Demand Surge Perspective on European Extratropical Cyclones

AIR

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Table of Contents

Overview

AIR Worldwide has been modeling demand surge since the 2004 and 2005 U.S. hurricane seasons. This demand surge model has been used in our detailed and aggregate modeling platforms to provide an alternative view of insured losses primarily for U.S models. Over the past 15 years or so, our understanding of the interdependence of non-catastrophic sources of construction market disruption with natural catastrophes has increased, specifically as it relates to insurance claims. This more targeted view will become part of our next generation financial model and will bring a global view of economic demand surge and other sources of loss inflation, which will be described in the next section, to catastrophe modeling.

Demand surge in Europe has always been an area of interest, but there have been challenges—partly because of the limited number of events that could cause demand and the corresponding data to measure the price response. Price data at the level of the local construction market is not readily available from one consistent source, as it is in the United States. Where it is available, many of the time series aren't long enough to coincide with natural catastrophes having an increased demand for additional work and triggering demand surge.

There is evidence that extratropical cyclones (ETC) in 1990 and 1999 caused demand surge, but understanding the extent of demand surge is difficult. Data measuring the change in prices for materials and labor is only available for a few countries and much of that is only available at country level, which is at a suboptimal resolution. For some countries we had to rely on less detailed construction cost data; for others the data just did not exist. In addition, the free movement of labor and materials across sovereign borders within the European Union has been in flux.

We will first look at the economic theory that explains demand surge via changes in market equilibrium, then we will consider how the cost data in the U.S. can be used along with the available European economic data to understand the phenomenon in Europe. We will also look at case studies of the ETC experience of 1990, 1999, and 2007 along with the data that supports a conclusion that there was demand surge, as well as the data that does not.

Demand Surge and Loss Inflation

Catastrophe models are used to understand the possible risk of loss to a property for rate setting. In addition, after an event takes place, these models can help explain what to expect for the value of claims before any adjustment factors. The increase in the value of claims from losses beyond the expected value from the event alone can be attributed to loss inflation. Demand surge is a term often used interchangeably with loss inflation, but it is just one component.

There are two major sources of loss inflation for property after a natural catastrophe. The first source is economic demand surge, which affects everyone in the area regardless of insurance coverage. The second source is related to claims, which includes both moral hazard—such as what is commonly called social inflation—and government intervention. These sources can affect insurance claims by artificially inflating the expected damage. Because the scope and the sources of these three types of loss inflation—economic demand surge, moral hazard, and government intervention—are different, they need to be examined separately to understand their contribution.

We have the data to quantify economic demand surge, so once we adjust expected claims for that piece, any remaining difference between expected and actual claim value can be used to quantify the other sources of property loss inflation. Next, we will move on to a deeper understanding of the economics behind demand surge.

What Is Demand Surge?

> *"…temporary increase in the cost of material, services, and labor due to the increased demand for them following a catastrophe."*

Figure 1. Actuarial definition of demand surge

Figure 1 shows the classic actuarial definition of demand surge typically used by the industry, but it is about economic demand surge rather than loss inflation in general. It describes an economic market equilibrium for the construction inputs of labor and materials that is thrown out of balance after a natural catastrophe happens. This temporary imbalance causes an increase in prices that is commonly called demand surge. The price increase will last until the supply and demand for these construction inputs adjust to a new market equilibrium.

To illustrate the concept of construction labor market equilibrium, we'll share an example and then go step-by-step through a market shock to understand the economics of demand surge. Let's assume that the diagram in Figure 2 represents Miami-Dade County in Florida in 2017. The yellow line represents the supply of residential and non-residential labor in that market, about 11K construction workers at the time. The vertical (y) axis is the wage price and the horizontal (x) axis is the quantity of workers. Each point on the upward sloping portion of the yellow line represents the number of workers willing to work for the wage on the y axis. At the top of the sloping portion of the yellow line, the wages are sufficiently high that everyone is willing to enter the job market.

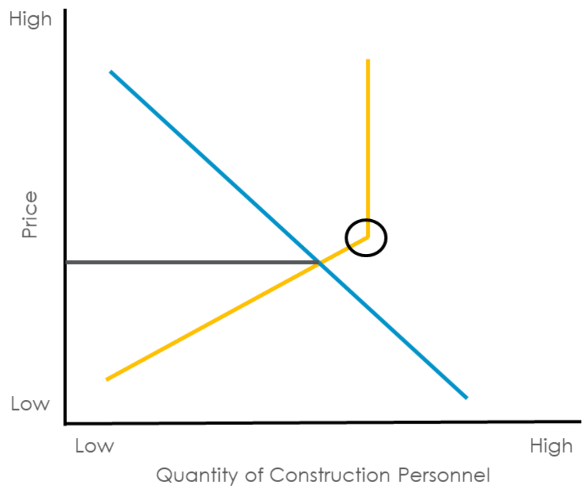

Figure 2. Construction labor market equilibrium (Source: AIR)

The supply of workers is limited in the short and medium term, which is why our supply curve becomes vertical at the inflection point (within the black circle). If demand is too high, no more workers are available to enter the market and the price goes up.

There are almost always construction projects in the pipeline to meet the growing need for new homes and office space when the conditions are right for them to move forward. At the start of every construction season, decisions to move forward on a project are based on the availability of materials and labor, their cost, and making a profit. The downward sloping blue line represents the demand for construction labor in the projects moving ahead this 2017 season. The point where projects make economic sense is where the demand and supply lines intersect and mark the price of labor for this market.

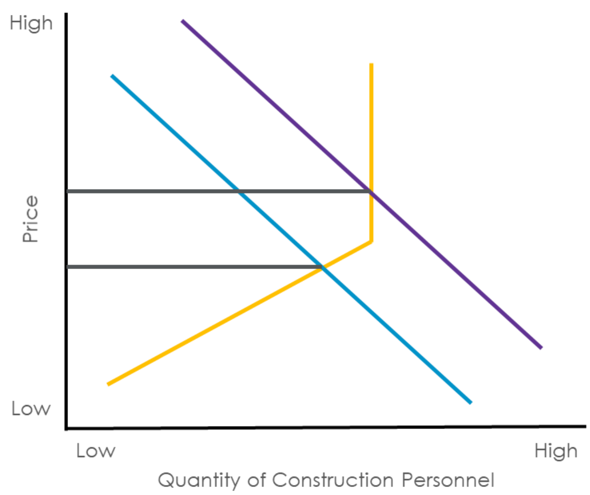

Figure 3. Disruption to construction labor market equilibrium (Source: AIR)

Figure 3 shows the market disruption after Hurricane Irma made landfall in Florida in the third quarter of 2017. The additional demand for labor to do repairs is represented by the demand curve shifting to the right, indicated here by the purple line. If the additional demand can be accommodated by the remaining workforce, we will see a new equilibrium price somewhere along the sloping supply curve, indicated by the yellow line. If the amount of work exceeds the existing supply, as in this example, the new equilibrium is on the vertical portion of the labor supply and we can see big jumps in the cost of labor. In the next section, we will be looking at labor price data that illustrates what can happen if demand intersects supply on the vertical or sloping portions.

We should see a similar response in the construction materials market. The actuarial definition implies the demand surge effects are local to the market disruption; however, research on data in the U.S. over the past 15 years has shown that there is no meaningful disruption to the materials market at the local level. Using detailed cost data for labor and materials from Xactware®, we can measure the impact that the additional demand has on reconstruction cost. This helps us see that labor disruption is a local phenomenon that mostly impacts the affected area, but materials market disruption is a national issue that affects all markets.

Labor Is Local, Materials Are Not

Figure 4 shows a chart of the second quarter year-on-year percentage change in materials basket of goods index for the states of Florida, California, Texas, and Massachusetts, and the U.S. national trend from 2003 to 2020. This Xactware data represents the construction inputs used for a typical dwelling. The time periods are on the horizontal axis, and the percentage change is on the vertical axis.

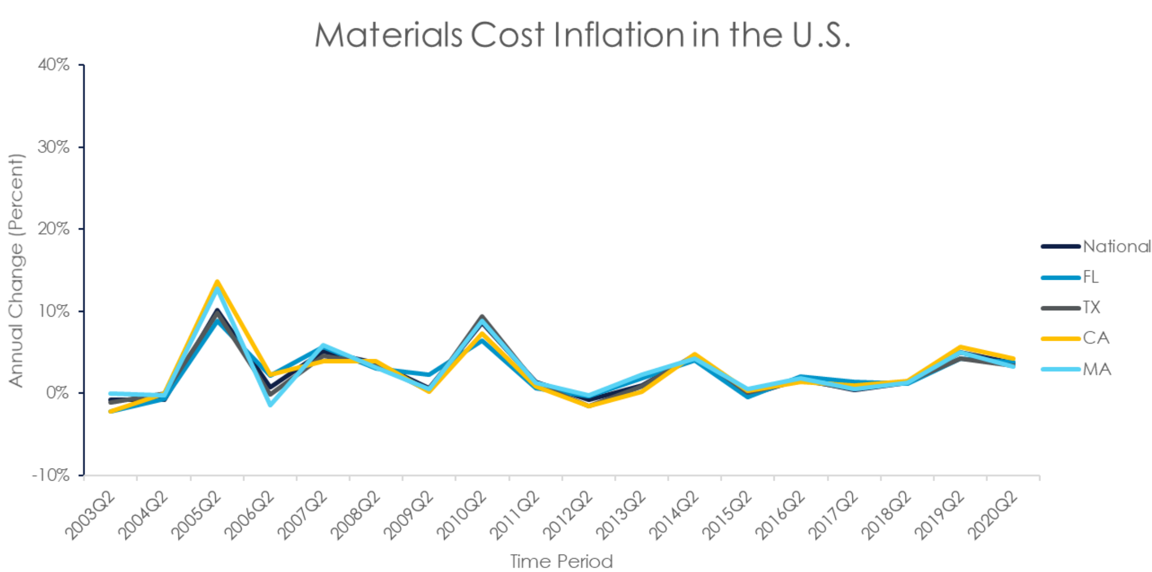

Figure 4. Year-on-year U.S. materials cost inflation (Source: Xactware)

There are minor differences regionally, but all the states follow the national trend. Let's focus on the price increases after 2004 and consider the events that happened in the second half of the year. First, the U.S. housing boom was at its height. There was increased construction going on in all these regions, especially Florida. We also saw one of the most significant hurricane seasons in decades, which included Charley, Frances, and Jeanne. In November a significant tornado outbreak heavily impacted the other Gulf states. We start to see regional events in the Southeastern U.S. combine with the national housing boom to increase materials costs at similar rates everywhere, even in the Northeastern and Western U.S.

The data suggests that any local disturbances in the construction materials market quickly adjust and the effect transfers the disruption to the national market. Effectively the demand surge on materials costs is a national response experienced by every local market.

Figure 5 shows the same chart but with the change in the construction labor rates from Xactware.

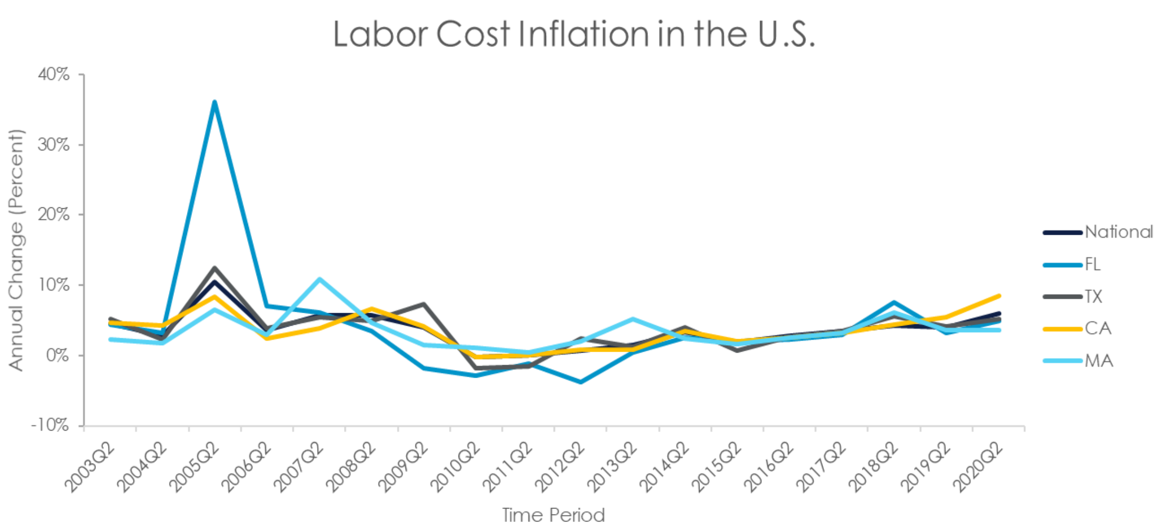

Figure 5. Year-on-year labor cost inflation (Source: Xactware)

There are two big differences in Figure 5, as compared to Figure 4. The first is that there is no consistent trend. The movements from 2014 to 2017 are similar, but for all the other time periods no real pattern is evident. The second difference relates to the medium blue line representing the annual changes in Florida. There is a big spike at the beginning, after the 2004 season, but no other region saw such a big increase. There is a general trend upward in the other regions, which is consistent with the national housing boom that began to peak at the end of 2005. In Florida the spike is caused by a housing boom demand for labor that was twice as high as any of the other regions in this chart.

Figure 5 is also an example of how prices spike when demand intersects with the vertical portion of the supply curve. Moving all the way to the right we see a spike in Florida following Hurricane Irma in September 2017, and a smaller spike in Texas after Hurricane Harvey in August 2018. This is an example of price adjustment when the demand curve intersects with the upward sloping portion of the supply curve.

Economic Demand Surge Is One Factor

We normally think of demand surge as one number, so how do we interpret two price movement uplifts with different geographic scope? A natural catastrophe that disrupts the construction materials, or labor markets, or both can have a national effect and a state effect in the U.S. The analogous disruption in Europe would have a European Union effect and a country effect. The challenge is: How can we combine the impact of labor and materials on the cost of reconstruction in a meaningful way?

For most construction, the cost of materials for the same structure does not vary much. Thus in a country where the construction wage is high, the proportion of labor can make up a substantial portion of the total cost. In a country where wages are low, the cost of materials can dominate the total cost. The magnitude of the local demand surge effect can be thought of as a function of the relative construction wage rate.

In Figure 6, the implication is that while both areas may be subject to the same materials market disruption, Country A is more impacted by the local labor market disruption.

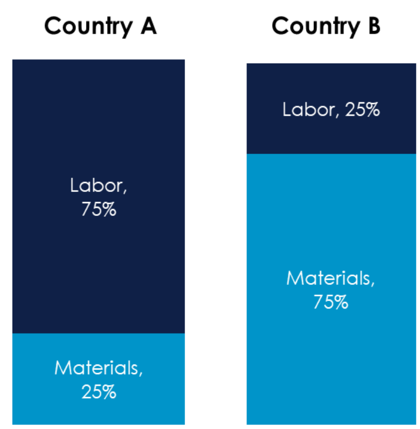

Figure 6. Labor and materials cost proportions vary spatially (Source: AIR)

If there is a 16% increase in the cost of labor affecting both, we can expect construction labor costs to be 16%*.75 or 12% higher in Country A because of the relative importance of labor, whereas the increase in Country B is limited to 16%*.25 or 4%.

Table 1 shows the total demand surge if material demand surge is 3% in both countries. We can expect total construction costs to be 15% higher in Country A because of the importance of labor, whereas in Country B the increase is limited to 7%. As labor gets less expensive, post-event materials demand surge becomes dominant.

Table 1. Weighted demand surge (Source:AIR)

	Country A	Country B
Local Labor Demand Surge	12%	4%
Materials Demand Surge	3%	3%
Total Demand Surge	15%	7%

So far, we have used the experience in the U.S. as an example to understand the economic concepts, primarily because of the abundance of data. Globally these same economic concepts should apply to other industrialized nations. In the next section we will look at how we applied these concepts to Europe.

Developing Global Economic Demand Surge

In the previous section we learned that to understand demand surge in a region we must have a catastrophic event significant enough to disrupt construction market equilibriums for labor, materials, or both. We also need to have a time series of price data after the event to understand the magnitude of the impact of local effects and cost inflation. Finally, it helps to know if the relative cost of labor is high enough that local effects need to be considered. In this section we will look at how we identify significant local effect regions for developing international demand surge models and at the challenges we faced in benchmarking the results.

In Figure 7 the bar chart on the top shows the relative construction wage rates for the bottom 5, and top 5 countries in Europe. This data comes from the last wage survey conducted by Eurostat. The lower hourly wage is found in Eastern European countries; the higher hourly wages are found in Western European countries. The highest hourly wages are close to the U.S. average. The differential between these two groups is quite significant, but it needs to be placed in context.

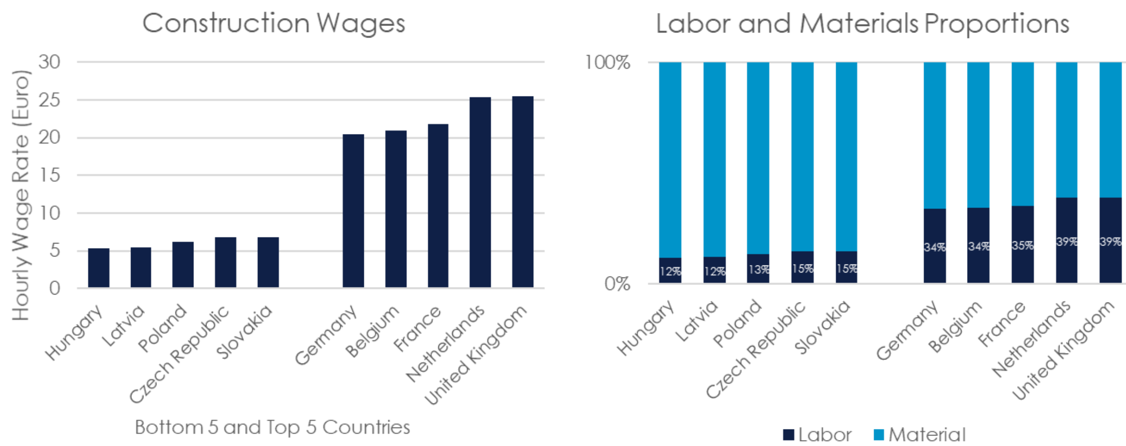

Figure 7. Top 5 and Bottom 5 European countries by construction wage rates (Source: Eurostat, AIR)

In the chart on the bottom of Figure 7, we can see the relative contribution of labor to the total construction cost for each group of countries. These proportions were calculated by assuming the same structure is being built in each country. It would take the same number of person hours and the materials costs are typically constant across each country. For the higher wage countries, the cost of labor makes up a larger proportion of the value of the work. If the labor cost were to increase 10% in all countries, it would contribute about 4% to the increase in cost in the UK and about 1% in Hungary. The takeaway is that all the countries are likely to be affected by construction materials demand surge; on top of that, higher wage countries are going to be affected by a more localized labor demand surge effect.

We also need to know which historical events were likely to have caused demand surge, and the labor and materials cost time series that cover those events. In general, we can find good data from Eurostat going back to 2000 for our most affected countries. Figure 8shows what is available starting in 2000 for a sample of countries. We will use this data to explore what happened in 2007, after an extratropical cyclone, Kyrill, tore across a wide swath of Europe in January. Before that we would have to go back to 1999 to find significant demand surge–causing events for a European extratropical cyclone, such as Anatol, Lothar, and Martin. Because the Eurostat index begins the year after these three storms struck, we looked for other data sets in the statistics department of each country affected to fill in the gaps.

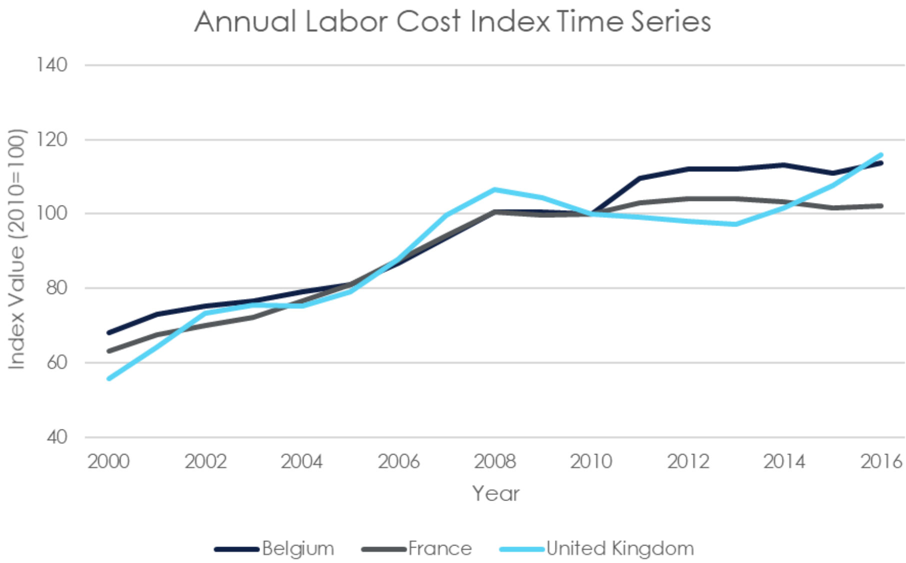

Figure 8. Construction labor index for selected countries (Source: Eurostat)

Table 2 lists the most available prices indexes and how they can be used as proxy data. The preferred data set is the construction cost index because it takes into account labor and materials costs and will give the most relevant comparison, but the data availability is limited the further you go back in time. In addition, the producer price index can be used as a proxy for building materials. Finally, the consumer price index can be used for industrialized countries when no other index is available, but we have seen instances where the construction cost index and consumer price index diverge significantly.

Table 2. Selected cost indexes

Index Name	Labor Cost	Materials Cost
Construction Cost Index (CCI)	X	X
Producer Price Index (PPI)		X
Consumer Price Index (CPI)	X	X

Another important consideration when interpreting data related to European historical events is how the free movement of labor has changed significantly from 1990 to 1999 to 2010. And at the end of 2020 Brexit became a reality, so we have every reason to believe labor movement restrictions between the UK and the European Union will increase economic demand surge in the UK from what we would see today.

Case Studies: Historical Evidence of Demand Surge in Europe

In this section we will review historic storms that affected Europe, their implications for excess demand for reconstruction, and the impact on costs following the events. Because we were limited to data that provides evidence of economic demand surge, the review focuses on the 1990 and 1999 extratropical cyclone seasons. As a point of contrast, we also looked at the 2007 season to consider the effect of labor and materials demand surge and we concluded that a *local labor market* disturbance does not appear to contribute to the uplift. For each of these scenarios, we will compare AIR's NGM demand surge model to available historical data, including Producer Price Indexes (PPI), Construction Cost Indexes (CCI), Eurostat construction labor indexes, as well as national construction indexes, which can be used as a proxy for changes in cost levels where they are available.

The 1990 ETC Season

During the winter of 1990, which was warmer than usual, a series of severe storms swept across Europe. Daria, which affected Europe January 25-26, struck an area that had already been struck by a series of storms; in February, after Daria, storms Herta, Wiebke, and Vivian struck. Daria alone—one of the most severe storms to have struck Europe on record—caused significant damage in six countries; most of the damage was in the United Kingdom. February 26-28, 1990, Vivian and Wiebke both struck Europe as the last of the devastating series of storms that affected Europe that year. These two storms alone, arriving just four weeks after Daria, caused more damage than Lothar and Martin nearly a decade later.

Figure 9 shows the storm damage in the left panel with the relative concentration of damage at the sub-national level. The damage map is overlaid with the tracks of the four major storms that year, also highlighting the areas of greatest impact. More than 70% of the losses are in the United Kingdom, Germany, and France, which means that the demand surge in these countries will determine the impact for the whole event. The right panel shows the relative country-level NGM demand surge impact.

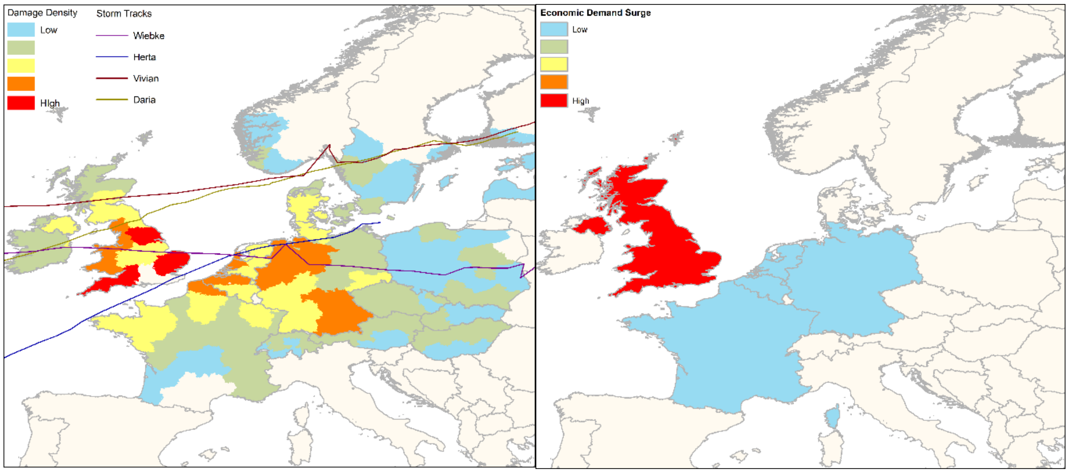

Figure 9. Cumulative damage concentration for 1990 ETC events (left panel); relative demand surge (right panel) (Source: AIR)

Table 3 shows the results of the NGM demand surge model for the three countries and the total impact for Europe, using a flat assumption of 3% that includes the long-term average for cost inflation for materials as a proxy for materials demand surge and general construction labor inflation; anything beyond that can be attributed to local variation. We can see that for the UK the model predicts about a 7% increase in prices after these events. This is consistent with the higher relative damage in the south and southeast of England. Contrast this with the lower increases in France and Germany where the highest relative damage is a magnitude lower but the predicted demand surge is negligible—mostly materials demand surge. Outside the most impacted countries, the predicted demand surge drops down to values that are consistent with no or minimal local effects and no increases in cost inflation.

For 1990 the data is limited, so we must use the Organisation for Economic Co-operation and Development (OECD) producer price index (PPI) to represent the materials trend and the consumer price index (CPI) for the labor trend. For construction statistics we can use the construction repair index from Germany, but for Europe we must create a weighted average of the PPI and the CPI because, while we were able to get specific construction statistics for Germany, these statistics were not available Europe-wide. The first thing to notice is the wide differences in the PPI and the CPI, which is to be expected because this is pre-European Union. It is also likely that the free movement of labor across national borders at the time would have played some part in these results.

Table 3. AIR demand surge research and other economic data sets for top 3 countries affected by 1990 ETC events. (Sources: AIR, OECD, National Statistics Offices)

Country	NGM Demand Surge	PPI	CPI	National Construction Statistics
United Kingdom	7%	5%	6%	n/a
Germany	4%	2%	4%	6%
France	4%	0%	3%	n/a
Europe	8%	5%	8%	6%

The 1999 ETC Season

In December 1999, Europe was hit by three powerful storms that were individually deadly and collectively catastrophic. Anatol hit Northern Europe on December 3 and was followed a few weeks later by Lothar and Martin. Anatol had wind gusts of up to 185 km/h when it reached the German Bight and southern Denmark. On December 26, Extratropical Cyclone Lothar hit the Brittany coast and just nine hours later had created a path of destruction across northern France. One day later, about 200 km south, ETC Martin battered areas near Bordeaux, Biarritz, and Toulouse. France was hit very hard, but heavy damage also occurred in other regions.

Figure 10 shows the storm damage in the left panel with the relative concentration of damage at the sub-national level. The damage map is overlaid with the three major storms' tracks that year also highlighting the areas of greatest impact. For Lothar and Martin, more than 65% of the losses are in France, which means that the demand surge in that country will determine how demand surge is viewed for the whole event.

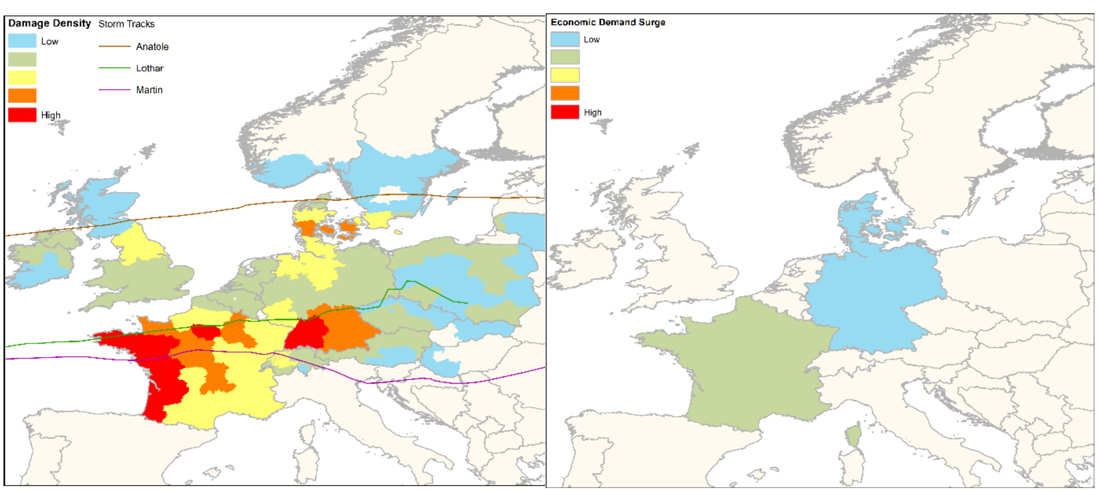

Figure 10. Cumulative damage concentration for 1999 ETC events (left panel); relative demand surge (right panel). (Source: AIR)

Although the events were widespread, economic demand surge occurred primarily in France. The right panel shows the relative country-level NGM demand surge impact for all three events.

Table 4 shows the supporting data for the two countries that are most affected by these three events—France and Denmark—and the total impact for Europe. This includes the assumption of using 3% as a general construction labor inflation, and long-term materials cost inflation proxy for demand surge, as above; anything beyond that can be attributed to local variation. We can see that for France, the model predicts about a 6% increase in prices after these events. Contrast this with the lower 4% increase in Denmark. The moderate increase in France is indicated by yellow; elsewhere the predicted demand surge drops down to values that are consistent with no or minimal local effects and no increases in cost inflation like those in Denmark.

For construction statistics we used the construction repair index from France and Denmark; in addition, we can see that the PPI comes in at a similar level for both countries at about 5%. For Europe we used a weighted average of the PPI and the CPI. It's important to note that the CPI is the weighted average of most other prices, so it is quite low at 1% relative to the PPI in France; while the PPI is increasing, most other prices are remaining stable or flat. The data from Europe show similar changes in the PPI and Construction Cost index. The European CPI, however, reminds us that costs and inflation vary widely across the EU and we need to be cautious when interpreting the data.

Table 4. AIR demand surge research and other economic data sets for 1999 ETC events. (Sources: AIR, OECD, National Statistics Offices)

Country	Economic Demand Surge	PPI	CPI	National Construction Statistics
France	6%	5%	1%	5%
Denmark	4%	4%	2%	5%
Europe	6%	7%	5%	6%

The 2007 ETC Season

The winter of 2006–2007 had an unusually large number of strong extratropical cyclones, including Britta, Karla, Lotte, Franz, and Hanno (also known as Per), which caused damage as far east as Lithuania. The worst storm during this season in terms of wind speed and damage was Kyrill, which reached the United Kingdom on January 18 just four days after Hanno struck Sweden. The wind speeds associated with Kyrill were lower than Lothar's in 1999, but Kyrill affected an unusually large area. Significant damage and at least 47 deaths were sustained in Germany and the United Kingdom, while Ireland, the Netherlands, Belgium, Austria, Poland, and the Czech Republic were also severely affected.

Figure 11 shows the storm damage density in the left panel with the relative concentration of damage at the sub-national level. The damage map is overlaid with Kyrill's storm track that year and highlights the areas of greatest impact. This season provides a different perspective: Kyrill has a large footprint, but the damage is much more spread out. The only country with a significant area of damage is southern Germany, but the density quickly drops off in the regions close by. The right panel shows the relative country-level NGM demand surge impact, which includes Germany, the Netherlands, and the UK as the areas most affected.

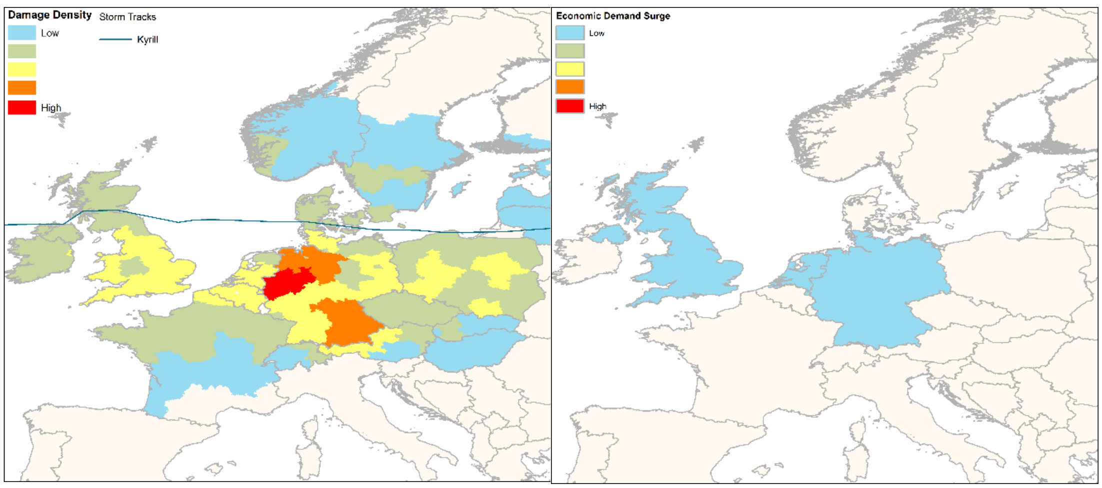

Figure 11. Cumulative damage concentration for 2007 ETC events (left panel); relative demand surge (right panel). (Source: AIR)

Although the events were widespread, economic demand surge would have been primarily expected in Germany. But the map on the right shows the NGM demand surge at the country level and the uptick is the same everywhere. What we are seeing is an example where there was material market disruption but no local labor market disruption. Materials cost increases were significant, but there was no disruption to the labor market causing a local uptick in Germany.

Table 5 shows the results of the NGM demand surge model for the three most impacted countries and the total for Europe. This includes the flat assumption of 3% comprising the long-term average for cost inflation for materials as a proxy for materials demand surge and general construction labor inflation. While there is a little uptick in labor demand surge in Germany, the Netherlands, and the United Kingdom, it is not significant and may not have been noticed.

For the supporting data in 2007, we can use the Eurostat construction labor index to get a much more realistic understanding of that market. We will still use the PPI to represent the materials trend. For construction statistics we can use the construction repair index for all our countries, but for Europe we will still use the weighted average of the PPI and the CPI.

Table 5. AIR demand surge research and other economic data sets for 2007 ETC events. (Sources: AIR, OECD, EuroStat, National Statistics Offices)

Country	NGM Demand Surge	PPI	EuroStat Construction Labor Index	National Construction Statistics
Germany	4%	5%	1%	4%
Netherlands	4%	7%	2%	6%
United Kingdom	4%	4%	8%	6%
Europe	3%	5%	4%	5%

The most relevant point in this chart is the comparison between the NGM demand surge factors and the national construction statistics (NCI). The NCI for these countries is relatively flat as the NGM demand surge factors are, but they are a little higher. The difference can be attributed to using the long-term average for cost inflation for materials as a proxy for demand surge, rather than the PPI. The NGM demand surge factors are presented with the long-term average inflation because it is what you would see for rate-making.

The most important takeaway is that this was a demand surge–causing event, but it is primarily a construction materials demand surge. Any local effects are too small to show up. Because demand surge is subject to many other additional factors beyond a single natural catastrophe, it's important to consider the data concurrent with when an event was happening.

Summary and Understanding Demand Surge Related to Future Events in Europe

In this paper we looked at economic demand surge after European extratropical cyclone events using the 1990, 1999, and 2007 seasons as case studies. The discussion started with how economic demand surge fits into the bigger picture of loss inflation and its impact in insurance claims after a natural catastrophe. We followed with a closer look at the economics behind demand surge and how the scope of labor and materials markets are very different. This leads to a broad inflation effect from the materials market that increases all claims, and a local effect that may or may not affect subsets of claims.

The case studies provided a look at the available data that could support the idea of European ETC demand surge. The 1990 and 1999 seasons showed evidence that there was a construction materials demand surge effect and a local labor demand surge effect, but in 2007 we *only* saw evidence of a construction materials demand surge effect.

It is also possible that construction worker freedom of movement within the EU having evolved over time played a role. In 1990 labor movement would have been relatively restricted compared to 2007 when Eastern European countries were joining the EU. The ability of construction markets to respond to increased demand was limited in 1990. The same events may have had a lower price response had they occurred more recently—something to keep in mind when considering the historical data, pre-Brexit. We could see the same response in the UK in the future, however, if the same circumstances were to arise. There were other sources of loss inflation on top of this. After Lothar and Martin, there was evidence that claims were artificially inflated due to less rigorous adjusting to speed up settlements. This would have to be considered in addition to the economic demand surge.

Key to understanding demand surge related to future events that affect Europe is the improving quality and availability of national construction statistics. In addition, detailed labor and materials construction cost data is becoming available for several countries outside the U.S. from Xactware. This will be valuable information for evaluating future events in Europe and around the globe.

About AIR Worldwide

AIR Worldwide (AIR) provides risk modeling solutions that make individuals, businesses, and society more resilient to extreme events. In 1987, AIR Worldwide founded the catastrophe modeling industry and today models the risk from natural catastrophes, supply chain disruptions, terrorism, pandemics, casualty catastrophes, and cyber incidents. Insurance, reinsurance, financial, corporate, and government clients rely on AIR's advanced science, software, and consulting services for catastrophe risk management, insurance-linked securities, longevity modeling, site-specific engineering analyses, and agricultural risk management. AIR Worldwide, a Verisk (Nasdaq:VRSK) business, is headquartered in Boston, with additional offices in North America, Europe, and Asia. For more information, please visit www.air-worldwide.com.

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