

MICRO-WHAT?

Quick FAQs on Microfinance with Dr. Genna R. Miller

“MARCH MADNESS”

Predicting Victories in NCAA Division I Basketball

THE WOBBLY BRIDGE

Making Sense of Global Financial Crises with Dr. Hyun Song Shin



EQUILIBRIA

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EQUILIBRIA



DUKE ECONOMICS REVIEW

EDITOR'S NOTE

Six months ago, a handful of economics students at Duke University set out to create an economics magazine that would serve as the voice of undergraduate economics students. After countless hours at Perkins Library and numerous idea-packed discussions that took us from ground zero, I am now proud to present to you the inaugural issue of *Equilibria*: The Duke University Economics Review.

It has been a remarkable journey for the six of us involved. We were, as Margaret Heffernan put it, “a fantastic model of collaboration: thinking partners who aren’t echo chambers.” Without their passion and perseverance, none of this would have been possible. *Equilibria* is not meant to be simply displayed in publication racks. It is meant to be read by students from all disciplines. As such, it presents a wide swath of topics, from finance to game theory, all competently discussed with as little technical jargon as possible.

As does every publication, *Equilibria* will evolve over time. I am honored to be at its genesis and excited about its future.



Han W. Lee

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MICRO-WHAT?

GET THE QUICK FAQs ON MICROFINANCE

Genna R. Miller, Ph.D.

PROFESSOR OF ECONOMICS, DUKE UNIVERSITY

Question: What do President Obama, Melinda Gates and Nobel Laureate Muhammad Yunus have in common?

Answer: They all have connections to the field of microfinance. President Obama's mother, Ann Dunham, worked with microfinance programs in Indonesia in the 1980's, including helping to establish the well-known microfinance institution (MFI) Bank Rakyat Indonesia (BRI). Melinda Gates, who will be this year's commencement speaker at Duke, has been active with microfinance programs worldwide through funding support by the Bill & Melinda Gates Foundation. In 2002 the Bill & Melinda Gates Foundation assisted in funding the incorporation of the non-profit organization MIX (Microfinance Information Exchange). MIX Market (at www.mixmarket.org) provides access to financial and social performance indicators for over 2,000 MFI's around the world. Muhammad Yunus, who shared the 2006 Nobel Peace Prize with Grameen

Bank in Bangladesh, is credited with originating and popularizing modern microfinance techniques which have assisted in reducing global poverty.

So with all of these interests in microfinance, what are some of the Frequently Asked Questions (FAQs) about microfinance?

1. What is Microfinance?

Most people think of microfinance in terms of microcredit or small-scale loans. The majority of microfinance operations do indeed consist of microcredit, through the extension of small loans to those in poverty who have little or no assets. These poverty-stricken groups and individuals have historically been marginalized and excluded from traditional and formal banking systems. However, individuals in poverty often find survival strategies through becoming micro-entrepreneurs in small, informal markets in their local areas. For example, many individuals become rickshaw drivers, weave baskets to sell on the

street, cook pastries in their home to sell to local workers, or may operate a small hair salon or other small, self-employed business. However, without access to credit, many of these poorer entrepreneurs cannot increase the scale and profitability of their micro-enterprises, leaving them to continue in a cycle of poverty. Microcredit is one means of reaching these previously "un-bankable" groups in order to provide credit access and to alleviate poverty by helping people to help themselves.

According to the State of the Microcredit Summit Campaign Report 2012 (Maes and Reed 2012), MFIs serve over two million clients globally. In developing areas micro-loans can be as low as US\$10 and often average around US\$100, whereas in the United States, loans under \$35,000 are usually considered microloans.

Although the majority of microfinance consists of microcredit, microfinance actually encompasses many other small-scale banking and

financial services, including micro-savings, micro-insurance, micro-pensions, and micro-consignment.

2. How does microfinance differ from traditional banking?

In a traditional banking system, banks take in deposits via checking and savings accounts and other financial instruments. Banks then lend out a fraction of these deposits and charge interest on the loans. In rationing credit, traditional banks face both moral hazard and adverse selection issues. Historically, traditional banks have dealt with the risks associated with adverse selection and moral hazard through the enforcement of contracts that stipulate the provision of assets as collateral by bank customers, as well as through due diligence through credit scores and other means.

But poverty-stricken groups often lack the financial assets used as collateral within traditional banking practices, and many countries do not have centralized, credit rating systems or appropriate institutions for the enforcement of formal credit contracts.

Yet, despite these market failures within traditional credit markets, informal lending to those in poverty has occurred within many areas and cultures of the world for centuries and continues in current times. These include rotating savings and credit associations (ROSCAs), credit cooperatives and credit unions and “moneylenders.” Moneylenders and other informal credit systems overcome moral hazard and adverse selection issues through locally-based, extensive relationships between family members, relatives, friends, and other village members who are familiar with one another.

These relationships may generate vast amounts of information about each participant, reducing the costs associated with risks based on informational asymmetries. Likewise, the close relations between participants may also reduce costs associated with contract enforcement and the transaction costs associated with monitoring loan customers, as the close relationships may enable these actions to be easily taken.

However, while informal lending may be able to overcome these market failures, such lending techniques also lack the large infusions of capital that are often needed in

*“OVERALL, MFIS TEND
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AND INFORMAL
MONEY LENDERS.”*

many poverty-stricken areas. In addition, local moneylenders often extract exorbitant interest rates from clients, due to the lack of alternative means of accessing credit and/or lack of information about alternatives. Thus, moneylenders often obtain a monopoly over local credit markets.

MFIs, however, bridge the gap between formal banking institutions that possess vast amounts of capital and informal lending practices that use local and relational information to overcome market failures but may be exploitive. In addition, many scholars and activists view MFIs as having a role in bringing about social change. Loans made through MFIs can assist those in poverty by enabling them to get what they need

for survival or by helping them to start or expand their own businesses and thus get out of the cycle of poverty. The basis of Yunus’s Grameen Bank established in Bangladesh in 1983 stems from both of these economic and social causes. Overall, MFIs tend to serve a middle ground between formal banking and informal money lenders, by providing access to capital without some of the requirements and institutions of formal banks.

Without the formal institutions of traditional banks, the group lending or joint liability model is one of the most unique and successful aspects of micro-lending practices. Individuals receive loans based on a joint liability contract with the bank/MFI, in which members of a small group of borrowers must stand jointly as guarantors for the debt of all group members.

The model of joint liability makes use of the rich amount of information that is generated through village, family, and friendship relations through group lending. As such, monitoring and enforcement occur, often through peer pressure as well as peer encouragement. In this way “social capital,” in the form of trust and cooperation, enable collective action to take place with respect to group loans. This mitigates the moral hazard and adverse selection problems and transfers the risks associated with such information asymmetries from the banks to the group borrowers themselves. In addition, many microcredit programs use additional features that are designed to enhance repayment, such as repayment schedules that involve early and frequent payments, as well as public repayment meetings.



3. Why do many MFIs focus on women as clients?

There are several reasons for this trend, and these reasons can be broken up into demand-side and supply-side reasons. Considering the demand for microfinance, it is important to recognize the ways in which gender roles have played out in many areas of the world, such that women are relatively more likely than men to be in poverty. Thus, the “feminization of poverty” may lead women to represent the majority of people in poverty. In addition, if gender discrimination pre-

vents women from having access to credit through formal means (i.e., commercial banks) women may be more likely than men to seek microcredit loans. On the supply-side, MFIs may be more willing to extend microcredit to women than to men, as studies have shown that, amongst microfinance clients, women have a relatively higher repayment rate than do men. Women’s higher repayment rates may be due to several gender-specific aspects. In particular, women are viewed to be more risk-averse than men with their loans and to be more passive in their

relations with group-members, thus complying with group pressures to repay loans. Women are also assumed to be the household managers, responsible for the maintenance of family care, and thus possessing skills that are relevant to loan repayment. In this respect, when women are viewed as primarily responsible for household maintenance, they also become key agents in poverty reduction. Specifically, several studies indicate that, within heterosexual households, when women control funds they are more likely to utilize the funds to improve the welfare

of their family and children, while men often use resources for their own consumption. Thus, women are often targeted by poverty reduction programs to assist in improving children's welfare in terms of food and educational spending. Also, the goal of women's empowerment is often cited as a main reason for targeting women as microfinance recipients. In particular, it has been found that individual income levels and access to funds are large determinants of bargaining power within households. Thus, women's increased income from microfinance loans may serve to equalize income inequalities and power imbalances within heterosexual households. In this way, targeting women as microfinance clients may serve social and economic goals of empowering women.

4. What's new in the field of microfinance?

There are three major, new trends in the field of microfinance:

a. Combining microfinance services with other social services: Many theorists argue that non-financial services are also important for alleviating poverty and that these services function complementarily with financial services to aid in poverty reduction. These non-financial services include healthcare, HIV/AIDS prevention, education, environmental conservation and preservation of cultural diversity. It has been found, for example, that combining HIV/AIDS prevention and healthcare with microfinance, serves to assist in poverty alleviation for clients by considering a more holistic concept of well-being that includes both income and health levels. In addition, reducing the incident of HIV/AIDS also im-

proves repayment rates for MFIs as clients who are healthier and have lower incidents of illness are better able to repay their loans.

b. Commercialization of MFIs: Many MFIs in the past few years have transformed from a non-profit model to a for-profit model, by going public and offering initial public offerings (IPOs). One of the earliest to do this was Compartamos in Mexico in 2007, and more recently, in 2010, SKS Microfinance Ltd (SKS), the largest MFI in India held an IPO.

Most of the MFIs have done this in order to obtain new injections of capital without having to rely on donor support. However, these MFIs have been critiqued as displaying 'mission drift,' as they may be more interested in maximizing wealth for shareholders rather than helping the poorest of the poor.

c. Use of new technologies - Information and communications technologies (ICT) have revolutionized the way in which microfinance occurs. Mobile banking and branchless banking have become more popular within the field, allowing for reduced administrative and overhead costs for MFIs. In addition, several MFIs, such as Grameen Bank, have enabled their borrowers to start micro-businesses using ICT such as mobile banks. In the Grameen case, there has been the establishment of 'telephone-ladies.' According to Grameen's website:

"To-date Grameen bank has provided loans to over 457,953 borrowers to buy mobile phones and offer telecommunication services in nearly half of the villages in Bangladesh where this service never existed before. Telephone-ladies run a very profitable business with these

phones" (Grameen 2012).

Similarly, groups like Kiva use ICT to generate peer-to-peer lending in which individuals can go online and make loans to individuals and groups who are in remote locations.

5. Does microfinance matter to Duke students?

Although the majority of Duke students will never be borrowers/clients of an MFI, they may know someone who is. What's more, Duke students have a huge opportunity to help bring about one of the Millennium Development Goals of the United Nations of eradicating extreme poverty by halving, between 1990 and 2015, the proportion of people whose income is less than \$1 a day. Importantly, Duke has its own microfinance student group, the Duke Microfinance Leadership Initiative (DMLI), started in 2008, so students can easily get involved with microfinance right here on campus. Students can also work through DukeEngage on projects that coordinate with MFIs such as Grameen Bank in Bangladesh. Students can also go work for an MFI as an analyst, loan officer, or in a management position. Duke students have always been great innovators, and as the "M2" generation, current students have unique experiences with media. This gives current students special capacity to use social networking and social media to impact global poverty by using these skills and experiences in the field of microfinance, as well as the opportunity to bring their creativity, motivation and intellectual curiosity to the field of microfinance. Students might develop new tools, methods and financial products to be used to shape the future of microfinance. ♦

PREDICTING “MARCH MADNESS”

CALCULATING DIVISION I MEN’S BASKETBALL UPSETS

Jae Bradley

BOWDOIN COLLEGE

Introduction

I attempt to build a statistical model that predicts NCAA Division I Men’s Basketball Tournament wins and losses, and margin of victory. While “March Madness” is known for its stunning and seemingly-improbable upsets, my model is able to predict the 2012 tournament results with as much as 88% accuracy.

Theory

Let us consider a simple production function for the point differential of a basketball game between team i and team j . This production function is comprised of one factor: the difference between the quality of team i , and the quality of team j . That is,

$$P_{i,j} = f(Q_i - Q_j) \quad (\text{Eq.1.1})$$

where $P_{i,j}$ is the difference between the number of points team i scores and the number of points team j scores, Q_i is the quality of team i , and Q_j is the quality of team j .

Now, in addition to a team’s tal-

ent, there are other factors that may influence whether a team wins or loses and by what margin. These factors include, home court advantage and a team’s momentum. Of these two factors, momentum is the least quantifiable, though later in the paper I attempt to proxy for it. Including these two factors into my simple production function,

$$P_{i,j} = f(Q_i - Q_j, \text{Home}_i - \text{Home}_j, \text{Momentum}_i - \text{Momentum}_j) \quad (\text{Eq.1.2})$$

where Home_i is a dummy variable that takes on a value of 1 if team i has home court advantage¹ and 0 otherwise; Home_j is a dummy variable that takes on a value of 1 if team j has home court advantage and 0 otherwise; Momentum_i is 1 if team i has momentum and 0 otherwise; Momentum_j is 1 if team j has momentum and 0 otherwise. Notice that the difference, $\text{Home}_i - \text{Home}_j$ can be 1 (team i is the only team that has home court advantage), 0 (both teams have home court advantage, or the game is played on a neutral

court), or -1 (team j is the only team that has home court advantage). This logic can also be applied for the difference $\text{Momentum}_i - \text{Momentum}_j$.

Empirics

Applying my simple production function to the NCAA Division I Men’s College Basketball tournament, there are a variety of ways to measure a college basketball team’s quality. These advanced statistical metrics include the Rating Percentage Index (“RPI”)², Ken Pomeroy’s College Basketball Ratings Index³, and Jeff Sagarin’s College Basketball Ratings Index⁴, among others. In my analysis I use the three aforementioned metrics.

I used RPI, Sagarin and Pomeroy data from the past three college basketball seasons, and in particular, I used a team’s RPI, Sagarin and Pomeroy rankings along with the team’s actual RPI and Sagarin value. From the Pomeroy metric, I used a team’s adjusted winning percentage, its adjusted net margin of victory

(calculated by subtracting its adjusted defense value from its adjusted offense value), and its “luck,” a measure given by Pomeroy.

In all cases, the “outcome” of my production function is the point differential between a high seed team and a low seed team. This creates a systematized way of measuring why a higher seeded team wins or loses a game. I use the outcomes of the past three NCAA Division I Men’s College Basketball tournaments.

In addition, I created three dummy variables, *Conference Championship* (1 if a team won its conference tournament⁵, and 0 otherwise), *Previous Tournament* (1 if a team made the NCAA tournament the previous year, and 0 otherwise), and *Home Court* (1 if a team is from a state that is, or neighbors, the state where the game is played, and 0 otherwise). *Conference Championship* is supposed to proxy for a “hot” team, that is, a team on a winning streak (since winning a conference tournament usually means winning 3 or 4 games in a row) and hopefully one with lots of momentum. *Previous Tournament* is supposed to proxy for experience. The logic is that a team that has been to the tournament before will have more experience dealing with the increased stress of the NCAA tournament. A better variable would be the ratio of upperclassmen to underclassmen, but this information was not readily available. Finally, *Home Court* proxies for any “home-field advantage” such as having more fans at the game, or not having to travel long distances (or multiple time zones).

Two potentially important variables that I did not have readily available data for are each head coach’s salary (a proxy for coaching abilities), and how much each insti-

tution spends on its basketball program (a measurement of resources available to a team).

Finally, I distinguished between the first round of the tournament⁶ and the following rounds of the tournament. Winning or losing in the first round versus winning or losing in the Final Four are two different results. Similarly, the impact of momentum, or the value of having previous experience dealing with the heightened stress of a deep tournament run has a significantly different effect in the national championship game than in the first round of the tournament.



Following from this distinction, I created three additional dummy variables, *Previous Upset*, *Blowout* and *Close*, to explain games that were not played in the first round of the tournament. These three variables are intended to help proxy for a team’s “momentum.”⁷ *Previous Upset* (1 if a team beat a higher-seeded team in the previous round, and 0 otherwise), *Blowout* (1 if a team beat its previous opponent by 20 or more points, and 0 otherwise), and *Close* (1 if a team beat its previous opponent by 3 or less points⁸, and 0 oth-

erwise) proxy for any “momentum” effects that these three situations might provide. Thus, my resulting empirical models are,

$$\begin{aligned} \text{Points}_{\text{First Round}, h, l} &= \beta_1 \text{RPI Rank} + \beta_2 \text{Sagarin Rank} + \\ &\beta_3 \text{Pomeroy Rank} + \beta_4 \text{Winning Per-} \\ &\text{centage} + \beta_5 \text{Net Margin of Victory} + \\ &\beta_6 \text{Luck} + \beta_7 \text{Conference} + \beta_8 \text{Previ-} \\ &\text{ous} + \beta_9 \text{Home} \end{aligned} \quad (\text{Eq.2.3})$$

$$\begin{aligned} \text{Points}_{\text{Other Rounds}, h, l} &= \beta_1 \text{RPI Rank} + \beta_2 \text{Sagarin Rank} + \\ &\beta_3 \text{Pomeroy Rank} + \beta_4 \text{Winning Per-} \\ &\text{centage} + \beta_5 \text{Net Margin of Victory} + \\ &\beta_6 \text{Luck} + \beta_7 \text{Conference} + \beta_8 \text{Previous} \\ &+ \beta_9 \text{Home} + \beta_{10} \text{Previous Upset} + \\ &\beta_{11} \text{Previous Blowout} + \beta_{12} \text{Previous} \\ &\text{Close} \end{aligned} \quad (\text{Eq.2.4})$$

where each variable (including the dependent variable) is the difference between the variable value of the higher-seeded team and the variable value of the lower-seeded team.⁹

To test these models, I used data from the 2009-2011 NCAA Division I Men’s Basketball tournaments to see how they would predict the 2012 NCAA Division I Men’s Basketball tournament outcomes.

The true test of the various models is seeing how well they predict tournament results.¹⁰ The probit models predict the correct victor with 88% accuracy for any first-round games and 81% accuracy for any other-round game while the OLS model predicts first-round and other-round games with roughly 80% accuracy. In comparison, Nate Silver’s first-round and second-round predictions from last year were accurate 75% of the time, but Silver was only accurate 33% of the time in later rounds. While my models’ accuracy may seem impressive, comparing their predictions against a

few “naïve” models illuminates how simpler models can achieve comparable results. For example, if somebody picked the outcome of a first-round game based solely on which team had the highest Sagarin value, they would be right 78% of the time. If they applied this methodology to other-round games they would be right 81% of the time. While my model produced relatively better results for first-round games (almost 10% more accuracy) my probit model had the same accuracy as the simple Sagarin model and my OLS model was only 3% more accurate. This suggests that predicting outcomes of games can be done within a reasonable degree of accuracy by simply looking at which team has a higher Sagarin value, or another statistical measure of a team’s quality.

The point differential accuracy of my OLS models (equation 2.3 and equation 2.4) was somewhat accurate. The average difference between the actual and predicted point differentials was around seven points for first-round games, and five points for other-round games. This means that the models were off by three to four possessions, an acceptable margin for error considering games last for forty minutes. However, games can be decided by as little as one point, so the results are not entirely desirable. (See table in online Appendix).

Conclusion

While my model was relatively accurate, there are always improvements that can be made. As I mentioned in my paper, obtaining the head coach’s salary and how much each institution invests in its basketball program would be useful data. Also, finding a better measure for “momentum” would be ideal. In

addition, some variables are rather subjective, such as “home-court advantage.”

My only metrics for measuring team quality are the RPI, Sagarin’s Index and Pomeroy’s Index. In no way do these metrics plumb the depths of “intangible” factors such as team chemistry. Yet, my model is between 80-88% accurate at predicting the outcomes of these basketball games. This seems to suggest the NCAA Tournament Seeding Committee does a relatively decent job of ranking its teams based on their quantifiable attributes, but they do not do a perfect job. If the Tournament Seeding Committee did a perfect job of seeding its teams based on their relative strength, then upsets would happen with much less regularity than they currently do. What this implies is that there are inefficiencies within the tournament seeding system, and these inefficiencies can be exploited. ♦

Endnotes

1. This has application in terms of the NCAA Men’s Division I Basketball Tournament where two teams can play at a site that is geographically close to both schools.
2. web1.ncaa.org/web_files/NCAANewsArchive/1981/19810215.pdf
3. <http://www.kenpom.com>.
4. <http://www.usatoday30.usatoday.com/sports/sagarin.htm>.
5. The Ivy League does not have a conference tournament. Instead, the regular season champion is given an automatic bid.
6. In recent years, “play-in” games have been considered to be the first round. However, in my analysis I consider the first round to be the round that includes all 64 seeded (eventually) teams.
7. To the best of my knowledge,

there is no economic literature that specifies how to model a team’s “momentum”.

8. Any game that went to overtime was automatically considered a “close” game even if the final score was decided by more than three points.

9. For all the “Rank” variables I took the opposite of the difference for interpretation purposes as many times the higher-ranked team had lower “Rank” values and thus, the difference was usually negative. For example, usually the best team in the country has an RPI Rank of 1 while an average team might have an RPI Rank of 150. Their difference is -149, thus I simply took the opposite value for all “Rank” variables.

10. For empirical results, see online appendix: <http://www.fivethirtyeight.blogs.nytimes.com/2012/03/13/five-thirtyeight-picks-the-n-c-a-a-bracket>.

11. While I do try and account for “momentum”, it is in a very crude way.

OIL ECONOMY DIVERSIFICATION

IN THE GULF COOPERATION COUNCIL

Jacob Ledbetter

UNIVERSITY OF ALABAMA AT BIRMINGHAM

Since the times of the Silk Road, the Gulf region has been a center for international trade, trading local goods for wealth and facilitating exchanges among other peoples. Since the oil discoveries in the 1930s and 1940s, the Gulf Cooperation Council (GCC) area has built a portfolio of wealth, largely contingent on the continued influx of petroleum revenues. As the GCC countries look ahead, forecasting the day when oil reserves dry up, current governments must address the concern that oil revenues will not always be filling the royal coffers. Though the GCC countries have been able to rely on oil exports to fund modernization initiatives since the 1960s, governments must now find ways to diversify their economies in order to sustain current standards of living.

Oil was first discovered in the Gulf in the 1930s and 1940s, during a time when the native population didn't exceed 4 million and the economy was a simple market based on the trade of pearls, dates, fish and slaves (Sultan et al. 2011). It took

additional 20 years before the first petroleum exports began; soon after that, the oil revenue began to pour into the region, causing the ruling governments to gain incredible wealth. Today, countries in the Middle East/North Africa region have a combined total GDP of roughly \$2.0 trillion; among the oil exporters, oil and gas account for nearly 75% of budget revenues (Institute of International Finance 2012). The region's reliance on oil and gas for economic growth leaves the member nations particularly susceptible to fluctuations in the energy market. To combat both the threat of energy market fluctuations as well as the potential for a future non-oil-based economy, Dubai first initiated reinvestment campaigns starting in the 1990s in an attempt to reinvest its petrodollars to diversify its economy (Sultan et al. 2011). The rulers of the surrounding states saw the overnight success of Dubai, largely attributed to its impressive branding campaign, and followed suit in the pursuit of more diversified econo-

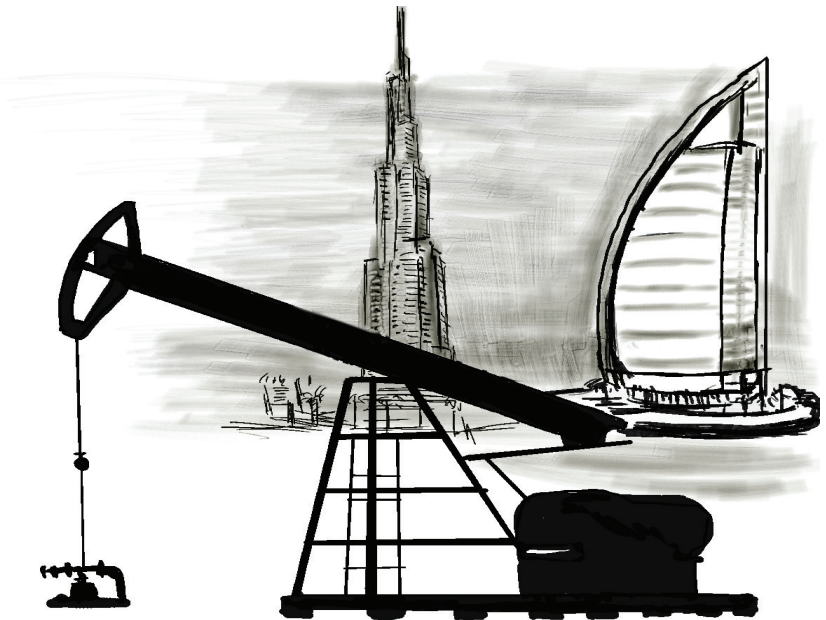
mies.

As the reinvestment and diversification campaigns continue among the Gulf states, common trends in the preferred industries of investment have emerged as these nations strive to develop knowledge economies. According to a 1999 study conducted by the World Bank, a country's knowledge economy index directly correlates to that country's GDP (Aubert and Reiffers 2003). To that extent, GCC nations have invested a substantial amount of money and resources into developing knowledge economies. Saudi Arabia, the UAE and Qatar are leading the pack in developing economic cities focused on research and development. Dubai's focus on attracting international business through its free zones has shown great success, with 95% of the emirate's GDP coming from non-oil sources in 2006 (Sultan et al. 2011). In a slightly different approach, Saudi Arabia has built six economic villages across the kingdom, in an attempt to spread the reinvestment dollars to all areas

of the country (Sultan et al. 2011).

The Qatar Foundation is another good example of this petrodollar reinvestment strategy. Founded in 1995, the mission of the Foundation is to determine “how the nation will use its vast revenues from hydrocarbon resources to transform itself into a modern knowledge-based economy” (Qatar Foundation 2012). Under the leadership of Her Highness Sheikha Moza bint Nasser, the organization has successfully launched numerous science and research institutes, most notably the Qatar Science and Technology Park. The Foundation also aims to prepare native Qataris for positions of leadership in the new knowledge economy through training programs in the premier King Abdullah University of Science and Technology in addition to numerous other schools and leadership programs. While developing knowledge economies, Gulf countries are also investing their petrodollars in tourism. Kuwait, Oman, Bahrain and the United Arab Emirates have undertaken massive building projects in order to attract upper-class tourism to their countries (Sultan et al. 2011), and these investments appear to be successful in drawing in tourist dollars. According to the World Travel and Tourism Council, the total GDP contribution from tourism in the GCC countries is expected to reach \$44 billion by year’s end (Bilateral Chamber 2012). The current trends in economic diversification in the Gulf are favoring tourism and knowledge-based industries such as research and development.

In addition to sector diversification, Gulf leaders, most notably Sheikhs Khalifa and Mohammad, are looking to new ways to generate electricity through alternative ener-



gy programs while increasing their global recognition. This diversified energy portfolio, funded by public reinvestment campaigns, aims to meet the growing energy demands of the nation in order to sustain increases in standards of living. The UAE and the United States signed an agreement, partnering to create a joint nuclear program by 2017 (Blanchard and Kerr 2009). The South Korea-built plant will help bridge the gap between current production and future demand; the latter is expected to increase 9% annually, leading to more than a twofold increase in energy demand by 2020. In addition to nuclear power, the Emirati government is emerging as a global leader in renewable energy with Masdar and the International Renewable Energy Agency (IRENA) in Abu Dhabi. In an interview at the IRENA headquarters, a top official explained that the government of Abu Dhabi made the most attractive bid for the head office, signaling a sincere wish to move away from an oil-based economy and in the direction of renewable energy and a modern, diversified economy (Mac-

Donald 2012). Sheikh Mohammed also announced the creation of a new solar park, to be operational by 2013 and fully realized by 2030. Both the goodwill gesture of IRENA and the physical manifestations of these new energy initiatives underscore the broader desire of Emirati leaders to show the nation’s potential to move away from oil dependence.

The governments of each of the GCC nations have taken bold steps to diversify their economies in an attempt to distance themselves from dependence on oil export revenues. Though each country has different approaches to the issue, commonalities such as developing knowledge-based economies, preparing native workforces to be industry leaders, and constructing world-class tourist attractions have emerged. While it is yet to be seen how well leaders have prepared their economies for an expected future decrease in oil export revenues, the initiatives toward economic diversification and oil independence are progressive steps toward a vastly different future. ♦

THE MOTIVATIONS BEHIND EXPLOITATION AND ENVY IN PRISONER'S DILEMMAS

Shelby Sugierski

UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL

Can cooperation emerge without a central authority in iterated prisoner's dilemma games? Robert Axelrod's 1984 book *The Evolution of Cooperation* concluded from a computer tournament that the simple tit-for-tat strategy consistently yielded a high degree of cooperation even without central authority. (Tit-for-tat literally means "equivalent retaliation." An agent using this strategy first cooperates and then replicates the opponent's previous action) Tit-for-tat found success through its characteristics of niceness, retaliation, forgiveness and clarity. However, this computer tournament was not meant to normatively model real-world interactions, but rather positively suggest the prisoner's dilemma strategy with the greatest chance for cooperation; clearly, not everyone plays tit-for-tat in their everyday interactions. In fact, there frequently exist both "exploitative" —defined as actively seeking to take advantage of others—and "envious" —seeking to minimize the gains of others, even

when this will not result in a gain for oneself—strategies in real-world prisoner's dilemma situations that do not have the cooperative characteristics of tit-for-tat. Why, then, do people employ these "mean" strategies?

I will examine the two distinct "mean" strategies of exploitation and envy and find that cooperation can emerge with an exploitative player because he will only exploit when he thinks he can get away with it; however, I will find that cooperation cannot emerge with an envious player because he is propelled by various motivations to consistently avoid cooperation.

First, it is important to understand the prisoner's dilemma to see why cooperation is difficult to achieve. The prisoner's dilemma involves two players, A and B, who can choose either to cooperate or defect and whose payoffs depend both on what they do and what the other player does. In the situation that Player A defects and Player B cooperates, A will have the best payoff

possible and B will have the worst. If both players defect, they will each get the second worst payoff, and if both players cooperate, they will get the second best. So, payoffs for A from best to worst would be to defect when B cooperates, cooperate when B cooperates, defect when B defects, and cooperate when B defects. The dilemma comes into play when A realizes that no matter what B does, it is best for A to defect. If B cooperates, A should defect in order to gain the highest possible payoff in the game; If B defects, A should also defect to avoid the worst payoff. If both players realize this and defect, they miss out on the better payoff of mutual cooperation.

Axelrod's computer tournament sought to find whether cooperation could emerge in an iterated prisoner's dilemma, thereby avoiding the poor payoffs for consistent mutual defection. Although tit-for-tat never scored higher than any other strategy against which it was pitted from a pure payoffs standpoint, this tournament gave "points" for the

avoidance of the mutual defection pitfall rather than for the overall payoff. One premise of this tournament was that in the real world, there are few to no situations in which a player can gain the best outcome by defecting when the other cooperates over and over in an iterated game, because the other player would not suffer the dismal payoff time and time again without changing their strategy or refusing to participate in the game anymore. Pairing strategies in a round-robin tournament, Axelrod found that the program tit-for-tat had the most success in encouraging cooperation. Tit-for-tat, firstly, was “nice”: it was never the first to defect and would cooperate until the end of the iterated game if the other player did so as well (Axelrod 2006). Secondly, it was “retaliatory”: tit-for-tat would defect on the next turn if the other player defected, proving it was not susceptible to being taken advantage of. It was “forgiving”: it would return to cooperation on the next turn after defecting provided the other player returned to cooperation as well. Finally, it was “clear”: unlike some other programs that used complicated algorithms, tit-for-tat was simple and intuitive and therefore held no secrets that would create doubt or complexity for either player.

However, many real-world strategies are not so “nice,” which is one of the most important reasons that tit-for-tat was the best at encouraging cooperation. Take the example of two countries, China and the United States, attempting to curb carbon emissions. They make a non-binding, yet strategically important, agreement to place a moratorium on certain activities that are known for needlessly polluting the

planet. If each follows through with cutting emissions, each will suffer some costs but see a greater benefit in a healthier planet; if each ignores the agreement, they will maintain current levels of production and consumption but the environment of the planet will suffer a comparatively greater toll. However, if, say, the United States ignores the moratorium while China cuts emissions, China is the “sucker” and the U.S. gets the best payoff of a cleaner earth without losing money. In such

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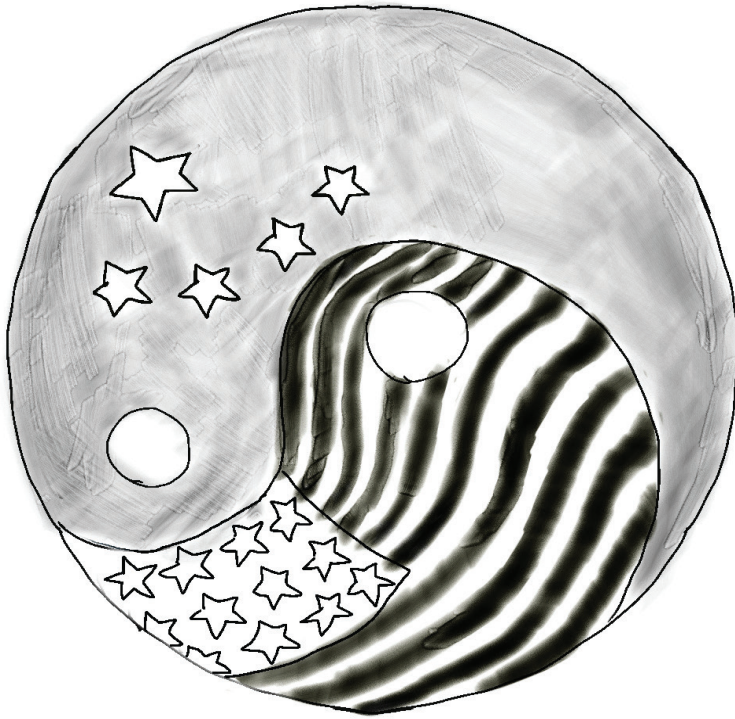
a case, it makes sense for the U.S. to try to be exploitative purely from a payoff standpoint if they think they will not be punished. If China and the U.S. begin by devoting resources to cutting carbon emissions in the budget each year, the exploitative U.S. may believe that it can “get away with” ignoring the agreement in the budget for a year, in which case they would get the greatest payoff that year.

If China is not retaliatory at this first defection by the U.S., the defection has helped the U.S. to successfully exploit the other player and gain a higher payoff while still usually playing cooperatively. Even if China never falls for the exploitative strategy’s trick again, the U.S. will

forevermore have a higher cumulative payoff, assuming China does not exploit them. So, in general, players may seek to be exploitative if they judge the other player to be fairly forgiving without necessarily being retaliatory; this dynamic may occur when one player is more powerful than the other. In these situations, cooperation can emerge because these players are assumedly rational, i.e. act for their own gain and only defect as often as they think they can get away with it without being punished. Rational yet exploitative players could still seek cooperation in an iterated game because they recognize that at a certain point, what began as exploitative behavior could eventually lead to a cycle of mutual defection if the exploitative strategy were played too often. Even if the exploitative player knew that tit-for-tat was the strategy with the greatest cooperation in iterated games, he may still have a personal advantage if the other player is playing a different strategy that can be exploited.

More confounding, perhaps, is the envious player: she will seek to make sure the other player gets an unsatisfactory payoff, even if it incurs costs for herself. This player appears irrational; she will always defect not because she knows it is the best thing for her to do, but because she knows that no matter what the other player does, the other player will not get either of the two best payoffs. In the example situation, the U.S. may be spiteful towards China and defect each time because they want to see China suffer a cutback in resources or an infected environment, no matter the environmental cost to the U.S.

There are a few reasons that an envious player may act the way that



they do in an iterated game where mutual cooperation would pay. First, it may be that this player's payoffs are higher or their costs neutralized when the other player suffers. So, although the non-envious player—China, in this case—is playing a prisoner's dilemma, the envious player has fundamentally changed the game into a non-symmetrical matrix. Now, the U.S.'s payoff in any outcome in which China suffers is higher. In fact, the envious player's payoff for mutual defection may be even greater than that for mutual cooperation, solely because the other player scores lower in a mutual defection. China still proceeds with their play as if both players were playing an iterated prisoner's dilemma game, which might include China seeking mutual cooperation; that is why the moratorium was agreed upon in the first place, after all. China doesn't know that the game has

changed.

The relevancy of this explanation may be disputed, because if the game is no longer a prisoner's dilemma for both players, then it should not be examined as a prisoner's dilemma. In that case, there is the chance that the envious player's preference for seeing others suffer rather acts as an external force on the envious player's payoffs, like the situation that Axelrod describes in which gang members are more likely to cooperate with each other in the classic prisoner's dilemma if their gang highly encourages them to execute the no-snitching rule at all times. In this situation, the payoffs for each individual game are not drastically changed; "it is only necessary to make the long-term incentive for mutual cooperation greater than the short-term incentive for defection." The payoffs of the prisoner's dilemma still stand,

but unlike the example of the gang members where cooperation is encouraged, the United States would be influenced by its preference for seeing China suffer to always defect. Alternatively, an "envious" player who seemingly constantly defects out of malice may actually just be misjudging the other player's willingness to cooperate. If the U.S. thought China would never cut carbon emissions even though they had agreed to, then the U.S. may always defect to get the punishment payoff for mutual defection. This payoff would be better than the only other choice if China always defects—the sucker's payoff. So, no matter the reason, whether because the game is changed, preferences are exerting force on long-term payoffs, or the "envious" player is simply misjudging the other player's willingness to cooperate, cooperation cannot emerge if a player is inclined towards envy. The envious player knows that the only way they can minimize the other player's payoff is to always defect.

Exploitative and envious players are of two different breeds. Exploitative players are simply seeking to take advantage of others for their own gain, but may prefer not to hurt others if it would give them no payoff or a low payoff. Envious players, however, do not subscribe to Axelrod's idea that cooperation in an iterated prisoner's dilemma is favorable, because they would rather see the other player suffer. Cooperation without a central authority may emerge in the former case, although cooperation will not be absolute; cooperation cannot emerge in the latter case due to the envious player's commitment to defection. ♦

PHILOSOPHIES ON ECONOMIC DOWNTURNS

Daniel Lim

DUKE UNIVERSITY

The phenomenon of economic downturn is perhaps best exemplified in the Great Depression of the 1930s. The key features of a depression include high unemployment, low national income, a lack of aggregate demand and secular stagnation. Although depression is defined by the outbreak of these features, The Times cites through Hobsbaum that unemployment in particular ‘has been the most widespread, most insidious and the most corroding malady of our generation: it is the specific social disease of Western civilization in our time.’ Therefore, this particular facet of depression has been the central topic of discussion for many economists. Keynes believed that economic problems could be solved primarily through state intervention, specifically by fiscal and monetary policies, whilst Schumpeter strongly advocated ‘creative destruction,’ a theory that backed entrepreneurs and their investment prospects, referring to them as agents of history – the origins of social and econom-

ic development. Although Hayek’s writing does not seem to fit directly into crossfire of economic mechanisms that the others create, we can consider how he delivers a critique of centrally planned economies and creates a direct response to the State-dominated Keynesian

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interventionist economics. Finally, Sweezy assembles a conglomeration of arguments, primarily those of Hansen and Schumpeter, and examines the history of economic stagnation.

Hansen and Keynes

During the Great Depression, Alvin Hansen suggested in his article, *The Theory of Technological Progress and the Dislocation of Employment*, that technological advancement, particularly laborsaving techniques, was the primary cause of depression. Instead of employing manpower, producers instead turn to machines and other forms of technology as means of production, decreasing the amount of jobs available in the economy, and hence increasing unemployment (Hansen 1932).

John Maynard Keynes suggested and evaluated various solutions that would counteract economic depression, including the reduction of wages, the spread of workers to other industries or the expansion of the current production scale. The first two solutions seem impractical as the former would lower purchasing power and further decrease demand, whilst the latter would cause a skill-occupation mismatch (Keynes 1933). Accordingly, the

only viable option appears to be that of expanding the current industry that is plagued by unemployment.

Although this option could lead to overproduction, Keynes indicates that lowering the product's price, restricting output or increasing wages can address this issue. But these options also have flaws. Firstly, lowering the price would be counterintuitive considering producers' profit motives. Secondly, lowering output would yet again cause a surplus supply of labor, giving rise to inefficient use of labor and causing even more unemployment. In turn, the government would have to deal with the social consequences of inactive labor by increasing expenditure on policies such as social welfare. This would plunge the government into greater national debt. Thirdly, an increase in wages would not necessarily increase aggregate demand, as it could cause consumers to save the extra disposable income they have. Moreover, wage increases could result in inflationary pressure, meaning that the aforementioned wage increase would not reflect a rise in the price of labor since costs of living also increase.

Keynes believes that these problems (of stimulating the industry) are primarily caused by either the fact that people do not have profit motives, or because there is a lack of liquid capital and hence a lack of productive investment. The latter cause explains the emergence of borrowing, lending, interest rates and intentional government budget deficits. According to Keynes, expansionary fiscal and monetary policy were the keys to economic recovery in a time of depression. In other words, increasing consumer access to liquid capital in the form of tax cuts (fiscal) and a lowered

interest rate (monetary), as well as stimulating the economy through government expenditure (fiscal), should theoretically stimulate positive economic growth.

Schumpeter

In contrast to Keynes, who believes that state-led fiscal and monetary policies moves society forward, Schumpeter accredits the source of positive economic and societal development to creative entrepreneurs, portraying in his theory of 'creative destruction,' in which new commodities, technology, sources of supply and organizational methods are the key 'agents of history' that will revolutionize the existing world (Schumpeter 1947).

"SCHUMPETER ACCREDITS THE SOURCE OF POSITIVE ECONOMIC AND SOCIETAL DEVELOPMENT TO CREATIVE ENTREPRENEURS..."

Considering this, it is easy to understand why Schumpeter opposes anti-monopolistic views. Monopoly profits can easily be re-invested to discover more 'agents of history'. However, it can be argued that a monopoly would unnecessarily restrict output and increase prices, hence negatively impacting the living standards of consumers (due to increase in living costs). Despite this, Schumpeter has suggested the existence of 'wasteful competition,' in which firms sink their capital for the sole purpose of undercutting their competitors; this

valuable liquid capital could have, in a non-competitive industry, be invested towards more worthwhile causes.

In response to Hansen's argument, Schumpeter discusses the five key contributors to the 'theory of vanishing investment opportunity'. Hansen suggested the opportunity for capital investment is slowly diminishing due to: market saturation, the falling rate of population growth, the end of geographical expansion, investment reduction in new technologies and the tendency of investment opportunities to stay in the public sector (Schumpeter 2004). Although he does not believe they 'indicate a break in the trend of capitalist evolution,' Schumpeter still examines these factors, as they were one of many explanations for economic depression at the time.

Hayek

In *Road to Serfdom*, Hayek criticizes centrally planned economies. Though not in direct response to Keynesian economics, his work opposes government interventionist policies. Hayek believes that in the formulation and application of government 'plans' is infinitely more than the aggregate power that the members of community possess (Hayek 1944). This is why he believes centralized power is highly formidable. Despite Keynesian belief that centralized intervention would stimulate exponentially higher economic growth than a purely market based system, Hayek asserts that this claim is being progressively abandoned and furthers that 'planning leads to dictatorship. It must be noted, though, that Keynesian thought does not exactly coincide with the centrally planned system that Hayek is critiquing. The idea



that Keynesian interventionist policies can help save an economy from collapse is perhaps the most distinct notion that comes close to the central economic plans Hayek refers to.

Hayek seems to advocate a market economy. In comparison to a decentralized system with 'automatic coordination through the price system,' he states that centrally planned systems are 'incredibly clumsy, primitive and limited in scope.' He furthers that today's economy would never have achieved the degree of differentiation and flexibility of today had we had to rely on central planning for industrial growth. As a counterargument, though, one must consider the Keynesian role in aiding the Great Depression of the

1930s. If the economy had been left to the will of the market, as Hayek condones, we may never have recovered from that slump. The revolutionary interventionist policies of Keynes did have a role in recovering the economy during the Depression.

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Sweezy

Paul Sweezy firstly suggests that the fundamental economic problem was not cyclical booms and busts, but secular stagnation, which includes lowered income, mass unemployment and chronic depression. He believes that Schumpeter's labeling of Hansen's argument as the 'theory of vanishing investment opportunities' is an apt characterization and accordingly examines the interactions of the economists' theories.

Many of Hansen's critics, including Schumpeter, saw little merit in this theory. Firstly, they believed that since the end of major geographical expansion came in the late nineteenth century, it did not

make sense why such adverse economic effects occurred three or four decades later (Sweezy 2004). Secondly, population growth does not correlate with investment stimulation. A higher population could just as well cause a higher unemployment rate, an increase in demand for housing and decreasing living standards. Thirdly, critics declared the effect of changes in technological innovation were unproved and could not be proved. These counter-arguments refuted Hansen's theory and prompted Schumpeter to ask a different question: why did the upswing in 1933 stop so far short of a normal cycle of prosperity, that is, with full employment, rising prices and tight credit?

Schumpeter suggested three different types of economic cycles. These cycles were: 'Kitchins,' which were short, basically inventory cycles; 'Juglars,' what most economists consider the usual business cycle; and 'Kondratieffs,' a theoretical cycle that lasts for fifty years or so. Schumpeter described the short upswing in the 1930s as 'the disappointing Juglar.' He blamed the 'anti-business climate' of the period or, as Sweezy calls it, the 'New Deal theory of stagnation.' Schumpeter furthers that this climate can be attributed to the personal act of the legislation administration. Schumpeter believes that such an 'anti-business spirit' had a 'dampening, repressive effect on entrepreneurs' confidence and optimism, blighting their hopes for the future and inhibiting their investment activities in the present.' We can recall that Schumpeter was an avid supporter of the theory of creative destruction and believed that entrepreneurs are key agents to positive economic development. His beliefs are hence

not in the least surprising. Despite that secular stagnation seemed to drop out of sight with the onset of the Second World War. By the 1970s, however, the economic issues returned with a twist reflected in its new name, 'stagflation.'

Stagflation is a concept that would have been unimaginable to Keynes, who had always believed that a stagnant economy and a high inflation could never happen simultaneously. Keynes was convinced that economic downturn occurred because of a lack of access to liquid financial capital. When stagflation occurs, there is a stagnant economy (and hence 'downturn'), but high inflation indicates ready access to financial capital (i.e. low interest rates, tax cuts). Hence, stagflation seems to contradict a portion of Keynesian theory.

"STAGFLATION IS A CONCEPT THAT WOULD HAVE BEEN UNIMAGINABLE TO KEYNES, WHO HAD ALWAYS BELIEVED THAT A STAGNANT ECONOMY AND A HIGH INFLATION COULD NEVER HAPPEN SIMULTANEOUSLY."

In comparing the modern economy that Sweezy critiques and the 1930s state that Hansen experienced, there are but a few minor economic differences. The economic structure is basically the same as it was in the early 20th century. Moreover, the saving potential is still enormous, may be even greater than before. Corporate concentration has increased and income distribution remains unequal. Changes in the tax structure have favored the corporations and the rich more so

than ever. Ultimately, the problem today still remains the same as that which Hansen discovered: a strong propensity to save and a weak propensity to invest.

Sweezy attributed existing stagnation to the nature of investment itself. He wrote 'it not only responds to a demand, it satisfies the demand,' pointing out the eventual problem of overproduction that occurs with various available investment opportunities. In time, it seems, investment opportunities return to a stagnant equilibrium.

Conclusion

The various responses that academics have to Keynesian perspectives give us an insight into the complexity of economic thought and also help us to understand the circumstances surrounding the Great Depression of the 1930s. Evidently, Keynesian economics has been harshly debated and consequently, its supporters have thinned in numbers since Keynesian inception. Nevertheless, following the recent Financial Crisis in 2008, faith in the school of thought has recovered to an extent, but critics of Keynesianism still remain and continue to highlight the flaws of the philosophy. ♦

WHAT'S SPECIAL ABOUT MACRO FINANCIAL RISK?

THE WOBBLY BRIDGE

Hyun Song Shin, Ph.D.

HUGHES-ROGERS PROFESSOR OF ECONOMICS, PRINCETON UNIVERSITY

Occasionally, financial markets experience episodes of disruption of such an extreme kind that they appear to stop functioning. Such episodes are marked by rapid price changes and financial distress on the part of many firms and households. The global financial crisis that erupted in 2007 has served as a live laboratory for many such distress episodes. Public announcements of important macroeconomic statistics, such as the U.S. employment report or GDP growth estimates, are sometimes marked by large, discrete price changes at the time of announcement, but those price changes are arguably the signs of a smoothly functioning market that is able to incorporate new information quickly. The market typically finds composure quite quickly after such discrete price changes. In contrast, there is something more to episodes of market turbulence of a more systemic kind; they have the feature that they seem to gather momentum from the endogenous responses of the market participants them-

selves. Rather like a tropical storm, they appear to gather more energy as they develop. Understanding the nature of such episodes is the first step toward dealing with them more effectively, and heading them off before they materialize. This essay is about what we know and don't know about such episodes of macrofinancial crises.

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Before we deal with the financial system, it is instructive to study the potency of synchronized feedback from an example from outside economics or finance. The saga of the Millennium Bridge in London is a revealing lesson on market failure from outside economics. Many readers will be familiar with the Millennium Bridge. As the name

suggests, the bridge was part of the Millennium celebrations in the year 2000. It was the first new crossing over the Thames for over a hundred years, constructed at a cost of £18 million. The sleek 325 meter-long structure used an innovative “lateral suspension” design, built without the tall supporting columns that are more familiar with other suspension bridges. The vision was of a “blade of light” across the river, connecting St. Paul’s with the new Tate Modern gallery. The bridge was opened by the Queen on a sunny day in June, and the press was there in force. Many thousands of people turned up after the tape was cut and crowded on to the bridge to savor the occasion. However, within moments of the bridge’s opening, it began to shake violently. The shaking was so severe that many pedestrians clung on to the side-rails. YouTube has a video of the events on the opening day. The bridge was closed shortly after the opening and was to remain closed for 18 months.

When engineers used shaking

machines to send vibrations through the bridge, they found that horizontal shaking at 1 hertz (that is, at one cycle per second) set off the wobble seen on the opening day. Now, this was an important clue, since normal walking pace is around two strides per second, which means that we're on our left foot every second and on our right foot every second. Walking produces a vertical force (depending on our body mass) of around 750 Newtons or 165 pounds at 2 hertz. However, there is also a small sideways force caused by the sway of our body mass due to the fact that our legs are slightly apart. Anyone who has been on a rope bridge should be well aware of the existence of this sideways force. This force (around 25 Newtons or 5.5 pounds) is directed to the left when we are on our left foot and to the right when we are on our right foot. This force occurs at half the frequency (or at 1 hertz). This was the frequency that was causing the problems.

But why should this be a problem? We know that soldiers should break step before crossing a bridge. For thousands of pedestrians walking at random, one person's sway to the left should be cancelled out by another's sway to the right. If anything, the principle of diversification suggests that having lots of people on the bridge is the best way of cancelling out the sideways forces on the bridge.

Or, to put it another way, what is the probability that a thousand people walking at random will end up walking exactly in step and remain in lock-step thereafter? It is tempting to say "close to zero". After all, if each person's step is an independent event, then the probability of everyone walking in step would be the

product of many small numbers - giving us a probability close to zero.

However, we have to take into account the way that people react to their environment. Pedestrians on the bridge react to how the bridge is moving. When the bridge moves from under your feet, it is a natural reaction to adjust your stance to regain balance. But here is the catch. When the bridge moves, everyone adjusts his or her stance at the same time. This synchronized movement pushes the bridge that the people are standing on and makes the bridge move even more. This, in

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turn, makes the pedestrians adjust their stance more drastically and so on. In other words, the wobble of the bridge feeds on itself. When the bridge wobbles, everyone adjusts their stance, which makes the wobble even worse. So, the wobble will continue and get stronger even though the initial shock (say, a small gust of wind) has long passed. Arup, the bridge's engineers found that the critical threshold for the number of pedestrians that started the wobble was 156. Up to that number, the movement increased only slightly as more people came on the bridge. However, with ten more people, the

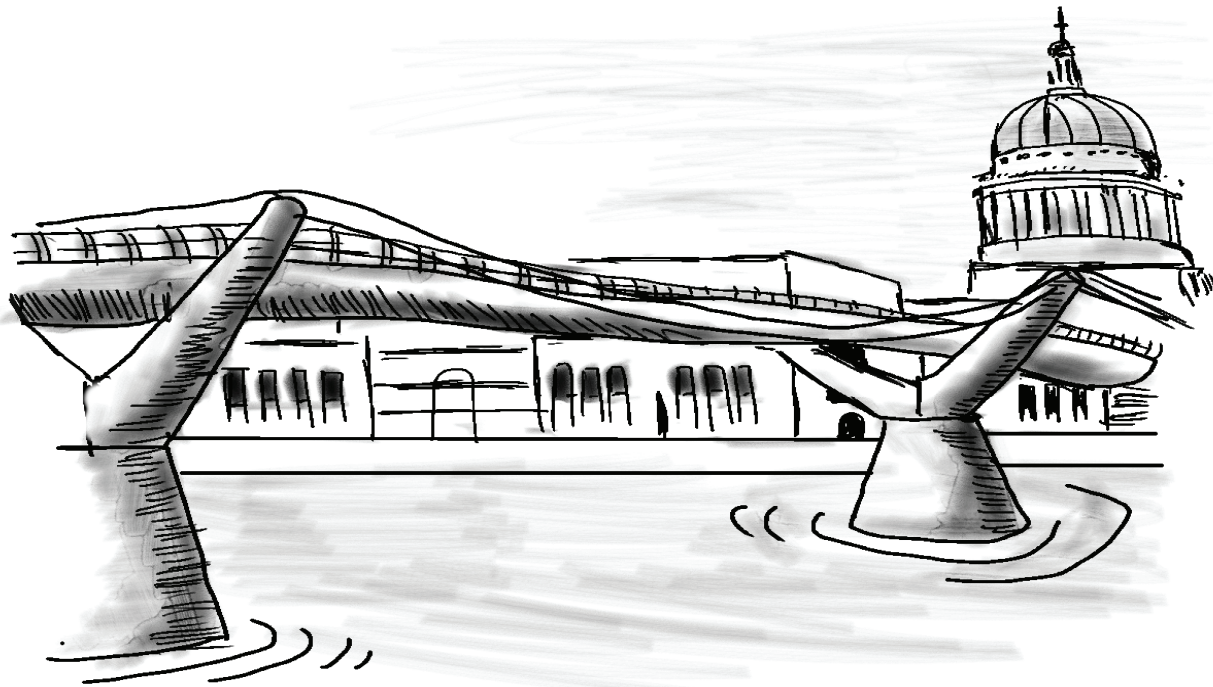
wobble increased at a sharply higher rate.

The wobble is an example of a shock that is generated and amplified within the system. It is very different from a shock that comes from a storm or an earthquake which come from outside the system. Stress testing on the computer that looks only at storms, earthquakes and heavy loads on the bridge would regard the events on the opening day as a "perfect storm". But this is a perfect storm that is guaranteed to come every day.

What does all this have to do with financial markets? Financial markets are the supreme example of an environment where individuals react to what's happening around them, and where individuals' actions affect the outcomes themselves. The pedestrians on the Millennium Bridge are rather like modern banks that react to price changes, and the movements in the bridge itself are rather like price changes in the market. So, under the right conditions, price changes will elicit reactions from the banks, which move prices, which elicit further reactions, and so on.

Financial development has meant that banks and other financial institutions are now at the cutting edge of price-sensitive incentive schemes and price-sensitive risk-management systems. Mark-to-market accounting ensures that any price change shows up immediately on the balance sheet. So, when the bridge moves, banks adjust their stance more than they used to, and marking to market ensures that they all do so at the same time.

The Millennium Bridge example serves to highlight the dual role of prices. Prices play two roles. Not only are they a reflection of the un-



derlying economic fundamentals, they are also an imperative to action. That is, prices induce actions on the part of the economic agents. Some actions induced by price changes are desirable, not only from the point of view of the individual, but from a system perspective, too. However, some actions borne out of binding constraints or actions that exert harmful spillover effects on others are undesirable when viewed from the perspective of the group. It is when the action-inducing nature of price changes elicit harmful spillover effects that the double-edged nature of prices takes on its maximum potency. The problem comes when the reliance on market prices distorts those same market prices. The more weight is given to prices in making decisions, the greater are the spillover effects that ultimately undermine the integrity of those prices. When prices are so distort-

ed, their allocational role is severely impaired. Far from promoting efficiency, contaminated prices undermine their allocational role. Financial crises could almost be defined as episodes where the allocational role of prices breaks down. The action-inducing role of price changes introduce distortions and cause an amplified spiral of price changes and actions that can cause great damage along the way.

Imagine an emerging market country defending a currency peg in adverse circumstances in the face of deteriorating macroeconomic conditions and hostile capital markets. Similar forces operate in more recent crises, including the events surrounding the runs on Bear Stearns and Lehman Brothers in the crisis of 2008. Defending the peg is often dictated by political goals more than economic ones, such as eventual accession to the European Union, the

adoption of the euro, or keeping the peg intact in order to shield domestic borrowers who have borrowed in dollars or euros.

However, defending the currency also entails raising interest rates and keeping them high. The costs of defending the currency bear many depressingly familiar symptoms - collapsing asset values and a weakened domestic banking system that chokes off credit to the rest of the economy. Whatever the perceived political benefits of maintaining a currency peg, and whatever their official pronouncements, all governments and their monetary authorities have a pain threshold at which the costs of defending the peg outweigh the benefits of doing so. Speculators understand well that their job is almost done when the finance minister of the stricken country appears on evening television vowing never to devalue the curren-

cy. Understanding the source and the severity of this pain is a key to understanding the onset of currency attacks.

Facing the monetary authority is an array of diverse private sector actors, both domestic and foreign, whose interests are affected by the actions of the other members of this group, and by the actions of the monetary authority and government. The main actors are domestic companies and households, domestic banks and their depositors, foreign creditor banks, and outright speculators - whether in the form of hedge funds or the proprietary trading desks of the international banks. Two features stand out, and deserve emphasis.

First, each of these diverse actors faces a choice between actions which exacerbate the pain of maintaining the peg and actions which are more benign. Second, the more prevalent are the actions which increase the pain of holding the peg, the greater is the incentive for an individual actor to adopt the action which increases the pain. In other words, the actions which tend to undermine the currency peg are mutually reinforcing.

Imagine that we are in Thailand in the early summer of 1997 just prior to the onset of the Asian financial crisis. For domestic financial institutions or companies which had borrowed dollars to finance their operations, they can either attempt to reduce their dollar exposures or not. The action to reduce their exposure - of selling Baht assets to buy dollars in order to repay their dollar loans, for example, is identical in its mechanics (if not in its intention) to the action of a hedge fund which takes a net short position in Baht in the forward market. For domestic

banks and finance companies which have facilitated such dollar loans to local firms, they can either attempt to hedge the dollar exposure on their balance sheets by selling Baht in the capital markets, or sitting tight and toughing it out. Again, the former action is identical in its consequence to a hedge fund short-selling Baht. As a greater proportion of these actors adopt the action of selling the domestic currency, the greater is the domestic economic distress, and hence the greater is the likelihood of abandonment of the peg. Everyone understands this, especially the more sophisticated market players that have access to hedging tools. As the pain of holding on to the peg reaches the critical threshold, the argument for selling Baht becomes overwhelming. In this sense, the actions which undermine the currency peg are mutually reinforcing.

The action-inducing nature of price changes turns up in this scenario through balance sheet stress in the twin crisis that combines a banking crisis with a currency crisis. The precipitous decline in the exchange rate means that the Baht value of foreign currency debts balloon past the value of Baht assets that have been financed with such loans. At the same time, the higher domestic interest rates put in place to defend the currency undermine the Baht value of those assets. Assets decline and liabilities increase. Equity is squeezed from both directions. As the Thai Baht collapses, the mutually reinforcing nature of price changes and distressed actions gathers momentum. As domestic firms with dollar liabilities experience difficulties in servicing their debt, the banks which have facilitated such dollar loans attempt to cover their foreign currency losses

and improve their balance sheet by a contraction of credit. For foreign creditor banks with short-term exposure, this is normally a cue to cut off credit lines, or to refuse to roll over short term debt. Even for firms with no foreign currency exposure, the general contraction of credit increases corporate distress. Such deterioration in the domestic economic environment exacerbates the pain of maintaining the peg, thereby serving to reinforce the actions which tend to undermine it. To make matters worse still, the belated hedging activity by banks is usually accompanied by a run on their deposits, as depositors scramble to withdraw their money.

To be sure, the actual motives behind these actions are as diverse as the actors themselves. A currency speculator rubbing his hands and looking on in glee as his target country descends into economic chaos has very different motives from a desperate owner of a firm in that country trying frantically to salvage what he can, or a depositor queuing to salvage her meager life savings. However, whatever the motives underlying these actions, they are identical in their consequences. They all lead to greater pains of holding to the peg, and hence hasten its demise.

Studying episodes of financial crises can be very revealing, as they are so rare. They reveal a lot about how well markets function, by studying those instances when they fail. What we have learned during the last few years will add much to our stock of knowledge. What we need to do to mitigate or to prevent such episodes is another story. ♦

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