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Earthquake Propensity and the Politics of Mortality Prevention

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Summary. — Governments can significantly reduce earthquake mortality by enforcing quake-proof construction regulation. We examine why many governments do not. First, mortality is lower in countries with higher earthquake propensity, where the payoffs to investments in mortality prevention are greater. Second, the opportunity costs of these investments are higher in poorer countries; mortality is correspondingly less responsive to propensity in poor countries. Third, mortality is higher at any level of quake propensity when governments have fewer incentives to provide public goods, such as in autocracies with less institutionalized ruling parties or in more corrupt countries.

Key words — disaster, mortality, political economy, democracy, risk, public goods

1. INTRODUCTION

No government can prevent earthquakes, but all governments can optimize the regulations that reduce mortality when disaster strikes. Yet, earthquake mortality varies widely and systematically across countries. We argue that a set of interrelated factors is responsible for these differences. One is that the propensity for experiencing a strong earthquake varies greatly across different parts of the world. Governments in countries with a higher earthquake propensity have stronger incentives to implement effective earthquake mortality prevention measures. As a consequence, a seeming paradox arises: earthquake mortality is *lower* in areas with *higher* quake propensity, controlling for the strength of an actually occurring quake.

This relationship, however, is contingent on additional economic and political factors that influence government incentives to undertake *ex ante* preventive measures that reduce earthquake mortality. First, the opportunity costs of earthquake mortality prevention policies tend to be higher at low levels of *per capita* income. Earthquake-proof construction is expensive; in poorer countries, households and governments have more effective ways to spend scarce resources than to invest in earthquake-proof construction. Second, political incentives to implement and enforce earthquake-proof construction standards vary with the level of democracy and governments' ability to credibly commit to enforcement. These political regime characteristics therefore also condition the inverse relationship between earthquake propensity and earthquake mortality.

Our analysis moves beyond earlier research showing links between institutions and earthquake mortality. Kahn (2005) finds that democracy reduces disaster mortality in specifications where all disaster types are pooled and neither disaster magnitude nor the likelihood of disasters are taken into account. Anbarci, Escaleras, and Register (2005) argue that inequality reduces the probability that citizens collectively agree to finance construction regulation and show that disaster mortality rises with inequality and with corruption (Escaleras, Anbarci, & Register, 2007). Our analysis augments and advances on this important prior research in four ways.

First, we argue that an important channel through which political incentives matter is by conditioning the responsiveness of governments to disaster propensity (and *vice versa*). Second, while we argue that elected governments are more sensitive to an elevated quake propensity than non-elected governments, both democracies and non-democracies exhibit considerable heterogeneity in political incentives to provide public goods and to make credible commitments to enforcing regulation. We explicitly take this heterogeneity into account, showing that democracies, more institutionalized autocracies and non-corrupt regimes respond more to a higher level of earthquake propensity than less institutionalized autocracies and corrupt regimes. Third, we argue that income also conditions the effect of disaster propensity: richer countries respond more to an elevated quake propensity than poorer countries. Fourth, we improve on previous research designs. In contrast to Kahn, we are able to take disaster propensity into account. And in contrast to Anbarci *et al.* (2005) and Escaleras *et al.* (2007), who also show an inverse relationship between earthquake propensity and mortality, we use more accurate measures of the magnitude and location of earthquakes and of quake propensity that take into account the exponential nature of the Richter scale. We also offer a different explanation for the result: while these papers claim that higher earthquake

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propensity improves the response to earthquakes because it offers more opportunities for "learning-by-doing," we argue that earthquake propensity affects the opportunity costs of investing in earthquake mortality reduction and, therefore, the incentives of political decision makers to respond to the threat of earthquakes.

In the next section, we discuss why government intervention is necessary for the prevention of earthquake mortality despite the fact that most buildings are privately owned. We then develop our theory in several steps, first explaining why there is an inverse relationship between earthquake propensity and mortality and then demonstrating how income and political incentives condition this effect. After a detailed description of our research design, we present our main estimation results in Section 5 and summarize the findings from an extensive set of robustness tests in Section 6. Consistent with our predictions, empirical analysis of earthquake mortality over the period 1962–2005 demonstrates that not only is earthquake mortality lower in democracies, in high quake propensity countries, and in rich countries, but the conditional political and income effects predicted by the theory are also significant and large.

2. EARTHQUAKE MORTALITY: THE NEED FOR GOVERNMENT INTERVENTION

Government policies have a substantial influence on disaster mortality through their influence on private risk reduction measures and through post-disaster aid (Neumayer & Plümper, 2007; Plümper & Neumayer, 2009). Although building collapse is the main cause of mortality in earthquakes (Osaki & Minowa, 2001) and buildings are often privately owned, government decisions have a large effect on earthquake mortality. On the one hand, government decisions entirely dictate the safety of key public buildings, such as schools and hospitals. On the other hand, governments can mitigate three potentially large market failures.

One is imperfect information. Earthquake-resistant features are costly to verify after construction is complete. Blondet *et al.* (no date) point to the clay and straw content of adobe bricks as being central to the earthquake resistance of adobe homes. Steel reinforcement bars make a well-known contribution to earthquake resistance in concrete buildings. However, not only is the steel itself invisible (encased, as it is, in concrete), but the durability of the steel depends on the quality and quantity of concrete around it. Since these features cannot easily be verified at reasonable cost, buyers are less willing to pay a higher price for quality construction and construction companies have weaker incentives to provide it. Escaleras *et al.* (2007) emphasize this information asymmetry in assuming that it is impossible for private parties to contract for high quality construction. In the absence of regulation, they argue, earthquake mortality is high.

However, even if construction quality were observable (e.g., by individuals who make daily visits to their home construction site), seismic design requirements are specialized and may not be well-understood by buyers or by building constructors themselves. In this case, information about how to design earthquake-resistant buildings is a public good that the market may under-supply. Building codes provide a way in which governments can provide information about appropriate earthquake-proof construction.

A second market failure in construction is the difficulty of using reputational mechanisms when construction failures are revealed only after low probability events such as earthquakes. Government enforcement of private contracts can obviate the need to rely on reputation. Finally, third, behavioral distortions are a pervasive phenomenon in the face of low-probability, high-loss events, when individuals frequently make decisions that lower their utility (Kahneman *et al.*, 1982). Even if fully informed about building quality, buyers may care too little about the benefits of building attributes that protect them against low probability events. One study in the United States shows that if the probability of a disaster is sufficiently low, individuals simply stop thinking about it (Camerer & Kunreuther, 1989). A laboratory experiment in the United States concluded that individuals are unwilling to pay *anything* for insurance against low probability events, even if the cost of the event is high (McClelland, Schulze, & Coursey, 1993). Private individuals tend to be reluctant to purchase construction quality, even when doing so leaves buyers better off, and government intervention can overcome such reluctance. [1]

Whether governments actually take actions to correct market imperfections or to construct earthquake-proof public buildings depends on their political incentives. Where those incentives are weak, earthquake mortality is likely to be higher. Escaleras *et al.* (2007) emphasize corrupt payments as the main reason that building codes are not enforced. However, the problem may not be an adequate number of building inspectors who take bribes, but rather weak political incentives to enforce the codes, which can also be manifested in an insufficient number of inspectors. Following the severe 2009 earthquake in Sumatra, the *Wall Street Journal* quoted the mayor of the hard-hit port city of Padang, with a population of 750,000 as saying that "Most of the buildings that collapsed were those that didn't follow updated building codes (...). The local government lacks resources to check all buildings (...) with only four staff members to check building licenses" (Wall Street Journal October 6, 2009, p. A11). In contrast, the budget for building and residential inspections and construction compliance in Washington, DC, a city with a population of approximately 600,000, amounted to 118 full-time equivalent positions. [2]

3. THE POLITICS OF EARTHQUAKE MORTALITY PREVENTION

The argument we develop here and test below is that higher earthquake propensity reduces the opportunity costs of transferring resources to the construction of more quake-proof buildings that decrease quake mortality. However, the effects of propensity are heterogeneous and differ for countries at different levels of economic development and with different political incentives. The opportunity costs of expenditures to limit earthquake mortality are higher in poor countries, so that rich countries should respond more strongly than poor countries to higher earthquake propensity. And in countries where citizens or members of the ruling party can more easily sanction leaders for poor performance, leaders should respond more strongly to higher earthquake propensity.

(a) *Earthquake propensity and opportunity costs*

It is well-understood that there are few technical obstacles to constructing buildings that have a fair chance of surviving even the strongest quake. However, the returns to an investment in earthquake-proofing a building vary sharply across regions and countries according to their earthquake propensity. Governments rationally abstain from passing