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The Region

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Persistent Poverty

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China Become?**

Taxing Wealth

Research Digest:

***Broken labor
matching efficiency?***

Optimal income taxes

Wealth and volatility

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Persistent Poverty on Indian Reservations: New Perspectives and Responses¹

Narayana Kocherlakota

President
Federal Reserve Bank of Minneapolis

Editor's note: The following is based on remarks delivered at the Federal Reserve System Community Development Research Conference on April 3, 2015, in Washington, D.C.

I want to talk to you about the community development needs and opportunities on American Indian reservations, by which I mean the self-governing American Indian communities collectively defined in federal law as Indian Country. But before I begin, let me note that the views I express today are my own, and not necessarily those of the Federal Reserve Bank of Minneapolis or the Federal Reserve System.

To set the stage for my discussion, recall that, in the 19th century, hundreds of formerly independent and culturally distinct tribes were forced onto reservations, often in remote areas. For many decades thereafter, their cultures and traditional governing institutions were suppressed, their land base was further stripped away and their affairs were largely controlled and governed by federal officials who permitted little local autonomy. Not surprisingly, economic development lagged on most reservations, leaving them as pockets of extreme rural poverty and underdevelopment. By the 1970s, however, civil rights activism and a shift toward decentralized economic policymaking created a consensus in support of greater tribal self-government. A combination of executive orders and federal legislation finally put tribal sovereignty and self-governance on firmer footing. At about the same time, other initiatives—separate in specifics, but similar in spirit—led to the passage of the Community Reinvestment Act (CRA) and the formation of the Federal Reserve System's community development function. Thus, meaningful tribal sovereignty within



the United States and the Federal Reserve System's formal commitment to community development both began about 30 to 40 years ago.

The community development needs of American Indian reservations immediately stood out by the CRA's criterion of low-to-moderate income. In 1970, the per capita income of Indians on reservations was, in units of 2009 dollars, not far above \$5,000 per year. This was about half to two-thirds of the income of blacks, Hispanics and nonreservation Indians and about a third of the income of whites. The per capita income of reservation Indians did not reach \$10,000 per year until Census 2000 and is still not far above that low threshold. Even now, poverty rates on reservations are nearly triple the national rate, and over 40 percent of children on reservations live in poverty.²

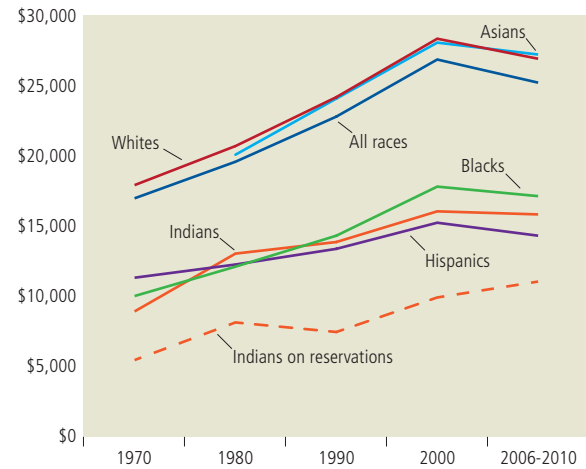
It is also important to note that progress has been made. Growth in real per capita income on Indian reservations accelerated in the 1990s and has outpaced U.S. per capita income growth since then (see Figure

1). As a result, the gaps have narrowed somewhat over time, and especially since the year 2000. I won't go into the details, but this is occurring even on many reservations without large casinos and reflects a lot of hard work by tribes and tribal members across the country. There's still a long way to go. But we should take heart, and draw inspiration for research, from the fact that on hundreds of reservations, representing over 90 percent of the reservation Indian population, per capita income has grown relatively fast over the past two decades.

The community development efforts of the people in this room and their partners around the world and in the Federal Reserve System also may have contributed, at least on the margin, to this relatively rapid growth in reservation Indian income since 1990. The Federal Reserve System's own work in Indian Country escalated in the early 1990s, after the denial of a proposed banking industry merger due to concerns that one of the institutions involved was not adequately serving an Indian reservation's credit needs. Partly as a result of this case, the Minneapolis Fed was encouraged by banks and tribes to assist in the development of enhanced tribal commercial laws, to facilitate the flow of credit on reservations. That effort blossomed into a major commitment and partnership with the Uniform Law Commission (ULC) to develop and provide national outreach and technical assistance for a model tribal secured transactions law and continues today in further work with tribes and the ULC toward a model tribal probate code.³ To complement the commercial law initiatives, the Minneapolis Fed helped organize Indian business alliances in several states, so that Indian business owners and others can advocate for good business laws and address financial and other barriers to business development on reservations. Other Reserve Banks, notably San Francisco and Kansas City, undertook related initiatives, such as programs to promote mortgage lending on reservations, and worked hard to build partnerships with the relevant federal agencies as well. Together and with staff at the Board of Governors, we organized periodic national listening sessions and conferences with tribal leaders, such as the Walking the Native Path conference in 1999, the Banking Opportunities in Indian Country conference in 2002 and a series of events across the country in 2011-2012. These last culminated in the Growing Economies in Indian Country national summit meeting at the Board of Governors in Washington, D.C., in

FIGURE 1

Real per capita income by census racial or ethnic category 2009 dollars



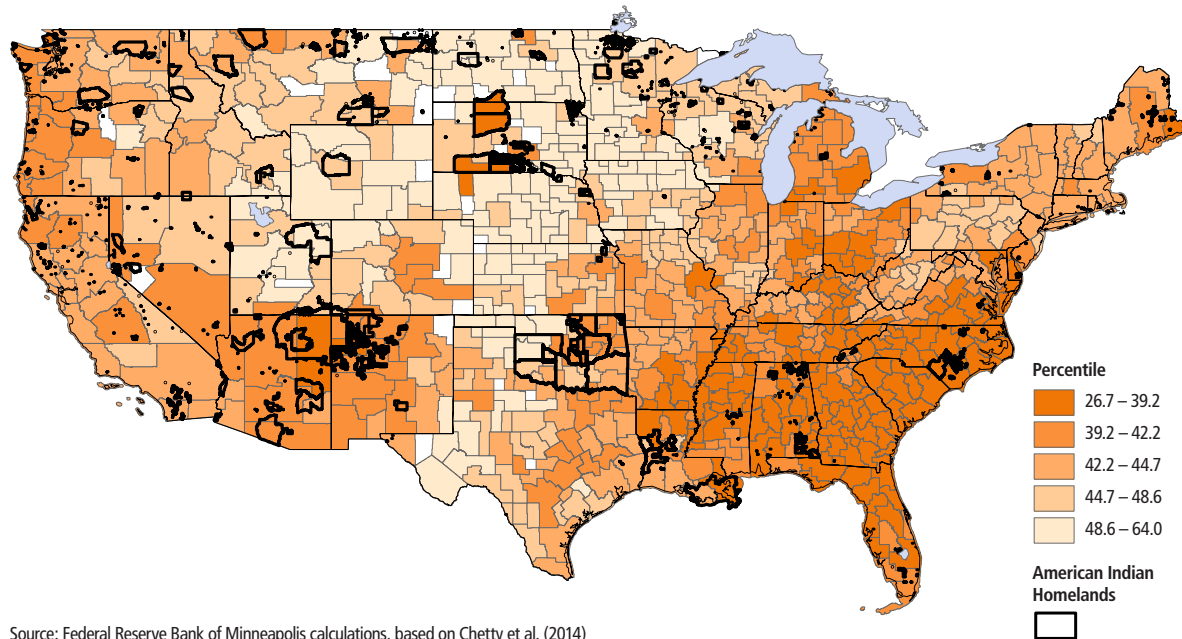
Source: Akee and Taylor (2014)

April 2012, where I was honored to deliver a keynote address on Indian Country economic development.⁴

Despite some encouraging progress, real per capita income remains disturbingly low on Indian reservations relative to the rest of the country. I will now discuss how the more recent research on intergenerational mobility presented at this conference adds another layer of concern about the level of economic development in Indian Country.

The seminal paper on intergenerational mobility by Chetty, Hendren, Kline and Saez has already been highlighted at this conference. However, let me reintroduce some of its key concepts before I apply them to Indian Country. One concept is a commuting zone, which is just a small group of contiguous counties, such as a metropolitan statistical area (MSA) in urban areas that serves as a spatial definition of a local labor market. The other concept is absolute intergenerational mobility.⁵ For each commuting zone, the Chetty study determines how children who matured there ultimately rank in the national income distribution as adults, at about age 30. Then they regress children's ranks on their parents' rank in the national income distribution about 14 years earlier. This determines a linear relationship, for each commuting zone, that predicts

Absolute upward mobility and American Indian reservations, by commuting zones



Source: Federal Reserve Bank of Minneapolis calculations, based on Chetty et al. (2014)

a child's rank based on the parents' rank. Finally, the Chetty research focuses on children whose parents' incomes were below the national median income, as represented by a child whose parents ranked at the 25th percentile of the national income distribution. The higher the child's rank compared to the parents' rank, the greater the level of absolute mobility. For the 1980-82 birth cohort, children of parents at the 25th income percentile typically rose to about the 43rd income percentile by age 30, where "typical" refers to the median commuting zone. In other words, median absolute mobility is about 43. However, the measure ranges considerably among commuting zones, from as high as 64 to as low as 27, a fact that has stimulated a lot of discussion at this conference.

Indian Country is a part of that discussion, as I know well. That lowest absolute mobility figure of 27 occurs in the Minneapolis Federal Reserve District in a commuting zone that is dominated by reservation land.⁶ However, the association of Indian reservations and low absolute economic mobility is not limited to my part of the country. The accompanying map shows the distribution of the absolute mobility measure by commuting zones, with darker colors indicating

lower mobility.⁷ It also shows the outlines of Indian reservations in the contiguous 48 states. The map shows, especially in the western states where the majority of the reservation population resides, a tendency for reservations to fall within the more darkly colored commuting zones. A similar pattern shows up if I ignore reservation boundaries and simply pick out commuting zones with a relatively high percentage of American Indian, Alaska Native or Native Hawaiian individuals.

In fact, for statistical purposes, let me focus on commuting zones where at least 5 percent of the population identifies as American Indian (alone). This picks out 72 commuting zones across the country, generally with significant reservations or Alaska Native settlements, and eliminates commuting zones where the American Indian population is too small to strongly affect the overall results. For those 72 commuting zones, the correlation between absolute mobility and the percentage of the population that identifies as American Indian is -0.7. The least mobile of the 72 are 17 commuting zones that fall in the bottom three deciles of the absolute mobility distribution reported in the Chetty study.⁸ These 17 have American Indian

populations ranging from 5,000 to over 150,000 and are found not just in the Great Plains, but also in Alaska, Hawaii, the Southwest and the Southeast.

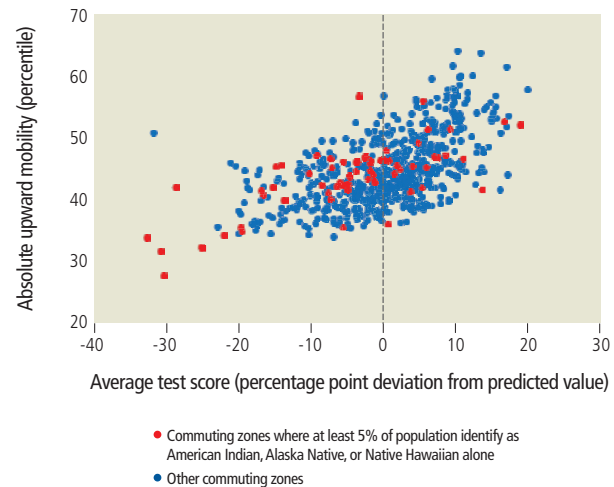
We can see, then, that American Indian reservations and population centers are significant in the lower tail of the intergenerational mobility distribution revealed by the research of Chetty and his co-authors. In my view, these findings of low intergenerational mobility underscore the urgency of addressing economic underdevelopment in Indian Country. It's not just that incomes have been very low on reservations for decades; we now have large-scale and very current evidence of poverty persisting across generations within individual families in many reservation-dominated commuting zones. This persistence represents a social and economic failure to develop the full productive and human potential of many of our children.

What then can be done to facilitate more rapid intergenerational mobility? Our understanding of effective solutions remains incomplete. However, it's worth noting that the Chetty study also shows that low mobility correlates with certain economic and social factors that vary across commuting zones. Commuting zones with a high percentage of American Indian, Alaska Native and Native Hawaiian individuals do not rank low on all of these factors. But they do on some of the most closely correlated factors, including *school quality*, as measured by either test scores or dropout rates.

Figure 2 shows the relationship between test scores, on the horizontal axis, and absolute mobility, on the vertical axis. The test score measure is expressed as the deviation, in percentile units, of the commuting zone's actual average test score from the test score predicted for that commuting zone in a regression of test scores on parental income. Thus, half of the mass of all the dots is to the right of zero and half is to the left. The red dots show commuting zones where American Indian, Alaska Native and Native Hawaiians make up 5 percent or more of the population. Although there are important exceptions to learn from, the mass of the red dots is shifted to the left, with low test scores (adjusted for parental income). Indeed, the far left-hand tail of the test score distribution consists primarily of commuting zones with a high percentage of American Indian, Alaska Native and Native Hawaiian individuals and low mobility. Again, this is only a correlation, not necessarily a causal relationship. But it suggests that we consider education as a factor in the low mobility

FIGURE 2

Mobility and test scores



Source: Federal Reserve Bank of Minneapolis calculations, based on Chetty et al. (2014)

seen in Indian Country and as an area where additional community development assistance and learning from best practices may be valuable.

More generally, though, the observations on low intergenerational mobility in Indian Country call for better research on the often complex causal relationships with factors like segregation, low-quality schools and single-parent households. They also call for sustained and well-coordinated multidimensional work on community development in Indian Country.

At the Federal Reserve Bank of Minneapolis, we are responding to these calls and intend to take the Federal Reserve System's long-standing work with tribal communities to a new level. In 2015, the Bank will establish a new Center for Indian Country Development. Its mission is "to help self-governing communities of American Indians in the United States attain their economic development goals." Note that this mission is national in scope. This reflects our intent that the Center provide energy and coordination to Indian Country development initiatives across the Federal Reserve System and take a lead role in forging Federal Reserve partnerships with other national and regional organizations.

Our current Indian Country experts will continue their work through the Center. Some of you know Sue Woodrow, currently our Helena Branch officer and


formerly a member of our community development staff. She has led many of our Indian Country initiatives since the early 2000s, including our core work on tribal business law development and implementation. I am happy to announce that Sue will serve as a co-director of the Center.

Sue's leadership will allow the Center to build on our Bank's past work on business law in Indian Country. But the mission of the new Center is deliberately broad in scope. It allows us to engage in a range of new issues, potentially including intergenerational mobility and related topics such as Indian Country education and workforce development. Accordingly, we are currently in the process of searching for a second co-director and expect to find an executive with a record of strong accomplishments in Indian Country. At the leadership level, the two co-directors will give the Center continuity as well as new energy and insights.

In addition, and even more importantly over the long term, we are establishing an external leadership council composed of 10 to 12 regional and national experts in Indian Country development matters. Its purpose will include advising on and assisting with the development of the Center's strategy and priorities. We also expect the leadership council to advise on emerging issues and policy matters and to assist in building important partnerships and support for the work of the Center.

Our plan is to officially launch the Center, and its website, by mid-year. Until then, we are posting information and updates at minneapolisfed.org/indiancountry.

As you may know, I have decided to not seek reappointment when my term as president of the Minneapolis Federal Reserve Bank ends next February. I expect to look back on the establishment of the Center for Indian Country Development as an important part of my legacy and am happy to say that it has the strong support of our management team and board of directors. When you meet again for the 2017 Federal Reserve System Community Development Research Conference, I hope you will be hearing good things about the work and research of the Center for Indian Country Development. Even more importantly, I hope you will also hear about improvements in education, income, business development and economic mobility in lower-income communities across the nation, including our American Indian reservations.

Thank you. 

Endnotes

¹ The author thanks Susan Woodrow and especially Dick Todd for much help in developing these remarks.

² See Akee and Taylor (2014, pp. 42-43).

³ For more background on this and related work, see Kocherlakota 2011 and <https://www.minneapolisfed.org/community/indian-country>.

⁴ See Kocherlakota (2012).

⁵ Chetty et al. (2014) also define a relative mobility measure that I will not make use of. Loosely speaking, an area's relative mobility compares children from the area's lower-income families with children from the area's upper-income families according to the typical difference between their respective places in the national distribution of income when they are adults. Intergenerational mobility in Indian Country is much closer to national norms by the relative mobility measure than by the absolute mobility measure. I focus on the absolute mobility of children from low-to-moderate income families, who account for the majority of children on reservations.

⁶ See Wirtz (2014).

⁷ Including Alaska and Hawaii would not change the overall pattern significantly.

⁸ See Chetty et al. (2014, Figure VIIIA).

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How Rich Will China Become?

*A simple calculation based on South Korea
and Japan's experience*

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Introduction¹

China's economy has grown enormously over the past three-and-a-half decades. Its gross domestic product (GDP), the most common measure of economic output, was \$10.4 trillion in 2014, making it the world's second-largest economy—only the U.S. economy is larger.² This growth has propelled China's standard of living, formerly one of the lowest in the world, to a level that the World Bank characterizes as "upper middle income." China's annual per capita GDP rose from \$1,300 in 1980 to \$7,700 in 2010, an increase of almost 500 percent.^{3,4}

This impressive performance for a country with 1.3 billion people has engendered a huge volume of research. Most of this work has naturally focused on explaining China's impressive growth. In this paper, however, we look at China's future: How rich will China become? Specifically, relative to the United States, how high will China's per capita income rise?

This question is of policy interest for many reasons. Perhaps the paramount U.S. policy concern is that, all else equal, higher standards of living in China mean a larger Chinese share of the

Executive summary

China's impressive economic growth since the 1980s raises the question of how much richer it will become over future decades. Its growing share of the world economy affects other national economies. Understanding the future course of the Chinese economy is therefore important for both fiscal and monetary policymaking in the United States and elsewhere.

Using fundamental growth theory, data from China and from Korea and Japan's similar "miracle" growth experiences, we provide a suggestive calculation for China's future per capita income. Our ballpark estimate is that China's per capita income relative to that of the United States will grow by a factor of two to three over the next half-century.

global economy, suggesting that shocks originating there will more strongly buffet the U.S. economy. To the extent that these shocks disturb the path of U.S. employment and inflation, they will influence U.S. monetary and fiscal policymaking.

Of course, estimating future growth of any economy is extremely challenging, so our goal here is to provide a suggestive calculation, a ballpark estimate, drawing from both theory and data. The theory we use is the neoclassical growth model, pioneered by Robert Solow in the 1950s.⁵ The key

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中國將富有富



Economic growth over five decades, three countries

FIGURE 1

Japan, 1951-2002

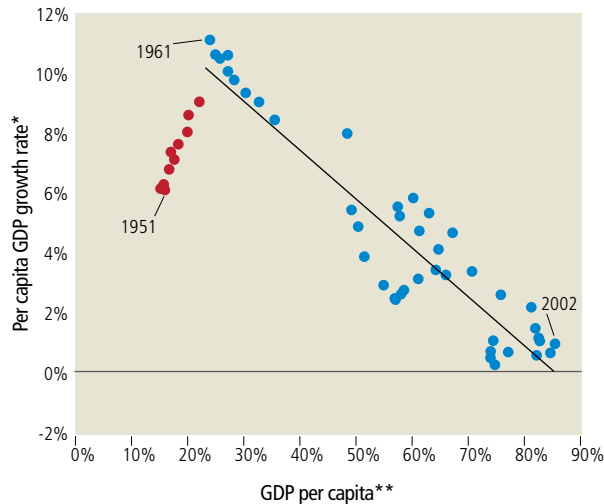
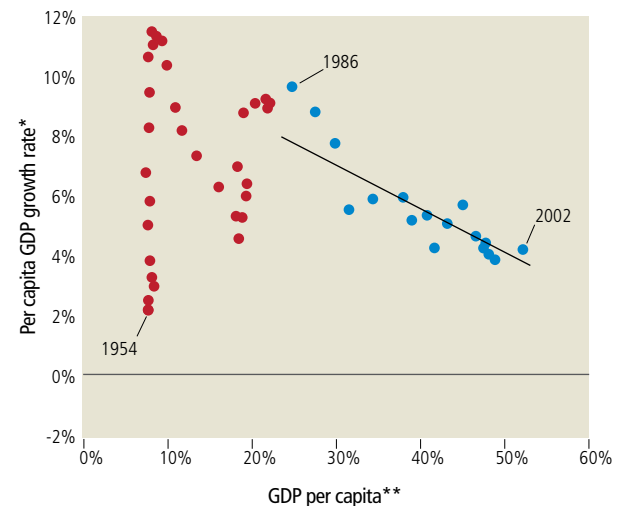


FIGURE 2

South Korea, 1954-2002



Note: Red dots indicate the rising growth rates of early years; blue dots indicate the declining growth rates of later years. Peak years for Japan and South Korea were, respectively, 1961 and 1986.

*10-year moving average

**Relative to U.S.; PPP-adjusted

Sources: Penn World Table 8.0. at www.ggd.net/pwt/; authors' calculations

mechanism in this model is accumulation of capital, which raises GDP per capita. But as Solow showed, the accumulation of capital in and of itself reduces the rate of future growth. Theory suggests, then, that China's growth will slow.

Our data are drawn from China's experience, of course, and also from South Korea and Japan, which experienced their own growth "miracles" in the decades preceding China's takeoff around 1980. The data complement theory in that the experiences of South Korea and Japan (and many other countries) involved high initial growth that has, in fact, slowed over time to rates similar to or even lower than the U.S. rate. (Indeed, China itself has experienced somewhat slower growth in recent years.)

Through this exercise, blending data and theory, we arrive at a rough estimate that China's per capita income relative to that of the United States will grow by a factor of two to three over the next

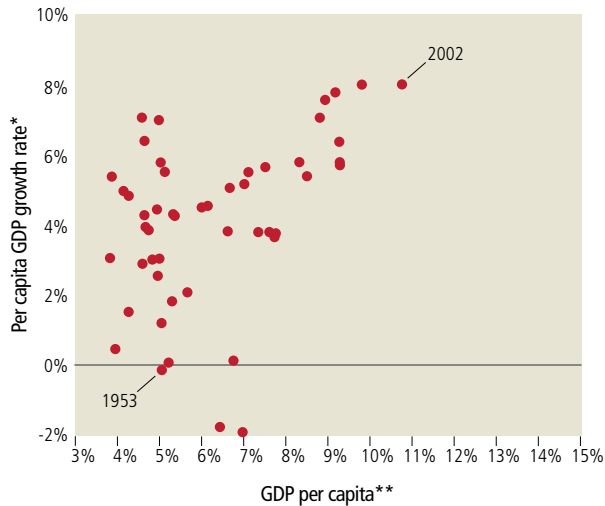
half-century.⁶ In this paper's conclusion, we discuss assumptions that underlie this forecast and how it might vary if the assumptions are altered.

Background theory and data

As mentioned, the theory that motivates our calculation is the neoclassical growth model, pioneered by Solow and developed by others over subsequent decades.⁷ This theory, one of the most important in all of economics, is centered on three ideas. First, capital accumulates in an economy as long as the return to new capital (additional future output) exceeds the alternative use of such resources (such as additional current consumption). Second, owing to diminishing marginal returns (each additional unit of capital produces less output than the previous unit), a growing country is less inclined to sacrifice something today for more of it tomorrow. In other words, all else equal, the economy will choose over time to consume more, and save and

FIGURE 3

China, 1953-2002



invest less. Capital accumulation will therefore slow and eventually stop in the absence of technological progress. Third, technological progress, which is not directly addressed by the model, is the force determining capital accumulation in the first place.

Taken together, these three ideas imply that an economy eventually converges to a “balanced growth” path in which its per capita GDP growth is determined only by systematic changes in technological progress.⁸

The import of this theory for countries’ actual growth experiences is that, in the absence of technological improvements, diminishing returns to capital accumulation will set in, and a country’s growth rate will decline over time. There is a good deal of evidence supporting this theory. For example, Japan and South Korea experienced impressive GDP growth of their own in the decades preceding and concurrent with China’s growth, and both have experienced diminishing

Blending data and theory, we arrive at a rough estimate that China’s per capita income relative to that of the United States will grow by a factor of two to three over the next half-century.

GDP growth rates.⁹ For example, Japan’s per capita GDP growth rate fell from 6.1 percent on average in the 1950s to 5.4 percent in the 1970s and to 2.2 percent in the 1990s. Similarly, in Korea, per capita GDP growth fell from an average rate of 8.5 percent in the 1980s to 5.8 percent in the 1990s and 3.8 percent in the 2000s.¹⁰

This slowdown is illustrated in Figures 1 and 2 for Japan and South Korea, respectively. Each point represents one year, from 1951 (Japan) or 1954 (South Korea) to 2002. The x-axis denotes the per capita GDP relative to the United States in that year. The y-axis denotes the average annual per capita GDP growth rate in the decade *including and following that year*.¹¹ For both countries, there is a clear pattern that could be described as an upside-down check mark. Initially, both countries grew very rapidly. But, eventually, as their per capita GDPs converged toward that of the United States, their growth rates declined over subsequent decades. In the next section, we show how this slowdown informs our analysis of China’s future per capita income.

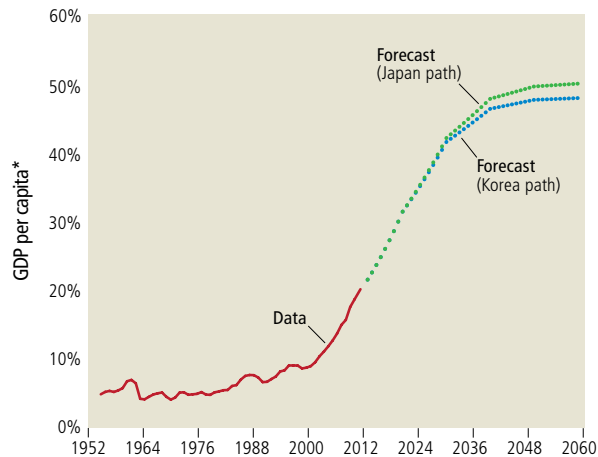
Suggestive calculation

Figures 1 and 2 demonstrate that some key “growth miracle” countries have seen their per capita GDP growth rates slow over time as they grew richer and caught up to the United States. The most important assumption in our analysis is that China’s growth will slow at the same rate as South Korea’s and Japan’s. Of course, without a consensus view of the reasons for South Korea’s and Japan’s slowdown, along with a strong understanding of the forces behind China’s growth, we cannot ascertain how good this assumption is.

Nevertheless, there are three hints that this assumption of similar growth paths is plausible. First, as discussed above, the neoclassical growth model predicts that in the absence of steady

FIGURE 4

China's per capita GDP (relative to U.S.)



Note: For Figure 4, we assume that China's growth rate peaked in 2011 and use the downward growth rate paths of Japan and South Korea to forecast China's future growth path.

*Relative to U.S.; PPP-adjusted

Sources: Penn World Table 8.0. at www.ggd.net/pwt/; authors' calculations

technological progress, a country's per capita GDP growth rate should fall over time. In the presence of steady technological progress, the country's per capita GDP growth rate will fall until it reaches the rate of technological progress. Moreover, steady technological progress is harder to achieve as a country evolves from one that imitates or assimilates existing frontier technologies to one that *develops* new technologies. Second, no country in the world has been able to sustain growth rates of 7 percent or higher for more than four decades. Third, South Korea, Japan and China are geographically close. They trade a great deal with each other, and both South Korea and Japan invest directly in China. These close economic ties suggest that their growth experiences could be similar.

Figure 3, like Figures 1 and 2 for Japan and South Korea, plots China's growth experience over five decades. As can be seen, though still quite poor relative to the United States, China has had a very high GDP growth rate. And, there are no signs of a slowdown until the data point labeled 2002, which (because the y-axis plots the average 10-year per

capita GDP growth rate) captures the growth rate from 2001 to 2011.

For our calculation, we assume that as of 2011, China's GDP growth has peaked or will peak soon, as recent data indeed suggest. We further assume that in ensuing years, China will follow Japan's (or South Korea's) path—that is, starting from 2011, China will experience the same downward growth trend as those countries. Specifically, for every 1-percentage-point increase in China's per capita GDP relative to that of the United States, we hypothesize that China's ensuing per capita GDP growth will decline by 0.162 percent (Japan) or 0.175 percent (Korea).¹² In other words, as China's per capita income catches up to the United States, it will experience slower rates of growth just as Japan and South Korea did. We assume this slowdown continues until China's per capita growth rate is the same as the U.S. rate.

Figure 4 shows the implications for China's per capita GDP if it follows either Japan's or South Korea's growth trend. In both cases, China's per capita GDP reaches a steady state of close to half the U.S. per capita GDP by around 2061. This means China's economy will continue to catch up to the U.S. economy for another several decades, but will eventually stop gaining before it becomes as rich (in per capita GDP) as the United States. This is not surprising, as both South Korean and Japanese economies have slowed considerably, and in Japan's case, appears to have hit a steady state at about three-fourths of U.S. per capita GDP.

Conclusion

Motivated by neoclassical growth theory, we used the "growth miracle" and slowdown experiences of South Korea and Japan to provide a suggestive calculation for how rich China will become relative to the United States.¹³ Our calculation implies that China will improve its per capita income at a faster pace than that of the United States for about the next 45 years. By around 2061, it will reach close to half of the U.S. income per capita. While China's income per capita *relative* to the United States will more than double from today, its *absolute* income per capita will increase by much more, by about a multiple of five.

While we think our exercise is well-grounded in theory and actual country experiences, we

recognize that there are major differences between the economies of South Korea and Japan, on the one hand, and the economy of China, on the other hand. South Korea and Japan are small compared to China and, hence, were able to join the global economy in a relatively seamless way. By contrast, as an economy with close to 20 percent of the world's population, China has had, and has needed to have, a large impact on global production and prices in order to generate high rates of GDP growth and improvements in its standard of living.

In addition, China's economic institutions, policies and economic organization are all quite different from their counterparts in South Korea and Japan during their growth miracle periods. However, for the purposes of our exercise, the most important dimension is how institutions and policies in China change going forward. To the extent they evolve similarly to the way they evolved in South Korea and Japan, our exercise provides a useful projection on the extent of China's convergence to U.S. per capita GDP. ⁸

Endnotes

¹ Tim Kehoe gave very helpful comments. This paper updates and extends previously unpublished work by Yi and Behzad Kianian on China's per capita income and GDP. The authors are grateful for Kianian's contributions in the previous work. Also see Kianian and Yi (2009).

² Source: International Monetary Fund; National Bureau of Statistics (China); authors' calculations.

³ The most widely used measure of standard of living adjusts a country's GDP for price differences across countries (purchasing power parity (PPP) adjustment). This paper uses PPP-adjusted GDP unless otherwise stated.

⁴ Source: Feenstra et al. (2013), Penn World Tables (PWT 8.0). These numbers are drawn from "rgdpo," which is output-side real GDP at chained PPPs (in mil. 2005US\$).

⁵ See Solow (1956, 1957)

⁶ We use the PWT 8.0 measure "rgdpo," which is output-side real GDP at chained PPPs (in mil 2005US\$).

⁷ See, for example, Cass (1965) and the references in Acemoglu (2009).

⁸ In the absence of technological progress, the economy reaches a steady state with zero per capita GDP growth. In the presence of (long-run) technological progress, the economy can reach a balanced growth path in which capital, GDP and consumption all grow at the same rates.

However, the conditions for the neoclassical growth model to yield a balanced growth path are more stringent than the conditions for the model to yield a steady state. In our calculations below, we assume such stringent conditions hold.

⁹ This is true for other countries as well, including Singapore, Taiwan, Ireland and Malaysia.

¹⁰ Source for Japan and South Korea: PWT 8.0, output-side real GDP at chained PPPs. The growth rates are logarithmic (log) growth rates.

¹¹ Specifically, the y-axis for year t gives the (log) average annual growth rate between year t-1 and year t+9.

¹² The 0.162 percent figure for Japan is estimated by regressing the 10-year moving average growth rate on GDP per capita relative to the United States for Japan between its 1961 growth rate peak and 2002. The 0.175 percent figure for Korea is calculated similarly, using data between its 1986 peak and 2002.

¹³ Other papers, using different approaches, have also argued that China's growth will slow down. See Pritchett and Summers (2013) and Kehoe and Ruhl (2010).

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Alvin Roth

In “normal” markets, prices adjust to equate demand and supply; the market clears. This simple premise is at the core of economic thought. But with surprising frequency, prices are not enough and can even be irrelevant. These markets are broken in the sense that price adjustment won’t clear them, and economists have long struggled to understand efficient allocation in such cases.

Alvin Roth began studying these “broken” markets in the 1970s. Decades later, in 2012, this body of work was recognized with the Nobel prize. By extending theory developed by mathematician Lloyd Shapley, his Nobel co-recipient, Roth had “generated a flourishing field of research and improved the operation of many markets,” said the Nobel committee. “An outstanding example of economic engineering.”

Roth’s theoretical, empirical and experimental research has transformed how medical residents find jobs, parents find good schools for their children and renal patients find kidneys that save their lives. Economics is often deemed impractical—too abstract from the real world to have pragmatic importance. Roth’s career is solid refutation of that notion.

Inspired by Shapley’s mathematical proof with David Gale that stable matches—those in which currently paired partners see no benefit from a different match—*can* exist in theory, Roth discovered that the mechanism used successfully since the 1950s to match U.S. medical residents with hospital jobs was quite similar to the Gale-Shapley algorithm. This careful analysis led to a 1995 invitation from doctors who had found that the growing number of married couples seeking hospital posts undermined the existing algorithm. No longer were matches stable. Roth helped redesign the algorithm, used with success ever since.

Similar analysis and redesign have been at the heart of Roth’s work, applied to kidney donations, public schools, law student clerkships and a wide variety of health care labor markets. Others have extended it into financial intermediation, Internet advertising auctions and even dating services. He addresses many of these topics in the following conversation, along with the success of experimental economics, the ubiquity of “repugnant” markets and the vital importance of coffee.

PHOTOS BY PETER TENZER

MATCHING MARKETS

Region: Perhaps we could begin with some general background on matching markets. In your Nobel lecture, you said, “You can’t just tell Google that you are showing up for work. They have to hire you.”

Roth: They do indeed.

Region: And you continued: “Matching markets are markets in which you can’t just choose what you want (even if you can afford it). You also have to be chosen.”

That suggests that prices alone don’t clear markets in certain cases. Could you elaborate on which markets that applies to, and why prices don’t equate supply and demand in those situations?

Roth: Well, it might be easiest to first talk about commodity markets because they are markets where we think price *does* do all the work. It takes a lot of design to make something into a commodity market.

Take wheat, for example. God makes wheat, but the Chicago Board of Trade makes #2 hard red winter wheat. It has a lot less variance than wheat. You know what you’re going to get and, therefore, you don’t have to care who you’re buying it from. You don’t have to inspect it. But before wheat was commodified, you had to have someone look at the wheat to see what you were buying. Similarly, before coffee was commodified in Ethiopia, you needed a man in Addis Ababa tasting the coffee; now you don’t.

In those markets, you can make an offer to the entire market. I want #2 hard red winter wheat from whomever; it doesn’t matter who I get it from.

But, of course, labor markets aren’t like that, and many other markets aren’t like that—because you care not just about the price, but also about who you’re dealing with. What that means is, if everyone has a different price—if dealing with you is so nice that I’m willing to

ON MATCHING MARKETS

There isn’t a sharp line between matching markets and commodity markets. There are markets where price does all the work: the New York Stock Exchange, for instance. The labor market is very personal, but price also matters a lot, so it’s somewhere in the middle. For school choice and kidney exchange, we don’t let prices work at all.

pay a higher price rather than deal with someone else—there’s no longer a small-dimensional vector of prices that organizes the market, like a price for each kind of wheat.

Instead, it’s personalized prices, maybe *doubly* personalized prices. How much will Google pay me to work for them? How much would I need to take their offer, rather than a different salary from Facebook?

The space of prices is larger, so even if you tried to organize the market entirely through prices, you would need to see many, many more prices than you do in the market for coal, where you only need a price per ton for each grade of coal.

There isn’t a sharp line between matching markets and commodity markets. I think there is sort of a continuum. There are markets where price does all the work: the New York Stock Exchange, for instance. Its job is to define at any moment the price at which supply equals demand for each of a bunch of financial commodities. The labor market is very personal, but price also matters a lot, so

it’s somewhere in the middle of the continuum. For school choice and kidney exchange, we don’t let prices work at all. And lots of markets fall somewhere between kidney exchange and the market for wheat.

Region: Would marriage be a matching market where price plays no role—at the kidney exchange end of the continuum?

Roth: Marriage is very much a matching market. You care who you’re matched to, and you can’t just choose who you want to be matched to; your proposal has to be accepted. And, yes, while prices play a role in so many things, a marriage is a very complex relational contract and it’s hard to specify it with prices.

Many, many markets are not decided only by prices. And there are some markets where we don’t allow prices to play a role at all.

STABILITY, PREFERENCES & SCHOOL CHOICE MECHANISMS

Region: One of your early papers—it might be the first with “matching” in its title—is your 1982 article “The Economics of Matching: Stability and Incentives.” In it you demonstrate, I believe, that it’s not possible to design a stable matching procedure in which all parties reveal their true preferences. You can get one or the other—either stability or true revelation—but not both.

On the other hand, you find that you can obtain stable outcomes if you limit the goal of true preferences to just one side of the match. How do these findings, which I hope I’ve summarized accurately, help in the design of good matching markets?

Roth: Well, let me say first that as we’ve begun to explore large markets, we’ve come to understand those results differently and better. But the reason it’s nice to be able to make it completely safe for people to reveal their true preferences is that then you can give them very simple advice.

Think about school choice mechanisms. When we talk about whether a mechanism is simple, we want to distinguish whether it's simple to describe or simple to engage with. There are some mechanisms that are simple to describe, but are difficult to engage with. An example is the school choice mechanism that a number of American cities used: the "immediate acceptance" mechanism once used in Boston.

Boston was one of the cities where school district leaders knew that parents had information about which schools would be good for their kids, so they wanted to assign children based partly on where parents wanted them to go. But what they decided to do, very benignly, to have a very simple mechanism, was to say, we'll ask parents for rank-order lists: "What's your first choice, second choice, third choice?" And we'll give as many people as possible their first choice.

Then, when a school has more people indicate it as their first choice than it has places for, we will have a priority system. Children who have older siblings going to the school get top priority; maybe children who live nearby will get some priority. Otherwise, we'll have a lottery. But we'll only use priority when a school is oversubscribed by people who ask for it as their first choice.

And then, after we've given as many people as possible their first choice, we'll do the same thing with the remaining people. We'll give as many people as possible their second choice using priority only to break ties when there aren't enough spaces and so forth.

So that choice mechanism, the old Boston mechanism, is very simple to describe. It's clearly benign in intent. But it made it very difficult for parents to know how to fill out their rank-order list. It wasn't safe for them to put down their true preference because if they didn't get their first choice, there was a good chance that their second choice might have filled all its places with people who asked for it as their first choice.

ON STABILITY, PREFERENCES & SCHOOL CHOICE MECHANISMS

The old Boston mechanism made it very difficult for parents. It wasn't safe for them to put down their true preference because if they didn't get their first choice, their second choice might have filled all its places. [Parents] had to think, "What school should I list as my first choice that I can actually get assigned to?" That's a very different question than which kindergarten teacher is the best with shy boys.

Region: And so parents strategized, right? They didn't necessarily state their true preferences because they knew doing so might result in bad school assignment outcomes for their children.

Roth: Yes, even if you had very high priority, you had to think, "What school should I list as my first choice that I can actually get assigned to?" That's a very different question than which kindergarten teacher is the best with shy boys, or whatever your particular problem is.

So, one advantage to changing to a system where we can prove it is safe for you to state your true preferences is that we can say to families, "You needn't worry that if you don't get your first choice, you will have any less chance of getting your second choice. Your chance of getting your second choice will be just as good as if you had listed it as your first choice, once you don't get your first choice."

With this system, you can now give families simple instructions that make it easy for them to convey to the school system the schools they really want—not the schools they think they have a good chance of being assigned to. That gives families an easier chance of getting the school they actually want.

It *also* gives the school systems data on which schools people really want. They might discover after changing the choice mechanism that there was some school that previously, with the old mechanism, many people listed as their first choice that now no one lists as their first choice.

Region: The flaws in the initial Boston mechanism came to light in the early 2000s, I think, and you and your colleagues were brought in to address those weaknesses.

Roth: Right. The old Boston system was the subject of an article by Atila Abdulkadiroğlu and Tayfun Sönmez. Around the same time, I'd been engaged with Atila and Parag Pathak in redesigning New York City's school choice system. Those events combined in various ways to get us all an invitation to talk to Boston public schools.

Since then, Parag Pathak and Atila Abdulkadiroğlu have gone on to become very deeply engaged in school choice. Not only have we helped design school choice systems in other cities, but Parag and Atila together with Josh Angrist and others have been taking very seriously the data that arise from these systems, for two reasons. One is that you can now get reliable information about which schools parents like, not just which ones they think they can get, as I mentioned.

But also, because there's some randomization in which kids get assigned to which schools when schools are oversubscribed, they can use that randomization to start making sensible inferences from the data about the effect of getting the school you want. They can do regression discontinuity studies; they can do

other things to not just help parents put their kids in schools they like, but to see what is the effect of doing that.

So all of a sudden there's an avenue of empirical research opening up, which Parag and Atila are leading participants in, which is going to really change our understanding of how families and students and schools interact with each other.

Region: Going back to Boston in particular, I think they adopted the "deferred acceptance mechanism" that you have worked on. Were you able to evaluate whether and how that improved outcomes?

Roth: That's the project that Atila and Parag with various colleagues, among them Josh Angrist, are pursuing now. We can see some improvements. We can see that preference lists got longer than under the old immediate acceptance algorithm that Boston used to use. In that system, the school system would first give as many people as possible their first choice, as many people as possible their second choice, et cetera.

So there wasn't much point in submitting a rank-order list of more than, say, three schools, because if you didn't get your top three schools, then the only schools available to you were going to be schools that still had places empty after everyone else had gotten their top three schools. And those were going to be a hard set of schools to deal with and to think about in advance, so there was no point in putting down your fourth and fifth choices. If those were pretty popular schools, they would surely be filled.

So, one of the changes we noticed after changing the system to make it safe to put down true preferences is that the choice lists got longer. It now made sense for families not just to focus on which school they could get as their first choice. The school they could get as their first choice under the old system might now be their third choice. Maybe it was a great half-day kindergarten, but they'd

ON MATCHING RESIDENTS AND HOSPITALS

Doctors finally decided to have a centralized clearinghouse. This was voluntary. But, in fact, both applicants and employers submitted rank-order lists and took the suggestions that the match gave them. They've had very high success rates. For a couple of decades, most doctors got their jobs that way. With some modifications, it's still working.

really like to put their kid in an all-day kindergarten. But they didn't have high priority for the all-day kindergarten, so it was risky. But wouldn't it be great if their kid *was* in an all-day kindergarten?

Now they can say: First choice is an all-day kindergarten, second choice is a different all-day kindergarten. Third choice is the half-day kindergarten that I'm across the street from. We started to see kids getting assigned to a popular half-day kindergarten as their third choice, which could never have happened before. In New York City, they also used the preference data as part of their process of figuring out which schools to close.

MATCHING RESIDENTS AND HOSPITALS

Region: I'd like to ask about a different market you've worked on. In 1984, you wrote about the evolution of the labor market for medical interns and residents. That was really pathbreaking both for medicine and for economics because

it provided clear analysis of an important market where good matches are paramount, but difficult to achieve. Could you describe briefly some of the initial problems with the internship programs that started in, I believe, the early 1900s?

Roth: Medical internships started in the early 1900s. But the medical match arose only in the 1950s because of a very troubled history that turned out to be typical of many markets and that has helped us understand more about how markets work.

In 1900, when you graduated from medical school, you looked for a job. We're talking about graduating in June and looking for a job that starts around July. By 1930, those jobs were being filled by Christmastime (before graduation) rather than June. Medical journals from the 1930s say, "We're now hiring our new interns without knowing their class rank and other important information we might get by waiting until they graduate. We can live with that, but let's not go any earlier."

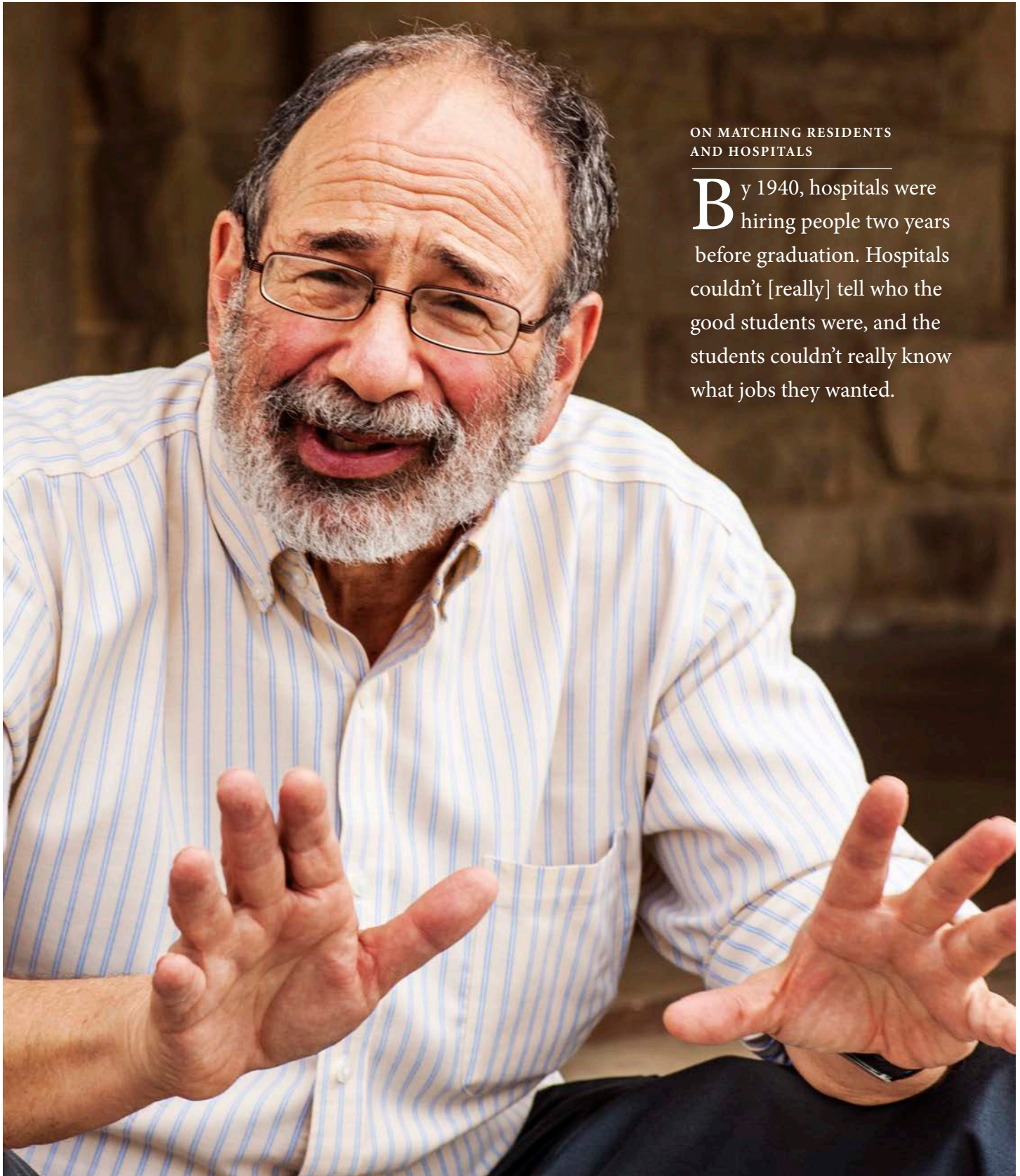
But, of course, it's hard to stop people from competing simply by asking them not to do so. By 1940, hospitals were hiring people two years before graduation. That was very inefficient. Everyone understood it was very inefficient. Hospitals couldn't tell who the good students were two years before graduation, and the students couldn't really know what jobs they wanted. They didn't yet have much experience with different medical specialties.

Region: This reminds me of athletic drafts going on as early as high school.

Roth: That's right. This unraveling process, this process of making offers earlier and earlier, turns out to be common to many markets. Athletic drafts are actually an attempt to control unraveling. Baseball players, who get hired through a draft, don't get hired at age 10; it's where there's no draft that future women tennis players are moved to Florida from the Czech Republic when they're 10 years old and sign professional contracts. Ath-

ON MATCHING RESIDENTS
AND HOSPITALS

By 1940, hospitals were hiring people two years before graduation. Hospitals couldn't [really] tell who the good students were, and the students couldn't really know what jobs they wanted.



letic drafts were partly attempts to put limits on the competition to hire athletes earlier and younger. Still, lots of markets go very early.

One market I've enjoyed studying is post-season college football bowls, and how the teams that will play in them are chosen. A playoff was introduced recently, but there's been a lot of evolution in how bowl games were arranged. In the 1990s, the NCAA tried to enforce a date called Pick'Em Day before which bowls shouldn't pick teams. Pick'Em Day was not even at the end of the regular season; it was two games before the end. But they couldn't enforce that. Bowl contracts were being signed *four* games before the end of the season.

That meant that while Notre Dame, say, might be the number one team in the country four games before the end of the season, they could just drop out of the rankings entirely if they lost two of those last games.

It was very hard to have good bowl games under those conditions and, for years, that market modified itself in various ways. There was the Bowl Championship Series, for example; there were all sorts of things. This year had a new iteration, in which four teams were chosen for a playoff. So, they've been trying harder and harder to get a bowl game where the number one team plays the number two team. But that's very much harder to do the earlier you decide which teams are going to play each other.

Region: So the unraveling seen with medical residency offers is present in many markets.

Roth: Right, medicine had that problem in the 1940s, and other markets have those problems. For instance, if you're a new law graduate from a fancy law school ...

Region: Could you first tell us about medical schools and the algorithm insti-

tuted to solve the matching problem?

Roth: OK. In the early '40s they had this serious unraveling. Around 1945, the medical schools intervened and managed to control the dates at which contracts were signed for post-graduation employment. The medical schools are a third party: They're not the doctors, they're not the hospitals, so they weren't suffering from the competitive self-control problem that kept forcing hiring earlier. By not releasing transcripts, not releasing letters of reference, they managed to get control of the date and move it back into the senior year of medical school. That prevented unraveling, but then they had terrible exploding offer problems—job offers that were retracted if not accepted quickly.

In 1945, they first said, "Don't make offers before a certain date, and leave those offers open for 10 days." So, suppose you got an offer from your third choice job, and your second choice said to you, "Stay calm; you're high on our waiting list. As soon as we get some rejections, we'll make you an offer." Well, you could afford to wait, since you had 10 days. But if everyone waits, then the waiting lists don't move.

So bad things happened on the 10th day—for instance, you might wait until almost the last minute and finally accept the offer from your third choice job, only to get an offer from your second choice just a little later. Maybe you accepted that one, too, and stalled a little before calling back your third choice and telling them you weren't coming, during which time everyone on their waiting list would have taken a job. The powers-that-be saw that the 10th day was chaotic, and so in 1946, they said, "You only have to leave offers open for 8 days ..." Needless to say, that didn't help.

Eventually, they couldn't agree on any amount of time that offers had to be left open. People would be getting calls that said, "This is such-and-such internship program. We're making you

an offer, but you have to tell us yes or no on the phone, because if we let you think about it, all the other candidates we want to make offers to if you say no will have taken other positions."

Fortunately, that problem has now been solved in the medical residency market, but it's happening right now with law clerks. So this isn't an ancient problem; it's still very present in other markets.

Region: I believe you've worked on this with Judge Posner.

Roth: Yes. Federal judges have tried over and over again, maybe a dozen times in the last 30 years, to deal with unraveling in the market for law clerks. They develop rules that they then cheat on. Right now, they're in a period of no rules. They just abandoned their most recent set of rules because everyone was cheating. So they're back to making very early exploding offers. If you're a law student who is going to get an offer of a clerkship, it will come sometime well before you graduate, and it will be earlier this year than it was last year.

Region: So you could be a 2-L.

Roth: Yes, it'll probably be in your second year. Some judge will make you an offer, and you will most often accept it on the spot because that's part of the deal for getting the interview. So you won't get to consider a lot of offers.

That's what was happening in medicine from 1945 to 1950 or so. The doctors finally decided to have a centralized clearinghouse. Their basic idea was that instead of students getting offers one at a time and having to say yes or no without being able to consider other offers, they were going to ask them to consider all the offers they might get—from all the positions they had interviewed for—in advance.

So they would elicit from students a rank-order list of the positions at which they'd interviewed. These positions had

salaries that were part of the job description, so the salary was already known. That wasn't going to be part of a market-clearing mechanism.

Similarly, they asked the internship residency programs to rank the people they interviewed. The initial algorithm for dealing with all these rank-order lists had some flaws that were quickly detected. After that false start, they got an algorithm that worked for a long time.

When I say “worked,” I mean all this was voluntary. The people running the match had no compulsory power. Applicants and employers didn't have to submit rank-order lists or wait until the time of the match. But, in fact, both applicants and employers submitted rank-order lists and took the suggestions that the match gave them—that is, the match would come out and say you've been matched to this hospital, the hospital should now please send a contract to the students they've been matched with and the students should return them and go to work there. And in July when you see which doctors are at which hospitals, it's the doctors who got matched to those residencies.

They've had very high success rates. For a couple of decades following the introduction of this system, most doctors got their jobs that way. With some modifications, it's still working.

KIDNEY DONATIONS

Region: Let's shift to another market in which you've been heavily involved: better kidney transplantation, through kidney exchange and the creation of donor chains. Would you give us some background on the problem and how your matching procedure has helped to address it?

Roth: This is work that lately I've been doing with Itai Ashlagi, and Mike Rees and his medical colleagues, but I began with Utku Ünver and Tayfun Sönmez, and Frank Delmonico and his medical colleagues.

ON KIDNEY DONATIONS

Sometimes you're healthy enough to give someone a kidney, but you can't donate to the person you love because kidneys have to be medically matched. That's where kidney exchange comes in. That's a simple exchange. It involves four operations, and they have to be done simultaneously—it's against the law to give “valuable consideration” for a kidney.

There's a worldwide shortage of kidneys for transplant. It's the treatment of choice for end-stage renal disease, but many people in the United States and elsewhere die each year because organs aren't available. Kidney dialysis enables people to stay alive while waiting for an organ.

Right now in the United States, we have 100,000 people on the waiting list for a deceased donor organ; we only do about 11,000 transplants of deceased donor kidneys each year, so they are in very short supply. But *deceased* donor kidneys are not the only source because healthy people have two kidneys and can remain healthy with just one. We do about 7,000 living donor kidney transplants in the United States, so they are in short supply too.

Region: Prices aren't permitted to do the work in this case.

Roth: Right, prices don't do the work here. It's against the law everywhere in the world except the Islamic Republic of Iran to pay people to donate kidneys. Incidentally, I've spent a lot of time think-

ing about what I call “repugnant transactions,” trying to understand what's involved in that. But prices are not legally allowed to clear this market.

The law says that a kidney must be a gift. If someone you love needed a kidney and you were healthy enough to give a kidney—if you don't have diabetes or high blood pressure or protein in your urine—then you could give someone you love your kidney.

Except that sometimes you're healthy enough to give someone a kidney, but you can't donate to the person you love because kidneys have to be medically matched. That's where kidney exchange comes in. It could be that you're healthy enough to give a kidney but can't give to the person you love, and I'm healthy enough to give a kidney but not to the person I love. But you could give a kidney to the person I love, and I could give a kidney to the person you love.

That's a simple exchange. It involves four operations, and they have to be done simultaneously. Because it's against the law to give “valuable consideration” for a kidney, you can't write a contract saying, “You guys give us a kidney today, and we'll give you one tomorrow.” So when we helped our surgical colleagues organize kidney exchanges, these were always done simultaneously, which means even a simple exchange needs four operating rooms, four surgical teams. It needs a lot of stuff, so it's a highly congested market; each transaction is hard to do. Obviously, you could get more transplants if it weren't so difficult, if you could do bigger exchanges.

Incidentally, this is a market that we can think of as a barter market, which is what William Jevons discussed when he talked about needing a “double coincidence of wants” to get barter going. You need someone who needs the kidney you have *and* who has the kidney you need.

Region: And, of course, that double coincidence of wants is part of the rationale for money's existence.



Roth: Absolutely. When Jevons was talking about money in the 1800s, his idea was that money was a market-design solution to the difficulties of barter. It allowed you to sell what you had and use the money to buy what you wanted.

Region: But money is not involved in kidney exchanges, and therefore ...

Roth: When my wife and I moved to Stanford, we sold a house in Boston and bought a house in California. We didn't have to swap houses. There would be a much, much different real estate market if it were against the law to use money to buy houses. But that's our situation with kidneys. It's against the law, for reasons that are worth understanding.

Often when you talk to economists, they say "isn't that crazy" and maybe it is. But if it's crazy, it's a craziness shared around the world. The only explicitly legal market for kidneys is in Iran. Everywhere else, it's against the law to buy or sell kidneys for transplant. There are black markets, of course. Some of them work very badly indeed. There are real worries about vulnerable people who might mistakenly sell their kidneys, not have good contracts to assure them of postoperative care, things like that.

Region: And the urban legends about waking up in a bathtub full of ice, missing a kidney?

Roth: Those urban legends are mostly legends. It takes a lot of matching before your kidney can be used, so the chance someone can slip you some drugs and take your kidney and use it I think are just that: legends. But there *is* a black market for kidneys. In Azerbaijan, for instance, one could buy a kidney, and a hospital where that could happen was pointed out to me when I traveled there.

Region: Fortunately, you're creating a legitimate kidney market.

ON PROPOSALS TO INCREASE ORGAN DONATION

Israeli organ donation legislation gives priority to registered donors and next of kin who donate organs. Early indication is that it is having a good effect and, if so, it's one of the few I've seen that has a big positive effect.

PROPOSALS TO INCREASE ORGAN DONATION

Region: Various proposals have been suggested to increase organ donation, from small nudges on driver's license applications to monetary incentives to rewards like prioritization on recipient lists. Which schemes seem to work best?

Roth: I was on a conference call this morning with a bunch of collaborators on a project to understand the early results of the Israeli change in organ donation legislation that gives priority to registered donors and next of kin who donate organs. Early indication is that it is having a good effect and, if so, it's one of the few I've seen that has a big positive effect.

Many of the other interventions are more complex. One reason is there's a difference between registrations and transplantations. In much of the world, not only do we ask people to register to be organ donors, but we also ask their next of kin for consent before we go ahead. How you ask and what kind of consent you get interact with each other.

It turns out to be hard to significantly increase deceased donations partly because, in the United States at least, we're already doing a good job of getting deceased donors. Very few deceased people

are eligible to give their organs. You have to die in a pretty special way, on a ventilator basically, so that your organs keep getting oxygen after you're dead. That's actually quite rare.

About 45 percent of Americans are on organ donor registries, and a very high percentage of those, if they die in an eligible way, get donated. The transplant coordinators approach the family and say, "You know that they're an organ donor." They start the conversation that way even though they're going to need consent, and they get it with a very, very high success rate.

If someone isn't on the organ donor list, then they say, "What do you think about organ donation?" In Massachusetts, the New England Organ Bank indicates they got about half of those to give consent. That means we're getting almost 100 percent of the registered donors who are almost half the population, and half of the unregistered donors, so we're getting almost 75 percent of all eligible donors.

It would be great to get more deceased donor organs, but there aren't that many that we're missing. There are other questions about the usage of donated organs. Not every donated organ that is "harvested," as they say, gets transplanted.

The situation is different for different organs. There are many people who need kidneys because dialysis can keep you alive for a long time while waiting for a new kidney. We do about 17,000 kidney transplants a year in the United States, about 11,000 deceased donor and 6 or 7,000 living donor transplants. Ten percent of living donor transplants are through kidney exchange now.

But hearts, I think we're talking fewer than 500 transplants a year. So there's a real shortage and a real need. It would be good to get more deceased donation. It'll also be good to have other advances. There will start to be artificial hearts; instead of pumping up and down, they go around and around. As those get better, there will be more hope for people who need new hearts.

Maybe we'll have stem cell therapies to grow new organs, maybe something else. I expect that my grandchildren will come to regard transplantation as an ancient, primitive form of medicine. They'll say, "Tell me again, Grandpa, you used to cut the organs out of dead people and sew them into sick people?"

Region: It almost sounds archaic now.

Roth: Yes, but of course it's miraculous. It makes people much better. But it's hard to do; it takes all sorts of advanced technology. Wouldn't it be better just to be able to build a new organ when you needed it?

EXPERIMENTAL ECONOMICS

Region: I'd like to talk a bit about experimental economics. You've been a huge proponent and practitioner of experiments in economics, but in a 2010 paper you wrote that experimental economics hadn't lived up to its promise in some respects, that it's still struggling. For example, the majority of economics departments don't have experimental economists or labs.

Why do you think that's the case? More importantly, in what respects *has* experimental economics succeeded?

Roth: Oh, I think experimental economics is a giant success story. It turns out economics as a profession is very open to new ideas. You know, I got my Ph.D. in 1974 not in economics, but in operations research, so economics was also welcoming to varieties of people.

In the time that I've been thinking about economics professionally, game theory has entered economics in a big way; experimental economics has made very substantial inroads into economics. Market design is starting to do so, as well.

When you try to do something new in economics, it often feels that things are slow and frustrating. If you measure them referee-report-by-referee-report, it seems like economics is incredibly

ON BREAKTHROUGHS IN PITTSBURGH

A lot of what makes a department a good place to work is that when you're onto something you're excited about and you walk out the door of your office and tell one of your colleagues about it, he's excited to hear about it, too. He says "That's great. Let's go have a cup of coffee, and you can tell me about it."

conservative. But when you look over a period of decades, economics is really open to new things, and experimental economics is one of the things that has entered quite a bit.

It's true that many economics departments do not have experimenters, but there aren't so many major economics journals that don't publish experiments, for instance. So I think experiments have made giant inroads in economics, and they are incredibly useful.

I wouldn't say that experimental economics hasn't lived up to its promise, although I think there's still room for growth. But I think that our understanding of what is the promise of experimental economics may have matured. There was a time when experimental economics looked like it was going to become a separate subject in economics rather than a tool that economists use.

I think that the way to view experimental economics is a little bit like the way we view econometrics. There are econometricians who specifically study econometrics, but all economists think about data and need to have tools to allow us to learn from data. Similarly, I think experimental economics isn't a

subject. It shouldn't be that experimental economists are those economists who study the ultimatum game. It should be experiments are tools that sometimes allow you to get answers to questions that you can't get in other ways.

Region: Have results from experimental economics helped propose and develop new ideas and theory?

Roth: Absolutely. For example, you see a lot of theory these days about preferences for fairness. These preferences show up in lots of ways, including in the general political discussion on income inequality. But you can study them very clearly in the laboratory and start to formulate what is it about income inequality and other kinds of inequality that might enter directly into your preferences. That's been a lively area in which theorists have looked closely at experimental results and proposed theories that in turn can be tested.

Region: And you're doing it with coercive pay.

Roth: Coercive pay is a tricky one. One possible question is, do high payments harm the quality of your decision-making? Could I tempt you so much with high pay that you rush into making decisions and do less due diligence?

Many economists think the idea of coercion is foreign to ideas of revealed preference. But we have consumer protection laws that say if you buy an expensive car on a Sunday, and on Tuesday you want to change your mind, you should be allowed to. So we have this idea that salesmen might be able to sell you things, we talk about high-pressure sales. And that means something like coercion.

We think that you might, in the presence of the salesman, sign a contract that when you went home you would regret. You haven't necessarily received new information, but you've had more time to think about it. We have a lot of consumer protection laws in many states that if you

buy a big-ticket item like a car, you can change your mind within a short period.

And, of course, that's meant to reduce the possibility of coercion. It's meant to not give salesmen the incentive to fool you in certain ways. If you were coerced, it's meant to give you time to reflect. In medicine, too, there are lots of laws that have phrases like "informed consent."

But as we better understand what uninformed consent is, we might be able to design markets that will more usefully address the concerns that people have about coercion. Again, for economists it's very funny to think about high pay as being coercive. If I offer you \$10 million for your house, you're going to go home and say to your wife, "Good news, we just sold the house."

If she says, "Did you think about it" and you say, "No, it seemed to me I really didn't have a choice," we wouldn't want to count that as coercion; it's "congratulations. You sold your house for way above what you thought you could get for it, and now you'll easily find another house."

BREAKTHROUGHS IN PITTSBURGH

Region: One last question, if I might. Many of your major breakthroughs occurred when you were at Pittsburgh. What was it about the research environment there that was so conducive to Nobel-winning work?

Roth: Well, Pittsburgh was a lot of fun. The living was easy. I walked to work. I'd walk with my kids to school and drop them off and walk on into work. My colleagues and I spent a lot of time drinking coffee and talking about economics.

The mathematician Alfréd Rényi is said to have said that a mathematician is a machine for turning coffee into theorems. Maybe economists turn decaf into models.

There were lots of people to talk to at Pittsburgh. It was a fruitful time. And it was a very good department. I think a lot of what makes a department a good

place to work is that when you're onto something you're excited about and you walk out the door of your office and tell one of your colleagues about it, he's excited to hear about it, too. He says "That's great. Let's go have a cup of coffee, and you can tell me about it." So there's the positive reinforcement you get just from having people think, "Isn't that great you're excited about something. You're thinking about something interesting." It makes places fun to work.

Here at Stanford, I try to organize regular coffees—I did this at Harvard and I do it here—regular coffees with students interested in different things. We have a Tuesday morning coffee for experimental economics and a Thursday morning coffee for market design. I think that a lot of intellectual interaction arises out of social interaction. You have to be talking to people before you're talking about work.

Region: Wonderful. It's been a pleasure talking with you. Thank you.

—Douglas Clement
March 11, 2015

More About Alvin Roth

Current Positions

Craig and Susan McCaw Professor of Economics, Stanford University, since 2013; Senior Fellow, Stanford Institute for Economic Policy Research, since 2013; McCaw Senior Visiting Professor of Economics, 2012

Senior Fellow, Stanford Institute for Economic Policy Research, since 2013

George Gund Professor of Economics and Business Administration Emeritus, Harvard University, since 2012; George Gund Professor of Economics and Business Administration, 1998-2012

Research Associate, National Bureau of Economic Research, since 1998

Previous Positions

A.W. Mellon Professor of Economics, University of Pittsburgh, 1982-98; Professor of Business Administration, Graduate School of Business, from 1985; Fellow, Center for Philosophy of Science, from 1983

Professor, Department of Business Administration and Department of Economics, University of Illinois, 1979-82; Associate Professor, 1977-79; Assistant Professor, 1974-79; Beckman Associate, Center for Advanced Study, 1981-82

Professional Affiliations

Member, Kidney Paired Donation Pilot Program Strategic Planning Team, Organ Procurement and Transplantation Network/United Network for Organ Sharing, since 2011; At Large Representative, 2009-11, 2012-14

Director, Market Design Group, since 2009

Chairman of the Board of Directors, Institute for Innovation in Public School Choice, since 2006

Member, Advisory Board, New Orleans Program for Kidney Exchange, since 2008; New England Exchange, 2006-11

Honors and Awards

Member, National Academy of Sciences, elected 2013

Economic Theory Fellow, Society for the Advancement of Economic Theory, 2013

Fellow, American Association for the Advancement of Science, elected 2012

Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel (with Lloyd Shapley), 2012

Fellow, American Academy of Arts and Sciences, 1998

Alfred P. Sloan Research Fellow, 1984-86

Fellow, Econometric Society, elected 1983

Guggenheim Fellow, 1983-84

Publications

Prolific author of books and other published research in the fields of game theory, market design and experimental economics, with significant contributions toward applying theory to real world problems. He blogs daily at marketdesigner.blogspot.com. His most recent book, written for non-economists, is *Who Gets What—and Why: The New Economics of Matchmaking and Market Design*, an Eamon Dolan Book, Houghton Mifflin Harcourt, Boston, New York, 2015

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Stanford University, Ph.D., operations research, 1974

Stanford University, M.S., operations research, 1973

Columbia University, B.S., operations research, 1971

For further background, visit

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Taxing Wealth

*Economic theory and empirical measurement
aren't yet able to provide accurate predictions on
the impact of wealth taxation*

Ellen R. McGrattan

Federal Reserve Bank of Minneapolis
University of Minnesota

Introduction

There has been much discussion recently, in both academic and policy circles, about instituting taxes on wealth to reduce its dispersion and avoid “arbitrary and unsustainable inequalities that radically undermine the meritocratic values on which democratic societies are based” (Piketty 2014, p. 1). In this paper, I argue that any such policy advice is premature. Better measurement of “wealth” and better theory that relates various measures of wealth are needed before economists can accurately predict—or provide sound policy direction regarding—the actual impact of taxing wealth.

In the United States, wealth is currently estimated with two conceptually different measures: (1) fixed assets, from the Department of Commerce, and (2) net worth, from the Federal Reserve. Neither is perfectly estimated, but both are needed to do the required policy analysis. More importantly, economists need a quantitatively valid theory of their relationship; currently, we lack sufficient understanding of their respective components and linkages, let alone the implications of taxing them. Here, I discuss recent progress in this direction, but caution that the theory is not yet policy-ready.

Executive summary

Some have proposed wealth taxation as a means of reducing economic inequality, but such proposals are premature. While economic theory and data measurement have solid grounding when analyzing other forms of taxation, such as income or sales taxes, this is not the case for wealth.

Total estimates of the two most widely used measures of wealth, fixed assets and net worth, vary widely over the six decades for which data are available. Trend lines in these two wealth measures are rarely correlated. In addition, the relationship between the two—and explanation of why they differ so radically—remains a theoretical puzzle for economists. Given this state of affairs, accurate predictions for the impact, and design, of wealth taxation policies are not yet possible.

Measurement

There are two widely used measures of total wealth in the United States. They provide completely different estimates. Both are needed, however, to predict the impact of “wealth” taxation.¹

The first measure is *fixed assets*, as calculated by the U.S. Department of Commerce’s Bureau of Economic Analysis (BEA 2014a) in its measurement of the nation’s wealth.² The BEA defines fixed assets as nonfinancial assets used in production for more than

Economic Policy Papers are based on policy-oriented research produced by Minneapolis Fed staff and consultants. The papers are an occasional series for a general audience. The views expressed here are those of the authors, not necessarily those of others in the Federal Reserve System.

In the United States, wealth is currently estimated with two conceptually different measures: (1) fixed assets, from the Department of Commerce, and (2) net worth, from the Federal Reserve. *These two wealth measures have rarely been close to one another.*

one year. This includes houses and office buildings, business equipment and consumer durables. The BEA recently added some intellectual property (IP) products; namely, research and development (R&D) and entertainment, literary and artistic originals.³

The second widely used measure of wealth, calculated by the Federal Reserve's Flow of Funds Accounts (FFA) division, is the *net worth* of households and nonprofit organizations. This measure is the sum of nonfinancial and financial assets, less liabilities. Nonfinancial assets include the market value of real estate and BEA estimates of certain fixed assets.⁴ Financial assets include deposits and securities held by financial intermediaries, directly held shares of corporations and equity in noncorporate businesses. Liabilities include debts such as home mortgages and other loans taken out by households and nonprofits.

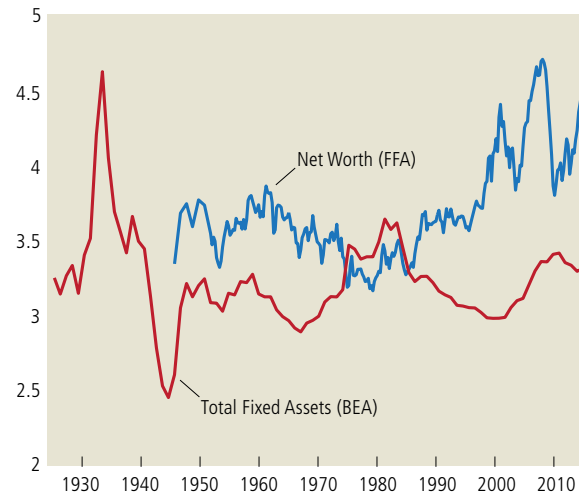
Both of these wealth measures are logically valid, though conceptually distinct, and both agencies measure their components quite carefully. How do they compare numerically? The following discussion and graphs indicate that *these two wealth measures have rarely been close to one another* during the roughly 60 years for which corresponding data are available. Several of their respective components, though logically similar, have also been quite different numerically.

Figure 1 plots the BEA's measure (total stock of fixed assets) and the Fed's FFA measure (net worth of households and nonprofit organizations) relative to gross domestic product (GDP).⁵ For nearly the entire period for which data on both measures are available (1952–2013), the FFA measure is higher.

Moreover, the two measures do not move in sync with one another. In fact, if the FFA series is annualized, there is a slightly negative correlation with the BEA measure. Starting in the mid-1960s, the

FIGURE 1

Household Net Worth and Total Fixed Assets (Relative to GDP)



Source: Authors' calculations

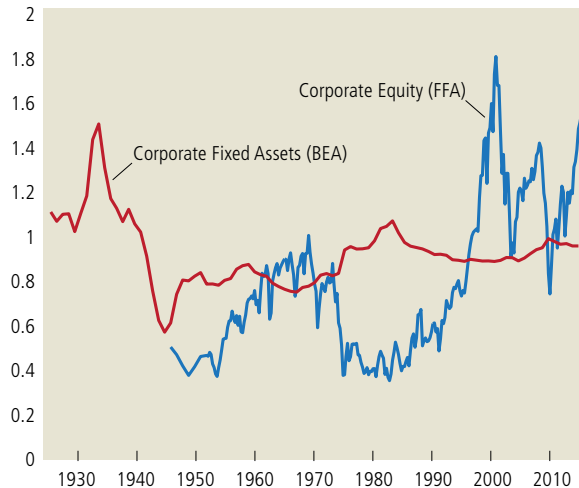
BEA measure of wealth rises relative to GDP, while the FFA wealth measure falls. These trends reverse in the early 1980s. During the 1990s technology boom, the BEA wealth measure of fixed assets remains below historical trends, relative to GDP, and then starts to rebound in the 2000s. The FFA's net worth measure of wealth rises relative to GDP over the 1990s, but then experiences large swings, on the order of 1 times GDP in level changes over a few years.

There are also significant differences between the FFA and BEA wealth estimates on two often-discussed asset subcategories: corporate equities and real estate.

Figure 2 displays the market value of U.S. corporate equities (the FFA measure) and corporate fixed assets (the BEA measure), both relative to GDP.⁶ Again, the two measures are very different. There is a slightly positive correlation between the annualized series, but the magnitudes in certain periods are different by a factor of 2. For example, in the late 1970s and 1980s, the FFA measure is around 40 percent of GDP, whereas the BEA measure is roughly equal to GDP. During the technology boom, corporate valuations shot up to 1.8 times GDP, while fixed assets

FIGURE 2

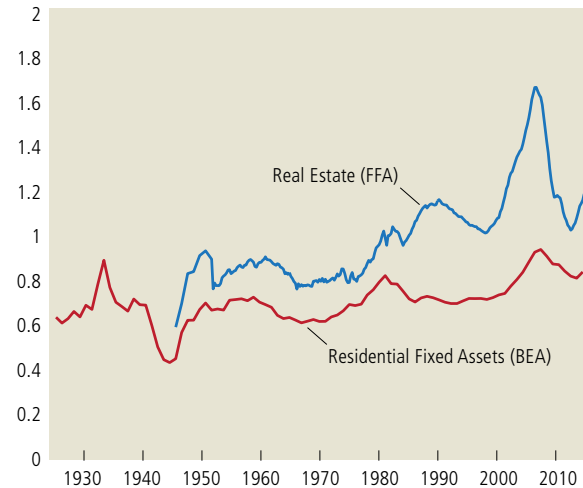
Corporate Equity and Corporate Fixed Assets (Relative to GDP)



Source: Authors' calculations

FIGURE 3

Real Estate and Residential Fixed Assets (Relative to GDP)



Source: Authors' calculations

hovered below 1 times GDP. At the start of the 2000s, equity values relative to GDP collapsed, rose sharply, collapsed and rose sharply once again. Meanwhile, BEA fixed assets remained close to 1 times GDP.

Figure 3 plots the FFA measure of real estate and the BEA's measure of residential fixed assets, both relative to GDP.⁷ Compared to the overall BEA and FFA wealth measures, and the corporate equity component, this segment of wealth is fairly similar, as measured by the BEA and the FFA. The correlation of the two annualized series is high, around 85 percent. Nonetheless, there are periods in which deviations between the series become large. In particular, real estate values rose relative to current-cost fixed asset values over the 1980s, with some reversal in the 1990s, and then rose dramatically in the early 2000s before reverting to the trend. The value of residential fixed assets also rose, but much less so.

Why are these measures of wealth so different? A small part of the difference is due to measurement; neither the BEA nor the FFA has perfect data, so estimates must be made. For example, the BEA includes R&D capital in fixed assets, but there are no data on R&D investments prior to 1953 (when the

National Science Foundation began surveying firms) and no data on prices or depreciation of R&D for any years. For the FFA, almost no data are available on equity values of noncorporate businesses and, therefore, the Federal Reserve imputes values.⁸ But, even if we had perfect data, the series are mechanically different because the BEA's measure of wealth is found by accumulating investment and the FFA's measure compiles values from available market transactions. Thus, they are conceptually different series.

To fully understand this difference, we need better theory.

Theory

Understanding the conceptual difference between the two measures of wealth just described is equivalent to understanding variations over time in Tobin's Q, a statistic named after Yale economist and Nobel Laureate James Tobin. Tobin's Q is the ratio of the market valuation of assets—the FFA measure of wealth—and the replacement or reproduction costs of those assets—the BEA measure of wealth.

As Brainerd and Tobin (1977) noted, "[T]his ratio has considerable macroeconomic significance and

usefulness, as the nexus between financial markets and markets for goods and services.”⁹

In the simplest theoretical model taught to first-year economics graduate students, Tobin’s Q is equal to 1. In other words, the market valuation of assets is equal to the expected present value of dividends or services paid to the asset holders and this, in turn, is equal to the cost of reproducing the physical stock of capital of the asset’s owner.

Consider, for example, the value of all U.S. corporations. If Tobin’s Q is 1 for corporate assets, then the value of all corporate equities (assuming debts are repaid first) is equal to the cost of replacing all physical capital in the corporate sector (such as buildings and equipment). More simply, corporate shareholders are owners of the capital stocks accumulated by corporations and, therefore, the stock market value should be equal to the value of corporate physical capital.

There are specific reasons that might explain why Tobin’s Q is not always 1. For example, Hall (2004) suggests that if it is costly for a firm to upgrade its capital stock quickly in response to an unexpected increase in demand, that would cause Tobin’s Q to vary from 1, but he finds that such “adjustment” costs are too small to make much of a difference.

McGrattan and Prescott (2005, 2010) analyze two other factors that show more promise in accounting for variations in Tobin’s Q: taxes on corporate distributions and intangible capital. Taxes on *corporate distributions* (dividends and share buybacks) directly affect Tobin’s Q; the higher is the tax rate, the larger is the government’s share of the distributions. In the 1960s, effective taxes on corporate distributions were high and equity valuations were low. Over time, tax rates have fallen and equity valuations have risen. Still, higher taxes don’t fully account for the dramatic variations we see in the data. (See the appendix for elaboration.)

Another factor that causes variations in Tobin’s Q is *intangible capital*. Intangible capital stocks that are not included in the BEA fixed assets, such as accumulated brand equity or organizational capital, are valued by corporate shareholders and do show up as part of the FFA’s measure of wealth. However, changes in these stocks are unlikely to imply the dramatic year-to-year or even day-to-day variations in stock market valuations that we observe in the U.S. time series.

So, two promising ideas—corporate distribution taxes and intangible capital—fail to fully account for the gap between theory and data. Still needed, then, is some factor that can account for dramatic swings in prices of financial assets, with little change in the physical capital stocks. Unfortunately, current economic theory is unable to explain the wide fluctuations in Tobin’s Q.

Policy implications

The fact that theoretical predictions for Tobin’s Q are not aligned with actual movements is significant for policy proposals to tax wealth. Piketty (2014) proposes taxing financial wealth, which corresponds to the measure of wealth reported by the Federal Reserve.¹⁰ To assess the impact of such taxation requires an accurate assessment of the policy’s impact on individual or household welfare, which economists usually measure as a function of lifetime consumption and leisure. That calculation, in turn, requires an accurate assessment of the policy’s impact on corporate decisions about investment in fixed assets, summarized in BEA data.

And, herein lies the problem: Economists need to better understand the nexus Tobin described between financial markets and markets for goods and services—the relationship between stock market valuation and fixed asset costs. As just discussed, current theory doesn’t explain why the two wealth measures have so rarely coincided.

This is not the case for many other types of taxation. Taxes on incomes, goods and property, for example, are well understood in theory, and the impact of tax changes is relatively easy to predict. Furthermore, most nations have centuries of practical experience with such taxes and recorded data that economists can study. In the case of a tax on financial wealth, we lack both theory and data.

This lack of previous experience with taxing financial wealth may stem from the fact that most governments need a stable revenue source for much of their spending needs. Infrastructure and public pensions, for instance, require long-term budget planning. Because financial wealth is volatile—as seen in Figure 1—it may not be a desirable tax base. Furthermore, government budget planning is difficult if tax bases are geographically mobile, especially as financial markets become more globally integrated.

Conclusion

In this paper, I've discussed two measures of wealth: fixed assets and net worth. Understanding their relation (summarized as Tobin's Q) is an essential step before implementing policies that impact the distribution of financial wealth. Unfortunately, current theory on this is insufficiently developed. Without a quantitatively valid theory or previous experience with taxing financial wealth, economists cannot make accurate predictions about the impact that such taxes will have on either aggregate wealth or its dispersion. Thus, any proposals to tax wealth are, at this point, premature. ^R

Endnotes

¹ In this discussion, I abstract from the wealth represented by human capital.

² More precisely, I am referring to the current-cost net stock of fixed assets and consumer durable goods. Earlier BEA documents refer to these stocks as fixed reproducible wealth. Current Federal Reserve documents use the terminology "replacement-cost value."

³ More exactly, according to the BEA's definition, fixed assets are produced (nonfinancial) assets that are used continuously in processes of production for more than one year. (See U.S. Department of Commerce 2014b.) BEA measures of fixed assets include residential and nonresidential structures (e.g., houses and office buildings), business equipment and consumer durables. As mentioned, the BEA recently added several intellectual property (IP) product categories. While accountants expense these IP products, the BEA includes them with fixed investment because they provide long-lasting services and profits to businesses and governments. Investment in fixed assets is included in the U.S. national income and product accounts; namely, as gross private domestic investment, government gross investment and expenditures of consumer durables. To construct net stocks in a particular year, the BEA uses the perpetual inventory method, which begins with stock from the year before, adds new investment and subtracts estimates of capital depreciation.

⁴ These assets include consumer durable goods, equipment of nonprofits and intellectual property products of nonprofits. The Fed uses the BEA estimate of fixed assets in certain asset categories when no market transactions are available.

⁵ The BEA's fixed asset data are available annually beginning in 1925 (with GDP for the pre-1929 period taken from early Department of Commerce documents), and the Flow of Funds Accounts (FFA) data are available annually for the period 1945-1951 and quarterly thereafter.

⁶ To avoid double counting corporate equity holdings (FFA Table L.213), I sum issues of nonfinancial plus financial corporations and subtract holdings of U.S.-chartered depository institutions, foreign banking offices, property-casualty insurance companies, closed-end funds, exchange-traded funds, brokers and dealers, and funding corporations.

⁷ The real estate value in household net worth includes owner-occupied housing as well as the residential land values. The BEA measures both owner-occupied and tenant-occupied residential structures, but I only include owner-occupied structures in the series shown in Figure 3 to make it comparable with the FFA measure. The BEA measure, however, does not include land, because land is not a fixed asset.

⁸ Piketty and Zucman (2014) collect data for the United States as far back as 1770. The earliest data are based on probate and tax records and are not reliable estimates of the FFA measure of wealth currently reported by the Federal Reserve. In fact, even early data reported by the Federal Reserve can be considered somewhat unreliable because roughly half of corporate value in 1945 was in businesses that were not publicly traded.

⁹ See also Tobin (1969).

¹⁰ National wealth is reported in the Federal Reserve's Flow of Funds Accounts (2014) and household wealth is reported in its Survey of Consumer Finances (2013).

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Appendix

Theoretically, changes in tax rates on corporate distributions (dividends and share buybacks) of the magnitude observed in the United States should generate large movements in Tobin's Q. (See McGrattan and Prescott 2005, and McGrattan 2012.) The theory is that a government tax on distributions effectively changes the ownership of the corporate payout stream and therefore changes the price that the public is willing to pay for corporate equity.

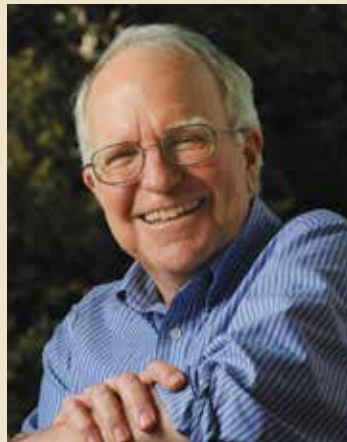
For example, if an individual faces a tax rate of 50 percent, then half of the dividends are paid to the government and the value to the individual is half of what it would be if the tax rate were 0 percent. In general, as the tax rises, the stock market value recorded by the FFA falls. But if household budgets are not greatly affected (because, say, the tax revenue is used for transfers or to buy goods that households value), then there is little change in household decisions regarding investment in physical capital and hence little change in the fixed assets measure recorded by the BEA.

In other words, distribution tax rate changes affect the FFA measure of corporate equities but not the BEA measure, leading to a Tobin's Q that deviates from 1. Over the post-WWII period, the effective tax rate on distributions has fallen significantly as statutory rates have fallen and tax deferrals through pensions have risen. Thus, theory would predict a rise in the FFA measure of corporate wealth and a rise in Tobin's Q. Unfortunately, though, this factor doesn't have enough explanatory power. Predictions generated by economic models that incorporate changes in distribution tax rates are not nearly as volatile as the actual U.S. observations.

Research Digest

Did the Great Recession “break” labor matching efficiency?

A close analysis suggests that matching efficiency has trended slightly downward for over a decade, but not due to recessions



Robert Hall



Sam Schulhofer-Wohl

During and since the Great Recession, economists and policymakers have been concerned that the U.S. job market was, in a sense, broken. Employers couldn't find suitable workers, and workers couldn't find good jobs. “Mismatch between skills and applicants, available and desired pay is a big conundrum in today's labor market,” suggested a 2012 *Wall Street Journal* article analyzing U.S. unemployment. A related term,

“structural unemployment,” implied that although plenty of people were looking for jobs, they just didn't have the right skills for the jobs available.

The broader policy question was whether stubbornly high unemployment rates were the result of insufficient demand or poorly functioning labor markets; the former might be amenable to monetary policy intervention, but the latter less so. For his part, then-Fed Chairman Ben Bernanke suggested that persistently

Research Digest

high unemployment was the result of a “broad-based shortfall in demand” rather than a “substantial increase in mismatch between available jobs and workers.” Still, many were convinced that labor markets were broken.

A recent paper by Stanford’s Robert Hall and the Minneapolis Fed’s Sam Schulhofer-Wohl (WP 721 at minneapolisfed.org) casts new light on the issue with a careful analysis of labor market “matching efficiency”—the ability of an economy to find the right worker for the right job. They conclude that standard methods of measuring matching efficiency arrive at an inaccurate finding of lower matching efficiency since the recession. If the volume of job-seeking is better measured and studied over longer employment time spans, they find, it appears that while U.S. matching efficiency has indeed declined since 2001, the recession had little impact on this downward trend, except among the long-term unemployed.

A closer look

The analysis focuses closely on the concept of “job seeker,” observing that people looking for jobs come in many different stripes. Some have been out of the labor force for a very long period. Others were laid off just last week. Still others currently have a job, but are looking for something better. Most research on matching efficiency has assumed that the right

measure of job-seeking volume is the stock of unemployed workers, but government statistics show that “only about a quarter of newly filled jobs involve hires of the unemployed. The remaining three-quarters come from out of the labor market or from job-to-job transitions,” write Hall and Schulhofer-Wohl.

So the economists take a fine-grained look at people searching for jobs, well beyond “the unemployed,” and come up with 15 job-seeker categories. They then estimate job-finding rates or probabilities for each (after adjusting for changes in labor force composition—that is, variations over time in age, education and gender distributions, since those traits influence labor prospects).

The variations in likelihood of finding a job vary widely by job status, the economists find. For a person just laid off, for example, they calculate an average employment probability at 1 to 3 months of 60.5 percent in 2012. Someone who recently entered the labor force, by contrast, had a much lower 1-3 month employment probability, about 15 percent. Those rates changed over time but, again, far more for some statuses than others. In 2001, a recently laid-off person had a 1-3 month probability of 59.7 percent, just slightly lower than in 2012. But a recent entry had a much better chance in 2001: nearly 31 percent probability of finding a job within 1 to 3 months.

In order to assess the effect of

labor market conditions not only on whether workers find jobs, but also on *how quickly* they do so, the economists do these calculations for a longer (12-15 month) time horizon as well as for the short span (1-3 month).

Trends in matching efficiency

They next develop a matching efficiency index by adjusting the job-finding rates for overall labor market tightness. Market tightness—the ratio of job openings to new hires—has an obvious influence on job-finding. If a labor market is relatively tight, employers find it harder to find suitable employees. Workers, on the other hand, have an easier time getting hired. So, for a given level of matching efficiency, job-finding rates will be higher when the labor market is tighter. By subtracting the effect of labor-market tightness from the measured job-finding rates, the economists can calculate their index of matching efficiency.

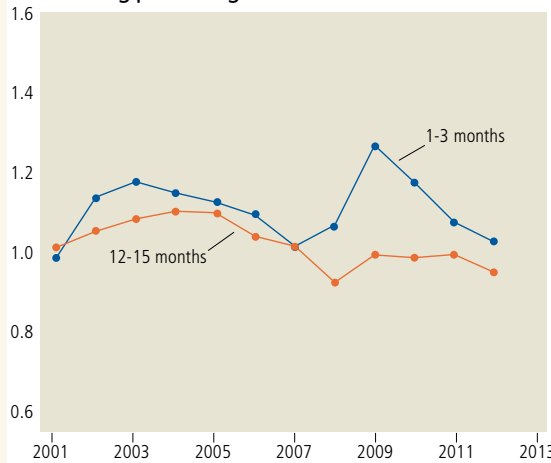
For all 15 job status categories, they estimate U.S. matching efficiency from 2001 to 2012 at different time spans. With job-finding rates adjusted for shifting labor force composition, their efficiency estimates are shielded from any changes in gender, age and education characteristics that occurred over the decade. In addition to the individual category estimates, the economists develop an overall labor force estimate, aggregating the 15 but weighting by the relative shares

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Overall matching efficiency, 2001 through 2012

FIGURE 1

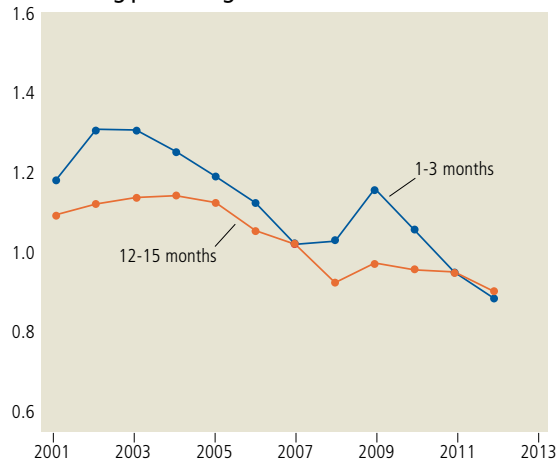
Excluding preexisting trend



Note: Matching efficiency shown on vertical axis is gauged relative to efficiency in 2007.

FIGURE 2

Including preexisting trend



“Matching efficiency has declined in some categories of unemployment,” but “most of the decline is the continuation of a trend that has existed since 2001 and possibly earlier.”

of each component in the three years preceding the financial crisis. Finally, because their interest is in whether the Great Recession itself affected efficiency, they calculate rates with and without adjusting for any preexisting trends in efficiency.

The results are seen in the accompanying figures.

The first figure shows “detrended” overall matching efficiency for short-span (1 to 3 months) and long-term (12 to 15 months) employment success rates. Both lines show that efficiency moves cyclically, rising as recessions

begin and falling during recoveries. But between the cycles, in 2001, 2007 and 2012, the blue line shows that short-span matching efficiency was essentially unchanged. Long-term rates jumped less with business cycles, but did shift slightly down.

The second figure is also revealing. Both lines move with business cycles (long-term less so), but they also trend downward, especially for short-term success rates. In other words, there does appear to be a slight decline in matching efficiency, but the two recessions didn’t cause it.

In sum, Hall and Schulhofer-Wohl conclude, “matching efficiency has declined in some categories of unemployment,” but “most of the decline is the continuation of a trend that has existed since 2001 and possibly earlier.” Still, an important reality is that efficiency declined significantly for those with permanent job loss, the truly long-term unemployed, a category that grew disproportionately in the Great Recession. “One important implication is that the decline in matching efficiency among the unemployed drove up the unemployment rate, but the labor market still generated large volumes of job-finding among groups not counted as unemployed.”

— Douglas Clement

Research Digest



Jonathan Heathcote



Hitoshi Tsujiyama

Optimal income taxes

Surprisingly, the current U.S. tax plan appears nearly optimal, if one assumes it accurately reflects Americans' taste for redistribution

Economics is rife with trade-offs. One of the most vexing for economists, policymakers and the public alike pertains to income taxes. Almost everyone favors some degree of taxation to provide essentials for those in need, but it's generally thought that too generous a safety net will discourage people from working to their full potential. So, what is the *best* possible income tax structure—one that generates the right quantity of good (support for the needy) for the least amount of bad (low work effort)?

In a January 2015 staff report, "Optimal Income Taxation: Mirrlees Meets Ramsey" (SR 507 online at

minneapolisfed.org), Minneapolis Fed economist Jonathan Heathcote and former Minneapolis Fed research analyst Hitoshi Tsujiyama, now of Goethe University Frankfurt, analyze this trade-off. They seek to determine, as they write, "What structure of income taxation maximizes the social benefits of redistribution while minimizing the social harm associated with distorting the allocation of labor input?" And their goal is quantitative. They hope to provide *numerical* guidance regarding the best structure for income taxes, not simply "this plan is better (or worse) than another."

Their strategy is to compare social

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“What is the taste for redistribution in the United States?” they ask. “We argue that the degree of progressivity built into the actual U.S. tax and transfer system is informative about the preferences of U.S. voters and policymakers.”

welfare under the existing U.S. tax system with that generated by two other options:

- (1) The best possible policy combining a flat tax system (in which everyone pays the same tax rate, regardless of income) with universal, identical lump-sum transfers.
- (2) The optimal Mirrlees policy, referring to the theory of optimal taxation developed by Scottish economist, James Mirrlees. A Mirrlees design is aimed at the best income tax schedule, without imposing any restrictions on the shape of that schedule.¹

The current U.S. system, note Heathcote and Tsujiyama, combines a progressive tax structure (tax rates are higher at higher income levels) with means-tested transfers (benefits given only after evaluating financial needs).²

Necessary assumptions

Any effort to optimize requires specifying a desired goal. The economists assume that Americans’ desire for redistribution is reflected in the existing U.S. income tax structure—arrived at through extensive political give-and-take over

decades of U.S. history. The paper’s findings hinge on this assumption since, they emphasize, the shape of the optimal tax-and-transfer system depends on the system’s goal. An objective concerned with only the poorest members of society would be very progressive. Absent any desire to redistribute, the government wouldn’t tax at all, other than to finance roads, parks, schools, national defense and the like. “What is the taste for redistribution in the United States?” they ask. “We argue that the degree of progressivity built into the actual U.S. tax and transfer system is informative about the preferences of U.S. voters and policymakers.”

Using a model Heathcote recently developed with two other economists [see SR 496, described in “The Goldilocks tax,” September 2014 *Region*, at minneapolisfed.org], they mathematically derive that redistributive “taste” from the actual degree of tax progressivity built into the U.S. tax code. “*This empirically motivated social welfare function* will serve as our baseline objective function,” write Heathcote and Tsujiyama. That is to say, the benchmark against which alternatives 1 and 2 will be measured.

Two other steps are needed. First, the economists assume that people have some degree of private insurance—they are not totally reliant on government if misfortune falls. The tax-and-transfer system thus cushions risks that individuals can’t buffer using family or other resources. Second, the economists calibrate the economy’s distribution of labor productivity from U.S. data on labor earnings. If people earn more, the model assumes, it’s because they’re more productive.

Building the model

Heathcote and Tsujiyama first establish their model’s economic environment (labor productivity, preferences about consumption and work effort, technology, insurance, government, the problem faced by family decision-makers). They then define mathematically the social planner’s three options—models that reflect (1) the current U.S. system, (2) the best flat-tax-plus-lump-sum-transfer proposal and (3) the fully optimal income tax given that actual labor productivity isn’t known to the planner.

The final step is to estimate quantitatively society’s preferences: the “taste” for redistribution. A utilitarian approach, where the tax planner puts equal weight on all households? A “veil of ignorance” (à la John Rawles) goal—the well-being of the least-well-off, since you could be

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that person? Or a simple “reap-what-you-sow,” laissez-faire target—to each according to his or her contribution? Again, the economists assume that U.S. redistribution preferences are reflected in the current system, so the two policy options are judged by the welfare gains or losses they achieve relative to what now exists.³

Results

The bottom line is that neither alternative would be much of an improvement. The best flat-tax-plus-transfer plan would actually reduce social welfare slightly, by around 0.6 percentage points of consumption, the economists estimate. And the best Mirrlees solution would raise welfare by just 0.1 percentage points. “These findings suggest that proposals for dramatic tax reform should be viewed with caution,” conclude Heathcote and Tsujiyama.

The source of the welfare drop under flat-tax-plus-universal-transfer: Compared to the current system, low-productivity workers would work too little because they’d face relatively high tax rates and receive large transfers. For high-income workers, the flat tax rate would be too low (they could be taxed more heavily without an undue productivity impact), so “high-productivity workers end up consuming too much.”

As for the optimal Mirrlees plan, the economists acknowledge that it is

“perhaps surprising” that it generates only a small welfare gain. After all, they write, the current system “violates some established theoretical properties of optimal tax schedules,” including the recommended zero marginal tax rate for the highest and lowest income levels. They note, moreover, that the optimal Mirrlees policy would generate output gains and have an average marginal rate 2.4 percentage points lower than the current rate.

Lessons for policy design

The economists draw several policy design lessons from their analysis. First, establishing the social welfare objective is crucial to the design of optimal tax policy; policy is shaped by the goal to be achieved. Second, the tax-and-transfer system should be designed to address only risks that can’t be insured privately. Third, a good estimate of the actual productivity distribution is important; a flat-tax-plus-transfer policy would be almost perfectly efficient if there were a “normal” productivity/earnings distribution—a bell curve—rather than one skewed to the high-income tail, as actually exists in the United States. And fourth, while truly optimal design is very intricate, a *nearly* optimal plan is far simpler, as represented by the versatile model developed by Heathcote and colleagues.

— Douglas Clement

Endnotes

¹ In addition, Mirrlees emphasized that since tax authorities can never accurately know a person’s actual productivity level, an optimal plan should be “incentive compatible,” meaning that its rules are designed to make it in a worker’s self-interest to reveal his or her true work ability.

² Both the current system and the flat-tax-plus-transfer system are “Ramsey” tax plans, referring to British economist Frank Ramsey. The “Ramsey Meets Mirrlees” of the paper’s title refers to these two influential theorists.

³ In additional exercises, Heathcote and Tsujiyama also analyze the alternative plans under different social welfare functions (utilitarian, laissez-faire and Rawlsian “veil of ignorance”). They examine results assuming no private insurance against risks, as well.

And in an extension of their baseline model, they add a productivity component meant to capture wage differences due to characteristics like age and education. This component, the economists assume, is privately uninsured but *known* by the social planner. If the planner therefore can alter tax rates to account for this component, the new plan will result in lower average marginal tax rates and can generate large welfare gains. These variations are all analyzed according to their impact on social welfare relative to the baseline model and assumptions, with a wide range of results.

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Crisis of confidence

Did a drop in household wealth set the stage for the Great Recession?



Jonathan Heathcote



Fabrizio Perri

It's human nature: When people get nervous about the future—fearing unemployment, diminished wealth or some other economic setback—they tend to increase saving as an insurance policy. But expectations of hard times can become self-fulfilling; precautionary saving reduces demand for goods and services, cutting output and putting people out of work. In turn, job losses and foundering businesses spur more desired saving. A vicious recessionary cycle takes hold.

A large body of economic research has examined the role of this mechanism in deep and protracted downturns, including the Great Recession and the

Great Depression of the 1930s. (See, for example, “Engineering a Paradox of Thrift Recession,” SR 478, and “Paradox’ Redux,” June 2013 *Region* at minneapolisfed.org.) But such crises of confidence are not inevitable; they require certain conditions to occur, according to recent research at the Federal Reserve Bank of Minneapolis.

In “Wealth and Volatility” (Minneapolis Fed SR 508, at minneapolisfed.org) Minneapolis Fed Monetary Advisers Jonathan Heathcote and Fabrizio Perri argue that lower asset values make the U.S. economy more vulnerable to confidence-driven downturns.

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“What’s novel about this paper is that a drop in the level of household wealth makes the possibility of a self-fulfilling crisis more likely,” Perri said in an interview.

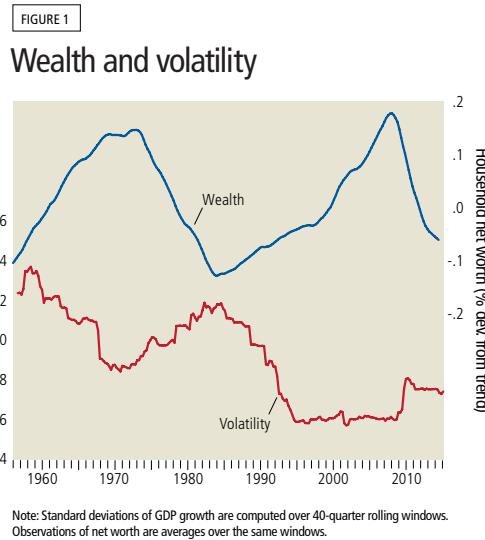
To test their theory, the economists develop a model economy in which the level of wealth influences saving behavior and aggregate demand. Heathcote and Perri complement that with an analysis of data on consumption by rich and poor households during the Great Recession. Their

findings have implications for public policy, suggesting that generous unemployment benefits can sustain consumer demand in the face of uncertainty by reducing the impulse to save.

Wealth and “animal spirits”

Over the past decade, U.S. households saw large and persistent declines in their net worth. Starting in 2007, households headed by individuals in their prime working years experienced a large (50 percent) and persistent drop in their median net worth. This drop marked the start of the worst economic retreat since the Great Depression.

This wasn’t the first time that a loss of wealth had coincided with a recession or period of economic frailty;



“Higher expected unemployment encourages people to save, because money put aside can smooth consumption in case of job loss. And how much they save depends upon household wealth, specifically housing prices in the model.”

macroeconomic data for the past 60 years (see Figure 1) show that when household wealth drops, aggregate output often becomes volatile, making the economy susceptible to weakness. Conversely, when net worth is high, output tends to be more stable and the economy more resistant to negative shocks.

Previous research on the link between asset values and output

volatility has emphasized the impact of output volatility on asset prices. But what if causality runs in the other direction, with fluctuations in asset values affecting variances in output—and in consumption and employment? In Heathcote and Perri’s model, changes in consumer confidence—what British economist John Maynard Keynes termed “animal spirits”—can drive economic fluctuations. Crucially, according to this hypothesis, asset values

determine the amplitude of these confidence-driven fluctuations—whether economic activity stays on a fairly predictable path or becomes more volatile, increasing the likelihood of a severe downturn. “Wealth here is the prerequisite, the thing that tells you whether the economy is fragile or not,” Perri said.

In the model, individual members of households decide how much to spend and save as the unemployment rate and other economic conditions change over time. The model is relatively simple, according to Heathcote and Perri, lacking features that make dynamic market models harder to solve. But it captures human motivations that are key to the economists’ analysis.

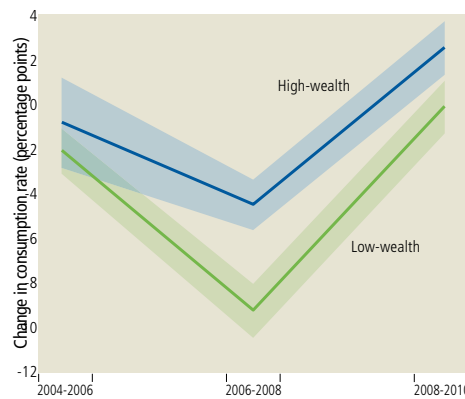
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Higher expected unemployment encourages people to save, because money put aside can smooth consumption in case of job loss. And how much they save depends upon household wealth, specifically housing prices in the model. When housing prices are high, people worried about their jobs save proportionately less—and therefore consume more—because wealth can be shared within the household, helping to support unemployed members. In this way, high wealth prevents a confidence-driven collapse in demand and output.

On the other hand, when housing prices fall, people are more disposed to save, and saving increases markedly with the expected unemployment rate. “Thus, a recession driven by a self-fulfilling wave of pessimism becomes possible,” Heathcote and Perri write. “If agents collectively expect higher unemployment, they all simultaneously reduce demand, leading to a fall in hiring and rationalizing the expected unemployment.”

Simulations from the model can generate patterns for housing prices and unemployment very similar to those seen in the United States over the course of the Great Recession. Housing prices decline well before

FIGURE 2
Changes in consumption rates for rich and poor



Note: Shading represents confidence bands
Source: Panel Study of Income Dynamics, Survey Research Center at the University of Michigan

“Both rich and poor households reined in spending, but the poor reduced expenditures about 4 percent more relative to the rich, suggesting that precautionary saving increases as wealth falls.”

the unemployment rate begins to rise. The economy contracts quickly, with plummeting asset prices and rapidly rising joblessness. And recovery is sluggish; in both the model and the real economy, housing prices remain depressed five years after the recession officially ended in 2009. The authors don’t try to explain the initial drop in house values; they assume a decline in consumer preference for housing.

The output of the model also fits the pattern of the Great Depression, in which a sharp decline in wealth after the stock market crash of 1929 was quickly followed by massive unemployment that lasted for years.

Heathcote and Perri’s theory predicts that confidence-driven recessions are necessarily persistent—once started, the cycle of self-fulfilling low expectations is hard to break—and that recessions with steep drops in output are likely to be especially long-lasting. Their theory also predicts that

the lower are asset values, the more volatile the economy becomes—and the greater the likelihood of a severe recession.

Rx for confidence

If household wealth determines the degree of precautionary saving in response to unemployment risk, low-wealth households should, theoretically, cut their consumption (in proportion to their income) more than high-wealth households during a recession. Breaking new empirical ground, Heathcote and Perri analyze two types of U.S. data on household income, wealth and expenditures to reveal just such a disparity during the Great Recession.

Their key finding is that at the onset of the recession, the expenditure rate

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of low-wealth households declined significantly more than that of high-wealth households (see Figure 2). Both rich and poor households reined in spending, but the poor reduced expenditures about 4 percent more relative to the rich, suggesting that precautionary saving increases as wealth falls.

Heathcote and Perri's investigation highlights the central role of household wealth in setting the stage for confidence-driven recessions and perpetuating them. It also informs policy choices for combating severe recessions. The economists compare two governmental responses to recession: increasing government spending and extending unemployment benefits. Both aim to revive the economy by stimulating aggregate demand.

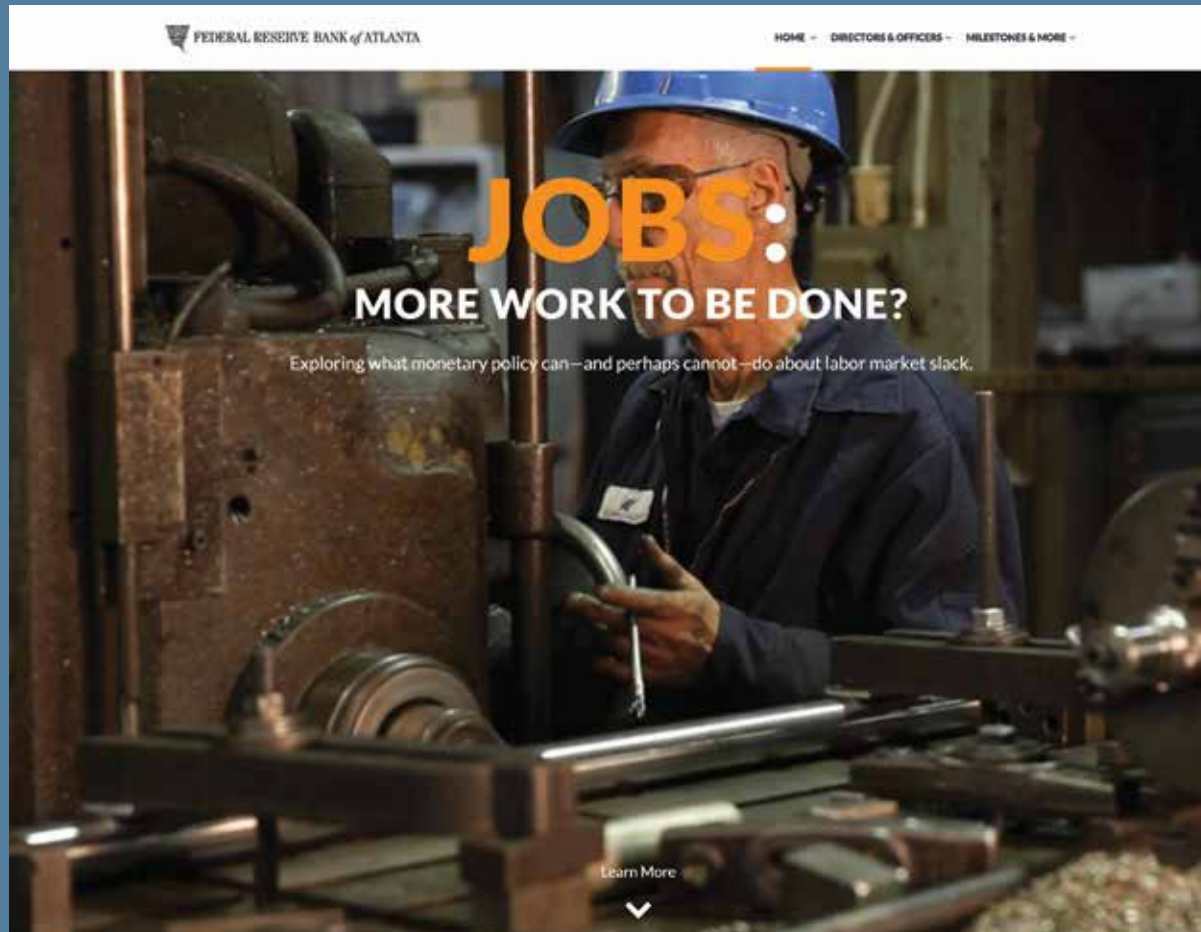
The reasoning behind government purchases financed by taxing workers seems sound: Aggregate demand should rise because public spending isn't constrained by the precautionary saving motive. But in the model, raising taxes on workers reduces personal wealth, encouraging household saving and canceling out the economic lift from higher government spending.

Taxing workers to provide generous unemployment benefits also diminishes household wealth. But this type of government intervention is more effective in combating recession than broad government

spending because it directly targets precautionary saving; a buffer against the pain of unemployment induces people to save less. "If the problem is that households aren't spending enough because they're worried about future unemployment risk, this policy is a good one because, by removing the cause of their worries, it encourages increased spending," Perri said.

—Phil Davies

VIRTUAL FED



Cutting the slack

With more than 3 million net jobs created and the unemployment rate falling more than a percentage point, 2014 was seen as a year of accelerating labor market recovery from the Great Recession. This matters a lot to the Federal Open Market Committee, the Fed's monetary policymaking body, which is charged with the goals of price stability and maximum employment—the so-called dual mandate set for the Fed by Congress. The question of how far the U.S. economy remains from full employment figures prominently in FOMC deliberations.

The Federal Reserve Bank of Atlanta dedicated its 2014 Annual Report to the problem. But this is no ponderous essay. With eye-catching artwork; smart, clean infographics; brief explanatory videos and links to a wealth of Fed resources, the Atlanta Fed's Annual Report is designed for online reading. Diverse labor market gauges, apparent wage stagnation, people working “part-time for economic reasons” and a host of other key labor issues are examined in clear and compelling fashion—a must-read Virtual Fed.

Read more about the hard work of measuring jobs at frbatlanta.org/about/publications/annual-reports/2014

—Joe Mahon