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Macro and oil price shocks on Chinese renewable energy transition

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ABSTRCT

Provided the key effects of oil price shocks on the business cycle, it raises great interests whether renewable energy promotion leads to a more sustainable economic growth for China, one of most important developing economies in the world. To answer this question, this paper examines key macroeconomic and oil indicators on the transition of renewable energy sector in China. We model these shocks as predetermined using a structural vector autoregressive model of Chinese economy and then examine the cumulative impacts on the transition process of renewable energy consumption and investment. Our results present significantly positive yet asymmetric impacts, with the effects cumulating to 2-5% in contraction and stable periods. It also presents first evidence of transition probability and duration for investment and consumption in renewable energy in China. All the evidence is important to the promotion of renewable energy sector in China.

Methodology

We employ a two-stage approach following the spirits of Kilian (2009). It models macro and oil shocks as predetermined variables from a structural vector autoregressive (SVAR) model of Chinese economy and then examine the cumulative impacts of shocks on the transition process of renewable energy consumption and investment. We start from estimating a SVAR (4) model as our data is at quarterly level:

$$Ay_t = A_1 y_{t-1} + A_2 y_{t-2} + A_3 y_{t-3} + A_4 y_{t-4} + DX_t + \epsilon_t$$

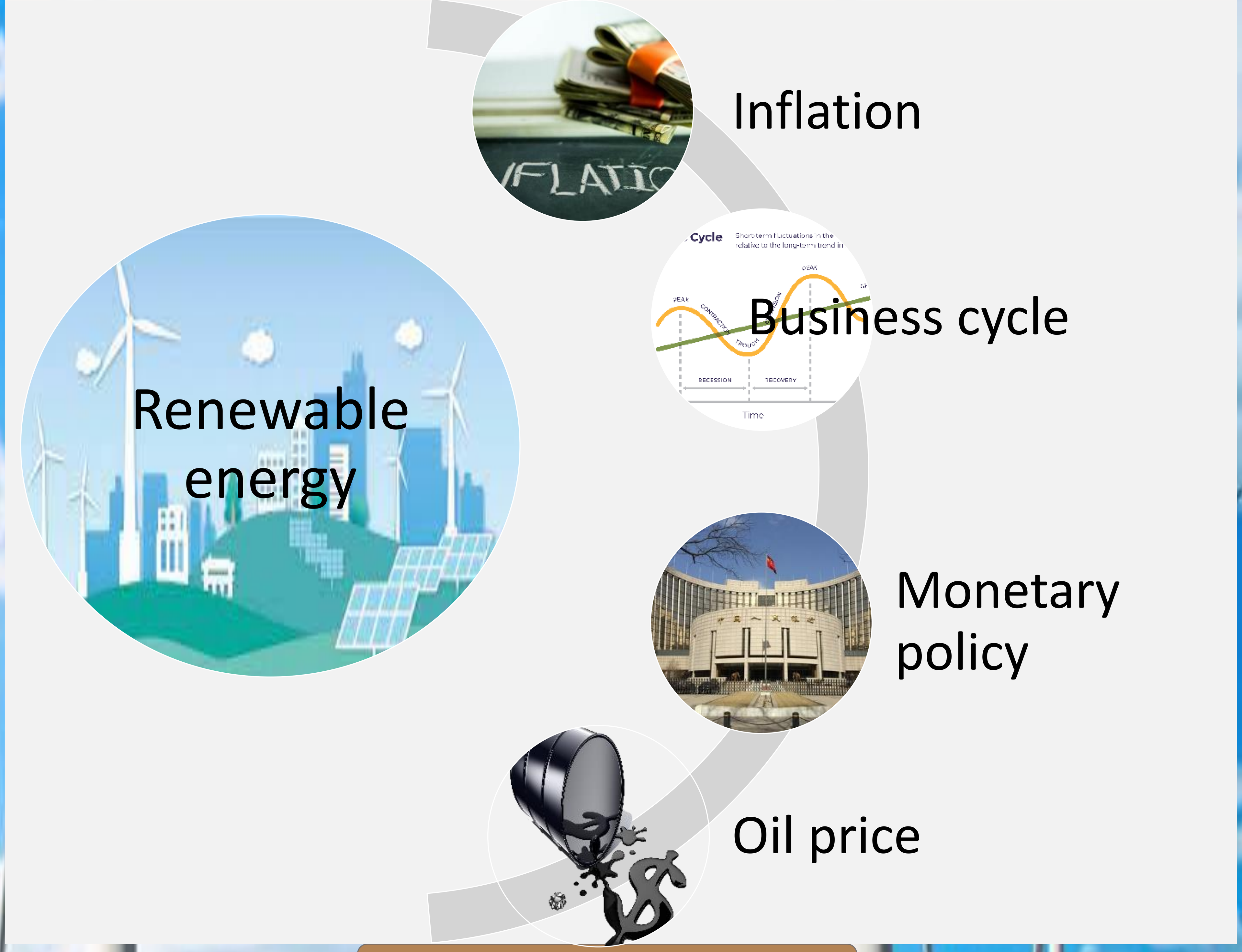
where $y_t = (\pi_t, y_t, i_t, o_t)'$ is a vector of inflation (π_t), output gap (y_t), monetary policy (i_t), and oil price (o_t). X_t is the vector of exogenous variables. Thus, the structural errors can be derived by imposing exclusion restrictions on A^{-1} in the reduced error from the reduced form VAR model. Here we identify $B = A^{-1}$ as:

$$\begin{pmatrix} u_{\pi,t} \\ u_{y,t} \\ u_{i,t} \\ u_{o,t} \end{pmatrix} = \begin{pmatrix} b_{11} & b_{12} & 0 & b_{14} \\ 0 & b_{22} & b_{23} & b_{24} \\ 0 & b_{32} & b_{33} & 0 \\ 0 & 0 & 0 & b_{44} \end{pmatrix} \begin{pmatrix} \epsilon_{\pi,t} \\ \epsilon_{y,t} \\ \epsilon_{i,t} \\ \epsilon_{o,t} \end{pmatrix}$$

In step 2, we estimate cumulative effects of predetermined shocks on the transition of renewable energy consumption and investment respectively. The transition process is modelled using a Markov-Switching model and contemporaneous and lags of structural shocks are included on the right-hand side:

$$r_t = \alpha_{s_t} + \sum_{j=0}^{q} \phi_{ijs_t} \epsilon_{k,t-j} + v_{s_t,k,t}, k = \pi_t, y_t, i_t, o_t$$

where r_t denotes either renewable energy consumption growth rate or the excess stock return of the renewable energy industry index. The model creates two different states based on the transition probability from period t to period t+1 of the consumption/return r_t. The specification allows shock effects to vary across different states, with associated error variance differently between two states such as $\sigma^2_{vs_1}$ and $\sigma^2_{vs_2}$.



RESULT

Table Markov-switching estimation results

	Inflation Shock		Business Cycle Shock		MP Shock		OP Shock	
	State1	State2	State1	State2	State1	State2	State1	State2
Panel A. Investment								
$\sum_0^q \phi_q$	5.50**	-3.03	1.53*	6.02	5.50**	-3.03	-8.33***	-10.18***
	(2.20)	(3.89)	(0.84)	(6.18)	(2.20)	(3.89)	(0.60)	(5.40)
Mean growth rate	-4.07**	4.92*	-4.48***	3.22*	-4.07**	4.92*	-5.48***	2.36
	(1.61)	(2.79)	(0.46)	(1.94)	(0.01)	(1.57)	(0.24)	(1.76)
σ^2	7.06	15.38	1.44	13.45	7.06	15.38	0.66	13.14
w_i	0.12	0.09	0.60	0.26	0.12	0.09	0.39	0.10
Duration	8.42	11.03	1.66	3.85	8.42	11.03	2.57	9.95
$\phi_{s_1} = \phi_{s_2}$	0.04		0.09		0.04		0.00	
Autocorrelation	0.32		0.48		0.32		0.65	
ARCH	0.51		0.80		0.51		0.68	
Panel B. Consumption								
$\sum_0^q \phi_q$	3.44***	2.20**	2.16***	0.39	3.14***	0.004	4.32***	0.44
	(0.49)	(0.92)	(0.87)	(1.99)	(0.57)	(1.15)	(0.54)	(3.82)
Mean growth rate	0.38**	4.78***	1.85***	6.21***	1.90***	5.22***	1.46***	5.96
	(0.29)	(0.94)	(0.79)	(1.02)	(0.30)	(1.13)	(0.11)	(2.79)
σ^2	1.16	7.37	1.84	9.32	2.18	8.52	0.57	8.45
w_i	0.35	0.08	0.80	0.43	0.68	0.28	0.70	0.31
Duration	2.82	13.09	1.25	2.30	1.48	3.63	1.44	3.21
$\phi_{s_1} = \phi_{s_2}$	0.00		0.04		0.00		0.00	
Autocorrelation	0.37		0.49		0.36		0.43	
ARCH	0.62		0.32		0.55		0.99	

Note: P-values are reported for joint significance test, autocorrelation and ARCH LM tests. Autocorrelation test is based on BG test. σ^2 refers to error variance estimated. Transition probability w_i refers to probability of staying one state and transition from another state, $P(s_t = 2|s_{t-1} = 1) = w_1$ and $P(s_t = 1|s_{t-1} = 2) = w_2$. Duration refers to expected duration (in quarters) in a state, and are computed as Duration $= 1/w_i$. P value is reported for asymmetry, autocorrelation and ARCH tests.

REFERENCES

Kilian, L. (2009), "Not All Oil Price Shocks Are Alike: Disentangling Demand and Supply Shocks in the Crude Oil Market", *The American Economic Review*, American Economic Association, Vol. 99 No. 3, pp. 1053–1069.