

Costs and Consequences of Flooding

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Background

- Annual property flood loss: \$2 Billion.
- Most flood losses occur in special flood hazard areas (SFHAs).
- Homeowner insurance policies do not cover flood loss.
- The National Flood Insurance Program (NFIP):
 - Rates and provides flood insurance policies to households and businesses.
 - In SFHAs, structures must have flood insurance to qualify for federally- sponsored mortgages.
 - Has a grandfathering system of provision of flood insurance for structures built before 1975.
 - NFIP is a self-sustainable program. Premiums pay for the expected losses.
 - Gives local governments an incentive to adopt building code and inspection systems that mitigate losses from flooding in SFHAs.

Objectives

- Evaluate the impact that the NFIP has had on the flooding costs and the distribution of these costs among payers (individuals, taxpayers, and NFIP).
 - Compare Pre-FIRM structures with Post-FIRM structures. Pre-FIRM structures are residences built before 1975 that are not subject to floodplain management regulations. Post-FIRM structures are regulated to be protected against flooding at a 99% level.
- Evaluate the NFIP's impact on development.

Model

$$\text{Post-FIRM Loss} = (\text{ELossC} \times 0.85) + (\text{ELossN}^* \times 0.15)$$

where

ELossC = Expected loss for compliant structure in SFHAs

ELossN* = Expected loss for non-compliant structure in SFHAs

$$\text{NoNFIPLoss} = (\text{ELossC} \times 0.47) + (\text{ELossN} \times 0.53)$$

$$\text{NFIP's Impact} = 3.1\text{M} \times [\text{NoNFIPLoss} - \text{Post-FIRM Loss}]$$

Loss Estimation

- The HAZUS data file contains square feet of residential and commercial property by block. Starting from the NFIP loss database, the model examines losses in known flood events, infers total losses by cost category (essentially structure and contents), then uses these to drive an engine for estimating losses by flood size. HAZUS stores most data at the Census Block level, with the ability to aggregate blocks into counties or other reasonable units.

Loss Estimation

- From the resultant flood levels in each Census Block, HAZUS estimates economic losses through damage curves that are a function of the elevation of structures.
- In the simulation run for this analysis, expected damages for structures located below BFE are identified by computing whether a Census Block would flood under a “100-year” flood event and to what depth.

Loss Estimation

- To obtain national measures of flood loss, we use secondary data from PricewaterhouseCoopers on the inventory of structures by flood elevation. We incorporated this national distribution of elevations into HAZUS to estimate the aggregate expected flood damage.

Who Pays?

To evaluate flood costs and NFIP's impact by payer we break down the cost estimates by payer, yielding:

Costs to taxpayers: *grants, tax breaks, temporary housing, SBA loan defaults.*

Costs to the NFIP: *insurance subsidies*

Uncompensated costs to flood victims:
Flood costs – relief

Figure 1. Assistance Reaction Functions for Uninsured Residences & No Mitigation

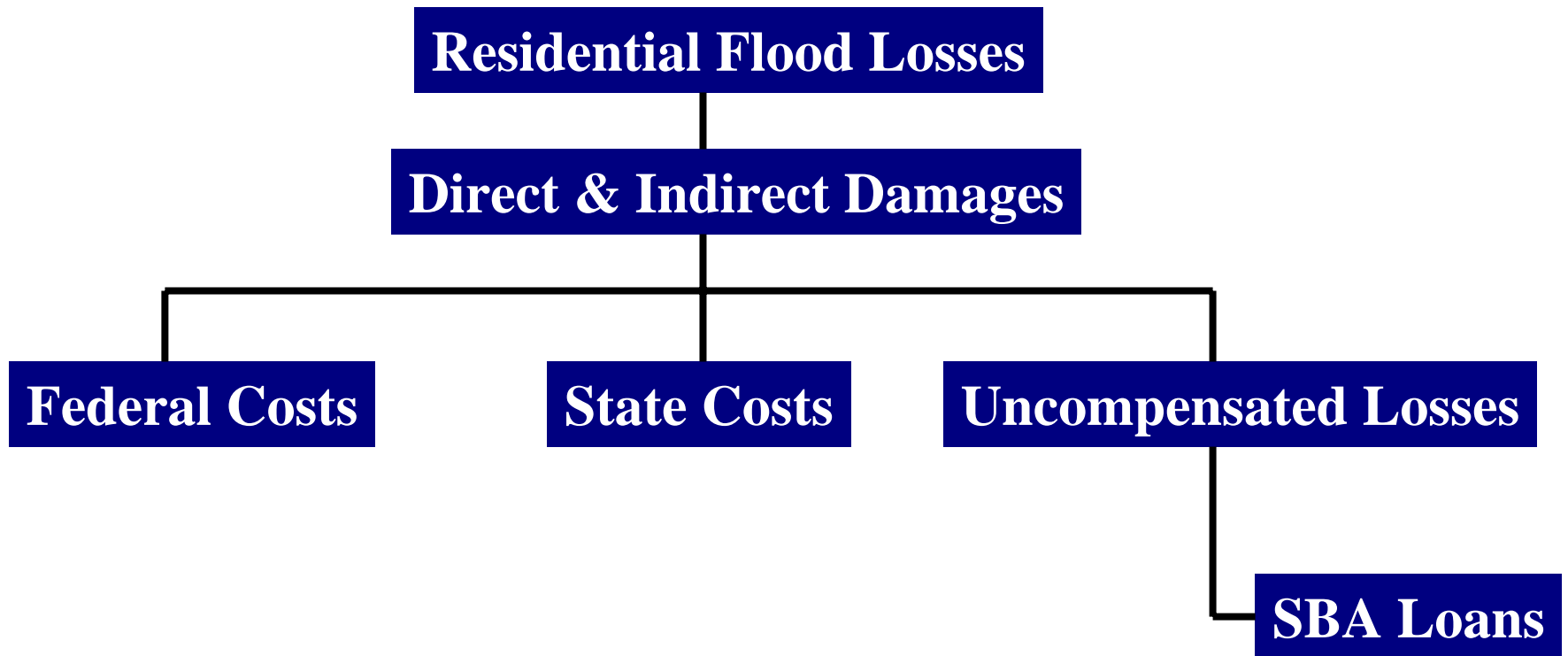


Figure 2. Assistance Reaction Functions for Uninsured Residences & Mitigation

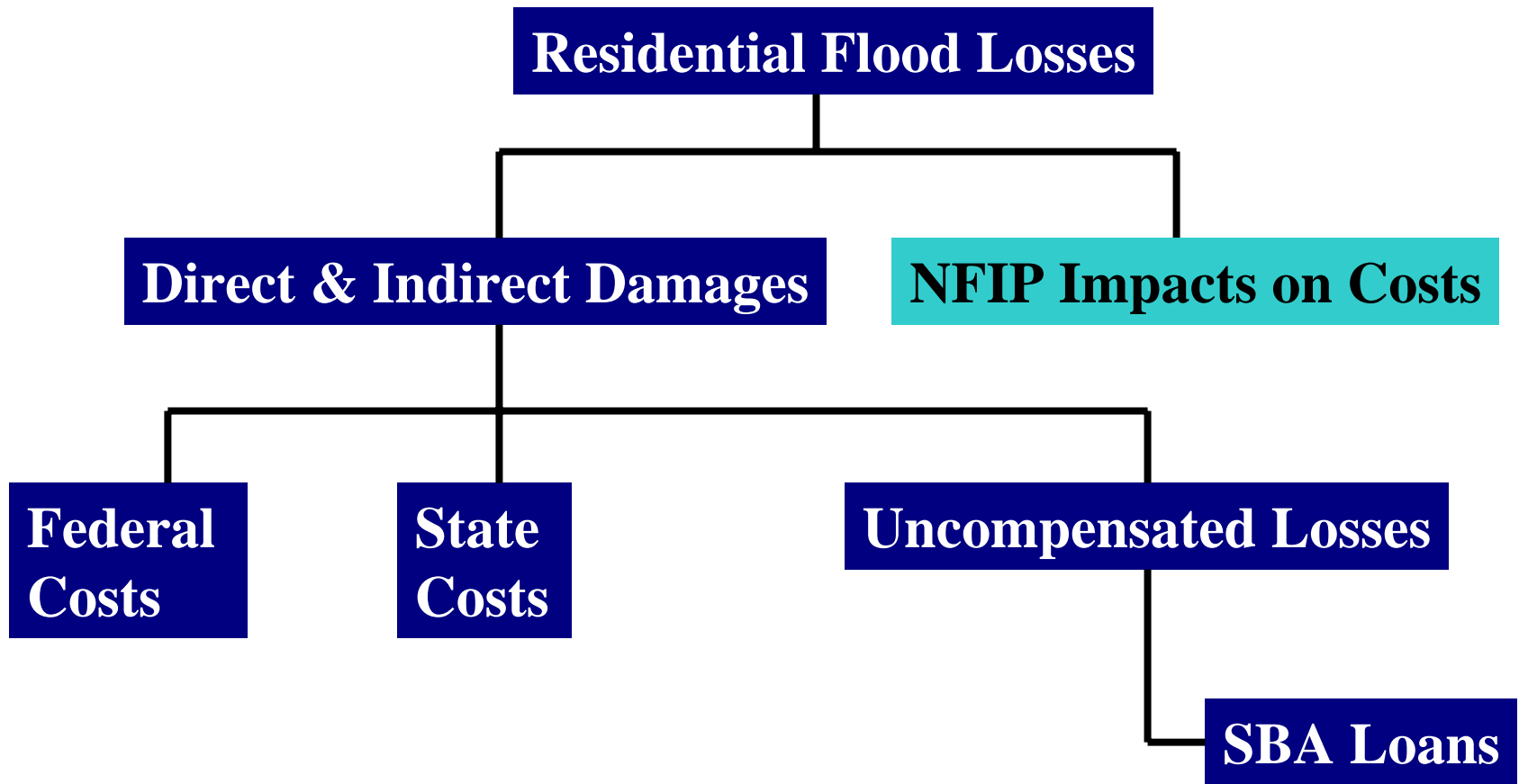
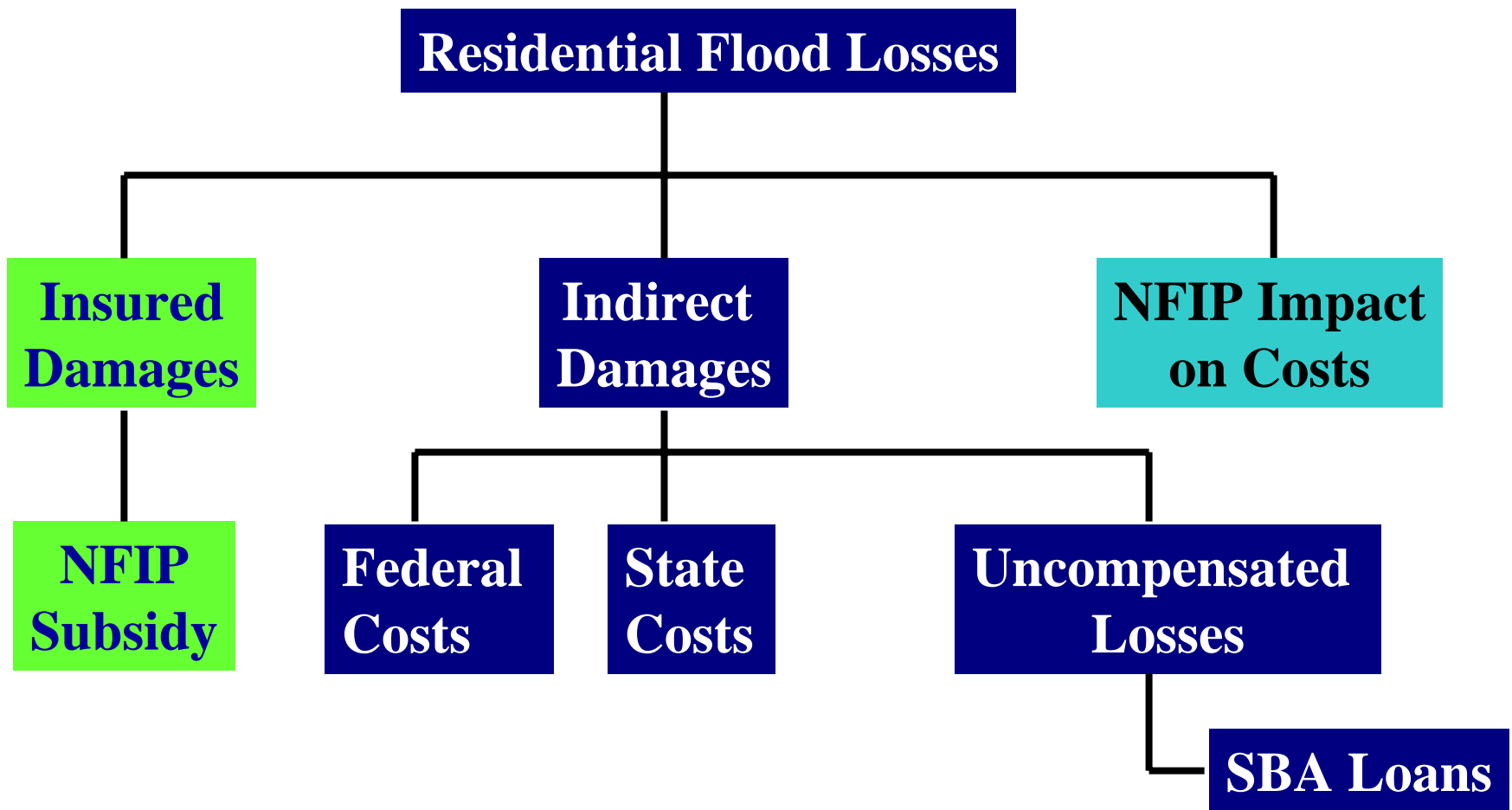


Figure 3. Assistance Reaction Functions for Insured Residences



NFIP's Impact

- Annual expected flood costs to the federal government is \$335M.
- The NFIP has reduced the expected cost of flood-related government assistance to residences by \$530M (70% decrease).
- Expected cost to the NFIP on subsidies to pre-FIRM structures is \$165M (18% of NFIP outlays).
- Expected uncompensated losses to individuals is \$770M.
- The NFIP has decreased the costs of flooding to individuals who reside in SFHAs by \$1.5B, a 67% reduction, with insurance penetration in SFHAs accounting for 50 percent of this reduction.
- Under a 100-year flood, average flood cost per-structure in SFHAs is \$4,130 and NFIP's impact \$2,335.

NFIP's Impact

- Average flood cost per-structure in SFHAs is \$290.
- Average flood cost per-structure located below the BFE in SFHAs is \$815.
- The average residence in SFHAs cost taxpayers \$48 annually.
- The average residence in SFHAs located below the BFE costs taxpayers \$125 annually.

Effects on Development

- The aggregate capitalized value (30 yrs) savings from the regulation of construction of the 3.1 million post-FIRM structures in SFHAs is \$9B.
- The capitalized value of the expected loss over the lifetime of a 30-year loan for a typical post-FIRM structure is only \$1,980.
- Average capitalized value of flood losses of the pre-FIRM structure:
With Subsidy (insured): \$16,010.
Without Subsidy: \$40,035.
- NFIP subsidy artificially inflates values of pre-FIRM structures. The average increase in value of pre-FIRM structures located below BFE is \$24,020. (Aggregate transfer value: 34B)

Bottom Line: The common belief that the NFIP has stimulated development and increased flood losses is not supported by our findings. New development in SFHAs incur relatively small flood losses. However, the NFIP subsidy to pre-FIRM structures below BFE has artificially increased the market value of these high risk structures. Thus, the subsidy has contributed to maintaining market demand for pre-FIRM structures located below BFE as well as providing a negative incentive to invest in flood mitigation upgrades.

Role of Local Governments

- Local governments play a crucial role in community development with direct impacts on the national health of the economy.
- Governments provide services that the private sector is not willing to undertake or capable to undertake under competitive conditions.
- Decentralized governments contribute to efficient provision of local public services, e.g., schools, public safety (police, fire, etc.)

- Local governments manage zoning and construction permits.
- An important related role of local governments is the management of preventive measures against economic losses from natural hazards.

Local Government System of Equations

Objective of local governments: manage public goods (education, safety, health) to maximize social welfare in the community subject to a budget constraint.

From Optimization theory, optimal choice variables are function of other variables in the model.

As a result, local government control variables (E, R, D, T), i.e., spending, own revenues, debt, transfers, are a function of characteristics of the municipality ψ .

$$GV(\psi) = \{R(\psi), E(\psi), D(\psi), T(\psi)\}$$

The classical linear regression model for the local government system of equations is:

$$\mathbf{GV}_{jt} = \mathbf{A} + \mathbf{B}\psi_{jt} + \xi_{jt}$$

where the vector of explanatory variables is

$$\psi_j = [Y_j \text{ Pop}_j \text{ G}_j \text{ L}_j \pi_j \text{ F}_j \text{ F}_{j-1} \text{ U}_j \text{ V}_j \text{ M}_j \text{ S}_j]$$

and the correlation of the econometric residual between equation k and i is:

$$\text{Cov}(\xi_{kt}, \xi_{it}) = \sigma_{ki}$$

Data

- Statistical Abstract of the United States
- US Bureau of Economic Analysis
- US Census
- National Flood Insurance Program
- National Weather Service

Results: Ex ante Flood Risk

- Local governments in municipalities with larger flood hazards have less debt.
- Flood hazards are also associated with significantly lower local revenues.
- Flood risk and local expenditure levels are not significantly associated at the 95% confidence level.

Results: Flooding Impacts

- After a flood event
 - local government expenses are temporally depressed,
 - revenues from state programs are depressed,
 - federal transfers rise significantly.
- Flood-related events force local governments to increase debt to fund recovery and maintain public services
- Expenditures recover the year after the flood, but debt levels continue to increase a year after the flood. Federal transfers to local governments increase in the period after the flood, but the rise is small relative to the additional debt local governments have to incur. (Five times smaller)