

# Global Factors and Animal Spirits

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Seminar is a broad survey drawing on

- Smith R.P. and G. Zoega, Global Factors, Unemployment Adjustment and the Natural Rate, *Economics the Open Access E Journal* 2008-22.
- — Keynes, Investment, Unemployment and Expectations, *International Review of Applied Economics*, 2009, 23(4) 427-444
- Dees S, Pesaran MH, Smith LV, Smith RP. 2009. Identification of New Keynesian Phillips Curves from a global perspective. *Journal of Money Credit and Banking* 41: 1481-1502
- — Supply, Demand and Monetary Policy Shocks in a Multi Country New Keynesian Model, in preparation

Grateful for ECB support, views are my own.

# Outline

- Animal Spirits?
- Reflected in global factors in unemployment and investment
- Problems of measuring global factors
- More structural models of global factors
- Global VAR
- Multi-country New Keynesian Model

# Animal spirits

Some suggest that economic variables share a substantial common component driven by 'psychological' factors which Keynes labelled 'animal spirits', but also labelled the state of confidence, expected returns, degree of risk aversion, etc.

This may generate a common factor that turns up in macro/financial variables in many countries and an issue is how might one measure it? It is useful to distinguish three types of attitude towards knowledge of the future

- risk: known possible states of the world, known probabilities
- uncertainty: known possible states of the world but unknown probabilities
- unawareness: unknown possible states of the world (Rumsfeld's unknown unknowns, black swans etc)

# Even with risk

- Loss/utility functions matter so expectations may not be unbiased
- Infinite regress problem of expectations about the expectations of others
- There may be rare events, fat tailed distributions and peso problems: Barro, Gabaix, etc .
- Moments of distributions (and thus expected values or variances) may not exist, Mandelbrot etc
- Present values may not converge (in  $P = D/(r - g)$  type calculations) if there is uncertainty about growth/discount rates; Geweke (2001), Weitzmann (2005), Pesaran et al. (2007).

Behavioural theories tend to assume that people do not form rational expectations, this is distinct from Keynes argument that there was no basis on which to form rational expectations.

*"human decisions affecting the future, whether personal or political or economic, cannot depend on strict mathematical expectation, since the basis for making such calculations does not exist"* (General Theory Ch12).

Role for direct measurement of expectations, e.g. Manski (2004).  
Consistent with 'sunspot' and multiple equilibria theoretical models and uncertainty based explanations for macro-finance puzzles like:

- the forward premium bias;
- the equity premium/risk free rate; and
- the long-rate conundrum.

Such common psychological attitudes will generate common components in agents actions and since this is an inter-dependent globalised world, there should will be global common components, global factors.

A common observation in markets is that in crises all correlations go to one. This is consistent with common factors. Suppose

$$y_{it} = \gamma_i f_t + \varepsilon_{it}$$

where  $\varepsilon_{it}$  is an idiosyncratic factor uncorrelated with the common factor  $f_t$  then

$$E(y_{it}y_{jt}) = E(\varepsilon_{it}\varepsilon_{jt}) + \gamma_i\gamma_j E(f_t^2)$$

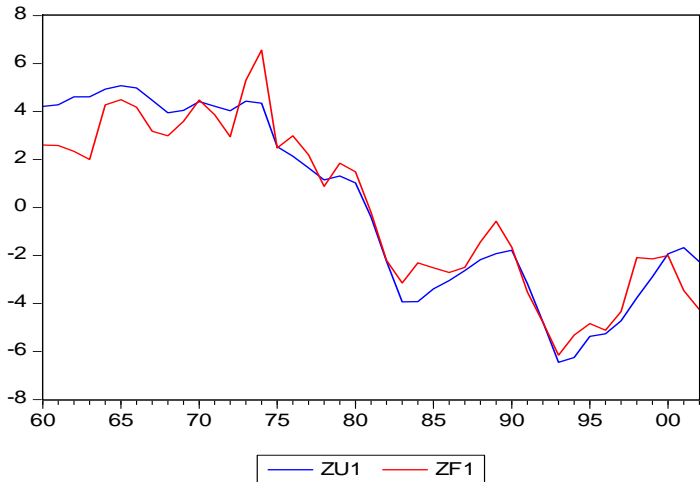
and the correlation between  $i$  and  $j$  will depend on the (time varying) variance of the common factor. Identification issues.

Smith and Zoega (2009) looked at common factor in the share of investment in GDP and the unemployment rate in 21 OECD countries over the period 1960-2002.

**Principal components, PC, for unemployment and investment**

	Unem			Invest		
	Eigen	%var	Cum%	Eigen	%var	Cum%
PC1	14.16	69	69	11.85	58	58
PC2	3.15	15	84	2.44	12	70
PC3	0.98	5	89	1.59	8	78
PC4	0.74	4	93	1.00	5	83

# First PCs of Unemployment (ZU1) and Investment (ZF1)



# Principal Components of Unemployment and Investment

First PCs are almost identical,  $R^2 = 0.92$ . Both are I(1), and cointegrated with a unit coefficient.

PC2s not highly correlated  $R^2 = 0.25$ .

PC1 for unemployment has almost equal weights across countries, range 0.18-0.26 except US 0.08, which has high weight on PC2.

PC1 for investment also has very similar weights. Both are very close to means.

Natural explanation in terms of an expected global rate of return, which drives both investment in physical and human capital?

PC1 behaved like a time-varying natural rate of unemployment in inflation equations and cointegrates with national unemployment and investment, explaining a large percentage of their variation.

For  $N$  large, PC1 can be treated as a weakly exogenous variable.

# Issues in measuring common factors

- Stationarity.  $U$ ,  $I$  and their common factor are all  $I(1)$  so the common factor measures secular not cyclical co-movements, unlike the usual work on global cycles, which uses (questionable?) stationarity inducing transformations.
- Variable and factor must cointegrate,  $y_{it} = \gamma_i f_t + \varepsilon_{it}$ ,  $\varepsilon_{it} I(0)$
- How many factors?
- Identifying and interpreting factors  
 $y_t = \Gamma f_t + u_t = (\Gamma P)(P^{-1} f_t) + u_t$ . In this case weights were close to equal so factor is close to mean, with an obvious interpretation.
- Determining factors: a priori or estimated weights.
- Establishing the source of the correlation (common behaviour, common factors, contagion).
- Role for a more structural approach?

## VARX\*

- considers  $N + 1$  countries,  $i = 0, 1, 2, \dots, N$  (US  $i = 0$  treated differently);
- vector of country variables  $\mathbf{x}_{it}$  (output, inflation, short and long interest rates, equity prices and exchange rates),
- measure global factors by trade-weighted averages of corresponding variables in other countries, so  $x_{it}^* = \sum_{j=0}^N w_{ij}x_{jt}$ , which are weakly exogenous (testable).
- estimate country by country as a cointegrating VARX\*

$$\Delta \mathbf{x}_{it} = \mathbf{c}_{i0} - \boldsymbol{\alpha}_i \boldsymbol{\beta}_i' [\mathbf{z}_{i,t-1} - \boldsymbol{\gamma}_i(t-1)] + \mathbf{C}_{i0} \Delta \mathbf{x}_{it}^* + \mathbf{G}_i \Delta \mathbf{z}_{i,t-1} + \mathbf{u}_{it},$$

where  $\mathbf{z}_{it} = (\mathbf{x}_{it}', \mathbf{x}_{it}^{*'})'$ ,  $\boldsymbol{\alpha}_i$  is a  $k_i \times r_i$  matrix of rank  $r_i$ , and  $\boldsymbol{\beta}_i$  is a  $(k_i + k_i^*) \times r_i$  matrix of rank  $r_i$ .

- allows for cointegration within  $\mathbf{x}_{it}$  and between  $\mathbf{x}_{it}$  and  $\mathbf{x}_{it}^*$ .

## GVAR

Then for  $\mathbf{x}_t = (\mathbf{x}'_{0t}, \mathbf{x}'_{1t}, \dots, \mathbf{x}'_{Nt})$  can write  $\mathbf{z}_{it} = \mathbf{W}_i \mathbf{x}_t$ , and stack the  $N + 1$  individual country models as a GVAR.

$$\mathbf{x}_t = \mathbf{a}_0 + \mathbf{a}_1 t + \mathbf{F}_1 \mathbf{x}_{t-1} + \mathbf{F}_2 \mathbf{x}_{t-2} + \boldsymbol{\varepsilon}_t. \quad (1)$$

The global variables  $\mathbf{x}_{it}^*$  and financial variables very important in the VARX\*.

Widely used structure to reduce curse of dimensionality.

Issue that the GVAR is difficult to interpret, or to identify what the shocks are and where they come from. A development is to use a similar approach to assemble a more structural model based on the standard 3 equation NK model.

# Deviations from Steady States

Variables measured as deviations from their steady states. Steady states are calculated as long-horizon forecasts from the GVAR. The steady states will then reflect any long-run cointegrating relationships and stochastic trends and ensures that the deviations from steady state are unambiguously  $I(0)$ .

The steady state (permanent-stochastic component)  $\mathbf{x}_{st}^P$ , is then uniquely defined as the 'long-horizon forecast' (net of the permanent-deterministic component). This corresponds not only to the natural definition of a steady state to which the system is tending but also to a multivariate Beveridge-Nelson (1981) decomposition, reflects any cointegrating relations and stochastic trends.

$$\mathbf{x}_{st}^P = \lim_{h \rightarrow \infty} E_t (\mathbf{x}_{t+h} - \mathbf{x}_{d,t+h}^P) = \lim_{h \rightarrow \infty} E_t [\mathbf{x}_{t+h} - \boldsymbol{\mu} - \mathbf{g}(t+h)].$$

The deviations from steady state are denoted  $\tilde{\mathbf{x}}_{it} = \mathbf{x}_{it} - \mathbf{x}_{it}^P$ , where  $\mathbf{x}_{it}^P$  is the permanent or steady state value, Typically  $\tilde{\mathbf{x}}_{it} = (\tilde{\pi}_{it}, \tilde{y}_{it}, \tilde{r}_{it}, \tilde{re}_{it})'$  deviations from steady state of inflation, output, the interest rate and the real effective exchange rate.

# New Keynesian Model

Phillips curve

$$\tilde{\pi}_{it} = \beta_{ib}\tilde{\pi}_{i,t-1} + \beta_{if}E_{t-1}\tilde{\pi}_{i,t+1} + \beta_{iy}\tilde{\mathcal{Y}}_{it} + \varepsilon_{i,st}, \quad (2)$$

IS curve with real effective exchange rate  $\tilde{r}e_{it}$ ; and foreign output,  $\tilde{\mathcal{Y}}_{it}^*$ .

$$\tilde{\mathcal{Y}}_{it} = \alpha_{ib}\tilde{\mathcal{Y}}_{i,t-1} + \alpha_{if}E_{t-1}\tilde{\mathcal{Y}}_{i,t+1} + \alpha_{ir}(\tilde{r}_{it} - E_{t-1}\tilde{\pi}_{i,t+1}) + \alpha_{ie}\tilde{r}e_{it} + \alpha_{iy^*}\tilde{\mathcal{Y}}_{it}^* + \varepsilon_{i,dt}. \quad (3)$$

Taylor Rule,

$$\tilde{r}_{it} = \gamma_{ib}\tilde{r}_{i,t-1} + \gamma_{i\pi}\tilde{\pi}_{it} + \gamma_{iy}\tilde{\mathcal{Y}}_{it} + \varepsilon_{i,mt}. \quad (4)$$

The (log) real effective exchange rate  $\tilde{r}e_{it}$  is modelled as a first order autoregression,

$$\tilde{r}e_{it} = \rho_i\tilde{r}e_{i,t-1} + \varepsilon_{i,et}, \quad (5)$$

- Estimated for 33 countries by GMM,  $\tilde{\mathbf{x}}_{it}^*$  provide identifying instruments, subject to theoretical restrictions;
- consistent treatment of exchange rates;
- rational expectations model solved;
- international transmission through equations and through usual supply, demand, monetary policy and exchange rate shocks which can be estimated and their correlations calculated;
- For consistency with the standard theoretical treatment, which assumes supply, demand and monetary policy shocks are uncorrelated we will calculate IRFs and FEVD for the case where the covariance matrix has the following bordered structure:

$$\Sigma_{\varepsilon}^0 = \begin{pmatrix} \Sigma_{ss} & \mathbf{0} & \mathbf{0} & \Sigma_{se} \\ \mathbf{0} & \Sigma_{dd} & \mathbf{0} & \Sigma_{de} \\ \mathbf{0} & \mathbf{0} & \Sigma_{mm} & \Sigma_{me} \\ \Sigma_{es} & \Sigma_{ed} & \Sigma_{em} & \Sigma_{ee} \end{pmatrix}.$$

This imposes the restriction that the structural shocks of different types are uncorrelated, but there is no restriction on the correlation of the exchange rate shocks with the structural shocks.

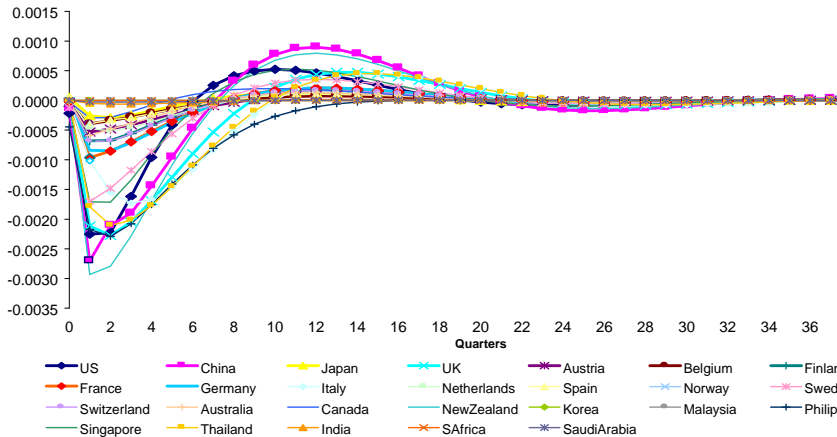
# Transmission

- Through direct effects in equations for deviations from steady state (IS curve, foreign output and real effective exchange rate)
- Through covariances of error in equations for deviations from steady states
- Through correlation of steady states, (steady state matrix singular)

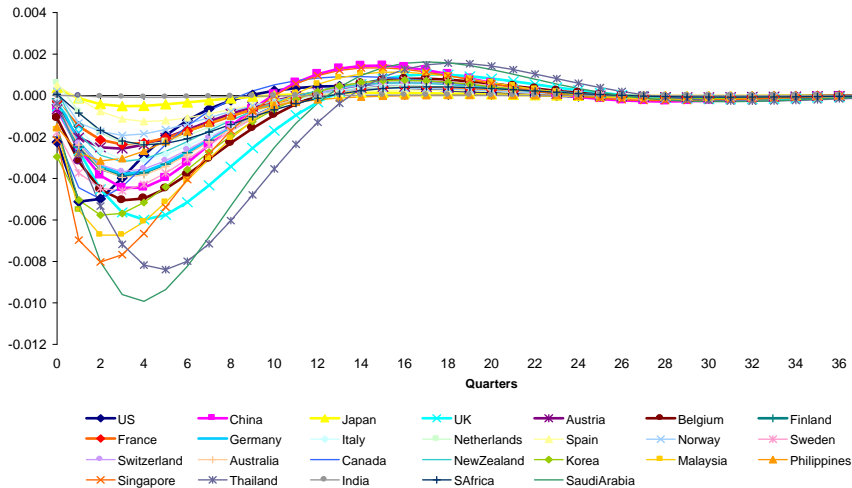
# IRFs & FEVDs

- Can calculate impulse response functions for composite shocks (e.g. global supply shock) on composite variables (e.g. output of the euro area)
- Can calculate Forecast Error Variance Decompositions
- IRFs seem sensible: positive global demand shocks increase output and inflation; negative global supply shocks increase inflation and reduce output
- Most of the lon-run variance comes from supply & demand shocks rather than monetary policy or exchange rate shocks
- Effects of US positive monetary policy shocks (increasing interest rate) on inflation and output shown below.

## Impulse response of a positive unit (+1%) monetary policy shock on inflation across Countries



Impulse Response of a Positive Unit (+1%) US Monetary Policy Shock on Output Across Countries



# Conclusion

- Global correlations/common factors are important
- may have a substantial behavioural/psychological component
- Difficult to measure
- May be able to establish common components in shocks to standard model
- Need to add financial variables to NK model