From the Lab

LABORATORY FOR AGGREGATE ECONOMICS AND FINANCE — SUMMER 2010

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Director's Message

by the Associate Director, Peter Rupert

This issue is largely devoted to describing two conferences that were sponsored by LAEF. In October 2009, LAEF hosted a conference on health and the macroeconomy. Christian Zimmerman from the University of Connecticut and I organized the conference. The idea behind the choice of papers was to try and build new synergies between macroeconomics and health economics. Traditionally, health economics has largely been studied by applied microeconomists. However, many issues have macroeconomic consequences. The chosen papers represented a broad array of topics, from the impact of tropical diseases on developing economies to health care reform in the United States.

In February of this year, LAEF hosted a conference that examined the effects of private information and moral hazard problems on firm dynamics. Papers at the conference addressed how various forms of contracts might overcome or mitigate such problems. These issues have been shown to be important when trying to understand the relationship between firm size, growth and age. If firms are somehow constrained in their ability to borrow, there may be long-run effects on not only growth but also on the probability of survival.

In the Fall 2009 edition of the newsletter we mentioned that Professor Espen Henriksen returned to LAEF for the academic year. Henriksen holds a Ph.D. from the Tepper School of Business at Carnegie Mellon University. Henriksen has recently taken a position as the senior financial economist with Norges Bank Investment Management that manages the Norwegian Government Pension Fund Global (known also as "the Norwegian Oil Fund"). The fund is one of the largest Sovereign Wealth Funds in the world. Henriksen will bring state-of-the-art modeling tools to help the Fund better understand investment strategies and decisions. He will also be working on improving the transparency, accountability and legitimacy of the fund by making it more accessible to academics. While at LAEF over the past year, Henriksen not only worked on a variety of projects (with Finn Kydland, Thomas Cooley, and others), he also taught a course in numerical methods for economic dynamics for advanced Ph.D. students. In the course, the students were taught basic tools of numerical analysis that can be used to address analytically intractable problems in economics. The generality with which the techniques were presented in this course makes them applicable to a wide range of fields, including econometrics, resource economics, labor economics, macroeconomics, finance, game theory, public finance, contract theory, and others. The course endeavored to explain not only when and how to use various numerical algorithms but also how and why they work; in other words, the course opened up the "black boxes" and provided the students with a versatile toolbox for their own research. Fortunately for UCSB, Henriksen has been allowed to stay and teach again in the fall. The Fall 2009 course was well-attended and gave many students new tools to help solve their various problems. Since then, Henriksen has been in great demand by students for help in designing and improving basic algorithms and code, as well as for guidance in the early stages of formulating the problem.

In the spring of 2010, LAEF hosted two conferences: "International Trade and Development" and "Credit, Default and Bankruptcy." Look for the proceedings of both conferences in the next issue of From the Lab, to be published in the fall.

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Health and the Macroeconomy

OCTOBER 2-3, 2009

In October 2009, the Laboratory for Aggregate Economics and Finance (LAEF) sponsored a two day-conference entitled "Health and the Macroeconomy." The study of health economics has traditionally been the realm of applied microeconomics. There is, however, an increasing awareness that health issues also have macroeconomic consequences. A prime example is the AIDS epidemic, which has fundamentally changed the labor market, as well as many other markets, in parts of Africa. Closer to home, the cost of health care is putting a new burden on governments and businesses; indeed, in a past press conference, President Obama said that health care reform was at the forefront of economic and public policy. Also, demographic changes can change households' saving behavior to the point of affecting capital accumulation and thus growth.

The conference sought to build new synergies between macroeconomics and health economics, first by assembling the macroeconomists working on health issues, second by encouraging interaction with traditional health economists. The covered topics were broad, from the impact of tropical diseases on developing economies to health care reform in the United States.

Academic organizers of the conference were Peter Rupert, Professor of Economics, UCSB, and Associate Director of LAEF, and Christian Zimmermann, Associate Professor of Economics, University of Connecticut.

VISITING CONFERENCE PARTICIPANTS

Javier A. Birchenall – *UCSB*
Björn Brügemann – *Yale*
Shankha Chakraborty – *University of Oregon*
Raquel Fonseca – *Rand Corporation*
Juan Carlos Córdoba – *Iowa State University*
Eric French – *Federal Reserve Bank of Chicago*
Jeremy Greenwood – *University of Pennsylvania*
Karen A. Kopecky – *University of Western Ontario*
Iourii Manovskii – *University of Pennsylvania*
Stéphane Pallage – *University of Quebec, Montreal*
Richard M. H. Suen – *University of California, Riverside*
Belgi Turan – *University of Houston*
Christian Zimmermann – *University of Connecticut*
Gary Hansen – *UCLA*

Summaries of each of the presentations follow. Note that speakers are highlighted in author listings.

FRIDAY, OCTOBER 2, 2009

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Shanka Chakraborty and Masumi Das

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Why do the Elderly Save? The Role of Medical Expenses
Mariacristina De Nardi, **Eric French** and John Bailey Jones

The Impact of Medical and Nursing Home Expenses and Social Insurance Policies on Savings and Inequality
Karen A. Kopecky and Tatyana Koreshkova

Fragility: A Quantitative Analysis of the U.S. Health Insurance System
Björn Brügemann and **Iourii Manovskii**

PRESENTATION SUMMARIES

Malaria Policy: Alternative Prevention and Eradication Strategies in a Dynamic Model

by Douglas Gollin and Christian Zimmermann

According to the World Health Organization, malaria causes more than one million deaths annually, most of which are among children. As a result, many countries have jointly dedicated billions of dollars to expunge the disease and mitigate its effects. However, governments have not gone through the proper analysis to determine the most efficient method of prevention before implementing a particular strategy. Gollin and Zimmerman (2009) seek to quantify the costs and, more importantly, efficacy of four prevention and control strategies: long-lasting bed nets, indoor residual spraying of pesticides, drug treatments, and vaccines. They find individuals will always choose to purchase protection no matter what strategy is used, so any government funding should focus on the efficacy of prevention methods.

The authors' model is similar to an Ayagari economy, with the addition of disease shocks specific to malaria in a developing country. If an agent contracts malaria the shock is permanent and stays with him or her forever. In the authors' model, borrowing-constrained households endogenously decide whether or not to purchase protection goods, thus influencing how long they live. People accumulate capital to insure against idiosyncratic shocks, as well as to purchase protection. To guarantee the individuals prefer to live a longer life, a subtle but necessary parameter representing the value of life is included in the log utility function. The malarial infection rate is the proportion of affected people in the economy. It is endogenous and dependent on households' choices of protection as well as on the prevalence of the parasite in the population. Malaria is transferred from human to human by mosquitoes; therefore, an area with few mosquitoes is likely to have a lower infection rate. This channel is included in the infection rate by an elasticity parameter, which the authors call the ecological factor. If there are no, or few, mosquitoes present in the environment, the ecological factor would be zero, and a high prevalence of mosquitoes would lead to an ecological factor close to one. Any successful prophylactic strategies that reduce the number of mosquitoes will have a negative effect on this elasticity.

If an agent chooses to purchase the available preventative good, he or she must purchase enough of that good to last a lifetime. Zimmerman and Gollin quantify the lifetime cost and efficacy of each strategy to see if people would purchase the appropriate amount of the protective goods themselves, or if the government should offer subsidies. Efficacy in their model refers to the ability of a protective good to reduce an agent's likelihood of catching the disease, and can have a slightly different interpretation based on the strategy used. The efficacy of a long-lasting bed net is 70% in their findings, which means that individuals have to stay under the bed net for 70% of the day and can spend the other 30% wherever they please. However, the efficacy of a vaccine is 50%, which means for every mosquito bite, an individual has a 50% chance of contracting malaria.

The most significant variable in the results is the fraction of sick people who took protective measures. In the model, everyone

Health and the Macroecomony conference participants, October 2009.

chooses to purchase the protection good no matter which prophylactic strategy is used. This implies the cost of treatment is not very important. Another interesting observation is no matter what treatment is taken, the impact on income compared to no one getting treatment is minimal or less depending on the ecological factor. What is crucial to these results is efficacy of treatment. If a high efficacy could be guaranteed, the increase in income would be more significant. Little would change if the government offered treatment for free. Therefore, the goal of those striving to eradicate malaria should be to aim for increasing the efficacy of prevention and control methods.

Famines, Food Aid and Aggregate Trouble

by Stéphane Pallage

Many programs worldwide provide food assistance and other humanitarian aid to developing countries. However, it is unclear whether these programs are operating efficiently due to the nature of those countries receiving aid. Many starvation problems in developing countries are in fact manmade. In this context, manmade implies that enough food is produced for everyone, but not everyone is able to consume the food. Someone, usually a powerful leader, may appropriate the food, causing some people not to have enough to survive. Conflict in these countries over food or other valuables exacerbates the situation. Therefore, any aid program aimed at delivering food to developing countries faces what is known as the Samaritan's Dilemma. If a kleptocrat or warlord knows a program is willing and able to offer relief to the citizens of the country, he is likely to steal more food in the first place. Pallage, in his presentation, addresses the following three ideas, all related to papers with Max Blouin: whether or not food aid can be used to avoid conflict, the food aid curse, and quantifying the impact of food aid in the aggregate.

The first issue is addressed using a single period game theoretic model. The author wants to show that foreign aid can have an important peace-promoting role. A small country with a continuum of agents faces a natural famine. Two warlords are each in control of one of the two airports where food aid is transported. Two types of agents live in the country — farmers and soldiers. The famine is natural, i.e., some farmers do not produce enough food to survive. Soldiers are fed by the warlord for whom they fight. If foreign aid is transported into the country, warlords collect a fraction of that food. The aid agency has a sufficient budget to feed all. Its goal in the model is to save lives and prevent conflict. The agency can decide ex-ante on the amount of food aid to send through each airport based on the size of armies. Warlords then choose army size to maximize their objective. The author shows that only one subgame-perfect equilibrium exists in which the warlords choose to have the same size army, and the aid agency chooses the delivery plan that minimizes the conflict. This model therefore shows that it is possible for foreign aid agencies to influence conflict if they use the warlord's own greed against him.

Humanitarian aid agencies are often confronted with the food aid curse, a form of the Samaritan's Dilemma which is extremely

difficult to solve. The existence of food aid agencies generates a demand for food aid. Some kleptocrats may deliberately generate famines in their territory to attract food aid. A typical way to solve such Samaritan's dilemmas is to deny the kleptocrat any help. This punishment, however, is not credible in the case of famines. Because their objective is to save lives, humanitarian agencies will not refuse to help. Such is the food aid curse. Blouin and Pallage build a punishment profile that helps resolve this curse. To do so, they construct a discrete time infinite-horizon model with a continuum of farmers in a given number of countries, all governed by a kleptocrat. Each farmer produces an amount of food greater than the subsistence level. However, the kleptocrat, only caring about his own consumption, steals some of the farmers' food. In the absence of foreign aid, under reasonable conditions, all farmers will be left with enough consumption to survive to the next period. However, if a food agency is active in the model and acts non-strategically by sending out whatever is needed to save lives, the kleptocrat will steal food away from everyone and starve the entire population. The agency is unable to threaten sending no aid because it is contradictory to the agency's goal. A solution exists, however. It implies a relatively complex self-enforcing agreement with the kleptocrats. If all behave well, i.e., they do not starve their population, they will be rewarded with a bribe. If one deviates at a given time, the aid agency will intervene at that time, but it will divide the budgets in the existing future periods between all non-deviating kleptocrats, completely exhausting the budget. In order for kleptocrats to cooperate they will need to be made indifferent between deviating and not deviating. Therefore, only a carefully chosen bribe combined with this punishment will actually prevent the food aid curse.

Finally, the question of whether food aid leads to aggregate trouble is tested using an infinite horizon model with heterogeneous agents. Agents receive idiosyncratic shocks to productivity and must reach the subsistence level of consumption to survive to the next period. A food agency exists to ensure that agents have the minimum level of consumption they need to survive. Pallage chooses reasonable parameter values to illustrate the possibly deleterious effects of food aid with a numerical example. Agents maximize lifetime utility with respect to budget and feasibility constraints. The results show that if subsistence consumption is above a certain threshold, savings can drop dramatically. Eventually, in the presence of food aid, everyone will choose to be without capital leading to a low steady-state output. Food aid may therefore not be neutral in the development of nations. The Samaritan's Dilemma can have serious aggregate implications on the recipient country's future.

HIV and Fertility in Africa: First Evidence from Population-Based Surveys

by Chinhui Juhn, Sebnem Kalemli-Ozcan and Belgi Turan

HIV/AIDS is a significant problem facing many countries today. In 2008 there were approximately 32 million people with HIV/AIDS. Roughly two million people die annually from this disease. The prevalence of AIDS is most prominent in Africa and much research has been done to determine the impact of this epidemic on economic growth. The link between mortality, fertility, and economic growth has been a much debated issue. Becker and Barro(1988) argue that increases in mortality induce a quantity/quality tradeoff. If an individual would like to have a set number of children live to adulthood, he or she now must increase fertility to reach the desired number, and decrease the amount of investment per child. Neoclassical growth models, on the other hand, predict that a fall in life expectancy will decrease population. With these competing forces in mind, Juhn, Kalemli-Ozcan, and Turan look to improve upon existing research using the Demographic and Health Surveys to examine the impact of HIV/AIDS on fertility. They find HIV has a negative impact on fertility as a result of physiological effects of the disease.

Unlike other surveys taken from prenatal clinics, the Demographic and Health Surveys allow for separation of those having protected and those having unprotected sex. Surveys taken from prenatal clinics will inflate the number of people in the population who have HIV since the sample only includes those who have unprotected sex. With new data, the authors are able to distinguish the physiological from the behaviorial effects of HIV/AIDS on fertility by running two distinct regressions. In the initial regression, the dependent variable is the fertility rate measured in terms of the number of births last year, three years ago, and five years ago. The regressors include an individual's own HIV status, along with several demographic controls. The results indicate that being HIV positive decreases the number of births last year by 0.03, approximately a 20% decline.

An indicator variable for condom use is added to the model to test whether the coefficient of 0.03 represents the pure physiological impact of the disease. The coefficient does not change significantly. Also, to account for possible unobserved heterogeneity between women who test positive for HIV and those who do not, the authors examine the impact of HIV-positive status on fertility history of five-year periods up to 20 years ago. A significant coefficient after ten years would indicate an innate difference in those with and without the disease. No significant difference is found. Therefore, Juhn, Kalemli-Ozcan, and Turan conclude the coefficient on one's own HIV status to be the physiological effect.

To determine whether or not behavior would change if an individual lives in an HIV-prevalent community, the fertility rate of an HIV-negative individual is regressed on the following; the fraction of adults with positive HIV status in the community, on controls for demographic characteristics, and on country and residence dummies. An increase in the prevalence of HIV in an individual's community has no effect on non-infected women's fertility. The results do not change when distance to the Democratic Republic of Congo, the origin of the disease, is used as an instrument for the fraction of the adult population with HIV. Therefore, the behavioral effect of living in an HIV-prevalent community is non-existent.

In order to determine the combined impact of both behavioral and physiological effects, the Total Fertility Rate is calculated for

all women and HIV-negative women in 13 different countries. In comparing the Total Fertility Rates they find a much smaller effect of HIV than is stated in previous studies. Lesotho, the country with the greatest observed change, only experiences a decrease of 8% in the Total Fertility Rate in the presence of HIV/AIDS.

References:
Becker, G.E., R.J. Barro. (1988). "Reformulation of the Economic Theory of Fertility", *Quarterly Journal of Economics* 103(1): 1-25.

Quantitative Aspects of Africa's Past Economic Development

by Javier A. Birchenall

The economic development of sub-Saharan Africa has been the focus of much recent research because of how significantly this region lags behind the rest of the world in many development indicators. This paper does not propose any new explanations in terms of *why* Africa lags behind the rest of the world, but focuses on a comprehensive discussion of a series of issues. Comparing development indicators in Africa to those in South and Central America demonstrates that Africa may have already lagged behind the rest of the world before European colonization.

The focus of this paper is limited to the pre-colonial epoch (i.e., 1500 A.D. and prior). The post-agricultural development of Africa is compared to that of South and Central America, using the geographic isolation of the new world as a "natural experiment." Kremer (1993) used this same idea to compare the Old and New Worlds. However, in contrast with Kremer's analysis, the comparisons made in Birchenall's paper are designed to reflect the fact that Africa and South and Central America had similar geographic and technological characteristics. Both of these areas had agriculture originate at approximately the same time (four to four-and-one-half thousand years ago). These areas also have the same axes of orientation (North to South), similar population size (seven million in 400 B.C.), and similar natural and climate conditions (both continents cross the Equator). The many similarities make Africa and South and Central America an ideal comparison.

As there were no aggregate economic measures such as GDP in the pre-colonial time period, Birchenall relies on measures of urbanization to proxy for economic development. City formation is thought to be a good measure of economic prosperity because cities are a complex form of organization that exhibits a significant degree of division of labor. Another advantage of using cities as a measure of economic prosperity is that existence of cities tends to be well-preserved. Chandler's (1987) archaeological data reveal that, between 800 A.D. and 1500 A.D., cities in Africa were less prevalent and less densely populated compared to the cities that originated indigenously in tropical America.

The discussion also examines disaggregate data using ethnographic information from the Standard Cross-Cultural Sample, SCCS. This data describes 186 culturally independent societies collected by anthropologists in 1868 and 1918. The SCCS attempts to describe conditions in the pre-colonial epoch. Several conference participants had questions regarding how representative this data was of the situation in 1500. Birchenall stressed that the data may not be exactly representative of the situation in 1500, but data quality and availability are extremely limited for earlier time periods.

Using this data, different regression equations were estimated where the different outcome variables were the number of large buildings and structures, and the level of food surplus and storage. These outcome variables are proxies for urban life. Several controls were included in the regressions, including measures of demography, geography, technology, pathogen stress, and ethnic diversity. Dummy variables for Africa and South and Central America were also included. The analysis revealed a negative and statistically significant "African dummy" and two features that seem to be important for understanding Africa's pre-industrial economic performance: the disease environment and the ethnic diversity within the continent. These findings suggest that Africa's current economic situation may not be due exclusively to the adverse effects of European colonization but also in part the consequence of pre-modern influences.

References:
Chandler, T. (1987) Four Thousand Years of Urban Growth: An Historical Census, St. Davis University Press.

Kremer, M. (1993) "Population Growth and Technological Change: One Million B.C. to 1990." *Quarterly Journal of Economics*, Vol. 88, 681-716.

Schooling and Development: The Role of Credit Limits, Public Education, Fertility and Morality

by Juan Carlos Córdoba and Marla Ripoll

The empirical evidence on expected years of schooling exhibits substantial dispersion across countries. As of 2005, UNESCO data indicated that a child in Australia would be expected to attend school for 20 years, while a child in Niger would be expected to attend school for 4 years. The goal of the Córdoba/Ripoll paper is to explain why there is such dispersion in years of school attendance. Several other papers have pursued the

same goal, but this one differs from others in that borrowing constraints are binding. Once borrowing constraints become binding, new explanatory variables for schooling choices are introduced that are irrelevant in frictionless models. Specifically, variables such as parental bequests, fertility and public education play an important role in the model developed, but only a small role in other, frictionless models.

The authors develop a model of a life-cycle economy with altruistic individuals. Individuals go to school from age 0 to age *s*, work from age *s* until retirement, and have children at a specified age *F*. Human capital is produced by schooling and experience, and is the sum of all the investments in schooling from the moment of birth to graduation. These investments are made out of expenditures which are composed of public subsidies and private funds. A partial equilibrium is quantitatively analyzed where wages, mortality rates (survival probabilities), fertility rates, the price of education, subsidies for schooling, and the maximum years of those subsidies differ by country.

The borrowing constraint is of central importance to students. Because this constraint is binding, parental bequests are much more important. In the model, there are no *unintended* bequests, only those that are deliberately given by altruistic parents who split the bequest among all of their children. In this way, fertility also plays an important role because the more children parents have, the fewer bequests each child receives. To achieve a binding borrowing constraint, the general interest rate is set below the rate of time preference. One conference participant pointed out that the interest rate plays a very important role in this model and is not the same for all countries. Córdoba responded that the authors have data to compute interest rates by country, but that expected inflation has to be subtracted. Hyperinflation, especially in Africa, makes these calculations very difficult. As a result, a single interest rate of 6% is used in the quantitative analysis.

When schooling is predicted by the model for each country, the predictions match the data much more closely than previous papers. The R-squared statistic is 0.7 compared to 0.27 that was reported by Bils and Klenow (2000). Counterfactual analysis revealed that fertility rates were the single most important determinant of schooling differences across countries. When fertility rates were equivalized across all countries to U.S. levels, the dispersion in schooling fell by 53%. This is because students rely heavily on parental bequests in the model, and these bequests are diluted with a larger number of siblings. Mortality rates were also found to be a significant determinant of cross-country schooling differences; when rates were equated to U.S. levels, the standard deviation of schooling fell by 36%. The bulk of this reduction is driven by changes in adult mortality rates rather than by child mortality rates. In contrast, wage differentials appear to play a minor role – reducing the level of dispersion by only 4% when U.S. levels are used in all countries.

References: Bils, Mark, and Peter Klenow. 2000. "Does Schooling Cause Growth?" *American Economic Review*, 90(5): 1160-83.

On the Rise of Health-Spending and Longevity

by Raquel Fonseca, Pierre-Carl Michaud, Titus Galama, and Arie Kapetyn

This paper seeks to assess the importance of health insurance in a life-cycle context. It improves upon previous work by combining health and retirement decisions. Few retirement models allow health to be endogenous, while health production models do not consider retirement as a choice. However, retirement and health production models can be expected to have interactions. The authors calibrate a dynamic model using data from the PSID, MEPS, and HRS to study the effects of health insurance on life-cycle decisions and health outcomes. The model features a realistic Social Security system and health insurance system, and allows for uncertainty in heath and employment.

In the authors' model, agents choose consumption, medical expenditures, and retirement to maximize their discounted utility. Agents can choose to retire beginning at age 55, and must retire by age 70. If an individual chooses to retire before 62 (the age at which Social Security benefits begin to apply), his expenditures must be financed out of his own accumulated wealth. Medical expenditures have several effects: they increase health, which in turn increases earnings; and they also reduce the probability of a health shock and influence future pension benefits. Several conference participants had questions about what medical expenditures included, noting that preventive measures that primarily take time (such as exercise) were not included, causing the amount of medical expenditures to be underestimated. Fonseca responded that medical expenditures in the model include all standard medical expenses (prescription drugs, hospitals, etc.), but do not include nursing home expenditures. The amount of expenditures in the model depends in part on an individual's employment status. The employment status can be one of three states: unemployed, employed and the employer provides health insurance, and employed but the employer does not provide health insurance. There is a normally distributed health shock and an employment shock.

Parameters were calibrated to data that focused on non-Hispanic, white men to eliminate some heterogeneity issues. The model was solved recursively, producing optimal decision rules that were used to simulate the choices of 2500 individuals who differed in initial conditions (assets, earnings and health status), as well as health and employment shocks throughout the lifecycle. The simulation yielded a distribution of medical expenditures that very closely replicated the data. Simulated consumption, income, and assets lined up closely with the median profiles from the data. One conference participant noted that it seemed as though the medical expenditure distribution did not capture medical expenditures in the last part of the life cycle very well, and that this is a common problem with many life-cycle models addressing similar questions. Fonseca noted that this was an issue that she and her co-authors were exploring further, but that overall the model and data were closely aligned. A preliminary experiment to see what would happen if there were an increase in the co-payment indicated that a 10% increase in the co-payment led medical expenditures to decline by 4%.

Technological Advance and the Growth in Health Care Spending

by Richard M. H. Suen

Two trends observed in the last half of the twentieth century in all OECD countries are the rise in personal healthcare expenditures and life expectancy. Existing research has argued in favor of the establishment of Medicare and Medicaid programs as the source of the trend. Suen offers an alternate explanation: the rise in personal healthcare expenditures and life expectancy can be attributed to new medical technology and income growth.

An overlapping-generations model with two commodities is used to evaluate this hypothesis. Agents live for a maximum of 104 years, and must retire at age 65. In addition to consumption goods, they are able to purchase medical services. Medical services are an input in the health production function and used to create new health units. Any improvement in medical technology affects the technology parameter of the health production function. The accumulation of health implies end-of-period health status is a function of the new units of health created, undepreciated beginning-of-period health status, and a health shock. The health shock is dependent on age and is zero if a person is healthy and negative if sick. The actual value of the "sick" shock is appropriately calibrated to represent cancer or coronary heart disease. An agent also faces a probability of death at the end of every period, which is a function of his or her end-of-period health status.

A significant aspect of the model is the ability of agents to insure against uncertainty. Different insurance schemes are offered under three steady states. The first steady state only includes private health insurance, representing the U.S. economy in 1950. Included in each contract for private insurance is a premium rate and reimbursement function. The second steady state represents the year 2001, and offers both private and public health insurance, with public health insurance comparable to the U.S. Medicare program. Every retired agent in the model receives public health insurance, however, there is a maximum limit to the expenses insurance will cover. Lastly, a steady state exists in which no insurance is accessible, but agents are still able to insure through the accumulation of assets.

The model is calibrated to create two steady state benchmark economies, one in 1950 and the other in 2001. After calibrating, the model can predict all of the change in medical spending that takes place over this time frame. The change in life expectancy predicted in the model at age 25, is an increase of 6.5 years compared to an increase of 4.1 years in the data. Therefore, the model can explain approximately 60% of the change in life expectancy. After removing insurance from the economy, there is a large increase in medical spending observed between 1951-2001 due to technological improvement and increase in income. However, at any point in time in an economy with no insurance, people will spend less on medical expenditures compared to an economy in which they are insured, a result of moral hazard. Therefore, increases in income and medical technology alone are able to predict the trend in medical expenditures and most of the rise in life expectancy. A conference participant asked how we can account for people making healthier decisions. Suen stated that there is currently no acceptable model that accounts for preventative behaviors, therefore, he does not include these decisions in this model. However, Suen acknowledged that creating a model to account for preventative behaviors is the next step.

Death and Capital: Physical and Human Capital Investment under Missing Annuity Markets

by Shankha Chakraborty and Mausumi Das

In the United States during the late 19th century, a sharp increase was seen in life expectancy and other characteristics of improved health. In the early 20th century, following the increased life expectancy, physical-capital-biased technological progress transitioned to human-capital-biased technological progress. Motivated by these trends, Chakraborty and Das create a theory to understand how changes in mortality impact investment in tangible versus intangible assets. They find an improvement in survival probability increases investment in both assets, favoring human capital.

An important distinction between tangible and intangible assets is necessary for the authors' model. Tangible assets are transferrable if annuities markets are present, whereas intangible assets are never able to be transferred. Annuities markets are absent in most developing countries, however, family altruism is a good proxy for these markets. For example, a child can acquire a family farm after his or her parent dies, but education is unable to be transferred.

Presented is a two-period, overlapping-generations model; the two periods representing youth and middle age to abstract from the effect of aging. At the end of youth, an agent bears a child, after which an agent has a probability of dying before he or she reaches middle age. The agent shares a fraction of family income with his or her child, which is the child's initial endowment in youth. If his or her parent does not survive to middle age, the child also receives the stock of tangible assets. An agent can invest to increase the productivity of tangible and intangible assets using income from the first period which will increase income in the second period if the agent survives. In the first thought experiment, the only asset is land, and land accumulates according to a standard capital accumulation function. If the probability of survival increases, the model shows that in the presence of annuities markets, an individual who wants to consume the same amount he or she did previously is required to save more.

To test the idea that altruism can account for missing annuities markets, the markets are removed. An individual in the first period receives initial income that includes the undepreciated asset along with a portion of family income. However, if the parent dies, the individual receives the undepreciated asset and all of the returns from that asset. The marginal benefit of missing annuities markets is higher at all survival probabilites because accidental bequests are beneficial to both parents and offspring.

Offspring receive a higher endowment and parents receive greater utility for this bequest. The greater utility overrides the loss in consumption as long as parents have a higher subjective discount rate relative to altruism intensity. Investment also increases under missing markets.

How does the scenario change if an agent has the opportunity to invest in both a tangible and intangible asset? The tangible asset is still land, and the intangible asset is human capital. The returns to these two assets are assumed to be independent of one another. In this setup, an adult agent shares a fraction of both land and labor income with his or her child. The relative fractions of the two are dependent on ease of sharing. If a child's parent dies, his or her endowment strictly includes the fraction of his or her parents' land income due to non-transferability of human capital. A conference participant asked if the assumption regarding the sharing of human capital is necessary. Chakraborty responded that the assumption is not necessary to generate the outcome, but it allows him to place a greater wedge between the tangible and intangible asset.

Optimal solutions indicate an increase in survival probability favors human capital investment relative to land investment. Similar results are obtained when annuity markets are taken away, implying that altruism is a good substitute for the missing markets especially for physical capital. In conclusion, higher survival probabilities, even under missing annuities markets, encourage investment in both land and human capital, with greater preference for human capital.

From Shame to Game in One Hundred Years: An Economic Model of the Rise in Premarital Sex and Its De-Stigmatization

by Jesús Fernández-Villaverde, Jeremy Greenwood and Nezih Guner

Premarital sex has been increasing for most of the twentieth century. However, societal attitudes towards premarital sex have lagged practice. For example, in 1968, 40% of 19-year-old women had premarital sex, but only 15% of women had a positive attitude towards having premarital sex. In 1983, 73% of 19-year-old women had premarital sex, but only 45% had a permissive attitude towards it. At the same time that premarital sex has been increasing, the efficacy of contraception has increased substantially. As a result, the cost of engaging in premarital sex has fallen. This has led to the paradoxical situation where, despite the fact that contraception has improved, the number of out-of-wedlock births has increased. The goal of this paper is to account for the rise in premarital sex, its lagged destigmatization, cross-sectional observations about sex in terms of socioeconomic status, and changes in the behavior of church and state.

The premise of the paper is that young adults act in their own best interest by weighing the costs and benefits of sex. An out-of-wedlock birth can have many consequences. It can damage a woman's prospect for marriage, potentially incur shame or stigma, as well as reduce her educational or career opportunities.

In the economic environment in this paper, parents invest effort in socializing their children. An overlapping generations model is developed where parents can influence their offspring's tastes about an out-of-wedlock birth. Young adults make their decisions about engaging in sex in the first period, and participate in a marriage market the following period. Parents derive utility from their own consumption and their child's marriage match, and incur disutility from socializing their children. The parents' problem, then, is to choose the level of socialization that maximizes their utility.

This is the basic model which produces several lemmas. The first is that, because men do not bear a cost of engaging in sex, they want to engage in premarital sex more than women. The second lemma shows that if there was a once and for all change in the efficacy of contraception, parents would reduce the level of socialization of their daughters. The third lemma is that if the efficacy of contraception goes from really bad to perfect, out-of-wedlock births in this model rise and then fall.

The computational experiment calibrates the model to U.S. data, and begins in 1900. The model is able to account for trends seen in the data. A church and state are subsequently added to the model, and a Ramsey-style problem is set up where the objectives of the church and state are to minimize their costs while taking the parents' decision rules as given. Historical evidence was presented showing that out-of-wedlock births and abandoned babies were quite costly. As contraception efficacy increased in the model, the socialization undertaken by parents and churches declined until the point where contraception was perfect and parents and churches chose not to socialize.

One conference participant noted that in this model no one wants to get pregnant out of wedlock. He suggested using this model to understand the effects of the incentives that were induced by some welfare programs in the 1960s that inadvertently encouraged women to have children out of wedlock.

Why do the Elderly Save? The Role of Medical Expenses

by Mariacristina De Nardi, Eric French and John Bailey Jones

Many elderly individuals hold on to a lot of assets until a very old age – much more than would be implied by a certainty life-cycle model with no bequests. Furthermore, those individuals with relatively high permanent income tend to deplete their assets even more slowly than those with relatively low permanent income. This paper seeks to understand what accounts for these two facts using a dynamic programming model of savings behavior after retirement that accounts for heterogeneity in life expectancy and medical expenses.

The novel contribution of this paper is to explain the saving behavior of the elderly using better data from AHEAD, a panel dataset that has very good information on the oldest members of the population, and includes nursing home expenditures. Splitting data into cohort and permanent income quintiles

(measured as social security and pension benefits) revealed that the median assets for those in the highest permanent income quintile were $150,000. Two years later, assets for the same people fell a small amount and every year after saw assets rise. In contrast, those in the middle of the distribution saw their assets decline over time, while those in the bottom of the distribution did not have many assets at the outset. The sample is restricted to singles — the first time an individual is seen, he could be widowed, divorced or never married. One conference participant asked whether the sample composition was changing over time. French responded that the sample composition was definitely changing over time — over half of the sample population was deceased by 2006. In the model, this change in sample composition is accounted for by mortality risk.

The authors develop a model to attempt replication of the above-described asset profiles. Many features of the model are very standard in the literature, including preferences with reasonable parameter values. The sources of uncertainty are health status and survival. Both of these variables are two-state Markov chains and depend on gender, permanent income and age. Medical expenses have a deterministic and stochastic component. The deterministic component depends on gender, permanent income, age, and health status. Agents know the data-generating process for all of the state variables, and choose assets and consumption each period to maximize their utility subject to their budget constraints.

The model is estimated using the method of simulated moments and fits the data extremely well. Medical expenditures are important in explaining the saving of the elderly, including the wealthier cohort. For example, the baseline model predicts that between ages 74 and 84, median assets for those in the top permanent income quintile fall from $170,000 to $130,000. When medical expenses are eliminated, median assets for the same group fall from $170,000 to $60,000. These results are due to the fact that out-of-pocket medical and nursing home expenses can be very large, and average medical expenditures rise very rapidly with age and income. Properly accounting for old-age expenditure on medical care and social insurance programs, which provides a consumption floor, is very important in explaining the savings of the elderly. Hence, they are likely to be key elements to take into account to properly evaluate policy proposals affecting the elderly.

The Impact of Medical and Nursing Home Expenses and Social Insurance Policies on Savings and Inequality

by Karen A. Kopecky and Tatyana Koreshkova

Average out-of-pocket medical expenses of an individual 65 years or older in the United States are about ten percent of GDP per capita. Even more astonishing, the top ten percent of payers account for 51% of total out-of-pocket expenditures, causing an unequal expenditure distribution with a Gini coefficient of 0.67. One of the main contributors of high medical costs over the age of 65 is nursing home expense, with an average individual's annual stay equivalent to 190% of GDP per capita. Given the significant level and unequal distribution of health expenditures later in life, Kopecky and Koreshkova look to further understand how medical and nursing home expenses, along with their respective government insurance programs, impact the distribution of wealth and savings in the population. They show public healthcare significantly decreases the aggregate capital stock, and more specifically, decreases the savings of individuals at the top of the wealth distribution.

Kopecky and Koreshkova design a general equilibrium model of savings behavior where all working agents are subject to earnings risk and agents over 65 face survival, medical-expense and nursing-home expense risk. Agents have a certain probability of entering a nursing home, dependent upon age and their medical expense shocks. Those living in a nursing home face a relatively lower probability of survival. There is no way to fully insure against risk. However, a means-tested social insurance program is available to everyone in the model to provide partial insurance. The minimum level of consumption guaranteed to a bankrupt individual under this program is dependent on the type of risk being faced: earnings, medical expense or nursing home expense. A pay-as-you-go social security program is also available to allow agents to further insure against risk.

A working agent or retired agent facing only medical expenses will choose assets and consumption to maximize utility subject to several constraints. However, an agent facing nursing home expenses will have the additional choice between public or private care. Public care requires an agent to sacrifice all income and assets except for a minimum level of consumption, while an agent in private care has no limit on consumption. Therefore, agents would never choose public care unless their earnings were less than or equal to the minimum consumption level. A conference participant asked why medical expenses are not a choice in the model. Kopecky said that endogenizing choice of care would be very complicated using this particular model, and would likely have difficulty producing the choices seen in the data. In the authors' model, it would be optimal for poor individuals to use care as much as possible once they get insurance, but in the data, these individuals actually go the doctor less often. Therefore, the authors simply make the assumption that the only reason high income people pay more in medical expenses is because they have fewer insurance opportunities available to them.

Kopecky and Koreshkova calibrate several parameters in the model to the data, and attempt to match several moments of the earnings and out-of-pocket medical expense distribution. The data does not include information on permanent earnings quintiles, so Social Security quintiles are used as a proxy. Since the main objective in their paper is to find the implications of earnings and health shocks on agents' precautionary savings decisions, the authors do not target the wealth distribution. Overall, the benchmark model seems to match the data well. In particular, the Gini coefficient for the wealth distribution in the model of 0.83 is extraordinarily close to 0.80, the coefficient in the data, despite the fact that it was not targeted. As in the data,

the model predicts that those individuals in the top earnings quintiles will pay the most out-of-pocket health expenditures and therefore will also have the greatest savings, as they expect they will need to pay for nursing home expenses in old age. On the contrary, those in the lower quintiles who benefit most from the social insurance will be discouraged from saving.

After fitting the model to the data, three public health care policy experiments are compared to a baseline economy where all expenses are paid out of pocket. In the first experiment, the government pays for all medical expenses, but no nursing home expenses. In the second experiment, the government pays for only the medical component of nursing home expenses. The final experiment is full coverage. The main results of the three experiments are the fall in the aggregate capital stock by 7%, 7%, and 12% respectively. The other prominent result is the fourth and fifth earnings quintiles are much more affected by public insurance for nursing home expenses relative to medical expenses. Individuals with higher incomes are more likely to pay nursing home expenditures out-of-pocket, whereas, those with lower incomes are more likely to pay the smaller early-in- life medical expenses. Overall, the authors' model shows nursing home expense risk is the main factor driving savings decisions of the top population quintiles, and offering public health care would significantly diminish the capital stock.

Fragility: A Quantitative Analysis of the U.S. Health Insurance System

by Björn Brügemann and Iourii Manovskii

Health insurance reform is currently a hot topic. Brügemann and Manovskii document salient features of the U.S. health insurance system, and develop a model that accounts for these features. The authors' goal is to develop a model that describes the current system and can subsequently be used to quantitatively assess potential policy reforms.

The health insurance system in the United States for those younger than 65 is largely employer-based. Of those adults who have insurance coverage, 61% have coverage through their employer, while 16% have coverage through Medicaid, 5% have private insurance (not affiliated with their employer), and 17% are uninsured. Of those who are insured, most are working families. Additionally, the pool of uninsured people is not a static pool; about 27% of uninsured people today have been uninsured for less than a year.

One of the most salient features of the data is the difference in insurance provision by large and small firms. It is well documented that the probability of a firm providing coverage strongly depends on its size. The data indicate only about 30% of firms with less than 10 workers offer coverage, compared with firms with more than 50 workers, of which 90% offer coverage. This fact is true even after conditioning on the average payroll. This fact may be explained by fixed costs of offering health insurance and/or by the limited ability of smaller firms to pool risk among workers. The latter explanation has not been modeled in the literature and is modeled in this paper.

A less well-known fact is that many firms discontinue insurance after a certain time period — 15% of those who provided coverage two years ago are not providing coverage today. Other important facts are: 1) smaller firms face a higher variability of insurance premiums from one year to the next; 2) if a firm provides health insurance, it has to make the same plan available to all workers and cannot adjust premiums based on health status; 3) firms cannot discriminate on health status either in hiring or firing; 4) insurance contracts are typically annual and premiums adjust on renewal; and 5) insurance companies *can* discriminate across groups but not individuals.

In the Brügemann-Manovskii model, there are workers and firms who interact in a frictional labor market. Workers are discrete and could be of two different health statuses. They supply one unit of labor each, and have no access to saving technology. Firms are different sizes and receive productivity shocks. They choose whether to provide insurance or not. A Markov equilibrium is studied where there is no reputation or commitment on the part of workers or firms. One participant asked whether the problem could be formulated as a competitive equilibrium. Manovskii responded that it is extremely difficult to think of a competitive equilibrium with the existence of the non-discrimination clause (the fact that firms cannot discriminate on health status in hiring or firing and cannot adjust insurance premiums based on health status). The model results are still at an early stage, but it was shown that the probability of a firm discontinuing coverage was declining in firm size. Manovskii emphasized that the variance of health composition is much larger in small firms than in large firms, firms cannot discriminate in wages or insurance coverage, and small firms start and stop coverage often. These three factors induce large flows of workers across firms and health insurance states in equilibrium.

Firm Financing, Dynamics and Growth

FEBRUARY 20, 2010

The Laboratory for Aggregate Economics and Finance (LAEF) sponsored "Firm Financing, Dynamics and Growth," a one-day conference at UCSB on February 20, 2010. This conference examined the effects of private information and moral hazard problems on firm dynamics. In particular, papers at the conference addressed how various forms of contracts can overcome or mitigate such problems. These issues have been shown to be important when trying to understand the relationship between firm size, growth and age. If firms are somehow constrained in their ability to borrow, there may be long-run effects on not only growth but also on the probability of survival. The conference was organized by Peter Rupert, Professor of Economics at UCSB and Associate Director of LAEF.

VISITING CONFERENCE PARTICIPANTS

Gian Luca Clementi – *New York University, Stern School of Business*
Thomas Cooley – *New York University, Stern School of Business*
Hugo Hopenhayn – *University of California, Los Angeles*
Vincenzo Quadrini – *University of Southern California*
Stéphane Verani – *University of California, Santa Barbara*
Mark L.J. Wright – *University of California, Los Angeles*

Summaries of each of the presentations follow. Note that speakers are highlighted in author listings.

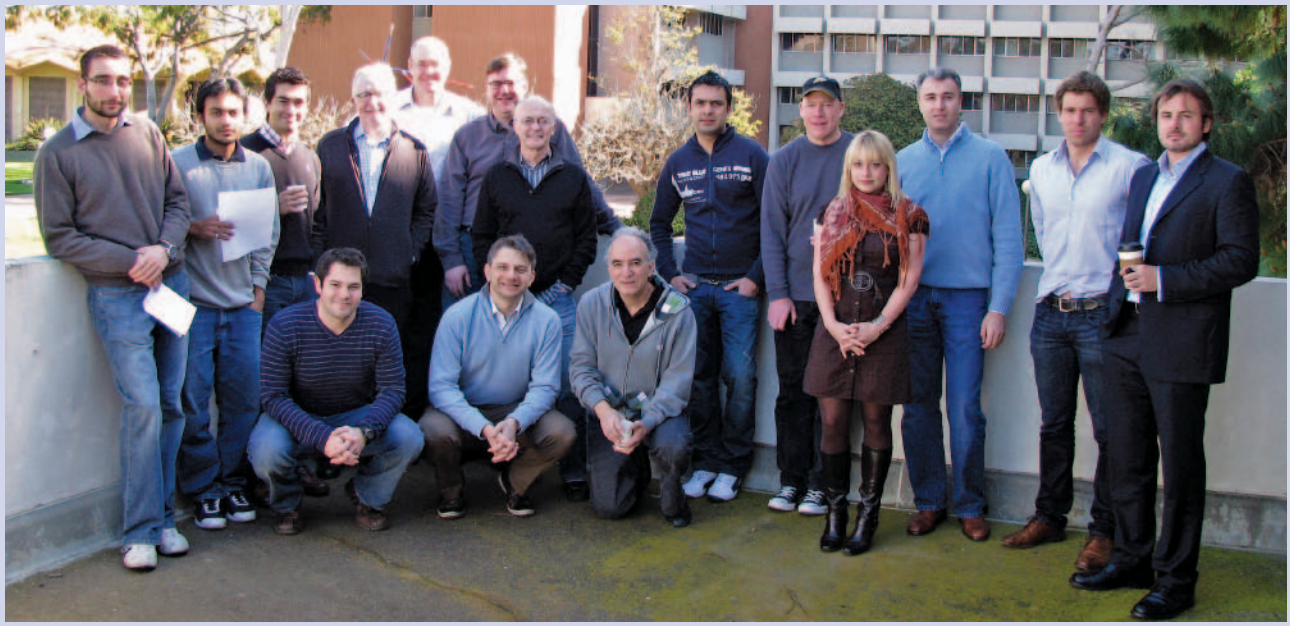
The Costs of Emerging Market Financial Crises: Output, Productivity and Welfare
Guido Sanderlis and **Mark L.J. Wright**

Limited Nominal Indexation of Optimal Financial Contracts
Césaire A. Meh, **Vincenzo Quadrini** and Yaz Terajima

A Theory of Firm Decline
Gian Luca Clementi, Thomas Cooley and Sonia De Giannatale

Aggregate Consequences of Firm-Level Financing Constraints
Stéphane Verani — Ph.D. Candidate, UCSB

Equilibrium Default
Hugo Hopenhayn and Iván Werning



Firm Financing, Dynamics and Growth conference participants, February 2010.

PRESENTATION SUMMARIES

The Costs of Emerging Market Financial Crises: Output, Productivity and Welfare

by Guido Sandleris and Mark L.J. Wright

This paper studies the links between changes in output, productivity and welfare, and makes a connection to the underlying production technology firms face. Emerging market financial crises are costly as output falls substantially: 15% in 2002 for Argentina, for example. Magnitudes of different aggregate variables have been a puzzle. Declines in capital and employment are much smaller than output. As a result, the Solow residual falls considerably, 9% in the Argentina example. It is not clear why output should decline. Declines in the national capital stock seem to be moderate, while the decline in wealth could be expected to result in greater labor supply. The focus turns to productivity and resource allocation. The hypothesis that resources are allocated more inefficiently during crises is proposed, and the paper presents a framework for measurement.

A small open economy is modeled similar to Backus, Kehoe and Kydland (1991), as domestic goods that are also exported are combined with imported goods to produce an aggregate good used for consumption, investment and government spending. Many industries produce different goods, and production takes place in plants that act competitively but are subject to idiosyncratic distortions. Agents have perfect foresight, with the exception being the financial crisis, triggered by a change in the international price of goods, the world interest rate, and the distribution of wedges. Wedges include shocks to productivity and also to the cost of input factors, which can be interpreted as subsidies or taxes. An increase in the variance of productivities leads to an *increase* in aggregate productivity since the most efficient plants become more productive. However, increases in the variance of factor wedges lead to a *decrease* in aggregate productivity, due to an increase in the most distorted plants.

Argentine data from 2002 suggest a drop in productivity for a large number of firms and a significant labor wedge. There is little evidence of a significant wedge in intermediate inputs or capital. The model suggests that one-third to one-half of the decline in output can be attributed to inefficient resource allocation. Perhaps deterioration of the financial sector influences the functioning of the labor or working capital market through the credit market. Kydland wondered if assuming the Argentine financial crisis was unexpected is reasonable. Wright then gave evidence that aggregate variables did not seem to react until the IMF made the announcement of the possible meltdown. Hopenhayn suggested that the picture might be different if 2004 data were studied as well. Uncertainty might cause firms to hold on to capital instead of reallocating it immediately. Wright replied that bond price data support the hypothesis that people were not optimistic with regard to a fast recovery.

Limited Nominal Indexation of Optimal Financial Contracts

by Césaire A. Meh, Vincenzo Quadrini and Yaz Terajima

Empirically, debt seems to be nominal even though theory suggests the optimal contract will be indexed to inflation. This paper proposes a mechanism which allows for endogenous partial indexation to study the effects of a price shock in economies with different price volatilities. Entrepreneurs finance projects through contracts with investors. Because of moral hazard problems, capital inputs are constrained by the entrepreneur's net worth. After entrepreneurs receive an unobservable idiosyncratic productivity shock, they observe the nominal value of output, without knowing actual productivity or price level. They make the contract renegotiation decision at this point, and find out the price level afterward. An unexpected positive price shock will be confused as a productivity shock and the investors will offer more capital to the entrepreneur.

Due to the hidden nature of productivity, any contract that makes payouts dependent on productivity will be renegotiated. Only contracts that are contingent on the observed value of output will not be renegotiated, allowing nominal price fluctuations to have real effects. Different monetary policy regimes are modeled with different price volatilities. Economies with greater price volatility will be less likely to confuse the inflation shock with a positive productivity shock. Information is noisy in the high volatility economy, so decisions are not affected significantly by the observation of revenues, and the value of the contract to the entrepreneur is less volatile. In fact, more firms obtain the optimal capital investment in the more volatile economy. This suggests that economies with higher price volatility

might be more stable. This is not the case: economies experience larger shocks on average, so they may still face greater macroeconomic volatility.

Kydland asked if the persistence of the shocks were important. Quadrini answered that persistence is not an issue: it is the unexpected component that drives the results.

Hopenhayn inquired why the agents were not renegotiating contracts conditional on price level. Quadrini explained that conditioning on price cannot induce better behavior, so it does not help improve efficiency. The entrepreneur either steals everything, or steals zero, and this is before price level is announced. It is the delay in observed price level which suggests, interestingly, that increased price volatility leads to less renegotiation, and more stable contracting.

A Theory of Firm Decline

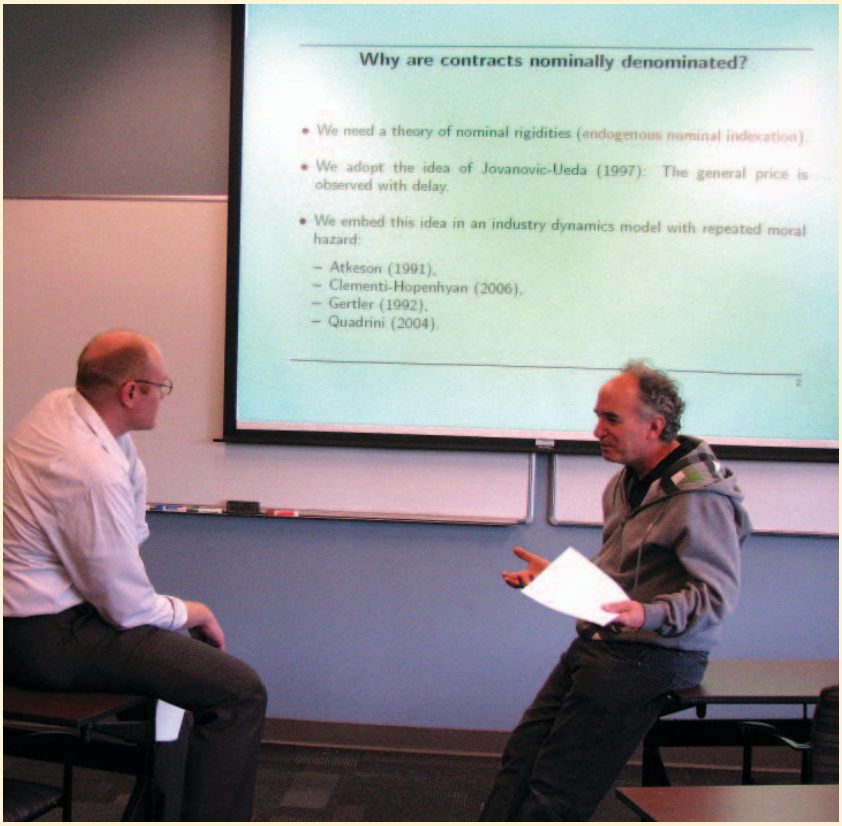
by Gian Luca Clementi, Thomas Cooley and Sonia Di Giannatale

While most of the literature on firm dynamics focuses on the evolution of young firms, the authors of this paper seek to explain firm decline. Other theories predict average firm size and value increase monotonically over time. This paper finds moral hazard through hidden effort causes the value paid to the investor to decrease over time (outside equity) as the entrepreneur has to be paid an increasing amount (inside equity) to extract effort.

Firm output is dependent on a productivity shock with a distribution conditional on entrepreneur effort. The marginal effect of effort is decreasing as entrepreneurs work more, while the marginal cost of effort to the entrepreneur is constant. If an entrepreneur starts off poor, the investor need only promise small compensation to induce the entrepreneur to put forth high effort. As the entrepreneur becomes wealthier, she requires greater compensation to put forth effort. Investments start small, but all resources are invested. The value of the firm and the investments then increase with good productivity shocks. However, entrepreneur compensation must also increase to continue to extract optimal work effort. At a certain capital level, it becomes too hard to extract high effort, and investors start promising less and investing less capital. The authors refer to this as the senility point in firm geriatrics.

Quadrini asked if capital stock depends on this upper bound for capital investment. Clementi replied that it does not matter for firm dynamics, but Hopenhayn pointed out that it does matter in terms of effort. There is a complementarity between optimal investment choice and effort. Discussion ensued on the application to CEO compensation; it seems this model would recommend that shareholders appoint a CEO, allow him to get rich, and then appoint a new one. Quadrini remarked that this is one explanation for the poor performance of firms with dynasties: when children of entrepreneurs take over the business, they usually do not perform well. Clementi suggested an interesting extension would be to allow shareholders (investors) to fire the CEO (entrepreneur).

While the authors were able to endogenize firm decline, some predictions do not match the data. For example, in the model, entrepreneur compensation increases as investor wealth declines. EXECUCOMP data from Standard & Poor's show that CEO compensation and shareholder wealth have a strong positive correlation. This motivated an extension of the model in which shocks are correlated over time. This implies an entrepreneur's effort does not only affect firm performance that period, but into the future as well.



Aggregate Consequences of Firm-Level Financing Constraints

by Stéphane Verani

Both private information and limited enforcement have been used in the firm dynamics literature to generate firm-level financing constraints which affect firm growth, volatility, entry, and exit. Verani's work compares the relative impact of each friction, and asks what the consequences are for aggregate variables when each friction amplifies the impact of aggregate shocks. In the private information economy, investors rely on entrepreneur reports as they do not observe firm-specific productivity shocks. In the limited-enforcement economy, shocks

are public information, but there is one-sided commitment and entrepreneurs may default. Each case is analyzed in a general equilibrium setting, and aggregate technology shocks are introduced for each. The main findings of the paper are that although firm growth is more volatile under private information, aggregate output is more volatile with limited enforcement only when punishment in case of default is not harsh.

Optimal contracts imply different firm growth behavior in the two economies. In the private-information economy, new firms start with a high enough value that they do not default during the first year, while firms in the limited-enforcement economy face a positive probability of liquidation during this period. Thereafter, firms only grow in the limited-enforcement economy, but a sequence of negative shocks could cause a firm to face liquidation in the private-information case. Thus, younger firms tend to be smaller in the private information economy, but reach unconstrained size faster. A positive aggregate technology shock corresponds to all new firms starting with a high productivity project; a negative shock implies only half of new firms start with high productivity. Higher rates of entry and exit in the private-information economy mean a shock is felt longer in the case of limited enforcement, one explanation for the aggregate volatility.

Questions arose over the effect of the aggregate shock on older firms. Clementi asked if a positive aggregate shock meant recession for existing firms due to higher factor prices. Verani responded that indeed, positive shocks are bad for incumbent firms, as all firms will be affected by price changes. The difference is with respect to the incentive compatibility (no-default) constraint. With limited enforcement, the aggregate shock affects this constraint, while it remains unaffected in the private-information economy. Quadrini speculated over the comparability of these two economies under the aggregate shock given this asymmetric effect. Participants agreed that other mechanisms for generating aggregate volatility might be worth exploring as well.

Equilibrium Default

by Hugo Hopenhayn

Hopenhayn and Werning introduce private information to a principle-agent limited commitment model to understand the implications of equilibrium default. Under standard limited-commitment models, incentive compatibility will ensure that default never occurs in equilibrium. By allowing outside offers to be private information there will be inefficient defaults, which are in some sense unanticipated. Hopenhayn referred to the private information friction as the "building block for borrowing constraints." The optimal contract will be risk-adjusted, one-period, non-contingent loans. Although default will occur along the equilibrium path, the probability of default will decrease over time, as inside equity increases and outside equity decreases. Lower default rates in turn cause investors to lend more over time.

One may think of not only a borrower-lender relationship, but also an employer-employee contract. An employee has incentive to bargain with her employer when outside offers arise. As the employer cannot accurately measure the value of the outside offer to the employee, sometimes resigning is the privately efficient (although socially inefficient) optimal response of the employee. Is there no revelation mechanism to force truth-telling? The optimal contract will always be a take it or leave it offer, implying the best that can be done is separation into two types: those who will default and those who will not. Hopenhayn was still considering the possibility of lotteries as a means of improving efficiency over default at the time of the presentation.

The interest rate that will implement this optimal contract is risk-adjusted and takes into account the strategic complementarities between current and future interest rates. High future rates imply the value of sticking with the contract are lower, thus the value of default is higher, which leads to a higher risk adjusted interest rate today. Quadrini asked if the marginal value of debt could be negative. Hopenhayn explained that the value of debt to the investor has a negative component, part of which is an increasing value of the outside option. Quadrini also pointed out that previous literature has excluded firm counteroffers by assumption. This paper gives some intuition behind why they may not.

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