

Simulating the Impact of Parametric Insurance on Earthquake-Induced Downtime: A Comparative Analysis of Two Clients

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1 INTRODUCTION & SCOPE OF WORK

An advantage of parametric over traditional insurance is the faster claims payout (Franco et al., 2018). A faster cash influx is believed to accelerate post-disaster recovery. In this study we use a regional recovery model to quantify the impact of claims payout time on asset downtime. Our analysis focuses on comparing the downtime of two assets exposed to an earthquake. Client A, managing Asset A, carries parametric insurance that releases funds one week after the event. Client B, managing Asset B, carries traditional insurance with a six-month payout delay. We show that the difference in their post-earthquake downtime is larger than the difference in their payout times. This occurs because the administrative (permitting) and technical (construction) capacities of a city affected by a major disaster are insufficient to meet the sudden surge in demand created by widespread damage. Resource constraints lead to first-mover advantage, as owners can get ahead of the queue that forms during recovery as damaged buildings start competing for administrative and technical resources. Our assumption is that the buildings enter the competition pool once financing is secured. This assumption is more plausible for buildings with significant structural damage, hence we focus on severely to completely damaged buildings.

We use a semi-virtual regional recovery model of San Francisco to simulate the recovery of about 15,000 buildings that experience severe to complete structural damage following a single realization of a magnitude 7.9 earthquake on the San Andreas Fault. The regional recovery model accounts for impeding factors, repair processes, and constraint in administrative and technical capacity that delay both permitting and reconstruction activities.

Client A has parametric coverage that is assumed to pay within a week after the event, and therefore has access to financial resources and can submit a building permit application for repairs and reconstruction well before most other owners, who typically require 2–6 months to secure financing. As a result, Client A avoids the long permit queue that forms later. In parallel with permitting, Client A begins mobilizing contractors and benefits from early access to a larger pool of design professionals, contractors, workers, and equipment.

Client B, by contrast, is assumed to wait six months after the earthquake until more traditional financial resources for rebuilding are available. By that time, most other building owners have already submitted their permit applications, overwhelming the city's administrative capacity and creating a long queue. In addition, many design professionals and contractors are already fully occupied, leaving Client B with limited options or requiring further waiting until design and construction professionals become available.

Although the regional recovery simulation relies on several assumptions and is preliminary, the underlying dynamic is clear: delayed access to financing has a compounding effect on post-disaster downtime. The severity of this effect depends on the scale of regional damage, the asset owner's ability to mobilize resources, and the post-disaster administrative and technical capacity

available to support recovery. We use regional recovery models to assess the magnitude of this effect.

2 METHODOLOGY

Regional recovery models extend traditional catastrophe models by taking asset-level loss and damage estimates, produced by catastrophe models, as inputs and incorporating additional information, including asset-level recovery step sequences and regional administrative, technical, and financial capacities (Figure 1).

First, we assess damage to all buildings in San Francisco from a magnitude 7.9 earthquake using Pelicun software (Zsarnoczay et al. 2024), the USGS ShakeMap (Worden et al., 2020), the National Structure Inventory (USACE, 2022), and HAZUS fragility functions (FEMA 2020). We then simulate regional recovery using the pyrecodes software (Blagojević and Stojadinović, 2025). Regional administrative and technical capacities are estimated by analyzing 10 years of building permit data for San Francisco and applying a scaling factor to reflect post-earthquake surges in capacity observed following past major events. Asset-level recovery step sequences and task durations are defined based on expert opinion and experience from past earthquakes in the US (Terzic and Koložvari, 2022). We assume a first-come, first-served allocation rule for administrative and technical resources.

We adopt 2 to 6 months as the typical insurance payout time for all damaged assets, except for Asset A, which receives funds within one week due to the parametric coverage they had contracted, and Asset B, which receives funds after six months.

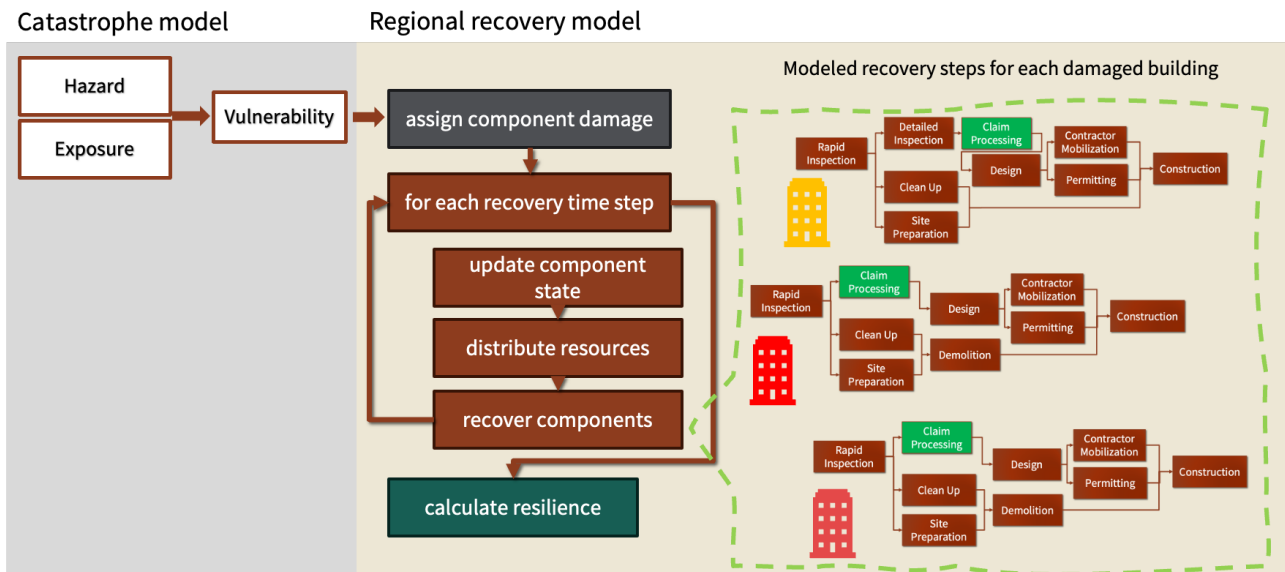


Figure 1. Regional recovery models extend catastrophe models by using asset-level damage as inputs. Recovery is simulated as a time-stepping loop with limited recovery resources assigned to damaged buildings at each time step.

3 RESEARCH OUTCOMES

Figure 2 presents simulated recovery progress for Assets A and B. Asset A is inspected in the first week following the earthquake, receives payout in the second week, the architectural design is done by week 10 and permit is obtained by week 19. In parallel with design and permitting, the site is cleaned up, prepared and the damaged building demolished on week 8 so that the rebuilding can start once the permit is received. Rebuilding starts on week 20 and is done by week 92, about 22 months after the earthquake. Asset A does not experience any waiting time between activities caused by limited administrative and technical capacities.

Asset B is also inspected in the first week following the earthquake, with site preparation, clean-up and demolition finished by week 7. Client B receives payout in week 27, with the design

professionals starting to work on the project in week 31. Client B submits the design for permitting in week 38 but waits until week 148 for the permit to start processing, and the permit is issued in week 159, when rebuilding starts. Rebuilding ends in week 228, about 4.5 years after the earthquake.

The initial difference in payout time of 6 months resulted in Asset B construction finishing 2.5 years later than Asset A. It should be noted that lower post-disaster permitting and construction capacities amplify the construction delay.

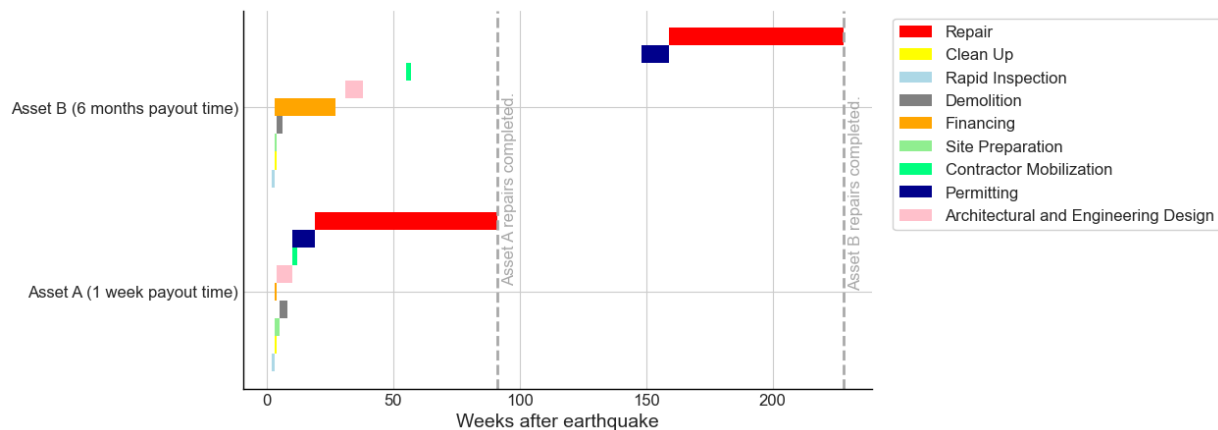


Figure 2. Gantt chart presenting recovery progress for Asset A and Asset B. Asset A is repaired about 2.5 years before Asset B. Difference in their payout time is 6 months.

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