# Distributions and Aggregates in HAOK and HANK

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# Keynote Speaker as Intermediary

- ▶ Keynes and Samuelson
- ▶ Arrow
- ▶ Burns and Mitchell and Koopmans, Marschak, Hurwicz, . . .
- ▶ Indiana Macro-econometrics and functional VARs
- ▶ HANK subversives

# Keynes's Macroeconomics

Senses in which Keynes intended *General Theory of Employment, Interest, and Money*, 1936 to be **General**: it

- explains equilibria with excess supplies/underemployed resources
- collapses to "classical" (i.e., Walrasian) theory when resources are fully employed
- justifies minimal fiscal-monetary interventions to attain full employment

# Keynes's policies

Keynes designed policies to sustain maximal role for individual choices while attaining aggregate efficiency

- ▶ Sustain a price level target, i.e., zero inflation tax
- ▶ Keep two government budgets
    - ▶ Always balance current account budget
    - ▶ Sustain present-value balance of capital budget, but time deficits to finance public works to attenuate business cycles (i.e., endorse Catchings-Foster 1920's proposal to use public works to sustain full employment)

# Keynes's stipulation

Keynes' light-handed policies presume that an adequate UK 1920's style social safety net is in place.

# HAOK Punchline: a "Neoclassical Synthesis"

- ▶ achieve full employment by using well timed public investment to sustain adequate aggregate demand
- ▶ when full employment prevails, allow Walrasian system markets to set relative prices and allocations

# Neoclassical Synthesis

> *When 9,000,000 men are employed out of 10,000,000 willing and able to work, there is no evidence that the labour of these 9,000,000 men is misdirected. The complaint against the present system is not that these 9,000,000 men ought to be employed on different tasks, but that tasks should be available for the remaining 1,000,000 men. It is determining the volume, not the direction, of actual employment that the existing system has broken down.*

J. M. Keynes, *General Theory*, 1936, chapter 24.

# Embracing the Neoclassical Synthesis

- ▶ Paul Samuelson
- ▶ James Tobin
- ▶ Milton Friedman
- ▶ Robert E. Lucas, Jr.
- ▶ · · ·
- ▶ Koopmans, Hurwicz, and Cowles commission econometric modeling tradition

# Subverting the Neoclassical Synthesis

- Kenneth Arrow
- Gianluca Violante, Galo Nuno, Mikhail Golosov, . . .

## How Keynes got to the Neoclassical Synthesis

Read Keynes *A Tract on Monetary Reform*, 1923, chapter 1.

Preoccupied with connections between inflations and

- ▶ Distribution of wealth and consumption among
  - ▶ investors
  - ▶ business class
  - ▶ earners
- ▶ Production

# Digression: Modern Counterparts

Benabou-Floden-BEGS imputations of welfare consequences of alternative government policies that flow from

- Redistribution
- Insurance
- Efficiency

# Keynes's Case for Price Level Targeting

> *We leave Saving to the private investor, and we encourage him to place his savings mainly in titles to money. We leave responsibility for setting Production in motion to the business man, who is mainly influenced by the profits which he expects to accrue to himself in terms of money. Those who are not in favor of drastic changes in the existing organization of society believe that these arrangements, being in accord with human nature, have great advantages. But they cannot work properly if the money, which they assume as a stable measuring-rod, is undependable. Unemployment, the precarious life of the worker, the disappointment of expectation, the sudden loss of saving, the speculator, the profiteer – all proceed, in large measure, from the instability of the standard of value.*

John Maynard Keynes, *A Tract on Monetary Reform*, 1924.

# Keynes Deplored Redistribution via Unforeseen Inflations

> *There is no record of a prolonged war or a great social upheaval which has not been accompanied by a change in the legal tender, but an almost unbroken chronicle in every country which has a history, back to the earliest dawn of economic record, of a progressive deterioration in the real value of the successive legal tenders which have represented money.*

John Maynard Keynes, *A Tract on Monetary Reform*, 1924.

# Redistribution via inflation

> *Moreover, this progressive deterioration in the value of money through history is not an accident, and has had behind it two great driving forces – the impecuniosity of Governments and the superior influence of the debtor class.*

John Maynard Keynes, *A Tract on Monetary Reform*, 1924.

# Redistribution via inflation

> *. . . the benefits of a depreciating currency are not restricted to the Government. Farmers and debtors and all persons liable to pay fixed money dues share in the advantage. As now in the persons of business men, so also in former ages these classes constituted the active and constructive elements in the economic scheme.*

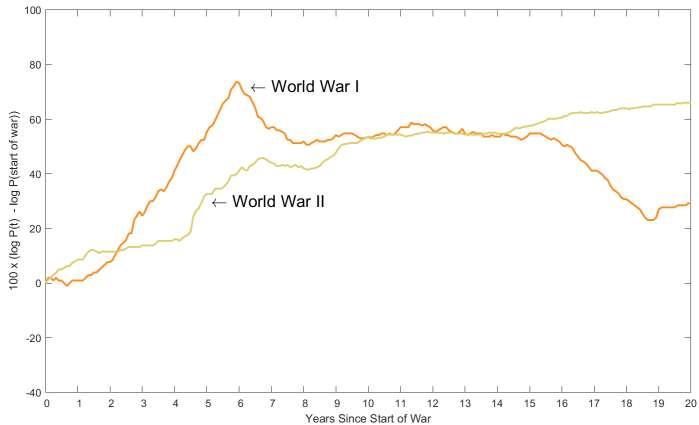John Maynard Keynes, *A Tract on Monetary Reform*, 1924.

# Digression: Keynes as historian and prognosticator

Peek at U.S. price level and public debt *ex post* return data assembled by George Hall of Brandeis University
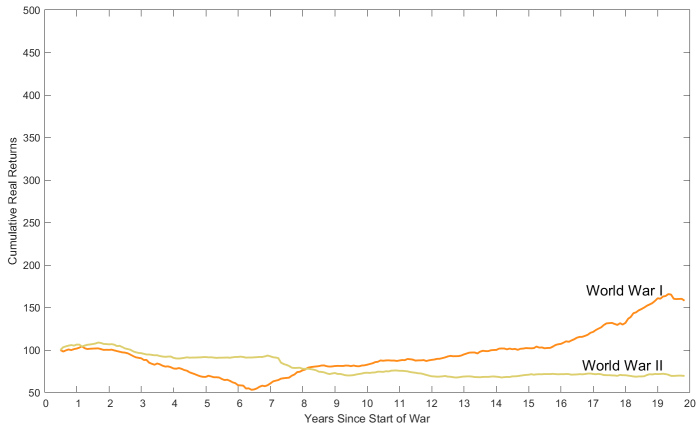
- ▶ Twentieth century
- ▶ Nineteenth century

# U.S. Twentieth Century Wars – Log Price Level

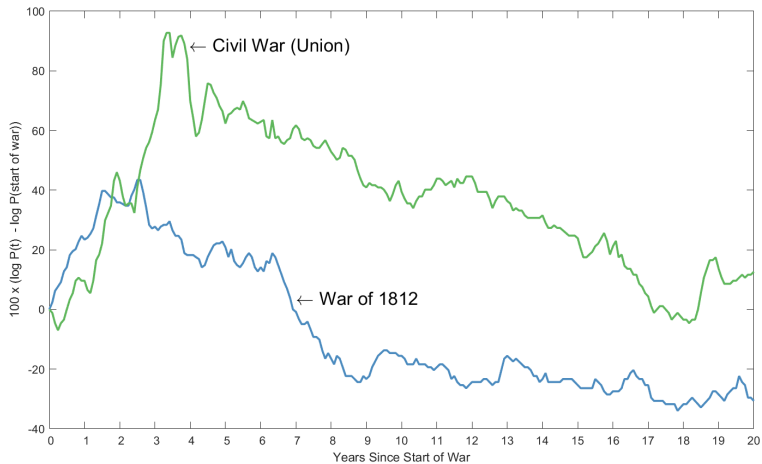# U.S. Twentieth Century Wars – Cumulative Real Returns

# Digression on U.S. Debt Default

- Extending WWI graph beyond 1933 would set stage for Sebastian Edwards's *American Default*, 2018
- Irving Fisher's "Debt Deflation" theory and using monetary policy to redistribute and repair balance sheets influenced the Roosevelt administration's decision to default
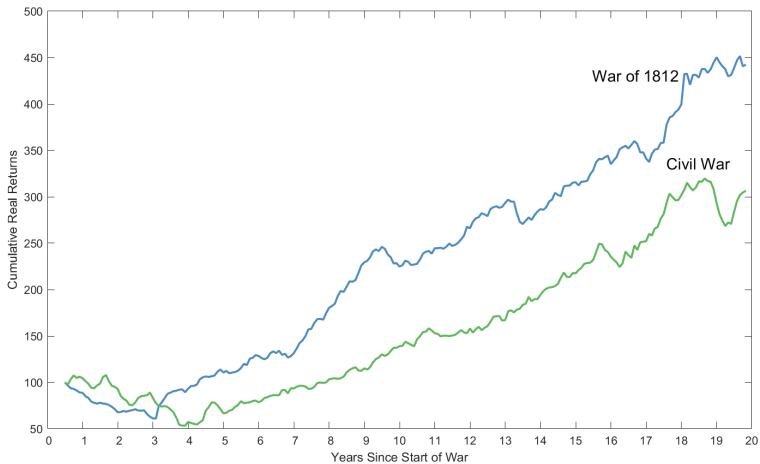
# Keynes as Forecaster and Historian of U.S.

- ▶ Keynes foresaw U.S. inflation-debt-outcomes in two twentieth century World Wars.
- ▶ Also foresaw outcomes from War on COVID-19, at least so far
- ▶ But what about U.S. in 19th century?

# U.S. Nineteenth Century Wars – Log Price Level

# U.S. Nineteenth Century Wars – Cumulative Real Returns

# 19th Century U.S. Political Economy

- ▶ Why was U.S 19th century pattern so different from 20th century pattern?
- ▶ Who chose what when?

# Advocate of Partial Default ("reschedule")

> *There seems to be a general concurrence as to the propriety and justness of a reduction in the present rate of interest ... The lessons of the past admonish the lender that it is not well to be over-anxious in exacting from the borrower rigid compliance to the letter of the bond.*

President Andrew Johnson (Fourth Annual Message December 9, 1868)

# Advocate of Honoring Public Debts

> *We denounce all forms of repudiation as a national crime;
> and national honor requires the payment of the public
> indebtedness in the utmost good faith to all creditors at
> home and abroad, not only according to the letter, but
> the spirit of the laws under which it was contracted.*

Republican Party Platform, plank 3, 1868.

# Keynes's 1924 Policy Priorities

> *If we are to continue to draw the voluntary savings of the community into "investments," we must make it a prime object of deliberate State policy that the standard of value, in terms of which they are expressed, should be kept stable; adjusting* in other ways *(calculated to touch all forms of wealth equally and not concentrated on the relatively helpless "investors") the redistribution of the national wealth, if in the course of time, the laws of inheritance and the rate of accumulation have drained too great a proportion of the income of the active classes into the spending and control of the inactive.*

John Maynard Keynes, *A Tract on Monetary Reform*, 1924.

# Questioning the Neoclassical Synthesis

Kenneth Arrow's review of Paul Samuelson's collected works.

# The Neoclassical Synthesis Scandal

> . . . *Samuelson has not addressed himself to one of the major scandals of current price theory, the relation between microeconomics and macroeconomics. Neoclassical macroeconomic equilibrium with fully flexible prices presents a beautiful picture of the mutual articulations of a complex structure, full employment being one of its major elements. What is the relation between this world and either the real world with its recurrent tendencies to unemployment of labor, and indeed of capital goods, or the Keynesian world of an underemployment equilibrium?*

Kenneth Arrow, "Samuelson Collected," *JPE*, 1967, p. 734.

# Arrow's Doubts

> *If the neoclassical model with full price flexibility were sufficiently unrealistic that stable unemployment equilibrium be possible, then in all likelihood the bulk of the theorems derived by Samuelson, myself, and everyone else from the neoclassical assumptions are also counterfactual. The problem is not resolved by what Samuelson has called "the neoclassical synthesis," in which it is held that achievement of full employment requires Keynesian intervention but that neoclassical theory is valid when full employment is reached.*

Kenneth Arrow, "Samuelson Collected," *JPE*, 1967, p. 735.

# Arrow's Doubts

> *The Samuelson-Keynes view of the world is that full employment is a valid proposition in $K(g)$ only for special values of $g$, whereas full employment holds in $W(g)$ for all $g$. If $g^*$ is such that full employment holds in $K(g^*)$, can it be true that theorems valid in $W(g^*)$ are also valid in $K(g^*)$? Obviously, it is not true that the two systems respond similarly to changes in $g$, since full employment remains valid in one but not in the other.*

Kenneth Arrow, "Samuelson Collected," *JPE*, 1967, p. 735.

# Econometric Findings Affecting Theories

> *The major developments, the development of more subtle theories of the consumption function and the distributed-lag theories of investment, have been closely associated with econometric investigation*

Kenneth Arrow, "Samuelson Collected," *JPE*, 1967, p. 733.

# Two Types of Statistical Models

A statistical model is a probability distribution $f(y|\theta)$ of a random vector $y$ indexed by parameters $\theta$

- **Descriptive model:** $\theta_{descrip}$ parameters are data reducers like regression coefficients, shock covariances; not fully interpreted in terms of objects intelligible to an economic theorist

- **Structural model:** $\theta_{struct}$ parameters are fully interpreted as pinning down preferences, technologies, endowments, information structures, surprises that instigate 'mistakes of foresight', . . ..

# Purposes of Statistical Models

- Descriptive model: dimension reduction, data compression, pattern recognition
- Structural model: uncover **invariants** that can support theoretical analysis of unprecedented policy interventions

# Koopmans versus Burns and Mitchell

- ▶ Koopmans "Measurement without Theory" (1947) said that Burns and Mitchell's *Measuring Business Cycles*, 1946 had constructed a descriptive statistical model

- ▶ Koopmans *Statistical Inference in Dynamic Economic Models* (1950) wanted to construct "structural" Keynesian econometric model so that they could recommend aggregate demand management policies that would implement the neoclassical synthesis. See Koopmans "The Econometric Approach to Business Fluctuations," *AER*, 1946.

# Connections between Two Types of Statistical Models

- Koopmans (1947) wanted $\theta_{descr} = F(\theta_{struct})$ so that
- he could try to recover $\theta_{struct} = F^{-1}(\theta_{descr})$

# Indirect Inference

- ▶ Auxiliary model is a descriptive statistical model that
  - ▶ Is a likelihood function that describes data well
  - ▶ Can be computed and maximized easily
- ▶ Estimate structural model by using using scores of an auxiliary model to generate appropriate GMM criterion. (Gallant and Tauchen, "Which Moments to Match," 1997.)

# Functional Autoregressions

Approximate Infinite dimensional VARS via $K$ dimensional VARS on coefficients of $K$ basis functions

- $\ell_{t+1}(x) = \int B(x, \tilde{x}) \ell_t(\tilde{x}) d\tilde{x} + u_{t+1}(x)$ or
- $\ell_{t+1} = B\ell_t + u_{t+1}, \quad u_{t+1} \perp \ell_t$
- $\ell_t(x) \approx [\xi_1(x), \ldots, \xi_K(x)] \cdot [\alpha_{1t} \ldots \alpha_{Kt}]$
- Basis functions $\xi_i(x)$: either sieves or functional principal components
- Run VAR on basis coefficients:

$$\alpha_{t+1} = A\alpha_t + u_{\alpha,t+1}, \quad u_{\alpha,t+1} \perp \alpha_t$$

- Back out approximate $\ell_t(x)$

# Indiana Macro

Fit functional VARs to cross section densities of interest to macroeconomists

- Indiana macro: structural and a-structural
    - Yoosoon Chang, Bo Hu, and Joon Y. Park describe how to incorporate co-integration and additive functionals a la Lars Hansen *Econometrica*, 2012.
    - Laura Liu and Mikkel Plagborg-Moller, estimate HA structural model
- Yale-Penn macro: Chang, Chen, Schorfheide: VAR for aggregates and cross-section consumption density as HMM

# Bernard Koopman, 1931

Koopman, Bernard O. "Hamiltonian systems and transformation in Hilbert space," *Proceedings of the National Academy of Sciences*, 1931.

- ▶ Koopman operators – map lower-order non-linear system into higher-order linear system by choosing measurements of state appropriately (eigenfunctions)
- ▶ Linked to recent application in machine learning of fluid dynamics: DMD – dynamic mode decomposition (shrewd use of singular value decomposition (SVD) on tall-skinny data matrix $X$).
- ▶ Promising links to functional autoregressions – same objects in play

# Findings and Uses

"Heterogeneity and Aggregate Fluctuations," by Chang, Chen, and Schorfheide, October 2022.

▶ A descriptive functional VAR fitted as hidden Markov model with inference done beautifully

▶ Informative discussion of mapping $\theta_{struct} = F^{-1}(\theta_{descrip})$ for some HANK models simulated under some conditions.

# Functional VARS in Macro: Findings and Uses

"Heterogeneity and Aggregate Fluctuations," by Chang, Chen, and Schorfheide, October 2022.

- ▶ Can be interpreted as describing how well "off-equilibrium", unprecedented feedbacks from cross-section dynamics to aggregates have been made to disappear through prevailing social safety-net and aggregate demand management policies.
- ▶ Counterpart of possible interpretation of costs of business cycles quantified by Robert E. Lucas Jr., "Macroeconomic Priorities," AER, 2003.

# More Indiana Macro is on the Way

In progress paper "How Do Macroaggregates and Income Distribution Interact?" November 2022, by Yoosoon Chang, Soyoung Kim, and Joon Y. Park.
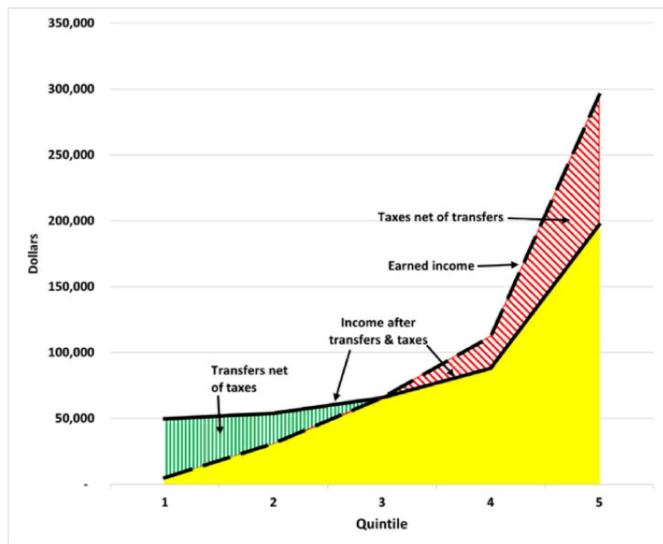
# American Inequality



Figure: From Gramm, Ekelund, and Early (2022)

# Optimal Welfare Provision

- Recursive mechanism design – a.k.a. dynamic programming squared
- History dependence via continuation values as states
- Pavoni and Violante, "Optimal welfare-to-work programs," *Review of Economic Studies*, (2007)

# Optimal Welfare Provision

- Pavoni, Setty, and Violante (2016), "The design of soft welfare-to-work programs," *Review of Economic Dynamics*.
- "... several policy instruments (e.g., job-search, assisted search, mandated work) the principal can use, in combination with welfare benefits, in order to minimize the costs of delivering promised utility to the agent. The generosity of the program and the skill level of the unemployed agent determine the optimal policy instrument to be implemented."

# Subverting the Neoclassical Synthesis

"Inequality, Business Cycles, and Monetary-Fiscal Policy,"
Bhandari, Evans, et al. *Econometrica* (2021).

- ▶ Apply Violante-style dynamic programming squared to *ex ante* heterogeneous agent HANK model
- ▶ Compare outcomes and policies under optimal history-dependent policies with those recommended by ordinary Taylor rule
- ▶ Interpret differences in terms of motivations of Ramsey planner

# Subverting the Neoclassical Synthesis

"Inequality, Business Cycles, and Monetary-Fiscal Policy,"
Bhandari, Evans, et al. *Econometrica* (2021).

- ▶ Responses of optimal policies to aggregate shocks differ
  qualitatively from what they would be in a corresponding
  representative agent economy and are an order of magnitude
  larger
- ▶ Taylor rule can be improved a lot
- ▶ A motive to provide insurance that arises from heterogeneity
  and incomplete markets outweighs price stabilization motives.

# Subverting the Neoclassical Synthesis

Sources of welfare gains

- ▶ insurance component is positive and greater than 100%
- ▶ redistribution component is small
- ▶ aggregate efficiency component is negative.

# Subverting the Neoclassical Synthesis

> . . . essentially all the welfare gains from optimal HANK
> policies arise from the additional insurance that they
> provide. Provision of insurance comes at the cost of
> sacrificing price stability, which creates deadweight losses
> and lowers total aggregate resources available for
> consumption. This explains why the aggregate efficiency
> component is negative.

# HANK versus HAOK

- Enduring and important issues
- I prefer hearing younger economists
- Use old economists like me as lower bound on what you should expect from yourselves