The Coronavirus and the Great Influenza Pandemic:

Lessons from the "Spanish Flu" for the Coronavirus's Potential Effects on Mortality and Economic Activity

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Session I. Epidemiological and Economic Factors

Introduction

Motivation

- **Rare disasters taxonomy**: Natural catastrophes, like pandemics, feature prominently
- **Great Influenza Pandemic 1918-20**: Measurable economic and financial impact
- **Uncertain COVID-19 outcome:** Especially when we wrote the paper in March 2020

This paper

- **Main goal**: Estimate the macroeconomic impact of the Great Influenza Pandemic
- **Secondary goal**: Establish plausible guides for COVID-19 or other pandemic outcomes
- **Strategy**: Assemble data on flu 1918-20 and war deaths 1914-18; disentangle WWI
- **Economic variables**: On average, 6% and 8% declines in GDP and consumption p.c.
- **Financial variables**: Lower realized real returns on stocks and bills (higher inflation)

Rare disasters: Taxonomy

- **Previous work**: Barro and Ursúa (2008, 2012) analyzed cumulative declines in real GDP and consumption per capita by more than 10%

- **Early 1920s:** We found a number of rare disaster observations with troughs between 1919 and 1921, which we hypothesized could be connected to the flu, but we had not separated its effect from that of WWI

- **Breakdown of macroeconomic disasters 1870-2006:**

Episode/period	C (28 countries)		GDP (40 countries)	
	Number of events	Mean fall	Number of events	Mean fall
Pre-1914	31	0.16	51	0.17
World War I	20	0.24	31	0.21
➡ Early 1920s (flu?)	10	0.24	8	0.22
Great Depression	14	0.20	23	0.20
World War II	21	0.33	25	0.37
Post–World War II	24	0.18	35	0.17
OECD countries	6	0.12	6	0.13
Non-OECD countries	18	0.19	29	0.17
Other	5	0.19	10	0.15
Overall	125	0.22	183	0.21

Note: These results update Barro and Ursúa (2008, table 7) to include the four countries with newly constructed data as shown in Table 3. (China is not included for C. New Zealand is included for C but was not in Barro and Ursúa 2008.) Declines in real per-capita personal consumer expenditure, C, and GDP are those of 0.095 or greater when computed from a peak-to-trough approach over multiple years.

Great Influenza Pandemic: Selected features

- **3 waves:** 1. March 1918 – August 1918
  2. September 1918 – January 1919
  3. February 1919 – June 1920

- **Oddities**: A) Age Patterns: ≈ 50% of deaths in ages between 20-45
  B) Little connection to standard socio-economic variables
  C) Rare physiological complications: rapid progression to fatal pneumonia
  D) Simultaneous infection of humans and swine [Influenza A subtype H1N1]
  E) Sequels of encephalitis lethargica

- **Social distress**:
  - Airborne disease
  - Savage quick deaths
  - Confusion, panic, quack remedies
  - Corpses piled in the streets
  - Closure of businesses and services

- **Famous: [Survivors]** Friedrich Hayek, General Pershing, Walt Disney, King Alfonso XIII, Mary Pickford, Georges Clemenceau, David Lloyd George, and Woodrow Wilson; **[Dead]** Max Weber, Gustav Klimt, Egon Schiele, and Marto siblings

Great Influenza Pandemic: Excess mortality

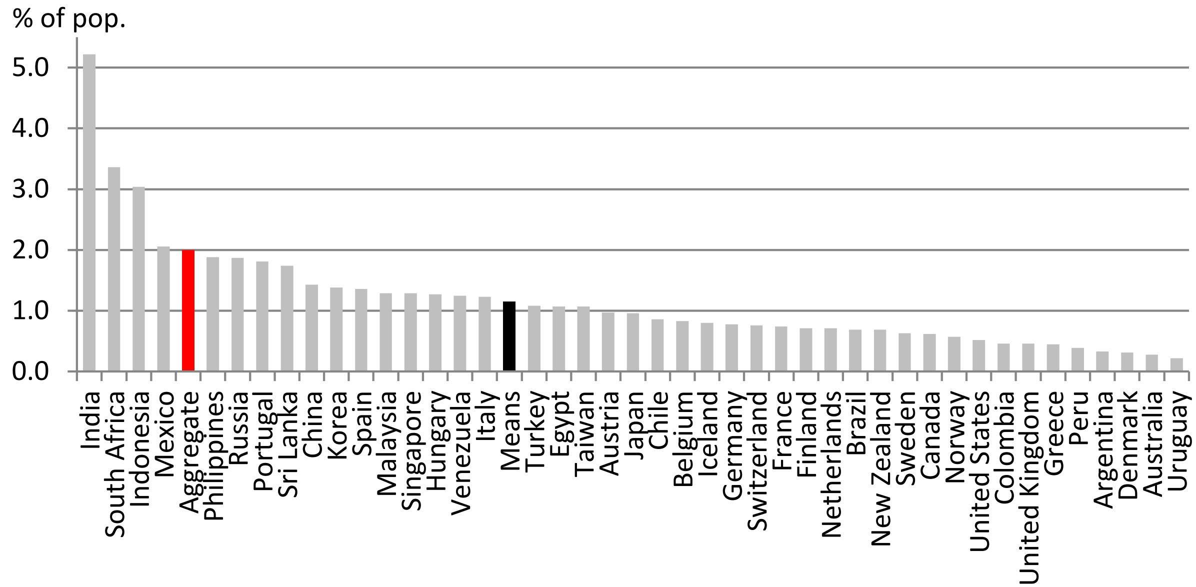
- **Array of sources**: Ursúa (2009), Weng (2016), Johnson and Mueller (2002), Murray, et al. (2006), Mitchell (2007), and the Human Mortality Database.

- **Sample**: 43 countries ~ 89% of world population in 1918 (larger share of world GDP)

- **World deaths**: 23.5m (1918) + 8.4m (1919) + 2.8m (1920) = 34.6m → 39m total

- **World death rates**: 1.38% (1918) + 0.49% (1919) + 0.16% (1920) = 2.0% world total

- **Country-level flu death rates**:



- **Comments:** (1) Morbidity data; (2) Possible impact of economic conditions.

World War I: Assessing intensity

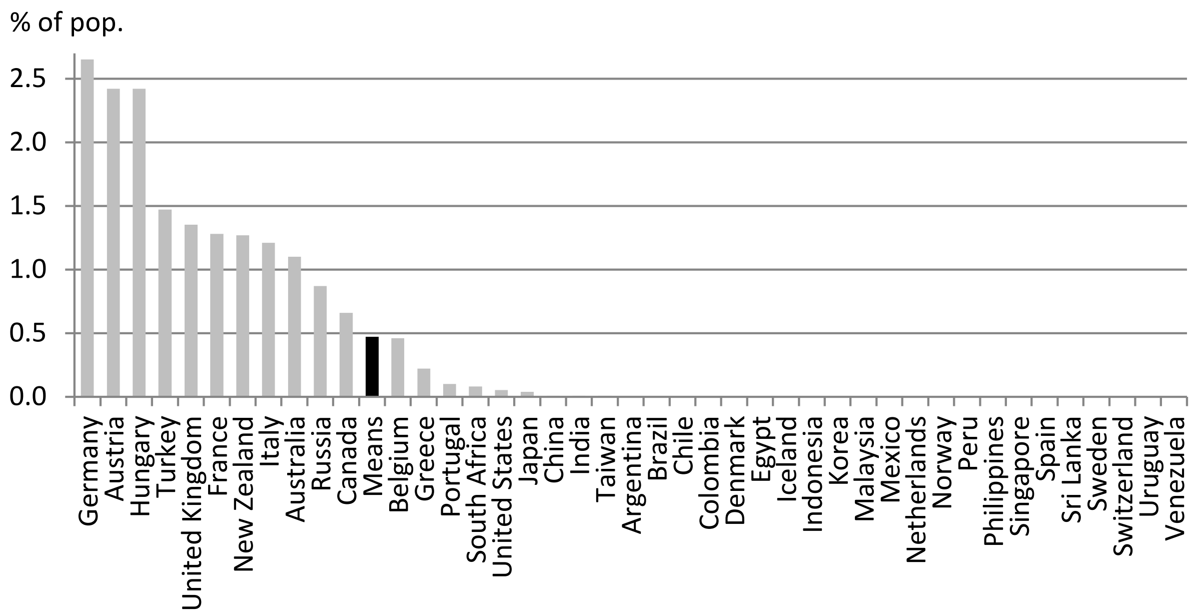
- **Approach**: Gauge war intensity by the ratio of military combat deaths---mainly from Urlanis (2003)---to total population

- **Sample**: 7 country combatants (used to proxy none available data for respective allies)

- **World deaths**: 6.2m total from 1914-18 (excludes prisoners of war and civilians)

- **World death rate**: 0.47% total from 1914-18

- **Country-level war death rates**:



- **Comments:** (1) 1918 matters for both; (2) Many countries suffered only the flu.

Economic outcomes: Regression results

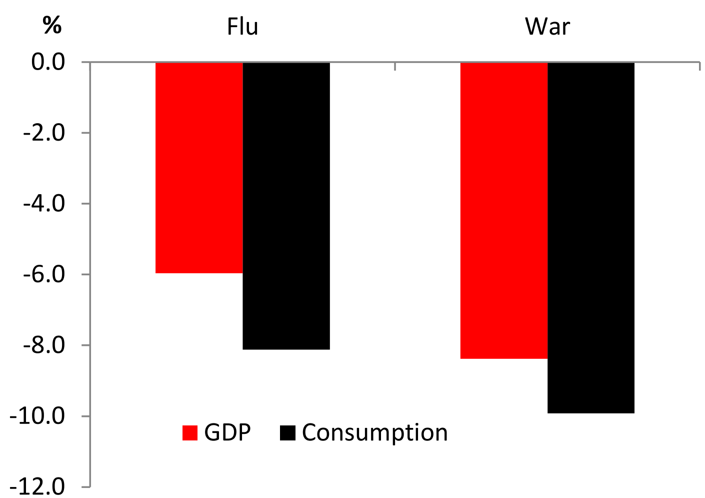
- **Samples:** GDP pc (42 countries), Consumption pc (30 countries); 1901-1929
- **Regression**: GDP or C pc growth vs. constants, flu death rates, war death rates [panel least squares; s.e. of coefficients allowing clustering of error terms by year]

Dependent variable	GDP growth rate		Consumption growth rate	
Independent variables	(1)	(2)	(3)	(4)
Constant	0.0202*** (0.0034)	0.0169*** (0.0035)	0.0179*** (0.0033)	0.0150*** (0.0034)
Flu death rate	-2.98** (1.27)	-2.67** (1.18)	-4.06** (1.92)	-4.18** (1.82)
Lag of flu death rate	--	2.68 (2.10)	--	0.96 (2.06)
2nd lag of flu death rate	--	2.22 (2.10)	--	1.38 (1.93)
War death rate	-17.9*** (3.0)	-13.3*** (3.1)	-21.2*** (3.8)	-21.2*** (4.1)
Lag of war death rate	--	-10.2*** (3.8)	--	2.0 (4.9)
2nd lag of war death rate	--	12.5*** (3.3)	--	8.8** (4.2)
p-value, lags of flu death rate=0	--	0.25	--	0.70
p-value, lags of war death rate=0	--	0.000	--	0.081
p-value, coeffs of flu add to zero	--	0.48	--	0.051
p-value, coeffs of war add to zero	--	0.012	--	0.085
R-squared	0.041	0.043	0.057	0.058
s.e. of regression	0.070	0.070	0.077	0.077
Number of observations	1183	1175	875	867

See note in the paper's p. 24

Economic outcomes: Key takeaways

- **Flu effect:** With 2% flu death rate → –6.0% in GDP pc and –8.1% in C pc
  - Cannot rule out flu effects on level of GDP pc that are fully permanent or temporary
- **War effect**: With 0.5% war death rate → –8.4% in GDP pc and –9.9% in C pc
  - Adverse effects on level of GDP pc appear to be ~50% permanent
    [In line with Nakamura, Steinsson, Barro, and Ursúa (2013) and Barro and Jin (2019)]
- **Estimated impacts:**



See note in the paper's p. 24

- **Country comments:** (1) U.S. is off, (2) GDP in India in line; (3) C in Canada in line.

Financial outcomes: Regression results

- **Samples:** Stocks (27 countries), Bills (21 countries), Inflation (35 countries)
- **Regression**: Same specification as before.

Dependent variable	Real stock return		Real T-bill return		Inflation rate	
Independent variables	(1)	(2)	(3)	(4)	(5)	(6)
Constant	0.063*** (0.017)	0.050*** (0.017)	0.026*** (0.008)	0.024*** (0.008)	0.024*** (0.009)	0.026*** (0.009)
Flu death rate	-13.1 (8.5)	-10.8 (8.2)	-7.0*** (2.2)	-6.8*** (2.1)	10.1*** (3.0)	10.0*** (2.8)
Lag of flu death rate	--	-2.3 (8.0)	--	4.5 (3.8)	--	-10.2** (4.8)
2nd lag of flu death rate	--	1.6 (6.2)	--	3.0 (3.8)	--	-0.8 (4.7)
War death rate	-40.0*** (14.3)	-30.9* (17.9)	-29.9*** (4.3)	-27.2*** (5.5)	28.6*** (4.3)	19.8*** (5.3)
Lag of war death rate	--	-15.4 (23.8)	--	-5.9 (9.3)	--	23.3*** (8.2)
2nd lag of war death rate	--	89.1** (36.4)	--	0.0 (6.2)	--	4.5 (5.6)
p-value, lags of flu death rate=0	--	0.93	--	0.33	--	0.102
p-value, lags of war death rate=0	--	0.050	--	0.59	--	0.012
p-value, coeffs of flu add to zero	--	0.35	--	0.89	--	0.89
p-value, coeffs of war add to zero	--	0.27	--	0.001	--	0.000
R-squared	0.028	0.082	0.106	0.113	0.089	0.113
s.e. of regression	0.209	0.204	0.091	0.090	0.098	0.096
Number of observations	533	529	520	512	893	885

See note in the paper's p. 25

Financial outcomes: Key takeaways

- **Flu effect** (at 2.0% flu death rate)**:**
    - *Stocks*: Negative (–26%) but insignificant
    - *Bills*: Negative (–14%) and significant; eventual recovery
    - *Inflation*: Positive (+20%) and significant; eventual decline
- **War effect** (at 0.5% war death rate):
    - *Stocks*: Negative (–20%) and significant; eventual recovery
    - *Bills*: Negative (–15%) and significant
    - *Inflation*: Negative (+14%) and significant
- **Comments on inflation**: (1) Data exclude hyper-inflation observations; (2) Data are possibly influenced by price controls.

Ongoing work

- **Policy differences**: Beyond GDP and C, we are assembling data on government expenditures and revenues, money supply, wage growth, exports, and containment measures

- **Higher frequency data**: Match with regional activity indexes in the U.S. and maybe other countries

- **Growth model with "structural" disasters**: Differentiated shocks to production inputs. Insights from finite horizon models (Blanchard, 1985; Yaari, 1965) may be useful

- **"Pandemic Markets"**: Deeper dive into asset price behavior at higher frequencies

Appendix

Non-disease natural disasters

Type	Location	Timing	Death toll (000) [% of local pop.]	Material losses
Earthquake	China (Shaanxi and suroundings)	1556	820-830 [≈ 40-60]	Cities and villages entirely destroyed
Volcano	Indonesia (Mount Tambora)	1815	92 [Up to 100]	All capital (connection to year-without-summer)
Flood	China (Yellow, Yangtze, Huai)	1931	1,000-4,000 [> 1.0]	70% rice crop destroyed; 80 million homeless
Cyclone	Bangladesh - West Bengal	1970	500 [≈ 18]	$USD 480 million
Mudslide	Venezuela (Vargas state)	1999	20 [≈ 6]	$USD 1.8-3.5 billion

Source: Constructed with information from Withington (2008) and news reports.

Disease natural disasters

Type	Location	Timing	Death toll [% of local pop.]	Economic effects
Plague of Athens (typhus or typhoid)	Athens (and Attica)	431 - 427 BC	100 k [≈ 30%]	City devastated; lost momentum vs. Sparta
Plague of Justinian (mainly bubonic)	Byzantine Empire	541 - 542	25 M [≈ 33%]	Constantinople caos; foregone reunification Roman Empire
Black Death (all plagues / virus)	Europe	1348 - 1351	25M - 50 M [≈ 30-45 %]	Wage increases; technology; property rights.
Great Famine (potato blight)	Ireland	1845-1851	1-1.5 M [≈ 13-19 %]	Potato price up 250-600%; 1 M emigrated
Great Influenza (A/H1N1)	Worldwide	1918 - 1920	*To be discussed…*	*To be discussed…*
AIDS (HIV)	Worldwide	1981 - present	29 M [Prevalence 0.8%]	Long-term in industrialized; high & short-term in Africa

Source: Constructed with information from Withington (2008) and Kohn (2008).

Influenza outbreaks

- **Localized**: 1732-33, 1742-43, 1762, 1767, 1775-76, 1782, 1803, 1830, 1950-51 (Britain) 1736-39 (Scandinavia) 1740, 1803 (France) 1789 (New England) 1820-40 (NZ) 1833 (Persia, Britain) 1837-39 (Samoa) 1900, 1926-28, 35-36 (Java) 1925-27, 1943-47, 1964-65, 1995-97 (Russia) 1928-29 (US)
- **Widespread**: 1580 (Asia, Europe, America) 1708-09, 1712, 1718-22, 1729-30, 1732-33, 1742-43, 1762, 1788-89 (Europe) 1781-82 (Asia, Europe) 1830-31 (Asia, America, Europe) 1836-37 (Asia, Europe, AUS, SAF) 1847-48 (Europe, Britain) 1889-90, 1918-20, 1957-58, 1968-69, 1977-78, 2009-10, 2020-21 (All) 1997-2000 (Asia)

Pre-COVID-19 related work

- **History**: Collier (1974), Crosby (1976), Iezzoni (1999), Kolata (1999), Davies (2000), Getz (2000), Barry (2004), Kohn (2008)

- **Epidemiology**: Vaughan (1921), Patterson & Pyle (1991), Potter (2001), Luk, Gross & Thompson (2001), Taubenberger & Morens (2006)

- **Statistics**: Sydenstricker (1918, 1931), Harris (1919), Frost (1920), Collins (1931), British Ministry of Health (1920), Jordan (1927), Johnson & Mueller (2002)

- **Economics**:

  - Disease, health and economic growth: Bloom & Godwin (1997), Arora (2001)
  - GDP p.c. growth across U.S. states from 1919 to 1930 : Brainerd & Siegler (2003)
  - Long-term effects of *in utero* exposure in post-1940 U.S. population: Almond (2006)
  - Mortality in U.S. states (flu and war) and manufacturing wages: Garret (2006)
  - Newspaper articles to gauge economic impact: Garret (2007)
  - Monetary cost of new pandemic: Meltzer, Cox & Fukuda (1999), World Bank (2008), USDH&HS (2005), CBO (2006), James & Sargent (2006), IMF (2006)

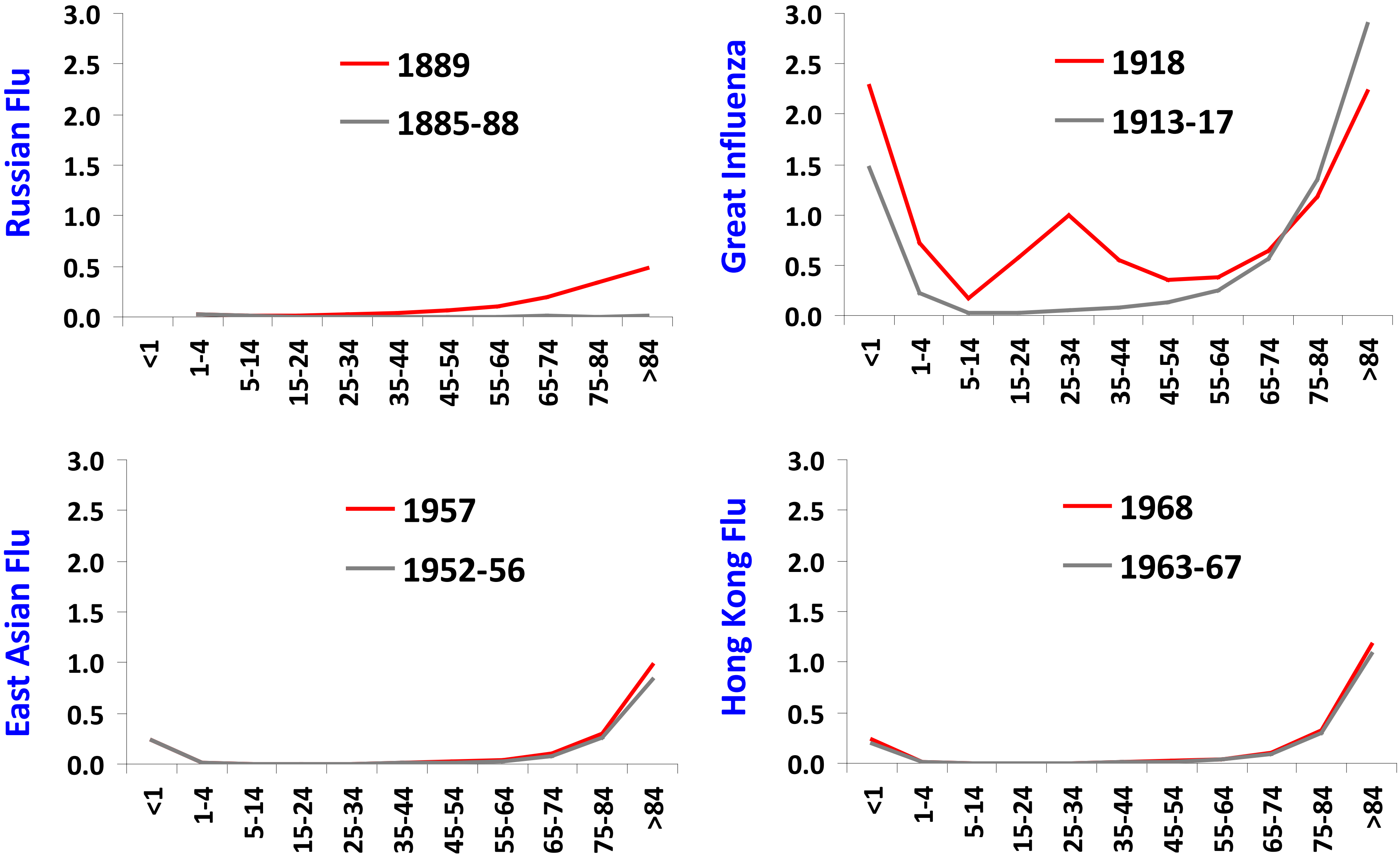
  - WWI U.S. economic mobilization: Rockoff (2005)
  - Estimates of U.S. GNP 1909-1928: Romer (1988)

Timing and variables

- **Great War:**
  - 28 July 1914–11 November 1918 (Armistice)
  - U.S. enters on April 1917
  - Definition of “combatant” (not all at the same time, some nominal)
  - Theaters of war (mainly Western and Eastern fronts + Pacific Islands)

- **Economic Policy:**
  - Important globalization up to 1914
  - Gold standard
  - Financing the war

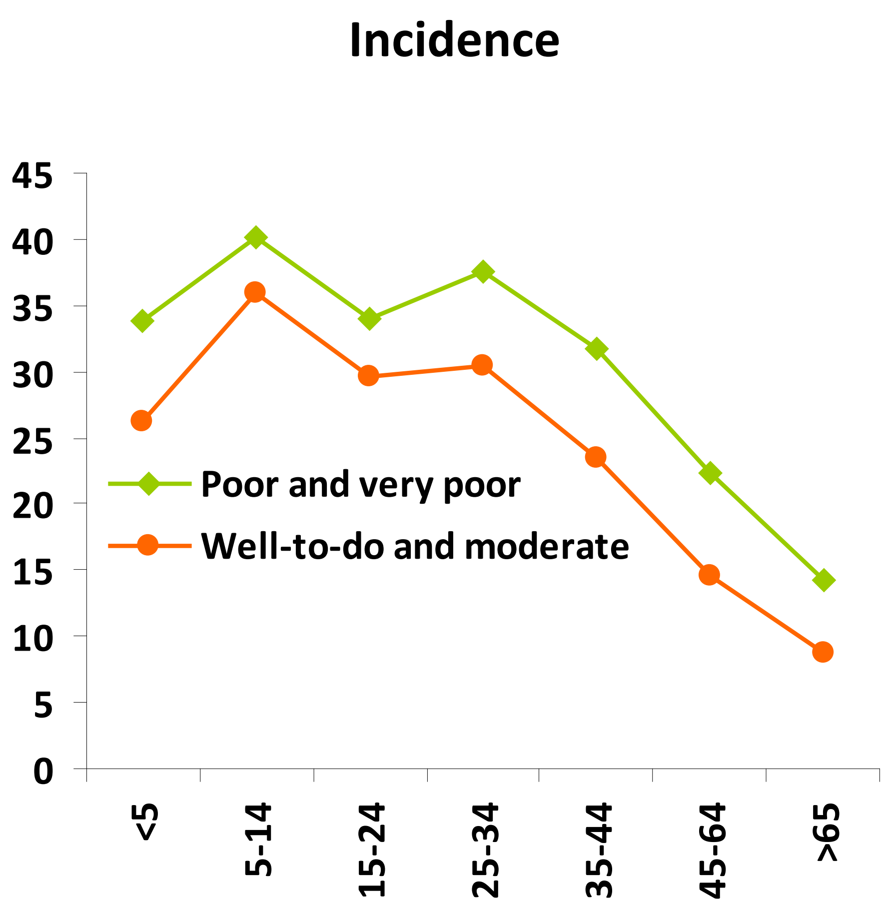
Mortality patterns by age (U.S.*, %)

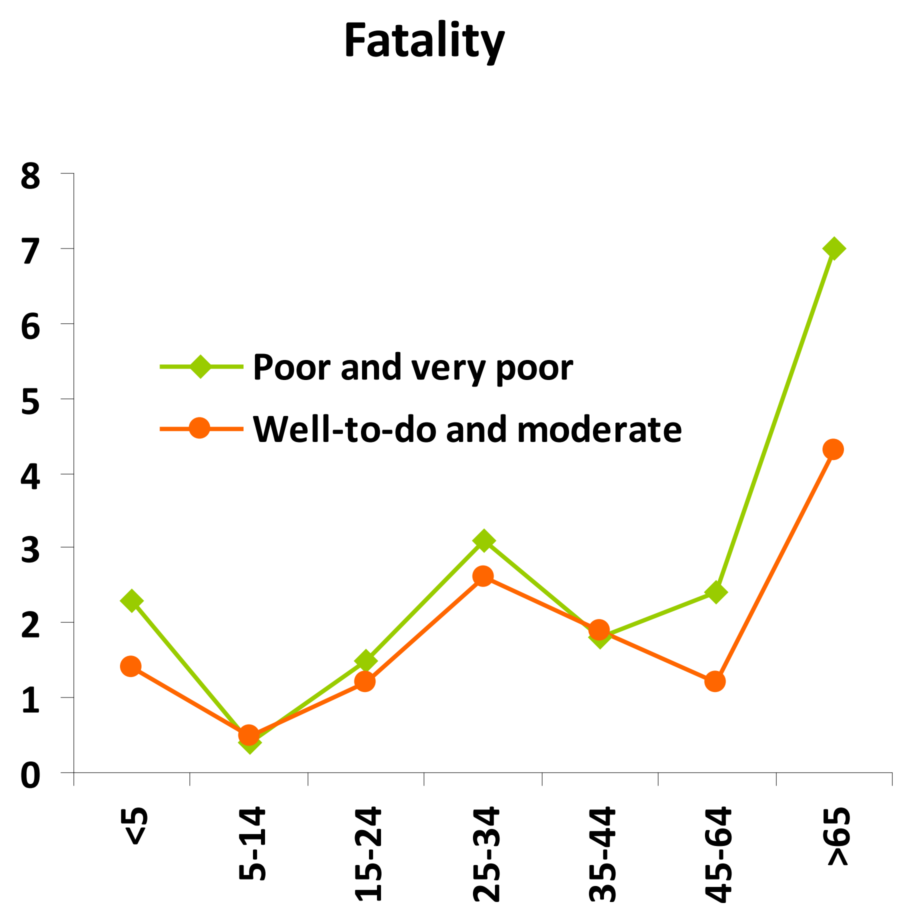


* Except 1889-90, which corresponds to England and Wales.

Sources: British Ministry of Health (1920), Luk, Gross, Thompson (2001)

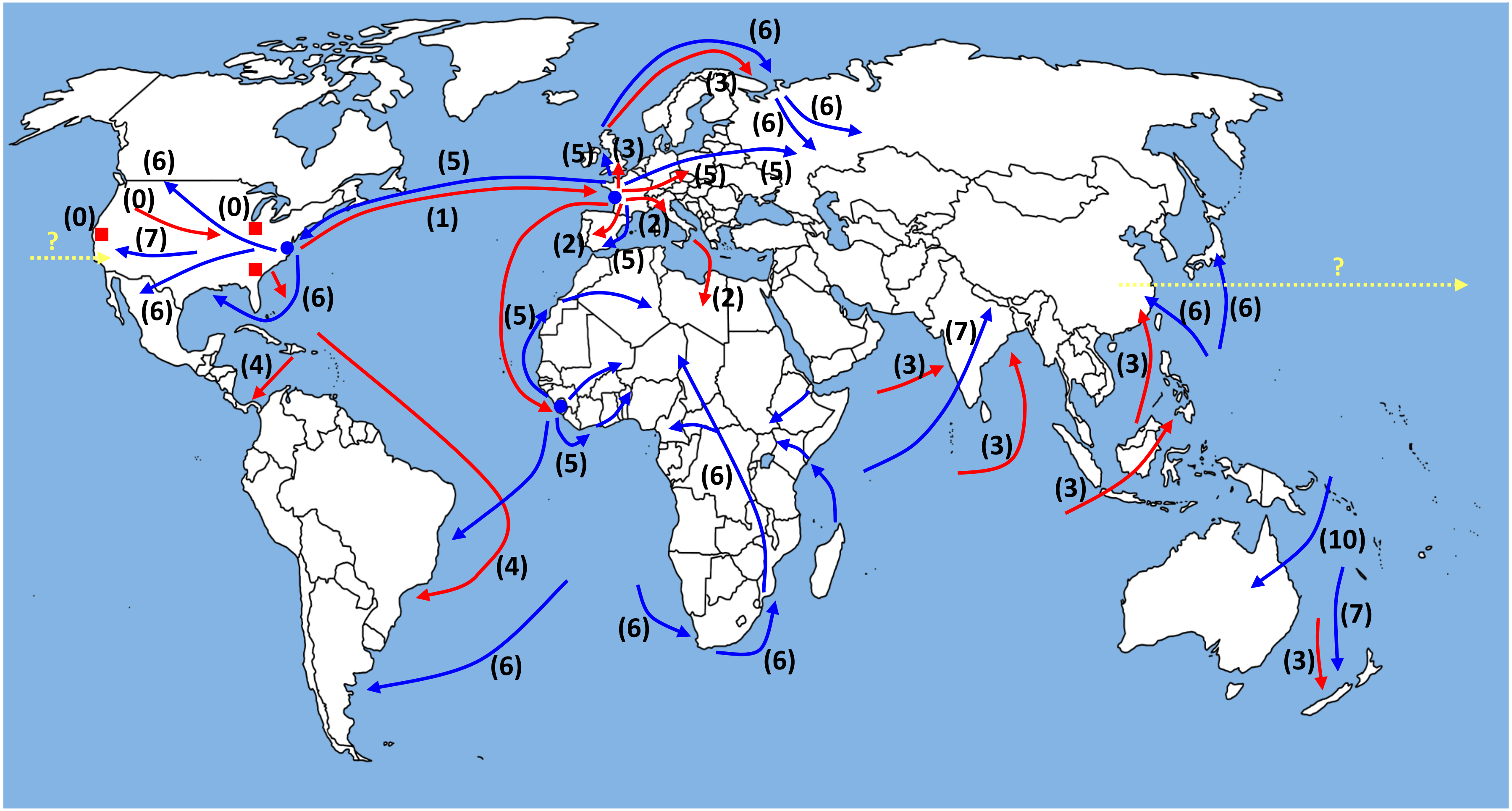
Patterns by economic status and age (U.S.; %)





Note: Data corresponds to nine urban localities with a population over 25k and relate to slightly over 100k individuals [New London, Baltimore, Augusta, Macon, Des Moines, Louisville, Little Rock, San Antonio and San Francisco].
Source: Sydenstricker (1931)

Diffusion patterns

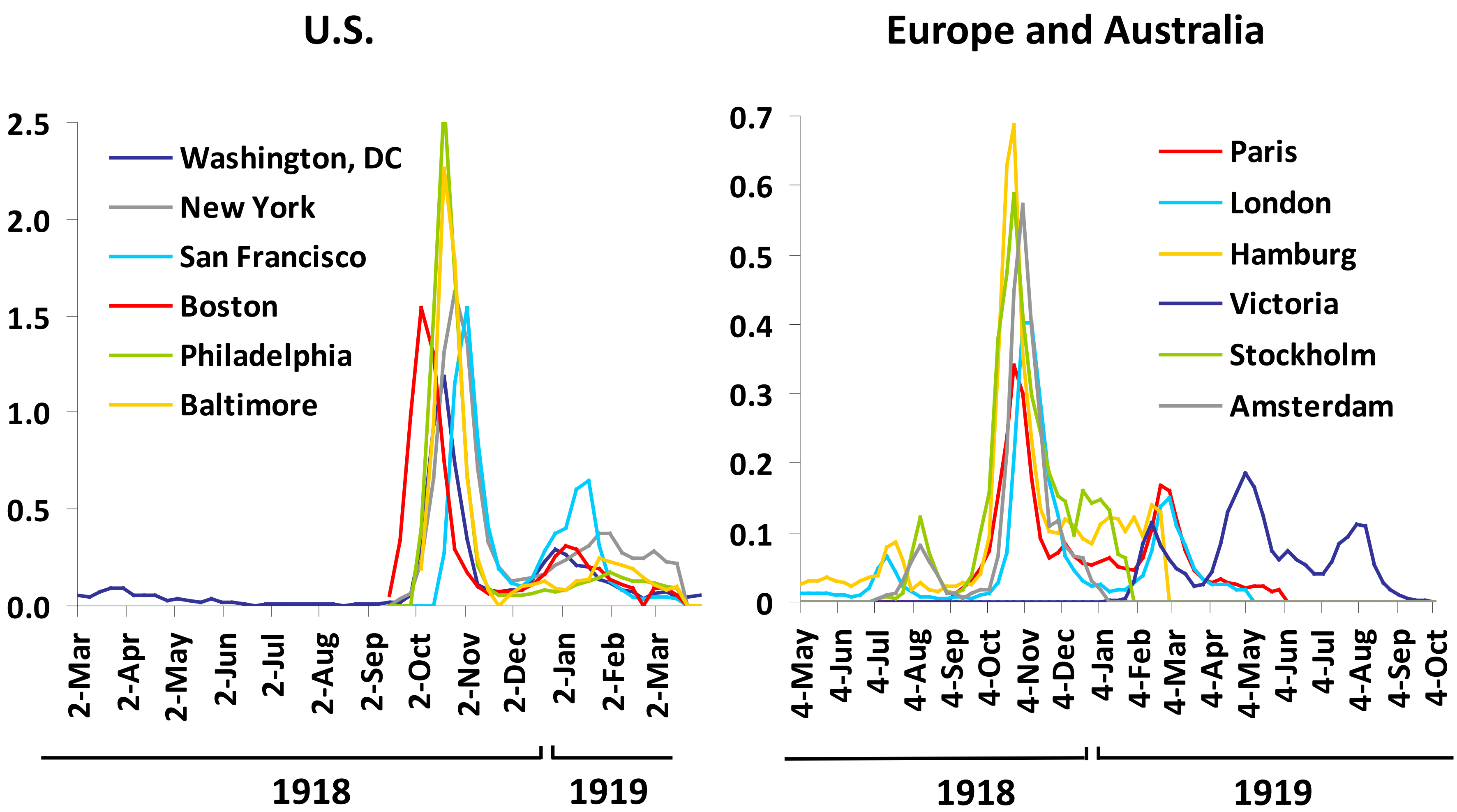


■ First outbreaks ● Focal points second wave (#) Months after 03/1918 when epidemic recorded

→ Spread first wave → Spread second wave

Source: Adapted from Potter (2001) and Patterson & Pyle (1991)

Deaths (by city; per 1,000 of pop.)



Note: Deaths correspond to influenza and pneumonia (except Victoria, Australia, which corresponds only to influenza).
Source: British Ministry of Health (1920) and others.

An idea of what it was

"These men start with what appears to be an ordinary attack of La Grippe or Influenza, and when brought to the Hosp. they very rapidly develop the most viscous type of Pneumonia that has ever been seen. Two hours after admission they have the Mahogany spots over the cheek bones, and a few hours latter you can begin to see the Cyanosis extending from their ears and spreading all over the face, until it is hard to distinguish the coloured men from the white. It is only a matter of a few hours then until death comes, and it is simply a struggle for air until they suffocate. It is **horrible**.

One can stand to see one, two, or twenty men die, but to see these poor devils dropping like flies sort of gets on your nerves. We have been averaging about 100 deaths per day, and still keeping it up. There is no doubt in my mind that there is a new mixed infection here, but what I don't know."

Source: Quote from physician stationed at Fort Devens outside Boston, late September 1918 (in Ryan [2009])

Comments on:

"The Cost of Privacy:
Welfare Effects of the Disclosure of COVID-19 Cases"

By David Argente, Chang-Tai Hsieh, and Munseob Lee

José F. Ursúa
Dodge & Cox

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Highlights

Key conclusions

- **Public disclosure can be an important tool to combat the spread of the virus**
  - Show that change in commuting flows observed in mobile location data predicts neighborhood heterogeneity in spread of the virus
  - Public disclosure lowers the projected number of patients over two years
  - Closer to "optimal" communing patterns when people can self-select based on perceived risks and costs (vs. indiscriminate interruption under lockdowns)

Key dynamics

- Information about infections increases commuting costs and lowers welfare – but also reduces the transmission of the virus across neighborhoods
- Responsiveness of weekend flows to a given change in commuting costs will be larger than that of weekday flows / Age differences

Some questions

- Equations are estimated from data on communing flows in Nov'19 vs. Jan-May'20. While Nov'19 is pre-pandemic, given that Jan-May'19 data were available, may it make sense to use this latter period as the benchmark?

- Would it be possible to test different parameters in the SIR model other than the transmission rate and the daily detection rate (last section). As examples, rate per day of recovery or death [authors use an estimate of duration of illness of 18 days], or amount of time quarantined people are isolated [authors use 8.5 for young and 10.2 for old], or fatality rates [authors use 0.21% for young, and 2.73% for old]?

- Intuitively, information dissemination can only be as good as the underlying information, but the authors assume 90% of cases are undetected, and that these cases follow the predicted commuting patterns of the model. What if they followed other patterns?

- Perceptions around infection probability may differ across demographic groups. How to account for this in the model?

- Authors estimate that at the peak of the pandemic, "economic welfare declines by 0.3%." This seems small? How to interpret it?

Some questions (cont'd)

- In the comparison to the "lockdown policy," the authors assume that these are applied to randomly selected 25% of the population, who are forced to stay in the home sector all days of the week (to match the number of cases observed over two years as in their full information disclosure case) over two years. Is this a reasonable comparison?

Table 2: Comparison of Full Disclosure with No Disclosure and Lockdown

	No Disclosure	Partial Disclosure	Full Disclosure (Korea case)	25% Lockdown Days 280 to 380
Total # of Cases	968,482	871,070	770,691	768,598
Total # of Death	26,083	22,082	18,360	20,136
age 20-59	7,520	6,879	6,184	6,013
age 60+	18,563	15,203	12,176	14,123
Welfare loss per day (%)	-	0.04	0.15	0.57
age 20-59	-	0.04	0.14	0.73
age 60+	-	0.05	0.17	0.07

Notes: The table reports the total number of detected cases, the total number of death, and the welfare losses over two years in the city of Seoul under no disclosure, partial disclosure, information disclosure (Korea case), and 25% lockdown from day 280 to 380. The economic welfare losses, compared to the no disclosure case, are shown in percent.

Some questions (end)

- Authors side-step the question of welfare losses due to privacy issues, stigmatization, etc. They also assumed no vaccine becomes available within the horizon of exercises (two years). That's a fair (and acknowledged) narrowing of the scope of the paper. But with the benefit of hindsight, it would be interesting to hear the authors' perspectives on observed outcomes, especially cross-country comparisons.