Gray Rhinos, Black Swans and Dragon Kings: Of Wars and Pandemics

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Overview

- It has become a commonplace among beleaguered leaders to say that the COVID-19 pandemic is a "war," albeit against an "invisible enemy."

- A pandemic is a natural disaster, whereas a war is man-made. In a pandemic it is a pathogen that kills people, whereas in a war people kill people.

- Nevertheless, the two kinds of disaster have much in common—and not just excess mortality. Each belongs to that class of rare, large-scale disaster variously characterized as a **gray rhino, black swan** or a **dragon king**.

Gray rhino

- An event that is dangerous, obvious, and highly probable."
- Examples: climate change and financial crisis at the global-policy level to disruptive technologies that reshaped entire industries … Hurricane Katrina, the 2008 financial crisis, the 2007 Minnesota bridge collapse, cyber attacks, wildfires, water shortages"—and a pandemic. (Wucker 2016)
- Problem with his concept: it conflates small and large disasters.

Black swan

- Any event that "seems to us, on the basis of our limited experience, to be impossible." (Taleb 2007)

- Our biases are formed by evolution and education, which lead us to expect most phenomena to be (like the heights of humans) normally distributed.

- But the statistical distributions of earthquakes, financial crises and wars*—to name just three examples—obey a quite different set of rules: often, though not always, "power laws." (Buchanan 2002)
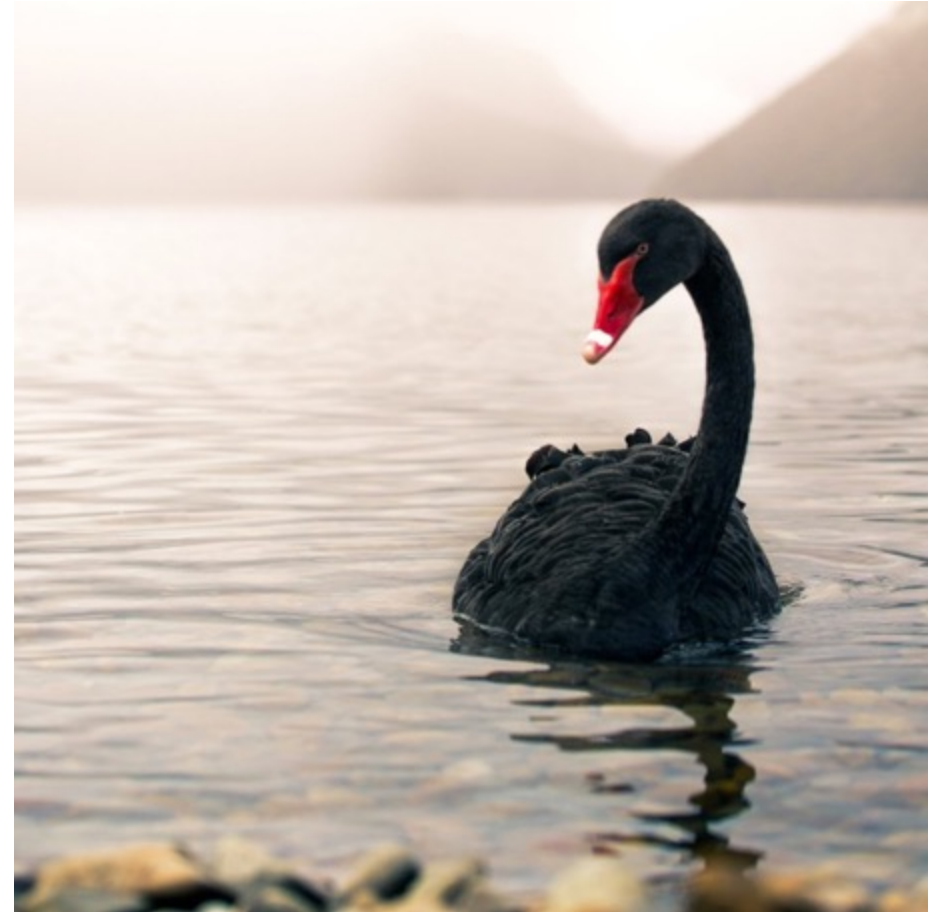
*Also: the distributions of meteorites and debris size orbiting around the Earth, forest fires, rain events, daily stock market returns, movie revenues, individual annual health charges and identity theft losses.

Dragon king

- An event so extreme that it lies outside a power-law distribution.

- Identifiable in six domains: city sizes, acoustic emissions associated with material failure, velocity increments in hydrodynamic turbulence, financial drawdowns the energies of epileptic seizures in humans and in model animals, and (possibly) earthquake energies.

- Dragon kings "exhibit a degree of predictability, because they are associated with mechanisms expressed differently than for the other events. Often, dragon-kings are associated with the occurrence of a phase transition, bifurcation, catastrophe, tipping point, whose emergent organization produces useful precursors." (Sornette 2009)

- *Could an event be at once a gray rhino and a black swan—and have consequences that make it a dragon king?*
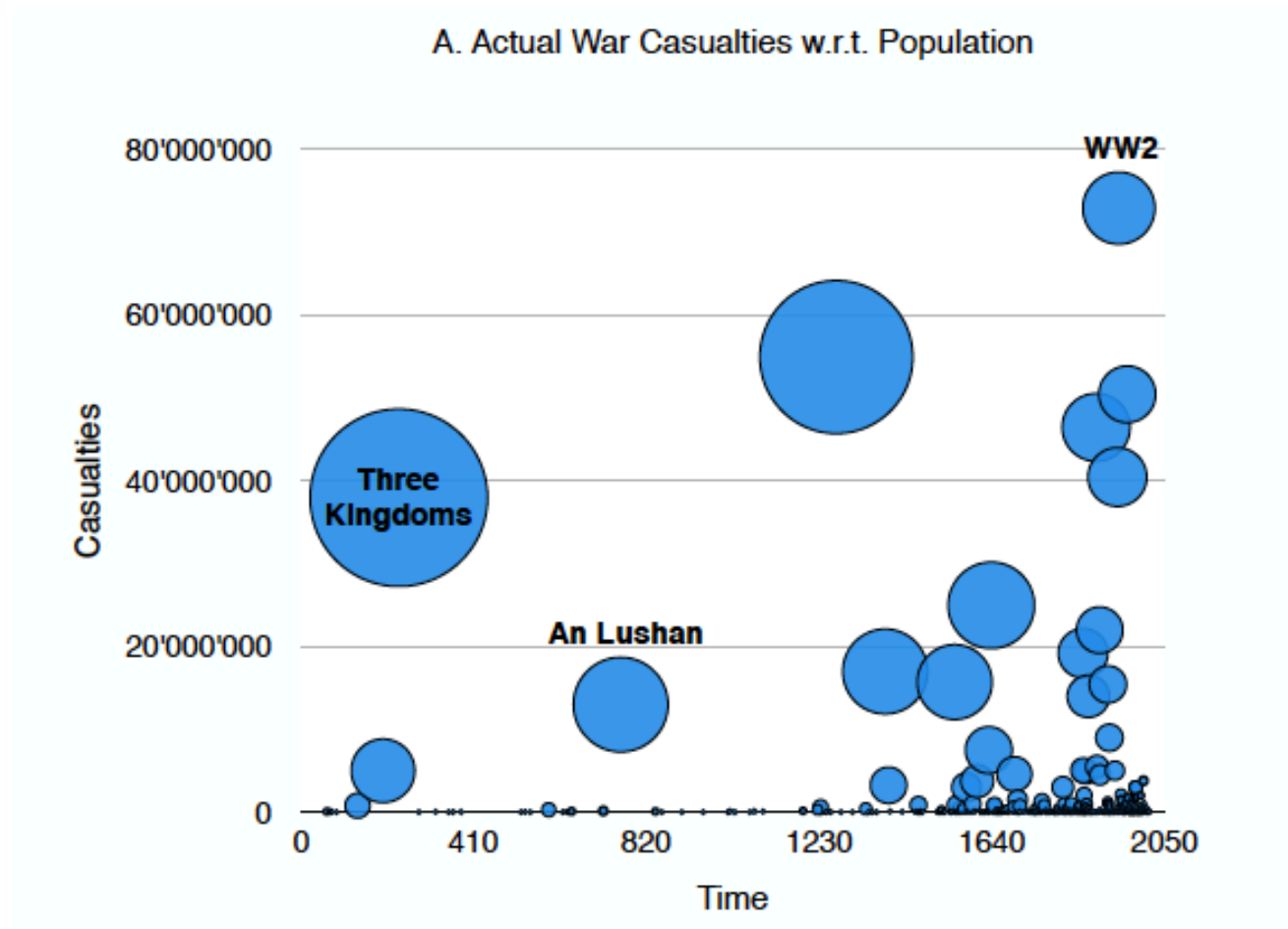

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How to recognize a really big pandemic. 20 pandemics have killed >0.05% of world population; 7>1%; 2>30%

		Start Year	End Year	Lower Est. (1,000)	Avg. Est. (1,000)	Upper Est. (1,000)	Rescaled (1,000)	Population (1,000,000)	Percentage of world population
1	Plague of Justinian	541	542	40,000	70,000	100,000	2,516,136	213	32.86%
2	Black Death	1331	1353	50,000	125,000	200,000	2,434,803	392	31.89%
3	Antonine Plague	165	180	5,000	7,500	10,000	283,355	202	3.71%
4	Cocoliztli Epidemic	1545	1548	5,000	10,000	15,000	165,668	461	2.17%
5	Third plague pandemic	1855	1960	22,000	22,000	22,000	133,173	1,263	1.74%
6	Spanish flu	1918	1920	39,000	39,000	39,000	129,205	2,307	1.69%
7	Smallpox epidemic	1520	1520	5,000	6,500	8,000	107,684	461	1.41%
8	Japanese smallpox epidemic	735	737	2,000	2,000	2,000	67,690	226	0.88%
9	HIV/AIDS	1920	2020	25,000	30,000	35,000	61,768	3,712	0.81%
10	Third Plague	1885	1885	12,000	12,000	12,000	55,439	1,654	0.73%
11	Plague of Cyprian	250	266	1,000	1,000	1,000	37,227	205	0.49%
12	Cocoliztli Epidemic of 1576	1576	1580	2,000	2,250	2,500	31,045	554	0.41%
13	Persian Plague	1772	1772	2,000	2,000	2,000	15,444	990	0.20%
14	Italian plague	1629	1631	280	640	1,000	8,831	554	0.12%
15	Plague of Athens	-429	-426	5	53	100	8,102	50	0.11%
16	Encephalitis lethargica pandemic	1915	1926	1,500	1,500	1,500	6,930	1,654	0.09%
17	Third cholera pandemic	1852	1860	1,000	1,000	1,000	6,053	1,263	0.08%
18	Russian flu	1889	1890	1,000	1,000	1,000	4,620	1,654	0.06%
19	Sixth cholera pandemic	1899	1923	800	800	800	3,696	1,654	0.05%
20	Plague of Sheroe	627	628	100	100	100	3,594	213	0.05%
21	Asian flu	1957	1958	700	1,100	1,500	2,852	2,948	0.04%
25	COVID-19 (current as of 09/03/2020)	2019	?	967	971	975	971	7,643	0.0127%

Cirillo and Taleb (2020), with amended figures in red

How to spot a really big war (1)

War	Dates	Duration (years)	Number of major powers involved	Battlefield deaths	Deaths per annum	World population	Date of population estimate	War dead as a percentage of world population
World War II	1939-1945	6.0	7	19,131,683	3,188,614	2,400,000,000	1950	0.80
World War I	1914-1918	4.3	8	9,450,000	2,197,674	1,750,000,000	1910	0.54
Thirty Years War	1618-1648	30.0	6	2,071,000	69,033	470,000,000	1650	0.44
Napoleonic Wars	1803-1815	12.0	6	1,869,000	155,750	813,000,000	1800	0.23
War of the Spanish Succession	1701-1713	12.0	5	1,251,000	104,250	600,000,000	1700	0.21
Seven Years' War	1755-1763	8.0	6	992,000	124,000	629,000,000	1750	0.16
War of the League of Augsburg	1688-1697	9.0	5	680,000	75,556	600,000,000	1700	0.11
French Revolutionary Wars	1792-1802	10.0	6	663,000	66,300	813,000,000	1800	0.08
Dutch War of Louis XIV	1672-1678	6.0	6	342,000	57,000	470,000,000	1650	0.07
Ottoman War	1682-1699	17.0	2	384,000	22,588	600,000,000	1700	0.06
War of the Austrian Succession	1739-1748	9.0	6	359,000	39,889	629,000,000	1750	0.06
Korean War	1950-1953	3.1	4	954,960	308,052	2,400,000,000	1950	0.04
Sources:								
Levy, *War*, table 4.1. I have added together his data for the Thirty Years War, which he subdivided in three.								
I have also amended his totals for battlefield deaths for the world wars, which were too low.								
World population figures are the lower estimates from the table produced by the US Census Dept								
http://www.census.gov/ipc/www/worldhis.html.								

How to spot a really big war (2)

A. Actual War Casualties w.r.t. Population

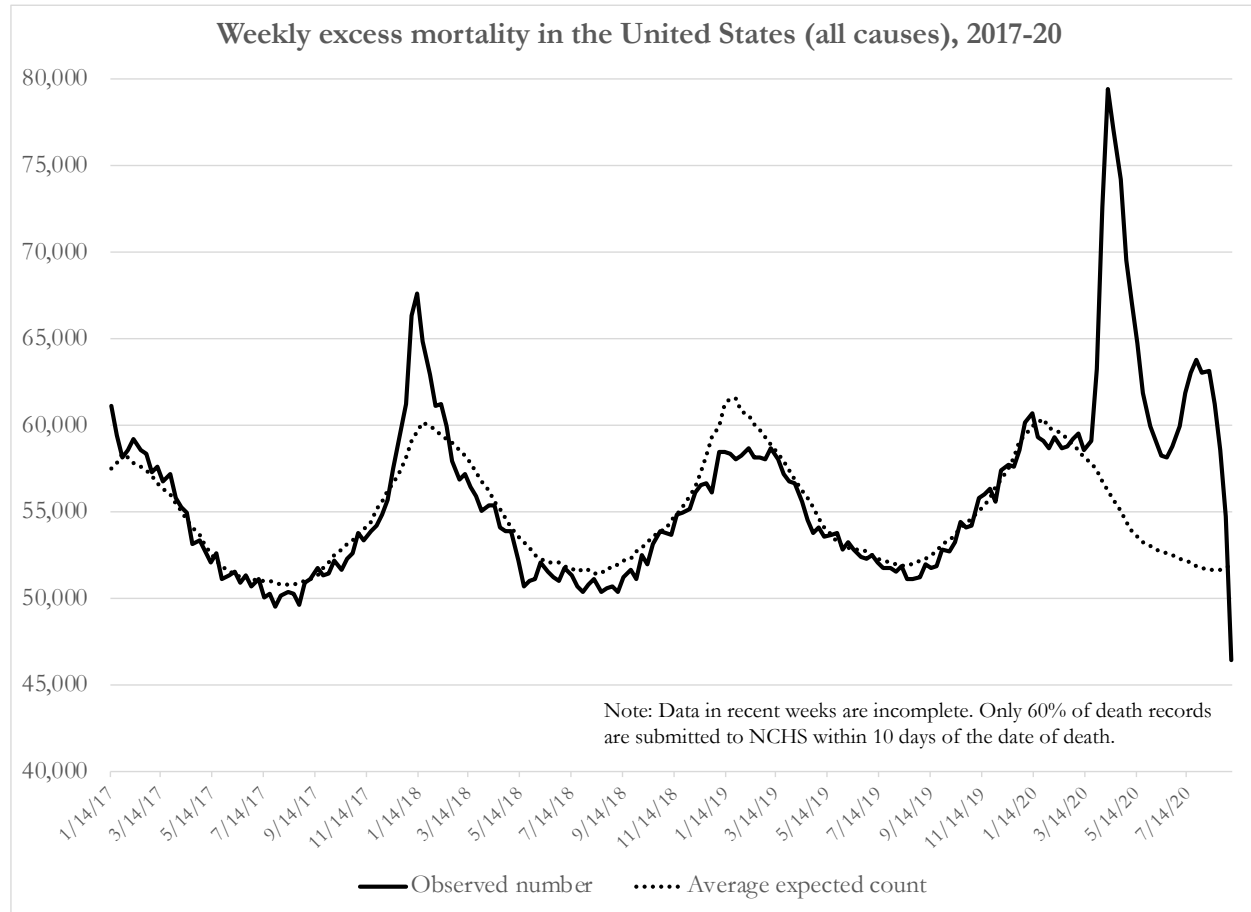Cirillo and Taleb (2020)

Where will COVID-19 come in?

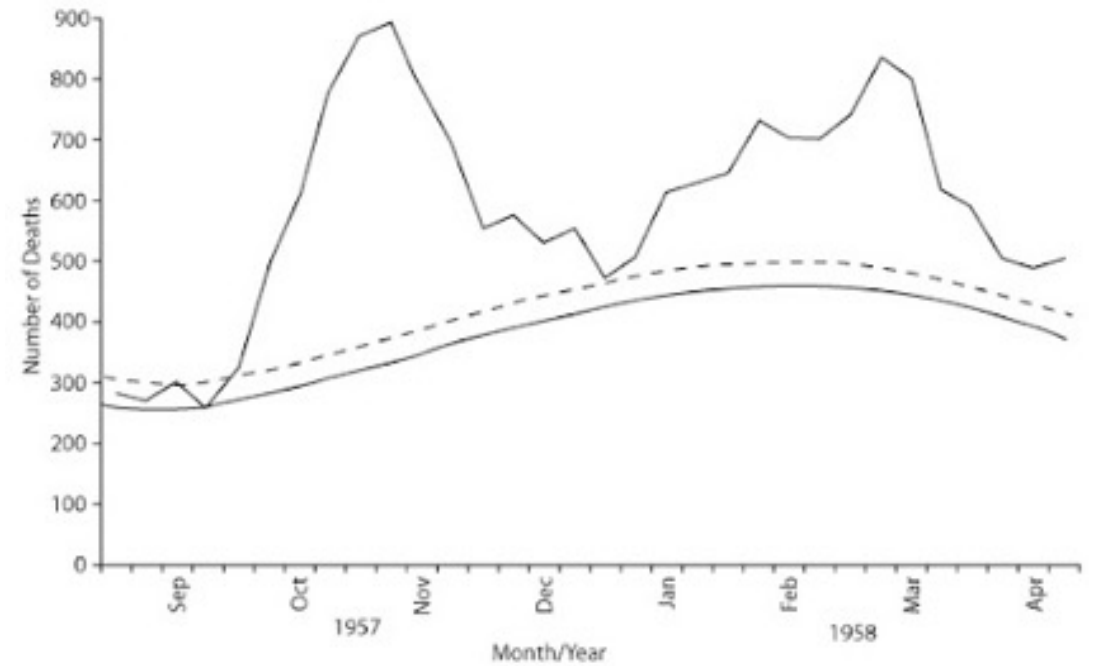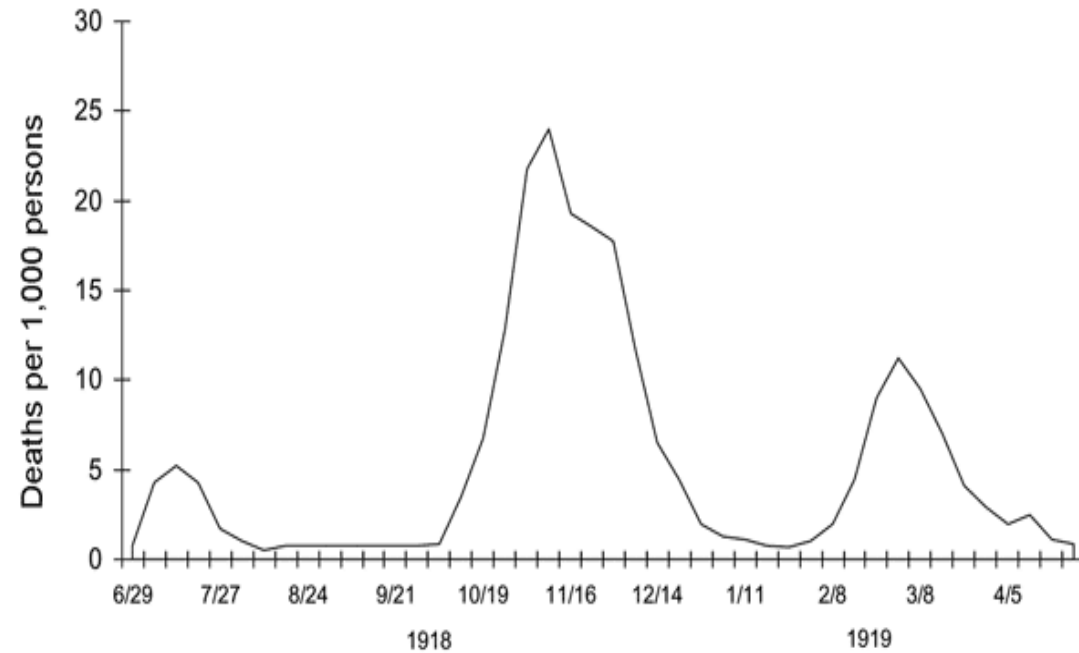- One highly influential epidemiological model suggested that the pandemic of 2020, in the absence of non-pharmaceutical interventions, could kill up to 40 million people (Walker et al. 2020). Relative to a world population of 7.8 billion, that would approximate closely to the battlefield deaths due to World War I.
- Ex ante, the upper bound of global mortality in a severe pandemic was estimated by Fan, Jamison, and Summers (2018) at 42.5 million.
- COVID-19 is clearly not so severe:
  - True infection fatality rate is probably not as high as 0.9%
  - Unlike in 1918-19 and 1957-58, mortality is heavily concentrated amongst the old
  - Drastic NPIs ("lockdowns") have limited spread
  - Vaccine is quite likely to be available next year
  - Mutation of virus seems unlikely to produce a worse strain.

In terms of excess mortality, unlikely to produce a severe second wave

Weekly excess mortality in the United States (all causes), 2017-20

Note: Data in recent weeks are incomplete. Only 60% of death records are submitted to NCHS within 10 days of the date of death.

—— Observed number   ······ Average expected count

Unlike in 1918 and 1957

Spanish (1918-19) and Asian (1957-58) influenza mortality in U.S.

Another way of comparing pandemics

H1N1 1918-19

	1918-19	Percentages of population	2020
World population	1,900,000,000	100%	7,794,798,739
Mortality	39,000,000	2.05%	159,998,500
United States	103,208,000	100%	330,527,774
Infected	30,239,944	29.3%	96,844,638
Deaths	675,000	0.65%	2,161,715
Excess deaths	550,000	0.53%	1,761,397
Implied IFR	2.23%		
IFR based on excess deaths	1.82%		
Sources: Barro et al. (2020)			
Brainard and Siegler (2002)			

H2N2 1957-58

	1957-58	Percentages of population	2020
World population	2,857,662,910	100	7,794,798,739
Mortality min.	700,000	0.02%	1,909,378
Mortality max.	1,500,000	0.05%	4,091,525
United States	177,751,483	100	330,527,774
Infected	44,437,871	25.00%	82,631,944
Excess deaths min.	14,110	0.01%	**26,237**
Excess deaths max.	115,700	0.07%	**215,143**
IFR min.	0.03%		
IFR max.	0.26%		
Sources: Glezen at al. (1996)			
Henderson et al. (2009)			
Viboud et al. (2016)			
https://www.cdc.gov/flu/pandemic-resources/1957-1958-pandemic.html			

And another

Characteristics of SARS-CoV-2, SARS-CoV, and pandemic influenza								
	Influenza 1918	*Influenza 1957*	*Influenza 2009a*	*Influenza 2009b*	*SARS-CoV*	*SARS-CoV-2*		
Transmissibility, R0	2.0		1.7		2.4	2.5		
Incubation period, days	Unknown		2		2–7	4–12		
Interval between symptom onset and maximum infectivity, days	2		2		5–7	0		
Proportion with mild illness	High		High		Low	High		
Proportion of patients requiring hospitalisation	Few		Few		Most (>70%)	Few (20%)		
Proportion of patients requiring intensive care	Unknown		1/104,000		Most (40%)	1/16,000		
Proportion of deaths in people younger than 65	95%		80%		Unknown	0.6–2.8%		
Number of U.S. deaths (adjusted to year 2000 population)	1,272,300*	150,600*	7,500–44,100	8,500–17,600	0	164,037**		
Mean age at death (years)	27.2	64.6	37.4		Unknown	Unknown		
Years of life lost (adjusted to year 2000 population)	63,718,000	2,698,000	334,000–1,973,000	328,900–680,300	Unknown	Unknown		
Source: Petersen, "Comparing SARS-CoV-2," tables 1 and 3.								
Notes								
a Range based on estimates of excess pneumonia and influenza deaths (lower range number) and all-cause deaths (upper range number); estimated from projections of mortality surveillance from 122 citie								
b Estimates from the Centers for Disease Control and Prevention using 2009 pandemic survey data.								
* Estimates based on the excess mortality approach applied to final national vital statistics.								
** Global. For SARS-CoV-2 to September 11, 2020								

The element of surprise

- The number of days between the archduke's assassination and the British declaration of war on Germany was 44.
- The number of days between China's admission of human-to-human transmission of COVID-19 (on January 20) and total global cases reaching 100,000 (March 3) was 46.
- The gray rhino feature: multiple warnings that it could happen.
- The black swan feature: widespread surprise when it actually did happen.
- The dragon king feature: massive consequences out of proportion even to the proximate level of mortality.
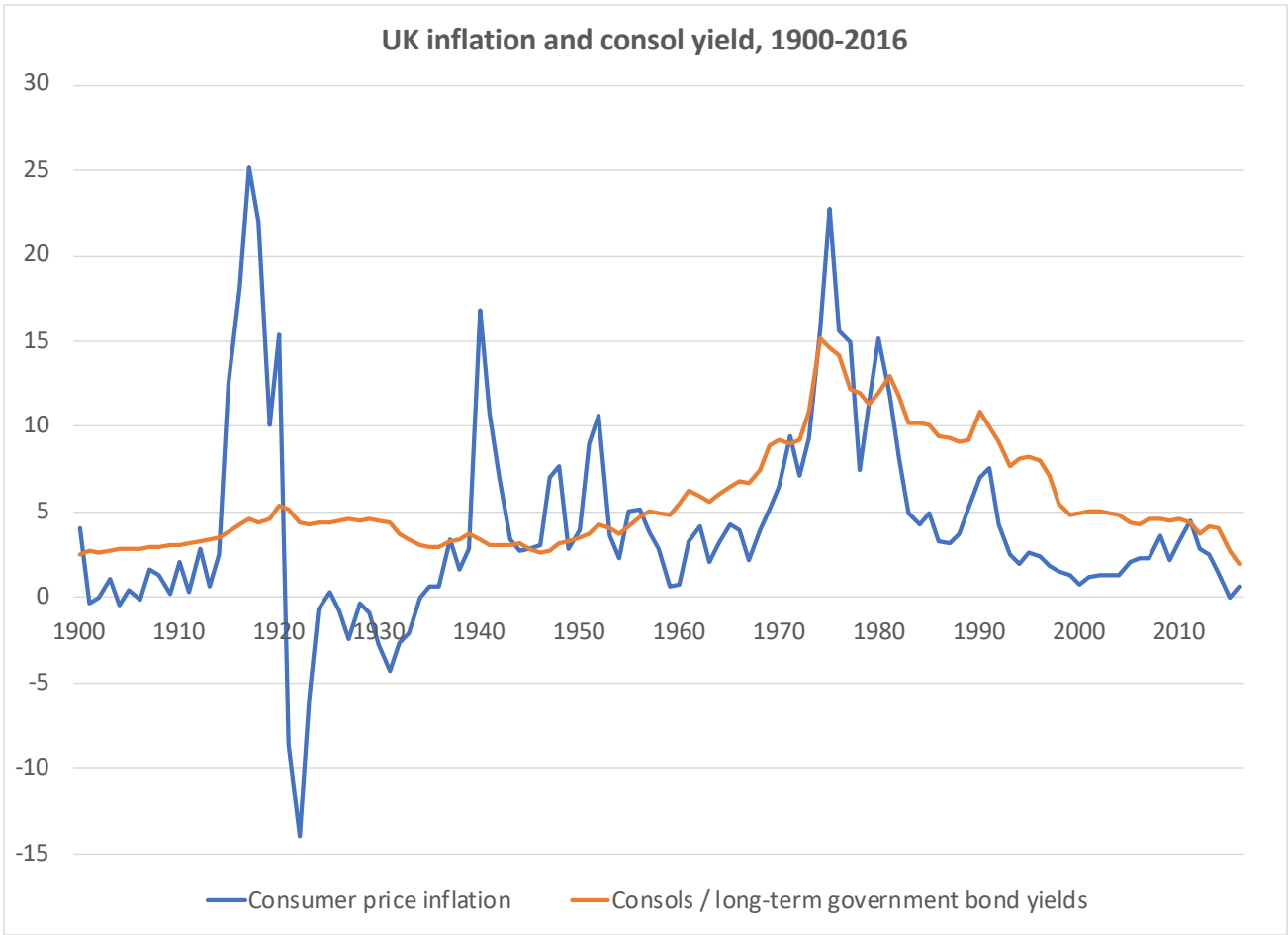
Similarities …

- What was in fact a gray rhino was perceived, when it appeared, as a black swan.
- An economic chain reaction as sudden stops in cashflow forced entrepreneurs out of business and people out of work.
- Central bank balance sheets grew substantially, as did public debts.
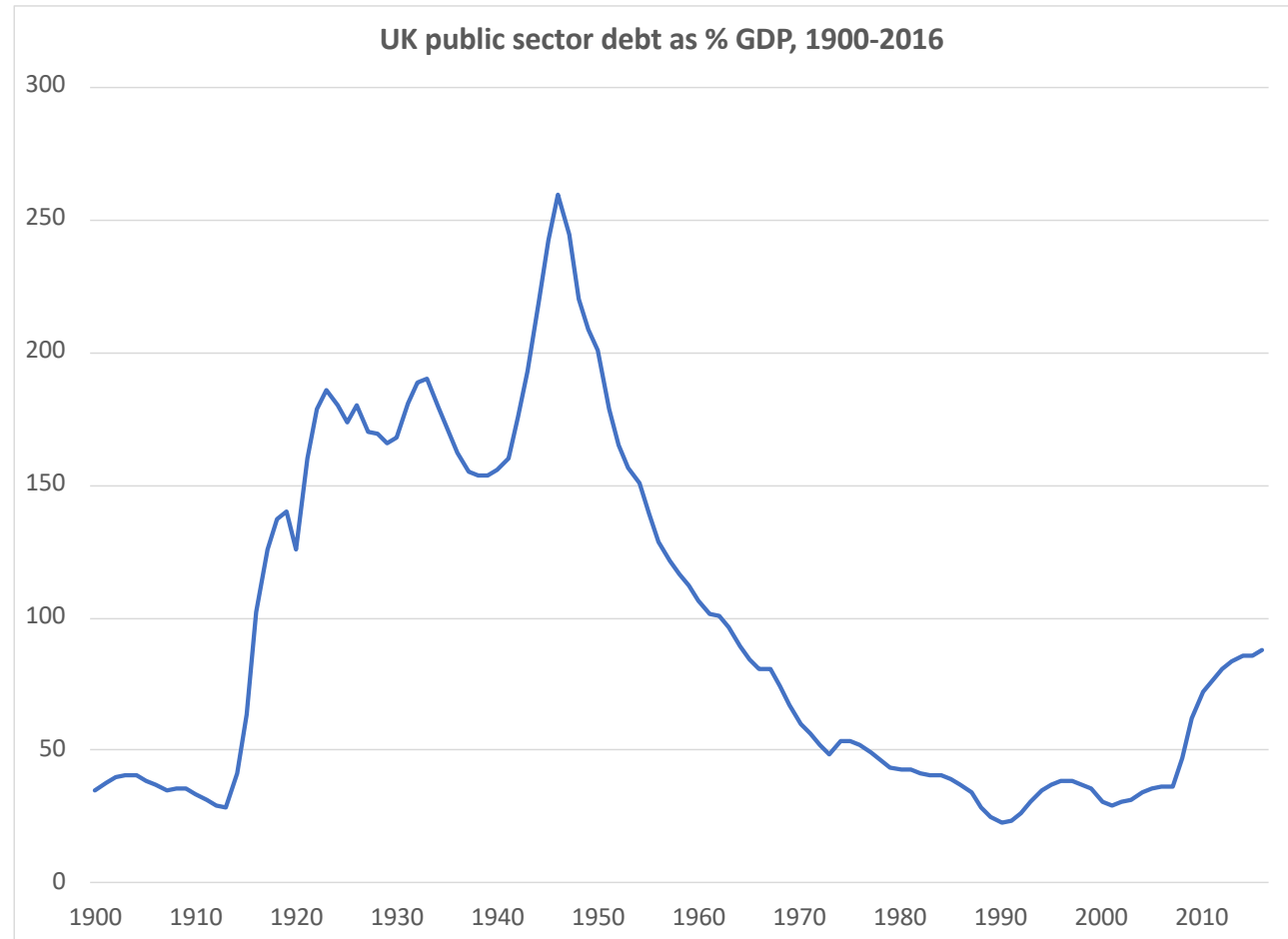- Defaults.
- Unforeseeable duration.

… and differences

- Less populous world, younger in average age, with worse medical science.
- Germans rather than germs were the enemy.
- Patriotic unity.
- Mobilization of industrial enterprises for the production of war materiel and the deployment of young men away from productive labor into very dangerous and destructive activities.
- Economic theories and policy tools: stock markets closed rather than pumped up with government money.
- Young men died.
- Inflationary.

The deflation v. inflation debate

UK inflation and consol yield, 1900-2016

Legend: Consumer price inflation — Consols / long-term government bond yields

Public debt

UK public sector debt as % GDP, 1900-2016

Bank of England

Central bank balance sheets

Bank of England balance sheet as % GDP, 1900-2016

Bank of England

Political and geopolitical consequences

- A swing to the left in the United States?
  - The appeal of "normalcy" or the desire for progressivism (New Deal).
- Or a right-wing backlash: recasting the bourgeois world?
  - Triumph of the national border over globalization.
  - A close election (as in 2000) precipitating constitutional crisis?

- The death of "Chimerica" and the intensification of Cold War II?
- Hegemonic transition from the U.S. to China?
- Emergence of a new Non-Aligned Movement?
- Rising probability of a "hot" war, e.g. over Taiwan.

A farewell to globalization?

	Post-war	Post-pandemic
Goods	Commodity and goods trade revived in the 1920s, but protectionism grew. Relatively few international supply chains.	Re-shoring of strategic elements, especially pharma. Global goods trade becomes less important for structural reasons (software, data.)
Services	Limited international service trade.	Services become more globalized as video-conferencing and remote working becomes the norm.
Capital	Globalization of capital continued until the 1929 Crash, except for Communist countries.	Strategic restrictions on key investments. Defaults triggered by COVID-19 likely to discourage lending to EMs for a time.
Data	De-globalization of telegraph networks for strategic reasons.	Continuing divergence of Chinese and Western internets; some divergence of regulation between EU and U.S.
Labor	Immigration restrictions were further tightened in the United States and elsewhere	Pandemic strengthens case for strict national border policing, especially if there is large-scale mass migration from poorer countries afflicted by the virus.

Goodbye to All That?