## Noise over the Business Cycle

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### Research Question

The key empirical question is how the effect of **noise** varies over the **business cycle** 

We employ a **regime switching** econometric model where transitions across states (recession and expansion) are **smooth** 

### Econometric Procedure - Overview

### We use a 2-step procedure

- Estimate series of noise shocks orthogonal to any other exogenous source of fluctuations
- Estimate a Smooth Transition Local Projection model (hereafter STLP) to estimate dynamic responses of key macroeconomic variables

### Step 1 - Overview

We estimate a noise shock as a change in the expected growth rate of Real GDP which is orthogonal to

- contemporaneous structural shocks
- 2 lagged principal components from a large dataset
- past and future TFP

# Step 1 - Estimation of $Z_t$

#### Data

- $X_t$  is log of Real GDP at time t
- $X_{t+k|t} = E[X_{t+k}|I(t)]$  provided by Survey of Professional Forecasters

#### Procedure

$$Z_t = (X_{t+4|t} - X_{t|t}) - (X_{t+4|t-1} - X_{t|t-1})$$

#### where

- $(X_{t+4|t} X_{t|t})$  is expected growth rate of Real GDP conditional on information set up to time t
- $(X_{t+4|t-1} X_{t|t-1})$  is expected growth rate of Real GDP conditional on information set up to time t-1
- ullet  $Z_t$  is a shock to the expectations of output growth rate

# Step 1 - Estimation of $\tilde{Z}_t$

**Problem.**  $Z_t$  is correlated with current and future fundamentals such as fiscal policy, monetary policy, current and future TFP.

**Solution.** Estimate  $\tilde{Z}_t$  as follows

$$Z_{t} = C + \sum_{j=-J}^{H} \delta_{j} \Delta TFP_{t+j} + \gamma SS_{t} + \mu PC_{t-1} + \tilde{Z}_{t}$$

where

- C is the constant
- ullet  $\Delta TFP_t$  is first difference of total factor productivity at time t
- $SS_t$  is a vector of structural shocks at time t from the dataset of Caldara and Kamps (2017)
- ullet  $PC_{t-1}$  is a vector of principal component at time t-1

 $\tilde{Z}_t$  represents a change in expectations which is not related to any source of fundamental fluctuations, i.e. a **noise shock**.

### Step 2 - Smooth Transition Local Projection

Following Auerbach and Gorodnichenko (2012), our basic specification is

$$Y_{t+k} = [1 - F(\eta_{t-1})] \Pi_E \tilde{Z}_t + F(\eta_{t-1}) \Pi_R \tilde{Z}_t + u_t$$

where

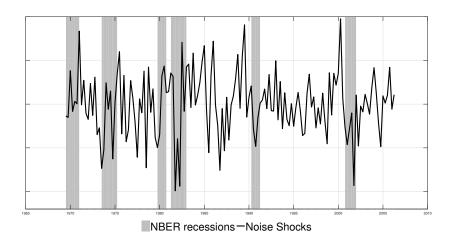
$$F(\eta_t) = \frac{\exp(-\gamma \eta_t)}{1 + \exp(-\gamma \eta_t)}, \quad \gamma > 0$$

and variables  $\eta_t$  is an index (normalized to have zero mean and unit variance) of the business cycle.  $[\eta_t > 0 \Rightarrow \text{expansion.}]$ 

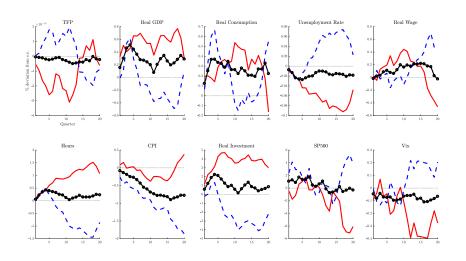
**Note.** We date the index  $\eta$  by t-1 to avoid contemporaneous feedbacks of  $\tilde{Z}_t$  on the underlying state.



# Noise Shocks $\tilde{Z}_t$



## Local Projection using Smooth Transition



### Main Issues

- SPF information set may be different to the one of economic agents.
- Porecast horizon of SPF may be to short to properly capture future beliefs.
- O Do we need to treat for possible trend in the data?
- Need to set up a reliable procedure for the confidence intervals.
- $\ \ \,$  Need to allow for endogenous feedbacks of noise on  $\eta_t$  in the local projection.

### Details on $\eta_t$ and STPL procedure

 $\eta_t$  is defined as the seven-quarter moving average of the output growth rate.

• Notice that we can easily consider dynamic feedbacks from noise to the state of the regime.

Following Auerbach and Gorodnichenko (2012) we calibrate  $\gamma$  to 1.5 for now.

 $\bullet$  Granger and Teravista (1993) suggest robustness checks procedure for  $\gamma.$ 

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