Epidemics, Crises, and Beliefs
From the Bubonic Plagues to COVID-19

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How do Crisis Experiences Affect Decision-Making?

Example: Effect of the Pandemic and Life in Quarantine

1. **Immediate Impact** of being “at home” on behavior/consumption: less or different interaction at work, in stores, with physician etc; online shopping, using yoga/HIIT apps, telemedicine; more trading (Robinhood trending on twitter; GameStop)

   **WALMART:**
   Walmart coupon: $10 off all departments

2. **Medium-Run Impact** of pandemic on earnings and wealth: job loss, uncertainty about future earnings, educational and job choices, testing at schools and universities, vaccination requirements etc.

   **STOCKS**
   **Everyone’s a Day Trader Now**

   Bored, isolated and out of work amid the pandemic, millions of Americans are chasing stock-market glory—and bragging about it online. Not everyone’s a winner though.

   By Michael Wursthorn, Mischa Frankl-Duval and Gregory Zuckerman
   Updated July 25, 2020 12:01 am ET

   Stuck at home in lockdown, millions of Americans are trading the markets like never before.

   At E*Trade Financial Corp., investors opened roughly 260,500 retail accounts just in March, more than any full year on record. Newer rival Robinhood Markets Inc., maker of a wildly popular trading app, logged a record three million new accounts in the first quarter.
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- **Long-Run Impact** of pandemic beyond changes (in jobs, health measures etc.) that “are here to stay.”
  - How does this experience alter beliefs and behavior in the long-run?
  - How do the long-run effect depend on personal exposure?
A Little Exercise in Magical Thinking

- Suppose we lived in a country where large parts of the population were vaccinated, and the vaccine is effective against all variants of the virus.
- Everybody in our country has their jobs and job security back, their earnings and earnings prospects, impact on accumulated wealth is minimal, we are giving lectures in person.
- Basically, we are back to the world of pre-COVID-19.

**Question:** Under these magical assumptions, would we be back to economic decisions and financial risk-taking from pre-COVID-19?

- That’s what an exclusive focus on SR + MR impact implies.
- That’s not what economists are saying, but arguments build on “economic conditions have changed;” we will not be back to pre-COVID-19 conditions.
- What about “we have changed” and will behave differently even if the world returned back to its pre-COVID version?
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Some Clues from Prior Epidemics

- **Epidemics** such as Bubonic Plagues, Tuberculosis, the 1918 Influenza, or HIV/AIDS generally recognized as essential for historical outcomes during those periods
  - Impact on par with the role of war, religion, economics, and high culture

- For **economic outcomes**
  - Change in demographics (e.g., Black Death transformed the demography of early modern Europe: significant plunge in population growth between the 14th and 18th centuries)
  - Change in GDP
  - Change in trade patterns, trade routes
  - Change in financial capital available
  - ...
  - Change in world views and beliefs
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The Impact of the Black Death on ‘Beliefs’

- Medical beliefs
  - “In the air” (smoking for health, masks)
  - More attached to certain surfaces than others (leather and waxed fabrics as protection)

- Religious beliefs and World Views
  - Substantially influence on religious beliefs, a new piety, cults of plague saints, and passion plays (Oberammergau).
  - Begin of the modern theodicy discussion
    - “The result was not so much atheism as a mute despair that was most often barely articulated—a psychological shock that, with historical hindsight and anachronism, one might call post-traumatic stress.” [Frank Snowden (Epidemics and Society, 2019)]
  - Emphasis on *vanitas* idea (earthly life is fleeting) ⇒ less investment, including less investment in human capital (education)
Impact of the 1918 Influenza Pandemic (“Spanish Flu”) on Education
(Li and Malmendier, 2021)

**Figure:** High School Graduation Rate by birth year (1940 Census). Bi-quadratic fit.
Impact of the 1918 Influenza Pandemic (“Spanish Flu”) on Education

African-American vs. White Students

Figure: High School Graduation Rates throughout various birth years for African American (left) and White (right) students; bi-quadratic fit.
Experience Effects

Traditional Models of Economic Decision-Making

- Effect of “personally experienced pandemic or crisis” no different from information about outcomes *ceteris paribus*.
- Effect of “living through a depression” on financial investment no different than effect of reading about it; of “having experienced unemployment” on consumption no different than knowing your risk of future unemployment; of living through a pandemic no different from knowing about likelihood and implications (controlling for wealth, income, age, etc.).

Models and Empirical Evidence of Experience Effects

- Personal experience has lasting impact on behavior (scarring effects).
- “Re-wiring” (Synaptic Tagging)
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A Famous Example (in the US): Depression Babies
(Malmendier and Nagel, QJE 2011)

“I don’t know about you, but my parents were depression babies, and as a result, avoided the stock market and all things risky like the plague.”
Participation of generation that experienced the 1930s Great Depression as teenagers/adults (13%) significantly lower than that of all other cohorts (26-32%).

1931-1940 cohort experienced the post-war boom years during their young adult life, has a participation rate at age 36-45 that is more than twice as high.

In 1941-50 cohort, the rate dips again, consistent with the fact that this cohort reached age 36-45 just after the depression years of the 1970s.
Depression Babies
(Malmendier and Nagel, QJE 2011)

**Approach:** Probit model \( \Pr(y_{i,t} = 1|x_{i,t}, A_{i,t}(\lambda)) = \Phi(\alpha + \beta A(\lambda) + \gamma' x_{i,t}) \) in SCF data, with \( A_{i,t}(\lambda) = \) weighted sum of past experiences (weights governed by \( \lambda \)) using ML to simultaneously estimate \( \lambda \) and coefficient \( \beta \).

1. Relate \( A_{i,t}(\lambda) = \) investors’ “lifetime stock-market experiences” to \( y_{i,t} = \) stock investment.
2. Relate \( A_{i,t}(\lambda) = \) investors’ “lifetime bond-market experiences” to \( y_{i,t} = \) bond investment.

**Results**

- Stock-market participation (Stock holdings > $0): IDR +14 pp
- Bond-market participation (Bond holdings > $0): IDR +15 pp
- No cross-fertilization!
Weighting Function

\[ A_{i,t}(\lambda) = \sum_{k=1}^{\text{age}_{i,t}-1} w_{i,t}(k, \lambda) R_{t-k} \text{ and } w_{i,t}(k, \lambda) = \frac{\text{age}_{i,t-k}^{\lambda}}{\sum_{k=1}^{\text{age}_{i,t}-1} (\text{age}_{i,t-k})^{\lambda}} \]

Illustration for 50-year old individual
Aggregate Perspective: Market Valuation

Average experienced returns

P/E Ratio

Returns

P/E
Aggregate Perspective (2): Market Composition

Difference in log stock market participation (old-young)

coefficient = 3.432; std.err. = 1.634
We can integrate experience-based learning in an **equilibrium model of asset markets**.

- **OLG model of finitely-lived agents with CARA preferences**
- **Heterogeneity (1)**: Belief heterogeneity due to different histories (past experiences)
- **Heterogeneity (2)**: Younger cohorts react more strongly to a dividend shock than older cohorts as it makes up a larger part of their lifetimes.
- **Implications for market composition**: A positive shock induces younger cohorts to invest relatively more in risky assets; a negative shock tilts the composition towards older cohorts.
- **Implications for trade volume**: Changes in the level of disagreement between cohorts lead to higher trade volume in equilibrium.

We can test these implications empirically.
Trading volume = market-cap weighted average monthly turnover ratio (shares traded over shares outstanding)

Deviation of TO ratio: log, linearly detrend, and CF-filter the yearly variable

Returns = inflation-adjusted increase in price over prior year; linearly detrended and CF-filtered

SD = current-year population-weighted SD of the changes in experienced returns across age-cohorts
Aggregate Perspective (4): International Capital Flows
(Malmendier, Pouzo, Vanasco, JIE 2020)

Experience effects help explain classic international macro puzzles regarding capital flows and portfolio investment, namely the tendency of investors to

1. hold an over-proportional fraction of their equity wealth in domestic stocks (home bias)
2. invest in domestic equity markets in periods of domestic crises (retrenchment),
3. withdraw capital from foreign equity markets in foreign & global crises (fickleness).

Basic intuition: More exposure to domestic risky-asset returns $\implies$ more precise prior.
Experience-based learning generates additional implications regarding

- the strength of these puzzles depending on the demographic composition.
- the strength of these puzzles in times of higher or lower economic activity,
- Intuition:
  - Countries with a larger number of young market participants overreact (more) to both domestic and foreign shocks.
  - As a result, retrenchment and fickleness are alleviated in young-demographics countries.
  - Cf. Heterogeneity (1) and (2) results above, applied internationally.

All tested and confirmed in data from the IMF, World Bank, World Federation of Exchanges.
Identifying Variation

Sources of variation in experience effects:

1. **Cohort (exposure to macro-level realizations)**
   - Generates generational effects (Gen X, Gen Y, Millennials ... Who will be Gen COVID? Along what dimension will they be scarred?)
   - Generates differences in generational differences over time, with generations diverging and converging depending on how their average lifetime experiences compare.

2. **Location (exposure to local realizations)**

3. **Individual (individual experiences)**
Identifying Variation

Example: “Scarred Consumption” (Malmendier and Shen, NBER WP)

\[ C_{it} = \alpha + \psi \text{UEP}_{it} + \beta \text{UE}_{it} + \gamma' x_{it} + \eta_t + \varsigma_s + \nu_i + \varepsilon_{it} \]

with

- \( C_{it} = \text{total consumption} \);
- \( \text{UEP}_{it} \) and \( \text{UE}_{it} = \text{'s past personal and macro (local/national) unemployment experience} \);
- \( x_{it} = \text{vector of controls for wealth (liquid, illiquid), income, lagged income, age, employment, family size, gender, education, marital status, race} \);
- \( \eta_t \) for time (year), \( \varsigma_s \) for state, \( \nu_i \) for household.
Illustration: Location-Based Variation in Consumption Scarring

- Born 1948; 2007-2013 in Pennsylvania
- Born 1948; 2007-2013 in Alabama
- Born 1975; 2007-2013 in Alabama

Expenditure Per Family Member (in $, lines)

- $1568
- $1677
- $1877
- $1632
- $777
- $613

Lifetime Experience of Unemployment (in %, bars)

- 5.81%
- 5.70%
- 5.46%
- 6.11%
- 6.06%
- 6.11%
- 6.20%

- -13%
- -7%
- -21%
Findings

Experience of personal and macro (local/national) UE years (decades) in the past

1. predicts *lower consumption* spending (PSID, Nielsen, CEX)
2. predicts *pessimistic beliefs* about own and economy-wide financial conditions (MSC)
3. *does not* predict lower or more volatile future income (PSID)
4. predicts *higher wealth-build up* (savings) (PSID)
Experience Effects – Key Features

1. Experiences over one’s lifetime so far have long-lasting effects on beliefs and choices.
   ▶ Different cohorts are affected differently.

2. Experiences are domain-specific.
   ▶ No cross-fertilization between different realms of economic decisions.
   ▶ Same pattern across domains (stocks, bonds, inflation, interest rate expectations, unemployment experiences etc.)

3. Extent of exposure matters.
   ▶ Different locations are affected differently.
   ▶ Implication: Different genders/races/... are affected differently in the long-run, even exposure has passed.
   ▶ Implication: Interaction with inequality.

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Example: Inflation Experiences $\implies$ Inflation Beliefs

German motivation ...

... and US motivation

Paul Volcker (1979): “An entire generation of young adults has grown up since the mid-1960s knowing only inflation, indeed an inflation that has seemed to accelerate inexorably. In the circumstances, it is hardly surprising that many citizens have begun to wonder whether it is realistic to anticipate a return to general price stability.”
Findings: Inflation Experiences $\rightarrow$ Inflation Beliefs

Malmendier and Nagel (2016), using MSC data since 1953

1. When forming inflation expectations, individuals put a higher weight on realizations experienced over their life-times than on other available historical data.
   - Similar to adaptive learning: people learn following simple “rules of thumb” (e.g., Bray 1982; Marcet and Sargent 1989)
   - Different from adaptive learning: people learn (more) from data realized during their lifetimes. (adaptive learning: all historical data)

2. Implicit weighting of past experiences again very similar to weighting pattern in stock-market (and other data) data!
   - Roughly linearly declining weights.

3. Significant impact on individual financial decisions, namely, long-term nominal-rate borrowing and lending.
- Born in Germany in 1914 into a family of bankers.
- Lived through Germany’s hyperinflation in 1923.
- Emigrated to the US in the 1930s.

Wallich dissented 27 times (!) during his tenure on the Fed Board, the highest number of dissents in Federal Reserve history, decades later.
Beyond Wallich: FOMC Members’ Inflation Experiences and Forecasts


**Staff forecast**: Greenbook forecast.

**Experience-based forecast**: AR(1) model forecast estimated based on weighted life-time inflation data for each FOMC member.
Information vs. Rewiring

- Traditional economic explanation for effects of past exposure on beliefs: information
- Results (taken together) challenge information channel, esp. applicability to experts (FOMC member, fund managers, bankers, physicians)
- Results challenge some behavioral channels, e.g., limited attention, cognitive challenges.

Information $\rightarrow$ Software $\rightarrow$ Hardware
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Information → Software → Hardware
Synaptic Tagging

(Cf. Laudenbach, Niessen-Ruenzi, Malmendier AEA P&P 2019; NBER WP 2020)

- Every time we have a new experience, our brain forms a connection between two neurons (synapse).
  - Synapses tell our body how to react to the world around us. The govern the way we experience life.
- The brain can reorganize pathways, create new connections, and even create new neurons (neuroplasticity) in response to learning, experience, and memory foundation.
- Generally, young brains tend to be more sensitive and responsive to experiences than older brains. But the brain never stops changing.
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Synaptic Tagging

- How and how often we make an experience matters.
  - Repeated stimulation of hippocampal neurons can induce a prolonged increase in synaptic strength (long-term potentiation (LTP), Frey and Morris (*Nature* 1997, *Trends in Neuroscience* 1998))
  - Prior or subsequent “learned knowledge” has very limited power to undo the effects.

Which Experiences?

- **Trauma with a big T**: German Hyperinflation, Great Depression, Pandemics
- **Trauma with a small t**: Daily Exposure, daily worry about food, prices, unemployment
- Other repeated (non-traumatic) exposure, including positive experiences
Example: Gendered Experiences


Within-Household Inflation Expectations

- Women have (more) positively biased inflation expectations, even within households.
- Unconditional difference driven by differences in grocery shopping.
Take Aways

Existing Research on Experience effects

- Longlasting effects of personal experiences on beliefs and risk-taking ("econ-PTSD")
  - From $y_{t,i} = f(x_{i,t})$
  - to $y_{i,t} = f(x_{i,t}, A(x_{i,t-1}, x_{i,t-2}, x_{i,t-3}, \ldots x_{i,0}))$

- Evidence from macro, labor, finance, political economy

- Evidence on the properties of experience effects: (1) longlasting effects, (2) recency bias, (3) domain specificity, (4) neuro-science foundation (synaptic tagging)

Opportunities for Future Research

- Applicability to: finance, gender, racism, children (ACEs), education

- Feasibility of accounting for experience effects: "Big Data" within-person

- Welfare and policy implications
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