A Central Question Following the 9/11 Attack

- What is the impact of catastrophic events on cities?
  - Will New York recover?
    - Will it shrink?
    - Will it stay the same size but not rebuild?
    - Will it get larger?
  - What role should government policy play?

Why is Japan relevant?

- Japanese cities have suffered a large number of catastrophic events
  - 1923 Great Kanto Earthquake (120,000 dead in Tokyo)
  - 1945 Allied Bombing of Japan (300,000 dead in 66 cities)
  - 1995 Kobe Earthquake (5,000 dead)
  - *Understanding what happened following catastrophes in Japanese cities may tell us about what is likely to happen to New York*
- Japan also collects large amounts regional historical data
  - *We can examine whether cities are fragile*

Remembering Our Theories

- When catastrophes strike cities
  - Random Growth theories tell us there will be no recovery
  - Locational Fundamentals (and IRS with small shocks) tell us things will return to normal
  - Increasing Returns to Scale theories tell us things might get even worse after the shock

Which of these theories is right?

How Does One Approach This Question?

- If economics were a laboratory science, you would want to conduct experiments by observing shocks to city sizes
- Natural experiment does same thing:
  - Allied bombing of Japan during WWII
  - Earthquakes
- Essential question
  - If you kill up to 21 percent of a city's people . . .
  - If you destroy up to 99.5 percent of a city's buildings . . .
  - ***Does the city return to its former size?***

Why Is This a Good Natural Experiment for Understanding Shocks to Cities?

- Big Shocks
  - 303 Cities total; 66 Cities Targeted; 140 Cities Damaged
  - Median City Hit With 17 Pounds of Napalm Per Person
  - Firebombing Extremely Effective in Japan
    - Japanese Houses Were Made From Wood, Straw, and Paper
    - Japanese Roofs Easier to Pierce by Bombs Than German Roofs
    - Firefighting Equipment Was Outdated
  - In Targeted Cities Half of All Structures (2.2 Million Buldings) Were Destroyed
  - 300,000 People Were Killed
  - 40% of Urban Population Was Rendered Homeless
  - Some Cities Lost Half of Their Population

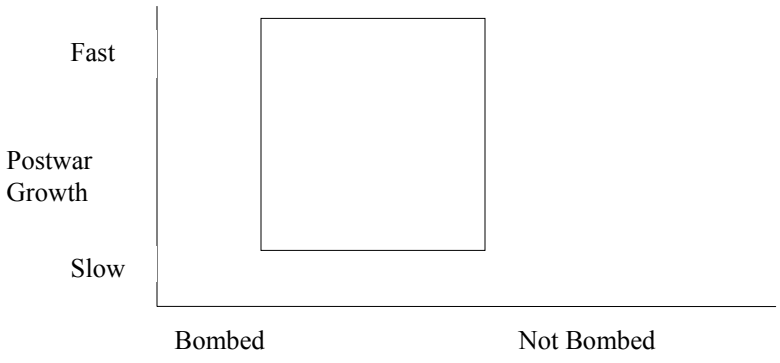
Examples of Destruction

- March 9, 1945: Tokyo
  - 1.7 Kilotons Dropped From 300 B-29's
  - Asphalt Streets Burn, Rivers Boil
  - 80,000 Killed That Day; 16 Square Miles Destroyed
    - More Civilian Casualties That Day Than Britain Suffered in All of WWII
  - Total Destruction in Tokyo by End of War Equals 56 Square Miles
    - More Area Destroyed Than in the 15 Most Damaged German Cities Combined
    - Median Targeted City Had a Higher Share of Structures Destroyed
- Hiroshima August 6, 1945
  - 21% of Population Killed
  - Two-thirds of All Buildings Destroyed

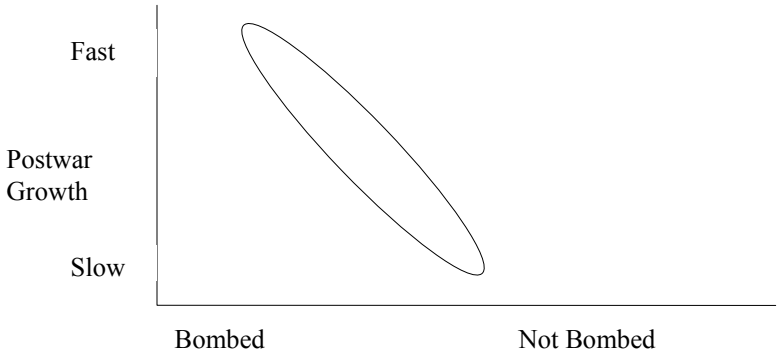
Characteristics of Shocks

- Large variance in shocks
  - 80% of cities in our sample, representing 37% of urban population went basically untouched. For example,
    - Sapporo (pop. 282,000) out of range of US bombers
    - Kyoto (1940 pop. 1.1 million) not bombed because cultural value and fear that it would incite Japanese to fight harder
    - Kitakyushu (pop. 820,000) not bombed because cloud cover on august 9, 1945 forced pilot of B-29 to drop atomic bomb on secondary target: Nagasaki (pop. 296,000)
    - Niigata (pop. 219,000) preserved as atomic bomb target
- Shocks were clearly temporary

Predictions of Random Growth

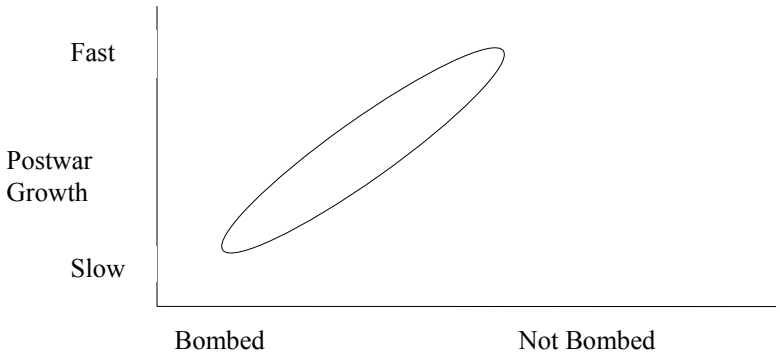


Predictions of Locational Fundamentals



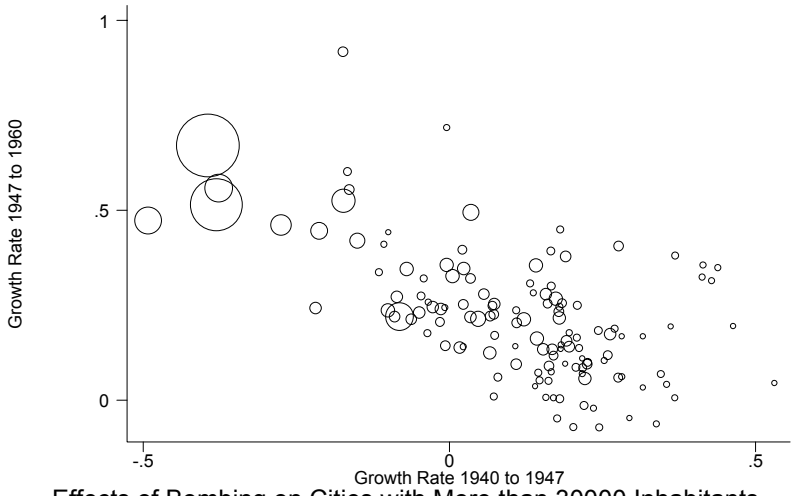
Growth During The War

Predictions of Increasing Returns (and Large Shocks)



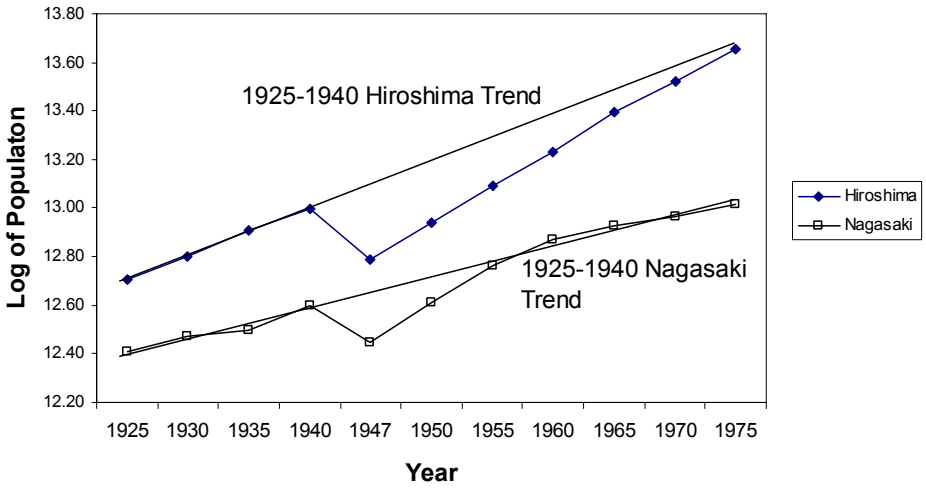
Growth During The War

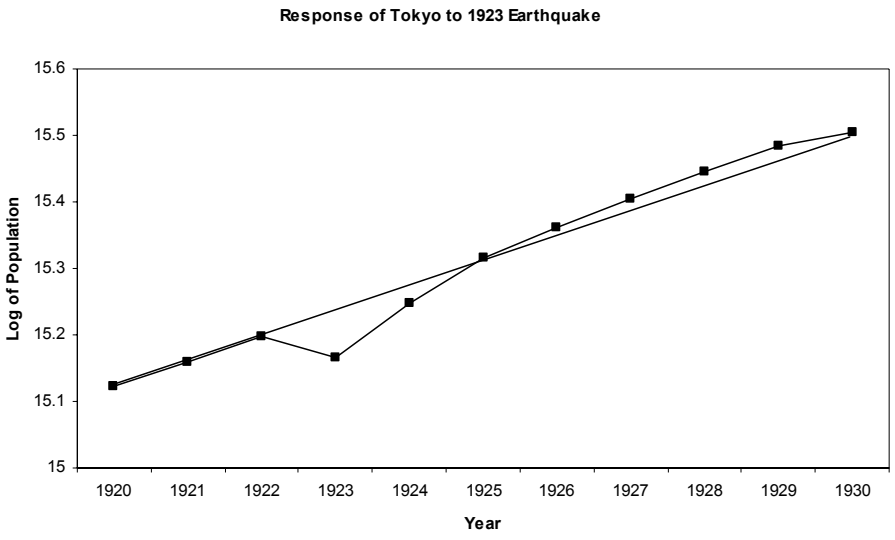
Figure 1



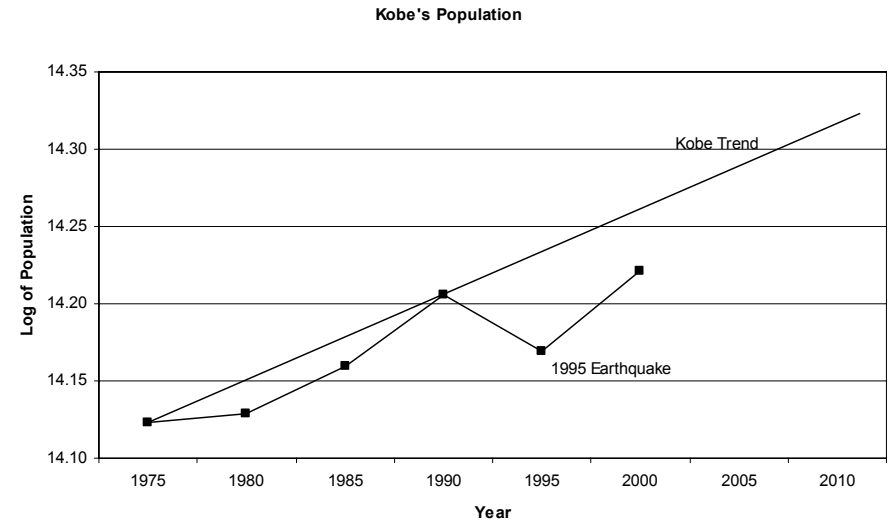
Effects of Bombing on Cities with More than 30000 Inhabitants

Population Growth




Response of Tokyo to 1923 Earthquake
Log of Population
15.6
15.5
15.4
15.3
15.2
15.1
15
1920
1921
1922
1923
1924
1925
1926
1927
1928
1929
1930
Year

13


Kobe's Population
Log of Population
14.35
14.30
14.25
14.20
14.15
14.10
Kobe Trend
1995 Earthquake
1975
1980
1985
1990
1995
2000
2005
2010
Year

14

Conclusions

- Cities are Robust!
  - No evidence of cities shrinking following attacks
- All cities recovered fully following attacks
  - Cities recovered to where they would have been without the attacks
  - Recovery takes on average 15 to 20 years for bombed cities although it appears to take less time for smaller shocks
  - Good news for NY
- Results imply locational fundamentals are key to understanding the size and persistence of cities