How Global Catastrophe Risks Affect the Supply Chain

Institute for Catastrophic
Loss Reduction
Friday Forum
May 24th 2013

Agenda

I. Supply Chain – A brief history

II. Past Catastrophes – How have they affected supply?

III. What and Where - Exposures to Supply

IV. Other Considerations

V. Questions

Agenda

I. Supply Chain – A brief history

Supply Chain – a brief history

Up to around 20 years ago

Supply chain was generally based on:

- Several hands being involved in the production and supply
- Manufacturers including substantial stock holdings
- Multi-sourced 3rd party suppliers playing a essential role of mass stockpiling/storage
- Broad choice of competing producers and suppliers of goods and products

Supply Chain – a brief history

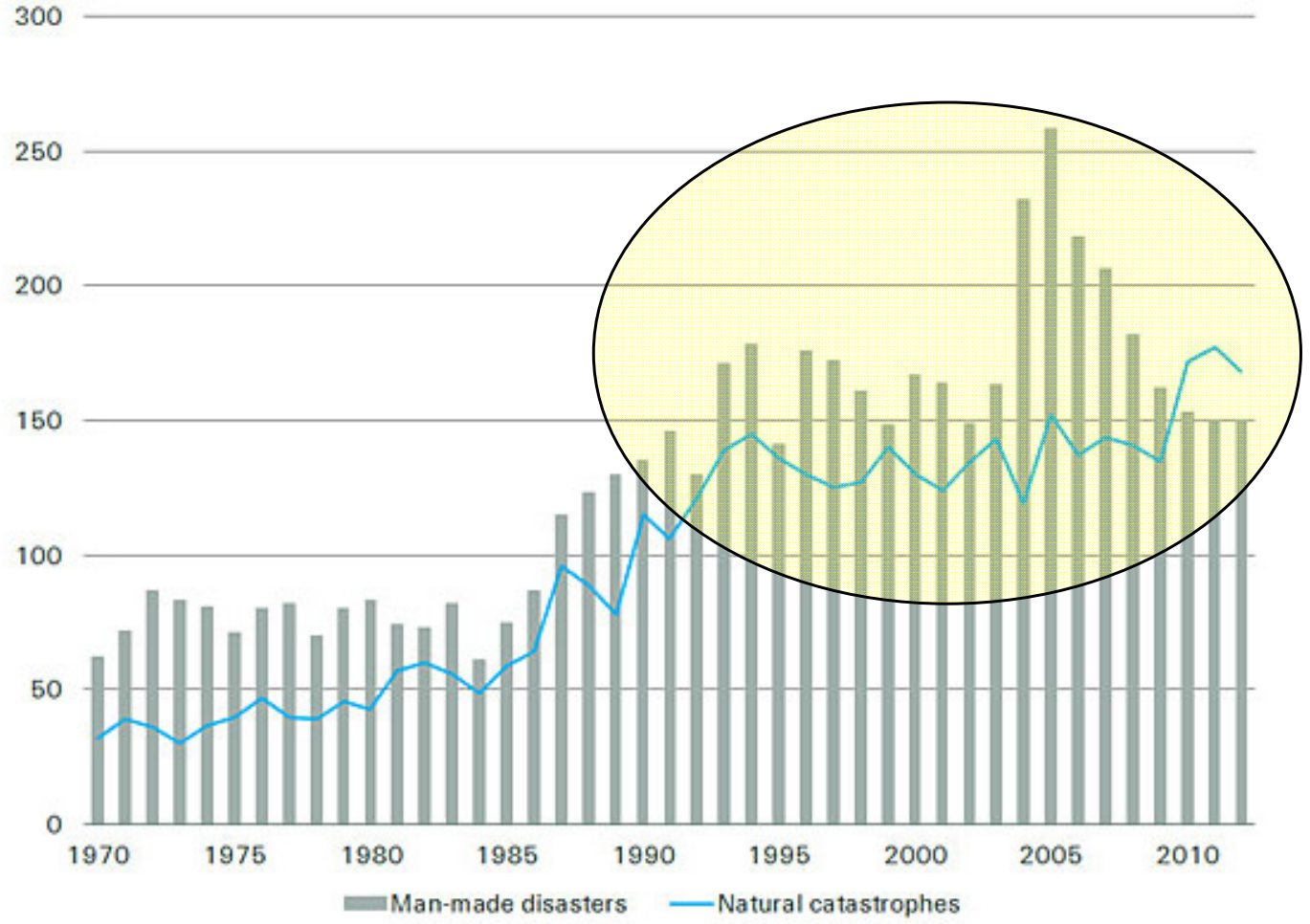
Last 20 years

Global competition has necessitated much greater cost efficiencies including:

- Less competing producers removing many alternative sources
- Adoption of “just-in-time” manufacturing and supply standards
- Direct and single sourcing replacing use of 3rd party suppliers
- Outsourcing of (key) components offshore
- Minimized stock holdings throughout entire supply chain
- Customer mindset of expected shorter lead times

Supply Chain – a brief history

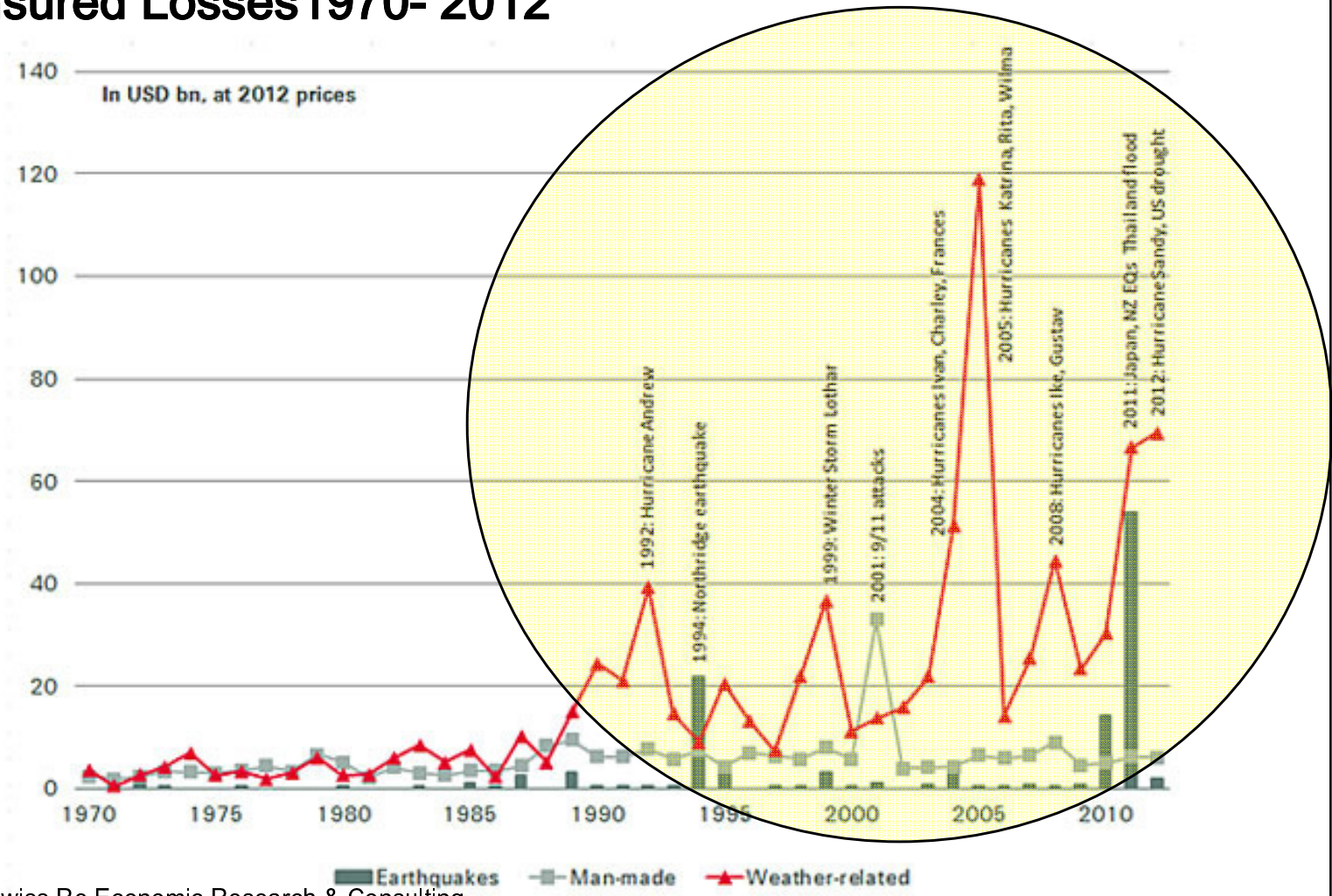
Number of Catastrophes 1970- 2012



Swiss Re Economic Research & Consulting

Supply Chain – a brief history

Insured Losses1970- 2012



Swiss Re Economic Research & Consulting

Agenda

I. Supply Chain – A brief history

II. Past Catastrophes – How have they affected supply?

III. What and Where - Exposures to Supply

IV. Other Considerations

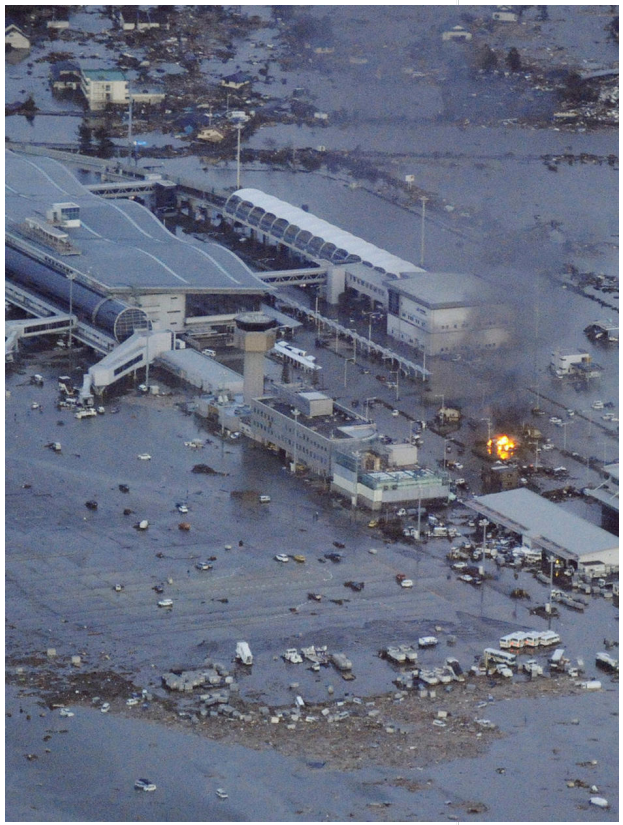
V. Questions

Agenda

II. Past Catastrophes – How have they affected supply?

Past Catastrophes – How have they affected supply?

Tohoku Earthquake (03/2011)



Facts

- Magnitude 9.0
- Most powerful to hit Japan region
- World's 4th largest since 1900;
- Tsunami waves along coast - some travelling 10 km inland;
- 15,790 deaths, 5,933 injured and 4,056 people missing;
- Core meltdowns at three reactors of Fukushima Nuclear Plant
- Total economic loss of USD210 billion
- Total insured loss estimate of over USD40 billion
- Initial report of estimated USD5B – USD15B CBI losses most likely at lower end of range

Past Catastrophes – How have they affected supply?

Japan earthquake: company loss estimates

Name of Organisation	Location	Loss estimate ($mn)	Loss Type
3M Company	US	250	Total losses
Apple Inc	US	500	Total losses
East Japan Railway Co	Japan	1,900	Total losses
General Motors Co	US	1,000	Contingent BI
Mazda Motor Corp	Japan	64	Contingent BI
Mitsubishi Paper Mills	Japan	200	Total losses
Nippon Telegraph & Telephone Corp	Japan	1,340	Total losses
Nissan Motor Co	Japan	49	Contingent BI
Oriental Land Co	Japan	120	Total losses
Sony Corporation	Japan	2,230	Total losses
Sumitomo Metal Industries	Japan	750	Total losses
Texas Instruments	US	30	Total losses
Tohoku Electric Power Co	Japan	1,500	Total losses
Tokyo Electric Power Co	Japan	15,000	Total losses
Toyota Motor Corp	Japan	1,240	Total losses
	Total	**$26,173**	

Past Catastrophes – How have they affected supply?

Japan earthquake: company loss estimates

Name of Organisation	Location	Loss estimate ($mn)	Loss Type
3M Company	US	250	Total losses
Apple Inc	US	500	Total losses
East Japan Railway Co	Japan	1,900	Total losses
General Motors Co	US	1,000	Contingent BI
Mazda Motor Corp	Japan	64	Contingent BI
Mitsubishi Paper Mills	Japan	200	Total losses
Nippon Telegraph & Telephone Corp	Japan	1,340	Total losses
Nissan Motor Co	Japan	49	Contingent BI
Oriental Land Co	Japan	120	Total losses
Sony Corporation	Japan	2,230	Total losses
Sumitomo Metal Industries	Japan	750	Total losses
Texas Instruments	US	30	Total losses
Tohoku Electric Power Co	Japan	1,500	Total losses
Tokyo Electric Power Co	Japan	15,000	Total losses
Toyota Motor Corp	Japan	1,240	Total losses
	Total	**$26,173**	

Past Catastrophes – How have they affected supply?

Tohoku EQ Loss scenario 1: Apple

Japan - An Electronics Supplier

Major supply impact due to:

- 20% of semiconductors
- 60% of silicon wafers;
- 90% of BT resin

Potential Claim?

- Initial $500M claim with no breakdown re PD, BI and CBI
- Little manufacturing done in Japan
- iPad 2
  - Launched three weeks after EQ
  - Contains at least five components from Japan including:
    1. Flash memory from Toshiba – alternatively sourced from Samsung;
    2. DRAM from Elpida Memory – alternatively sourced from Micron Technology in US;
    3. Compass from **AKM Semiconductor** – hardest to re-source

Past Catastrophes – How have they affected supply?

Apple – Is there coverage?

BI & CBI Basics:

- BI covers loss of income caused by direct damage to the insured's property by insured perils
- CBI covers loss of income caused by direct damage at one of the insured's supplier's/customer's locations by insured's perils

Questions Being Asked About Apple's CBI Extension

- AKM didn't incur direct damage losses
- AKM was unable to the supply compasses due to:
  - massive damage to infrastructure
  - on-going power shortages
  - 20km evacuation zone around Fukushima affecting 7,000 businesses and over 100,000 people
- Basis of Apple's loss was NOT caused by the direct damage to AKM's property
- Basis of supplier's shut down was caused purely by damage/stoppage due to the external factors

Past Catastrophes – How have they affected supply?

Japan earthquake: company loss estimates

Name of Organisation	Location	Loss estimate ($mn)	Loss Type
3M Company	US	250	Total losses
Apple Inc	US	500	Total losses
East Japan Railway Co	Japan	1,900	Total losses
General Motors Co	US	1,000	Contingent BI
Mazda Motor Corp	Japan	64	Contingent BI
Mitsubishi Paper Mills	Japan	200	Total losses
Nippon Telegraph & Telephone Corp	Japan	1,340	Total losses
Nissan Motor Co	Japan	49	Contingent BI
Oriental Land Co	Japan	120	Total losses
Sony Corporation	Japan	2,230	Total losses
Sumitomo Metal Industries	Japan	750	Total losses
Texas Instruments	US	30	Total losses
Tohoku Electric Power Co	Japan	1,500	Total losses
Tokyo Electric Power Co	Japan	15,000	Total losses
Toyota Motor Corp	Japan	1,240	Total losses
	Total	**$26,173**	

Past Catastrophes – How have they affected supply?

Japan earthquake: company loss estimates

Name of Organisation	Location	Loss estimate ($mn)	Loss Type
3M Company	US	250	Total losses
Apple Inc	US	500	Total losses
East Japan Railway Co	Japan	1,900	Total losses
General Motors Co	US	1,000	Contingent BI
Mazda Motor Corp	Japan	64	Contingent BI
Mitsubishi Paper Mills	Japan	200	Total losses
Nippon Telegraph & Telephone Corp	Japan	1,340	Total losses
Nissan Motor Co	Japan	49	Contingent BI
Oriental Land Co	Japan	120	Total losses
Sony Corporation	Japan	2,230	Total losses
Sumitomo Metal Industries	Japan	750	Total losses
Texas Instruments	US	30	Total losses
Tohoku Electric Power Co	Japan	1,500	Total losses
Tokyo Electric Power Co	Japan	15,000	Total losses
Toyota Motor Corp	Japan	1,240	Total losses
	Total	**$26,173**	

Past Catastrophes – How have they affected supply?

Tohoku EQ Loss scenario 2: GM

Automobile (Electronics) Supply Claim?

Following the Japan EQ reports that:

- 230 of 3,000 parts ran short or out of supply
- Auto-plant shutdowns costing $200M per day
- Renesas Electronics
  - 40% WW share of microcontroller market
  - 8 plants in affected area - many shut down for up to 4 months
- Hitachi
  - factory closed that manufactures 60% of global car engine airflow sensors.

GM Loss?

Following the EQ:

- Initially advised insurers of potential $1B CBI claim
- Disruption and shut downs in Louisiana, Texas, Spain and Germany
- 3 months after EQ, GM stated:

  "our Japanese auto part suppliers had fared better than initially expected and that subsequently events in Japan wouldn't have a material impact on our 2011 results"
- casting doubt on the magnitude of the initial estimated loss.

Past Catastrophes – How have they affected supply?

Within Months After Tohoku: Exceptional Rapid Recovery

- Japanese cultural and organizational traits
- 80% of Japanese manufacturers, retailers and service companies to pre-earthquake levels by July 1st
- Leading Japanese shares recovering to pre-earthquake levels by July 15th
- Toyota, Honda and Nissan returned domestic production close to normality by early July
- In spite of a nationally changed power grid work week, i.e. Saturday to Wednesday

Past Catastrophes – How have they affected supply?

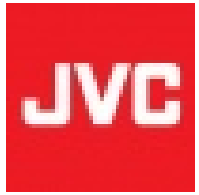
Thailand Floods (10/2011)

Facts

- Largest Thai floods since 1940's
- Result of 40% > monsoon rains, deforestation, lacking catchment areas, high tides and bureaucratic mismanagement
- Over 500 deaths
- More than 4 million homes, businesses and manufacturing facilities damaged or destroyed
- Flooding of 1,000 industrial facilities (representing 430 multinationals) under 2m water for up to 2 months
- Total economic losses of almost $50B - Thailand's costliest
- Total insured losses of over $15B (
- While 85% of insured loss estimated to being business interruption, share of CBI remains unclear

Past Catastrophes – How have they affected supply?

Thailand Floods Supply Chain Fallout



Past Catastrophes – How have they affected supply?

Thailand Floods Supply Chain Fallout

Past Catastrophes – How have they affected supply?

Thailand Floods Loss Example 1: Western Digital

Thailand: The Global Hard Drive Supplier

Major supply impact due to:

- 43% of world's HDDs
- More than 60 manufacturers HDDs and their components
- Single WD facility produced 25% of the global supply of "sliders", an integral part of HDDs

Potential Loss Scenarios?

Customers: Apple, Lenovo, Cisco, Dell, NettApp, TiVo, Super Micro Computer, Hewlett Packard

I've been on the phone with the heads of all four of our disk drive partners and I'm ***not even sure they have a complete picture about when they're going to be back up and running****...this is going to be pretty tough for the industry* M. Whitman, HP CEO - 1month after WD plant flooding

HP ***blames Thailand flooding*** *for more than half of its $2.3B drop in annual revenue* - 4 months after WD plant flooding

Suppliers: Semiconductor makers LSI Corporation, Marvell, Semtech, Sanmina-SCI

Sanmina-SCI Corp says its fiscal first-quarter net income plunged 70 percent - 3 months after WD plant flooding

Marvell Technology lowers fourth-quarter revenue outlook, citing Thailand flooding - 3 months after WD plant flooding

Past Catastrophes – How have they affected supply?

Thailand Floods Loss Example 1: Western Digital

Global HDD Market Rankings

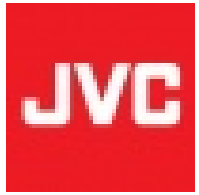
Pre-Flood	Post-Flood
1) Western Digital	1) Seagate
2) Seagate	2) Western Digital
3) Hitachi	3) Toshiba
4) Toshiba	4) Hitachi
5) Samsung	5) Samsung

Increased Consolidation Activity

1) Seagate with Samsung
2) Western with Hitachi (2.5”)
3) Toshiba with Hitachi (3.5”)

Past Catastrophes – How have they affected supply?

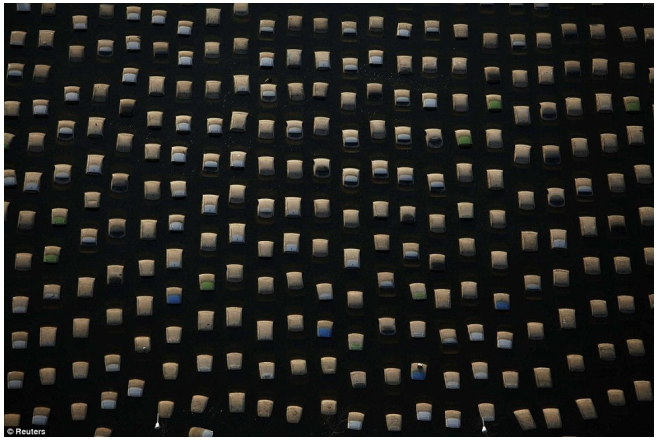
Thailand Floods Supply Chain Fallout



Past Catastrophes – How have they affected supply?

Thailand Floods Supply Chain Fallout

HONDA



Past Catastrophes – How have they affected supply?

Thailand Floods Loss Example 2: Honda

Honda Thailand: Driving Under Water:

- 45 day,10ft flooding/bombardment at Ayutthaya plant
- One tenth (35) tier-one suppliers flooded
- More than 1,000 assembled cars destroyed
- 6,300 Thai-based workers laid up for 5 months versus initial 12-month estimate
- Stoppage of 15,000 or 30% global output of Civic, Jazz, CR-V and City models per month affected

Potential Losses?

- Global production disruptions in 4th quarter in India, Indonesia, Japan, Canada, US & Europe.
- 2011/12 production loss of over 200,000 units globally
- Severe disruption of two important launches:
  - Brio - Honda's first micro car almost immediately after November launch
  - Delay of latest CR-V model pushed into 2012
- 2012 fiscal year – sales down 11%, unit production down 24%, net profit down 60% ($3.2B)

Calculated Risk Return ?

8 large flooding events since 1942 = certainty of predicability

versus

1. Skilled workforce that is still relatively cheap
2. Proximity to Southeast Asian car markets and mfg centres
3. Enlightened regulatory approach
4. Thailand's stable, long success at building infrastructure

Past Catastrophes – How have they affected supply?

Thailand Floods: Outstanding CBI Coverage Issues

- Reinstatement issues
- Global industrial policies based on first-loss limits with multiple locations
- Event limits not normally specified in Thai policies but probable on global contracts
- Dates of damage varies for different industrial estates
- 4-month gradual occurrence equates to sudden and accidental event?
- Are the floods to be classified as multiple events?
- Potential of many "sub-tier" suppliers that are unnamed in CBI and Supply Chain coverages

Past Catastrophes – How have they affected supply?

Superstorm Sandy (10/2012)

Facts

- Largest recorded Atlantic storm - 3,200km diameter affecting 21 states reaching into the Great Lakes
- Extremely rare combination of Cat. 1 hurricane merging with cold front from north and jet stream to the west forcing storm directly towards shore during full moon enhanced gravitational phase
- 285 deaths
- 8.5 million homes and businesses affected by loss of power
- Total economic losses of ~$65B
- 1.38 million claims resulting in over $25B in insured losses
- Considered largest commercial cat loss in US history with supply chain interruptions losses estimated to represent 15%
- Densely populated, non-manufacturing/outsourcing area's supply networks mainly affected by energy, port/road and communication failures and closures

Past Catastrophes – How have they affected supply?

Superstorm Sandy – Substantial Supply Chain Losses?

US P & C Insurers

- 2012 underwriting results better than 2011
- Combined ratio of ~107% including roughly 3.5% for Sandy

Verizon

- 4Q 2012 consolidated earnings - 16% reduction in adjusted EPS due to Sandy

Staples

- 4Q 2012 sales declined 5% directly attributed to two aspects of Sandy:
  1. Lower customer traffic
  2. More competitive Black Friday due to enhanced online "market disarray"

UPS

- 2012 operating profit negatively impacted by ~$75 million (5.6%) due to Sandy

Delta Airlines

- $122 million impact from Sandy:

1. Cancellation of more than 20,000 flights
2. Petroleum refinery purchased in early 2012 to offset the supply risk of higher jet fuel prices sustained $85 million PD/BI loss

Past Catastrophes – How have they affected supply?

Superstorm Sandy: Outstanding CBI Coverage Issues

- Which peril(s) actually caused the damage? Wind, rain, storm surge, flood, off-premises power, civil authority, looting, vandalism
- Which deductibles/waiting periods to apply? Wind, rain, storm surge, flood, off-premises power, civil authority, looting, vandalism
- Which limits/sublimits/exclusions to apply? Wind, rain, storm surge, flood, off-premises power, civil authority, looting, vandalism
- Do affected customers/suppliers (1st tier / 2nd tier) need to be specifically listed in CBI policies?
- Did insured physical damage take place at customers/ suppliers (1st tier / 2nd tier) premises?

Past Catastrophes – How have they affected supply?

Other Recent Catastrophes – Any Supply Chain Losses?

Australia Floods

- Strictly BI claims
- Many of suppliers of raw materials were quickly re-sourced

New Zealand Earthquakes

- Very few claims
- Still outstanding issues due to imposition of CBD and four zones around Christchurch for extended period

Chile Earthquake

- Less sophisticated industries (e.g. pulp and paper, fish farms) affected
- Regional shortages - all have been re-sourced
- 36% of pre-2010 stored wine destroyed with 2010 harvest being hard hit

Agenda

I. Supply Chain – A brief history

II. Past Catastrophes – How have they affected supply?

III. What and Where - Exposures to Supply

IV. Other Considerations

V. Questions

Agenda

III. What and Where - Exposures to Supply

What and Where - Exposures to Supply

Past Catastrophic Disruptions of Supply - Lesson's Learned

What

1. The more sophisticated the materials/parts/products being supplied

   and

2. the exclusivity of the material's/part's/product's market

the more difficult the replacement of supply

Where

Developing Economies

- suppliers of low-cost, mass-produced components (e.g. China)
- suppliers of raw materials (e.g. Africa)

Developed Economies

- suppliers of high-end, low-volume components (e.g. Germany)
- suppliers of raw materials (e.g. Canada)

What and Where - Exposures to Supply

Where to Expect Catastrophic Disruptions of Supply?

1) Underwriting Supply Chain and Global Nat Cat Exposures

- Swiss Re's example which includes a dedicated team of geoscientists constantly tracking/analyzing 119 country/region specific scenarios:

Australasia

- Australia
  - 5 earthquake
  - 4 tropical cyclone
  - 1 flood
- China
  - 2 earthquake
  - 1 tropical cyclone
  - 1 flood
- New Zealand
  - 3 earthquake

North America and Caribbean

- USA
  - 4 earthquake
  - 4 flood
  - 2 tropical cyclone
  - 1 tornado
  - 1 convective storm
- Canada
  - 3 earthquake
  - 1 convective storm
- Mexico
  - 1 earthquake
  - 1 flood
  - 2 tropical cyclone

Rest of World

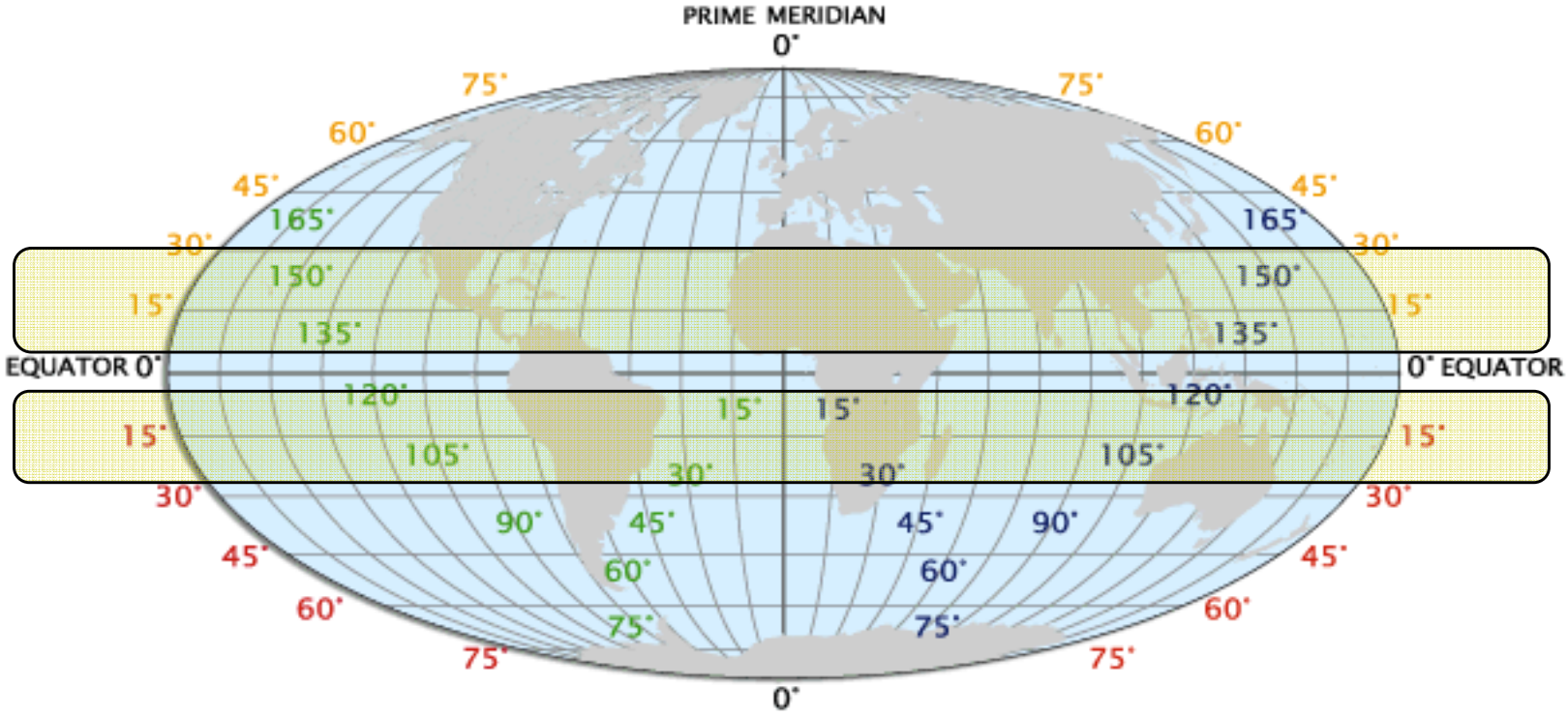
- Europe
  - 19 earthquake
  - 8 flood
  - 5 wind storm
- Africa
  - 5 earthquake
- Middle East
  - 3 earthquake

What and Where - Exposures to Supply

Where to Expect Catastrophic Disruptions of Supply?

2) Climatic Predisposition

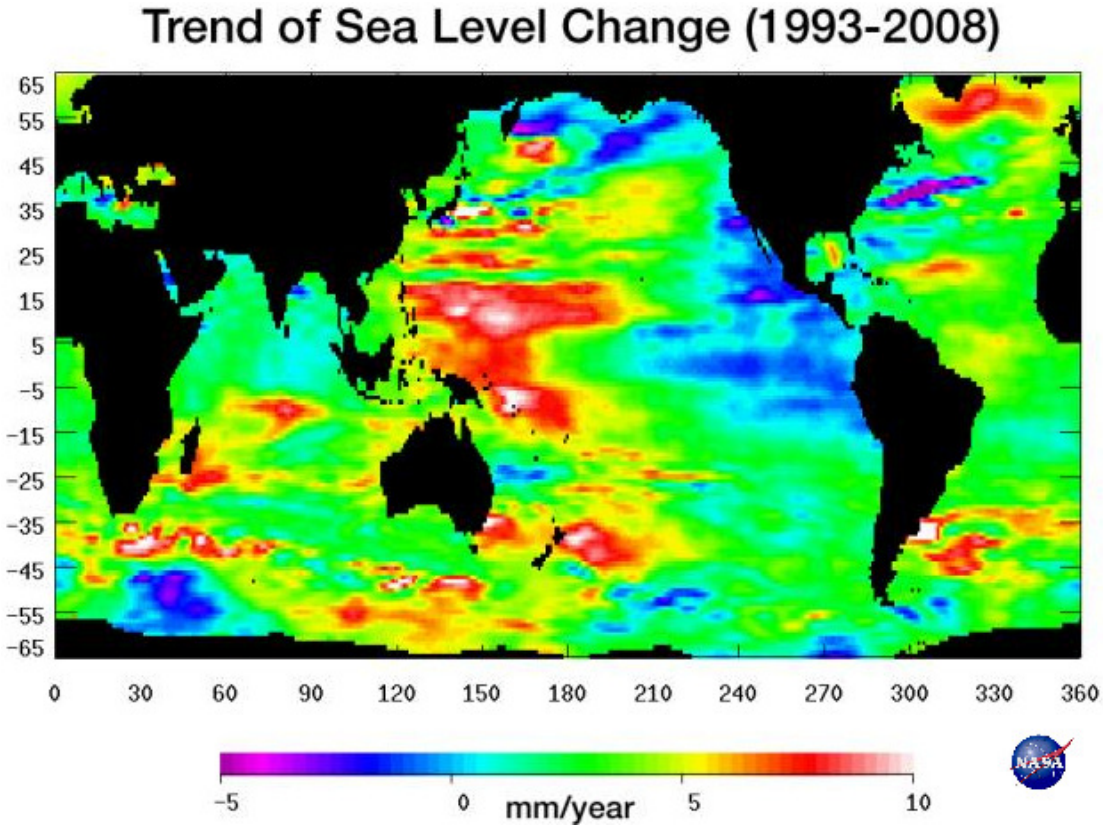
- Most tropical cyclones occur between the latitudes of 30 degrees north and south, but not within ±5 degrees of the equator



What and Where - Exposures to Supply

Where to Expect Catastrophic Disruptions of Supply?

3) Climatic Change



- Sea levels rising disproportionately in Australasia

What and Where - Exposures to Supply

Where to Expect Catastrophic Disruptions of Supply?

4) Socioeconomic Issues

- Countries with rapidly growing populations
- Infrastructures already overburdened at the best of times

"A wide variation in the number and intensity of natural hazards is normal and to be expected. What we have witnessed over the past decades, however, is ***not nature's variation but a clear upward trend caused by human activities****. There were* ***three times as many great natural disasters in the 1990s as in the 1960s, while disaster costs increased more than nine-fold in the same period****."*

Former UN Secretary-General Kofi Annan

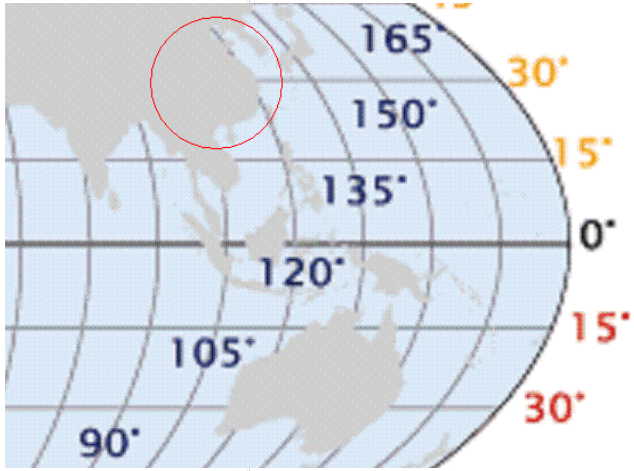
What and Where - Exposures to Supply

Where to Expect Catastrophic Disruptions of Supply? How About China?

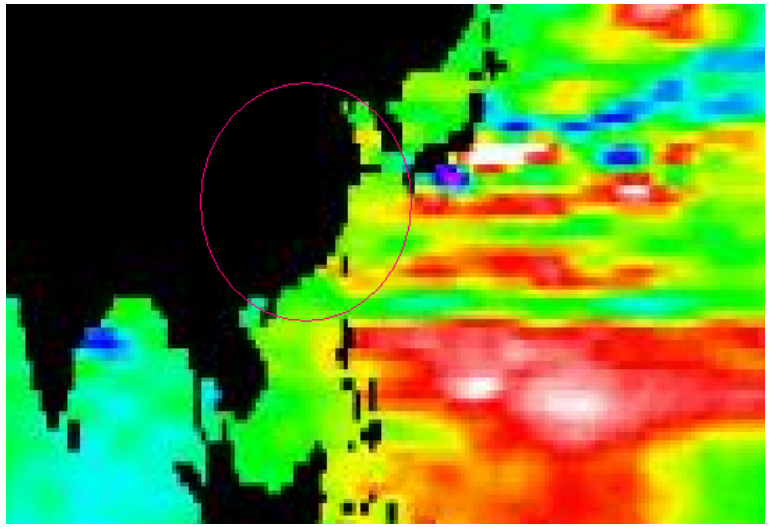
1) Geographic specific scenarios?

- 2 earthquake
- 1 tropical cyclone
- 1 flood

2) Between latitudes of 30° north and south?



3) Rising sea levels?

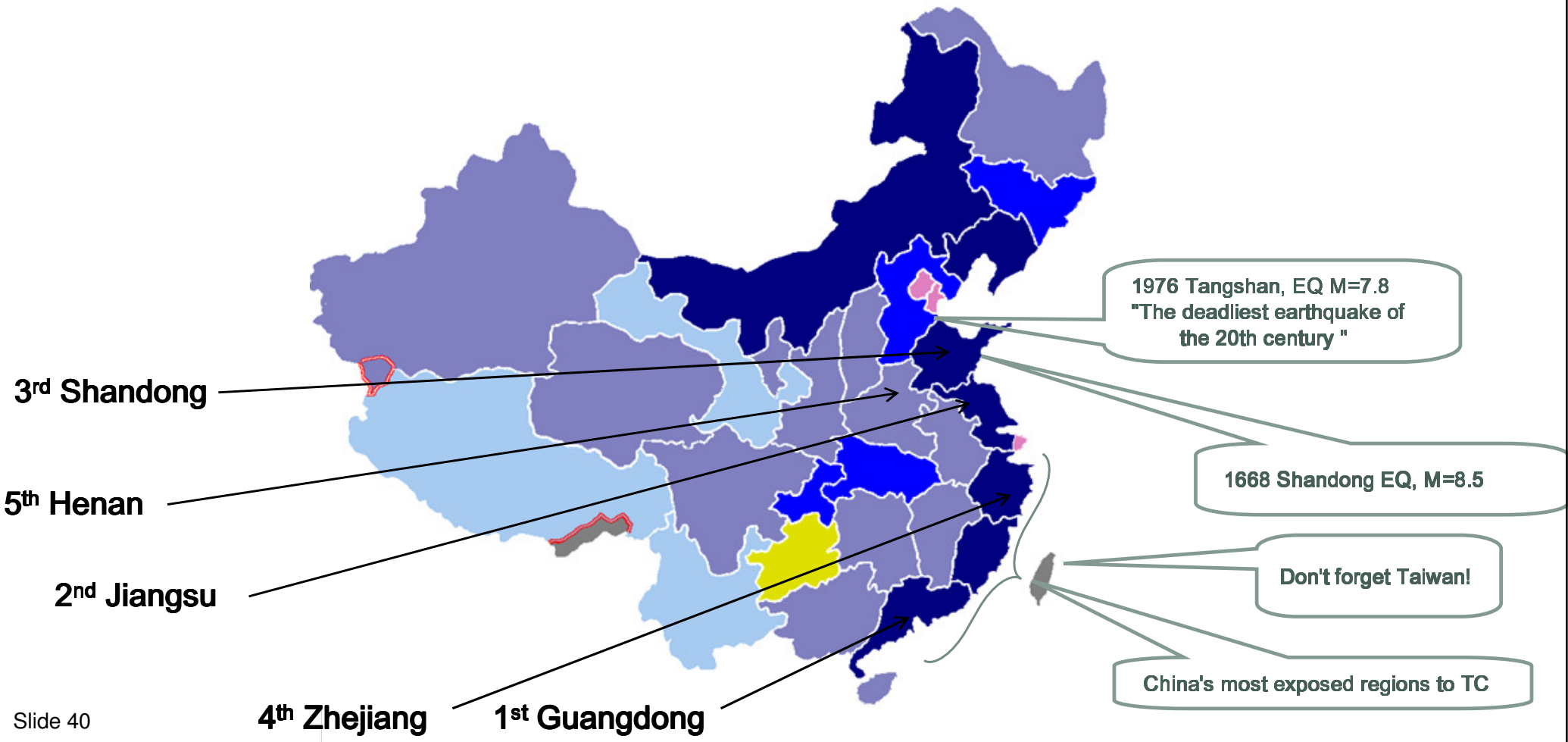


4) Socioeconomic changes?

- Rapidly growing population
- Infrastructure not keeping up

What and Where - Exposures to Supply

Where to Expect Catastrophic Disruptions of Supply? How About China?



Agenda

I. Supply Chain – A brief history

II. Past Catastrophes – How have they affected supply?

III. What and Where - Exposures to Supply

IV. Other Considerations

V. Questions

Agenda

IV. Other Considerations

Other Considerations

1) Evolution of CBI Coverage

Previously:

- Not very thought out or focused underwriting process
- Competitive evolution turning CBI as an extension to traditional property (BI) policies
- Increase in coverage quantum through “limit creep” over the years
- Vague CBI endorsements sometimes covering “any supplier of goods or services"
- Coverage of 2nd tier suppliers in addition to 1st tier with/without direct damage

Other Considerations

1) Evolution of CBI Coverage

More Recently:

- Underwriters more conscious of exposures, accumulations and global supply chain, e.g. CBI questionnaires, applications revamped by most global insurers
- Coverage/limits becoming more definitive and under greater scrutiny
- Greater onus on insureds to identify their suppliers/customers in their business-continuity plans
- Coverage more often limited to the 1st tier suppliers/customers or limited perils (non-EQ, non-FL) for 2nd tiers
- Coverages for civil authority, ingress/egress, service interruption, power interruption, extended period of liability being more carefully underwritten

"Cat-exposed CBI policies need to be overhauled" Munich RE

Other Considerations

2) Modeling of Supply Chain Exposures

- CBI is not modeled in any of the 3rd party (e.g. RMS, AIR, EQE) or proprietary (e.g. Munich Re , Swiss Re) catastrophe models
- Time element losses are connected to physical damage to building/contents at the specific geocoded location
- Multi-tier supply chain loss cost pricing is now clearly on radar screen, e.g. global project recently started by PwC

"Our CBI pricing model is in the beginning stages. We liken it to the state of nat-cat modeling following Hurricane Andrew" pwc

Other Considerations

3) Governmental & Regulatory Involvement in Supply Chain

2012 National Strategy for Global Supply Chain Security

1. Promote the efficient and secure movement of goods
2. Foster a resilient supply chain

   Enhance security of infrastructure, maximize the flow of legitimate trade, mitigate systemic vulnerability, think globally, understand and address vulnerabilities

2013 B-9 Earthquake Exposure Sound Practice Guideline

Office of the Superintendent of Financial Institutions Canada

Provision 4. PML Estimates

- PML estimates should properly reflect non-modelled exposures
- These non-modeled exposures may include contingent business interruption
- Their accumulation may be significant and need to be considered as part of an insurer's earthquake PML

Questions?

Paul Cutbush | Aon Benfield Canada ULC
Senior Vice President Catastrophe Management | Aon Benfield Analytics
150 King Street West, Suite 1900 | Toronto, Ontario M5H 1J9
t: +1.416.598.7364 | f: +1.416.979.7724
paul.cutbush@aonbenfield.com | aonbenfield.com