The Scale of Indirect Damage from Flooding
A Case Study: Mississippi River Flooding of May 2011

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Abstract
There are growing risks to economic activity in flood-plain regions due to the increasing severity of climate change-driven storms. In May 2011, heavy rains led to surging flood levels along the entirety of the Mississippi River basin. This eventually required the US Army Corps of Engineering to blast open floodgates in order to save major cities like Baton Rouge and New Orleans from catastrophic damage. However, this was at the cost of sacrificing millions of acres of farmland and sparsely populated parishes all over the southern basin region. Beyond the direct flood damage, business was disrupted while the Mississippi River was unable to be used as a trade route. But these disruptions, known as ‘indirect damage,’ can sometimes have a net positive result for firms that do not sustain much physical damage and can benefit from the ensuing price increases of their products. In the long term, however, increasing defense and recovery measures from flood incidents will be required in such regions in order to maintain economic activity. Overall, sustainable development would require either an avoidance of those risky zones, which is socially and economically impractical due to the large existing populations and infrastructure, or a focus on preventative measures.

Author’s Note
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1. Introduction and Opinion

According to the Intergovernmental Panel on Climate Change (IPCC), more frequent and powerful storm systems resulting from global warming-induced climate change are causing stronger natural disasters (IPCC, 2007). There are numerous recent examples of supposedly “once in a century” events, such as Hurricane Katrina overwhelming New Orleans in 2005; Hurricane Irene hitting the Northeast on September 2011; the 9.1 Richter magnitude Tohoku earthquake and the subsequent tsunami impacting the east coast of Japan in May 2011; and most recently, the monsoon floods ravaging Thailand for months.
Moving forward, forecasts for sustainable economic and environmental growth in flood-prone regions must take into account the risks of both direct damage and indirect damage, specifically supply chain disruptions and price spikes. Accordingly, future funds and efforts should be devoted to the creation of more resilient transportation infrastructure, as well as more effective preparatory measures. Finally, research into indirect damage must be expanded in order to provide empirical guidelines for both firms and governments to measure and manage the hidden risks of development in flood-prone regions.

2. Indirect Damage Explanation

2.1 General

The Mississippi River flooding left a swath of devastation along its entire length during May 2011. In Arkansas alone, over one million acres of land were affected, contributing to an estimated $500 million loss in crops, according to the state Farm Bureau. (Hobor, 2011). Furthermore, the state of Mississippi had nearly 10% of its farmland affected by the flooding, leading to an $800 million loss (NOAA-NCDC, 2011). In both cases, studies reporting the extensive damage to both agriculture and aquaculture do not generally incorporate the losses accrued from indirect damage.

Although the field of indirect damage has not been heavily researched or officially defined, it involves the effects of an event beyond those caused by active destruction. The direct damage of flooding includes crops that are washed away, power lines that are knocked over, and property damage. The indirect damage of flooding consists of the next level of effects that have economic impact. For example, a delay in the shipment of raw materials, which would lower a manufacturer’s production and subsequent sale, constitutes indirect damage. Indirect damage can be further extended to tertiary levels and beyond in forms of retail price increases and limited supplies for consumers.

However, indirect effects are not only limited to damage: if business increases due to the event and the rise in revenue outweighs the loss from this event, there is potential for economic gains. For example, a hurricane hitting a region would destroy property and infrastructure, but the reconstruction could actually have positive indirect effects on firms in sectors like construction.

2.2 Supply Chain / Transition

Companies that retain enough production capacity after a disaster have the opportunity to benefit from increased demand and prices due to the reduced supply of crippled competitors. As such, firms should utilize widespread supply chains to reduce concentrated risk exposure and to ensure sustainable growth. At the same time, however, a larger distribution network has more points subject to failure and runs the risk of greater downtimes and losses.
3. Supply Chain Risk

3.1 Automobiles (Japan)

Accordingly, supply chain is a crucial component of a firm and is vulnerable to indirect damage in the form of shipping delays and facility closures. For example, Toyota's “Just-In-Time” method maximizes efficiency by ordering exactly what is needed for the next cycle of production, thus eliminating the cost of warehousing excess supplies. After Toyota's supply chain was cut off by the Tohoku earthquake-tsunami, Toyota had to delay production until dozens of subcontractors and transportation infrastructure were ready as well. (Toyota, 2011a). Thus, even after Toyota facilities were repaired and electricity service was sufficiently restored, Toyota took nearly six months to recover to full manufacturing capacity (Toyota, 2011b).

Likewise, Nissan and Honda, the two other major Japanese automakers, shut down their production lines and faced a long path to recovery after the disaster. These supply chain disruptions even spread to the US due to the lack of key parts sourced from Japan. Even Ford and GM felt the consequences, as GM shut down a truck plant in Louisiana for nearly a week due to part shortages. Similarly, Ford temporarily ran out of red and black paint ingredients for its pick-ups and SUVs (Rooney, 2011; Valdes-Dapena, 2011). Generally speaking, it was the shortage of specialized goods that hindered production across the globe.

3.2 Mississippi River

This past May, flooding in the Mississippi River cut off the supply chain of a significant portion of the southern USA and barred passage across several stretches ranging from one to nearly fifteen miles. This, in turn, shut down barge traffic along the entire length of the river (U.S. HHS, 2011). Historically, ports of trade from cities like Minnesota and New Orleans have facilitated the rapid and inexpensive transfer of goods from north to south and vice versa. However, the flooding forced the closure of certain segments where navigation proved hazardous and ships could stray off course and breach a levee or a sea wall, resulting in many ports shutting down their operations.

According to CEO Gary Larange, closing the Port of New Orleans would cost the US economy $300 million per day. In May 2011, the port fortunately avoided closure and only diverted three boats. However, Larange admits that the economy still took a blow; excessive silt build-up caused water levels to remain two feet below desired levels for nearly three months, which impeded barge movement (G. Larange, personal communication, November 15, 2011). As stated by Mr. Larange, “every 1 inch of water depth lost to a cargo vessel - that would be the equivalent of losing the shipment of 5,000 running shoes valued at $5 million” (NOAA). This means that each barge during that time period was unable to transport nearly $120 million worth of cargo. Considering that the Port receives about two thousand barges per year, the Port of New Orleans was unable to process $60 billion worth of goods during the three months following the flooding (Port of New Orleans). The economic damage derives not from the port’s loss of delayed or
diverted shipments, but from the cascade of short-term costs to those firms that received fewer products. The damage, in turn, is transferred to the consumer in the form of higher prices.

4. Positive or Neutral Outcomes from Indirect Damage

4.1 Positive Outcomes (Dow Chemical)

This disruption also had major indirect consequences for individual firms. The effects ranged from negative to positive depending on the sector. The agricultural giants, DuPont and Monsanto, along with petrochemical firms, such as Dow, have had very different economic outlooks compared to the rest of the region. Even though major production facilities such as those in Plaquemine, Louisiana are practically on the river, there was no major damage reported for the petrochemical industry’s plants. In fact, the vast majority was shut down while the river was closed to shipping traffic to cut their losses (ICIS, 2011b). However, the end result was ultimately profitable because the demand for their products rose due to the physical flood damage to farmland. Seed and fertilizer had to be replaced along with essential chemicals such as ethylene (used in packaging). There were also accompanying price spikes because the millions of acres of washed farmland needed replanting before the growing season ended.

Between May 13 and 16 alone, before flooding reached its peak and forced temporary facility closures, US spot market prices of ethylene jumped by 5% merely due to the fear of future cutbacks (ICIS, 2011a). This fear of rising futures prices can be linked to Dow Chemical’s reporting of volume increases and double-digit price increases in the ethylene market from “unplanned production shortages and planned turnarounds” as well as “tight supply and continued strong demand.” In the second quarter of 2011, Dow’s Chemicals division posted $1 billion in sales, up 23% from the same quarter in 2010. Even as volume fell by 3%, prices rose by 26%, which more than doubled the quarterly net income from $100 million to $282 million (Dow, 2011). The rise in demand due to production shutdowns was certainly a factor, but the fear of shortages was the primary cause of the massive increase of contract prices.

4.2 Neutral Outcomes (Rail & Commodity Prices)

Transportation firms had varied outcomes depending on their mode of travel. Railways were not seriously affected, as companies posted profits on par with previous quarters. Union Pacific freight volume rose by only 3% while price per unit rose 13%. The total revenue jumped 16% to nearly $4.9 billion, even though fuel and other costs drove expenses 19% higher. Higher costs, including flood mitigation costs such as the repair of damaged signals and rail lines, left net income at 16.2% of revenue, down only 0.8% from a 17% profit margin from last year, a relatively neutral outcome (Boyd, 2011).
Even though many feared that the rise of commodity prices would lead to increased prices for basic necessities, this never really came to pass. However, there were consumers that felt the final brunt of all of these price increases. Whether in the transport, chemical, or retail sectors, the cascading incremental price increases add up to a significant expense for the average shopper. For example, as the Bureau of Labor Statistics reported for May 2011, there was a 0.4 point rise in the consumer price index of food, with all categories rising in price except those of fruits and vegetables. This was the same increase as in April 2011, revealing the willingness of firms to absorb some of the increased costs rather than pass it all onto the consumer (U.S. BLS, 2011).

5. Need for Future Research of Indirect Flood Damage

Ultimately, the effects on the global economy following the Mississippi River flooding, the tsunami off the coast of Japan, or any instance of indirect flood damage, are still being uncovered. Further research into the exact economics of indirect damage is important, given its widespread effects even at extreme geographical distances and across industries. This need is exacerbated by the fact that existing studies focus solely on property damage from water damage and the risk analysis of this threat. Often, research papers concerning flood damage will thoroughly cover the risk of direct physical damage and only give a quick reference to the existence of ‘indirect damage’ while noting that its parameters need further analysis. Cochrane shed light on the lack of classification and in-depth analysis of indirect damage (Cochrane 2004) in his paper, which described the difficulties surrounding this elusive category. Is indirect damage merely ‘lost income’ or is it something more? (p.291) When are the aftershocks of a catastrophic event considered over, and when is it just the general failure of the economy that causes periods of stagnation? (p.294)

To meet the rising levels of indirect flood damage, research into both quantitative and qualitative factors must be undertaken. Crucial topics for further research include: additional travel time due to route closures, the flexibility of the mode of transport for goods, price changes due to delays and shortages, and the long-term effects of disruptions of travel due to natural disasters. These findings should be pursued both on an empirical level, by following the developing trends in disaster zones, as well as on a theoretical level, by defining the factors that a company can weigh to better manage the risk of supply chain disruption.

6. Conclusion

The supply chains of regional, national, and international markets are vulnerable to unexpected severe flooding. The possibility of flooding forces businesses to plan ahead and pursue alternative pathways to ensure the on-time delivery of products in sufficient quantities. The entire market, from producers, shippers, wholesalers, and retailers all the way to consumers, is subject to the ability of government and businesses to maintain stable supply chains in times of natural
disasters. Natural disasters will continue to challenge price stability and sustained economic growth as long as the effects of climate extremes continue to be felt.

The discipline of sustainable development demands that we also consider the long-term costs of preventative measures in flood-prone regions. Through preventative measures such as relocation, societal and economic profit can be made, and fewer government-funded recovery efforts would be needed. Environmental conservation efforts could also be implemented by reducing the overuse of resources in reconstruction and allowing assets to shift toward less risky regions where development would be longer lasting. In areas of extreme or frequent flooding, commercial gains may be outweighed by the cost of massive flood-resistant infrastructure. In that case, while it may be productive on a firm level to be located in those high-incident zones, the government should discourage this by offering assistance to relocate or by revoking subsidies in high-risk areas. Government intervention requires strong political will because the private sector may attempt to thwart regulation, and local populations may be pitted against higher levels of government. However, if there is government inaction, the national citizenry would ultimately foot the recovery and reconstruction bill. As such, studies that prove long-term losses due to supply chain disruptions would allow companies and governments to properly stationed in a cost-effective and sustainable manner.
Bibliography


