FROM THE LAB

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A Message from the Director

Finn Kydland

This issue of From the Lab reports on a LAEF-sponsored two-day conference entitled "Growth and Development." The study of development economics has traditionally been the realm of applied microeconomics whereas the study of economic growth has been conducted within the field of macroeconomics. There is, however, an increasing awareness that growth and development issues need to be studied together, and that there are important interactions between the micro and the macro level. This requires the use of growth models that are firmly grounded in the available micro evidence. This conference sought to bring together recent studies that proceed in this spirit. The unifying goal of these studies was to understand cross-country differences in income and productivity. The specific topics covered ranged from the study of innovation and adoption of new technologies to the implications of barriers to entry into the formal economy.

Academic organizers of the conference were Berthold Herrendorf, Associate Professor of Economics, Arizona State University, and Gustavo Ventura, then at the University of Iowa, now Professor of Economics, Arizona State University.

The conference summaries – of the paper presentations as well as the accompanying discussion taking place among the conference participants – all are done by UCSB PhD students. Two of our most frequent summarizers, Till Gross and Stéphane Verani, are graduating and will be leaving us this summer, Till for Carleton University and Stéphane for the Federal Reserve Board.

A great success story resulted from Till and Stéphane being the summarizers of our conference on "International Trade and Development" about a year ago (summarized in our Fall 2010 issue). While realizing where the research frontier in the industrial-organization/international-trade area more or less was situated, it struck the two of them that potential existed for an important advancement to the literature. Within a couple of months, they had done enough of the research to write a reasonably complete first draft of their paper "A Theory of Firm Dynamics and International Trade." This paper has since been presented in seminars at several universities.

Their paper embarks from the fact that recent empirical studies have documented important differences in the behavior of large and small firms, as well as between exporting and non-exporting firms. Moreover, a consensus is growing that financing frictions impact firm dynamics significantly. To investigate how financial frictions affect the patterns of trade, Gross and Verani employ a model economy with monopolistic competition in which these frictions lead to firm heterogeneity. In their model, such heterogeneity is not induced by a one-time productivity draw, as in much of the modern trade literature. Rather, firms are heterogeneous because they face different financial conditions, which are the outcome of financing decisions that are constrained efficient under private information. Preliminary findings suggest that the model can account for many of the empirical regularities documented in the industrial organization and international trade literature.

The next issue of From the Lab will feature proceedings of the "Organization of Markets" and "Putting Information into (or taking it out of) Macroeconomics" conferences hosted by LAEF in the Spring of 2011.

Laboratory for Aggregate Economics and Finance

Finn Kydland
Director

Peter Rupert
Associate Director

Carmen Earle
Business Manager

2112 North Hall
University of California,
Santa Barbara
Santa Barbara, CA 93106-9215
U.S.A.
Phone: (805) 893-2258
Fax: (805) 893-8830
Email: carmen@econ.ucsb.edu
www.laef.ucsb.edu

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Economic Growth and Development

NOVEMBER 12-13, 2010

VISITING CONFERENCE PARTICIPANTS

Benjamin Bridgman – *BEA*
Francisco J. Buera – *UCLA*
German Cubas – *Banco Central del Uruguay*
Douglas Gollin – *Williams College and Yale University*
Berthold Herrendorf – *Arizona State University*
Viktoria Hnatkovska – *University of British Columbia*
Charles A. Jones – *Stanford GSB and NBER*
Joseph P. Kaboski – *Notre Dame*
Peter J. Klenow – *Stanford University and NBER*
Per Krusell – *IIES, Stockholm University*
Julio C. Leal-Ordóñez – *CIDE, Mexico City*
Oksana Leukhina – *University of Washington*
Igor Livshits – *University of Western Ontario*
Marti Mestieri – *MIT*
Piyusha Mutreja – *University of Syracuse*
B Ravikumar – *University of Iowa*
Diego Restuccia – *University of Toronto*
Marla Ripoll – *University of Pittsburgh*
Andrés Rodriguez-Clare – *Penn State University*
Todd Schoellman – *Arizona State University*
Nancy Stokey – *University of Chicago*
Akos Valentinyi – *Cardiff Business School*
Guillaume Vandenbroucke – *University of Iowa*
Gustavo Ventura – *University of Iowa*

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

Distortions, Infrastructure and Labor Supply in Latin American Countries

by German Cubas

One stark feature of Latin American countries' data is the historically low labor force participation rates of these countries relative to the United States. A closer look reveals that this is driven primarily by a large difference in female labor force participation (LFP) rates. In 1990, 39% and 37% of working-age women participated in the labor force in Brazil and Mexico, respectively. In contrast, this number was 69% for the U.S. What is even more striking is the increase in female LFP in Latin American countries since the 1990s. By 2005, Brazil's female LFP had virtually caught up with the U.S. at about 70%. Mexico lagged behind but still improved female LFP by a full ten percentage points in only 15 years. A back-of-the-envelope calculation suggests that differences in overall LFP accounted for about 20% of income differences between the U.S. and Latin America in 1990. What explains these trends? In this paper, Cubas proposes that the low adoption of household appliances due to high prices and restricted access to utilities (water and electricity) are at the heart of the explanation of why so many women chose not be a part of the workforce. The opening of Latin American economies to trade in the 1990s made household appliances affordable, and improved access to utilities allowed households to use these technologies.

An overlapping generations model of home production is used to explore these trends. The economy is populated by households who derive utility from market consumption, non-market consumption, and leisure. Households are composed of a male and a female, each endowed with one unit of time. Males always work in the market. Females choose each period to work in home production or in the market, or to enjoy leisure. Home production is such that the purchasing of a durable good guarantees a minimum amount of non-market consumption. Agents are heterogeneous in market labor ability and in asset holdings. Additionally, households are heterogeneous in the adoption of a new technology (household appliances) and in access to utilities. Once a household adopts the new technology, it does so forever, and the female works in the market. If a household does not have the new technology but has access to utilities, the female does housework and the household decides each period whether to purchase the technology or not. Finally, if the household does not have access to utilities, then it is not able to purchase the technology and the female does housework forever.

The model is asked to deliver differences in LFP and adoption of household durables in an array of dimensions. Specifically, the object of interest is female LFP and adoption of household appliances by the U.S., Brazil, and Mexico in 1990 and in 2005. Calibration is targeted to match country and time-specific income distributions, population age composition, access to utilities by income quintile, gender wage gaps, and household appliance prices. The model succeeds strongly in replicating adoption and female LFP for the United States, female LFP in Brazil in 1990, the increase in adoption in Brazil in 1990, and the increase in adoption rates in Mexico. The model underperforms in replicating LFP in Mexico and adoption in Brazil. These quantitative discrepancies, Cubas noted, seem to indicate that Mexico's LFP case is more complex than the model allows for, and that washing machines are not the best measure of household appliance use in Brazil.

Castes and Labor Mobility

by Viktoria Hnatkovska, Amartya Lahiri, and Sourabh B. Paul

From 1947 to 1983, India's average annual GDP growth rate was about 3% to 3.5%. From 1983 to 2005, India's average annual GDP growth rate hovered between 8% and 10%. Has this economic miracle been reflected in the economic outcomes of one of its poorest and most disadvantaged groups, the Scheduled Castes and Scheduled Tribes (SC/ST)? What are the key channels through which macroeconomic gains have improved the economic outcomes of SC/ST households? Hnatkovska, Lahiri, and Paul use data from five successive rounds of the National Sample Survey from 1983 to 2005 to compare patterns of occupation choices, education attainment and wages of SC/ST households to those of non-SC/ST households. The authors conduct their analysis along two dimensions: an intra-generational comparison that focuses on the time series evolution of education, occupation and wages, and an inter-generational comparison that focuses on educational mobility, occupation/industry mobility, and income mobility.

The results indicate that the households of SC/ST groups have advanced their economic outcomes significantly relative to non-SC/ST groups. In the past 25-30 years, SC/ST have converged to non-SC/ST in education attainment levels, occupation distribution, relative wages, intergenerational education mobility, and intergenerational income mobility. Moreover, these trends are sharpest among

younger age cohorts and among urban households. The one area where SC/ST and non-SC/ST differences have remained unchanged is in intergenerational occupational and industry mobility rates. That is, children in non-SC/ST households continue to be more likely to work in different occupations, and/or different occupations, and/or different industries than their parents relative to children from SC/ST households.

Conference participants asked for clarification for the choice of social group and time frame that were chosen for the study. Ideally, one would like to perform the comparison among all classes. A participant wondered why the analysis started at the 1980s if the major SC/ST affirmative action reforms were introduced in the 1950s. The response to both questions was data limitations. Another participant found it troubling that in the education analysis, levels of education higher than secondary education (technical, college, etc.) were grouped together. This by itself would bias education mobility rates to be higher for lower levels of education. At the end of the presentation, there was some discussion for future work on testing different possible explanations of the results. One likely candidate is Becker's (1957) theory where the costs of discrimination for firms increase as competition increases. Other possible theories are better opportunities that arise from better macroeconomic conditions, effective affirmative action laws, or increased political empowerment from democracy. It was suggested that an interesting test would be to compare the outcomes of SC/ST households in India with those of West Bengal, which is a communist state in India.

Explaining Educational Attainment across Countries and over Time

by Diego Restuccia and Guillaume Vandenbroucke

Time series data on schooling across countries display a puzzle. In 1950, schooling levels were much lower in poor countries than in rich ones. However, between 1950 and 2005, poor countries had a much faster increase in average years of schooling than rich countries even though income per capita levels of poor countries failed to catch up with the rich. Restuccia and Vandenbrouke put forth a model of human capital accumulation with non-homothetic preferences that generates this kind of behavior. When exogenous changes in productivity levels, productivity growth, and life expectancy across countries and over time are incorporated, the model is able to explain 89% of the difference in schooling levels between rich and poor countries in 1950, and account for 78% of the increase in schooling over time in poor countries.

An overlapping generations model is constructed that features cohorts with separable preferences over consumption, leisure and schooling. Specifically, cohorts have log utility over schooling and log utility over consumption above a subsistence consumption level. These preferences have the desirable property that the income effect of schooling is decreasing in wealth. For very high levels of income and consumption, the income effect is almost completely cancelled out by the substitution effect. In addition, Restuccia and Vandenbroucke assume that the subsistence level of consumption is increasing in productivity. Without this last assumption, the model is not able to match the curvature of the time series of hours of work in U.S. data. The human capital accumulation technology follows Bils and Klenow (2000), and is a function of educational services and schooling. Finally, the authors abstract from life-cycle decisions by assuming that consumption and leisure are constant for a specific cohort given that the interest rate equals the discount rate.

Discussion arose among conference participants over the use of non-homothetic preferences in the model. One participant pointed out that the distribution of income within countries matters when agents have non-homothetic preferences, but this is not explicitly modeled. Another participant mentioned that it is hard to tell a story where the level of subsistence consumption is changing with productivity, and even harder to map micro data to this subsistence consumption level. Vandenbroucke replied that these assumptions on subsistence consumption should not be interpreted literally but should be understood as a reduced-form expression that can be obtained from a variety of models, such as a model of home production. The assumption of schooling entering positively in the utility function was also debated. One participant pointed out that it is hard to make sense of the college over high school premium if agents derive positive utility from schooling. Vandenbroucke replied that it is not clear that people derive negative utility from schooling since we see cases of people getting schooling after they retire. Overall, the questions centered around the desirability for better micro foundations in the paper. The problem, however, is that micro data on some of these countries for these years are limited and/or of poor quality, so in the authors' view, a reduced form approach seems appropriate. A suggestion was made that to overcome data issues the authors could repeat their exercise with different U.S. states instead of different countries.

Beyond GDP? Welfare across Countries and Time

by Charles A. Jones and Peter J. Klenow

Welfare is at the heart of many important questions in economics. Yet, the search for a better measure of welfare than GDP per capita remains elusive. In this paper, Jones and Klenow attempt to construct such a measure in a novel manner. The result is a summary statistic that takes into account average consumption, leisure, life expectancy and inequality in a way that mimics the consumption equivalence calculation pioneered by Lucas (1987). Two basic approaches are developed. One approach relies on macro data, which are widely available but require strong modeling assumptions. The other approach uses micro data which allows for much more generality but is constrained by limited data.

In order to perform comparisons, preferences are assumed to be the same across countries. For the baseline calculations, log utility is assumed. Data on consumption and leisure can be plugged into the utility calculation directly. The next ingredient is to assume the perspective of a person who decides what fraction of U.S. consumption would make him indifferent between living the life of a random person in a different country for a year, facing that country's mortality rates, and its distribution of consumption and leisure. Effectively, the perspective is that of a person behind a Rawlsian veil of ignorance. In practice, this scenario is introduced as an expected utility calculation over the probability that an agent lives one more year given that he is a assigned a specific age. These probabilities are calculated from data on mortality rates. Finally, the agent prefers less consumption inequality as it reduces uncertainty of the wealth level he will be assigned. If consumption is assumed to be log-normally distributed, as it is in the baseline, then a disutility for variance comes out naturally from the expected utility calculation. The baseline calculation reports the geometric average of the compensated variation and the equivalent variation.

The calculations deliver four key findings. First, GDP per capita is highly correlated with welfare. This might lead one to think that this exercise just confirms that GDP per capita is sufficiently informative about welfare. However, the remaining findings reveal that differences between GDP per capita and welfare measurements are important as well. Second, Western Europe looks more like the U.S. due to its lower inequality, higher life expectancy, and additional leisure. Third, many developing countries are much poorer than income data suggest because of a combination of shorter lives and extreme inequality. Fourth, from the years 1980 to 2000, average growth rates of welfare have been faster than average growth rates of income, mainly due to the large gains in life expectancy throughout the world (except in Africa).

Using micro data, the authors are able to improve the measure in several aspects. Specifically, with Household Survey data, one can measure consumption inequality directly rather than inferring it from income inequality, relax the assumption of log-normal distribution of consumption, verify that the measure of consumption is consistent across people, account for leisure inequality, and adjust for the age composition of population and age-specific consumption, leisure and survival rates. Repeating welfare calculations with these modifications, however, does not overturn any of the key findings. The authors are quick to note that these calculations can be refined and expanded in many other directions. With more and better micro data one could account for factors such as morbidity as well as mortality and deal with issues arising from mismeasurement of the informal economy. It is also not clear how to account for other factors that affect welfare but were excluded in the analysis, such as crime, environmental conditions, and political freedoms, among others. An interesting test that was proposed by a conference participant was to see if immigration patterns confirm the results of the paper. The quest for the ideal welfare measure continues.

The Macroeconomics of Microfinance

by Francisco J. Buera, Joseph P. Kaboski and Yongseok Shin

The provision of credit to the poorest entrepreneurs with little or no collateral requirement, formally known as microcredit or microfinance, has become one of the most popular economic development policies. As of 2007, the microfinance industry served around 533 million people in developing nations, with access growing by up to 29% a year. Programs that provide credit to small businesses are common even in rich economies such as the United States. Yet, all quantitative evaluations of these programs are almost exclusively limited to microevaluations. Buera, Kaboski and Shin attempt to fill this void and quantify the macroeconomic impacts of economy-wide microfinance. Their findings suggest that the effects of microfinance on income per capita are minimal. The positive effects on Total Factor Productivity (TFP) from opening access to credit to the poor but productive entrepreneurs are more than offset by the overall decline in capital due to the lower savings rate of poor agents. Microfinance implemented with higher loans, however, raises TFP, capital and income per capita.

Microfinance is studied in the context of a model where agents are heterogeneous in exogenous entrepreneurial productivity and endogenous wealth. Entrepreneurial talent evolves stochastically. Agents decide each period to work for a wage or start a business in the small-scale sector (services) or large-scale sector (manufacturing). There is a fixed cost to starting a business. A financial friction in the form of collateral requirements (imperfect contract enforceability) hinders poor but productive agents from obtaining the funds to become an entrepreneur. Microfinance is introduced as a guaranteed minimum loan not limited by an agent's wealth or talent. The model is calibrated to the U.S. economy, and experiments are done by changing the size of the microfinance loan (which also increases the number of agents who have access to microfinance) and increasing the enforcement parameter (improvement in institutions that raises borrowing limits for all agents). Of these experiments, the largest impact on output comes from the improvement in the enforcement parameter. A comparison between one sector and two sectors in the second part of the paper illustrates the potential positive impact of microfinance if it reaches the large scale sector.

The paper generated a lively discussion among conference participants. One of the issues that was raised was that of insurance. In the paper, poor agents have a low savings rate because they do not have a precautionary savings motive. Having the option of working for a wage serves as an implicit insurance for poor agents. Wealthy agents, on the other hand, hold precautionary savings because their wealth can decrease over time. One participant pointed out that, contrary to the model, wealthy people are better insured than the poor in the data. Buera responded that the data also show that entrepreneurs have a higher savings rate than non-entrepreneurs. Another participant mentioned that the results might change drastically if unemployment or earnings risk were included in the model, since that would make poor agents hold more precautionary savings. It was also pointed out that loan default decisions are not explicitly modeled and the incentives for not defaulting are an important aspect of microfinance. Instead, agents are assumed never to default. Buera replied that the microfinance industry boasts repayment rates of over 97%, therefore this assumption is well-founded. It was the participant's opinion that no default should be an equilibrium result rather than an assumption.

Catching Up and Falling Behind

by Nancy Stokey

Evidence in the literature broadly points to the conclusion that growth is largely explained by technology differences. Development stories have taken many different forms: some countries experiencing rapid growth, catching up to the frontier, while others lose ground. Stokey develops a model that attempts to explain both phenomena through technology diffusion and human capital accumulation as the determinants of income growth. Closely resembling a Nelson-Phelps (1996) type model, technology flows in from abroad at a rate determined partly by the closeness of the country to the world technology frontier. Human capital augments technology growth as well as productivity in labor. Households choose between goods production and human capital accumulation, both costly endeavors.

Additionally, two policy variables play an important role in the equilibrium results. Local technology growth is negatively affected by a policy that serves as a barrier to growth. The author interprets the variable as any policy that impedes access to or adoption of new ideas, or reduces the profitability of adoption (p. 11). Secondly, to allow for balanced growth, time spent investing in human capital is subsidized by the government. There are two long-run possibilities in the model. For low barriers to technology growth, or high values of the subsidy to human capital, there exists two balanced growth equilibria for relative technology levels. As barriers to growth increase or subsidies decrease, the two equilibria disappear, leading to stagnation. Stagnation in the model implies falling further behind

the technology frontier. Stokey calibrates the model and examines transition dynamics resulting from a decrease in barriers to technology adoption or an increase in human capital subsidies. The result closely resembles that of growth miracles. The transition to a higher balanced growth path features a small period of rapid total factor productivity growth, which translates into rapid income and consumption growth. This phase is followed by a longer period of modest TFP growth approaching the balanced growth level of technology.

The model suggests the transition to balanced growth is influenced to a greater extent by barriers to adoption as opposed to education subsidies. Discussion arose concerning this result. A conference participant suggested that if consumers faced borrowing constraints, as is true in most developing economies, the role of the education subsidy would be more important. The author agreed and mentioned the model would have to be changed to allow education to be a stronger conduit of TFP growth.

Competition and Productivity

by Benjamin Bridgman

An increase in competition has been found to increase labor productivity. Existing literature notes this trend and has argued that productivity gains come largely from a reduction in restrictive work rules. These rules are in the form of constraints on a firm that induce wages to be paid for non-productive work hours. This paper explores and models this mechanism.

Bridgman, admittedly, uses a stylized notion of work rules in the form of fixed labor costs. This form captures characteristics of work rules that weaken the link between pay and hours worked. The model consists of a monopoly firm that uses capital and labor in production. Labor is represented by a union that dictates a wage and work rules to the firm. Therefore, the union is in a position to extract profits from the monopoly and to pass them on to their members. The version of the paper presented at the conference consisted of unions having lexicographic preferences, first to maximize employment, and then after full employment is realized, maximize the wage. Outside the monopoly sector there exists a continuum of competitive sectors in which labor can freely move. For a worker, leaving the monopoly sector entails losing union representation and receiving the competitive wage. Finally, competition is studied through the introduction of a foreign sector that produces the monopoly product at a given foreign price. Competitive and non-competitive equilibria are obtained depending on the price level in the foreign sector.

In equilibrium, work rules provide a way for the union to extract a higher level of profits from the firm by increasing labor demand without decreasing wages. Since the union can dictate the labor fixed cost (*i.e.* the level of unproductive workers), wages and labor demand don't have a strictly decreasing relationship. The author uses a baseline model without competition which is characterized by high foreign prices, high monopoly wages, and full employment of union workers. As foreign prices are lowered, the union must lower work rules to maintain full employment, a direct result of lexicographic preferences. The reduction in work rules leads to an increase in output. Since full employment is maintained, productivity increases.

The results of the paper rely on the form chosen for union preferences and questions arose as to the motivation of these preferences. The author noted there was some empirical evidence that unions care about employment to the point of sacrificing wage levels. A conference participant suggested a motivation for lexicographic preferences could come from implementing the model in a dynamic setting. In the first period, the union has an incentive to remain small so that in the following period it provides more power to each member. With this approach, a preference could be derived for maintaining a threshold employment level, therein motivating the lexicographic framework implemented in the static setting.

Informal Sector, Productivity and Tax Collection

by Julio C. Leal-Ordóñez

In most developing countries, a large percentage of economic activity is done through informal markets. In Mexico, the primary example in the Leal-Ordoñez paper, 31% of employees work in an establishment classified as informal. Additionally there is a large connection between firm size and informality. The paper shows that informal establishments are concentrated at the low end of the distribution of firm size as measured by number of employees, and that these establishments have consistently lower capital-labor ratios compared to formal establishments. Previous work has shown that the link between formality and firm size could be a result of tax avoidance.

The determinants of an informal sector, including tax avoidance, have been largely explored in the literature, but the consequences on growth have had little development. The author's goal is to develop an equilibrium model that examines the extent to which the size distribution of firms (*i.e.* the distribution of formality) is the result of a distortion induced by incomplete enforcement and to determine the effect of this distortion on labor productivity.

The economy is populated with a continuum of heterogeneous agents separated by entrepreneurial ability. Each agent faces an occupational choice. He or she can become an entrepreneur, who can operate a firm in the formal or informal sector, or become an employee. In the formal sector, firms are required to pay output taxes, however tax avoidance is possible by operating in the informal sector as long as capital per worker is below a threshold. In equilibrium, this creates an incentive for low productivity entrepreneurs, and hence those with low capital-to-output ratios, to operate in the informal sector. The author defines a steady-state equilibrium and shows that the equilibrium can be characterized by three threshold levels of entrepreneurial ability. The individuals with the lowest ability become employees, those with ability in a non-measure-zero range become informal entrepreneurs, and those at the upper end of the distribution become formal entrepreneurs. This separation exists given that taxes are not too high and the threshold for tax avoidance is not too low. Finally, the author calibrates the model to match the Mexican economy and investigates the effects of incomplete enforcement policies on labor productivity. The exercise consists of implementing full tax enforcement while decreasing the tax rate to keep tax revenue unchanged, in order to quantify the costs of incomplete enforcement. The author finds that under complete tax enforcement, the model generates a 17% increase in labor productivity and a 64% decrease in the tax rate. The increase is largely due to increased capital accumulation and to a lesser but non-negligible extent, total factor productivity changes.

The model uses data from the Mexican Urban Household Survey. The author's motivation for using the data follows from the fact that it has a richer set of information about informality. A conference participant suggested that the Mexican census could provide an equally informative data set while providing a better connection with establishments. Another conference participant raised a concern about the possibility of bribes playing an important role as a tax that firms pay to operate informally, a so-called informal tax. Another participant added that the World Bank has data on bribes in developing countries. The discussion centered on the use of these data sources to enhance the story of tax avoidance as a mechanism for informality.

The Intensive Margin of Technology Adoption

by Diego Comin and Marti Mestieri

Following the work of Comin and Hobijn (2004) and Comin, Hobijn and Rovito (2006), Comin and Mestieri develop a model that incorporates an extensive and intensive margin of technology adoption in order to quantify the relationship between cross-country differences in these measures and cross-country differences in productivity growth. For a particular technology, the extensive margin is defined as the length of time a country takes to adopt the technology, while the intensive margin refers to the number of goods demanded that embody the technology relative to aggregate demand. The two-margin description of technology adoption allows the authors to better match the concepts to the data.

The authors use a one-sector neoclassical growth model with endogenous technology adoption that leads to growth in total factor productivity (TFP). Technology in this framework is a set of production methods used to produce closely related intermediates. At the microeconomic level, firms decide technology adoption at the extensive margin by choosing an adoption lag in capital vintages. The set of available vintages grows at a constant rate, interpreted as a growing technology frontier, so the adoption lag is defined by a decision not to adopt the entire available set of vintages. The intensive margin is modeled as the number of capital applications (producers) of a particular vintage. The set of vintages is split into two subsets defining new and old technology. The economy is populated by different markets (islands) that differ by adoption costs and technology parameters. The authors then study balanced growth equilibrium such that, for each country, both margins are constant. The equilibrium provides an endogenous level of TFP for a new technology. The structural framework provides determinants of a time path for TFP. Data on TFP for particular country-vintage pairs are then used to estimate adoption intensities and lags. The result is a large cross-country dispersion in intensive margins across a number of technologies. The dispersion in the extensive margin, however, has declined significantly over the last two centuries.

A conference participant asked, given the empirical findings on convergence of adoption lags, what characteristic of the model could be driving those results. Mestieri suggested the possibility of a decrease in the costs associated with adoption.

Sources:

Comin, Diego, and Bart Hobihn. 2004. "Cross- Country Technology Adoption: Making the Theories Face the Facts." Journal of Monetary Economics, 51(1): 39-83.

Comin, Diego, Bart Hobijn, and Emilie Rovito. 2006. "Five Facts You Need to Know About Technology Diffusion." NBER Working Paper #11928

The World Distribution of Productivity: Country TFP Choice in a Nelson-Phelps Economy

by Erika Färnstrand Damsgaard and Per Krusell

Growth accounting suggests that productivity differences explain a large proportion of income differences across countries. This feature is well noted in the growth literature, yet little work has been done to understand the distribution of TFP across countries. Data suggest that there are large TFP differences and there is evidence that the distribution is double-peaked. The authors' goal is to provide a framework to explain these empirical regularities.

Damsgaard and Krusell extend a Nelson-Phelps framework, which is characterized by total factor productivity (TFP) growth depending on investment in human capital (or education) and a spillover effect. The spillover effect is captured in a "catch-up" term which depends on the distance away from the frontier technology. The economy is populated by a continuum of countries that produce output and invest in TFP. TFP decisions are endogenous, taking the world technology as given, a fact the authors note is vitally important for a model to explain the world productivity distribution. Each country has a dynastic utility maximizing household that is endowed with one unit of immobile low-skilled labor, which is used for production, and some high-skilled labor used for TFP accumulation. High-skilled labor can move freely between countries. The focus is necessarily on the mobility of high-skilled workers, while low-skilled labor is simply included as an input in production.

Since the focus of the paper is on TFP across countries, the authors solve a planner's problem and focus on balanced growth equilibria. If an assumption about perfect world capital markets is added, the key equilibrium equation is primarily dependent on a parameter that defines the strength of the catch-up effect. The authors show for high values of this parameter (*i.e.* when the catch-up term is strong), a symmetric balanced growth equilibrium exists and is stable. As the catch-up parameter is lowered, the symmetric balanced growth equilibrium turns unstable, then disappears completely. As the symmetric balanced growth equilibrium disappears, an asymmetric balanced growth equilibrium surfaces. This equilibrium is characterized by two stable TFP points and hence a bimodal distribution. The intuition of the two equilibria is as follows: The catch-up term generates convergence in the model since it provides faster TFP accumulation for countries at the low end of the distribution relative to those at the high end. However, country-specific gains from TFP investment due to large decreases in future investment costs generate divergence. The authors note these gains are in the form of dynamic increasing returns to technological investment. The force that dominates in equilibrium depends on the strength of the catch-up term.

At Krusell's direction, discussion occurred about the interpretation of the catch-up term. The term in the model captures both technological catch-up and dynamic increasing returns. Krusell suggested that one term capturing these two effects could potentially be problematic. A conference participant mentioned using dynamics to interpret the term as a convergence parameter. Another participant suggested using the model to explain a distribution of firm size, which could provide a better setting to interpret this term.

Laboratory for Aggregate Economics and Finance
University of California, Santa Barbara
Santa Barbara, CA 93106-9215 U.S.A.

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