Entrepreneurs in the 21st Century – Non-destructive creation: how entrepreneurship sustains prosperity

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NON-DESTRUCTIVE CREATION:

HOW ENTREPRENEURSHIP SUSTAINS PROSPERITY

Many modern beliefs about entrepreneurship have their roots in Joseph Schumpeter's challenge to the traditional view that growth results from the accumulation of capital. According to the received wisdom of the time, thrifty ants prospered. Spendthrift grasshoppers starved.

Schumpeter argued instead that the development of new "combinations" by entrepreneurs, rather than the steady accumulation of capital, led to long term growth. Economist Robert Solow's 1956 and 1957 papers validated Schumpeter's claim. They reported the "shocking" finding that "most of the growth of the economy over the past century had been due to technological progress" (Stiglitz 1990). An increase in the use of capital accounted for only 12.5 percent of the doubling of gross output per man hour from 1909 to 1949; the remaining 87.5% was due to "technical change." And, any technical change requires, as William Baumol (1993) points out, requires entrepreneurial initiative.

In this lecture, I will examine how entrepreneurship contributed to economic growth in the 20th century and whether it will continue to make this contribution in the 21st century. My point of departure is Schumpeter's claim that "creative destruction" represents the essence of modern entrepreneurship – that in order to build something new the entrepreneur also has to destroy the old. In fact, I will suggest today, many innovations do not displace existing products and services because they create and satisfy entirely *new* wants. This non-destructive form of entrepreneurship is as necessary for economic prosperity as creative destruction.

I focus on the entrepreneurial system of the United States. I believe my general analysis applies to other wealthy countries, but I have nothing to say about the applicability of the U.S. system to other parts of the developed world. And although I briefly discuss the phenomenon of outsourcing from low wage countries, I do not analyze the role of entrepreneurship in these countries either.

1. Symbiotic relationships

Sensible people know that over the long run, economic growth requires productivity growth – for per capita living standards to increase, so must per capita output. But we often mistakenly believe that productivity growth comes just from improved efficiency – using fewer resources to satisfy our current wants. We fail to recognize that the creation and satisfaction of new wants can also increase per capita output. For instance, an artist may increase her productivity by developing new techniques that speed up her output of paintings. Alternatively,

she may develop a new oeuvre that commands higher prices. She may produce exactly the same number of canvases as before, but, provided her work sells at higher prices, her *economic* output and productivity increases. Moreover, the new oeuvre may serve as a substitute for more traditional paintings, so innovator's productivity gain comes at the expense of the productivity of artists' who face reduced demand. But it doesn't have to: the new oeuvre may appeal to completely new sensibilities and find a place on walls that otherwise would have remained bare.

In fact, economies cannot sustain increases in productivity and living standards simply through increasing efficiencies in the satisfaction of existing wants. In the short run, increased efficiencies reduce costs and as costs decline, people consume more of the good or service. But eventually, the law of diminishing utilities sets in. Sated consumers refuse to buy more even if prices continue to decline. After that, further increases in efficiencies reduce the demand for labor.

In principle, societies could accommodate the reduction in the demand for labor by increasing everyone's leisure. Over the last century, economic growth has helped reduce working hours and increase vacations. But somehow, beyond a certain point, societies seem unable to accommodate reductions in the demand for labor by spreading the work around. Efforts to control unemployment by mandating reductions in work weeks or increasing the number of holidays don't seem to work.

Rather, it is the entrepreneurial activity of creating and satisfying new wants that keeps the system humming. It employs the labor and purchasing power released by increased efficiencies in the satisfaction of old wants. It also creates incentives for continued increases in efficiencies even after demand for old wants has been fully satisfied: Producers who satisfy old wants have to keep economizing on their use of labor because they must compete for employees (and share of consumers' wallets) with innovators who satisfy new wants.

Outsourcing to low wage countries resembles efficiency improvement in its symbiotic relationship to the satisfaction of new wants. It improves living standards in wealthy countries, provided the human capital released can be used to make new goods and services. Otherwise, like improvements in efficiency, outsourcing can reduce the demand for domestic labor.

2. The historical record

Improvements in efficiency as well as the satisfaction of new wants played significant roles in the economic growth of the 20th century. As is well known, the industrial revolution led to a surge in incomes: According to Bradford DeLong (2000), world GDP growth per capita was virtually zero until the 18th century. In the 19th century, per capita incomes more than doubled

and then in the 20th century increased more than eightfold. According to DeLong, although virtually all of human kind saw improvements in its material well being, growth rates were strongest in the industrial nations of the West. For the U.S. DeLong estimates a ten and a half-fold increase in real per capita GDP in the 20th century.

In part, the growth that followed the industrial revolution resulted from more efficient methods of production of existing goods. For instance innovations such as tractors, threshing machines, fertilizers, pesticides and hybrid seeds led to vast improvements in agricultural productivity. As productivity increases reduced costs and increased the affordability of food, per capita consumption grew. But the increase in the consumption of food or other existing goods doesn't come close to accounting for the ten-and-a-half-fold increase in overall per capita G.D.P. According to William Nordhaus's (1997) estimate less than 30% of the goods and services consumed in 1991 bear much resemblance to the goods and services of the late 19th century. "Most of the goods we consume today" Nordhaus writes, "were not produced a century ago. We travel in vehicles that were not yet invented that are powered by fuels not yet produced, communicate through devices not yet manufactured, enjoy cool air on the hottest days, are entertained by electronic wizardry that was not dreamed of and receive medical treatments that were unheard of."

Some of the new goods replaced the goods consumed by our forebears. Cars and buses replaced horses and stagecoaches. Steamships grounded sailing ships and Ready to Eat cereal pushed homemade porridge off breakfast tables. As did the improvements in agricultural productivity, many of the new products reduced prices and costs. For instance candles provided the primary source of artificial light till about the early 1800s. These were followed by lamps that used whale oil, sperm oil, town gas, kerosene and electricity. Nordhaus calculates that these innovations reduced the price of light by 99 percent – from 40 cents per 1,000 lumen hours in 1800 to a tenth of a cent today.

But in fact, many new 20th century products did not displace existing products – rather they created new markets and satisfied new wants. They were like a new oeuvre of art purchased for spaces that would otherwise remained bare. Air-conditioners reduced temperatures in previously un-cooled factories stores and office buildings. Airplanes did not reduce the demand for automobiles – people flew when they would not have driven. New drugs and vaccines offered cures for diseases for which treatments did not previously exist. In 1938, the New York Times observed that the typewriter was "driving out writing with one's own hand," yet Petroski (1990) reports the sale of 14 billion pencils in 1990.

Moreover even those apparently destructive new products also created new markets because they had features that the products they displaced did not. For instance, automobiles provided much faster and not just cheaper transportation than did horse carriages, so people could live in spacious houses located at some distance from their workplace. This helped create demand for suburban housing that did not previously exist. Similarly incandescent lamps didn't merely replace candles and kerosene lamps: their intense luminosity helped create a market for cricket and baseball played at night.

The innovations in information technology of the late 20th century have followed the same pattern as the electro-mechanical innovations of earlier decades. According to a U.S Department of Commerce (1998) report, the share of the Information Technology (IT) sector (computing and communications) grew from 4.2% of the gross domestic product of the United States in 1977 to 6.1% in 1990 to 8.2% in 1998. This is not because computers have displaced traditional goods and services. Rather, IT has accounted for a disproportionate share of growth: according to the Department of Commerce IT industries have been responsible for more than one quarter of real economic growth that is, about three times their share of the economy.

The digital revolution has certainly involved some substitution. For instance, calculators displaced slide rules, micro-processor based workstations displaced mini-computers and CDs displaced cassette tape recorders. But, there has also been at least as much non-destructive creation. The personal computer (PC) did not blow away the traditional mainframe computer in a gale of creative destruction. The PC's killer application, the spreadsheet, did not displace any existing mainframe based applications. Rather it allowed users, many of whom had not previously used computers extensively, to perform analyses and simulations which they would not have otherwise performed. Similarly the enormous growth of the home market for PCs did not reduce the demand for mainframe computers.

Over 30 years after the introduction of minicomputers and more than 20 years after the introduction of microcomputers, the mainframe remains an important category. Total worldwide revenues of large-scale computer processors (or mainframes) amounted to $16 billion in 1997 compared to $16.2 billion in 1982. But because total demand grew from $38 billion to $183 billion, mainframes' *share* of the total computer market dropped considerably, from 42% to about 9%. (Bhide 2000)

The role of PCs in expanding the pie rather than destroying existing markets apparently represents a common feature of the digital revolution. New communications services – E-mail, newsgroups, and "chat" – provided a critical mass of users for the Internet and on-line services such as AOL. These services do not however seem to have abated the demand for traditional

phone lines – U.S. cities continue to require new area codes. And those new products that have displaced old products, have often done so *after* they have created a new market. For instance as I discovered in the course of a consulting study for a now defunct typewriter manufacturer, shipments of word processing units increased fourteen-fold growth between 1977 and 1981. But because word processors increased primary demand by satisfying some hitherto unmet want, the sales for typewriters in the United States remained steady at around a million units a year during this period. Similarly, one day (after standards and coverage issues have been resolved) cell phones may make land line phones obsolete. But not before consumers have purchased hundreds of millions of units in applications where land line phones had not been used.

Innovations that created markets for new goods and services gave lie to predictions that mechanization and mass production would create mass unemployment. Productivity improvements on the farm, which would ultimately allow about 2 percent of the workforce to feed the entire population, reduced agricultural employment in the U.S. from 11.7 million in 1900 to 5.9 million in 1960. Changes in production technologies also put many highly skilled artisans out of work. But, total employment more than doubled – from 29 million in 1900 to 68 million in 1960. The labor released by the farm and workshop was quickly absorbed by factories established to serve new markets. And, the assembly line worker earned more than the farmer or skilled artisan. For instance by 1900, the average annual manufacturing wage was more than twice the agricultural wage. This gap continued to widen, as real wages in manufacturing increased at 1.7 percent per year through the first seven decades of the 20th century.

Products that satisfied new wants also created jobs in new service industries. Refrigerators and air-conditioners had to be transported, advertised, sold by a new kind of retailer, installed and periodically serviced. The transportation, advertising, retailing and other such 'service' industries in fact created more jobs than the manufacturing sector. As early as 1920 – long before the term the 'service economy' had been coined – employment in trade, transportation and other private service providing sectors was 15% greater than in the manufacturing. By the end of the 1960s, employment was nearly 70% greater.

Although wages in the manufacturing sector stagnated after the 1970s, and manufacturing jobs topped out at about 20 million in 1980, overall employment and incomes in the U.S. continued to rise. The number of gainfully employed Americans in 2000, for instance, was 135 million – a nearly 35% increase over the 99 employed individuals in 1980. Real U.S. GDP per capita during this period rose by 57%, and disposable personal incomes by nearly 50%. Apparently the growth of businesses in sectors such as information technology that satisfied new wants more than compensated for the lack of growth in manufacturing. For instance, the

production of computers, semiconductors and communications equipment increased 13-fold between 1992 and 2000. Employment in IT services nearly doubled in this period from just over 2 million to 3.6 million. Wages in this sector are about 85 per cent higher than in the economy as a whole. The growth in IT wages has likewise been about 1.6 times faster.

In the latter half of the 20th century, the expansion of markets for new goods and services encouraged – and was facilitated by – imports from low wage countries. According to Edward Leamer's (2001) calculations, merchandise imports amounted to about 20% of U.S. production between 1900 and 1930. This number then fell to less than 10% after the Hawley-Smoot Act which imposed tariffs on imports from 15% to 60% and the outbreak of the Second World War. U.S. imports revived slowly in the 1950s and 1960s before accelerating in the 1970s. Now more than half of manufactured goods consumed in the U.S. are made abroad.

The resources released by imports fostered the growth of industries that satisfied new wants in the United States. Cheap TV sets from the Far East allowed U.S. households the wherewithal to purchase PCs powered by Intel microprocessors and Microsoft software. Similarly engineering graduates who would have otherwise been employed by U.S. TV manufacturers were available for employment by U.S. I.T. companies. Conversely the growth in incomes and employment in the new industries helped U.S. consumers pay for the goods produced overseas.

3. Distinctive Features

To understand what made the entrepreneurial system so good at creating and satisfying new wants, let us examine some differences in the economic performance of the 19th and 20th centuries. As mentioned, growth was slower during in the 19th century even though the level of incomes and productivity at the start of the period was lower. The higher 'base' at the start of the 20th century should have meant lower rates of growth. Standard supply side arguments would also predict more sluggish growth – tax rates were higher in the 20th century, regulation more extensive and property rights were arguably weaker.

Economic activity was less volatile in the 20th century, in spite of two great wars. In the 19th century, several depressions interrupted economic growth. In the 20th century, apart from the Great Depression, downturns were relatively mild and short-lived. Schumpeter attributed booms and depressions to periodic bursts of creative destruction followed by lulls in innovative activity. Why didn't this occur in the 20th century? Was it simply because the more effective use of counter-cyclical fiscal and monetary policies eliminated booms and busts?

Another puzzle: As mentioned, technical progress rather than capital accumulation was the principal source of growth in the 20th century. Nicholas Crafts's (2000) estimates suggest that in the 19th century capital accumulation made a larger contribution to growth than did technical change. Yet the new products invented in the 19th century were extraordinary. The inventions credited to the period 1850 to 1900 include the monorail, the telephone, the microphone, the cash register, the phonograph, the incandescent lamp, dynamite, the electric train, linotype printing, the steam turbine, the gasoline engine, the street car, movies, motorcycles, automobiles, refrigerators, concrete and steel construction, pneumatic tires, aspirin, and x-rays. These may well overshadow inventions credited to the entire 20th century.

The entrepreneurial system that evolved during the 20th century has three features that can help explain these puzzles:

Broad Participation

Participation in the process of creating and satisfying new wants become more broad-based and inclusive. In the 19th century, inventions of new products were made by a few individuals. Edison brought forth a remarkable cornucopia including incandescent bulbs, motion pictures, and gramophones, from a small facility in Menlo Park (New Jersey, not California) with fewer employees than the typical Silicon Valley startup. Alexander Graham Bell had one assistant. Automobile pioneers were one or two man shows -- Karl Benz and Gottlieb Daimler in Germany, Armand Peugeot in France and the Duryea brothers of Springfield, Massachusetts.

But small outfits couldn't develop products for mass consumption. The early automobiles were expensive contraptions, owned according to Nathan Rosenberg (1976) by a few buffs who rode around the countryside terrifying horses. They couldn't be used for day to day transportation because they broke down frequently and lacked a supporting network of service stations and paved roads. One or two brilliant inventors couldn't solve these problems on their own.

In the 20th century the tasks of converting inventions into mass-market products pervaded society. As often as not, the pioneers paved the way for followers who built on and refined the first offerings. Planned and unwitting collaborations, taking place simultaneously and in sequence made products that initially only kind of, sort of worked commercially viable. For instance, when the first personal computer, the Altair, was introduced in 1975, its aficionados derived less practical use from their machines than did the turn-of-the century automobile buffs. Lacking basic input or output devices (such as keyboards and printers) Altairs could not even scare horses. Numerous innovations -- such as electronic spreadsheets, the mouse, graphical user

interfaces, and local area networks turned this oddity into a ubiquitous artifact. A procession of individuals – Ed Roberts, Gates and Allen, Jobs and Wozniak, Bricklin and Frankston, Mitch Kapor, and Robert Metcalf – to name just a few, made all this happen. Only a few of their individual contributions represented breakthroughs, but collectively they created an industry that changed the world.

Similarly the Internet does not have a solitary Alexander Graham Bell. Rather, many entrepreneurs, venture capitalists, executives of large companies, members of standard setting institutions, researchers in university, commercial and state-sponsored laboratories, and even investment bankers and politicians have revolutionized the way we communicate. Some participants in the revolution have acquired considerable wealth but not fame. Mention of Sir Timothy Berners-Lee's name for instance often evokes puzzled looks.

Many consumers – and not just a few well-to-do buffs – have taken chances on products intended to satisfy wants they didn't realize they ever had. Although its importance is often overlooked, this 'venturesome consumption' has played a critical a role. The success of the Japanese consumer electronics industry, I once wrote (Bhide 1983), has as much to do with the spirited purchasing habits of Japanese consumers as it does of the innovativeness of Japanese producers. But while Japanese consumers have been venturesome in just a few spheres, U.S. consumers have been willing to try all sorts of novelties. And with many willing subjects, U.S. entrepreneurs have been able to conduct a large number of experiments.

In turn extensive experimentation, in conjunction with improved monetary and fiscal tools, may have helped eliminate the booms and busts that Schumpeter attributed to innovative activity. When entrepreneurs conduct many different experiments, the probability that at all times some new industry will boom increases. Thus in the midst of a deep recession in 1982 the PC industry took off and in the current downturn, WiFi sales have surged.

Broad participation in the entrepreneurial system, in turn, was facilitated by an educational system that made literacy nearly universal and provided college educations to about 30 million members of the U.S. workforce. The belief that change is desirable and inevitable also grew beyond a few visionaries. Many came to believe that they could prosper by pursuing the New, New Thing, and if they didn't, they risked falling behind.

Their growing acceptance turned such beliefs into self-fulfilling prophecies. Consider for instance Gordon Moore's famous observation that the number of transistors that built on a chip doubles every eighteen month. Semi-conductor companies, who believe in this so-called "law", invest the resources needed to make it come true. Downstream customers, (such as PC manufacturers) and providers of complementary goods to their customers (such as applications

software companies) design products in anticipation of the eighteen months cycle. So when the new chips arrive they find a ready market, which in turn validates beliefs in Moore's Law and encourages even more investment in building and using new chips.

Similarly, the propensity of consumers to open their hearts and wallets to new offerings has involved the dilution of prior beliefs in the moral and economic value of thrift. Through the end of the 19th century, according to Max Weber's thesis, religious convictions about thrift sustained the 'spirit of capitalism'. Weber argued that merchants and industrialists accumulated capital believed they had a moral duty to strive for wealth as well as to lead austere lives. In fact, because venturesome production requires venturesome consumption, excessive thrift injures rather than helps modern capitalism. As it happens, U.S. consumers have been more inclined to keeping up with the recently acquired baubles of their neighbors than towards excessive thrift. Their venturesome spending has also been sustained by an efficient marketing and distributions system and by a financial system that provides credit to the young and penurious.

Diversity of the entrepreneurial species

A diverse set of organizational forms evolved in the 20th century system that specialized in different kinds of innovation. As mentioned, in the 19th century innovation was undertaken by individuals or very small firms. The large professionally managed corporation became an important contributor to innovation in the first half of the 20th century. In the second half of the century, the diversity of the entrepreneurial species further increased. Researcher laboratories in universities that had hitherto focused just on creating knowledge began to develop commercially useful technologies. Similarly, professionally managed venture capital funds saw explosive growth.

The emergence of new organizations did not make individual entrepreneur extinct. Rather the old and new entrepreneurial species complemented each other's contributions. The big publicly traded corporation for instance has the capacity to undertake very large initiatives that require the advance coordination of many individuals and the pooling of the capital of many investors. Individual entrepreneurs face capital constraints and the coordination of their efforts occurs more through after the fact mutual reaction rather than through conscious planning. But, the same governance mechanisms that give big corporations an advantage in pooling capital and labor also discourages them from undertaking novel initiatives where it is difficult to reach a consensus about likely outcomes. Individual entrepreneurs in contrast can freely pursue novel projects because they aren't answerable to anyone.

Therefore swarms of individuals often conduct the early experiments from which new industries emerge. Then, after the early uncertainties have been resolved, organizations which can mobilize resources on a larger scale help bring the new products and services into the mainstream. For instance, between 1975 and 1980 individual entrepreneurs, rather than large companies tried to create useful applications for personal computers when they were quirky toys. But after these efforts had borne fruit it was the launch of IBM's PC in 1981(when IBM accounted for more than 60 percent of the world wide sales of mainframe computers) that 'legitimized' the personal computer with data processing managers of large companies. The multi-billion dollar investments that Intel and Microsoft made after that helped carry the PC into virtually every home and office.

Similarly talk about the potential of nano-technology dates back to at least the early 1990s; but, actual investment by public companies and venture capitalists has been small. Much of the action has come from individual entrepreneurs and university researchers who have been following their dreams and hunches. If and when their efforts succeed, we can expect to see the large capital providers to jump in.

Incentives for 'non-destructive' creation

Entrepreneurial individuals and firms don't have any altruistic concern about the instability of a system that relies just on creative destruction; rather, they undertake non-destructive innovations because creating and satisfying new wants often provides more attractive opportunities. The early technical deficiencies of new products like automobiles and personal computers make them unsuitable substitutes for existing tried and tested substitutes. Therefore, as Clay Christenson (1997) has pointed out, innovative products usually start up serving a function that existing products do not.

Even when a new product is technically superior, displacing an existing product is expensive. The innovator has to overcome resistance from the businesses that face the threat of substitution as well as from users who have invested in the old regime. For instance, theatres which now use projectors for celluloid film have been unwilling to incur the costs of switching over to higher quality digital projection systems. Overcoming this resistance reduces the profitability of the enterprise and makes the funding requirements prohibitive for many entrepreneurs.

For large companies, the incentive to favor non-creative destruction is weaker but not absent. They do have the resources to overcome the unwillingness of consumers to incur switching costs. And, where they are the incumbent oligopolists, the issue of competitive

retaliation does not arise. But large companies also face pressure from stock-markets and employees to keep increasing their revenues. This encourages large companies to develop new sources of revenues rather that substitutes for their existing revenues. For instance, Robert Cringely (1996) suggests that IBM executives backed its PC initiative in 1980 because they thought personal computers would not reduce the demand for IBM's other products, so "every sales dollar brought in to buy a microcomputer would be a dollar that would not otherwise have come to IBM." Similarly the "rational drug discovery approach" established by Roy Vagelos at Merck stipulated that the company would focus on areas "where there were no therapies or drugs available" (Nichols 1994)

4. Looking ahead

The new want machine, which has an excellent record, does not however create jobs at exactly the same rate as increases in efficiency and outsourcing, or cyclical downturns, causes traditional industries to shed them. And indeed, following the boom years the late 1990s when unemployment reached historic lows, the new want machine appears to have been unable to keep up. Is this a permanent phenomenon that will resurrect Luddites and protectionists?

No one can predict when new industries will start adding jobs faster than old industries shed them. Standard macro-economic policies cannot speed things up. Tax cuts and easy money might stimulate 'old' economy demand for automobiles and housing, but they cannot overcome the unwillingness of U.S. consumers to use Short Messaging Services on their cell phones. Nor can powerful private sector patrons ensure success. In the early 1980s for instance, venture capitalists and entrepreneurs were much taken by the promise of artificial intelligence. They started so many companies around M.I.T. that a portion of East Cambridge came to be known as Intelligence Alley. To my knowledge, none of these companies survive. Microsoft bet big and wrong on proprietary on-line services instead on the Internet. Kleiner Perkins, the venture capital firm that counts Sun Microsystems among its many successes invested in the Segway Human Transporter. A senior partner, John Doerr, said that the Segway would be "as big as the Internet." It isn't yet.

But, although it would be foolhardy to make predictions about what great new markets lurk around the corner, we have every reason to believe that that the new want machine remains in excellent shape.

We haven't run out opportunities for non-destructive creation. It may be true, that because we have run out of "stomach space" (Bresnahan and Gordon 1997) new food products must replace old food products. We may also have exhausted our 'free' time – cellular phones

that may not displace land lines, do absorb the time that we might otherwise devote to quiet reverie. Nevertheless the scope for satisfying other kinds of new wants remains ample.

Expenditures on health care for instance are almost certain to expand. Modern medicine found cures for many diseases in the 20th century and increased life expectancies in the U.S. for 47 years in 1900 to 77 today. No treatments exist however for a great many other diseases and current life expectancies are well below any theoretical limit for the human lifespan. The aging of the population similarly provides ample opportunities for goods and services that enhance the quality of the lives of older citizens. Among the young (or would be young), the desire to look and feel good has sustained many new businesses. The number of health clubs in the United States has tripled in the last 20 years and now have 13% of Americans enrolled as members. Cool new ways for altering body parts continue to be found: a doctor in L.A. has apparently just pioneered the implantation of tiny platinum jewels, shaped like a star into the corner of the whites of the eye (Rundle 2004). Businesses have created non-destructive sales by finding new ways to tickle the senses – for instance by selling ringer tones and face plates for cellular phones. Such consumption might not please all tastes, but they have maintained the growth of the modern shopping basket in the past and in all likelihood will continue to do so in the future.

The system for discovering and exploiting these opportunities is in excellent shape; its crucial elements have become stronger over the years, not weaker. The number of individuals who can and want to participate in entrepreneurial activities and the diversity of organizations through which they can participate is greater than ever before. So whereas the performance of the 20th century economy is a difficult act to follow we have reasons to hope for an encore.

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