The Great Ratios in economics: A retrospective, Prepared for the Post-Keynesian Economics Society Annual Workshop

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29 May 2019.

Introduction

- Belief that certain variables, typically ratios, are approximately constant over the long-run is an old one.
- Klein & Kosobud (1961) labelled them *Great Ratios*, Kaldor (1957, 1961) described them as *Stylized Facts*.
- Examples: share of wages, capital output ratio, real exchange rate, stock-flow norms in MMT.
- Envy of physical constants: Max Planck's constant.

Outline

- History
- Theoretical basis for the belief,
- Empirical issues some examples,
- Econometric issues as to the meaning to be attached to "approximately constant" and the "long-run".
- Explanations for instability
- No real conclusion

Issues

- Duhem-Quine problem. Always testing joint hypotheses (the substantive hypothesis and auxilliary assumptions about measurement, specification etc), so you never know what is rejected.
- Kaldor: "Since facts, as recorded by statisticians, are always subject to numerous snags and qualifications, and for that reason are incapable of being accurately summarized, the theorist, in my view, should be free to start off with a 'stylized' view of the facts - i.e. concentrate on broad tendencies, ignoring individual detail, and proceed on the 'as if' method, i.e. construct a hypothesis that could account for these 'stylized' facts, without necessarily committing himself on the historical accuracy, or sufficiency, of the facts or tendencies thus summarized."
- Interesting philosophical literature on the status of "stylized facts".

Kaldor Facts

1. Growth in output and productivity of labour at a steady trend rate
2. A continued increase in capital per worker,
3. A steady rate of profit higher than the 'pure' long-term rate of interest as shown by the yield of gilt-edged bonds.
4. Steady capital-output ratios; income and capital tend to grow at the same rate.
5. A high correlation between the share of profits in income and the share of investment in output; a steady share of profits (and of wages) in societies and/or periods in which the share of investment in output is constant. the steady *share* of wages implies real wages grow at the same rate as productivity.
6. Differences in the *rate* of growth of labour productivity and output in different societies in the range 2-5%.

Technical issues.

Implications and Status of the Kaldor facts

- Kaldor (1961) None of these 'facts' can be plausibly 'explained' by the theoretical constructions of neo-classical theory. ... In this respect classical and neo-classical theory, arguing on different grounds, come to the same conclusion - Adam Smith, Ricardo, Marx, alike with Bohm-Bawerk and Wicksell, predicted a steady fall in the rate of profit with economic progress.
- Solow (1970, p2) commented that there "is no doubt that they are stylized, though it is possible to question whether they are facts".
- Jones & Romer (2010 p225) in *The New Kaldor facts*, take the old ones for granted. "Kaldor's first five facts have moved from research papers to textbooks. .... These features are embodied in one of the great successes of growth theory in the 1950s and 1960s, the neoclassical growth model." Their new facts relate to ideas, institutions, population and human capital.
- Ironic that they regard Kaldor's facts as embodied in the neo-classical model, whereas Kaldor regarded them as being inconsistent with it.

The long-run?

- As Keynes noted "The long run is a misleading guide to current affairs. In the long run we are all dead. Economists set themselves too easy, too useless a task if in tempestuous seasons they can only tell us that when the storm is past the ocean is flat again."
- Economic or statistical definition?
- Economic long-run is when adjustment to equilibrium is complete. Adjustment of what? How can you infer equilibrium when you never observe it: the ocean is never flat.
- Economic interpretation of a constant ratio in terms of a unit elasticity.
- Statistical definitions: K&K no deterministic trend, found most were not constant. More recently that the ratio is stationary, integrated of order zero, I(0).

The Econometric long-run

- Long-run equilibrium plus partial adjustment process ,

$$\begin{aligned} y_t^* &= \alpha + \beta x_t, \\ \Delta y_t &= \lambda(y_t^* - y_{t-1}) + u_t. \end{aligned}$$

- Estimated by least squares as

$$\Delta y_t = a_0 + b x_t + a_1 y_{t-1} + u_t,$$

- If a long run equilibrium exists,
  - $\lambda = -a_1 \neq 0$, Can test whether there is adjustment and whether equilibrium exists
  - $\widehat{\beta} = -\widehat{b}/\widehat{a}_1$, estimate long run coeffiient if equilibrium exists
  - test for a ratio being constant, $\beta = 1$,

Error correction model, ECM

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- Developed by Phillips, Sargan, Hendry
- Slightly more general than the partial adjustment model

$$\begin{aligned}\Delta y_t &= \lambda_1 \Delta y_t^* + \lambda_2 (y_{t-1}^* - y_{t-1}) + u_t, \\ \Delta y_t &= a_0 + b_0 \Delta x_t + b_1 x_{t-1} + a_1 y_{t-1} + u_t,\end{aligned}$$

- Long run relationship requires that $\lambda_2 \neq 0$, $b_1 \neq 0$, $a_1 \neq 0$, for equilibrium relationship to exist (cointegrating relationship if both $I(1)$.
- In long-run relatiomship exists, long-run coefficient is $\widehat{\beta} = -\widehat{b}_0 / \widehat{a}_1$.
- Flexible framework, can be written as autoregressive distributed lag, ARDL

$$y_t = \alpha_0 + \alpha_1 y_{t-1} + \beta_0 x_t + \beta_1 x_{t-1} + u_t$$

Theoretical Mechanisms

- Steady state requirements, e.g. for balanced growth as with Kaldor
- Arbitrage, e.g. deviations from purchasing power parity open up profit opportunities. Limits to arbitrage.
- Solvency conditions for balance of payments deficits or government debt income ratios. Intertemporal budget constraint.

Share of Wages

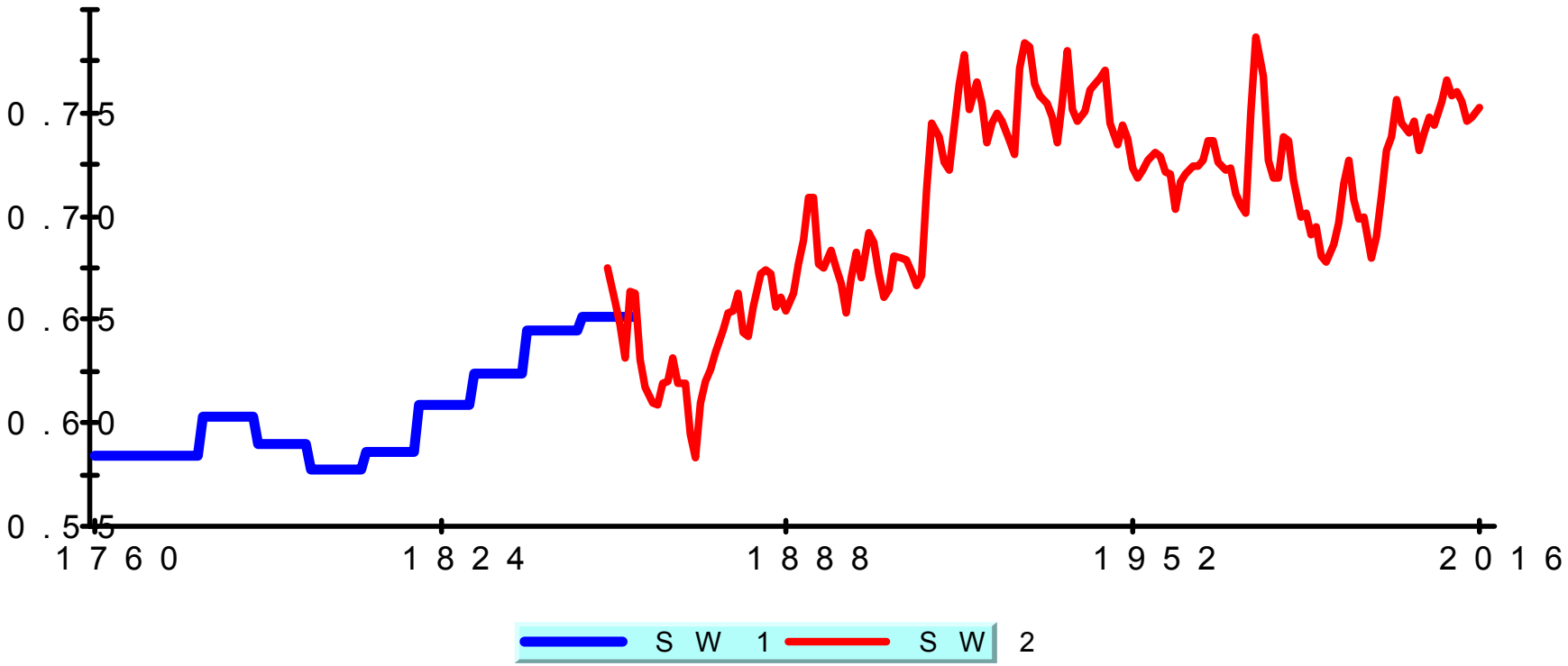

Fig 1. UK share of wages. Source Bank of England.

$/£ real exchange rate

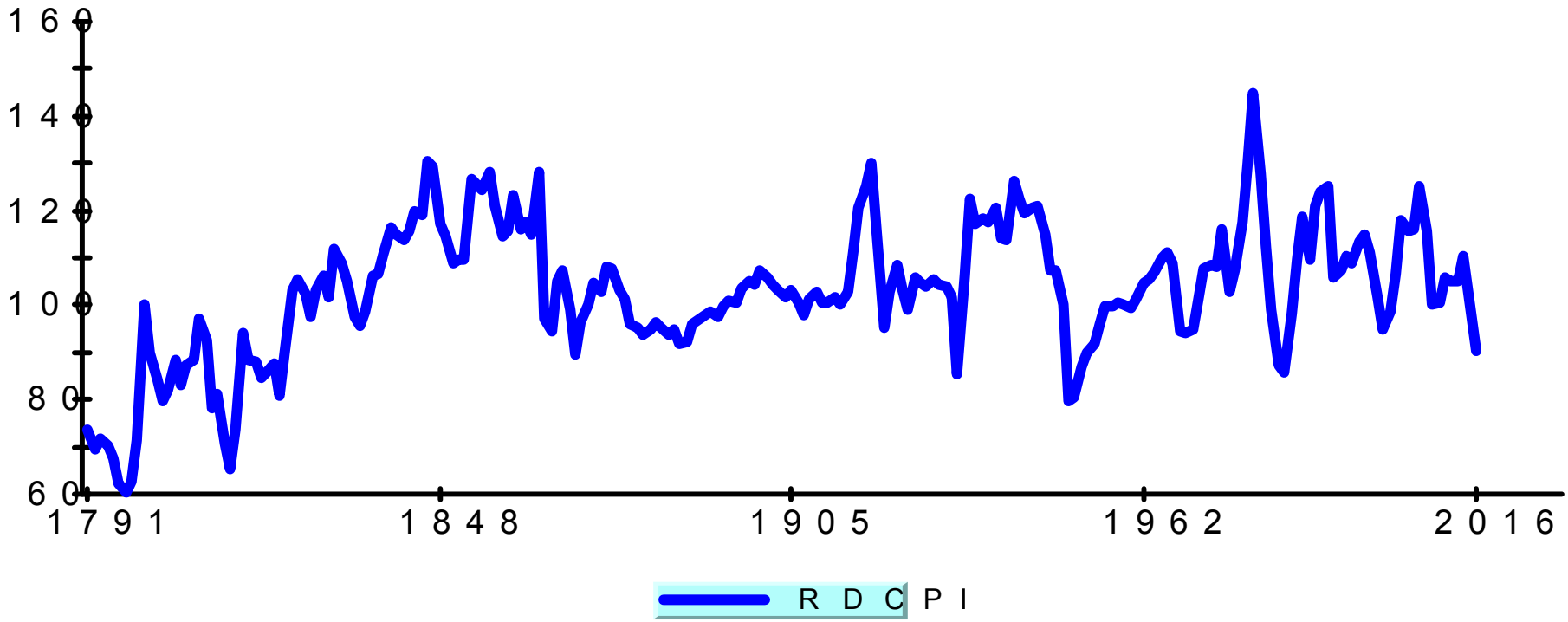

Fig 2. Real (CPI) $/£ exchange rate. Source Bank of England.

Sterling real effective rate

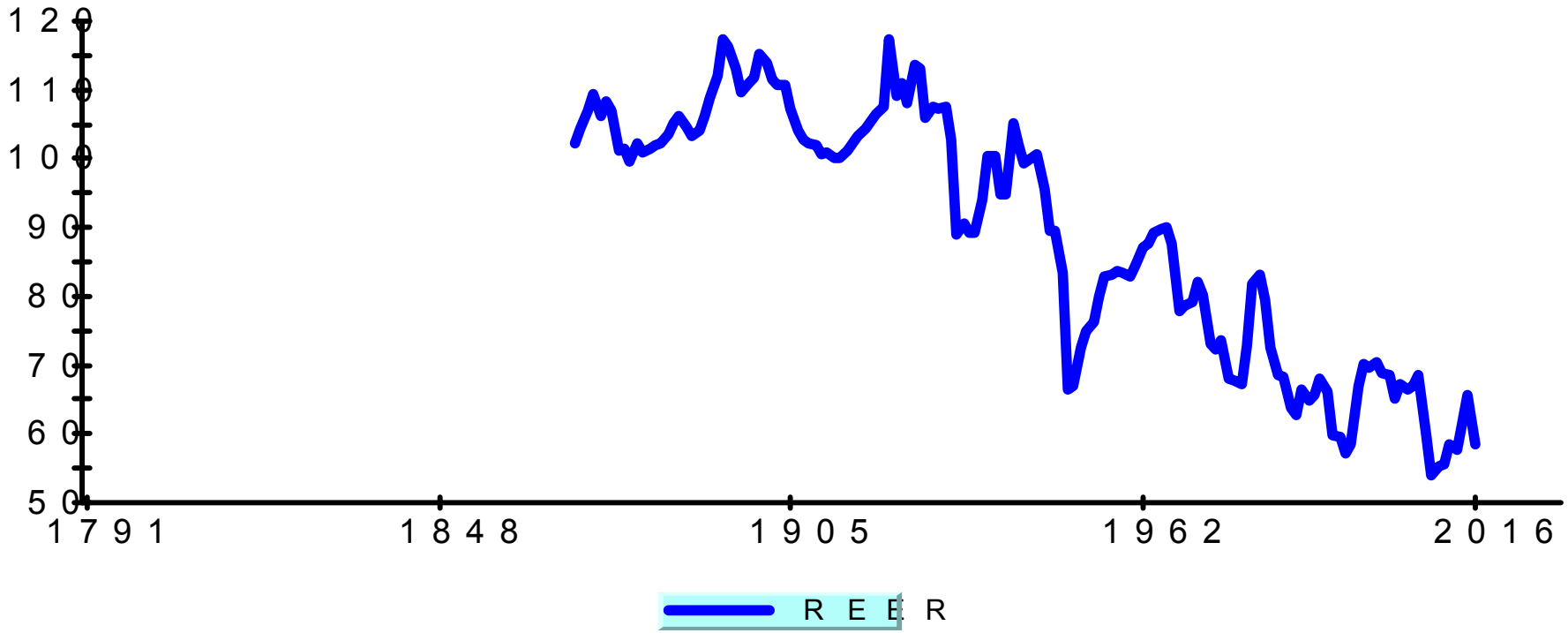

Fig3. Sterling Real Effective Exchange Rate, source Bank of England.

Long-run stability

- If x_t and y_t are logs of components of the ratio, then in

$$z_t = y_t - \phi_t - \beta x_t + \gamma t. \tag{1}$$

stability may fail because

1. $\beta \neq 1$;
2. $\gamma \neq 0$;
3. level shifts in ϕ_t
4. stochastic trend, z_t is not $I(0)$, but $I(1)$ random walk like behaviour because there is no stabilising feedback.

- Stabilising feedback embodied in ECM of Sargan and Hendry and cointegration of Engle & Granger (1987). Logs of the variables I(1) linear combinations, such as the log of the ratio, may be I(0) stationary. Common stochastic trend cancelled out in linear combination.

Unit root test

- Suppose economic theory suggests that $\beta = 1$ and $\gamma = 0$ above, so the logarithm of great ratio, $z_t = y_t - x_t$, should be constant in the long run.
- Often y_t and x_t will be $I(1)$ stationary after being differenced once, then one might test if the great ratio is stationary, $I(0)$, using a unit root test for $H_0 : \alpha = 0$, against $H_1 : \alpha < 0$ in

$$\begin{aligned} \Delta z_t &= \mu + \alpha z_{t-1} + \varepsilon_t, \\ \Delta y_t - \Delta x_t &= \mu + \alpha(y_{t-1} - x_{t-1}) + \varepsilon_t. \end{aligned} \tag{2}$$

Vector Error Correction Model

- This can also be represented in a vector error correction model dropping the restriction that $\beta = 1$, as

$$\begin{aligned} \Delta y_t &= \mu_1 + \alpha_1 (y_{t-1} - \beta x_{t-1}) + \varepsilon_{1t}, \\ \Delta x_t &= \mu_2 + \alpha_2 (y_{t-1} - \beta x_{t-1}) + \varepsilon_{2t}. \end{aligned} \tag{3}$$

- Can test whether they cointegrate with a unit coefficient. Cointegration requires feedback, at least one of α_1 or α_2 are non zero.
- Little evidence that logs of Great Ratios were I(0). Exception is the long-span \$/£ exchange rate

Real exchange rate 1792-2016

Define s_t as the log \$/£ and $d_t = (p_t^* - p_t)$ log CPI differential. They do cointegrate with

$$z_t = \underset{}{s_t} \underset{(0.07)}{-0.93} \underset{}{d_t},$$

$$\Delta s_t = \underset{(0.15)}{0.36} \underset{(0.034)}{-0.082} z_{t-1} + \varepsilon_{1t} \quad \begin{matrix} R^2 = 0.025 \\ SER = 0.070 \end{matrix},$$

$$\Delta d_t = \underset{(0.12)}{0.29} \underset{(0.028)}{+0.065} z_{t-1} + \varepsilon_{2t} \quad \begin{matrix} R^2 = 0.023 \\ SER = 0.058 \end{matrix}.$$

One cannot reject $\beta = 1$ and both α_i are significant. A lot of the adjustment happens after wars or major shocks, when the real exchange rate diverges substantially from its long-run value.

Reasons for non-cointegration

- Theory wrong e.g. Samuelson-Balassa effects and bands of inaction. for PPP.
- Suppose you believe in the theory, can you find other reasons to reject the empirical results?
- Problems of measurement. If there are errors in measuring the growth rates the errors in the log level will be I(1).
- The span of the data matters many series that may appear to be I(1) over short periods but I(0) stationary over long periods, like the exchange rate example above. While the \$/£ exchange rate is not stationary over shorter spans, it is over centuries.
- Econometric problems.

Econometric problems 1

Properties of tests. Univariate unit root tests or multivariate cointegration tests. In either case inference will be sensitive to

- (a) the choice of null, (unit-root or no cointegration versus stationarity or cointegration)
- (b) the nature of the deterministic terms included: intercept, trend and any dummy variables;
- (c) the treatment of serial correlation, parametrically through the addition of lags or non-parametrically though the use of long run variances, with corresponding sensitivity to choice of lag length and window size;
- (d) how well the asymptotic critical values approximate the small sample values.
- (e) choice from large number of estimators e.g. for cointegration Engle-Granger, DOLS, fully modified, Johansen, etc. and their properties differ

Econometric problems 2

- Tests for a unit root null may have little power if the autoregressive coefficient is close to but not equal one.
- Changes in volatility may make detection of mean reversion more difficult.
- Stock and Watson (2017) emphasise that evidence for cointegration can be very fragile in the case of departures from exact unit roots. Small deviations from a unit root can cause large size distortions in cointegration tests.
- There may be structural breaks, regime changes and
- Other non-linearities

Conclusion

- Empirical evidence for the stability of the great ratios is decidedly mixed.
- But the empirical evidence is always conditional on a set of auxiliary hypotheses about measurement and estimation methods and we do not know whether it is the substantive hypothesis of stability of the ratios or the auxiliary hypotheses that lead to rejection.
- It may be sensible, to assume the variable constant for some purposes, such as the analysis of long run growth, but not for other purposes, such as the study of cyclical processes. This is the position Kaldor took.
- In other cases, one needs to question all the elements: theoretical framework, data quality and econometric techniques - to try and resolve the inconsistency.