

Prasad, Eswar S.

Article

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NBER Reporter

Provided in Cooperation with:

National Bureau of Economic Research (NBER), Cambridge, Mass.

Suggested Citation: Prasad, Eswar S. (2013) : Saving in developing countries, NBER Reporter, National Bureau of Economic Research (NBER), Cambridge, MA, Iss. 1, pp. 12-15

This Version is available at:

<https://hdl.handle.net/10419/103236>

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contrary view of the selection of Mexican migrants, see J. Fernández-Huertas Moraga, “New Evidence on Emigrant Selection,” *Review of Economics and Statistics*, 93(2011), pp. 72–96.

¹¹ D. McKenzie and H. Rapoport, “Network Effects and the Dynamics of Migration and Inequality: Theory

and Evidence from Mexico,” *Journal of Development Economics*, 84 (2007), pp. 1–24, and “Self-Selection Patterns in Mexico-US Migration: The Role of Migration Networks,” *Review of Economics and Statistics*, 92 (2010), pp. 811–21.

¹² G. Hanson, “Why Isn’t Mexico Rich?”

NBER Working Paper No. 16470, October 2010, and *Journal of Economic Literature*, 48(2010), pp. 987–1004, and M. Clemens, “Economics and Emigration: Trillion-Dollar Bills on the Sidewalk?” *Journal of Economic Perspectives*, 25 (2011), pp. 83–106.

Saving in Developing Countries

Eswar S. Prasad*

The evolution of national savings in developing countries (a broad term that I use here to refer to middle-income emerging markets, as well as less developed low-income economies) has received considerable attention in discussions of global current account imbalances. In the run-up to the global financial crisis, these imbalances were characterized by large and rising current account deficits in the United States, United Kingdom, and a few other advanced economies, matched by corresponding surpluses in many emerging markets and a few oil-exporting economies. Rising saving rates in China and many other Asian economies began to receive increased attention from researchers around this period, and Federal Reserve Chairman Ben Bernanke’s 2005 speech arguing that the “savings glut” in emerging markets was a proximate cause of the imbalances gave further impetus to that research.¹

Economists have been more successful in explaining changes in saving rates within specific countries over time than

in explaining differences in saving levels across countries.² The fact that Asian economies traditionally have had higher saving rates than developing and industrialized economies in other regions has received some attention, but there is no persuasive explanation for this phenomenon. Economists have had to rely on weak non-economic explanations, such as the argument that Asians are culturally predisposed towards saving. This hypothesis has been formally tested using data from the U.S. Census to examine whether immigrants to the United States from high-saving countries tend to save more than immigrants from low-saving countries. The results show that there are significant differences in immigrants’ saving behavior by country of origin, but those differences do not match up with the differences in national saving rates. In particular, immigrants from high-saving Asian countries do not save more than other immigrants.³

Saving in Asia

Given their high and rising saving rates, Asian economies have been the subject of considerable research. In an early contribution focusing on the region, Susan Collins looks at rising national saving rates in nine Asian developing econo-

mies (plus Turkey) over the period 1960–84. She concludes that high growth rates, a low dependency ratio, and high income levels are all positively associated with saving rates. She argues further that there are structural differences between low-income and middle-income countries in the determinants of savings.⁴

Charles Horioka and Akiko Terada-Hagiwara find that domestic saving rates in developing Asia rose during the period 1966–2007. They conclude that the main determinants of those trends were the age structure of the population (especially the elderly dependency ratio), income levels, and the level of financial sector development.⁵ They forecast that over the next two decades the domestic saving rate in developing Asia as a whole will remain roughly constant, despite rapid population aging in most of those economies, in part because the negative impact of population aging on the domestic saving rate will be largely offset by the positive impact of higher income levels.

National saving comprises saving by households, corporations, and the government. Household savings typically has attracted most of the attention of researchers because it is more amenable to theoretical modeling than the other components of national saving, and because its determinants can be analyzed using

*Eswar S. Prasad is a Research Associate in the NBER’s International Finance and Macroeconomics Program and the Tolani Senior Professor of Trade Policy and Professor at Economics at Cornell University. His profile appears later in this issue.

household-level survey data. Corporate saving (retained earnings) has received less attention, but in fact has been the key driver behind the surge in national savings in major Asian emerging markets during the latter half of the last decade.⁶

While household saving rates have also trended up in most major Asian economies, one prominent Asian economy where the household saving rate has fallen quite significantly over the last two decades is Korea. Young Jun Chun evaluates the effects of population aging and fiscal policies on national saving in Korea.⁷ Using a life-cycle model that incorporates a generational accounting approach, he argues that rapid population aging and the long-term budgetary imbalance have and will continue to drive down the national saving rate in Korea.

China

The sheer scale of China's saving, which now exceeds 50 percent of GDP, has drawn considerable research attention. Dennis Yang, Junsen Zhang, and Shaojie Zhou look at determinants of all three components of saving in China and conclude that economic, demographic, and policy trends in the internal and external environments of the Chinese economy are likely to lead to a decline in national saving in the foreseeable future.⁸

With greater access to household-level datasets, there has been an intense focus on explaining the rise in China's household saving rate. From 1995 to 2005, the average urban household saving rate in China rose steadily by 7 percentage points, to about one quarter of disposable income. The urban saving rate has continued to rise since then, driving the national household saving rate higher as well. Marcos Chamon and I use data from China's Urban Household Surveys to explain why households are postponing consumption despite rapid income growth.⁹ Tracing cohorts over time indicates a virtual absence of consumption smoothing over the life cycle. Saving rates have increased across all demographic groups, although the age profile of savings has an unusual pat-

tern in recent years, with younger and older households having relatively high saving rates. We argue that these patterns are best explained by the rising private burden of expenditures on housing, education, and health care. These effects and precautionary motives may have been amplified by financial underdevelopment, as reflected in constraints on borrowing against future income and low returns on financial assets.

In subsequent work, Chamon, Kai Liu, and I examine the role of precautionary saving motives in explaining both the increase in China's household saving rate since the mid-1990s and the interesting fact that the age-savings profile has become U-shaped during the 2000s.¹⁰ We find that, in addition to the factors identified in our earlier research, rising income uncertainty and pension reforms help to explain both of these phenomena. Using a panel of Chinese households covering the period 1989–2006, we document that strong average income growth has been accompanied by a substantial increase in income uncertainty. Interestingly, the permanent variance of household income remains stable while it is the transitory variance that rises sharply. A calibration of a buffer-stock savings model indicates that rising savings rates among younger households are consistent with rising income uncertainty and that higher saving rates among older households are consistent with a decline in the pension replacement ratio for those retiring after 1997. We conclude that rising income uncertainty and pension reforms can explain more than half of the increase in the urban household savings rate in China since the mid-1990s, as well as the U-shaped age-saving profile.

Other researchers have used less disaggregated data to provide complementary perspectives on household saving behavior. Horioka and Junmin Wan conduct a dynamic panel analysis of the determinants of the household saving rate in China using a life-cycle model and panel data on Chinese provinces for the period 1995–2004.¹¹ They find that the main determinants of variations over time and

over space are the lagged saving rate, the income growth rate, (in many cases) the real interest rate, and (in some cases) the inflation rate. They find little evidence that variables relating to the age structure of the population have the expected impact on the household saving rate. Their results provide mixed support for the life-cycle hypothesis and the permanent income hypothesis, and are consistent with the existence of inertia or persistence in household saving behavior.

Other research on China has emphasized demographic factors as one of the main determinants of the rising household saving rate. Chadwick Curtis, Steven Lugauer, and Nelson Mark undertake a quantitative investigation using an overlapping-generations model.¹² In their model, dependent children's utility enters into parents' utility so that parents choose the consumption level of the young until they leave the household. Working agents give a portion of their labor income to their retired parents and save for their own retirement, while the aged live on their accumulated assets and on support from their children. These researchers take future demographic changes, labor income, and interest rates as exogenously given. They argue that their calibrated model accounts for much of observed increase in the household saving rate from 1963 to 2009.

While evidence of conventional demographic factors, such as an aging population, in driving household saving rates has been mixed, there are other aspects of changing demographics in China that have been the subject of research as well. Shan-Jin Wei and Xiaobo Zhang propose a novel and unorthodox explanation based on competitive saving resulting from unbalanced sex ratios (tilted in favor of males) in China.¹³ As the sex ratio rises, Chinese parents with a son raise their savings in a competitive manner in order to improve their son's relative attractiveness for marriage. The pressure on savings spills over to other households. Both cross-regional and household-level evidence supports this hypothesis. They conclude that this motive potentially can account for about half of the actual

increase in the household savings rate during 1990–2007.

Abhijit Banerjee, Xin Meng, and Nancy Qian exploit the changes in China's demographics caused by its family planning policies to study the effects of changes in the demographic structure on savings and wealth.¹⁴ They find that children provide a substantial amount of support for elderly parents and that sons provide more support than daughters. Their empirical estimates support the predictions of a simple life-cycle model, based on which they conclude that the exogenous reduction in fertility because of family planning policy caused a significant increase in household savings, and that all of the increase is driven by parents who have a daughter as their only child.

Corporate Savings

As in other Asian economies, corporate saving was a principal driver of the rising national saving rate in China.¹⁵ During 2003–7, the share of household saving in GDP actually declined, even though the household saving rate (saving as a share of disposable income) continued to rise. This apparent anomaly is the consequence of a greater share of national income going to capital than to labor. If households effectively own the firms in an economy, either directly or indirectly, this should not matter because firms' profits will increase household disposable income. However, in China, a majority of firms are still state-owned and most of them don't pay dividends to the state.

China's high corporate saving rate has received attention in policy circles, but has been the subject of only limited research so far. Tamim Bayoumi, Hui Tong, and Wei examine firm-level data and conclude that it indicates a global trend of rising corporate saving over the period 2002–7.¹⁶ Chinese state-owned firms only recently were required to pay out dividends to the state, and these payments are still quite low relative to profits. However, these authors conclude that there is no significant difference in the savings behavior and dividend patterns

between Chinese majority state-owned and private listed firms. Other evidence reported by Loukas Karabarbounis and Brent Neiman suggests that China is not special and that declining labor shares and the rise of corporate saving are global phenomena.¹⁷ One factor behind these phenomena is the global decline in the cost of capital beginning in the 1980s, which has led firms around the world to shift away from labor and towards capital, financed in part with an increase in corporate saving.

More Work Ahead

With developing economies playing an increasingly important role in the global economy, there is growing interest in explaining saving behavior in these economies from both micro and macro perspectives. Increase in access to household and firm-level datasets in China and other developing economies has set off an exciting research program, although a number of questions have not yet been conclusively answered. For instance, the micro evidence suggests a range of plausible explanations for the rise in China's household saving rate, although there is no easy way to distinguish among these different hypotheses in a unified framework. Integrating the micro and macro perspectives to explain the determinants of saving-investment balances in these countries is likely to remain a fertile area of research.

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⁴ S.M. Collins, “Saving Behavior in Ten Developing Countries,” in *National Saving and Economic Performance*, B. D. Bernheim and J. B. Shoven, eds., January 1991, pp. 349–76. Also see S. Edwards, “Why are Saving Rates So Different Across Countries? An International Comparative Analysis,” *NBER Working Paper No. 5097, April 1995*, and *Journal of Development Economics, Vol. 51, no. 1 (October 1996)*, pp. 5–44.

⁵ C.Y. Horioka and A. Terada-Hagiwara, “The Determinants and Long-term Projections of Saving Rates in Developing Asia,” *NBER Working Paper No. 17581, November 2011*, and in *Japan and the World Economy, Vol. 24, no. 2 (March 2012)*, pp. 128–37.

⁶ See E.S. Prasad, “Rebalancing Growth in Asia,” *NBER Working Paper No. 15169, July 2009*, and *International Finance, Vol. 14, Issue 1, pp. 27–66, Spring 2011*.

⁷ Y. J. Chun, “Population Aging, Fiscal Policies, and National Saving: Predictions for Korean Economy,” *NBER Working Paper No. 12265, May 2006*.

⁸ D.T. Yang, J. Zhang, and S. Zhou, “Why Are Saving Rates so High in China?,” *NBER Working Paper No. 16771, February 2011*, and in *Capitalizing China*, J. Fan and R. Morck, eds., forthcoming from the University of Chicago Press.

⁹ M. Chamon and E.S. Prasad, “Why Are Saving Rates of Urban Households in China Rising?,” *NBER Working Paper No. 14546, December 2008*, and *American Economic Journal: Macroeconomics, January 2010, Vol. 2(1)*, pp. 93–130.

¹⁰ M. Chamon, K. Liu, and E.S. Prasad, “Income Uncertainty and Household Savings in China,” *NBER Working Paper No. 16565, December 2010*.

¹¹ C.Y. Horioka and J. Wan, “The Determinants of Household Saving in China: A Dynamic Panel Analysis of Provincial Data,” *NBER Working Paper No. 12723, December 2006*, and *Journal*

¹ B. Bernanke, “The Global Saving Glut and the U.S. Current Account Deficit,” *Sandridge Lecture, Virginia Association of Economists, Richmond, VA, March 10, 2005*.

² See S. Edwards, “Why are Saving Rates so Different Across Countries? An International Comparative Analysis,” *NBER Working Paper No. 5097, April 1995*, and *Journal of Development Economics, Vol. 51, no. 1 (October 1996)*, pp. 5–44. That paper also has a good survey of the literature that preceded it.

³ C.D. Carroll, B. Rhee, and C. Rhee, “Does Cultural Origin Affect Saving

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¹² C.C. Curtis, S. Lugauer, and N.C. Mark, “Demographic Patterns and Household Saving in China,” NBER Working Paper No. 16828, February 2011.

¹³ S. Wei and X. Zhang, “The Competitive Saving Motive: Evidence from Rising Sex Ratios and Savings

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¹⁴ A. Banerjee, X. Meng, and N. Qian, “The Life Cycle Model and Household Savings: Micro Evidence from Urban China,” forthcoming as an NBER Working Paper.

¹⁵ E.S. Prasad, 2011 (*op. cit.* endnote 7)

¹⁶ T. Bayoumi, H. Tong, and S. Wei,

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¹⁷ L. Karabarbounis and B. Neiman, “Declining Labor Shares and the Global Rise of Corporate Saving,” NBER Working Paper No. 18154, June 2012.

The Effect of Climate Change and Biofuel Mandates on Agricultural Output and Food Prices

Wolfram Schlenker*

The four staple commodities—maize, soybeans, rice, and wheat—account for roughly 75 percent of the world’s caloric consumption, either directly as food or indirectly in the form of feedstock for animals. The U.S. share of global caloric production in those four commodities is 23 percent, about three times Saudi Arabia’s market share in oil production. Of particular importance is U.S. maize (sometimes also called corn), the country’s largest crop, accounting for 10 percent of global caloric production. Given its market share, any policy or shock that affects U.S. maize production has worldwide ramifications for commodity prices, which move together because they are close substitutes.

While agriculture constitutes a small fraction of U.S. GDP, it is responsible for a large part of consumer surplus because agricultural demand is highly inelastic. The tripling of commodity prices between 2005 and 2008 reduced global

consumer surplus from the four basic commodities by approximately 1.25 trillion dollars annually. While various causes have been mentioned as possible driving forces behind the recent price increase, my past research has focused on two of them: the effects of weather on agricultural yields and the effect of biofuel mandates on food prices.

The Effects of Weather/Climate on Yields

Agricultural production, except for some specialty crops that are grown in greenhouses, depends directly on weather. Because weather is predicted to change over the next century, one natural question is how that will affect agricultural production and prices.

a) Extreme heat and crop yields

Michael Roberts and I linked a county-level panel of corn and soybean yield, the two largest crops in the United States, as well as cotton, a warm weather-crop, to a fine-scale dataset of weather outcomes that explain the distribution of temperatures within each day.¹ Yields increase linearly in temperatures up to 29°C (84°C) for corn, 30°C (86°F) for soybeans, and

33°C for cotton—above that, further temperature increases become harmful. The relationship above the threshold is again linear, but the slope of the decline above the optimum is an order of magnitude steeper than the incline below it: that is, being 1 degree above the optimum for ten days has the same effect as being 10 degrees above the optimum for one day. Both decrease annual maize yields by 6 percent. Note, however, that we are incorporating the entire temperature distribution within a day, and the largest fraction of a day is usually below the threshold. It takes several days with a maximum above the threshold to obtain a 24-hour exposure period above the threshold.

Most U.S. counties are expected to suffer yield declines under climate change. The predicted increase in the frequency of temperatures above the threshold accounts for the largest share of the estimated effect on yield, and trumpets the effect of temperature changes below the threshold, as well as precipitation changes.

Adaptation to extreme heat seems difficult or prohibitively costly. We obtain the same statistical sensitivity to extreme heat whether we look at the panel, a pure time-series linking annual overall U.S. yields to weather, or a cross-section linking aver-

*Schlenker is a Research Associate in the NBER’s Program on Environmental and Energy Economics and an Associate Professor of Agricultural and Resource Economics at the University of California, Berkeley. His profile appears later in this issue.