Daniel K Tarullo: Longer-term challenges for the American economy

Speech by Mr Daniel K Tarullo, Member of the Board of Governors of the Federal Reserve System, at the 23rd Annual Hyman P. Minsky Conference "Stabilizing Financial Systems for Growth and Full Employment", Washington DC, 9 April 2014.

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In the more than five years that I have been a member of the Board of Governors of the Federal Reserve System, it has been hard not to concentrate on near-term economic prospects. The severe decline in the economy precipitated by the financial crisis and the magnitude of job and production loss in the Great Recession that followed have made a focus on recovery both understandable and imperative. But as I have prepared for Federal Open Market Committee (FOMC) meetings every six to seven weeks by examining incoming data and the analyses of our own staff and of outside economists, I have been struck by the evidence of longer-term challenges to the American economy that poke through shorter-term discussions.

There is considerable ongoing debate about whether the financial crisis and recession amplified changes already afoot in the economy, accelerated them, or simply revealed them more clearly. Whatever one's view on that question, the confluence of some apparently secular trends raises important questions about our nation's future growth potential and our ability to provide opportunity for all of our people. Indeed, these changes reflect serious challenges not only to the functioning of the American economy over the coming decades, but also to some of the ideals that undergird the nation's democratic heritage. This evening I will address in some detail four particularly important developments:

1. Productivity growth has slowed. As a result, the overall economic pie is expanding more slowly than before.
2. Some indicators further suggest that workers have been claiming a smaller share of the overall economic pie during the past decade.
3. Inequality has continued to increase, meaning that a larger portion of overall economic resources is commanded by a smaller segment of the population.
4. Economic mobility across generations is not particularly high in the United States, and it has not been increasing over time.

After detailing these trends, I will turn briefly to both the role and the limits of monetary policy in countering them.[1]

Structural challenges for the American economy

Lagging productivity growth

Over the long term, the pace at which our standards of living increase depends on the growth of labor productivity – that is, the increase in the amount of economic value that a worker can generate during each hour on the job. Unfortunately, the data on productivity growth in recent years have been disappointing. Although output per hour in the nonfarm business sector rose about 2-3/4 percent per year from the end of World War II through 1971, productivity has risen just 1-1/2 percent per year since then, excluding a brief burst of rapid growth that occurred roughly between 1996 and 2004.

[1] Stephanie Aaronson of the Board's staff contributed substantially to these remarks.

Just as it took economists a long time to identify the sources of the surge in productivity that began nearly two decades ago, they are only now beginning to grapple with the more recent slowdown. Some have argued that the burst of productivity growth that began in the mid-1990s was the anomaly, and that the more pedestrian pace of growth over the past decade represents a return to the norm.[2] In this view, the long period of rapid productivity growth that ended in the 1970s grew out of the technological innovations of the first and second Industrial Revolutions. But now, despite continued technological advances, a return to that pace of performance is thought unlikely. In particular, these authors argue that the information technology revolution of the past several decades – including the diffusion of computers, the development of the Internet, and improvements in telecommunications – is unlikely to generate the productivity gains prompted by earlier innovations such as electrification and mass production.

This somewhat pessimistic perspective is far from being conventional wisdom. While productivity has increased less rapidly in recent years than during the first three-fourths of the 20th century, per capita income (a statistic available over a longer time span) is still rising more quickly than it was even during the second Industrial Revolution. Indeed, some have argued that the problem with new technology is not with productivity growth but with our ability to capture the productivity in our statistics. Moreover, many economists and technophiles remain optimistic that we have yet to fully realize the potential of the information revolution, and that technological change will continue to bring inventions and productivity enhancements that we cannot imagine today.[3] This view holds that there is no reason productivity could not continue to rise in line with its long-term historical average.[4]

It must be noted that, even among the productivity optimists, there are differences over how the expected progress will affect job creation and income distribution. In particular, some in this camp believe that we are likely to see a continuation of the pattern by which recent productivity growth seems to have mostly benefited relatively skilled workers. It may also have favored returns to capital investment, as opposed to labor, in greater proportion than past productivity gains.

While there is some reason for optimism about the prospects for technological progress, there are grounds for concern over the decline in the dynamism of the U.S. labor market, an attribute that has contributed to productivity growth in the past and has traditionally distinguished the United States from many other advanced economies. Historically, the U.S. labor market has been characterized by substantial geographic mobility. Our high rates of geographic mobility are one facet of the overall dynamism of our labor market, which is also manifest in the continual churning of jobs through hirings and separations, as well as firm expansions and contractions – a process that the economist Joseph Schumpeter called

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[2] See, for example, Tyler Cowen (2011), *The Great Stagnation: How America Ate All the Low-Hanging Fruit of Modern History, Got Sick, and Will (Eventually) Feel Better* (New York: Dutton); Robert J. Gordon (2010), "Revisiting U.S. Productivity Growth over the Past Century with a View of the Future," NBER Working Paper Series 15834 (Cambridge, Mass.: National Bureau of Economic Research, March); and Robert J. Gordon (2012), "Is U.S. Economic Growth Over? Faltering Innovation Confronts the Six Headwinds," NBER Working Paper Series 18315 (Cambridge, Mass.: National Bureau of Economic Research, August).

[3] See, for example, Erik Brynjolfsson and Andrew McAfee (2011), *Race Against the Machine: How the Digital Revolution Is Accelerating Innovation, Driving Productivity, and Irreversibly Transforming Employment and the Economy* (Lexington, Mass.: Digital Frontier Press); Erik Brynjolfsson and Andrew McAfee (2014), *The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies* (New York: W.W. Norton & Company); and Martin Neil Baily, James Manyika, and Shalabh Gupta (2013), "U.S. Productivity Growth: An Optimistic Perspective," *International Productivity Monitor,* no. 25 (Spring), pp. 3–12. See also Ben Bernanke (2013), "Economic Prospects for the Long Run," speech delivered at Bard College at Simon's Rock, Great Barrington, Mass., May 18.

[4] See, for example, David M. Byrne, Stephen D. Oliner, and Daniel E. Sichel (2013), "Is the Information Technology Revolution Over?" *International Productivity Monitor*, no. 25 (Spring), pp. 20–36.

"creative destruction."[5] To give a sense of the magnitude of this process, while *net* job gains and losses are typically measured in the hundreds of thousands each calendar quarter, *gross* job creation and destruction commonly run at a pace of roughly *7 million* jobs each quarter. Creative destruction has been shown to improve productivity as jobs that have low productivity are replaced with jobs that yield greater productivity.[6]

However, a variety of data indicate that this feature of labor market dynamism has diminished. Since the 1980s, internal migration in the United States over both long and short distances has declined. To give an example, the rate of cross-state migration was less than half as large in 2011 as its average over the period from 1948 to 1971.[7] And, while we still see the level of employment rising and falling over the business cycle, the gross flows of people between jobs and of jobs across firms that underlie the observed aggregate changes have fallen over the past 15 years.

At this point, we do not have a full understanding of the factors contributing to the decline in labor market dynamism. As a number of economists who have studied the issue have pointed out, some of the explanations may be benign or even positive.[8] For instance, the aging of the population accounts for some of the decline in migration and job churning, as older individuals are less likely to move and change jobs; such demographic factors probably do not represent an adverse reduction in dynamism. Moreover, some of the decline in turnover could be the result of individuals and firms finding productive job matches more quickly than before. For many employers and workers, the Internet has reduced the cost of posting job openings and the cost of searching for jobs. This more efficient process could result in better matches between firms and workers and thus fewer separations. Similarly, a reduction in firm uncertainty about the costs and benefits of investing could reduce firm-level churning in jobs. In both cases, workers and firms are able to achieve a good outcome with less turnover and presumably no loss of productivity.

While it seems possible that improved information could be a force behind the reduction in geographic mobility and labor turnover, there are less benign possibilities as well. For instance, an increase in the costs to firms of hiring and firing individuals or an increase in the costs to individuals of changing jobs could lead to fewer productivity-enhancing job changes. Alternatively, the reduction in churning could itself be a function of slower productivity growth, as slower productivity growth implies lower benefits to forming new matches.

One recent trend that is particularly disturbing is stagnation in the formation of new firms. Statistics from the Bureau of Labor Statistics (BLS) show that the number of establishments in operation for less than one year rose between the mid-1990s, when the data start, and the early 2000s. But, smoothing through the ups and downs of the business cycle, new firm formation has been roughly flat since then. Moreover, the number of individuals working at such firms stands almost 2 million below its peak in 1999. Given the role of innovation by entrepreneurs and the well-documented importance of successful young firms in creating jobs, these trends are disheartening.

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5 Joseph A. Schumpeter (1942), *Capitalism, Socialism, and Democracy* (New York: Harper & Brothers).

6 See, for example, Lucia Foster, John Haltiwanger, and C. J. Krizan (2001), "Aggregate Productivity Growth: Lessons from Microeconomic Evidence," in Edward Dean, Michael Harper, and Charles Hulten, eds., *New Developments in Productivity Analysis* (Chicago: University of Chicago Press); and Lucia Foster, John Haltiwanger, and C. J. Krizan (2006), "Market Selection, Reallocation, and Restructuring in the U.S. Retail Trade Sector in the 1990s," *Review of Economics and Statistics,* vol. 88 (November), pp. 748–58.

7 For more information on the rate of cross-state migration, see Raven Molloy, Christopher L. Smith, and Abigail Wozniak (2013), "Declining Migration within the U.S.: The Role of the Labor Market," Finance and Economics Discussion Series 2013–27 (Washington: Board of Governors of the Federal Reserve System, September).

8 For additional details on the decline in labor market dynamism, see Henry R. Hyatt and James R. Spletzer (2013), "The Recent Decline in Employment Dynamics (PDF)," Center for Economic Studies Working Paper Series 13–03 (Washington: U.S. Census Bureau, March).

The lagging share of national income accruing to workers

A second adverse development in recent years has been the apparent reduction in the share of overall national income that accrues to workers. Here I will be brief and suggestive because the scholarship is far from settled. But the basic trends in the data are troubling. Labor's share of total income generated in the nonfarm business sector has been on a downtrend since the 1980s and has fallen sharply since the turn of the millennium. It stood at 56 percent at the end of 2013, the lowest level since the BLS began collecting data on the measure in 1948.

To be sure, various conceptual and measurement challenges make it difficult to compute labor's share of income with any degree of precision. However, taken at face value, these data have significant implications for the distribution of income in our society, given how skewed the holdings of capital are. Economists have focused less attention on the factors underlying the apparent decline in labor's share of income than they have on the rise in income inequality in general, but among the candidates are technological change, which has allowed for the substitution of capital for labor in the handling of routine tasks, an increase in firm bargaining power, and perhaps a decline in competition in product markets.

The increase in inequality

Of the trends I have identified, the one that has received the largest amount of press attention recently is the rise in income inequality. While income inequality has been increasing since the 1970s, over the past two decades the process has been characterized by what some have called polarization, with those at the top of the distribution accumulating a significantly larger share of income, those at the bottom of the distribution experiencing modest relative gains, and those in the middle of the income distribution falling further behind in relative terms.

Gauging by one fairly comprehensive measure of income used by the Congressional Budget Office, the share of income garnered by those in the top 1 percent of the distribution more than doubled between 1979 and 2007 to about 17 percent, while the share accruing to those in the 1st through 80th percentiles fell 9 percentage points.[9] And while it is true that those at the upper end of the income distribution were disproportionately affected during the financial crisis, with the result that inequality actually fell a bit in the wake of the recession, high earners also appear to be benefiting disproportionately from the recovery. Thus, the crisis does not seem really to have changed the trajectory of inequality.

As interesting as these statistics on inequality are, they obscure a key part of the story – one that has been an important part of our identity as Americans: whether a family has the ability, through hard work, to attain a better standard of living. And on that point, we find that households in the middle and lower parts of the earnings distribution have experienced, at best, only modest improvements in inflation-adjusted income.[10] Between 1979 and 2007, households in the middle quintile of the income distribution – a functional definition of the middle class – saw their real labor income (adjusted for household size) rise only about 3 percent. Meanwhile, households in the bottom one-fifth of the distribution did a bit better, experiencing about a 24 percent rise, although this figure reflects an improvement of just 1 percent per year, and that from a very low base. In contrast, income rose more than 70 percent among households in the top one-fifth of the earnings distribution.

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[9] This measure of income accounts for total compensation, including health benefits, and capital income, government transfers, and taxes while also adjusting for household size. See Congressional Budget Office (2011), Trends in the Distribution of Household Income between 1979 and 2007 (Washington: CBO, October).

[10] This measure of income covers total compensation, including benefits, and adjusts for household size. See Congressional Budget Office, *Trends in the Distribution of Household Income,* in note 9.

The polarization of the labor income distribution has been mirrored in the types of jobs we are creating. Since the 1990s, job gains have been concentrated at the upper and lower ends of the earnings distribution. There have been healthy gains in employment in highly paid occupations, such as computer and information systems managers, and a rise in low-paid jobs, such as home health-care workers, but growth has been much slower in occupations with earnings in the middle of the distribution, such as machinists. This trend accelerated during the Great Recession and the ensuing recovery. For example, food services, retail, and employment services, all low-wage industries, accounted for nearly 45 percent of net employment growth from the start of the recovery through early 2012, while employment in a number of industries that offer good jobs for mid-wage workers – including construction, manufacturing, and finance, insurance, and real estate – did not grow in those years or grew too slowly to make up for their job losses during the recession.[11]

There is no single explanation for the rise in inequality and the decline in the share of jobs that provide a middle-class standard of living. Economists generally agree that technological change and globalization have played a role.[12] Both of these forces have reduced the demand for workers whose jobs had involved routine work that can easily be mechanized or offshored while, at the same time, increasing the productivity of higher-skilled workers. However, it is less clear whether technology and globalization are sufficient explanations for the increased share of income going to those at the very top of the income distribution. It may be that by increasing the effective size of the markets for their skills, technological change and globalization can also explain some of the large increase in earnings of top athletes, musicians, and even chief executive officers. In the popular press, the phenomenon of the very few reaping enormous windfalls has become known as the winner-take-all economy. However, other researchers have noted that a large share of the top earners is found in industries such as finance and law, suggesting that deregulation, corporate governance, and tax policy may have also played a role in the trend toward rising inequality.

Economic mobility has not increased to mitigate higher inequality

Despite the fact that rising inequality has compounded the stakes associated with one's position in the income distribution, mobility up and down the economic ladder from one generation to the next in the United States has been stagnant. Work by Raj Chetty and his coauthors using income tax data has shown that a child who was born in the early 1990s had about the same chance of moving up in the income distribution as a child born in the 1970s.[13] Combining these results with previous research suggests that mobility has not increased in the postwar era. And, despite the long-held view of the United States as the land of opportunity, we actually fall short of other advanced economies in terms of intergenerational mobility. In the United Kingdom, for example, about 30 percent of sons with low-income parents end up being low-income themselves, while in the United States the comparable figure is over 40 percent.[14]

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[11] For more information on this trend, see National Employment Law Project (2012), "The Low-Wage Recovery and Growing Inequality (PDF)," data brief (New York: NELP, August).

[12] The literature on the reasons for the rise in inequality is extensive, but one recent work that tries to address the issue is David H. Autor, David Dorn, and Gordon H. Hanson (2013), "Untangling Trade and Technology: Evidence from Local Labor Markets," NBER Working Paper Series 18938 (Cambridge, Mass.: National Bureau of Economic Research, April).

[13] For a discussion of mobility in income distribution, see Raj Chetty, Nathaniel Hendren, Patrick Kline, Emmanuel Saez, and Nicholas Turner (2014), "Is the United States Still a Land of Opportunity? Recent Trends in Intergenerational Mobility," NBER Working Paper Series 19844 (Cambridge, Mass.: National Bureau of Economic Research, January).

[14] For more information on intergenerational mobility, see Markus Jäntti, Bernt Bratsberg, Knut Røed, Oddbjørn Raaum, Robin Naylor, Eva Österbacka, Anders Björklund, and Tor Eriksson (2006), "American Exceptionalism in a New Light: A Comparison of Intergenerational Earnings Mobility in the Nordic Countries, the United

The role of monetary policy

As must be apparent, the challenges I have discussed are not susceptible to easy or rapid solution. It is equally apparent that monetary policy cannot be the only, or even the principal, tool in addressing these challenges. But that is not to say it is irrelevant. There is not as sharp a demarcation between cyclical and structural problems as is sometimes suggested. Monetary policies directed toward achieving the statutory dual mandate of maximum employment and price stability can help reduce underemployment associated with low aggregate demand. And, to the degree that monetary policy can prevent cyclical phenomena such as high unemployment and low investment from becoming entrenched, it might be able to improve somewhat the potential growth rate of the economy over the medium term.[15]

More generally, reducing labor market slack can help lay the foundation for a more sustained, self-reinforcing cycle of stronger aggregate demand, increased production, renewed investment, and productivity gains. Similarly, a stronger labor market can provide a modest countervailing factor to income inequality trends by leading to higher wages at the bottom rungs of the wage scale.

The very accommodative monetary policy of the past five years has contributed significantly to the extended, moderate recoveries of gross domestic product (GDP) and employment. To this point, however, there has not been a corresponding upturn in wages. To be sure, there have been notable wage increases in specific areas of the country enjoying economic growth much higher than the national average. And, as is nearly always the case, labor shortages in discrete skilled job categories may be placing some upward pressures on wages for those jobs (though, judging by such aggregate data as we have, not by as much as one might have thought based on the widespread anecdotal reports of skilled labor shortages).

But one sees only the earliest signs of a much-needed, broader wage recovery. Compensation increases have been running at the historically low level of just over 2 percent annual rates since the onset of the Great Recession, with concomitantly lower real wage gains. The reasons for the lag in wage gains in the context of continuing moderate growth are not totally clear. Nominal wage rigidity on the downside may have played a role to the extent that employers were reluctant to cut nominal wages even in the period from late 2008 to early 2009, when they were eliminating jobs in staggering numbers. The secular labor market factors mentioned earlier are also likely relevant.

There is, of course, also a debate around the question of how much of current unemployment – particularly long-term unemployment – is structural and thus how much slack still exists in labor markets. Last week Chair Yellen explained why substantial slack very likely remains. I would add to her explanation only the observation that, in the face of some uncertainty as to how best to measure slack, we are well advised to proceed pragmatically. We should remain attentive to evidence that labor markets have actually tightened to the point that there is demonstrable inflationary pressure that would place at risk maintenance of the FOMC's stated inflation target (which, of course, we are currently not meeting on the downside). But we should not rush to act preemptively in anticipation of such pressures based on arguments about the potential increase in structural unemployment in recent years.

In this regard, the issue of how much structural damage has been suffered by the labor market is of less immediate concern today in shaping monetary policy than it might have

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Kingdom, and the United States (PDF)," IZA Discussion Paper Series 1938 (Bonn, Germany: Institute for the Study of Labor, January).

[15] For details on the potential growth rate of the economy, see Dave Reifschneider, William Wascher, and David Wilcox (2013), "Aggregate Supply in the United States: Recent Developments and Implications for the Conduct of Monetary Policy," Finance and Economics Discussion Series 2013–77 (Washington: Board of Governors of the Federal Reserve System, November).

been had we experienced a period of rapid growth during the recovery. Remember that, just a few years ago, many forecasters – in and out of the Federal Reserve – were projecting growth rates at an annualized rate of 4 percent or greater for at least a year. That expectation raised the question of whether a reasonably rapid tightening in monetary policy might at some point be needed. But now, in part because we did not have such a spike in the early stages of recovery and instead have had modest growth in place for several years, it seems less likely that we will experience a growth spurt in the next couple of years that would engender concerns about rapid wage pressures and changes in inflation expectations.

The importance of a national investment agenda

In short, by promoting maximum employment in a stable inflation environment around the FOMC target rate, monetary policy can help set the stage for a vibrant and dynamic economy. But there are limits to what monetary policy can do in counteracting the longer-term trends I have discussed. In economic research and in policy debates, we need more focus on these issues and more attention to concrete proposals to address them. I would suggest that one element, though by no means the only one, in such a program is a well-formulated government investment agenda.

A pro-investment policy agenda by the government could help address some of our nation's long-term challenges by promoting investment in human capital, particularly for those who have seen their share of the economic pie shrink, and by encouraging research and development and other capital investments that increase the productive capacity of the nation.

There is already a well-known list of investments that have been shown to be successful. For instance, early childhood education can increase the educational attainment of children from low-income families as well as improve other outcomes.[16] In addition, recent innovations in job training programs, which more tightly link the training to the needs of employers in sectors of the economy with a demand for workers, have been shown to increase both the employment and wages of participants.[17]

Investment in basic research by the federal government is another area in which greater investments could yield significant returns and in which a public policy role is warranted because of externalities. Econometric studies suggest that the rates of return to this type of investment can be very high.[18] And a range of policy commentators agree that there is a continuing role for government investment in infrastructure, including various forms of transportation, as a way to enhance productivity. Not too long ago, the American Society of Civil Engineers gave the United States a rating of D on its roads and bridges. Improving that

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[16] For more information on the effect of early childhood education, see James J. Heckman, Seong Hyeok Moon, Rodrigo Pinto, Peter A. Savelyev, and Adam Yavitz (2010), "The Rate of Return to the HighScope Perry Preschool Program," *Journal of Public Economics*, vol. 94 (February), pp. 114–28; James Heckman, Rob Grunewald, and Arthur Reynolds (2006), "The Dollars and Cents of Investing Early: Cost-Benefit Analysis in Early Care and Education," *Zero to Three*, vol. 26 (July), pp. 10–17; and Elizabeth U. Cascio and Diane Schanzenbach (forthcoming), "The Impacts of Expanding Access to High-Quality Preschool Education," *Brookings Papers on Economic Activity*.

[17] For a discussion of such rates of return, see, for example, Sheila Maguire, Joshua Freely, Carol Clymer, Maureen Conway, and Deena Schwartz (2010), *Tuning in to Local Labor Markets: Findings from the Sectoral Employment Impact Study* (Philadelphia: *Public/Private Ventures*).

[18] See Zvi Griliches (1992), "The Search for R&D Spillovers," *Scandinavian Journal of Economics*, vol. 94 (Supplement), pp. S29-S47; and Charles I. Jones (2002), "Sources of U.S. Economic Growth in a World of Ideas," *American Economic Review*, vol. 92 (March), pp. 220–39.

system, both by doing necessary maintenance to maintain safety and functionality and by reducing congestion could yield substantial benefits.[19]

This agenda might sound ambitious. In fact, spending in these areas is currently not a very large proportion of federal outlays. For example, the entire federal budget for nondefense research programs – including expenditures on health research, the National Aeronautics and Space Administration, and the National Science Foundation – is only 2 percent of federal spending (or less than 0.4 percent of GDP), well below the share in the 1960s, when we last made a significant effort to advance our capacities in math and science during the era of space exploration. Moreover, spending in these areas has been the target of much of the budget restraint in recent years. Even in the area of physical infrastructure, we have fallen behind past efforts. After a surge associated with fiscal stimulus during the recent recession, public spending on infrastructure has tumbled, resulting in the slowest growth (1 percent) in the state and local capital stock since WWII.

I certainly am not intending here to join the broader debate on fiscal policy, either short or longer term. But I do note that fiscal policymakers could promote the longer-term prospects of the nation by increased spending in areas that are likely to yield increases in living standards. The amount of increased investment spending that could reasonably be absorbed would be quite modest in comparison with the very large amounts associated with major fiscal issues such as health-care expenses. And even a strong investment agenda would not be a complete response to the economic challenges I have discussed. But, like monetary policy, it could play a useful role.

Conclusion

The longer-term challenges to the American economy that I have identified this evening are real. But I certainly do not regard a continuation of these trends as inevitable. On the contrary, the American economy is still possessed of great advantages and potential that, while always and necessarily evolving, have served us well over the years.[20] My principal aims this evening have been, first, to echo those who have been drawing attention to these challenges in recent years and, second, to encourage more discussion and debate of the specific policies that can best help us meet these challenges. As should be apparent in my remarks on monetary policy and an investment agenda, I believe that there are policies already developed and available to us that can contribute to this effort. My hope is that such policies will be pursued and that others, perhaps yet to be developed, will follow.

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[19] For more details on the U.S. infrastructure, see American Society of Civil Engineers (2013), 2013 Report Card for America's Infrastructure (PDF) (Reston, Va.: ASCE); and Her Majesty's Treasury (2006), The Eddington Transport Study – The Case for Action: Sir Rod Eddington's Advice to Government (PDF) (London: Her Majesty's Stationery Office)

[20] These advantages – such as the country's substantial natural resources, a stable but adaptive legal framework for economic activity, a dynamic labor market, and a fostering of entrepreneurship – have contributed to productivity growth that is estimated to have averaged about 2-1/4 percent over the past 140 years. See David M. Bryne, Stephen D. Oliner, and Daniel E. Sichel (2013), "Is the Information Technology Revolution Over?" *International Productivity Monitor*, No. 25 (Spring), pp. 20–36.