Exiting from QE
by
Fumio Hayshi and Junko Koeda

Federal Reserve Bank of San Francisco

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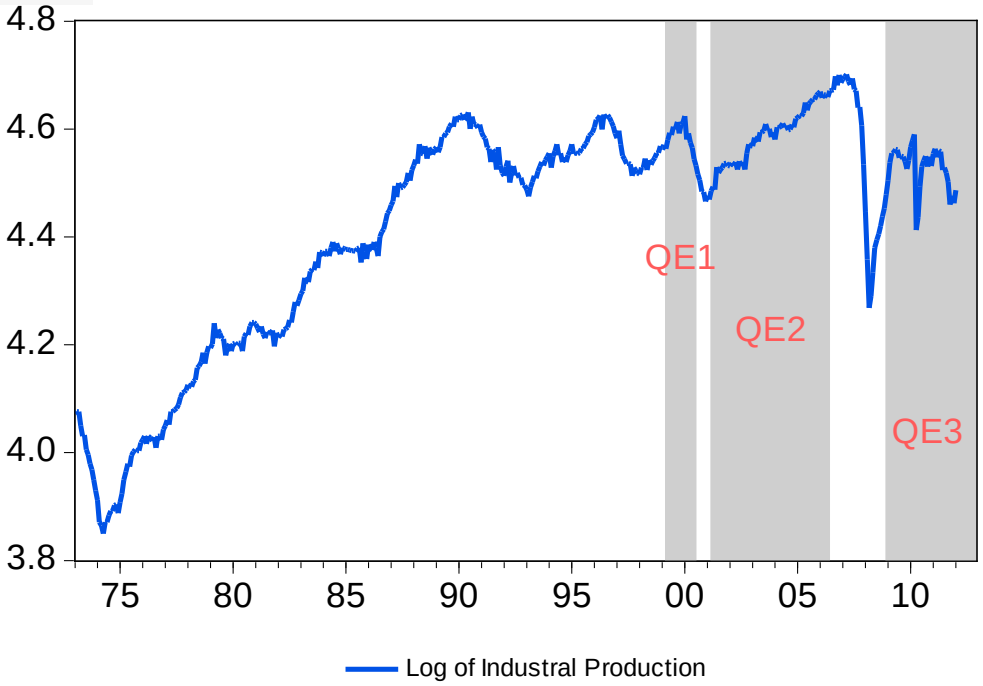
Roger E. A. Farmer, Distinguished Professor, UCLA

What this Paper Does

- Uses a structural VAR with endogenous regime switching to study QE in Japan.
- I will focus on three questions
  - Did the economy behave differently during periods of QE?
  - How did policy behave during QE and non QE periods?
  - Was QE effective?

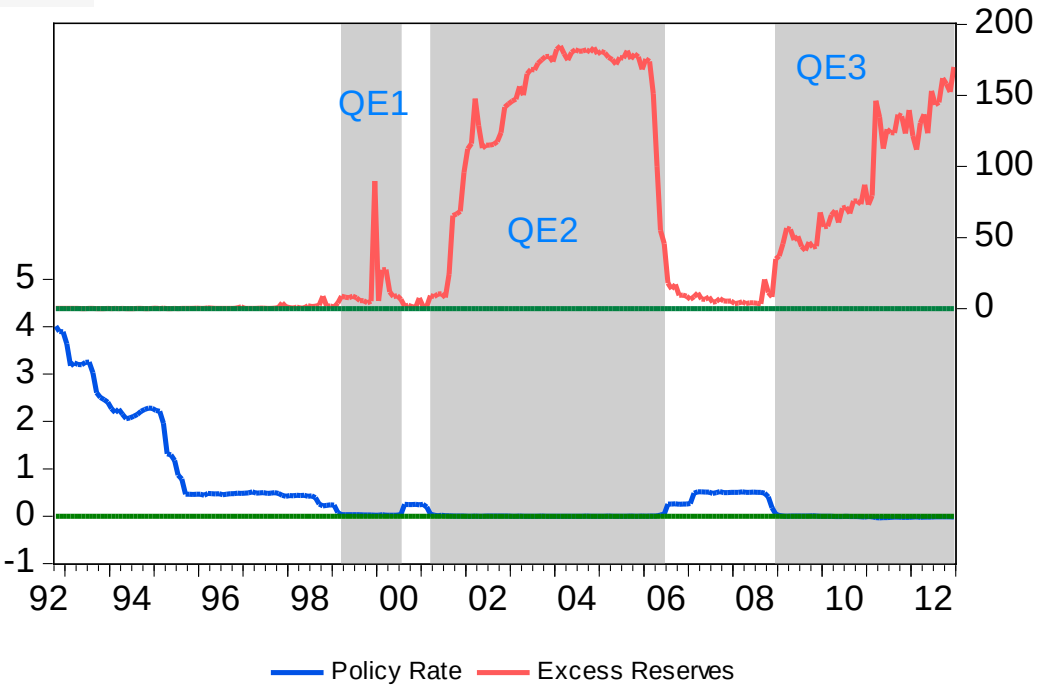
Japan is Scary



No growth in Industrial Production since 1990

Is this the future of the US?

Japan and QE



Policy rate reached zero in March 1999

Three periods of QE since then

QE1 1999m03-2000m07
QE2 2001m03-2006m06
QE3 2008m12-present

Vars, Svars and Models

$$E\left[F\left(X,Y,X',Y',U'\right)\right]=0$$

Theorists build models.

X is a vector of endogenous variables

Y is a vector of policy variables

Primes denote the future

U' is a vector of shocks

Linearized Models Lead to Vars

$$X' = AX + BY + V_1'$$ Private sector reduced form

$$Y' = CX + DY + V_2'$$ Policy sector reduced form

- Identification question
  - How is *U'* related to *V'?*
- Hayashi-Koeda answer
  - Reduced form private sector
  - Model Policy sector: Two Taylor Rules

Regime Switching Models

$$E\left[F_S\left(X, Y, X', Y', U', S\right)\right] = 0$$

Model depends on regime S

Regime Switching Models Lead to Markov Switching Vars

$$X'_{S1} = A_{S1}X + B_{S1}Y + V'_1$$
$$Y'_{S1} = C_{S1}X + D_{S1}Y + V'_2$$

$$E\left[VV^T\right] = \Omega_{S1}$$

$$X'_{S2} = A_{S2}X + B_{S2}Y + V'_1$$
$$Y'_{S2} = C_{S2}X + D_{S2}Y + V'_2$$

$$E\left[VV^T\right] = \Omega_{S2}$$

$$\Pr\left(S' = Si\right) = G\left(X, Y\right)$$

Estimation

- Estimate private sector by least squares separately in each regime
- Estimate policy rules and switching with maximum likelihood

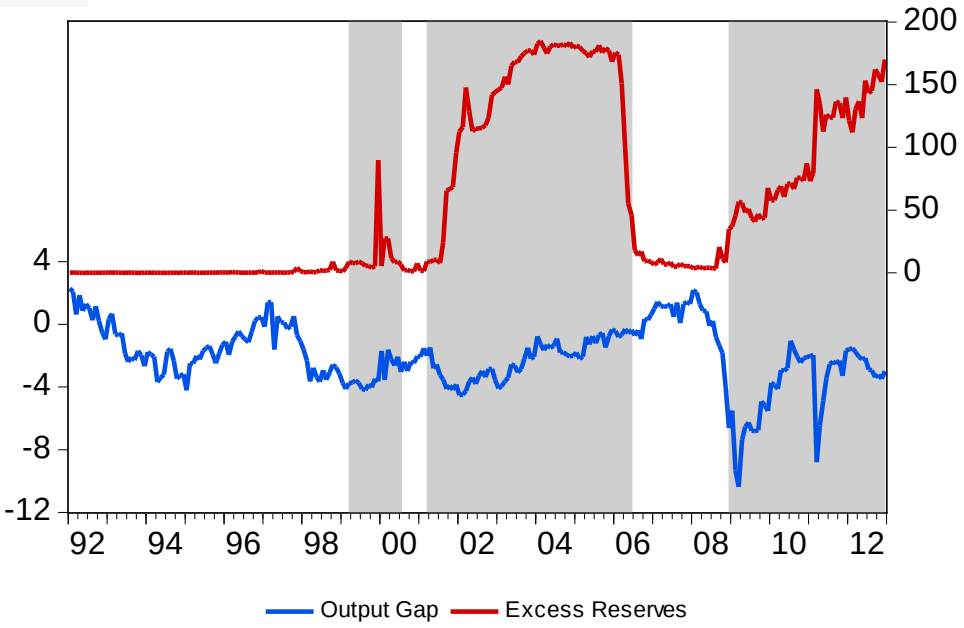
$$X_{S1}^{'} = A_{S1}X + B_{S1}Y + V_1^{'}$$

Estimated by Least squares

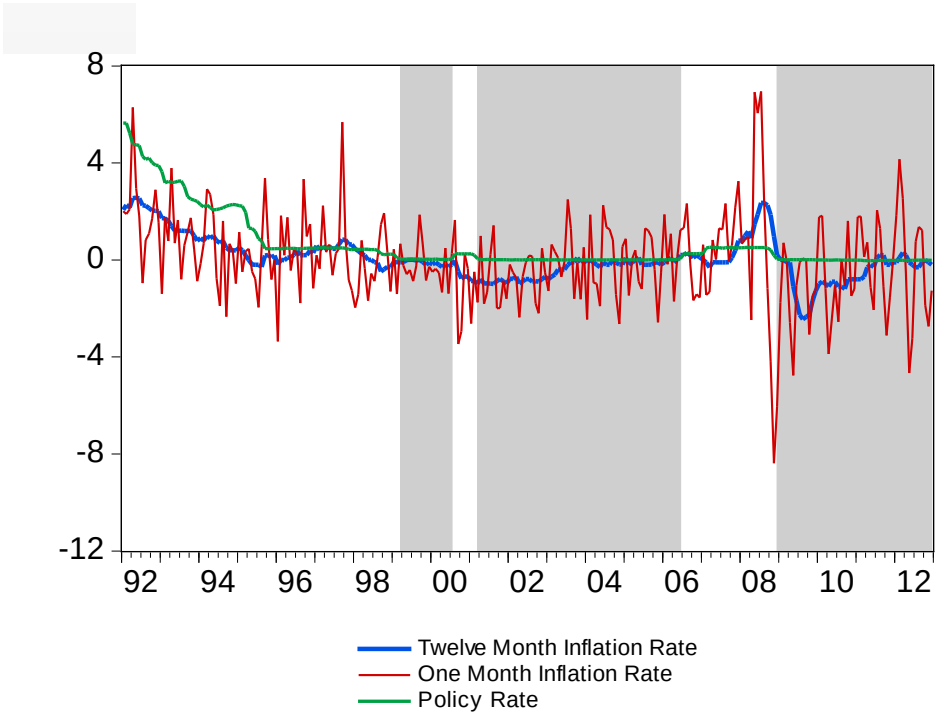
$$Y_{S1}^{'} = C_{S1}X + D_{S1}Y + V_2^{'}$$

Estimated by Maximum likelihood

Data: The output gap and excess reserves



Data: Inflation and the Policy Rate



Points I will Make

- There is a not a lot of evidence that the inflation process changes much across regimes
- There is strong evidence of a change in the persistence of the output process
- There is some evidence that QE affects output

The inflation process

Private Sector Equations

Table 6: Inflation and Output Reduced Form, January 1992 - December 2012

lagged subsample P (set of t's such that s_{t-1} = P)								
$t-1$ is in	dependent variable	coefficient of const.	p_{t-1}	x_{t-1}	r_{t-1}	m_{t-1}	bank crisis dummy	R^2
P (123 obs.)	inflation (p_t)	−0.23 [−0.9]	0.10 [1.1]	0.14 [1.7]	0.39 [3.6]		0.39 [1.2]	0.19
	output (x_t)	−0.20 [−1.4]	−0.00 [−0.1]	0.93 [21]	0.02 [0.3]		0.08 [0.5]	0.80

lagged subsample Z (set of t's such that s_{t-1} = QE1, QE2 or QE3)							
$t-1$ is in	dependent variable	coefficient of const.	p_{t-1}	x_{t-1}	r_{t-1}	m_{t-1}	R^2
QE2 & QE3 (112 obs.)	inflation (p_t)	0.15 [0.3]	0.22 [2.4]	0.16 [1.8]	0.05 [0.0]	0.0002 [0.1]	0.11
	output (x_t)	−1.21 [−3.3]	−0.02 [−0.3]	0.77 [14]	−0.98 [−0.5]	0.0052 [2.6]	0.75

Note: Estimation by OLS, t-values in brackets, p is the monthly inflation rate stated at annual rates, x is the

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Twelve month or one month inflation?

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QE Period

	INFL	GAP
INFL(-1)	0.860569	-0.029928
	(0.04334)	(0.21983)
	[19.8550]	[-0.13614]
GAP(-1)	0.022055	0.792535
	(0.01155)	(0.05858)
	[1.90950]	[13.5287]
C	-0.077047	-1.230802
	(0.08348)	(0.42342)
	[-0.92291]	[-2.90683]
XRES(-1)	0.000654	0.005303
	(0.00047)	(0.00241)
	[1.37923]	[2.20349]
R_POL(-1)	-1.183732	-3.430306
	(1.60536)	(8.14227)
	[-0.73736]	[-0.42130]
R-squared	0.889077	0.751892

Normal Period

	INFL	GAP
INFL(-1)	0.909263	-0.327566
	(0.03163)	(0.14211)
	[28.7459]	[-2.30505]
GAP(-1)	0.041884	0.990800
	(0.01043)	(0.04688)
	[4.01385]	[21.1345]
C	0.024853	-0.194790
	(0.03297)	(0.14812)
	[0.75381]	[-1.31506]
R_POL(-1)	0.026649	0.165771
	(0.01824)	(0.08195)
	[1.46097]	[2.02288]
DUM	0.036263	0.162394
	(0.04117)	(0.18495)
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R-squared	0.950827	0.805507

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No price puzzle here

Some Comments on Counterfactuals

- The authors conduct counterfactuals
- This is a minefield for ordinary Svars
- It is a minefield with nuclear landmines for regime switching Svars

Some words of praise

- The method of regime dependent Vars is an interesting extension to the Svar literature
- The finding of expansionary QE under regime switching is important
- There is a job for theorists to understand the mapping from structural models to Svars