Shifts, Shocks and the determination of equilibrium output

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Trend Output and the Output Gap

- OECD stress population, labour force, unemployment with equilibrium estimates
- Also look at capital stock and production technology with technical progress
- We focus on three things they do, and one they do not
  - The role of production technology and the capital stock
  - The concept of equilibrium unemployment
  - Break points and end point problems
  - The role of energy in the production function
- We also look at the end point problem

Production technology and the capital stock

- Output depends on technology and efficiency adjusted labour and capital inputs
- Technology/efficiency changes can be neutral, capital or labour augmenting
  - The Kapital bundle is $KB_t = B_k(Ke^{k(t)})$ but capital augmented technical progress must be temporary or the capital share rises without bound Atkinson (1969)
  - The Labour bundle is as $LB_t = B_L(Le^{L(t)})$ and labour augmenting technical progress can continue permanently. Includes education, skills and labour market institutions
  - Technical progress can also be neutral and augment both bundles, $NP_t = e^{N(t)}$
- Output is a function of all of them $Y_t=F(KB_t,LB_t,NP_t)$

Problems with Production Functions

- If Cobb Douglas then the estimate of the importance of technical progress is reduced and growth comes from inputs (Rodrik 1998)
- If you assume neutral technical progress the then you bias the technology estimate toward Cobb Douglas (Antras 2004)
- Micro evidence is technology is CES with elasticity of substitution 0.5
- Using time varying weights gets a good estimate of time varying technical progress and is independent of the underlying technology.
- If you assume Cobb Douglas you will get trend output wrong

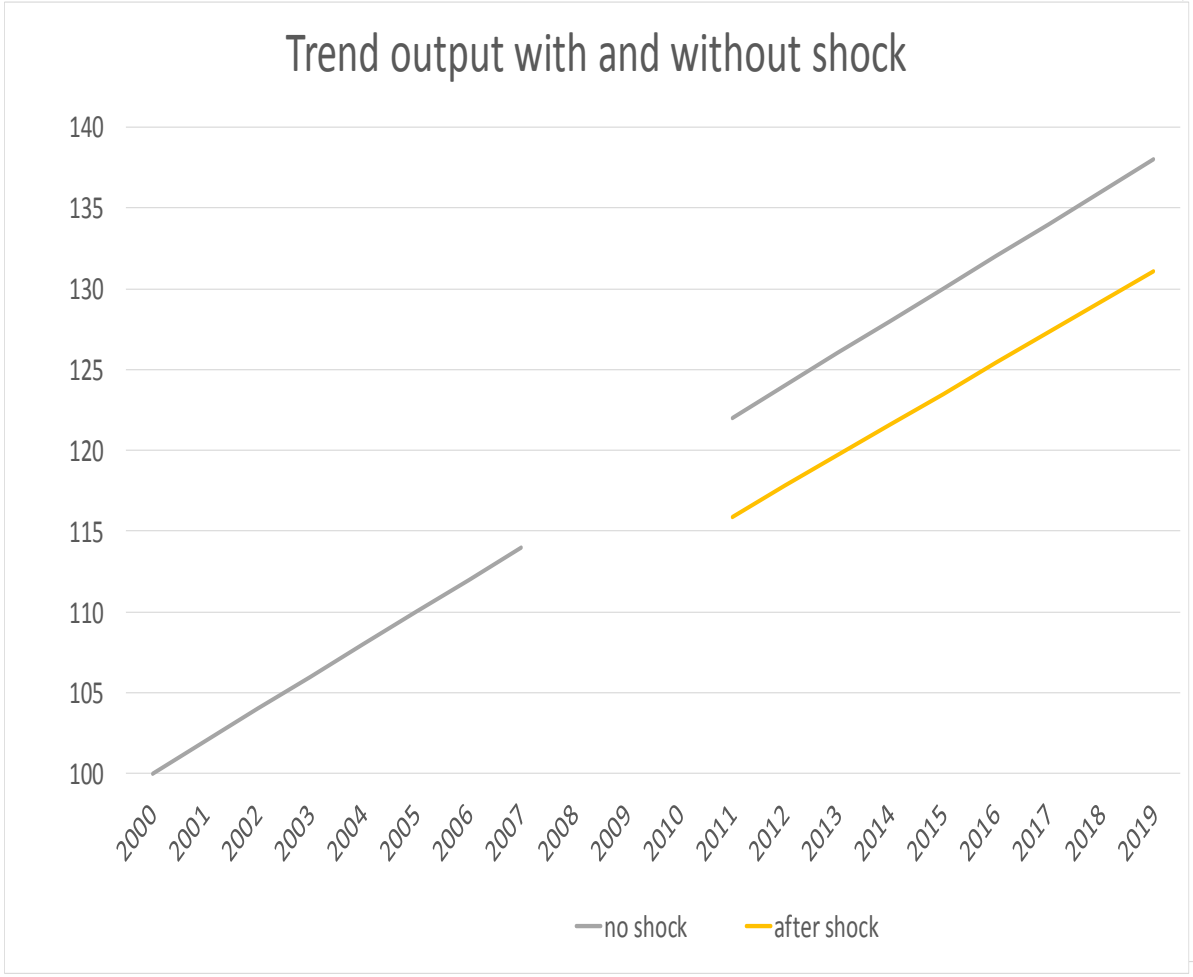
The concept of equilibrium unemployment

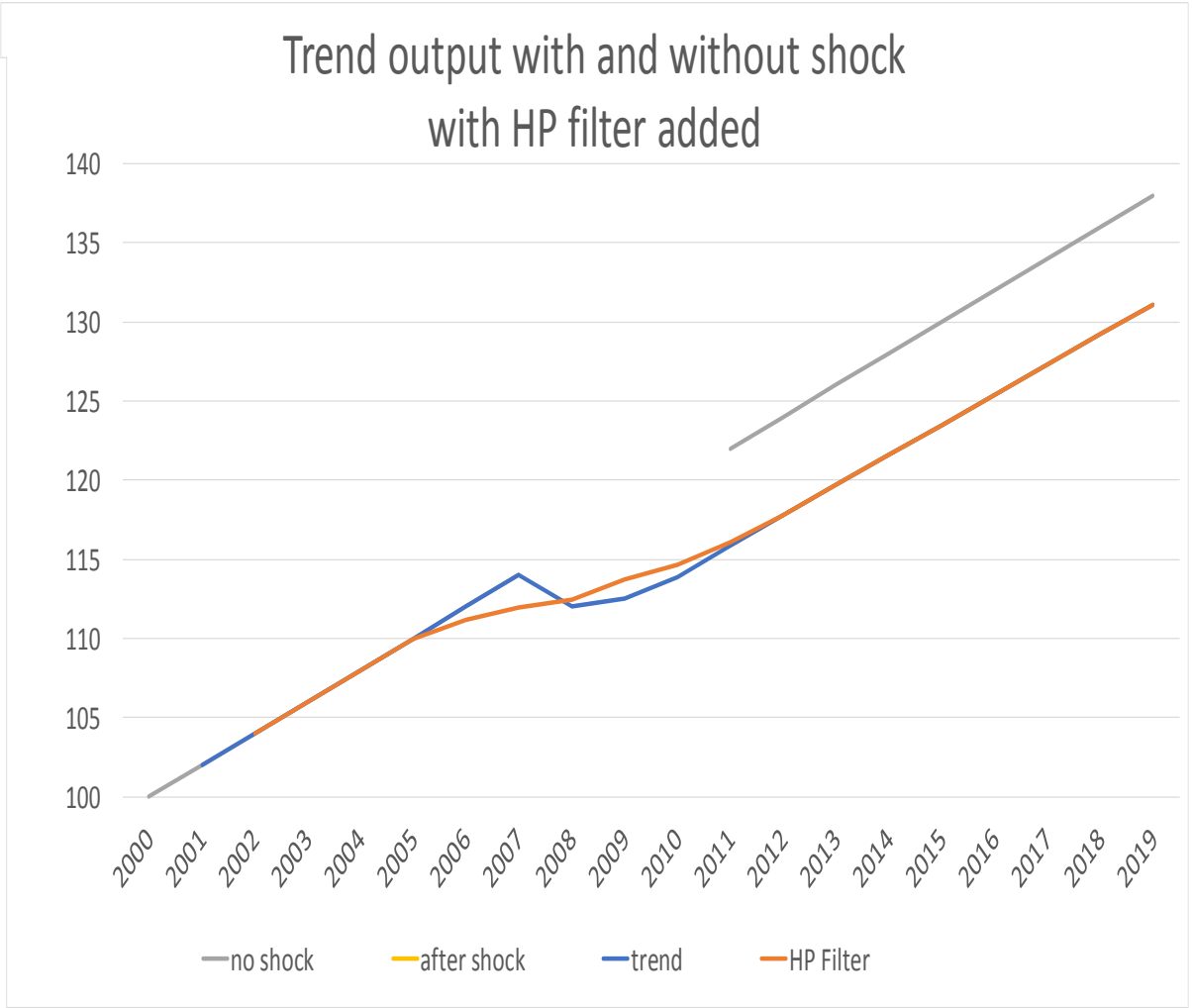
- The OECD uses an expectations adjusted Philips Curve with an embedded Kalman filter on unemployment to calculate equilibrium unemployment
- Employers pay the marginal product or nominal wages deflated by producer price of output and include employer paid labour taxes.
- Workers receive the nominal wage after income taxes and deflate it by the consumer price which include import prices and indirect taxes
- Equilibrium unemployment depends on the wedge between producer and consumer prices, on the real exchange rate and on the tax wedge
  - changes in these can be large and permanent giving end point problems
  - they are all absent from the augmented Philips curve
  - they could be included to deal with this end point problem

Break points and end point problems

- The OECD discuss end point problems and also the problem of dealing with breaks like 2007-8. Common with Hodrick Prescott and other filters
  - Earthquakes are break points. The capital stock is reduced and trend output falls. The break will be clear if the only filters used are for the NAIRU and (neutral) technology
- We should not change our output gap estimates before breaks
  - Sudden changes in institutions, real exchange rates, etc, change trend output
  - Probabilistic events like financial crises have two outcomes for trend output
- 2008 Lehman crisis was not inevitable (Ball 2018) and we need two paths
  - It shifted technology/efficiency by destroying trusted links between producers and with banks, and raised risk premia and the equilibrium capital stock

Which to choose for potential around a crisis?





The role of energy in the production function

- Changes in energy use change potential output by substituting for capital
  - In the 1970s oil price shocks changed potential by 10%
  - Energy intensity has fallen a lot since 1975 but it matters
- Best to include energy intensity in the capital bundle as a branch
  - Climate changes policies reduce carbon use without necessarily changing price, but quantity goes into production function
  - For climate change need to distinguish renewables
- Effects feed slowly in to potential but immediately in to costs