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Experiencing the March 11, 2011 Earthquake

Hugh Patrick

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Hugh Patrick
Center on Japanese Economy and Business
Columbia Business School

Experiencing the March 11, 2011 Earthquake
Tokyo, March 9-21; Western Japan, March 21 – April 3

This report serves three purposes: to record my observations and impressions from being in Tokyo before and after the March 11 earthquake; to summarize trips to Kobe and across Honshu to the Japan Sea coastal area; and to provide some thoughts as further information became available during April.

Japan now faces its worst crisis since World War II. The earthquake quickly became a triple disaster. The immense tsunami generated by the earthquake hit the Iwate, Miyagi, and Fukushima prefecture coastlines with great devastation and loss of more than 22,000 lives. The tsunami also crippled the Fukushima Dai-ichi nuclear power plant, creating potential radiation threats and global repercussions for energy policy.

Many of the effects of the triple disaster are long-lasting, and the flow of new, important information requires a continual revision of our understanding. This is particularly true regarding the Fukushima Dai-ichi power plant and electricity shortages, as well as development of energy policy. Accordingly, early May is my cut-off date for new information.

0.1 Context

I caution that this report is based on impressions at the time - that is, when news coverage was focused on human-interest and nuclear-scare, and there were not enough facts to make detailed analyses. I had no special access to information on what was happening in the affected areas. I focus on life in Tokyo. Accordingly, I do not have much to add about the ongoing recovery and reconstruction efforts in Tohoku. My observations range from very general to quite specific.

Especially during the first few days, information was partial. Like everyone, I relied on the media, in my case television (NHK - which had good coverage in English - CNN, BBC), the local English language newspapers (Yomiuri, Japan Times), and the Financial Times and International Herald Tribune. I was outraged to learn when, in speaking on the phone during the week with my wife and children in the US, how sensationalist, ignorant, incorrect, and out of context much of the US TV coverage was. While CNN in Japan was earlier and quicker to cover

the Fukushima Dai-ichi story as it first developed, even in Japan it tended to be sensationalist, without providing a good context.

This report also draws significantly on excellent discussions I had in Tokyo with company executives, friends, acquaintances, and even strangers, of all ages. Their information, insights, views and attitudes, and the flavor of their comments and anecdotes importantly shaped my perspectives. Virtually all my conversations that week typically began by asking if the person's family and friends were OK (they were), was their home significantly damaged (no), and what had they done that first night (Friday) when subways and trains were not operating and the roads were jammed (most walked home).

I The Earthquake

The Great East Japan Earthquake (Higashi Nihon Dai Shinsai), as it is now formally called, measured 9.0, making it the biggest earthquake in Japan's recorded history. The epicenter was off Sendai along the Sanriku coast, in the Tohoku region (northeastern Honshu). The 1923 earthquake that devastated Tokyo was 8.3, the 1995 Kobe quake was 6.8. The Chile earthquake in 1960 of 9.5 is the strongest ever recorded.

The Richter scale for earthquakes is exponential. A 6.0 earthquake is about 33 times and a 7.0 about 1000 times as strong as a 5.0 earthquake. The Japan Meteorological Agency also uses a different seismic intensity scale, from 0 to 7, which measures the shaking at a point on the earth's surface, rather than at the seismic shock epicenter underground.

1 Shaking and Swaying

I was sitting at a desk in my room on the 35th floor of the New Otani Hotel Tower Building in Tokyo when the earthquake struck. Suddenly at 2:46 PM the building began to shake. "Oh, an earthquake", I thought. But the shaking became stronger and wouldn't stop; and I couldn't get up from my chair. And the building began to sway strongly. It was very scary. Once it stopped, I went to the window to see if any buildings had collapsed, or if there were any fires. But it all looked the same. I was safe, the building was safe, and people were safe. And that was essentially true for everyone in Tokyo. Japan's strict building codes from several decades ago ensured that essentially no buildings collapsed; Tokyo's many buildings swayed dramatically, but withstood the shocks.

A major aftershock (7.5) occurred about 30 minutes later, and we were told to evacuate the building. Going down the stairs was surprisingly easy, as I did not feel any need to rush. After a half-hour on the street in front of the hotel, and then several hours in the lobby, because the

elevators were still not in operation, I obtained another room on a low floor, easy to walk up to. It was only after I was in my room that Friday evening that I saw TV, which repeatedly showed scenes of tsunami devastation - only a few different ones, continuously repeated - alternating with reports and scenes of Tokyo streets jammed with people walking because the subways and trains were not working. The morning after the quake, the elevators were operating, so I returned to my 35th floor room.

Thus began a fascinating 10 days. There was widespread anxiety. As it turned out, there was no real danger in Tokyo, although over the next 10 days life was a bit inconvenient. Like most of the world, I was riveted by the heart-rending, continuously updated reports of death and destruction. With entire villages turned to rubble, some 450,000 people were made homeless.

But what makes this crisis qualitatively different is the partial meltdown at four of the six nuclear reactors at Tokyo Electric Power Company's Fukushima Dai-ichi power plant. Fukushima Dai-ichi now joins Chernobyl, Kyshtym, Windscale, and Three Mile Island as one of the five most-significant nuclear accidents, as measured by the International Atomic Energy Agency, an intergovernmental agency for scientific co-operation.

2 Life Goes On

I was in Tokyo for the 25th anniversary conference of the Columbia Business School's Center on Japanese Economy and Business (CJEB), titled "Japan, US, China in the World Economy", to be held on March 16. But of course it was postponed. Virtually every event in Tokyo – conferences, seminars, university and school graduation ceremonies – was cancelled. Wonderfully, all of my many scheduled meetings the week of March 14th with Center corporate sponsors, other professionals, recent university graduates, and other friends were possible; indeed a few were added for the Saturday, Sunday, and even Monday holiday morning, March 21st.

Since the Hotel Okura Tokyo was where the conference was to have been, from March 14 I was comfortably ensconced there. I stayed one night beyond my initial registration, but had to move to the main building from the south wing "to save electricity". The hotel was virtually devoid of guests.

3 First Impressions

My most immediate, compelling, and enduring impression was of the great strength of the Japanese people and Japanese society in abnormal circumstances. I have long known this strength, and more or less take it for granted. However, it has particularly shined through in this

period of adversities and difficulties. People in Tohoku, even in the most severely hit areas, have been calm, orderly, brave, resolute, even stoic. They have been helpful to others, pragmatic, flexible, honest, prepared to endure, and determined to prevail.

As one friend noted, people even lined up in orderly queues to buy toilet paper to hoard. I know of no significant instances of looting or other criminal activities in those early, chaotic days in the afflicted Tohoku areas. The phrases gambatte (endure) and sho ga nai (it can't be helped) were repeatedly used when I met with Japanese during the week. One Japanese friend told me he is more proud of the Japanese than he has been in years.

4 The Context

The area affected directly has 14.3% of Japan's population. The seven Tohoku prefectures have 12.7 million people and Hokkaido has 5.5 million. Tohoku GDP in 2007 was 46.7 trillion yen (\$584 billion at 80 yen/dollar), 9.0% of Japan's total. The population of Iwate, Miyagi, and Fukushima prefectures is 5.7 million, and its share of GDP is 4.0%. On the order of 500,000 people left their homes in Iwate, Miyagi and Fukushima (the afflicted prefectures), of whom several hundred thousand continued to be in emergency evacuation centers in the first weeks, as TV continuously reported in excruciating detail.

The tales of losses, of survival, of houses, buildings, and businesses destroyed were very moving, indeed really difficult to watch for long. The sympathetic responses of Japanese, and indeed of people all over the world, have been compelling. In the face of many problems, the quick government efforts, as well as private initiatives to rescue people, find bodies, and handle evacuations were impressive.

To understand the nature, efforts, and implications of the triple disaster, one has to place them in appropriate contexts. The earthquake not only was unprecedentedly strong for Japan, it created a huge tsunami, which happens mainly when earthquakes are offshore. Perhaps the earthquake alone was less devastating than the 1995 Kobe earthquake, but the combined damage with the tsunami resulted in far greater loss in lives and property (real capital, in economist's jargon).

In Japan I did not see comparisons with the Great Kanto earthquake of 1923, but that certainly was far worse. Fire raged two days and nights. Some 143,000 people died, much of Tokyo and Yokohama were destroyed, and the way reconstruction was funded eventually led to Japan's financial crisis of 1927.

If not fire, water. Major tsunamis have hit the Sanriku coast of Tohoku several times since 1896 - notably in 1933, 1960 (from the Chile earthquake), and now. The 1896 tsunami killed 20,000

and a wave topped 120 feet in one village. Over the past two decades or so, high walls and sluice gates were built along the coast to defend against tsunamis, but they were not big enough to handle the tsunami of March 11.

The devastations are regional. While Kanto (Tokyo and surrounding area) and Tohoku have been affected by electricity shortages and anxieties about the spreading of radioactive materials, this is not at all the situation in Kansai (Osaka, Kobe, Kyoto) or other parts of western Japan.

As I stress throughout this report, what makes this disaster qualitatively different is the damage to nuclear reactors at the Tokyo Electric Power Company (TEPCO) Fukushima Dai-ichi plant. On the day of the earthquake, once the Fukushima Dai-ichi damage was recognized, Japan's National Industry Safety Agency ordered the evacuation of people within a 10 kilometer radius, and the next afternoon, ordered the evacuation of everyone within 20 km, and those beyond 20 km but within 30 km to remain indoors if they did not leave. There were about 68,000 people living within the 20 km radius, and another 92,000 in the 20-30 km zone, for a total of 160,000 within 30 km.

5 Tokyo Following the Earthquake

The biggest problem for me - for everyone in Tokyo - in the days immediately following the earthquake was the lack of information. Just how threatened were we, staying in the city?

For the first six to ten hours or so, cell phones and regular phones were out, and trains and subways were shut down. People wanted to know whether their family and friends were safe, and their homes OK. Fortunately there was a weekend to recuperate and adjust. On Monday March 14, people reported to work in an overcast, somber Tokyo as everyone voluntarily conserved electricity.

An unprecedented 262 significant aftershocks were recorded in the first week. We felt numerous aftershocks every day, but neither I nor anyone seemed to worry much about them. It was easy to get around Tokyo – taxis were abundant, subways and trains were working again, and traffic was light because gasoline supplies were short.

As the week after the earthquake progressed, our greatest concern was the possibility of dangerous radioactive air spreading to Tokyo, though in fact the actual recorded levels were very low. Ultimately, like most Japanese in Tokyo, I came to be (and am) persuaded that even in the highly unlikely worst-case scenario (which I thought to be complete meltdown or explosion), Tokyo's air will not become dangerous. Nevertheless, until TEPCO brings the Fukushima Dai-

ichi nuclear reactor problem under control, the psychological costs to Tokyo residents will probably be substantial, if latent.

I found rather remarkable the return to a sort of normality to Tokyo life when the work week began Monday March 14. On reflection that should not be surprising, given the way Japanese behave in their very structured, orderly, diligent society, but it was a subtle surprise to me. Still, the atmospherics of Tokyo were far different from the normal, pre-earthquake time and from what I experienced later in Kobe and western Japan.

It felt a bit grim; it was too early to enjoy life again. Grey weather combined with voluntary, cautionary, sharply reduced lighting in railroad stations, other public places, stores, and buildings to save electricity gave the sense both of difficult times and resoluteness and determination.

People had to deal with less-frequent and more-erratic commuter train service. Everyone recognized the need to conserve electricity, reinforced by plans TEPCO announced from the beginning of the week to schedule rolling blackouts in different parts of Tokyo and the Kanto area more-widely. I gathered electricity would not be curtailed within the central wards of Tokyo. One reason given by the government was to sustain manufacturing and other business activities. But they surely did not want to interrupt electricity service to foreign embassies (as mentioned to me by several Japanese) or to their own government political and administrative offices. And that made sense.

The media reported how convenience stores almost immediately sold out of instant noodles and staple foods that did not require refrigeration. Other practical daily necessities such as disposable diapers and small batteries also quickly disappeared from store shelves. Such shortages were temporary, as stocks could be readily resupplied. Friends in Nagoya and Kobe later told me of mailing batteries and diapers to their families in Tokyo. Port facilities and roads southwest from Tokyo were not damaged, so transport to Tokyo was not a problem.

Shortages of gasoline in Tokyo deepened as the week progressed, leading to long lines of cars waiting at stations. By the second weekend (March 19 – 20) many (probably most) gas stations were sold out and closed. One friend said the senior bureaucrats (and no doubt company officials) with assigned cars and drivers do not use them much during the day, so perhaps many of those queuing at gasoline stations were the drivers of these cars. Early in the week, one senior government official stated that Tokyo's gas inventory was all in cars, not in gas stations.

A retired major international oil company executive, a Japanese friend for many years, told me gasoline supply is not a fundamental problem. The government has 120 million barrels of oil reserves which can be released. Most refineries are not in the afflicted area. Japanese refineries

have a long-run operating capacity of 92%, since they must close periodically for routine maintenance. In Okinawa there is a very large refinery that was running at about 80%.

Another friend told me that after the earthquake the government immediately, quietly, and informally requisitioned the inventories of major gasoline suppliers in order to support the Self-Defense Forces, the police, firefighters, rescue teams, and other units dispatched to the afflicted areas. Gasoline delivery trucks were rerouted to Tohoku to deliver these essential supplies. I don't think there was much opportunistic pricing during the week or two it took for supplies to return to normal.

Throughout the week there were long lines of taxis everywhere, waiting for customers. When I asked a taxi driver, he said he and his company have no fuel problems, only a lack of customers. I remembered only later that most taxis run on propane.

As more and more information became available, people's personal and business concerns evolved. Early in the first week, colleagues at several companies with offices in Sendai told me, to my surprise, that staff there were all safe, their offices were open and in operation, and the large buildings they were in had electricity. Since the TV I was seeing showed only the tsunami damage of Sendai's low-lying coastal areas, I did not realize that damage to the central business district (which is several kilometers inland), and much of the rest of the city, was small. Similarly, Fukushima City and most other inland cities and towns were not seriously damaged. The main devastation was in towns and villages right on the coast.

The two ongoing threats to one's sense of personal safety in Tokyo were further severe earthquakes and, more importantly, the possibility of radioactive fallout from Fukushima Dai-ichi.

A couple of days after the earthquake, the Japan Meteorological Agency reported a 70% probability of a major aftershock (earthquake) within the next three or four days, and a 50% probability for the three days after that. We certainly felt numerous aftershocks every day and night.

6 Radiation

There continues to be extensive media coverage of the Fukushima Dai-ichi power station. There are 14 nuclear power reactors in Tohoku near the earthquake epicenter. Besides the 6 at Fukushima Dai-ichi, there are 4 at Fukushima Dai-ni, 3 at Onagawa northeast of Sendai (operated by Tohoku Electric Power Company), and Japan Atomic Power Company's Tokai Dai-ni near Mito. Of these, 3 at Fukushima Dai-ichi were already shut down for routine

maintenance. The 11 in operation, including those at Fukushima Dai-ichi, automatically shut down when the earthquake occurred. It is the 4 tsunami-damaged units at Fukushima Dai-ichi that were and continue to be the huge problem.

Actual levels of radioactivity in the air once it appeared in Tokyo were very low, as TV and the media carefully and thoroughly discussed, analyzed, and explored. Media coverage of the evolving conditions in the different reactors was also detailed and thorough. The government steadily provided a great deal of factual information, and academic and other specialists appeared on TV and in other media to analyze the available evidence about the Fukushima Dai-ichi situation. Neither the government nor the Japanese media were willing publicly to discuss worst-case scenarios, probably on the reasonable grounds that would only increase anxiety, even panic.

Of course analysis of the worst-case scenarios was what I wanted in deciding whether to continue to stay in Tokyo. Fortunately, I benefitted from discussions with several American and Japanese Tokyo resident friends who were carefully analyzing information and studies from various sources, including an MIT science website, I learned by Wednesday (March 16) they had concluded that even if the Fukushima reactors were to melt down or explode (assumed to be the worst-case scenarios), dangerous radiation levels would not spread to Tokyo. Their analyses were strongly empirical.

This reaffirmed my sense that I was safe in Tokyo. And that seemed to have been the widespread sense of Japanese in Tokyo, though apparently not of some other foreigners. I was pleased later to learn from the September 22 presentation by Professor David Brennan, Higgins Professor of Radiation Biophysics, College of Physicians & Surgeons of Columbia University, at the CJEB March 22 symposium at Columbia, “The Economic, Health, and Political Consequences of Japan's Earthquake,” that Tokyo was and is indeed safe.

There were other radiation issues causing anxiety. Milk, leafy vegetables, and other agricultural products produced in parts of Fukushima contained excessive levels of radioactive particles which had fallen onto crops and grass eaten by the cows. The distribution and sale of affected products was immediately halted, thereby bringing this localized situation rather quickly under control. This was another case of excessive, media-hyped fear, not only in Japan but abroad.

Behaving in seeming panic and without adequate information, the US, Korea, China, and other Asian economies halted food imports from Japan. Japan is a large net importer of food, but does export very small amounts of high quality, very fresh, vegetables, fruits, and fish, as well as brand-name rice. My intuition is that Japanese safety standards had been initially set to defend (I won't say “protect”) Japanese from even slightly radioactive imported foodstuffs. Nonetheless, the government's assurances that Fukushima vegetables were safe for adults to eat not

surprisingly were met with skepticism by some Tokyo residents. Of course, farmers elsewhere in Japan grow lots of vegetables, so I do not think this is or will be a serious problem for Tokyo.

On Wednesday, March 23, the radioactivity issue developed a new, temporarily dangerous dimension when the Tokyo government announced that because radioactive Iodine 131 had been detected in the city water supply, infants less than 1 year old should not drink tap water. Not surprisingly, families with small children - and surely others as well - immediately rushed out to buy bottled water. The water samples measured a level of 210 becquerels of Iodine 131. The recommended upper limit for adults is 300. The radiation had been carried by air from Fukushima, was caught by rainfall, and thereby entered the water supply. Iodine-131 has a half life of just eight days, so the threat fairly quickly came to an end. A day or two later the government reported the water was safe again.

The government's reports came within hours of when the water was first sampled. But people became concerned about how soon they would be informed of further dangers. It certainly seemed rational for families with small children, and probably adults as well, to stockpile bottled. It will be interesting to see how long such hoarding persists.

7 Disrupted Plans

The canceling of many events in Tokyo following the earthquake initially was in part because of possible travel difficulties for attendees. More recently, some international events were cancelled because of foreigner fears, albeit misguided, of radiation dangers. Initially, many celebratory events were cancelled not only in Tokyo but in other parts of Japan as expressions of sympathy and concern. This was not a time to party, or to be seen partying. Young friends told me their graduation ceremonies at the University of Tokyo and Keio University in late March had been cancelled, and I am sure that was the case throughout Kanto.

Nonetheless, as widely reported in the news, one elementary and junior high school in an afflicted area in Tohoku determinedly held its graduation ceremonies to show their students (and families) that life goes on and that Japanese will prevail. Many new school year openings in April were delayed. One businessman, whose son's senior year at Keio University has been delayed for a month, suggested to me that all universities should delay opening until September, because of electricity shortages and other disruptions, but fundamentally in order to change their schedules henceforth to conform to the Western school year beginning in September.

An estimated 20,000 or so foreigners living in Japan quickly left the country, including 1500 or so Chinese working in Tohoku. I found it somewhat surprising that some foreigners left Tokyo, but perhaps not unreasonable, especially those with nervous families. Some temporarily went to Osaka, Kyoto, or further west. It happened to be a school vacation period, just before schools were scheduled to begin the new school year in April, so such travel did not seem abnormal.

A senior official in one large, internationally oriented Japanese company told me when we met on March 18 that his company had decided to pay the roundtrip plane fares home for their expatriate employees, and when appropriate have them come back to Tokyo. He explained that many of them did not know Japanese well, did not know how to deal with possible food or other shortages in their neighborhood stores, or with electricity blackouts, or interruptions in the train or subway services. So, to allay their family's anxieties, it was better to help them leave temporarily. The next day I happened to speak with a young Japanese working in the same company, in his first year after university graduation; he said the company made it clear that all Japanese were expected to report to work, and not to find excuses to leave Tokyo.

In chatting with the president of another very large, internationally oriented, Japanese company, I learned that, when the earthquake struck, he was at a meeting at his office in Tokyo on one of the top floors of his company's headquarters, a building of some 40 stories or so. Once a number of decisions were immediately made, late in the afternoon he walked up to the top floor, went around all the work spaces to encourage his staff, and then did the same on each floor as he walked down to the ground floor. Fortunately he lived nearby, so he easily walked home. But then he had to climb more than 20 floors to return to his condo home, where his wife was waiting. Like others, he had not been able to speak with her because cell phones and land phones were not working.

A business friend told me he walked seven hours to get home. He asked me whether I knew what was really selling in stores as he walked home. I had seen a newspaper article reporting that bicycle stores had sold out, but I assumed their inventories were not large. He said it was women's sneakers. Female office workers wear pumps (with heels) to work and they wanted more comfortable shoes to walk home in. Later in the week I meet a young college graduate who had been at the office of her new employer. She said she walked home (two hours or so) in pumps because the lines of women to buy sneakers at stores along the way were so long it did not seem worthwhile waiting.

Another recent college graduate told me she walked a bit and then got on a bus. On the bus was an elderly lady who said she had been in Tokyo during World War II as a child when it was bombed, and this earthquake was not nearly so frightening as that. The traffic was so jammed

that walking was faster than the bus, so my friend got off and walked. Fortunately, by midnight or so the commuter trains were running, enabling her to get home.

Another friend, a Japanese businessman, told me he was so tired that when he got into a taxi after work at about 8 PM that he fell asleep for two hours. When he awoke, the taxi had been able to go only a few blocks due to the traffic jam. The driver told him he was sleeping so soundly that he didn't want to wake him. Eventually the taxi was able to take him home, several hours later.

My most poignant conversation in Tokyo was with a young waitress in one of the hotel's restaurants. She spoke some English, learned primarily during a year in the UK four years ago. She was working part-time in the mornings, and attending a college night-school program in hotel management. She was at the hotel when the earthquake hit. Because she had to work the next morning, she had stayed overnight at the hotel's facilities for its staff.

Her college has a program, for those who pass an exam, to work for a year in a hotel in the US, the Philippines, or one of several other foreign countries. She would like to do that, but fears she would have difficulties finding a job in Japan on her return, so she felt it was better simply to look for a job in Japan after she graduates. She was from Wakabayashi, a small coastal town near Sendai. Before the earthquake, she had planned to return to work in Sendai, but now that seemed completely uncertain.

She could not contact her parents until six days after the earthquake. Her parents were safe and remained in their house, which was not damaged. However, the tsunami destroyed half the town and swept away her two uncles; they remained missing. She has no brother or sister. She was quiet and calm, and displayed little emotion other than what I took to be stoicism.

II East and West of Japan: Seemingly Different Worlds

Not surprisingly my scheduled meetings the week of March 22-25 with Governor Masaaki Shirakawa and other senior officials of the Bank of Japan, and with Tsunehisa Katsumata, chair of TEPCO, were cancelled, as were several other scheduled meetings. Moreover, my planned trip from Tokyo on March 26 to Sendai, to see the opening game of Sendai's Rakuten Eagles baseball team, and following the game to go to Kobe the next day, had been cancelled. I later learned that the earthquake had done modest damage to the stadium building, but mainly to the artificial turf, which had to be replaced. I was pleased that the Eagles were able to hold their opening home game in their Sendai stadium on April 27.

Late Friday March 18, I decided to take a train to Kobe on March 21, a holiday, which was several days earlier than I had initially planned. I then proceeded as scheduled on a trip with friends the week of March 28 to the Japan Sea coast. I felt that I could not accomplish a great

deal more with a further four days in Tokyo. I did not think it was necessary to leave Japan, even though the American Embassy announced on March 17 that it would provide charter flights out of Japan for American citizens, and the US State Department urged Americans not to travel to Japan.

While many Americans, including me, often think of Japan as running north-south, Japanese think of it as running east-west. Kanto (which means east of the invisible line, and includes Tokyo), Tohoku (which translates as northeast), and Hokkaido are east. Everything else is west.

I stayed at the Hotel Okura in Kobe from March 21 to 28, having several Center-related business meetings, seeing a few friends, decompressing from what had been an exciting, intense stay in Tokyo, and beginning to prepare a preliminary draft of this report. I then took my scheduled combined business and pleasure trip with Japanese friends, a couple about my age, in their car to Tottori and Shimane Prefectures.

We drove to Himeji, and then across Honshu through the mountains, spending two nights at hot-springs hotels (onsen) before arriving in Matsue, a city of about 200,000. En route we visited various notable sites, including a huge silver mine with 350 kilometers of tunnels at various levels. It was initially established in 807, and was developed and modernized over time as rich new silver veins were found. Not surprisingly, it had come under the direct control of the Tokugawa shogunate and then the Imperial government, before being sold to the Mitsubishi Corporation in 1896. It ceased operations in 1973, and now is a tourist attraction in a rather remote area. We also visited the national top-ranked, huge and very lovely Adachi Japanese garden.

While in Matsue we spent a fascinating morning at a private waste disposal company, meeting with the president and inspecting the plant, located at a nearby port, and its large kiln (incinerator). This visit had been arranged by a friend from the Development Bank of Japan, who had helped arrange the financing of the kiln's construction a decade earlier.

In the afternoon we met with the head of the research institute of the major local bank to receive a briefing on the Tottori and Shimane economies. We spent April 1 night in Okayama before returning to Kobe. On April 3 I flew to Seoul, South Korea, as scheduled.

The focus and flavor of Kobe and all the other places we visited was very different from that of Tokyo. Life was so normal: no shortages of anything, bright lights, fine food, and plenty of water. It was the end of the spring vacation period, just before the new school year begins, and stores and streets were bustling. The hotel was happily filled with young couples and families with their children. As usual on weekends, scrumptious wedding receptions were held at the Hotel Okura Kobe; unlike in Tokyo at the time. Despite stories of foreigners decamping from

Tokyo for Kansai, I saw only one foreign couple at my Kobe hotel; maybe foreigners were in Osaka or Kyoto.

I have two main explanations of why western Japan was suddenly so different from Tokyo.

First, due to a quirk of economic history, there is no shortage of electric power in western Japan. In western Japan electricity is 60 Hertz, the system having been established in the 1880s by General Electric's provision of equipment and technology to a new company in Osaka. At about the same time the German firm Siemens, following European standards, built a 50 Hertz system for Tokyo Electric Lighting Company, TEPCO's original name. I vaguely remembered that from learning Japanese economic history decades ago, but somehow did not realize these two different systems persist today. (Consumer products in Japan generally work on either 50 or 60 Hertz, but production equipment, especially motors, does not.)

Japan's nine major electric power companies (plus one in Okinawa) are highly regulated, local public utility monopolies. It is technologically possible to convert electricity from 50 to 60 Hertz, and vice versa, but it is expensive. There are only two frequency converter plants, both of modest size. So, like Tokyo before the earthquake, in Kobe and throughout western Japan, neon lights were on everywhere; and stores, train stations, and buildings were, as always, too brightly lit for my taste.

Second, in western Japan the Tohoku triple disaster was far away, geographically and psychologically. Of course great sympathy was expressed for those lost or suffering in Tohoku. Kobe friends remembered their earthquake 16 years ago, in at least one case having lost family members. As elsewhere in Japan, there was an outpouring of donations to help Tohoku. And the increasing difficulties at the Fukushima Dai-ichi nuclear power station of course received immense media coverage, but quite appropriately in western Japan there seemed to be little sense of personal danger or risk. After all vegetables, milk, and water supplies were local and safe.

The main concerns I heard were about the possible danger of local nuclear power plants; one person in Matsue bemoaned the fact that there was a nuclear power plant only a few miles to the west, and the wind typically blows to the east. And several people on the Japan Sea coast expressed irritation that the Koreans had suddenly stopped buying their delicious, perfectly safe, fresh fish.

No doubt the supply chain difficulties affected some manufacturers in western Japan, as well as elsewhere. However, on my travels there, I was not especially looking for these problems, and there were no obviously manifestations of them. Life was so incredibly normal.

III Economic Impact of the Earthquake

On the whole, it was my impression that the government moved rapidly and effectively in dispatching the Self-Defense Forces, police, firefighters, and others to the afflicted areas to rescue people, evacuate people to temporary facilities, recovers bodies, and begins the huge removal of debris. The main highways in Tohoku were quickly restored to operation. However, recovery will be a slow process. And, the lack of clear-cut decisions - particularly for dealing with those evacuated from devastated coastal villages and from the Fukushima Dai-ichi danger zone - is dismaying, if perhaps not unexpected.

Of course, certain economic effects were obvious. Most immediate was the terrible losses of lives (human capital) and houses, buildings, and production facilities (physical capital). The number of confirmed dead gradually increased as bodies were found; I assume almost all those still listed as missing are no longer alive, so the toll will be some 22,000 dead. I have not seen a breakdown by age, but presume that older people are a disproportionately large share. The early estimates of the physical losses ranged up to ¥25 trillion, about 5% of GDP.

There are macroeconomic, structural, and unexpected specific-industry effects, which reflects both the reliance of supply chain systems on very specific, often seemingly minor, components from afflicted Tohoku plants and the present and expected shortage of TEPCO electric power to its Tokyo and Kanto customers, especially in peak times of electricity demand during the summer.

Most of the macroeconomic effects are straightforward. In the short run, production capacity was destroyed or damaged, so supply capacity has been reduced. But demand declined, not only in Tohoku but throughout the country, in part as people cancelled various celebrations and parties. I was charmed to see Tohoku sake brewers on TV urging people to drink their sake. Following admonitions not to entertain (or be seen entertaining), a counter-message went out urging people to eat out, spend, and thereby restore demand. Not surprisingly, it was expected that the economy's ongoing recovery prior to the earthquake would now stall for a couple of quarters, until perhaps mid-fall 2011, before resuming GDP growth. In the medium run, government and private reconstruction expenditures in Tohoku will increase domestic investment absolutely and as a share of GDP, and generate somewhat more rapid growth.

One key issue is whether the triple disaster will serve as a catalyst moving the economy out of its two decades of mediocre economic performance, widespread underemployment as well as overt unemployment, mild but persistent deflation, and some rather pessimistic attitudes about Japan's future. It was, and still is, too early to tell. Much depends on the responses of individuals and companies – the Keynesian animal spirits – and the political will not only to support reconstruction but to address Japan's fundamental structural problems.

1 Electricity Shortages

An immediate issue in Tokyo and elsewhere in Kanto and Tohoku was how to deal with electricity supply shortages because TEPCO's electricity production initially dropped 40%. The next concern was how to deal with electricity shortages at peak times in the hot days of the coming summer. TEPCO scheduled daily rolling blackouts for most of the Kanto area (except central Tokyo) the first week (March 14 – 20) after the earthquake, and for most of the next week. However, the immediate, deep voluntary electricity conservations and efforts by railroads, companies, buildings, and other public areas and households, was impressively large, and made TEPCO's blackout schedule even more difficult for everyone.

It quickly became clear that rolling blackouts were an emergency solution only. The steady supply of stable electricity flows with low volatility is essential for all production facilities engaged in continuous operations, and important to services, especially restaurant and entertainment establishments as well as data banks.

The owner of an ice cream plant in Kanto told me that in the first weeks after the earthquake the plant had to halt production and clear production pipes two hours before scheduled electricity supply interruptions, and it took two hours after power was restored to restart production. Break-even was 75% of capacity, but in the first weeks the plant was able to operate at only 40%. By early May it was only back to 70%.

My concerns while I was in Japan about electric power shortages in Tokyo and beyond were reinforced when I met in Korea with Korean economists and businessmen, who were concerned this would be a huge problem for Tokyo in summer 2011, and indeed perhaps summer 2012 as well. Japanese voluntary conservation efforts would strengthen further, and companies and households would adjust somehow, it was assumed, but would not be sufficient.

It was not until late April, back at Columbia, that I learned that TEPCO owns shut-down thermal (oil) electric power generating facilities in Kawasaki (next to Tokyo) and elsewhere that it will quickly re-open. On March 25, TEPCO estimated its peak generating capacity would be about 46.5 million kilowatts in summer 2011, much less than estimated peak demand of 55 million kw. However on April 17, TEPCO revised its peak generating capacity by summer to 52.0 million kw. The gap is now much narrower, but much depends on how cool (or hot) the summer is, and the degree to which households, as well as businesses, conserve electricity by using less air conditioning.

Government policy thus far has been based on direct guidance (controls) rather than market-oriented price mechanisms to constrain demand and increase supply. Large firms in Kanto were initially asked to cut electricity consumption by 25% by the summer; this was then reduced to 15%. Executives I spoke with said they would make their best efforts, as they did not want to suffer reputation loss. METI officials have suggested increasing the household price of electricity in excess above normal monthly patterns, but that has yet to be accepted by the government.

Independent producers of electricity, typically for their own uses but with excess capacity, can sell to the grid. My understanding, without much information, is that while their costs are about 14 yen per kilowatt hour, above the now-controlled prices, so independent producers have little incentive to generate and sell electricity beyond their own needs. I gather the government has not allowed the price to rise. In any case, the amount of such excess capacity is small relative to anticipated supply shortages.

Electricity is essential for a modern, advanced, industrial, urban economy. Energy policy, and particularly nuclear energy policy, has become one of the most important issues in Japan following the earthquake. It will be debated in the coming months, and the answers are far from clear. It is directly related to the future role of nuclear generation of electricity. In some way this is symbolized by Fukushima Dai-ichi: how to contain the reactors and achieve cold shutdown, what to do over the longer run to keep the reactors cool, and what to do about the radioactively contaminated areas. On April 17 TEPCO announced it would take six to nine months to achieve cold short of its three Fukushima Dai-ichi reactors. Until then, some limited leakage of radioactive materials will persist, as I understand it, and it will not be safe to move back into the 30 kilometer radius or other nearby areas where the winds blow.

The 10 nuclear reactors in the afflicted Tohoku area that were safely shut down have not been re-opened and are not likely to be in the near future. Local resident opposition makes that impossible. In 2007 TEPCO's Kashiwazaki-Kariwa nuclear power plant in Niigata prefectures was damaged by an earthquake and has now been repaired, and four of the seven reactors have been put back into operation. However the Niigata governor has said he would not allow the remaining three to re-open until they are assured to be safe.

In early May Prime Minister Naoto Kan made two key nuclear energy decisions.

One was a strong request (essentially a demand) that Chubu Electric Power Company close its Hamaoka nuclear facility in Omaezaki city, Shizuoka prefecture. The plant has long been considered by far Japan's most dangerous nuclear facility, particularly to tsunami damage. It is 120 miles southwest of Tokyo and sits on a major fault line. A government study forecasts an 87% chance that a magnitude 8.0 or higher quake will hit the area in the next 30 years. Nearly

80,000 people live within a six-mile radius. Chubu agreed to a temporary shut-down of the two active reactors at the site, and will not restart a third that was down for routine maintenance. The plant provides about 10% of Chubu's power supply. Company officials estimate it will take two to three years to build a 12-meter-high tsunami wall stretching nearly a mile along the coast.

Second is a decision to halt construction of the planned 14 nuclear facilities. Importantly, this is not an abandonment of nuclear energy; Kan stated that their opening would be delayed until safety could be reassessed and assured in light of the Fukushima Dai-ichi experience.

There are immediate, as well as longer-run issues. Will shut-down nuclear reactors be re-started? If so, when, and under what circumstances? The governor of Fukui prefecture (on the Japan Sea side on Honshu), site of 13 of the nation's existing 54 nuclear energy reactors, has stated he will not allow them to be opened after routine maintenance until he is assured they are really safe.

The worst-case scenario is that it will be politically impossible in the coming months to restart on schedule, if at all, any of the 33 reactors now shut down - 11 in the Tohoku epicenter area and 22 for routine maintenance. They will have to meet higher and as yet undefined safety standards. In such a case, all of Japan, not just Tokyo and eastern Japan, will have significant electricity shortages this coming summer and beyond. How the trade-offs between perceived safety difficulties and electricity shortages will be dealt with is likely to be a major political and administrative problem in the immediate future as well as the longer run.

However, both the central and local governments have provided significant subsidies and benefits to the local small coastal communities where nuclear reactor plans have been sited. The electric power companies pay large property taxes, and typically have become the largest employer. As a consequence, these sited communities flourished. Not re-opening reactors after routine maintenance will mean loss of jobs and other local benefits on which many of these communities have become dependent. How this plays out will be an important factor in Japan's future nuclear policy.

2 Supply Chain Interruptions

In the first week following the earthquake, the media reported potential supply chain interruptions because factories in Tohoku producing very specific components had been damaged and production halted. The affected factories often were the dominant or even sole suppliers of essential specific items and components. Even when production resumed, aftershocks required ongoing recalibration of precision machines.

Frequently the problems have been at the lower levels of production, involving parts that individually are relatively inexpensive, but are often made by smaller, highly specialized sole-source producers. A large assembly company typically has several major (Tier 1) suppliers of large parts and components. Those companies each have several suppliers (Tier 2) of more specific subcomponents. However, at the next one or two levels down in the specificity of the production process (Tiers 3 or 4), there may be only one company producing a small item for all the suppliers at the next tier up.

A wide range of industries have been affected.

For example, the automobile and electronics industries, not only in Japan but abroad, were dependent on microprocessors produced by the damaged Renesas Electronics Corporation plant in Ibaraki Prefecture, which has a 30 percent global market share. The microprocessors are custom-designed for a specific car model for each of the major automobile assemblers in Japan and abroad, so it was not possible to substitute microprocessors from other plants or other suppliers. And, I was told of a 1500 yen (\$19) component used in many Toyotas that is produced by only one damaged factory in Tohoku.

b: I was told that inventories of a particular engine brush necessary as a replacement part for Shinkansen and other train engines were produced in one damaged plant in Hitachi, so if production is not resumed, train schedules would have to be reduced from late May or so.

A Tokyo consultant to Japan's food processing industry told me that a particular sealant for packaging food was produced in only one damaged factory. Two weeks later, just before leaving Japan, I read a newspaper article about a shortage of natto (fermented soybeans, a food staple) due to disruption of production in Tohoku. The second paragraph of the article said that natto production had resumed in just two days. The third paragraph said the problem was the lack of the sealant to package natto.

It was difficult while I was in Japan to assess the broader industry or macroeconomic impacts of these supply chain interruptions, and it is still premature to make a good assessment.

As subsequent reports came in throughout April, the responsiveness both of the afflicted producer companies in Tokyo and of the companies purchasing their products has been impressive. Toyota and other large companies sent some 2000 engineers and other technicians to restore production at their suppliers, and sub-suppliers. The production interruptions due to supply chain difficulties have been significant, but basically only short-run, at most probably only six months, and most within three months of initial damage.

These costs indicate that supply chain management based on economies of scale in production and just-in-time assembly with low inventories will have to be rethought. In particular the reliance on one geographic location for the production of any component for which close substitutes are not readily available may well end. Additional factories will open elsewhere, even at the loss of economies of scale. The key question for Japanese manufacturers is where they will locate these new factories – elsewhere in Japan or abroad.

3 Declining Sectors

Most of the Japanese directly hit by the tsunami lived in low-lying coastal villages and towns with local ports in the Sanriku area. They were mainly farmers, fishermen, and those who provided local services in their communities. And many were not young. As elsewhere in Japan, young adults had gone to larger cities, not only in their prefecture but farther away. This is not surprising; farming and fishing in Japan have not been internationally competitive for decades. Their participants have been able not only to survive but to have good incomes and live well due to Japan's highly protective system of production. Producers are subsidized both directly by the government and indirectly by import restrictions, with the costs falling on taxpayers and consumers. The farming and fishing industries have been declining gradually by generational change; young new entrants continue to be far fewer than those retiring or dying. The average age of farmers is 65.

Driving from Himeji, west of Kobe, through the mountains and villages and on to small port towns on the Japan Sea coast, reinforced my concerns about these adjustment issues. I thought as we drove: these little villages nestled in valleys, and these little fishing village ports, have no future. Unless they happen to have hot springs (onsen) with good tourist facilities, as a few do, they cannot compete in a globalized world. They are tenacious and politically powerful, but unless taxpayers are prepared to subsidize them forever, and the government is willing to continue its protectionist policies in a liberalized global economy, they will eventually disappear. The economy's future, as it has been for more than four decades, lies in sophisticated, specialized, high value-added manufacturing and especially services, essentially in urban settings.

IV Conclusion

The responses in Japan to these triple disasters are an ongoing, rapidly changing process. This report is basically impressionistic; my thoughts have evolved over time starting from my first week in Tokyo following the earthquake. Given what I know as of early June 2011, here are some of my conclusions.

Two of my biggest concerns are the control, cooling, and containment of the Fukushima Dai-ichi nuclear reactors, and the specter of electricity shortages throughout Japan.

Parts of Tohoku have been damaged, but not Japan as a whole. The earthquake did localized damage in Tohoku, but it was not so severe. The greatest damage was inflicted on the Sanriku coastal areas hit by the tsunami – small villages and their ports, not the central business areas of any major cities. The clean-up process of debris will take time. Decisions on what and where to rebuild have yet to be made, and longer-run living solutions for many evacuees are still far from clear.

The biggest direct damage was the flooding of the Fukushima Dai-ichi facility's four nuclear reactors. The contaminated land and the evacuation of residents in nearby areas (up to 30-40 kilometers away) is a major problem. Fukushima Dai-ichi is qualitatively different from the earthquake and tsunami disasters, and probably much worse. Its long-term effects are impossible to evaluate well. Low but sustained doses of radiation may affect children even more than adults in the areas near the reactors, but it appears there is essentially no danger elsewhere.

Certainly within Japan (and elsewhere) energy policy will be rethought. The most fundamental energy-related issue will be what to do about nuclear power plants, both in the nearer term and in the long-run. One of my concerns is that it will be politically difficult to re-open reactors currently shut-down for routine maintenance in plants that had been presumed to be safe, and hence that there will be a national electricity shortage.

Japan's wariness of nuclear power will probably be long-lasting; new nuclear power plants may well not be built in the foreseeable future, and even best-case (from a power-supply standpoint) the re-opening of plants down for routine maintenance are likely to be delayed. Coal and oil give off emissions, including CO₂, pollute the air, cause deaths, and are a factor in global warming. Probably Japanese electricity plants will increasingly rely on LNG. Alternative energy sources are very expensive.

Thus, electricity shortages will be an ongoing problem at least for Tokyo, Kansai, and much of Tohoku since TEPCO produces about one-third of Japan's electric power. TEPCO will increase electricity supplies somewhat in the near future by re-opening shut thermal plants. A key problem is how to supply electricity in periods of peak demand – notably early afternoon hours on hot summer weekdays this summer and next. In the longer run electric power companies will invest in building natural gas-fueled power stations, to meet demand and to replace existing facilities.

The other direct macroeconomic effects on Japan are clear and more manageable. Growth has been interrupted, perhaps for six months or so, but the economy will grow more rapidly in 2012

and 2013 than earlier projected because of reconstruction expenditures in the affected Tohoku areas.

The supply chain interruptions are essentially short-run, and are being overcome more rapidly than expected. In the longer run, both producers and assemblers may hold larger inventories. And, producers will probably give up some economies of scale by having smaller, more geographically dispersed factories, Will the dispersion be within Japan, or will companies build in foreign countries? The answers are not obvious: they probably depend on the importance of potential technological leakages to competitors.

It had been hoped that a crisis would force politicians and bureaucrats - perhaps at the insistence of the public and the media - to cooperatively address the substantive, fundamental structural issues underlying Japan's two decades of miasma. But seven weeks after the March 11 earthquake, that does not seem to be happening. Petty politics, with very few constructive policy proposals, seem to continue to prevail. Political leaders, bureaucrats, the public - none see the earthquake and tsunami as the crisis that should shake things up and sweep in needed changes. But that yet may happen.