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How do we build tomorrow's economy?
Peters and Co.
Keynote Address

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Chateau Lake Louise

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- Thank you, Jeff.

- I was delighted to receive your invitation to speak at this conference—it was because of a fortunate, serendipitous alignment in our calendars that I was able to accept.

- You see, I was already coming to Lake Louise this week, so the timing of your invitation couldn't have been better.

- I'm here with my senior team for one of our semi-annual retreats. We taking some dedicated time to think about future trends in post-secondary education—and consider how the University of Alberta will need to respond in this time of change—what we should look like 5, 10 years from now.

- I imagine that you're engaged in a similar process—thinking about future trends in oil and gas and how investment professionals should be thinking about future prospects for this year—5, 10 years down the road.

- So I thought I would take as my topic the following question: how do we build tomorrow's economy?

- Planning for the future is an essential activity at every organization—but it's a risky endeavor.

- Predictions about the future are notoriously unstable—and in this period of intractable economic uncertainty, even more so.

- I was at a dinner recently at which a senior Canadian economist was speaking. His predictions for future economic growth in Canada were bleak.

- He forecast an economic growth of 1.6 to 2.0% based on the sum of labour market growth rate of 0.8% plus productivity growth rates of 0.8%. The consequences for social programs and prosperity were grim.

- Then came another surprise announcement by two leading Canadian academic economists Erwin Diewert and Emily Yu.

- They content that the productivity rates estimated by Statistics Canada are inaccurate. Namely they say that our multi-factor productivity growth was closer to 1.0% over the period 1961 to 2011 as compared to 0.28% predicted by Statistics Canada over the same period.

- These are significant differences which call into question our confidence in predictions of economic growth in the future.

- There story doesn't end there. Yet another pair of economists have explained in a response article to Diewert and Yu that the difference between one assessment and the other was the result of differing methodologies.

- I have often wondered why some call economics a dismal science—I'm starting to see why!

- From my perspective as a research scientist, one of the problems with economic forecasting is that it rarely predicts the effects of disruptions—disruptions brought about by unanticipated scientific and technological innovations.

- Although the scientific method, itself, is based on logic and reason, scientific discovery—by contrast—does not always progress linearly.

- Instead, many discoveries are the result of happy accidents or serendipitous events. Let me give you an example.

- When scientist Alexander Fleming left for a summer vacation in 1928, he didn't clean up his work area. He preferred to let various slides and bacterial specimens pile up for two and three weeks before cleaning them.

- As chance would have it, that summer the weather and the air currents were just right to transport a rare microscopic penicillium mold spore onto one of the slides in Fleming's pile when he returned after a few weeks.

- That chance event, of course, led to the discovery of penicillin—perhaps the most important medical discovery of the 20th century.

- Other major innovations like the transistor and the Internet were also discovered indirectly—the researchers were looking for something else entirely when they stumbled upon the really important discovery.

- Such unanticipated discoveries can have had profound effects on economic growth and productivity—and yet could we predict their arrival?

- In my view, the first step to understanding and anticipating tomorrow economy is to examine the scientific revolution and technological innovation underway in universities and research laboratories.

- Studies have shown that 90% of income growth in the UK and the USA after 1780 can be attributed to science, technology and innovation.

- Michio Kaku, author of *Physics of the Future,* reviews the waves of historical change that have occurred over the past two hundred years —and the corresponding periods of major economic growth—and shows that disruptive technical innovations are at the root.

- Steam power and the industrial revolution of the 19th century literally reshaped human society and created enormous new wealth.

- A century later, a similar wave of change occurred during the automotive revolution, when close to 3000 automotive start up companies were in operation.

- Now the Internet and computer technologies are having a similar impact.

- Over a period of six decades, we have witnessed the transition from vacuum tubes, to transistors, to integrated circuits, to personal computers and the Internet.

- We are on the brink of an age of ubiquitous computing where everything becomes intelligent because there are chips embedded everywhere.

- While researching his book, Michio Kaku interviewed numerous scientists and engineers to develop a detail portrait of the future.

- By 2030, he expects that the Internet will be everywhere. We currently access it on computers and smart phones, but, he suggest, we will progress to accessing the Internet through our glasses and contact lenses.

- He suggests that the uses for the Internet are still only in its infancy but we are beginning to witness its power.

- From banking on hand held cell phones to helping farmers access the latest knowledge on climate, crops and fertilizer, the Internet is democratizing access to knowledge and generating wealth for the poorest citizens.

- In developing countries around the world, the internet and our increasingly easy, cheap access to it are providing the basis for frugal innovation so essential to elevating the quality of life for millions of citizens.

- The economic implications—as we know—are huge.

- Enrico Moretti, professor of Economics at the University of California Berkeley, estimates that in the US alone, the number of jobs in the Internet sector has grown 634% over the past decade, which is 200 times the growth rate of any other sector.

- And these are good jobs, having experienced income growth in the neighbourhood of 700% over the last ten years. Clearly, the Internet's impact on productivity and growth is significant.

- Another major scientific frontier is molecular medicine. In 1953, Watson and Crick unlocked the structure of DNA which gave birth to understanding the basis of life.

- In 2003—only 10 years ago—the human genome was decoded at a cost of about $3 billion. Soon improvements in genome sequencing and rapid decreases in the cost of information processing will lower the cost to only $1000 per genome.

- What could this mean? Each one of us will have access to information on our own genome.

- We will be able to identify predisposition to genetic diseases whether its heart disease, mental illness or Alzheimer's, taking advantage of the latest medical breakthroughs and making necessary life style changes to decrease our risks.

- Current medical research on the growth of organs based on stem cells, . . . the detection and treatment for hundreds of forms of cancer,. . . and gene therapy will inevitably lead to the development of new healthcare technologies to transform and extend our lives.

- We are going to be healthier longer, making it possible for us to remain in the labour force longer, and potentially changing our expectations of labour market growth rates in the developed world.

- If information technology and biotechnology are two developments driving productivity growth and the size of the labour market, then a third in the wings is nanotechnology.

- In 1959, Richard Feynman, Nobel Laureate physicist, gave a seminal talk entitled "There's plenty of room at the bottom."

- Feynman proposed that it was possible to make very small machines and devices on the basis of individual atoms, giving birth to the science of nanotechnology.

- Scientists are currently using the science of nanotechnology to build molecular transistors and quantum computers.

- Nanotechnology is also offering profound breakthroughs in medicine. We can expect the use of nano machines which can be injected to treat cancer cells, detect very small tumours and other diseases.

- It is possible that surgery could be eventually replaced by molecular machines that clean arteries, treat diseased organs and rebuild tissue in- situ.

- All of this—in combination with innovations in information and biotechnologies—will bring unimaginable social and economic benefits—and no doubt, a number of unintended negative societal consequences that will require new social innovations.

- Lester Thurow, a former dean of the MIT Sloan School of Management, has said that "today, knowledge and skills stand alone as the only source of comparative advantage ..... Silicon Valley and Route 128 are where they are simply because that is where the brain power is. They have nothing else going for them."

- He too believes that knowledge and technology is shaking the foundations of twenty first century capitalism.

- That change is front and centre in Alberta, even though—unlike the Silicon Valley and Route 128—we are, where we are, not only because of brain power but also because of a wealth of natural resources.

- Nevertheless, from our vantage point, we can see clearly how the transition from a resource-based, industrial society to a knowledge society is well on its way.

- Natural resources are undoubtedly still a critical part of our economy, but we have come to a point where harvesting those resources is increasingly dependent on major advances in various technologies—sophisticated technologies that will only emerge from highly creative thinkers working in an idea and discovery-rich environment.

- We also know that we must prepare for a future much less dependent on natural resources and begin to build the basis of a new economy.

- How can we build that new economy?

- Brain power rather than brawn must become our pre-eminent natural resource and our first point of investment—if not, we will not keep up to new and emerging global competitors.

- Advanced economies and developing economies, both, are increasingly focused on knowledge and innovation. Investments in R and D are growing globally after being relatively stagnant in the eighties and nineties.

- The number of patents granted per year has doubled to 800,000 compared to two decades ago.

- Developing nations are pouring significant resources into generating human capital and new knowledge as they seek to move away from low wage manufacturing economies to high wage advanced businesses.

- Let me give you a few details to illustrate:

- China, in little more than sixteen years, has made incredible strides—both in terms of economic growth and the development of talented human capital.

- An estimated $20 billion has been spent on building an elite sector in China's high education sector. The result is that, in the last 16 years, China has:

    - quadrupled the number of its bachelor degree graduates to three million a year, and

    - increased the number of doctoral degrees in engineering and natural science to over 20,000 per year from 2,500. They are now only slightly behind the US which produces 22,500 per year.

- Does investment in graduate education on this scale make a difference?

- Consider this: In the same period, China's share of global high-technology exports increased from 7.5 percent to 20 percent today.

- India is also aggressively pursuing education and research and development as priority areas.

- They aim to provide undergraduate education to 30 percent of its youth by 2025 – up from its current rate of 12 percent.

- To meet this ambitious goal, India has increased the budget for higher education for 2010-2015 to nine times the amount of the previous five years.

- In addition to other strategies, India has entered into an agreement with the United Kingdom to establish 14 world-class, research intensive "innovation universities" in partnership with elite universities such as Oxford and Cambridge.

- Now, you might say China and India are populous nations with whom we can hardly imagine competing.

- But consider smaller countries like Israel or Finland. Israel has been leading the world with innovations. Major companies such as Intel, Microsoft, IBM, and Google have major research and development centres in Israel.

- Israel has more companies listed on the NASDAQ stock exchange than any other country in the world except the US. Why?

- Israel has the highest percentage of engineers in the work force and the highest ratio of university degrees. It ranks 1st in the world on public expenditure on education and has the highest rate of R&D investment in the world – four times that of Alberta.

- Imagine that – a wealthy region like ours is investing four times less.

- To be considered in their league, we must strive to be on par with them.

- More importantly, it is vital that we recognize that these global shifts in investment in human ingenuity, creativity and skills are also shifting the global landscape of jobs. This shift will eventually have an impact on Alberta—to our benefit or our detriment depending on our choices.

- There is a hollowing out of the labour market currently underway in North America.

- Blue collar manufacturing and middle wage white collar routine jobs are being outsourced or are disappearing, while high-wage innovation jobs are growing, along with low- wage service jobs that cannot be outsourced.

- Enrico Moretti, in his recent book, *The New Geography of Jobs*, distinguishes between traded and non-traded jobs. The former create wealth, while the latter are a consequence of a high-quality traded job.

- His statistics suggest that for every high-tech job—namely a scientist, software engineer, designer, digital artist, mathematician—

- five additional local jobs are created outside the high-tech sector.

- Three of these jobs could be high-paying professional jobs, such as doctors, lawyers and accountants, while two of them are lower-paying service jobs such as yoga teachers and hair-dressers.

- A very strong multiplier effect is at work which benefits the whole community.

- The problem is that without the investment in the high-quality end of things, this multiplier effect is not at work in every community.

- Indeed, Moretti points out that increasingly there are three America's:

    - There are the "brain hubs," cities with a highly educated labour force, and good innovation jobs. Think of San Francisco, Seattle and Austin.

    - At the other end are cities that were dominated by traditional manufacturing jobs, which are in serious decline, like Detroit and Cleveland.

    - Then there are the cities in the middle that could go either way depending on the decisions and investments they make in talent and resulting high quality jobs.

- Let us examine some of the “brain hubs” and their characteristics.

- The Silicon Valley leads the world in its innovation activity, attracting a third of all venture capital investment. [in the US?]

- Ambitious start-ups from around the world go to the Silicon Valley because it attracts talent and ideas which help companies grow into global giants like Google and Apple.

- Other brain hubs are Austin, Raleigh-Durham, and Boston Cambridge and San Diego and Seattle.

- These regions share three characteristics that economists have identified as factors that enable brain hubs to form and grow:

    - A thick labour market, namely access to a great choice of skilled people,

    - the presence of specialized service providers,

    - and knowledge spill-overs as a result of the presence of great universities.

- Great universities like, University of Texas in Austin, Duke University and University of North Carolina, Chapel Hill, MIT, Harvard and Tufts, the University of California San Diego and the University of Washington. All of which feed the economic ecosystem of their respective brain hubs.

- But, a university is not enough to produce a brain hub.

- Sociologist Lynne Goodman Zucker and economist Michael Darby have also discovered that the presence of an academic superstar in a critically important area is a key element in the creation of a cluster.

- This was the case for Cambridge, San Diego and the Bay area.

- They happened to have academic stars in a specific field of biotech when the biotechnology revolution got under way in the seventies.

- The result? A thriving biotech sector with over 350 billion in investment, nearly 400 therapeutic biotech products and thousands more in clinical trials.

- Unfortunately, it is difficult to actively try to manufacture the right conditions to create a brain hub. There's always an element of serendipity involved that can't be reproduced.

- And, once a brain hub is established it can develop a "stickiness" that drains the talent, knowledge, and investment capital from other regions.

- Can Alberta create a brain hub?

- Some might argue that we have one centred on oil sands technology and development:

- As many of you will know, the University of Alberta is a leading partner in a regional cluster of oil sands research centres, which includes the Alberta Research Council, CANMET Energy Technology Centre in the Natural Resources Canada laboratories in Devon and Syncrude Canada.

- This R&D cluster produce 60% of the world's publications on oil sands.

- The U of A is home to 16 Industrial Research Chairs, three Canada Research Chairs and one Canada Excellence Research Chair, all devoted to oil sands research.

- And we've attracted stellar talent to the province, including Dr. Thomas Thundat, Canada Excellence Research Chair in Oil Sands Molecular Engineering.

- In addition to cultivating talent, our industry partners have collectively invested close to $50 million in the past decade alone.

- The result is that the oil sands industry—once considered a lost cause—currently produces 1.6 million barrels of oil per day, employs more than 100,000 people, and sends royalties of $1.9 billion into provincial coffers annually.

- Every dollar invested in the oil sands generates nine dollars of economic activity inside and outside of Alberta.

- By many measures, the research, talent, and industrial brain hub generated around the oil sands is a tremendous success. But, there is also a great potential for future collapse if the focus remains solely on the production of oil.

- Canadian cities like Calgary and Edmonton should learn a lesson from Detroit.

- In the forties and fifties, Detroit was an innovation hub and the centre of a mighty cluster, involving the auto industry.

- What went wrong? Detroit failed to utilize its vibrant economic ecosystem to seed the birth of a new economy to replace the auto sector when it went into decline.

- It might have been used its foundation in automatic technologies as a springboard to the new economy: perhaps becoming a centre for robotics, new media, or design.

- Other high technology sectors could have grown out of the auto sector but this did not happen. So today it is a city in serious trouble.

- In Canada, the strength of the resource economy, in Alberta, Saskatchewan and BC has masked some of shifts occurring in the geography of jobs.

- However, we can see the signs of cracks here and there—and areas of significant weakness.

- Too few of Alberta's young people are participating in post-secondary education—we have the lowest participation rate in Canada, in part because they choose lower-skilled employment in the resource sector.

- On the other hand, too many young people who do attend universities and graduate are under- employed because of the lack of high-wage innovation jobs.

- Alberta has also among the lowest R and D investment of any province in Canada and the lowest business expenditures in R and D, BERD, compared to OECD averages.

- Linked to this is the fact that the number of graduate students, post-doctoral fellows, and R and D personnel, on the whole, remains low in Alberta.

- Remember what I told you about China and India just a few minutes ago?

- Alberta and Canada need to step up their innovation agendas and recognize the speed of globalization, along with the rapid migration of talent and capital.

- So what can Alberta and Canada do to build tomorrow's economy?

- In the short term, Alberta should invest more of its resource driven wealth and prosperity into seeding the future.

- And, I also urge the resource sector to continue to fund and produce the innovation needed to strengthen the energy "brain hub" we have now, so that it creates auxiliary service and product sectors with high-knowledge jobs.

- Over the longer term, Alberta should stimulate and foster R and D that will build domestic capacity in new technologies that leverage off its existing energy knowledge and innovation in environment, water, and alternative energies, especially those based on natural gas and hydrogen.

- Alberta also has the potential to become a leading agri-food business centre, given the food security issues facing the world.

- There's so much potential waiting to be maximized. That's why you—and why the U of A's senior team—are here in Lake Louise, preparing and planning for the future.

- All of us can see how new technologies are bringing disruptive change to our respective sectors. How we embrace, manage, and anticipate that change will affect our future success.

- Although we may not be able to predict everything with certainty—there is one thing I believe we can count on: The 21st century will belong to those who learn how to harness human capital to its fullest. Thank you.