



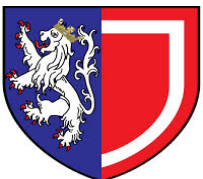
Rebuilding the Benchmark Macroeconomic Model

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**Paper Presented at the 2017 INET “Reawakening” Conference
Edinburgh, UK, 21 – 23 October**

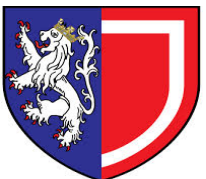
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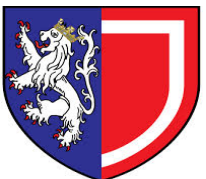


1 The Need to Rebuild

- When the Great Moderation collapsed into the GFC, macroeconomist looked rather foolish
 - What should core macroeconomic theory now look like
 - what should we teach the next generation of grad students?
- During the Great Moderation, the New Keynesian Dynamic Stochastic General Equilibrium (DSGE) model became the ‘benchmark model’: the one taught to graduate students
- But that benchmark model has let us down;
 - it explains neither why the GFC happened,
 - nor why the recovery since the GFC has been so slow.
 - And the influence of that benchmark model has damaged the ability of those economists working on “policy models” for policymaking institutions – in particular central banks and Finance Ministries – to give good policy advice.



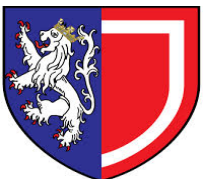
- What might a new benchmark model that we can use in our teaching actually look like? Does it require a ‘paradigm shift’?
- This paper builds on and develops the arguments in a paper, called “The Rebuilding Macroeconomic Theory Project: an Analytical Assessment”, which we have written for the forthcoming issue of the *Oxford Review of Economics Policy (OxREP)* on Rebuilding Macroeconomic Theory.
- Plan of this paper
 - In Section 2 we discuss past paradigm shifts in order to help us understand whether we need a new paradigm
 - In Section 3 we describe the benchmark DSGE model
 - In Section 4, we show why this model was unable to either explain why the GFC happened, nor why the recovery since the GFC has been so slow.
 - In Sections 5 6, 7 and 8 we suggest what to do next
 - The paper is evolutionary rather than revolutionary
 - Maybe it is even conservative! But there is much to do.



2 Past Paradigm Shifts

2.1 The 1930s

- The punchline of the 1930s is that, prior to that time, economists only had Alfred Marshall's partial equilibrium method of analysing macroeconomic problems. Then the Great Depression came along.
 - To explain the Depression Keynes took the Marshallian model and added nominal rigidities. This meant that, in response to a fall in investment, the economy did not rapidly return to full employment.
- To understand implications, Keynes invented new content:
 - the consumption function, the multiplier, and liquidity preference.
- However, to understand implications Keynes needed new method:
 - the kind of general-equilibrium analysis provided by the IS–LM system
 - What happens in the goods market affects the labour market and *vice-versa*
 - This change in both content and method was a clear paradigm shift.

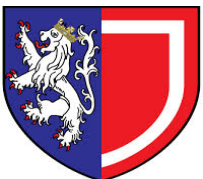


2.2 The 1970s and 1980s

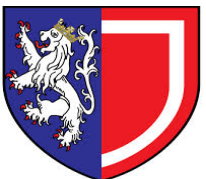
- The punchline of the 1970s is that, when the Great Inflation came along, economists were no longer able to use the fixed-price IS–LM system, or the models based on it, to give adequate policy advice.
 - However, compared with what had happened in the 1930s, the response was not a decisive paradigm shift. Instead, there was a much more contested outcome, the consequences of which are still being felt

An Evolutionary Approach

- The first set of responses to the Great Inflation came from ‘saltwater economists’ from the US East Coast and those working in the UK, who wanted existing models to evolve.

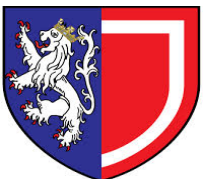


- There were four steps to evolutionary approach:
 - incorporating a Phillips curve,
 - allowing for adaptive inflation expectations, & vertical long-run Phillips curve,
 - the creation of an explicit nominal anchor through the adoption of an inflation targeting regime,
 - and to the modelling of an endogenous supply side of the model, by allowing for endogenous capital accumulation.
- This led to significant evolution
- Policy remained interventionist, but full-employment Keynesianism gave way to inflation targeting.
 - This implied that any long-run reduction in unemployment could only be brought about by supply-side reforms that increased investment, raised technical progress, or improved labour-market practices, rather than by stimulating aggregate demand.
 - Furthermore, in this new regime, active fiscal policy made way for an active monetary policy.
 - Led to new benchmark New Keynesian model (see below)
 - But this was evolutionary change, not a new paradigm



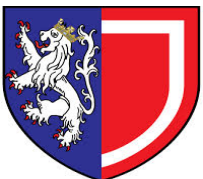
A Revolutionary Approach

- The second response to the Great Inflation was a revolutionary
 - The ‘freshwater economists’ in the US thought that the inflation of the 1960s and 1970s had discredited active Keynesianism.
- Their striking response had two components.
- First a new method which arose out of the Lucas critique:
 - models to be microfounded, optimizing, and forward- looking, with expectations of the future being model-consistent, or “rational” expectations
 - This method – the microfoundations hegemony - has been **largely accepted**,
 - This feature appears in the benchmark model presented below.
- Second, a requirement that the economy be treated as if it is in constant equilibrium
 - and therefore does not require policy intervention.
 - This second requirement has been **comprehensively rejected**
 - Reason provided in papers by Fischer (1977), Taylor (1980) and Calvo (1983)
 - Even if all of those who adjust have forward looking rational expectations, the existence of staggered timing of price changes can still lead to gradual adjustment, to nominal rigidities, and so to a role for aggregate demand



3 The Benchmark NK DSGE Model: Smets Wouters (2007)

- An IS curve determining aggregate demand, it has 2 components.
 - A forward-looking Euler equation for consumption of representative consumer.
 - A forward-looking equation for investment by the representative firm which is driven by Tobin's Q , which is influenced by the real interest rate in relation to the marginal cost of capital, and by the size of capital adjustment costs
- The natural level of output is determined by a production function
 - using capital and labour, given the level of technology.
- Aggregate demand can differ from the natural level of output because of nominal rigidities and so an output gap can emerge.
- Such a gap causes inflation, in a way described by the forward-looking Phillips curve, depending on a Calvo price-setting process.
 - Monetary policy is represented by a Taylor rule.
 - Determines nominal interest rate, and thus the real interest rate, Influences both Euler equation and investment function.
 - The following two pages present two standard simulations
 - Illustrate the key problem: Ramsey growth path is a unique “attractor”



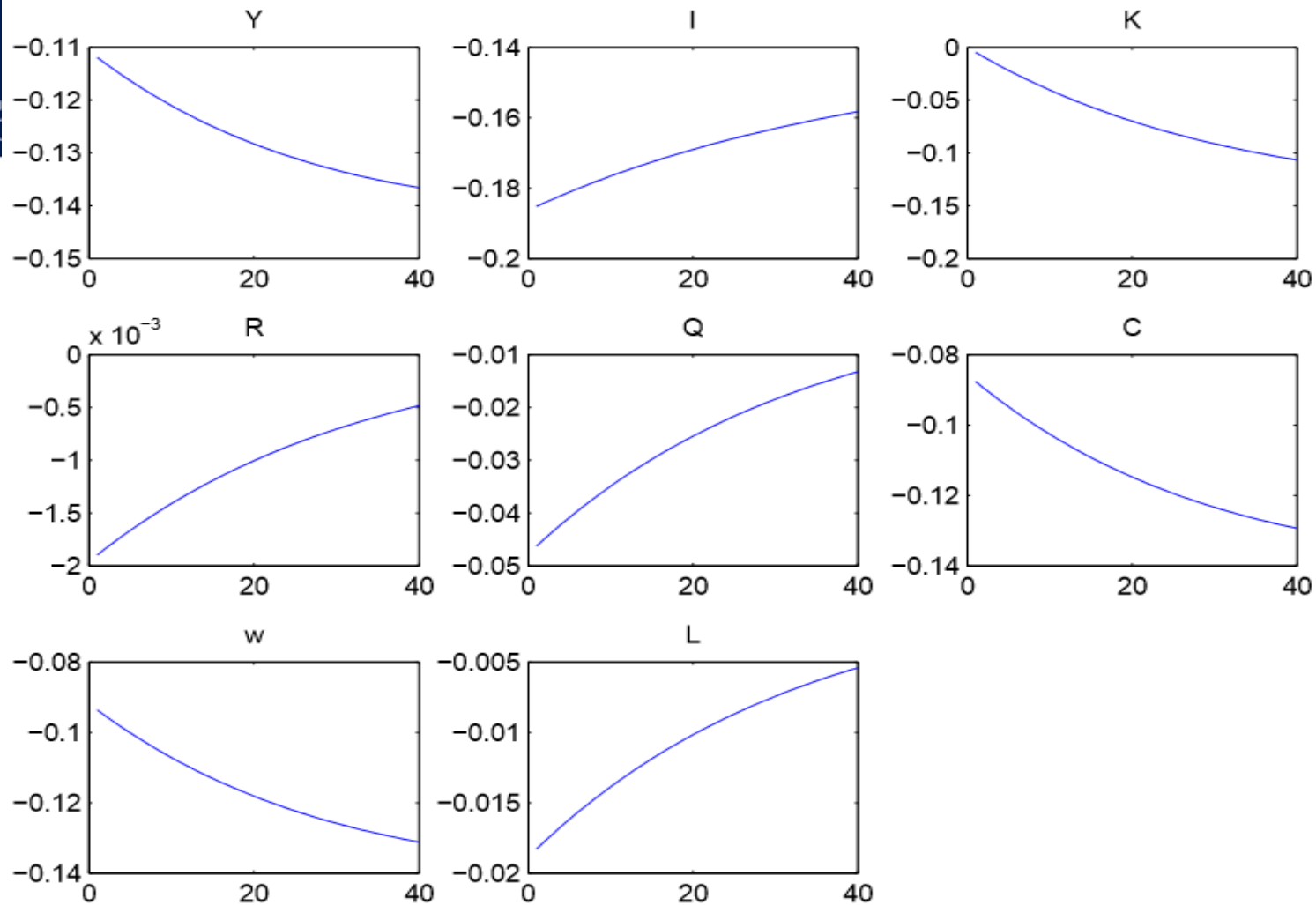
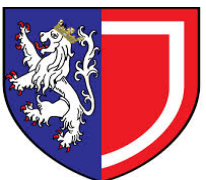


Figure 1: Response to a 10% negative TFP shock

Notation: C , I , Y , L , K , w , R , and Q , represent (respectively) consumption, investment, output, labour supply, the capital stock, the real wage, the (gross) real interest rate, and Tobin's Q .



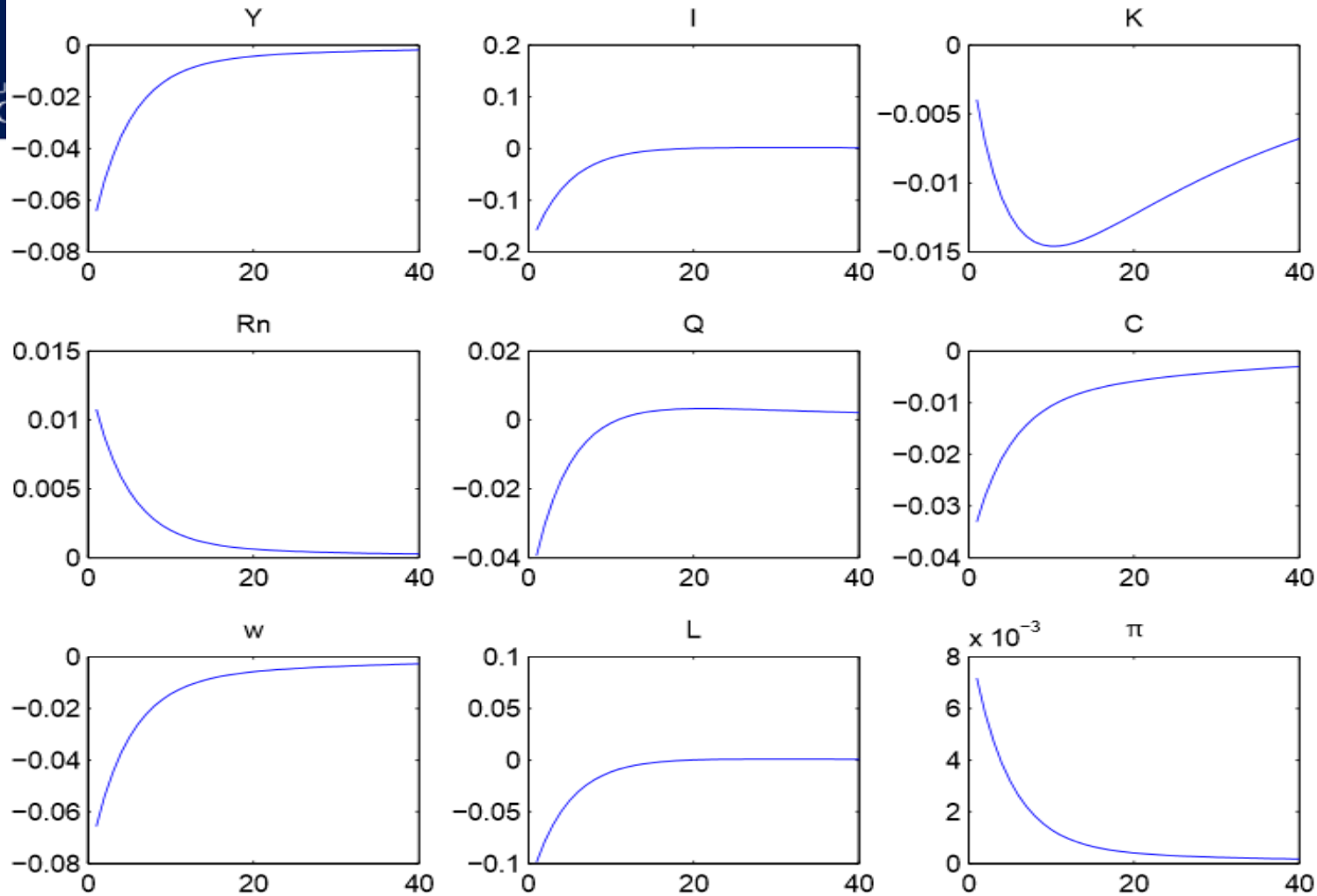
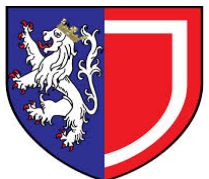


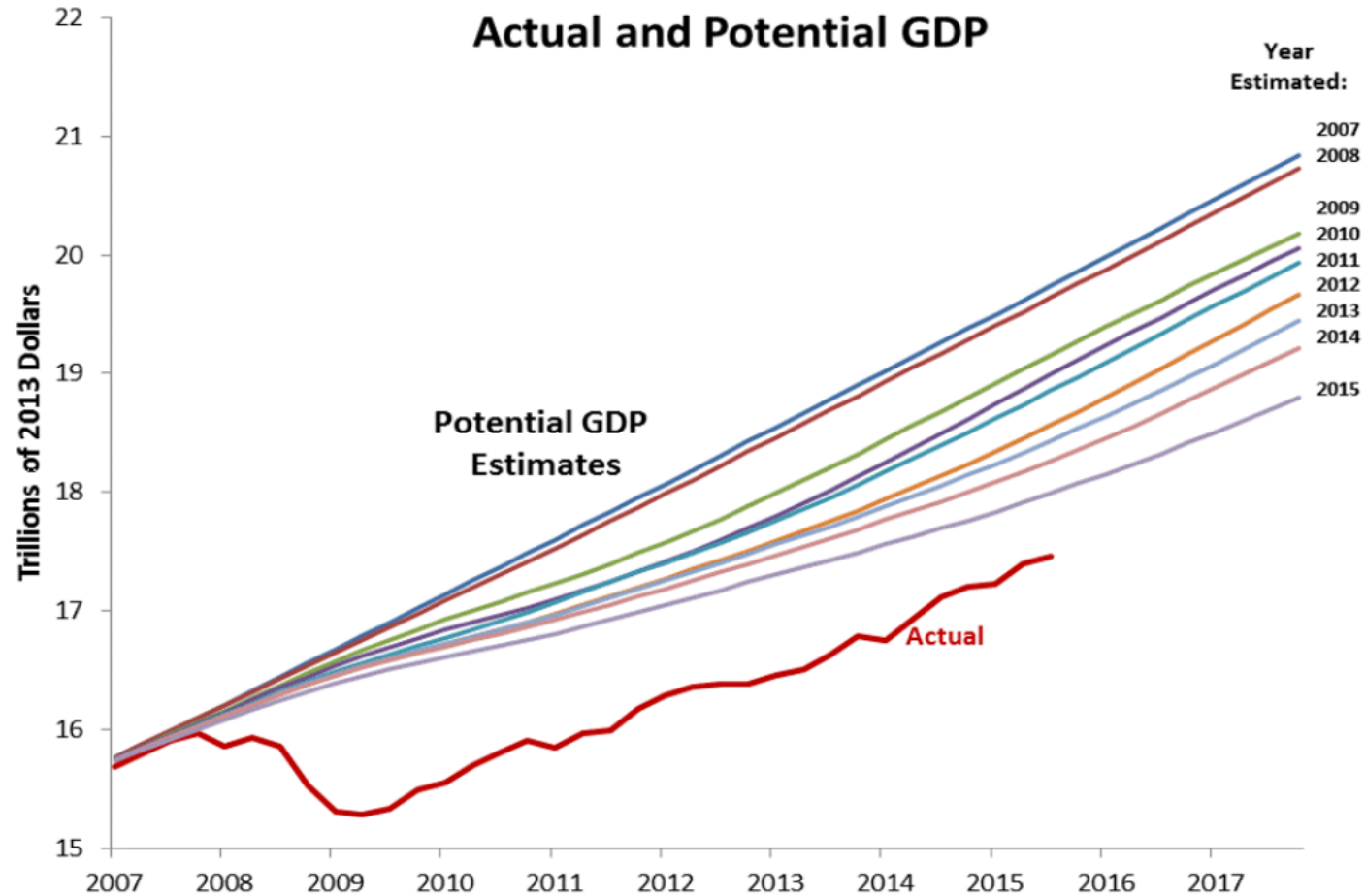
Figure 2: Response to a 1% positive cost-push shock

Notation: C , I , Y , L , K , w , R , Q , and π represent (respectively) consumption, investment, output, labour supply, the capital stock, the real wage, the (gross) real interest rate, Tobin's Q , and inflation.

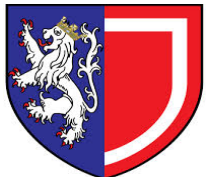


4 Why model is not fit for purpose

4.1 Can't explain severe crisis & slow recovery

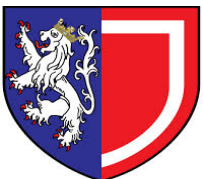


Sources: CBO Budget and Economic Outlooks 2007-2015, Bureau of Economic Analysis



The Difficulty is not surprising....

- It comes from the two critical assumptions underpinning DSGE models:
- First, the efficient markets hypothesis gives rise to an expectations-augmented yield curve in which there is no endogenous risk premium.
- Second, a rational expectations model like our benchmark model always converges back to the Ramsey equilibrium growth path. (cf the simulations discussed above)
 - This is true even if there is a very large reduction in private demand which causes the zero bound to the nominal interest rate to be reached.



4.2 Can't explain permanent effects of autonomous demand expansion

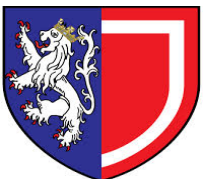
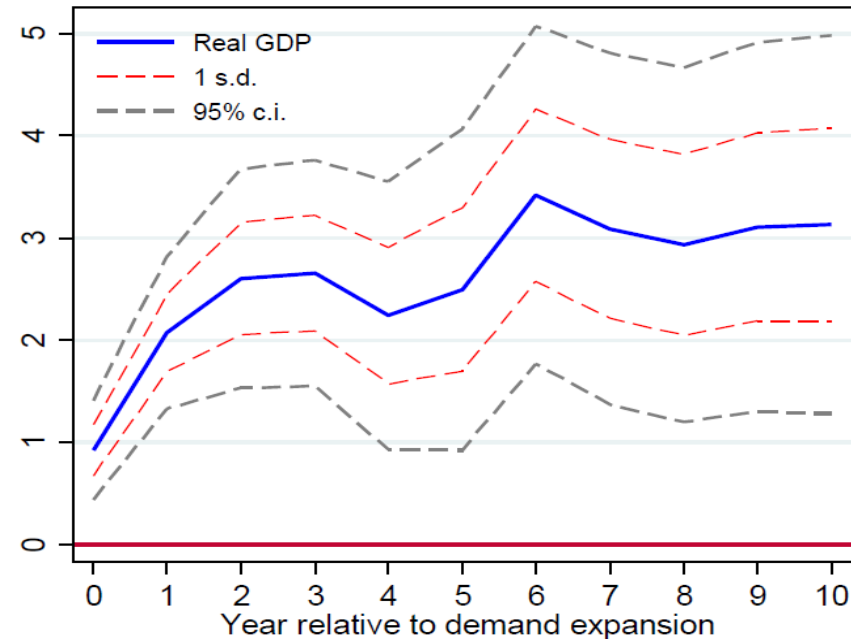
The following four slides capture pictures from an INET paper:
Girardi, D., W. P. Meloni. W, and A. Stirati (2017)

EFFECTS ON GDP

Impulse-response function (IRF) through LPs (% points on the vertical axis). We assess the effects of demand expansions by measuring the average GDP variation after an expansion **relative** to a control group of countries that in the same year have not had an expansion (controlling for country & year effects and lags of the dependent variable).

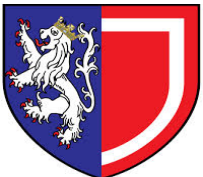
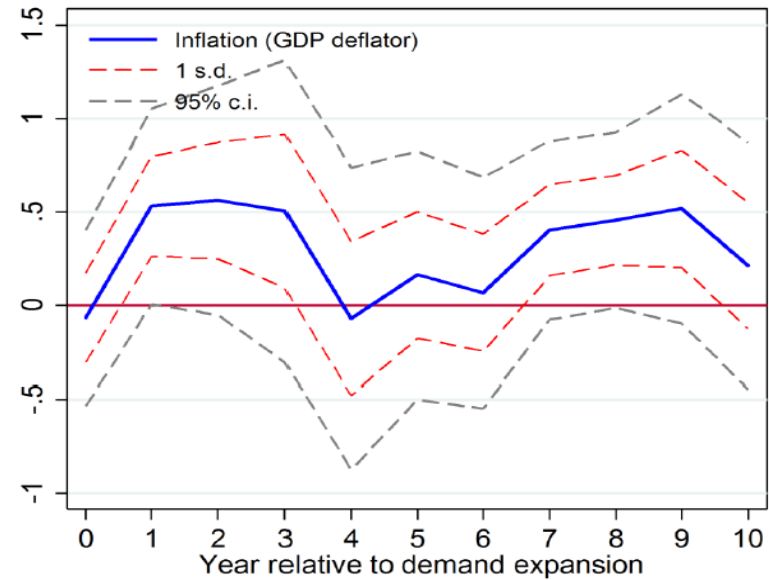
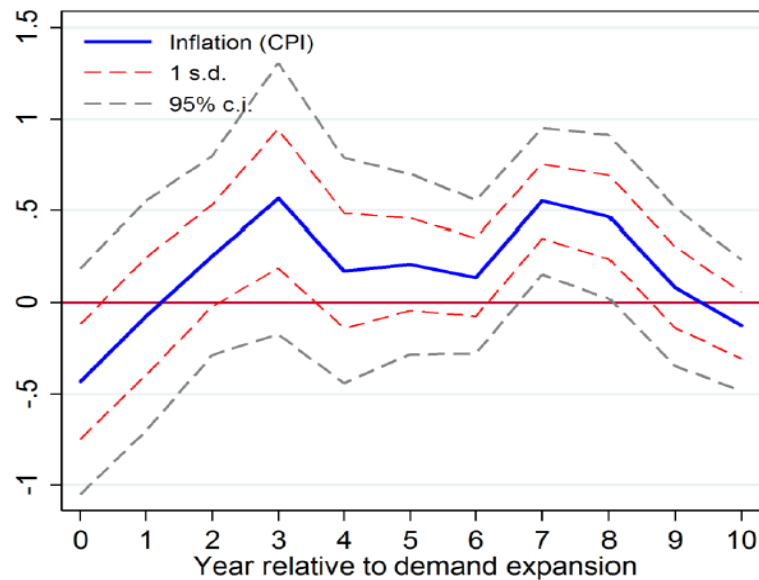
The graph shows the gap in $\log(GDP)$ in 'treated' and 'control' units between $t=0$ (the year of expansion) and $t+h$.

This gap stabilizes at the end of the period with **no sign of mean-reversion**: there is no sign of a 'return' to a path independent of the change in autonomous demand.

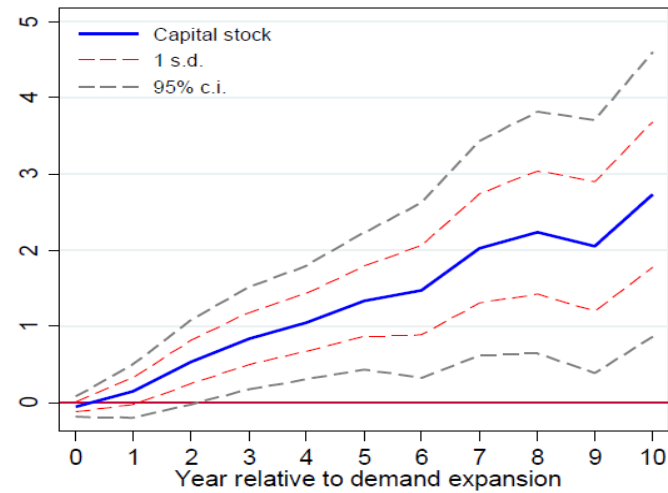


EFFECTS ON INFLATION

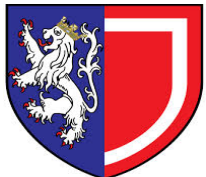
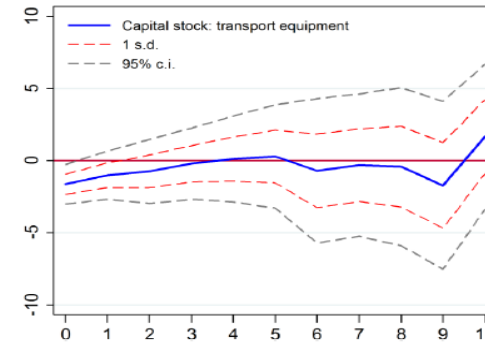
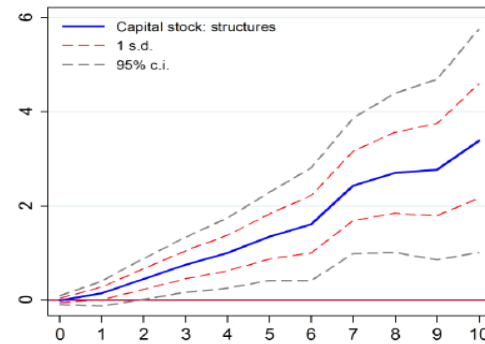
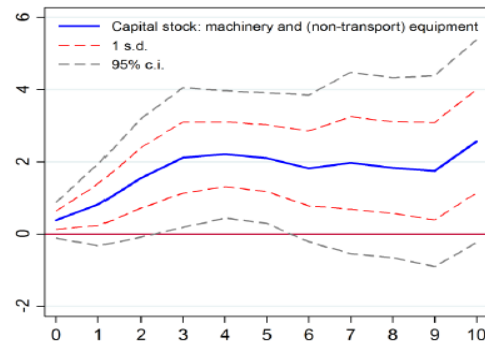
Effects of autonomous demand expansions on inflation:
positive but small, short-lived, statistically non-significant



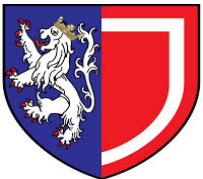
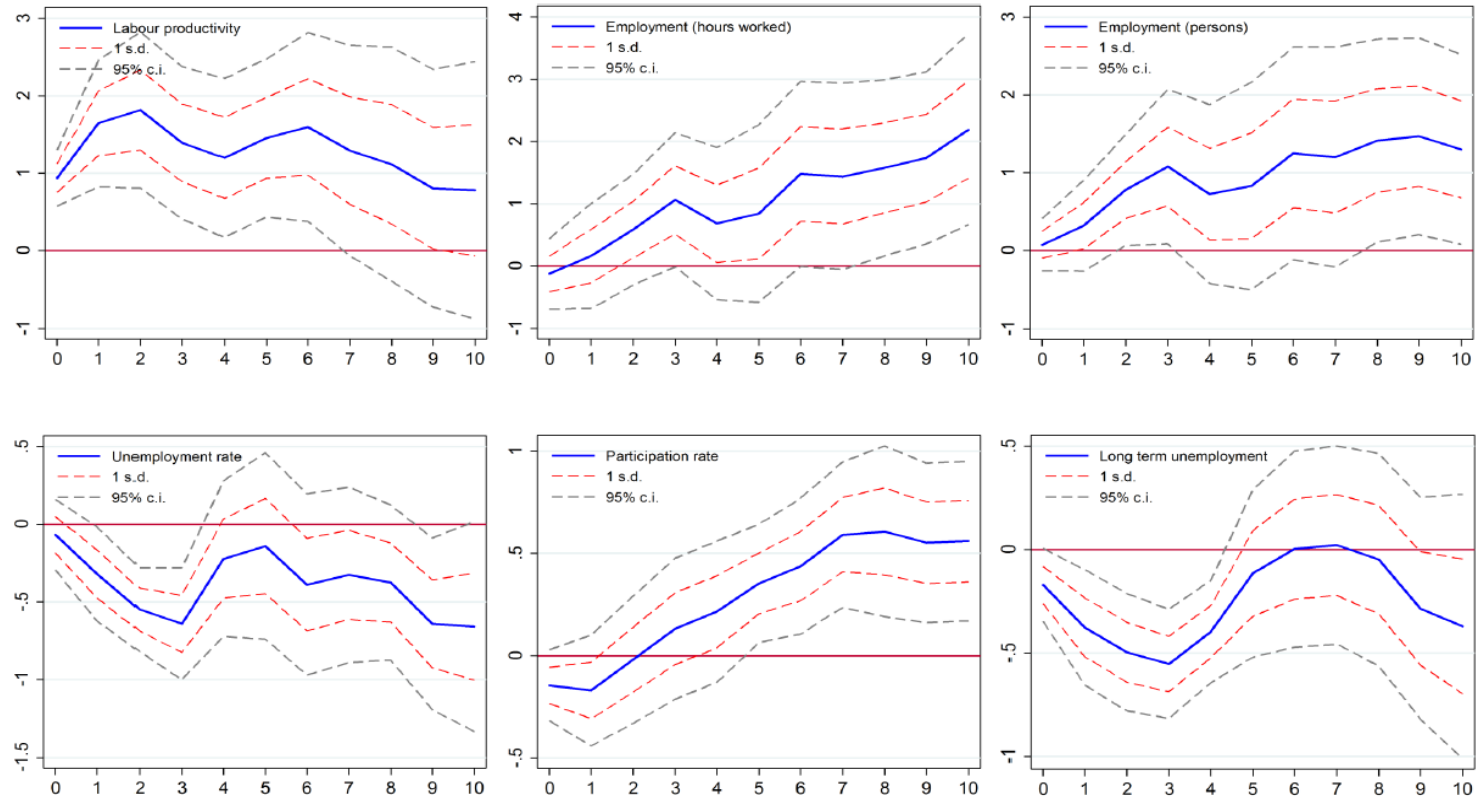
EFFECTS ON CAPITAL STOCK



Effects of autonomous demand expansions on capital stock: positive, persistent and statistically significant, reflects expansion in structures and machinery.

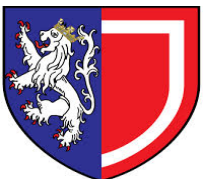


PRODUCTIVITY AND LABOUR MARKET



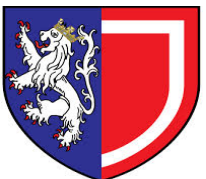
4.3 Other issues discussed at the INET conference

- The above two arguments suggest that there is a need for a radical rethink
- Three issues discussed at the INET conference also point in the same direction.
 - First, the increase in inequality leading to an increase in the propensity to save. To model this we need at least two classes of consumers and a study of the effects of inequality of wealth and income on their spending patterns and thus on aggregate demand
 - Second a declining cost of capital, and need for capital in the service sector, can help to provide an explanation for the low level of investment expenditure.
 - Third if both consumption and investment are low this points to a low level of private sector demand and suggests the need for looser fiscal position even ten years after the onset of the crisis.
- There are additional reasons for a rethink which we discuss below.



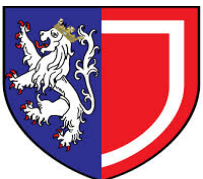
5 Can we build a new benchmark DSGE model that is tractable?

- Cavallero (2010) insists that changes are needed which are not piece by piece, but systematic; maybe this will be a “paradigm shift”
 - like that in the 1930s which produced general equilibrium thinking
- Carlin and Soskice (2018) provide a striking first pass at such a story.
 - They aim to provide a model focusing on the short to medium run
 - one which provide an explanation of why recovery has been so slow
- Take the benchmark model. Make the following five assumptions:
 - a zero bound to interest rates,
 - the absence of disinflation in the presence of high unemployment,
 - strategic complementarities among investors producing multiple equilibria,
 - the assumption that technical progress is embodied in investment so that a low-investment outcome will give rise to a low rate of technical progress,
 - and sufficient myopia among investors and consumers that the possibility of a good outcome in the future does not an optimistic shadow
 - Then a Keynesian unemployment equilibrium is possible:
 - Of course a good equilibrium is also possible –
 - but these five assumptions are sufficient for it not to be achieved!



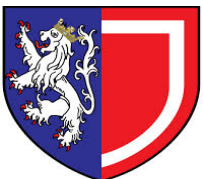
6 Our own more general suggestions

- Carlin and Soskice clearly do away with the microfoundations hegemony
- We now make our own suggestion about what needs to be done, drawing on the points identified in Section 4 of these slides.
 - We would also do away with the microfoundations hegemony
- We argue that four changes are needed
 - We think that the three behavioural equations of the model: describing consumption, investment, and price-setting, must all be amended or replaced.
 - In addition, we argue that a gap should be introduced between the rate of interest set by monetary policymakers and the rate affecting consumption and investment decisions



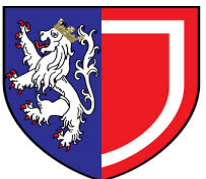
Consumption

- A distribution of consumers with different levels of wealth would make it possible to study inequality, and also the first-order effects of redistribution on aggregate consumption (due to different marginal propensities to consume).
- In an overlapping generations structure the real interest rate can stay above the marginal product of capital for extended periods (or even permanently), which may help explain the slow recovery.
- Including housing would make it possible to study consumers' decisions to invest in houses rather than productive capital, which in turn lowers real income in the long term.
 - It appears possible to include this in a simple overlapping generations model (see Barrell and Weale, 2010, and Wang, 2011).
 - However, this will be insufficient if the purpose is to study the house price booms and collapses that Hendry and Muellbauer argue must be examined in a policy model.
 - Such an analysis would require a more complex treatment that also considers the down-payment constraints and varying access to equity withdrawal that characterise home loans.



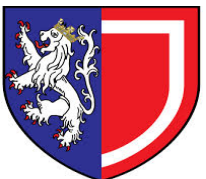
Investment

- The Tobin's Q investment equation needs to be replaced by one which allows for liquidity constraints, and for finite horizons which would dampen the responses to changes in Q.
- These constraints are important in explaining the downturn in investment immediately after the GFC.
- But these changes would not help in explaining why, even though equity markets are strong and cash flow is weak, corporate investment in advanced countries is still so low.
 - Here the ideas of Carlin and Soskice may be crucial
 - The ideas of Turner may be crucial
 - The ideas of Vines and Wills may be crucial



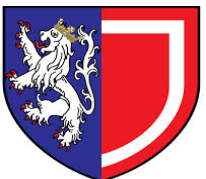
Inflation

- The Calvo-contracts equation for inflation needs to be replaced with one which allows for search and unemployment effects, and inertia (like backward-looking expectations), which will of itself make the effects of demand shocks more long lasting
 - The fact that sustained high unemployment did not lead to deflation during the crisis calls for a rethink of Phillips curve.
 - The absence of deflation is crucial to the Carlin and Soskice story
- Relative price adjustment between heterogeneous goods is also important.
 - This is something emphasized by Ghironi (2018), in his model with heterogeneous firms
 - It is emphasised by Adair Turner
 - McKibbin and Stoeckel (2018), in their examination of the effects on the global structure of relative prices of the rise of emerging-market economies show that this is important.



Interest Rate Wedge

- Finally, we think that a gap should be introduced between the rate of interest set by monetary policy-makers and the rate affecting the consumption and investment decisions of the private sector.
- Such a gap may be another important reason why investment in advanced countries has not recovered since 2008.
- The issue here relates to the need to relax two of the critical assumptions underpinning the benchmark model: the efficient market hypothesis, and rational expectations.
 - The efficient markets hypothesis means that things can never go wrong because of a risk premium, providing that solvency is ensured – there can be no liquidity problems
 - The rational expectations assumption (and its implication that an economy will eventually re-converge to the Ramsey growth path) means that there can never be a really serious crisis.
 - Inserting a gap between the policy rate and the rate affecting investment decisions may be a way of fixing this

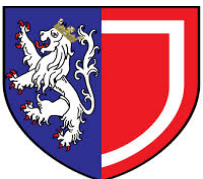


7 Some more general suggestions.

The suggestions in this section are from the papers in forthcoming OxREP issue

7.1 Financial Frictions

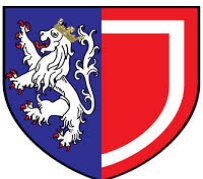
- Given that the 2008 crisis originated in the financial sector, which the benchmark DSGE model assumed works frictionlessly, it is natural that there is widespread mention of financial frictions
 - Liquidity constraints suggested by Blanchard, Vines and Wills, and Wright.
 - Balance sheet effects, like a stock of leverage affecting borrowing capacity, are mentioned by all of Blanchard, Hendry and Muellbauer, Stiglitz, Wren-Lewis, and Vines and Wills;
 - Blanchard has argued that ‘own funds’ affect spending decisions.
- In summary, ‘stocks should affect flows’: capital for banks and collateral and wealth effects for individuals and firms.
- Stiglitz: risk has first-order effects which are often ignored, seen most clearly in the long time it takes for the collateral of banks to be restored after shocks.
- Vines and Wills argue that the yield curve should be endogenous
 - Carlin and Soskice (2018, this issue) argue for a need to include a financial accelerator and debt-financed investment in the model, and see a need for including the effects of a leveraged banking system



7.2 Relaxing Rational Expectations

- Blanchard, Ghironi, Haldane and Turrell, and Stiglitz, argue that the agents in our models look too far into the future, and that this leads to unrealistic consumption behaviour (the Euler equation) and price-setting behaviour (in Calvo contracting).
 - This can have important implications for policy, for example such forward-lookingness may lead to low estimates of fiscal multipliers as agents overweight the prospect of future tax increases—as noted by Hendry and Muellbauer, and Stiglitz.
- Blanchard (2017) suggests incorporating finite horizons, not necessarily coming from finite lives and incomplete bequests, but instead from bounded rationality or from myopia.
- Haldane and Turrell suggest that a less rigid framework, like ABMs, would allow for many different degrees of rationality, and should make it possible to include the effects of heuristics that make sense in an uncertain world with costly information.

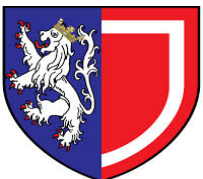
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7.3 Heterogeneous Agents

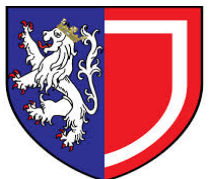
- Both consumers and producers.
- Lindé, Carlin and Soskice, Ghironi, Ricardo Reis (2018, this issue), and Vines and Wills, cite recent work by Kaplan *et al.* (2016) and Ravn and Sterk (2016) that parsimoniously includes both heterogeneous agents and search and matching frictions in a DSGE framework.
- Haldane and Turrell offer ABM as another way to do this.
- Stiglitz argues that doing this is crucial because the distribution of income matters, both for demand and for welfare outcomes.
 - He discusses the adjustment to a negative shock; a fall in real wages can reduce demand and increase unemployment if workers have a higher marginal propensity to consume than owners of capital.

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7.4 Better Microfoundations

- Three different interpretations of what this might mean.
- The first approach would improve microfoundations in existing core model.
 - Krugman: the fact that sustained high unemployment did not lead to deflation during the crisis calls for a rethink of Phillips curve.
 - Blanchard also identifies the *ad hoc* approach to understanding price stickiness as a problem, arguing that the deep reasons behind this, like the costs of collecting information, probably have implications which reach beyond wage and price setting, and that we ignore these at our peril.
- The second approach would bring a deeper approach to microfoundations than is currently used, and is advocated by Wright.
 - Wright argues that the use of money, credit, and other assets in facilitating exchange should emerge as outcomes of, rather than inputs to our theories. He argues for microfoundations in the way that versions of Mortensen and Pissarides (1994) or Burdett and Mortensen (1998) models are accepted as benchmarks in labour economics.
 - The third approach – agent-based modelling - would bring a radically different approach to microfoundations, relying on simulation methods



8 Conclusions

- We have described what needs to be done to achieve a new benchmark model.
 - This may a hopeless and misguided search. Maybe even the simplest characterization of a useful model requires a complex model. Nevertheless we are hopeful that a new benchmark model may be found. And we are hopeful that it may be possible to find such a model simple enough to teach our students.
- Two things are necessary for progress to be made in this direction
- First, it is time to do away with the microfoundations hegemony
 - It is time for our subject to allow more room for, and show more respect for, those engaged in building, and using, policy models. These macroeconomists are now doing our equivalent of experimental physics.
 - The second—and related—lesson is that there needs to be more pluralism.
 - There may no longer be a true church

