Pandemic Risk on Small Businesses

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Executive Summary

The Covid-19 pandemic has been one of the most significant events in modern economic history. Unfortunately, the insurance industry did not fully provide the public service it does in so many other areas, and it was up to chaotic and politicized government stimulus to manage the risk. In this paper, we attempt to create a new framework for pricing pandemic risk, using recent data from Covid-19. We argue such risk, especially now as there is a wealth of recent data, is more insurable than previously thought. Small, retail businesses in urban areas are the focus of our analysis, since they bear the most risk and are thus a clear target for future risk management. We first analyze the risk that a pandemic pose to such businesses by looking at the sustainability of such businesses, analyzing costs (rent, wages) along with revenue, then generalizing this to a multi-dimensional equation to compute sustainability. We hope that this data is usable for businesses to better prepare for future pandemics and prevent bankruptcy. We also model how long our predictions will remain relevant, as the cost of a pandemic becomes less certain the more the situation changes from Covid-19. We end with some recommendations for a hypothetical pandemic insurance product, for both the public and private sectors.

Background Information

Background

Plagues have ravaged humanity since before recorded history, deeply influencing the course of human events. Documented since Biblical times, the most destructive event was the Bubonic Plague, a bacterial malady spread by fleas. It afflicted Eurasia in the 14th century and killed an estimated 60% of the population of Europe. In more recent history, the Spanish Flu, a viral infection related to Covid-19, killed an estimated 2.7% of the world's population.

Population expansion, urbanization, and globalization have sharply increased the magnitude of pandemic risk in the last 1000 years. The relatively recent possibility of bioterrorism or biological warfare also increases fear of events of this kind. Advances in prevention and mitigation such as public sanitation, vaccination and quarantining have followed.

Covid-19 emerged in Central China in late 2019, likely contracted from a bat. The pandemic quickly spread across the world and was declared a pandemic in March 2020. Insurance was not involved in managing pandemic risk for the vast majority of businesses. In fact, when industry leader Munich reinsurance offered pandemic coverage in mid-2018, no one bought it.

Since the pandemic, retail businesses across the globe have been shutting down. Businesses most at risk are the ones in 'prime' real estate locations that require heavy foot traffic and sales to make up for high rents. New York City, the largest urban area in the United States, has many businesses that fit this description.

Problem Statement.

For our purposes we will analyze the risks of small, retail businesses in New York. We chose to analyze these because they represent the upper limit of risk: they tend to have less savings, have less access to credit, be more reliant on foot traffic and have greater share of fixed costs to total costs than larger business and those outside of urban areas. Because of this high exposure to pandemic risk, they represent the most likely candidates for customers of a pandemic insurance product. In this paper we propose that the risk a business faces due to a pandemic is finite, calculable, and mostly dependent on a fixed number of predefined variables. In the past the need for pandemic insurance was less clear. Covid-19 may serve as a wakeup call, showing the magnitude of the risk.

Data Methodology

Identification

In order to estimate pandemic risk we identified five key variables that will affect a small

business: wages, rent, and revenue, and pandemic frequency and severity.

Wages and rent are the most significant cost for the vast majority of businesses, dwarfing

other operating expenses.

The data for rent comes from an ABS Real Estate journal publication, noting trends in

retail spaces and establishing averages for the size of retail stores, combined with the REBNY

Retail Report which outlines the mean rent per square foot seasonally and annually.

Our wages data comes from the BLS government website, which focuses on the retail industry.

From the historical revenue data from the Census Bureau, we extrapolate what the trend for retail

revenue would be now and in the future. The data is from 1997 to 2017, and helps provide a

strong historical foundation. Up to date revenue information for New York isn't available, but we

used a JP Morgan Chase research paper, which measured loss of revenue for urban small

business nationwide, and Okun's law, which relates frictional unemployment to economic output,

to approximate the loss of revenue due to pandemic. Combined with the employment data, we

extrapolate future trends and apply them to our model.

To find pandemic frequency, we cite University of Minnesota's Center for Infectious Disease's

static figure drawn from historical data since 1700, combined with a dynamic figure from the

National Institute of Health that estimates how pandemic risk increases over time in response to

a myriad of trends such as globalization, urbanization and environmental degradation. We

combine these two and extrapolate.

To estimate the severity of pandemic, we use new cases per capita. This comes from JHU's New Cases by County dataset. This measure leaves much to be desired, but severity is vital to the use of our model to predict the cost of a hypothetical pandemic after Covid-19. It also is useful as a stand in for unemployment data as we observed that there is a close relationship between unemployment and new COVID-19 cases per capita, and cases of disease are updated more frequently than unemployment data.

Data Reliability.

All our data comes from accredited institutions and scientific journals, if not government organizations. Our assumptions stem from well thought out logical inference and are listed in the "limitations" section.

## Mathematical Methodology

Initial Thoughts

With the overarching goal of our paper to price pandemic risk, the first and foremost step that we took was to identify potential risk factors that small businesses face.

From our research, the most important ones seem to be the severity of the pandemic, employability, and the rent prices during such a crisis.

Employability

The employment trend in NYC's Retail sector has historically been increasing at a steady rate until 2014, where it stood almost static all the way until 2019.

The reason for this stagnation is because the population of New York City stopped growing around that period and thus the employment numbers remained static.
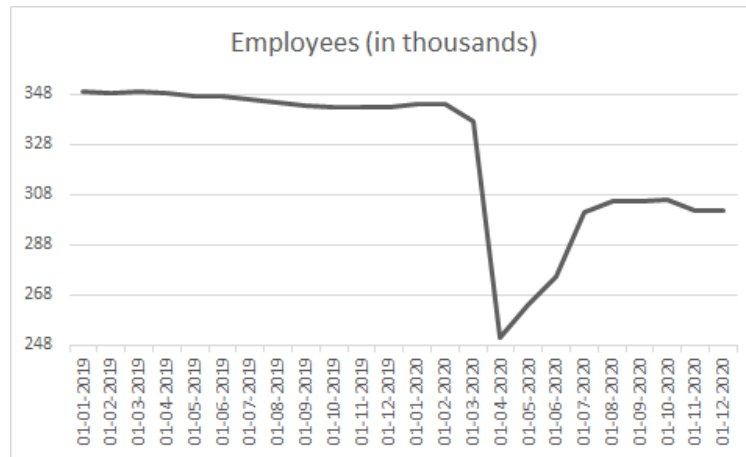
Once the COVID-19 pandemic hit, the employability in the retail sector took a big hit, with almost a 29% decrease in employment within the first few months. After the initial drop, the employment numbers rose up to just under a 12% decrease (from the initial employment level at the beginning of the year), once the COVID restrictions were loosened and more people could go back to work.

New COVID-19 Cases

With the loosening of the restrictions initially put in place, though, the overall number of cases increased drastically. The drop in employment can be easily correlated to the sharp increase in new cases initially, but then once the new cases start going down and restrictions are removed again, the new case numbers rose significantly. This would make sense because once the COVID restrictions are no longer in place, cases will rise. What is surprising is the relation of the new cases to the unemployment data.
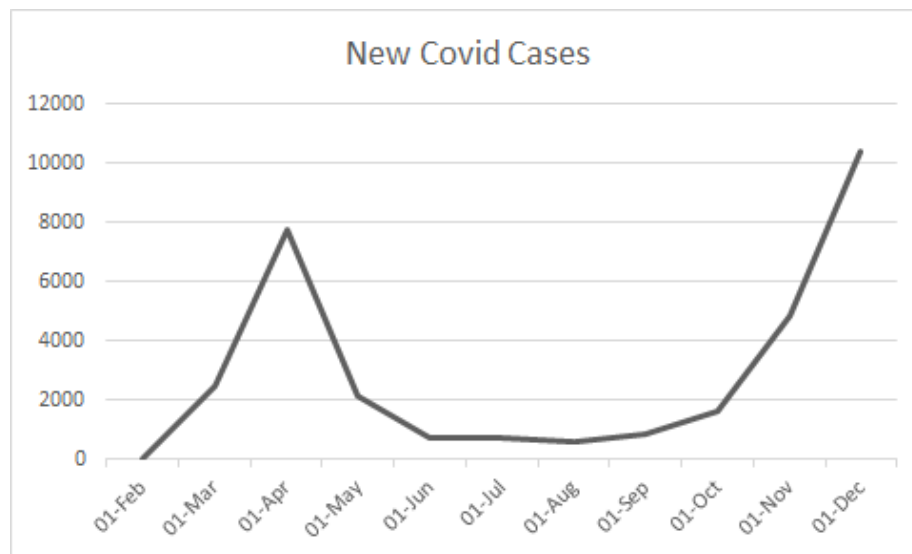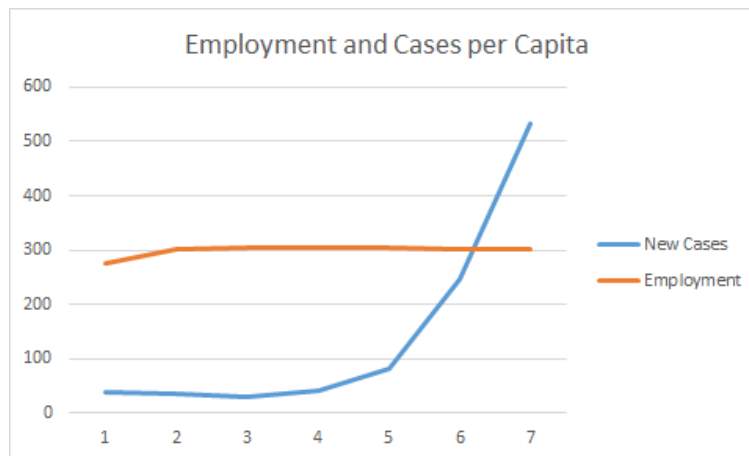
Relation Between New Cases and Unemployment

Our initial hypothesis was that as the number of COVID-19 cases increase, unemployment

would increase because new restrictions would be put into effect.
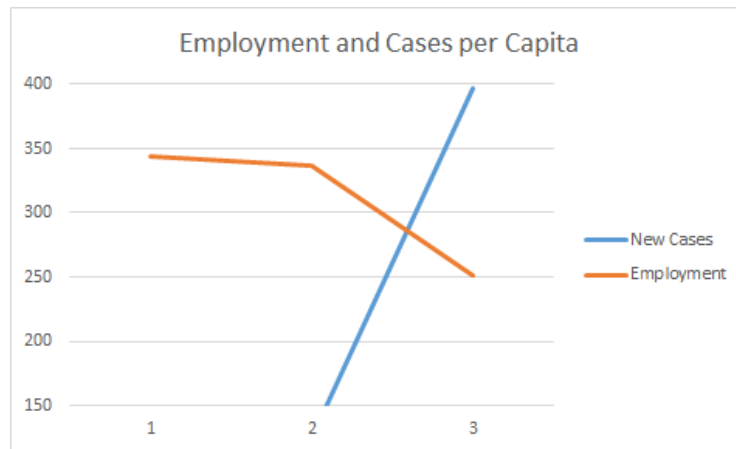

 What ended up happening was that the new restrictions were never put into place, which made

the new cases skyrocket and unemployment stagnate at 12%.

Revenue (Adjusted)

Revenue data available from the Retail Trade sector is available in 5-year cumulative groups

We took the original revenue available to us from the dataset, and then adjusted it to be the average revenue per retail establishment in NYC and accounted for the Payroll of these establishments in our initial calculations itself.
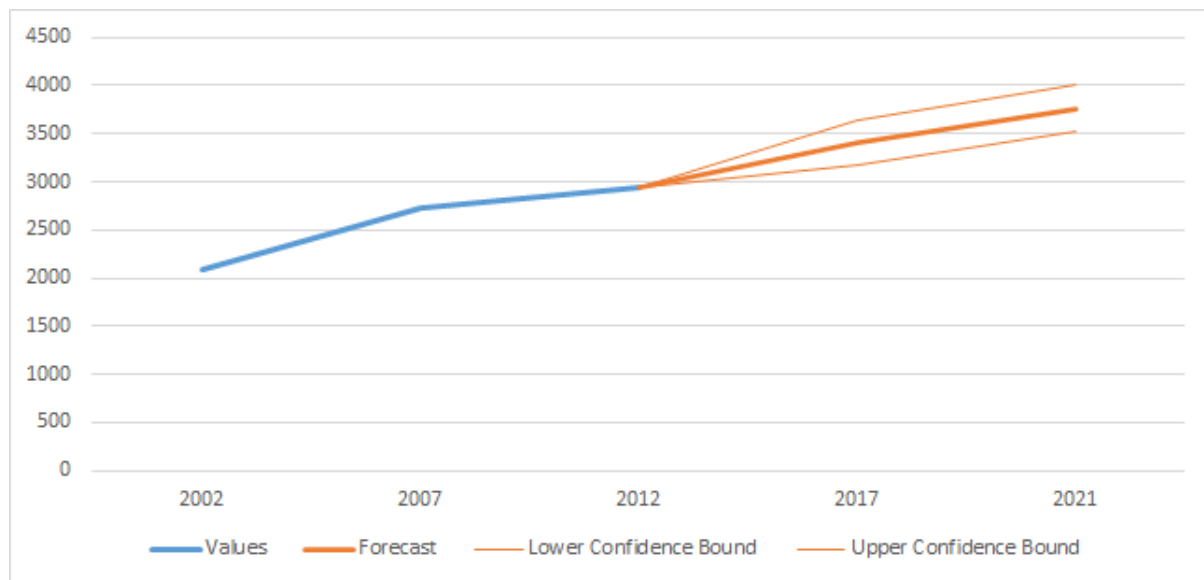
The Revenue forecasting estimates with 95% Confidence that the revenue during 2021 would be between $3.523 million and $4.003 million.

Historically, the revenue in the retail industry has been growing at a steady pace in NYC and can be modeled by the LSRL: Revenue is approximately 84.5x - 167000 where x is the year.

The revenue is not available as a time series and due to the lack of revenue data during the pandemic, we had to estimate the revenue during the pandemic based on a few different parameters.

Rent

Rent in retail is extremely important. If you don't make rent, you may not even have a store to open.

During the pandemic, on top of reduced foot traffic plummeting business revenue, owners must worry about not making rent in time.

Rent Prices in New York, especially in the Retail sector, are high. Using REBNY's reported data, we constructed a confidence interval for the ppsf in famous NYC localities.

The rent prices are between $261.41 and $910.826 per square foot annually.

Through ABS' Real Estate journal publication, we also know that the average retail store in the US is approximately 2,200 sq ft in size.

From this we can conclude that the annual rent for a small retail business in NYC would be somewhere in between $575,000 to $2 million a year.

Estimating Revenue during COVID-19

To estimate the revenue during COVID-19, first we look at the unemployment metric.

We know that at its highest, the unemployment in the retail sector grew to 29% in NYC. This lasted for approximately 2 months.

The loss generated during this time can be approximated using Okun's $\dfrac{\overline{Y} - Y}{\overline{Y}} = c(u - \overline{u})$ Law.

Where the left-hand side of the equation describes the change in output and the right-hand side of the equation is the subsequent change in unemployment.

Which can be rewritten as: $\dfrac{\Delta Y}{Y} = 0.03 - 2\Delta u.$

Where Delta Y is the change in output and DELTA CHANGE THIS u is the change in unemployment

This version of Okun's law is known as the growth rate version [of Okun's law]

After solving this we find that the adjusted Revenue during the pandemic would be between $2.273 million (-39.6%) and $2.582 million (-31.4%).

Second, we look at statistical papers published following the pandemic on retail losses experienced by restaurants in urban areas.

According to which the losses experienced are approximately 40%. This figure is close to our model's bounds, and thus reaffirms our model's functionality. From this, we propose that the estimated loss on average to a retail business in New York would be between 30-40%.

Taxes and Incidentals

Taxation is also important in pricing pandemic risk. Most small retail businesses would be at a loss during the pandemic and would not have to pay taxes for the year.

In other years we estimate that approximately 33% of the business revenue would be paid towards taxes.

We also approximate that approximately 15% of the business revenue on a normal year goes towards unavoidable expenditures such as insurance, liabilities and assets.

Pricing Pandemic Risk

Finally, after establishing all these variables, we are ready to estimate the pandemic risk quantitatively and qualitatively.

The Risk of a Pandemic

Calculating an actual estimate of the risk of a pandemic is something that a lot of very smart people have tried doing for a long time. Our approach to it is very simple. We assume that the probability of a pandemic occurring is about 3 in 100 years (0.03/year), which is based on us having 9 pandemics in the last 300 years. We understand that such an estimate may not be very accurate, but it is the best that we can do when it comes to estimating such a random and rare event.

Losses During a Pandemic

The loss faced by small businesses during a pandemic is because of the massive loss in revenue but static rent prices.

From our numbers we see that during a pandemic small business may generate revenue on average between $2.2 million and $2.5 million and have to pay a rent of somewhere in between $0.5 million and $2 million.

On top of this, businesses may be liable for Incidentals ranging from $0.5-$0.6 million.

Already we can see that in most cases, businesses may not survive the initial 2-month hurdle during which pandemic restrictions are in effect.

Expected Loss Due to a Pandemic

Assuming moderate to severe losses during a pandemic, a small business can expect losses of

over $300,000 within the first few months of a pandemic.

This loss will decrease over time, but the company may still remain in loss if it's margins are

closer than 12% because even after the initial hurdle, losses will remain stagnant at 12%.

The Expected loss, hence, would be approximately $9k.

This may seem like a small number, but this is because it is spread out over a very large time

span.

The risk of a pandemic may be small but when it does happen, the costs add up and what

happened to NYC during this pandemic may happen again, setting the city back economically

and destroying the legacy of many historical mom and pop shops.

Risk

Our model generated a single, expected value of loss for the average small business in the dataset, for an event like Covid-19. This is combined with the frequency of such events, roughly 3 per 100 years, to create the expected cost to insurers. This necessitates a yearly payment of 5% percent of the yearly revenue of the average business in the dataset.

Risk, however, is not uniformly distributed. It is affected by two of the key variables that we earlier list: rent and revenue. The higher share of total expenses rent (nearly always the largest fixed cost of a firm) embodies, the more vulnerable the firm is to crises like pandemics. A firm with high revenue, all things equal, will more likely have the resources to save, and be more prepared for sudden shocks. Though it is mostly out of the scope of this project, global risk of pandemic is also changing due to globalization, urbanization, environmental degradation, increases in precautionary government spending, increases public awareness, and improvements in medical technology. This is further discussed in the "limitations" section.

Limitations

Pandemic response could be an antifragile system - one that becomes more robust with stress. There is far more capacity for dealing with a new pandemic than there was in early 2019, as embodied in greater precautionary government spending, public awareness, and vaccine technology. All things equal, a new pandemic would be less costly than Covid-19 has been, though how much less costly depends on a myriad of factors.

Recommendations

A purely free insurance market, we contend, does not see commonly adopted pandemic insurance apart from a few edge cases (i.e., sporting arenas and theaters). This is for four reasons: Firstly, the great variability in risk businesses face (due to differences in the inputs into our model) will cause many to opt out of coverage. This has the potential of causing a "death spiral" akin to the feared scenario in health insurance premiums, in which the dropping of coverage by low-risk customers results in higher premiums, which causes more to drop coverage and so on. Reason two is the high cost and high time interval risk of pandemic. Risks with these characteristics are famously difficult to insure, as was said in an article on Munich Reinsurance's ill received pandemic insurance effort, "No CFO was eager to be the first among their competitors to take on a significant new cost."[5] Reason three is that, while the risk of a pandemic emerging and the cost of shutdown are relatively quantifiable, there are other factors that affect the cost that pandemic poses to business, namely government policy and public fear. These two factors determine consumer behavior, which directly translate into revenue, and are near-impossible to model. We attempt to quantify them through the "severity" measure based on new cases, though this is a poor approximation. Finally, reason four is market perception of risk. Historically, pandemics have tended not to remain in public consciousness for very long. The Spanish flu, though far more deadly, has had a small fraction of the cultural impact of the First World War it happened concurrently with. These events are usually quickly forgotten, and this hurts the long-term prospects for demand.

To overcome these hurdles, such a policy (unless heavily subsidized) should have a capped amount of compensation. This will help stave off a "death spiral" by limiting the difference in risk reward calculus between businesses. Another possible precautionary measure

would be to make pandemic insurance compulsory, but there is little reason to expect political will for this (at least in the United States). A theoretically identical policy with seemingly more political potential would be to introduce a "pandemic risk tax" (premium) on retail stores. Ideally this tax would be proportional to the risk inputs identified in our model to incentivize businesses to shift towards lower-risk practices. The revenue from this could be used to fund "stimulus" (payout) in the case of pandemic. The Federal Reserve is more than qualified to play the role of reinsurer. Still, a model like flood or earthquake insurance, in which private companies create subsidized products, seems more likely if not more laudable.

Adopting some system like those discussed above is attractive not only for macroeconomic stability, but also could help avoid the high stakes political battles over stimulus that have left so many without support. Insurance, through a macroeconomic lens, could be simply an organized stimulus; instead of providing low interest or subsidized loans, it does the opposite, with the customer making payments slowing over decades only to get the (likely subsidized) sum afterward. Apart from the incentive of subsidy per se, government support for pandemic insurance would do much to decrease the political risk and uncertainty that was likely part of the reason pre-Covid-19 pandemic insurance was rarely so adopted in the first place.

Lastly, greater public awareness of the risk of pandemic would be a tremendous boon to the prospects of a pandemic insurance product. A campaign to keep the possibility noted, from the private or public sectors, would be a good first step.

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