COVID-19 and Urbanization

Dr. John Rutledge 27 February 2021

Summary: *Cities bore the brunt of the COVID-19 pandemic. In response, many people fled the city for safer, less crowded locations. Some argue that people will never return to the cities. A careful review of the historical record and of two separate bodies of academic research show they are wrong. Throughout history, the productivity advantages of living and working in cities have made them magnets for young, energetic, creative people. It will take time, but cities will return stronger than ever, as they have after every pandemic in history.*

Cities were the epicenter of the COVID-19 pandemic, with more cases and more deaths than outlying areas. Frightened city dwellers—those who could afford to do so--abandoned the city and moved their families to safer, less crowded suburban and rural locations. A review of historical pandemics strongly suggests they will return once the danger has subsided.

For the reasons why cities are so resilient, I review two different bodies of research. First, a half century of economic research shows that cities exhibit economies of scale, known as agglomeration economies, that make people in cities more productive than they are in less densely populated areas.

Second, recent research in complex adaptive systems by theoretical physicists at the Santa Fe Institute shows why cities exhibit economies of scale. Like networked organisms in physical science, cities exhibit superlinear scaling properties. That means doubling the size of a city more than doubles the major measurable characteristics of a city, including income, wealth, innovation, creative activity, the birth and death of businesses, crime, garbage, and the spread of diseases. “On average, as city size increases, socio-economic quantities such as wages, GDP, number of patents produced, and number of educational and research institutions all increase by approximately 15% more than the expected linear growth…That 15% productivity advantage is true for all cities, in all countries, in all time periods where there is adequate data”.

That superlinear scaling law is the reason why cities were initially hit harder than the countryside by COVID-19; it is also why cities will come back faster than the countryside once the disease has been tamed.

Cities Bore the Brunt of COVID-19

The table below, compiled by the United Nations, shows that in every major country, COVID-19 hit the people who live in large cities especially hard. For example, based upon UN data through July, 2020, 82% of the 4,748,806 cases of COVID-19 in the U.S. were recorded in just the four largest cities plus Washington, DC. (UN-Habitat, 2010). Other countries had the same experience.

Table 1.5: Incidence of COVID-19 in urban areas (July 2020)

Country	Number of confirmed cases	Number of cases recorded in capital city and four major cities	Percentage of cases recorded in capital city and four major cities (%)	Number of cities with over 100k population	Number of cities with over 100k population with recorded cases
Algeria	26,764	23,174	87	40	39
Argentina	173,355	163,217	94	30	27
Bangladesh	223,453	174,733	78	30	29
Brazil	2,554,042	1,460,545	57	324	308
Chile	351,575	299,844	85	49	49
China	82,880	76,441	92	401	322
Colombia	257,101	216,196	84	65	65
Egypt	91,583	74,119	81	41	39
Germany	212,331	184,691	87	79	79
Ghana	31,851	24,532	77	13	13
Iraq	110,032	84,662	77	29	29
Italy	248,229	224,381	90	48	48
Mexico	450,570	367,561	82	188	164
Nigeria	39,977	23,661	59	82	82
Peru	389,717	292,833	75	26	24
Qatar	109,305	104,123	95	2	2
Russia	864,948	651,147	75	168	157
Saudi Arabia	266,941	225,971	85	24	24
South Africa	434,200	388,154	89	57	56
Spain	302,814	181,433	60	56	49
United Kingdom	307,256	267,884	87	84	84
United States	4,748,806	3,874,766	82	317	317

Source: UN-Habitat, Global Indicators Database 2020.

Figure 1: Concentration of COVID in Major Cities by Country

It makes sense that people in cities are more likely to be in sneezing-distance of each other than are people who live in the suburbs or countryside. It also makes sense that those who could afford to do so fled the city when COVID hit to protect themselves and their families from the virus. Those who could not afford to leave stayed.

Frightened People Fled the City to Escape COVID-19

According to a New York Times analysis of cell phone records, 420,000 people moved out of New York between March and June of last year; 137,000 people (including more than one of my partners) filed with the Post Office to have their mail forwarded to addresses outside the city in March and April (Paybarah, 2020).

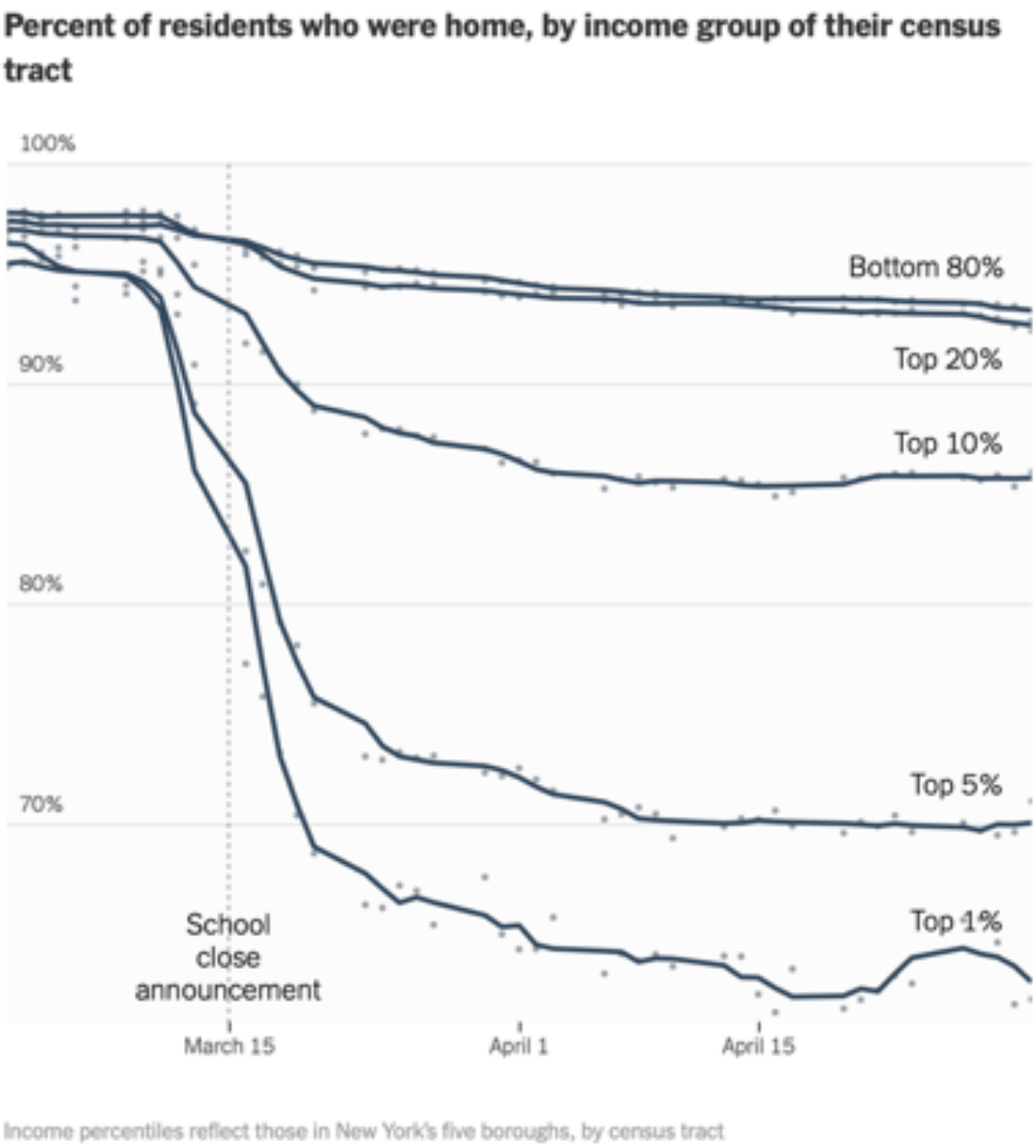

Figure 2: High-Income People Fled the City. The Rest Stayed Home.

Of course, not everyone can afford to leave town. Data shows that fleeing the city is a luxury good, as it has been throughout history. In the chart above, cell phone records show that one in three high-income families left town while the bottom 80% of earners largely stayed put (Quealy, 2020).

They haven't yet returned. Data on office card swipes from as recent as December 2020 show that only one in seven office workers in San Francisco and New York have returned to work. Not surprisingly, rent per square foot of office space has declined in both cities. (Leonard, 2020)

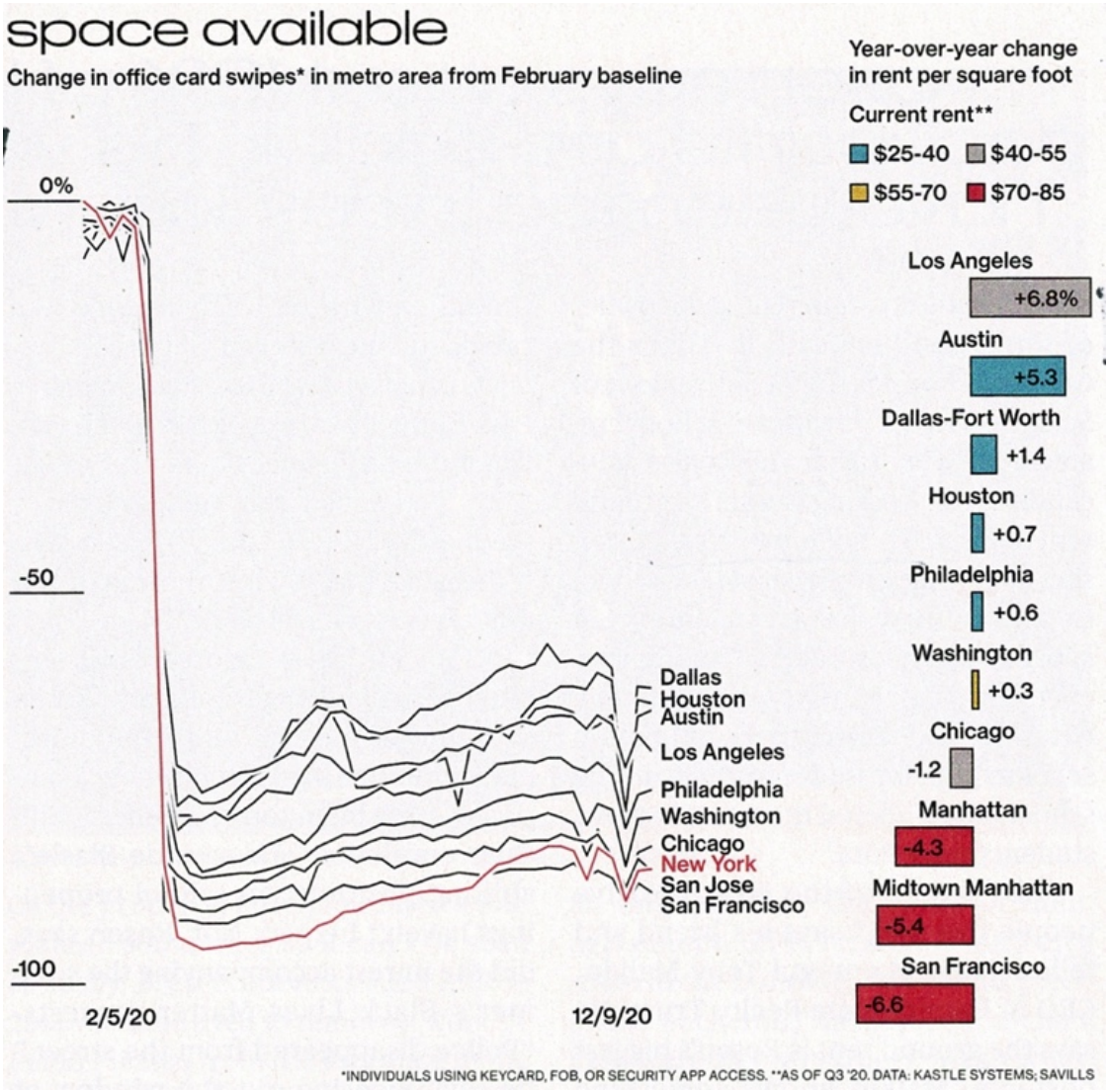

Figure 3: Change in Office Card Swipes from February 2000

Some say that frightened residents, now that they have learned to work from home and communicate with colleagues on Zoom, will never come back to the city (Baker, 2020). “There’s going to be a reverse of the urban boom, ” according to Stanford economist Nick Bloom (Buhayar, 2020). Both the historical record and the scientific literature say they are wrong. Major cities will be back stronger than ever.

Historical Record

A tour of my bookshelf would show that I have a longstanding interest in systems biology, epidemiology, and the history of plagues, with off-putting titles like *Elements of Mathematical Biology* (Lotka, 1956), *Plague* (Camus, 1975), *Plagues and peoples* (McNeill, 1996), *Disease and History* (Cartwright, 1972), *Rats, Lice and History* (Zinsser, 1934), *The Impact of Plague in Tudor and Stuart England* (Slack, 1985), and *Guns, Germs and Steel* (Diamond, 1997) along with a score of books on the agent-based models used to model the dynamics of disease transmission (Epstein, 2013; Gilbert & Troitzsch, 2005; Wilensky, 2021). To me, plagues and pandemics are real-world manifestations of my real intellectual passion complex adaptive systems and far-from-equilibrium physics, where interactions among agents, not the decisions of an

individual agent, drive all major change, including changes in asset prices. I will discuss these ideas later in the text. Go ahead, call me a nerd.

There have always been plagues and pandemics. Many were far more deadly than COVID-19, as documented in the chart below.

Name	Time period	Type / Pre-human host	Death toll
Antonine Plague	165-180	Believed to be either smallpox or measles	5M
Japanese smallpox epidemic	735-737	Variola major virus	1M
Plague of Justinian	541-542	Yersinia pestis bacteria / Rats, fleas	30-50M
Black Death	1347-1351	Yersinia pestis bacteria / Rats, fleas	200M
New World Smallpox Outbreak	1520 – onwards	Variola major virus	56M
Great Plague of London	1665	Yersinia pestis bacteria / Rats, fleas	100,000
Italian plague	1629-1631	Yersinia pestis bacteria / Rats, fleas	1M
Cholera Pandemics 1-6	1817-1923	V. cholerae bacteria	1M+
Third Plague	1885	Yersinia pestis bacteria / Rats, fleas	12M (China and India)
Yellow Fever	Late 1800s	Virus / Mosquitoes	100,000-150,000 (U.S.)
Russian Flu	1889-1890	Believed to be H2N2 (avian origin)	1M
Spanish Flu	1918-1919	H1N1 virus / Pigs	40-50M
Asian Flu	1957-1958	H2N2 virus	1.1M
Hong Kong Flu	1968-1970	H3N2 virus	1M
HIV/AIDS	1981-present	Virus / Chimpanzees	25-35M
Swine Flu	2009-2010	H1N1 virus / Pigs	200,000
SARS	2002-2003	Coronavirus / Bats, Civets	770
Ebola	2014-2016	Ebolavirus / Wild animals	11,000
MERS	2015-Present	Coronavirus / Bats, camels	850
COVID-19	2019-Present	Coronavirus – Unknown (possibly pangolins)	2.2M (Johns Hopkins University estimate as of Feb 1, 2021)

Note: Many of the death toll numbers listed above are best estimates based on available research. Some, such as the Plague of Justinian and Swine Flu, are subject to debate based on new evidence.

Figure 4: Deaths from Major Pandemics in History

Examples include:

1) the Plague of Athens in 430 BC that altered the course of the Peloponnesian War, described by Thucydides, who was himself stricken (Strassler, 1996)
2) the Plague of Justinian in 541 AD that killed 30-50 million people
3) the Black Death of 1347 that killed 200 million people, half of Europe's population (Koyama, Jedwab, & Johnson, 2019), inspired Boccaccio to write *Decameron (1351),* provided the setting for

many of Shakespeare's plays (2001, 2008, 2011, 2017), and likely hastened the end of feudalism (Cohn, 2007)
4) Smallpox (1520 onwards) that killed more than 50 million people in Europe and wiped out both the Incan and Aztec civilizations (Snowden, 2019)
5) the Great Plague of London in 1665 that drove Isaac Newton from Cambridge to the countryside where he invented differential calculus and the theory of optics and formulated the law of gravity
6) the Spanish flu of 1918 that infected over one third of the world's population and killed 40-50 million people

In each of these examples, people were terrified and those who could fled cities for the countryside. Their intense experiences were memorialized in art and literature (Crawford, 1914). In each of these examples they moved back to the city once the pandemic had subsided (Snowden, 2019). What made them come back?

	Urban population (million)								Percentage urban							
Region	2000	2005	2010	2015	2020	2025	2030	2035	2000	2005	2010	2015	2020	2025	2030	2035
World	2868	3216	3595	3981	4379	4775	5167	5556	46.7	49.2	51.7	53.9	56.2	58.3	60.4	62.5
High-Income Countries	822	870	919	955	989	1019	1049	1076	76.8	78.6	80	80.9	81.9	82.8	83.9	85.0
Middle-Income Countries	1935	2211	2511	2825	3145	3456	3757	4045	41.6	44.7	47.9	50.8	53.7	56.5	59	61.5
Low-Income Countries	109	133	162	199	243	296	359	432	25.7	27.2	28.9	30.9	33.2	35.7	38.3	41.2
Africa	286	341	409	492	588	698	824	966	35	36.9	38.9	41.2	43.5	45.9	48.4	50.9
Asia	1400	1631	1877	2120	2361	2590	2802	2999	37.5	41.2	44.8	48	51.1	54	56.7	59.2
Europe	517	525	538	547	557	565	573	580	71.1	71.9	72.9	73.9	74.9	76.1	77.5	79.0
Latin America and the Caribbean	397	433	470	505	539	571	600	627	75.5	77.1	78.6	79.9	81.2	82.4	83.6	84.7
Northern America	247	262	277	291	305	320	335	349	79.1	80	80.8	81.6	82.6	83.6	84.7	85.8
Oceania	21	23	25	27	29	31	33	35	68.3	68	68.1	68.1	68.2	68.5	68.9	69.4

Figure 4: U.N. Projections: Populations of Urban Areas

Over long periods, the forces driving increases in urbanization have proven powerful enough to overcome people's fears and bring them back to the city. After countless pandemics, wars, and other disasters, 85% of people in High-Income countries live in urban areas today. The United Nations predicts that the global urban population will grow by more than one billion people in the next 15 years, as shown in the table above (UN-Habitat, 2020).

There are many reasons why people come back to the city but foremost among them is that people living in cities are more productive and creative. Countless academic studies have shown that cities exhibit economies of scale.

Two separate bodies of academic literature, in economics and in physics, help us understand why cities are so resilient. The first is the literature on agglomeration economies developed by labor economists. The second is the literature on superlinear scaling in complex systems developed by theoretical physicists at the Santa Fe Institute. Taken together, they help us understand why cities exhibit economies of scale.

Economies of Scale in Urbanization: The Economics Literature

There is a long history in economics of writing about the productivity benefits from specialization of labor in cities, going back to Adam Smith's (1776) pin factories, David Ricardo's (1817) comparative advantage, and Alfred Marshall's (1890) analysis of the textile industry.

The economics literature focuses on the microeconomic factors—today we would call them externalities—that make people and businesses in urban areas more productive, such as specialization of labor and capital, job matching, labor pooling, short supply lines, shared suppliers, and shared knowledge. Labor economists refer to them, collectively, as agglomeration economies.

There is broad agreement among the group of labor economists known as urbanists, including two with Nobel Prizes (Krugman, 1991; Romer, 1986) that agglomeration economies are significant in urban areas. The causes of agglomeration economies are articulated by Duranton and Puga (2004). For a review of the empirical evidence, see Glaeser's (2009) encyclopedic literature review citing 130 studies, itself cited 348 times by other authors, and the more recent literature review by (Giuliano, Kang, & Yuan, 2019).

In the 1980s, a group of dissenters, known as suburbanists, argued that the growth of information technology and consequent reduction in information costs would change all that, make distance irrelevant, erode agglomeration economies, and reverse the growth of cities. (Bloom, 1997; Cairncross, 1997; Kotkin, 2000). As the UN data reported in Figure 5 above show the urbanists prevailed; cities have continued their march toward increasing density.

The consensus view today is that the driving force of urbanization is the fact that density speeds the transfer of knowledge and flow of ideas, illustrated by the fact that three-quarters of all U.S. venture capital investments in startup companies are made in just two metropolitan areas, the San Francisco Bay area and the Boston-New York-Washington D.C. corridor (Florida, 2020) (Glaeser, 2009). As reported by Florida (2012), this supports Ehrenhalt's (2013) Great Inversion thesis that future urban in-migration will be dominated by affluent, educated professionals in their 20s and 30s, that will more than replace an outflow of people who are on average older, less-educated, and more likely to be recent immigrants. As Autor (2019) shows, this change in the demographic composition of urban populations increases the average education level of urban residents and supports rapid increases in urban incomes.

The COVID-19 pandemic has reopened the debate. Some, echoing the arguments of the urbanists in the 1980s, that advances in technology—in this case Zoom meetings—makes it no longer necessary for people to go to the office. They believe the exodus from major cities will be permanent (Baker, 2020). But the vast majority of recent studies supports the urbanist case that, once COVID-19 is safely behind us, the growth of cities will resume (Daalder, 2021; Florida, 2020; P. Romer, 2020; P. F. Romer, Brandon, 2020).

Nobelist Paul Romer (2020) sums up the evidence, "The underlying economic reality is that there is tremendous economic value in interacting with people and sharing ideas. There's still a lot to be gained from interaction in close physical proximity. For the rest of my life, cities are going to continue to be where the action is."

Economies of Scale in Urbanization: The Complex Systems Literature

Every serious study of urbanization begins by giving homage to Jane Jacobs's classic *The Death and Life of Great American Cities (1961),* in which she described a city as a living organism where chance interactions among people in densely-populated urban neighborhoods are the source of creative activity and growth. And yet, with few exceptions (Krugman, 1996), the economics literature has failed to fully exploit her insights, focusing on static equilibrium conditions between economic agents, rather than viewing cities as complex, interactive, dynamical systems.

Recently, a group of theoretical physicists, led by Geoffrey West at the Santa Fe Institute, have applied the tools of complex adaptive systems to explore the dynamic behavior of cities over time. Their results provide overwhelming scientific evidence showing economies of scale in urbanization (Kempes, 2020).

In an influential paper published in *Nature*, Luis Bettencourt and Geoffrey West (2010) of the Santa Fe Institute explore the source of urban economies of scale. They present new analysis of large, urban data sets covering hundreds of cities and urban centers in regions and countries across the world over many decades. Their results are summarized, below, in the graphic showing the relation between the relative population size of a given city to a wide variety of socio-economic metrics.

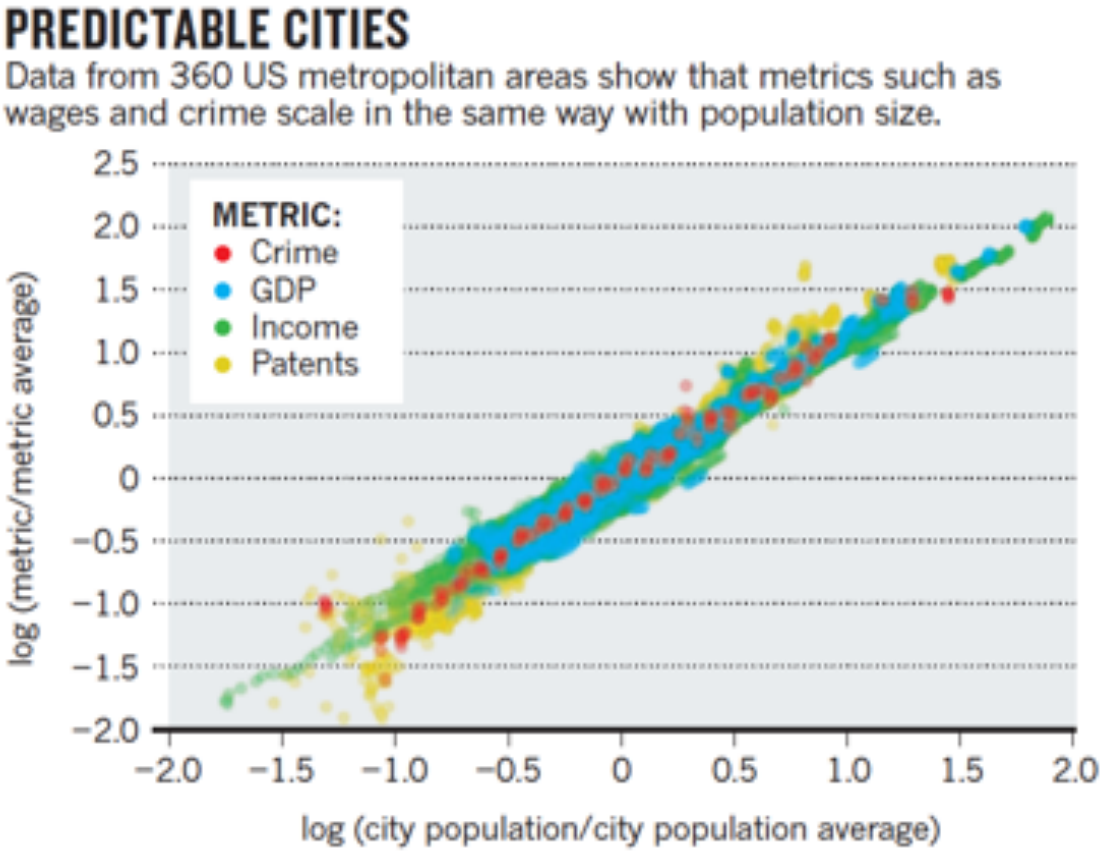

Figure 5: The Relation Between Size and Performance Metrics for 360 Cities

Interestingly, as shown in the graphic above, they find that the major characteristics of a city, including income, wealth, innovation, creative activity, the birth and death of businesses, infrastructure, crime, garbage, and the spread of diseases are all driven by population density according to the same, simple scaling law.

> "On average, as city size increases, socio-economic quantities such as wages, GDP, number of patents produced, and number of educational and research institutions all increase by approximately 15% more than the expected linear growth. There is, however, a dark side; negative metrics including crime, traffic congestion, and incidence of certain diseases all increase following the same 15% rule. The good, the bad, and the ugly all come as an integrated, predictable package." (p. 913).

That 15% productivity advantage is true for all cities, in all countries, in all time periods where there is adequate data. In other words, "cities are approximately scaled versions of one another." (p. 913) This is similar to results in biology showing economies of scale in organisms and in communities like anthills and beehives, where continuous adaptation, rather than equilibrium, is the rule. (although there the scaling metric is closer to 20%)

Their results reflect the properties of the networks that cities depend on to supply the flow of energy and other resources needed to sustain life. For example, doubling the population of a city of any size requires only an 85% increase in infrastructure—roads, mass transit, parks, electrical power, or hospitals. The result is economies of scale in the growth of cities, the source of the productivity and economic growth advantages described in the economic studies cited in the previous section.

Their results show why large cities like New York were hit approximately 15% harder than small ones in the COVID-19 pandemic. And they show why large cities like New York will come back faster than smaller cities once the pandemic is behind us. The 15% productivity advantage can be viewed as a gravitational force that "acts as a magnet for creative and innovative individuals, and stimulants for economic growth, wealth production, and new ideas." (p. 913).

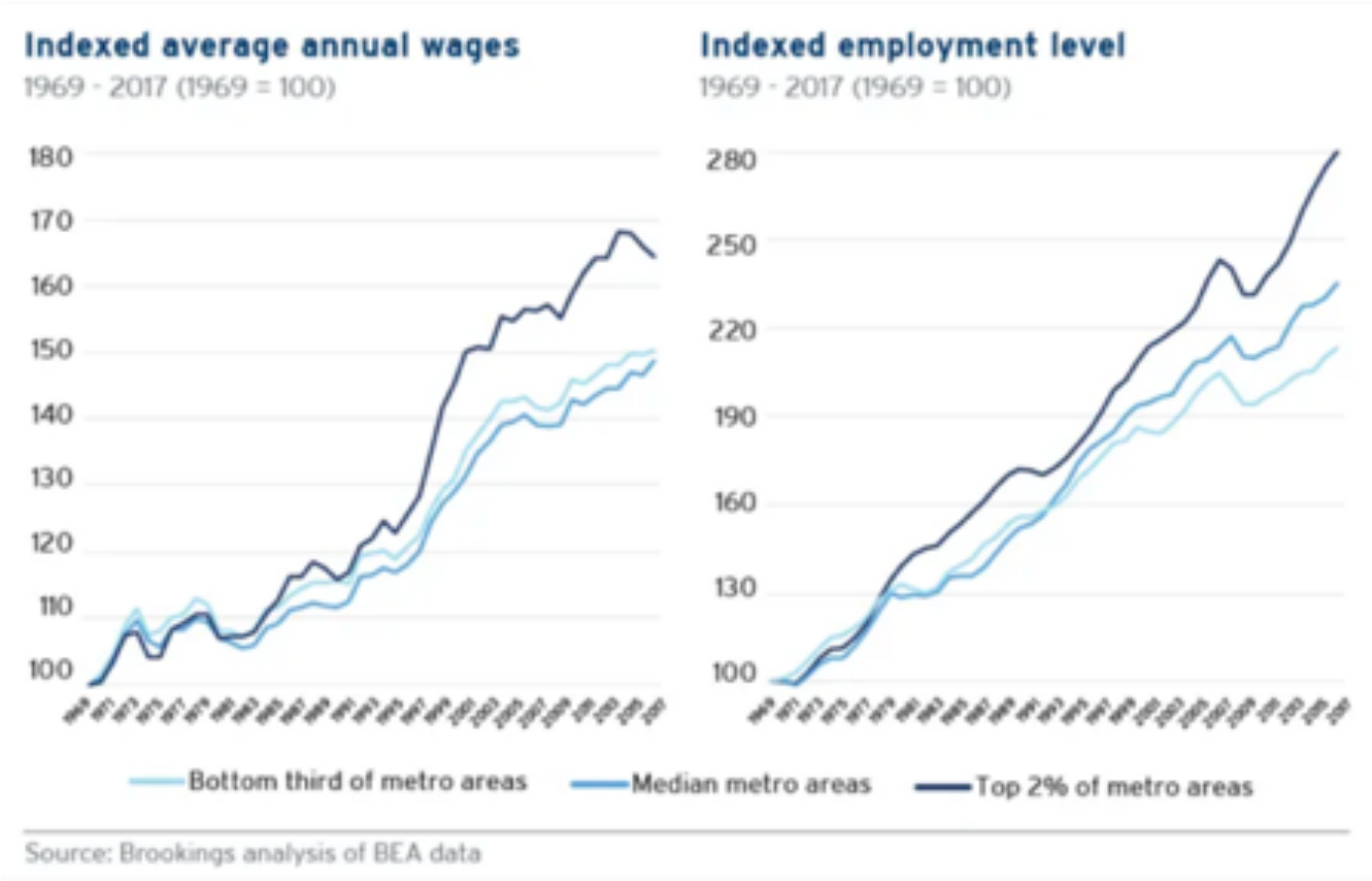

Figure 6: The Impact of City Size on Wages and Employment

These results explain the economies of scale identified in the economics literature. Both wages and employment levels grow faster in large metro areas than small ones over time, as shown in the chart above (Atkinson, 2019). And the composition of cities changes with population density, with more high-skill and professional jobs and fewer low-skill jobs as density increases, an advantage which appears to be increasing over time, as shown in the chart below (Autor, 2019).

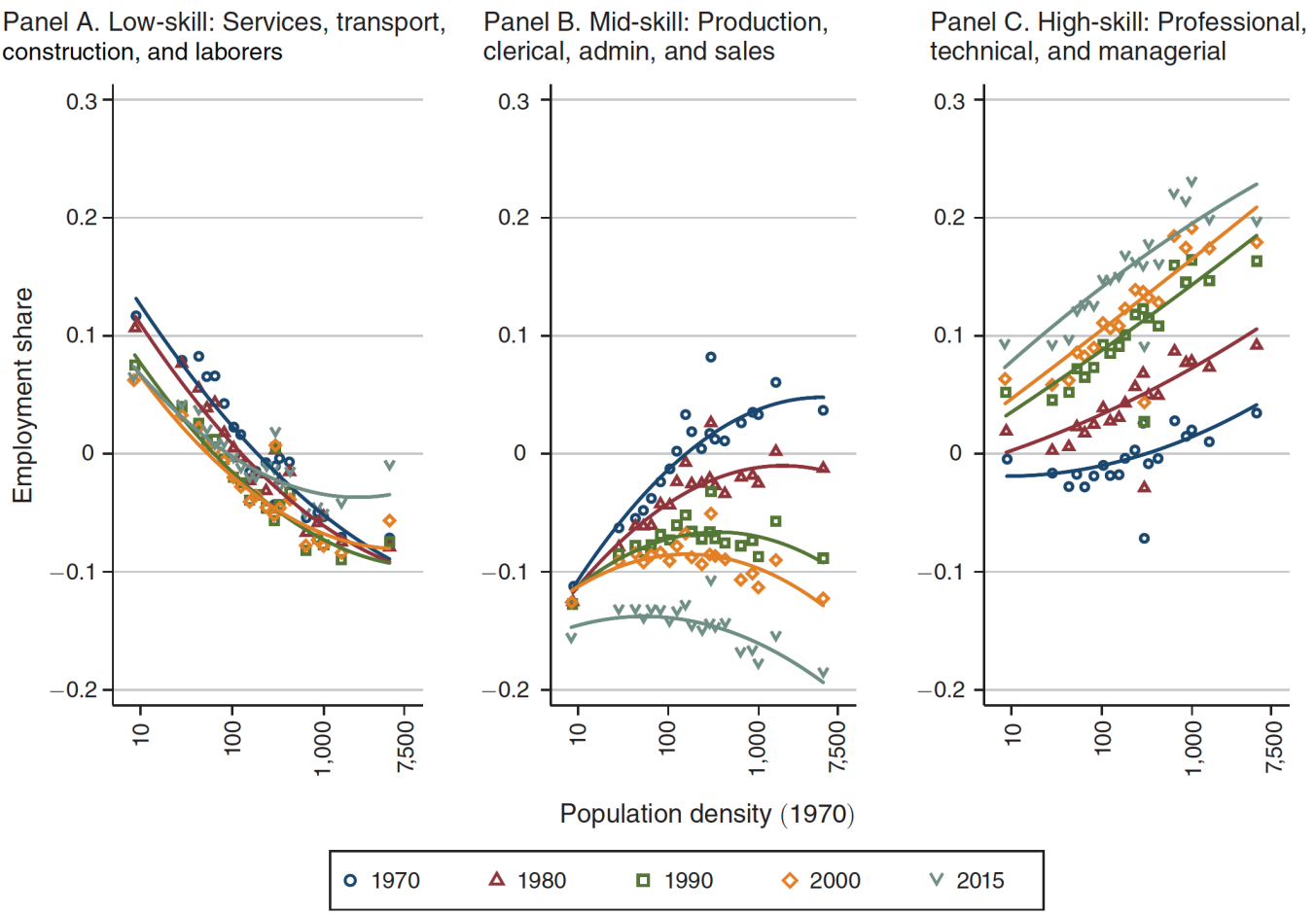

Figure 7: Employment Shares Among Working-Age Adults by Population Density 1970-2015

Before we leave this section, there is one more important result to point out. In a separate paper, Bettencourt, Lobo, Strumsky and West (2010) examined the performance of 360 U.S. metropolitan areas relative to the value predicted by the estimated 15% scaling law described above. They found that that some metropolitan areas (e.g., New York and San Jose) systematically outperform the scaling law and others (e.g., Detroit) systematically underperform the scaling law, likely representing local factors unrelated to population size, such as local geography, taxes and regulations and the like.

Interestingly, they find that the process describing the impact of local advantages and disadvantages displays long-term memory: "any initial advantage or disadvantage that a city has relative to its scaling expectation tends to be preserved over decades." That fact gives investors important information about where to look for investments over the next few years as the economy rebounds from COVID-19 pandemic.

Summary: They'll Be Back

So far, the analysis in this paper has focused on a single question: will cities ever be able to recover from the pandemic? Our conclusions are:

- There is a reason--superlinearity--why cities like New York were hit harder than suburban or rural areas others during the pandemic.
- That same reason will make people return to the cities once the pandemic is behind us, just as they have done for thousands of years. With apologies to Arnold, they'll be back.

- Historically relatively successful cities, like New York and the San Francisco Bay area, where local factors have made them outperform expected levels, will recover faster than other, historically less successful cities. Estimates show that outperforming cities will continue to be more successful than other cities for many decades into the future.

One implication for property investors is clear. As the economy recovers from the COVID-19 pandemic, investors will be rewarded for focusing on urban property, not suburban or rural property, and they should focus on top quality assets in historically successful cities like New York and San Francisco, not chase apparent bargains in smaller, less historically successful areas.

Implications for Investors

In the remainder of this paper, I want to focus on a broader topic: how these conclusions fit into an overall investment strategy. That requires us to consider three issues:

1) the appropriate overall role of real estate in asset allocation,
2) which subsectors of real estate to focus on, and
3) the most complicated issue of all, when is the right time to make the investment.

Answers to these questions must be made in the context of an analytical framework capable of explaining the periods of growth punctuated by collapses into economic and financial crisis once or twice each decade that characterize developed economies like ours. I will describe such a framework below.

For reasons explained in depth in a separate article (Rutledge, 2021), accepted macroeconomic models of the sort taught in many PhD programs and used by the Fed and other central banks are disappointing in this regard. Their myopic fixation on explaining output and employment—the economy's profit and loss statement—makes them unable to explain the much larger events taking place in asset markets—the economy's balance sheet. And their worship of so-called micro-foundations has led them to characterize the economy as being in general equilibrium at all times, only being nudged away by temporary, gentle, normally distributed exogenous shocks. The end product has been elegant models that do a poor job explaining the real world. For that reason, I have spent much of the past four decades developing an alternative framework designed to embrace asset market shocks and financial crises as normal events. The following section is a brief summary of the logic behind our approach and how to apply it to the post COVID-19 economy and markets.

Far from Equilibrium Economics, Storm Systems and Weather Map Investing

The analytical framework behind our investment strategy differs from standard macroeconomic models in two important ways.

First, it is asset-centric in the sense that it acknowledges that our economy asset markets are many times bigger and more influential than are GDP accounts. Disturbances in our $400 trillion balance sheet have much more dramatic effects on people's lives than disturbances in our $20 trillion GDP accounts. To a first approximation, all economic crises arise in the asset markets. We even name our crises after asset market events like the savings and loan Crisis, the dotcom crisis, and the subprime debt crisis. My work on this issue started during the inflation of the late 1970s and was first published in a series of articles in the *Wall Street Journal*, *New York Times*, and *Financial Times* in the early 1980s (Rutledge, 1981, 1982a, 1982b, 1982c, 1983, 1984, 1985a, 1985b, 1986a, 1986b, 1986c). I have used this framework to advise pension funds corporations, and policy makers and to make investment decisions for more than four decades.

Second, our analytical framework is designed to represent an economy not as a flow of goods and services in static general equilibrium but as a complex adaptive system, operating far from equilibrium, and prone to

the periods of sudden, dramatic collapse that a physicist would call phase transitions and we know as financial crises (Solé, 2011; Sornette, 2003). I have outlined the logic of that approach in a recent journal article (Rutledge, 2015).

My interest in financial crises grew out of my early days as a private equity investor where I learned two painful lessons: 1) financial markets are not always in price-clearing equilibrium as promised by the textbooks and 2) the cost of capital during the periods of nonprice credit rationing that always accompany financial crises is much, much higher than the interest rates posted in the newspaper.

As a personal aside, I was introduced to complex adaptive systems, network theory, criticality, and far-from-equilibrium physics dates in the early 1990s by my (brilliant) daughter Jessica one weekend in 1994 when she came home for the weekend with friends from college. Jessica was an economics major at Williams but found the economists too boring (told you she was brilliant) so she lived in the math dorm with more interesting friends. I was puzzled by an experience I had recently observed in my private equity practice where I had witnessed credit markets close down like a snapping turtle, which is not supposed to happen in economics. She and her friends told me about an exciting new idea called "Complex Adaptive Systems", they had learned about from one of the math professors. We stayed up all night talking about it. I read everything I could find on it, which wasn't much—remember, no Internet—and started looking for more. I mentioned my interest to Shortly my friend and client Bill Miller at Legg Mason, who told me he was Vice Chairman of the Santa Fe Institute where the serious work on complex systems was taking place. Bill gave me a copy of *Linked (2002)*, Barabasi's book on network theory. My brain has not been the same since. After writing and lecturing on the topic for many years, I developed a course in far-from-equilibrium economics and finance that I taught for many years to the PhD students at the Claremont Graduate University (Rutledge, 2020).

In our framework, a financial crisis is a phase transition from a state of general equilibrium to a failed-network state caused by a sudden collapse of financial markets known as a cascading network failure (Barabasi, 2002). You can think of a phase transition as an avalanche, earthquake, tsunami, or hurricane, each of which is an energy transformation that produces sudden, violent change (Bak, 1996). Understanding the nature and timing of these phase transitions between periods of more-or-less general equilibrium and periods of capital market breakdown is the essence of understanding financial crises. It is also the essence of designing an investment strategy.

The Four Stages of a Financial Crisis

I think of an economy experiencing a financial crisis as traveling through four stages. In the first stage, the economy is in a state of full employment that economists call general equilibrium. In the second stage the financial markets suffer a brief but violent collapse. In the third stage, credit markets are effectively closed for business and the economy limps along in recession. In the fourth stage, financial networks regrow lost connections and the economy grows back toward full employment, after which the round trip is complete and we find ourselves again in stage 1 at full employment.

Complex Systems Framework Applied to Subprime Debt Crisis

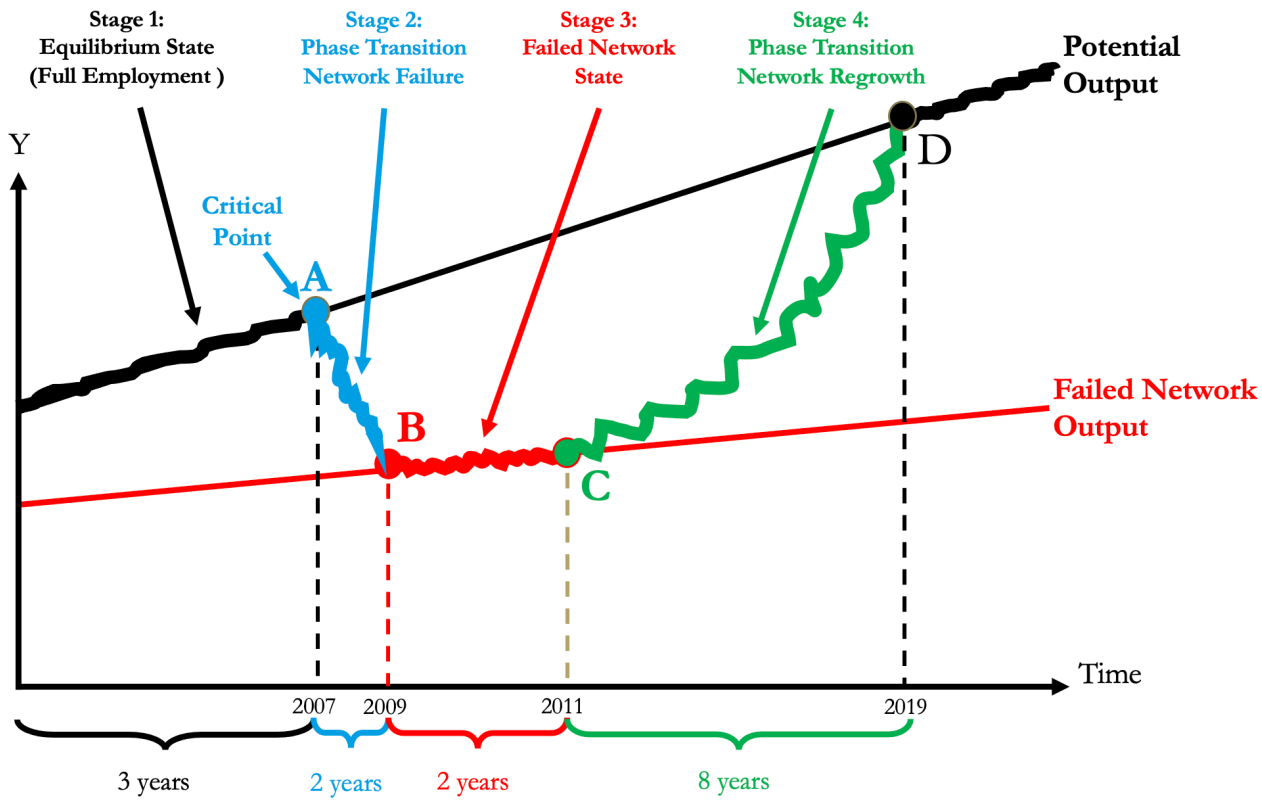

Figure 8

Figure 8 above applies this analytical framework to the subprime debt crisis as an example of how an investor should think through the investment timing decision in a world where financial crises are regular events. You can find a more thorough description of our analytical framework in a separate article (Rutledge, 2021).

There is a lot of information piled into Figure 8 so I will build it up layer by layer to give you a mental model for thinking about financial crises in a complex systems model. The first layer is that we will distinguish between two very different states of the economy. But first I want to explain what I mean when I use the word "state". The concept of multiples states is unusual in economics but very common in the physical sciences where there is a long tradition of studying the dynamics of systems. The most familiar example to most people is states of matter. We all know that water and ice are simply two different physical states of a system of H2O molecules. Both are made up of the same basic units; what's different is the rules of engagement among the units, how they interact with one another. In the liquid state they are far enough apart that they can move; in the solid state they are locked into an unmoving structure. As a researcher, which state I want to consider will be determined by what question I want to ask.

As a second example, imagine that you are landing at LAX at midnight after a long flight from Maui and you want to get home and climb in your bed in Newport Beach. How long will it take to get home? I use this to explain multiple states to my students—it is a true story. If you consult Google Maps for the best route, it will tell you that the distance is 48 miles and that it will take you 48 minutes to get there. In my case, it took two and a half hours (with a one-year-old in the back seat). What went wrong? The problem was simple.

Google assumed that the transportation system was in its normal state and knew that the best route was to take the freeway. Unfortunately, Google didn't know that the system was in an alternative state; the freeway had just closed for repairs so I would have to take surface streets all the way home.

When analyzing the behavior of systems there are always assumed underlying states to consider. For the highway story it is the difference between the state of the transportation system when everything is working and the state where part of it is shut down. For economies it is the difference between the state of the economy when the financial system is working and the state where part of it is shut down. In both cases the underlying cause of the second, less efficient, state is a network failure that reduces the system's throughput. I describe the two states relevant to financial crises more fully below.

State 1, represented by the black line labelled "Potential Output", shows what the path of output would be if the economy were able to remain in a state of general equilibrium at all times. We can think of the black line as potential output, as full employment output, or as general equilibrium from the textbooks. In general equilibrium, a market economy is extremely efficient. Market prices are doing their job of reliably transmitting information on wants and scarcities along the communications network we call the market to the people who need the information so they can make decisions, as described by Hayek in his classic article (1945). If nothing ever went wrong with the information network, this would represent the growth of the economy over time.

State 2, represented by the red line labelled "Failed Network Output", tells us what the output of the economy would be over time if financial markets never worked properly. By not working properly, I mean just the opposite of Hayek's smoothly functioning markets; a situation where people do not trust the information signals (prices) they receive from the economy's financial markets. The resulting cascading network failure interrupts the functioning of financial markets just like what happens when a power grid goes down during a thunderstorm. The lights go out until the network has been restored.

Now let's walk through the timeline of a financial crisis from beginning to end. We will divide the timeline into four **stages**, each representing a different state of the economy and markets.

Stage 1, the heavy black segment to the left of point A in Figure 8, is where our story starts. It is 2007. The economy is crawling up the black line from left to right, operating at full employment, or general equilibrium, having fully recovered from the 2001 dotcom crisis. The economy was strong in 2007: growing output and employment, rising profits and valuations, and a housing boom facilitated by the rapid growth of fancy new securitized mortgage products that everybody loved but nobody understood. Sure, home prices had just started to fall but there was little reason to worry; financial markets were so efficient there wouldn't be more than a speedbump. We had no idea there was another financial crisis just around the corner. Unfortunately, as pointed out by Minsky (1992), good times breed excessive optimism, weakening credit discipline, and overborrowing, ending in what is now referred to as a "Minsky Moment" when liquidity disappears and financial markets freeze up. That moment is Point A on Figure 8. You can think of it as Saturday when the news cameras showed Lehman employees leaving the building carrying cardboard boxes.

Stage 2, the heavy blue segment between points A and B, is the crisis phase. It represents the air pocket, or phase transition, when the economy switches from a state of general equilibrium to one characterized by failed networks accompanied by the sudden, violent meltdown of financial markets. Like violent storms in nature, the crisis phase is destructive but short-lived. It puts tremendous pressure on overleveraged investors, turning them into forced sellers, and creates extraordinary opportunities for unleveraged investors with positive cash flow and plenty of cash.

Stage 3, the heavy red segment between points B and C, represents the bottom of the recession, the clean-up period after the crash when unprepared investors struggle to make debt and interest payments and

lenders force refinancing and fire sales of quality assets. Stage 3 is a time of extraordinary distressed-credit opportunities.

Stage 4, the heavy green segment between points C and D, is the longer period following the recession when financial markets are becoming more accommodating to borrowers and the economy slowly grows back toward full employment. This is the time of major improvements in profitability and performance, easing credit standards, and rising valuations. It ends when the economy has once again reached full employment and valuations have recovered to normal levels, starting the whole process again.

Asset Allocation, Market Timing Issues

Not surprisingly each stage of this process has its own return profile and its own best investment strategy. Using the dates shown in Figure 8 from our analysis of the subprime debt crisis, the cumulative returns for various asset classes during each of the four stages are shown in Figure 9 below.

	I. Full Employment		II. Crash		III. Recession		IV. Recovery	
	Start Date	Length	Start Date	Length	Start Date	Length	Start Date	Length
	2005	3 years	2007	2 years	2009	2 years	2011	8 years
Period	1/1/05 – 3/1/07		3/1/07 – 4/1/09		4/1/09 - 10/1/11		10-1-11 – 1/1/20	
GDP increase	5%		-3%		6%		20%	
Job Growth	+195k jobs/month		-235k jobs/month		+31k jobs/month		+197k jobs/month	
Returns								
Cash	4.0%		2.6%		0.1%		0.7%	
Bonds	7%		5%		23%		38%	
S&P 500	27%		-44%		45%		229%	
Real Estate	46%		-73%		202%		196%	
Multifamily	41%		-67%		191%		173%	
Office	79%		-66%		187%		129%	
Retail	43%		-72%		190%		84%	
Industrial	30%		-81%		189%		272%	
Hospitality	39%		-79%		255%		322%	

Figure 9: Four Stages of Returns in the Subprime Debt Crisis

Stage 1 Returns. Not surprisingly, all asset classes show positive returns during Stage 1, the full employment period that precedes a financial crisis. But the returns are modest for fixed income investments and comparable for most equity asset classes, perhaps reflecting strong operating performance in a growing economy that has already been capitalized into asset prices and financial markets doing their job arbitraging away abnormal returns.

This is the time when an astute investor reduces leverage, harvests fully valued assets, and builds cash. This is easier said than done. At this point investor have made a lot of money for a long time; every bone in their body is screaming to stay invested.

Stage 2 Returns. Returns on risk assets are uniformly negative during Stage 2, the crash section of the financial crisis. Only cash and bonds show positive returns, driven by aggressive interest rate cuts by the Fed during the crash.

For investors who raised cash during Stage 1, this is a time for patience. For those investors who missed the opportunity to raise cash during Stage 1, it is too late to sell.

Stage 3 Returns. The period after the crash is an extraordinary time to be an investor. Bonds show good returns, equities even better, but the big money is made in real estate. Investors who have bought top quality assets at discount prices show ext5raordinary gains, even during a recession.

This is a time to (carefully) deploy cash into special situations created by the crisis. During Stage 3, commercial real estate investments far outperform other asset classes.

Stage 4 Returns. Stage 4 is every investor's dream. Investors make money in two different ways. First, both businesses and real estate assets show improving operating performance driven by strong economic growth as the economy works its way back toward full employment. Second, financial markets are beginning to function more efficiently again, which means easier credit availability and rising valuations. With rising cash flows and rising valuations investment returns are extraordinary, with cumulative returns in Hospitality (322%), Industrial (272%), and Multifamily (173%) on top of the impressive returns they have already earned in Stage 3.

This is a time to be fully invested in prime real estate assets, to invest in their growth, and to prepare for the harvest stage that will arrive again once the economy has reached general equilibrium.

Taking Stage 3 and Stage 4 together, real estate investments acquired early in Phase 3 after the meltdown, and sold at the end of Stage 4 when the economy had reached full employment again were worth 8.9x the initial investment, ranging from 6.6x for Office, 7.9x for Multifamily, 10.7x for Industrial, and 15x for Hospitality.

For these reasons, we believe the most interesting opportunities after the COVID-19 pandemic will be in real estate, not in the stock market. Both the likelihood of higher inflation and the near certainty of higher tax rates will drive investors to restructure portfolios away from long-duration financial assets, like equities and bonds, and towards property and other real assets. This will result in substantial capital gains for real asset owners.

Within real estate, we believe there will be especially attractive opportunities in three areas:

1. Multifamily. Operating performance will improve significantly when young people move back to the city. Cost of capital will decline sharply once financial markets are functioning properly again.
2. Hospitality. We expect to see exceptional opportunities to buy hospitality assets at deep discounts driven by the financial distress of current owners and weak operating performance during the COVID-19 lockdown. When cities are back in business again, the hotels will be full again.
3. Office. Distressed owners and pessimism over the future of the office will create opportunities to buy offices in the best locations at discount prices over the next two years. Although there may be changes in the demographics of who is showing up for work in offices, financial, professional, and creative businesses are going to expect their employees to show up for work again.

The key is timing.

We have not seen the COVID-19 financial crisis yet. Financial markets began to seize up last March—at one point there were no bids for Treasury bonds—forcing the Fed to engineer massive purchases of assets and the Federal government to unleashed two trillion dollars of fiscal stimulus with the CARES Act. These policy interventions stopped the financial market meltdown and temporarily supported the economy. Household disposable income during March-December of last year was roughly 10% higher than it had been a year earlier, even though ten million people lost their jobs and millions more were unable to work. A second, smaller, stimulus package in December included $600 stimulus checks; as a result, government checks made up more than 30% of household income in January. Next month, when the $1400 checks from the Biden stimulus package are mailed, people will be awash in cash again. But the stimulus checks can't go on forever.

The stimulus measures delayed the beginning of credit crisis but did not prevent it. When the stimulus ends later this year, as it surely will, asset owners will find themselves with more debt and less cash flow than was true before the pandemic began. People will have to make mortgage, credit card, and student loan payments again. Lenders will again be able to enforce loan agreements and seize assets in delinquency. The result will be tightening credit and forced asset sales, which will create exceptional opportunities to deploy capital in the second half of 2021 and all of 2022.

Complex Systems Framework Applied to Post-Pandemic Investment Strategy

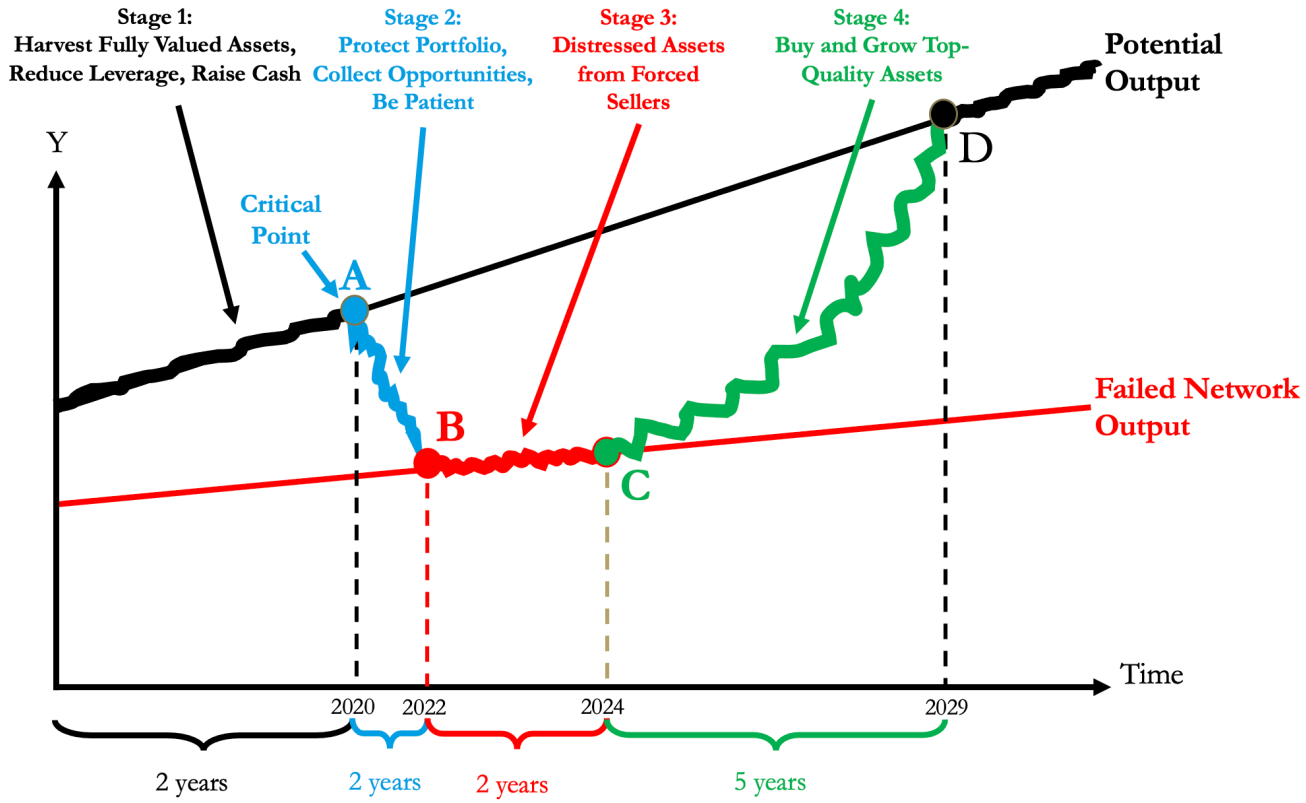

Figure 10

Figure 10, above, paints a picture of how the four stages of th3 post COVID-19 economy are likely to play out. In constructing the illustration in Figure 10, I have used the data from the Subprime Debt Crisis to mark the endpoints of the four stages of the credit cycle, showing two years for Stage 2 and two years for

Stage 3. I assumed 5 years to illustrate the period of recovery and network regrowth in Stage 4. That's somewhat shorter than the 8 year Stage 4 period in Figure 8 for the Subprime Debt Crisis but there is no clear case to prefer one over the other. We know that the stage 4 network regrowth process will take much longer than the Stage 2 meltdown but there is no way to make a precise estimate of when we will reach full employment output again.

In summary, the massive government stimulus provided by Congress and the Fed have delayed the onset of the financial crisis but have not prevented it. I expect tightened credit and a wave of forced selling once stimulus has ended later this year. That will create an opportunity to buy prime assets at discount prices in 2021 and 2022, setting up extraordinary gains for investors for an extended period. The best returns are likely to be found in urban real estate, not public equities, fueled by rising operating performance as the young people who fled the COVID-19 pandemic move back into the city and go back to work.

JR
28 February 2021

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