current peer review system is under severe strain, with consequences for the quality of science and the rapidity of dissemination of scientific results. Several studies have found that the current way of performing peer review can be inefficient, slow, and even biased. Almost every scientist has ideas on how to improve the system, but it is very difficult, if not impossible, to perform experiments to determine which measures are most effective. The project implements a simulation framework in which many ideas of how to improve the review process can be quantitatively tested.

Intellectual Merit The framework is built using agent-based modeling. Scientists, manuscripts and journals are digital agents and a peer review system emerges from their interaction. Multiple experiments can be run: for example, one proof-of-concept application shows how changing the way peer review is performed can dramatically alter the pace at which science is disseminated.

The research develops a full-fledged and open-source simulation software that allows to study alternatives to the current system.

Broader Impacts The proposed work is potentially transformative of the way science is carried out. This framework can be used to identify better and more efficient models for peer review, leading to profound changes on scientific publishing and funding. Also, if this exploratory research is successful, a new computational branch of sociology of science could emerge. Changing the way peer review is performed to favor faster and more efficient solutions could potentially have broad effects on the daily work of scientists, including more time for academic training and research, and less time spent revising and reformatting manuscripts and grant proposals. Favoring unbiased practices could enlarge the representation of minorities in science.

Timeline and Budget

There will be plans for holding meetings and attending conferences. The funding will also be used for fees related to the publication of papers on the subject. Total Budget is $202,400 lasting tentatively from October 15, 2010 to October 15, 2011. Hugh Ching will devote 40% time at $60 per hour for a total of $50,000.00 and George Hsieh will devote 20% for a total of $25,000.00. The salaries of two half-time research assistants/programmers at $30 per hour add a total of $62,400. Additional $65,000 will be used for travel ($20,000), administration cost ($30,000), publications ($5,000), communication fees ($2,000), consulting fees ($5,000), and other expenses ($3,000).

Anticipated Results

This proposed research will develop a valuation software system for the determination of the value of a research project for the purpose of comparing the calculated value to the budget requested. The peer review process will be used only to obtain the inputs, which should be expressed as approximate time-invariant quantities, not the final value, which will be calculated by the valuation software system. The consideration of the expected future return will be extended to infinity in time. The valuation system will provide full disclosure of inputs to infinity in time and, thus, full accountability. The valuation system can also be used to survey the rate of return on investment for research projects with social benefits. This research could transform the current qualitative backward-looking peer review process into a quantitative forward-looking funding review process directly comparable to the budget requested.

Reference:

1. Gerad Debreu, **The Theory of Value: An axiomatic analysis of economic equilibrium**, New Haven and London, Yale University Press 1959

2. Hugh Ching, US Patent *"Quantitative Supply And Demand Model Based On Infinite Spreadsheet"* (Pat. No. 6,078,901) June 2000

3. Hugh Ching, *"Infinite Spreadsheet Valuation System"* Software system at http://www.infinitespreadsheet.com

4. International Valuation Standard Council *"Exposed Draft of Proposed New International Valuation Standasrds"* published June 2010, page 37

5. Pratt, Shannon; Robert F. Reilly, Robert P. Schweihs (2000). **Valuing a Business**. McGraw-Hill Professional. McGraw Hill. ISBN 0071356150