

Macro Markets

Creating Institutions for Managing Society's Largest Economic Risks

Robert J. Shiller

Yale University

Conference on Neural Networks in the Capital Markets

California Institute of Technology

Pasadena, California

November 17, 1994

Clarendon Lectures in Economics

Robert J. Shiller

MACRO MARKETS

Creating Institutions for
Managing Society's Largest
Economic Risks

Markets as Inventions

History of innovations in market structure shows irregular progress, marked by inventive activity

- First markets, replaced reciprocal gift giving (Polanyi, The Great Transformation, 1944)
- Stock markets, not possible until corporate law developed
- Futures markets, with clearing house, margin accounts, 1860s
- Financial futures (CME, currency futures, 1972)
- Options markets (CBOE, 1973)
- Cash settled futures markets (Eurodollar futures at CME, 1981)

- Stock index futures (KCBT 1982)
- Consumer price index futures (CSCE 1985, failed; Brazil 1987)
- Real estate futures (London Fox, 1991, CBOT, 1996?)

Markets as Accidents of History

- Currency futures awaited floating exchange rates in 1971
- Stock index futures blocked until 1981
SEC - CFTC agreement on jurisdiction
- CPI Futures were not approved until 1985, when there was no inflation
- London Fox attempt at property futures foiled by scandal

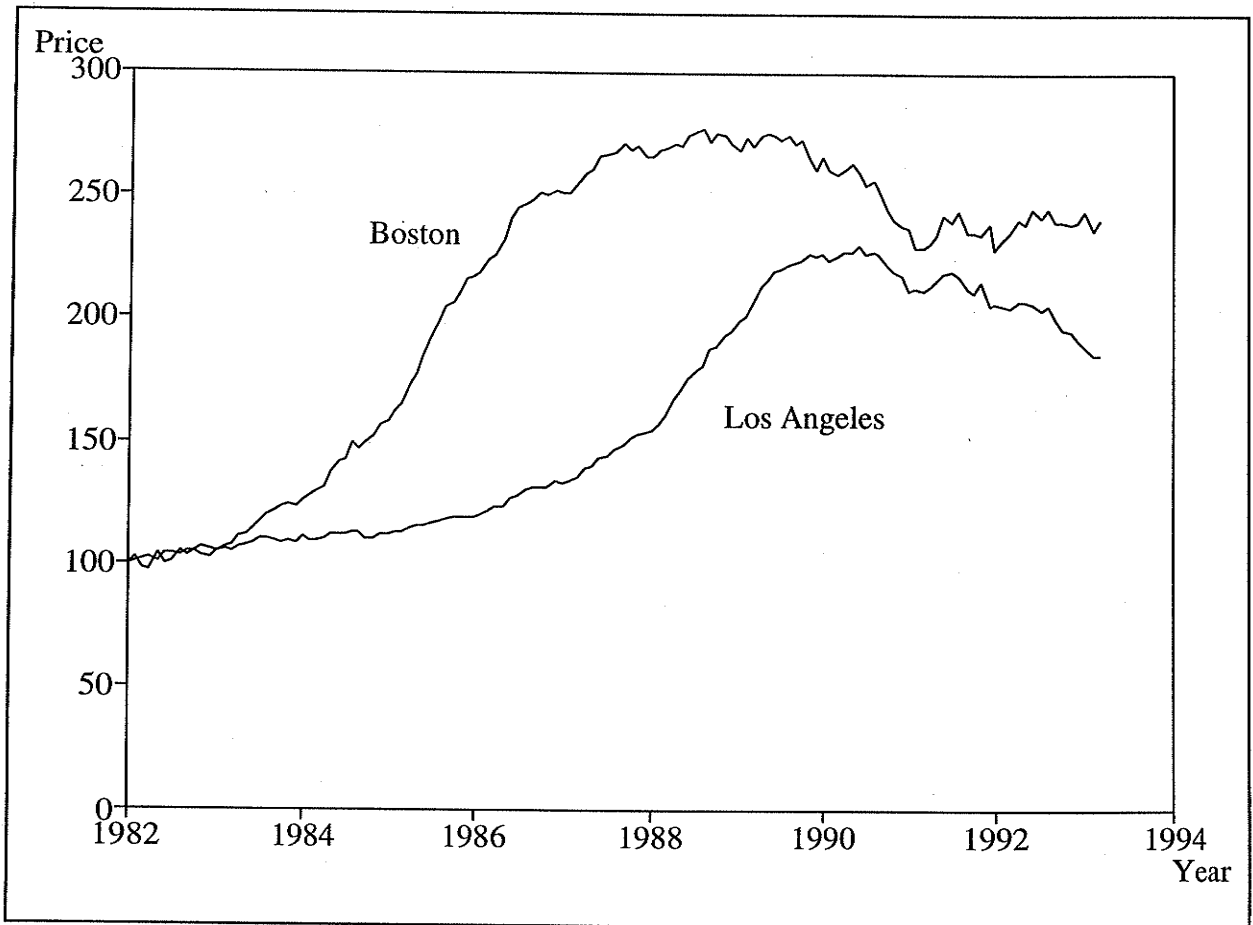


Figure 1 Case-Shiller Home Price Indices, monthly, January 1982 to March 1993, for Boston and Los Angeles, scaled to 100 in January 1982. Source: Case Shiller Weiss, Inc., Cambridge MA.

Index Participations

May - August 1989

American Stock Exchange:
Equity Index Participations
(EIPs)

Philadelphia Stock Exchange:
Cash Index Participations
(CIPs)

Perpetual Futures

$$s_t = f_t - f_{t-1} + d_t - r_{t-1} f_{t-1}$$

where f_t , f_{t-1} are perpetual futures prices at times t and $t-1$ respectively, d_t is dividends paid (or income index) at time t and r_{t-1} is the return of a competing asset between time $t-1$ and t .

$$\delta_t = E_t \delta_t^* \quad (11)$$

$$\delta_t^* \equiv -\sum_{j=0}^{\infty} \rho^j \Delta d_{t+j} \quad (12)$$

$$\xi_t = \delta_t - \rho \delta_{t+1} + \Delta d_t. \quad (13)$$

$$\delta_t - \delta_t^* = \sum_{j=0}^{\infty} \rho^j \xi_{t+k}. \quad (14)$$

$$\text{var}(\xi_t) = (1 - \rho^2) \text{var}(\delta_t - \delta_t^*). \quad (15)$$

$$\delta_t = -e1' A (I - \rho A)^{-1} z_t \quad (16)$$

$$\xi_t = e1' (I - \rho A)^{-1} u_{t+1} \quad (17)$$

$$\text{var}(\xi_t) = e1' (I - \rho A)^{-1} \Omega (I - \rho A)^{-1} e1. \quad (18)$$

Standard Deviations of Returns

GDP Futures Markets 1960-1990

Argentina	9.86%
Brazil	5.86%
Canada	2.56%
France	5.27%
Germany	4.39%
Japan	8.38%
Mexico	6.01%
Nigeria	10.74%
USA	1.62%

USA GNP 1900 to 1992:
4.72%

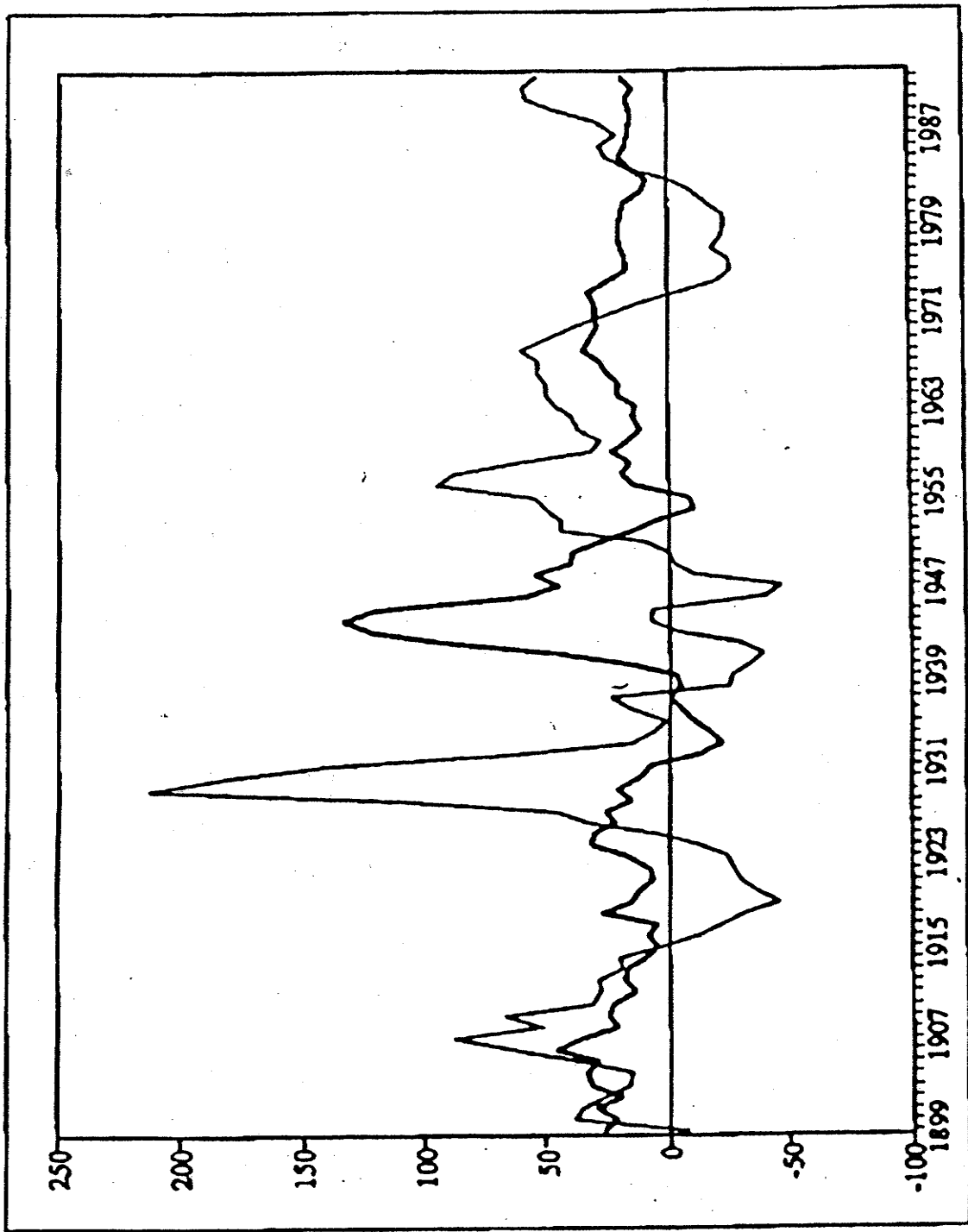


Figure 2 Ten-year growth rates (in percent) ending in year indicated. Heavy solid line: real per capita GNP. Solid line: real Standard and Poor dividends.

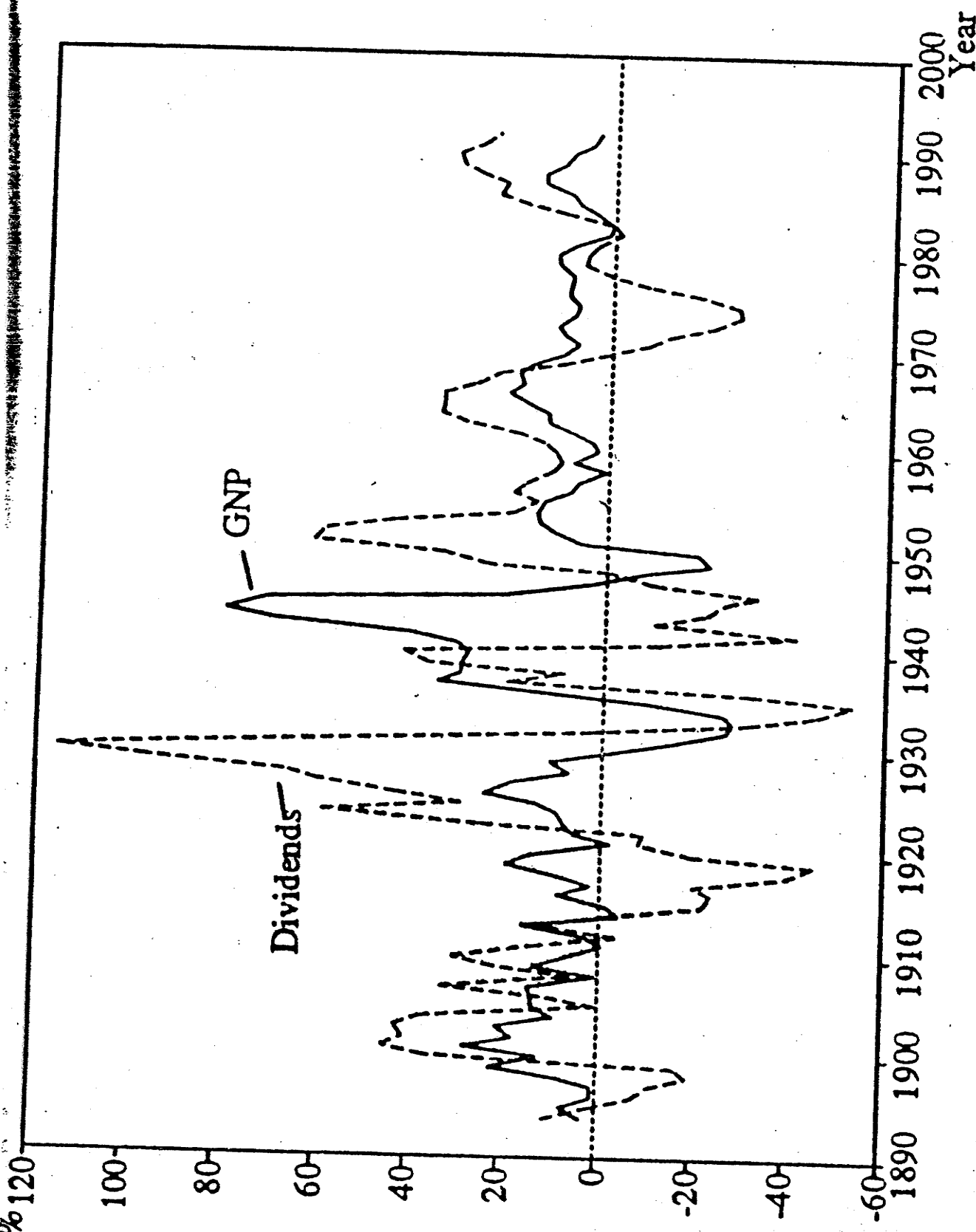


Figure 4.2. Growth rates for five year periods ending in year shown for real dividends (dashed line) and real per capita U. S. GNP, 1894-1992. Source: Standard and Poor's *Compendium* and *Financial Review*.

$$U_c = \sum_{t=1}^T u_{ct} \quad (1)$$

$$u_{ct} = \text{constant}_c + \frac{1}{x_{0c}} \bar{x}_{ct} - \frac{\alpha}{x_{0c}^2} \text{var}(x_{ct}) \quad (2)$$

$$\text{var}(x_{ct}) = \mathbf{\Omega}_{cct} + \bar{\beta}_c' \bar{A}' \mathbf{\Omega}_c \bar{A} \bar{\beta}_c + 2 \bar{\beta}_c' \bar{A}' \mathbf{\Omega}_{ct} \quad (3)$$

$$\bar{\beta}_c = -(\bar{A}' \mathbf{\Omega}_c + TPx_{0c})$$

$$\bar{\beta} = -(\bar{A}' \Omega + TP\mathbf{1}'x_0) \quad (5)$$

$$P = -\bar{A}' \Omega \mathbf{1} (T\mathbf{1}'x_0 \mathbf{1})^{-1} \quad (6)$$

$$S = \sum_{c=1}^C w_c U_c \quad (7)$$

$$S = \text{tr} \left(w (T \ln(x_0) - T x_0^{-1} \bar{\beta}' P \mathbf{1}' - \frac{1}{2} x_0^{-2} (\Omega + \bar{\beta}' \bar{\beta} + 2 \bar{\beta}' \bar{A}' \Omega)) \right). \quad (8)$$

$$S = tr(w(\ln(x_0) + \frac{x_0^{-2}}{2}(\bar{\beta}'\bar{\beta} - \Omega))) \quad (9)$$

$$L = \bar{A}'\Omega\bar{M}wx_0^{-2}\bar{M}'\Omega\bar{A} - \lambda(\bar{A}'\Omega\bar{A} - 1) \quad (10)$$

$$\Omega\bar{M}wx_0^{-2}\bar{M}'\Omega\bar{A} = \lambda\Omega\bar{A} \quad (11)$$

$$\bar{M}'\Omega\bar{M}\bar{\beta}' = -\lambda\bar{\beta}' \quad (12)$$

TABLE 2B
WEIGHTS (A) ON COUNTRY GROWTH RATES
FOR PRINCIPAL COMPONENTS
MEAN-VARIANCE UTILITY CASE

COUNTRY	PC1	PC2	PC3	PC4	PC5
CANADA	-2.42e-1 1	-4.07e-1 0	5.392e-1 0	-4.98e-10	7.360e-1 0
MEXICO	-8.25e-1 1	-5.93e-1 0	5.844e-1 0	5.043e-10	5.872e-0 9
USA	3.565e-1 0	7.236e-1 0	1.785e-1 0	6.389e-10	-3.80e-1 0
BRAZIL	-5.48e-1 1	-1.08e-0 9	1.893e-0 9	-1.20e-09	-2.09e-0 9
INDIA	9.242e-1 1	-8.02e-1 0	-1.45e-0 9	-3.39e-09	8.275e-1 0
JAPAN	-7.09e-1 0	3.224e-1 0	-7.11e-1 1	-1.01e-09	-4.16e-1 0
FRANCE	-1.40e-1 0	-4.94e-1 0	1.511e-1 0	-1.46e-10	1.034e-0 9
GERMANY, WEST	-1.47e-1 0	-1.03e-0 9	-9.59e-1 0	3.088e-09	-1.63e-0 9
ITALY	-1.41e-1 0	-6.08e-1 0	-1.65e-1 0	4.301e-10	2.439e-0 9
UNITED KINGDOM	5.594e-1 2	-4.94e-1 0	-1.90e-1 0	-4.41e-10	-1.56e-0 9

TABLE 2C
CONSUMER SURPLUS PER PC AS PERCENT OF GDP
TWENTY YEAR CASE

COUNTRY	PC1	PC2	PC3	PC4	PC5
CANADA	67.78%	1.40%	11.49%	0.02%	0.05%
MEXICO	5.06%	2.39%	20.34%	2.29%	18.11%
USA	35.36%	2.46%	0.03%	0.02%	0.01%
BRAZIL	23.94%	22.00%	126.95%	1.73%	3.49%
INDIA	126.52%	8.70%	22.42%	10.90%	0.07%
JAPAN	539.25%	5.31%	0.16%	0.10%	0.02%
FRANCE	7.58%	0.08%	0.49%	0.09%	0.24%
GERMANY	12.00%	23.16%	15.07%	8.11%	0.80%
ITALY	12.27%	2.72%	0.56%	0.51%	0.69%
UNITED KINGDOM	51.59%	0.07%	1.58%	0.16%	0.98%

COUNTRY	PC6	PC7	PC8	PC9	TOTAL
CANADA	0.59%	0.04%	0.35%	1.46%	83.18%
MEXICO	1.23%	0.23%	0.93%	0.05%	50.62%
USA	0.00%	0.00%	0.00%	0.00%	37.88%
BRAZIL	0.01%	0.30%	0.05%	0.06%	178.53%
INDIA	0.09%	0.11%	0.00%	0.00%	168.81%
JAPAN	0.01%	0.00%	0.00%	0.00%	544.87%
FRANCE	0.03%	0.29%	1.69%	0.06%	10.56%
GERMANY	0.26%	0.07%	0.00%	0.00%	59.48%
ITALY	3.56%	0.45%	0.03%	0.01%	20.80%
UNITED KINGDOM	0.24%	2.62%	0.25%	0.01%	57.50%