Online Appendix

to accompany

"Asymmetric Responses of Consumer Spending to Energy Prices: A Threshold VAR Approach"*

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^{*} The views expressed herein are those of the authors and do not necessarily represent the views of the Federal Reserve Bank of Cleveland or the Federal Reserve System. Contact information: <u>edward.knotek@clev.frb.org</u> and <u>saeed.zaman@clev.frb.org</u>.

A.1 Results for Durable Consumption, Using Full Sample

	Linear VAR	TVAR
Marginal likelihood	-513.2	-471.0
Estimated threshold		0.37% [0.34, 0.39]

Table A1.1: Marginal Likelihood Values and Estimated Threshold

Notes: The estimated threshold is the posterior mean of the retained draws; the numbers in the brackets correspond to the 70% interval. The reported marginal likelihood values correspond to the log of the expected posterior likelihood. The estimation sample is February 1959 to June 2014.





Notes: The figure shows the impulse response functions from the linear VAR and threshold VAR starting in either regime 1 or regime 2 estimated with monthly data over February 1959 to June 2014. The responses represent the cumulative posterior median responses of durable consumption to a one-time estimated +1% and -1% shock to energy price inflation. The grey shaded areas are 70% probability bands. Regime 1 corresponds to the low energy inflation regime and regime 2 corresponds to the high energy inflation regime.

Figure A1.2: Cumulative Response of Durable Consumption to +5% Energy Shock (upper panel) and -5% Energy Shock (lower panel)



Notes: The figure shows the impulse response functions from the linear VAR and threshold VAR starting in either regime 1 or regime 2 estimated with monthly data over February 1959 to June 2014. The responses represent the cumulative posterior median responses of durable consumption to a one-time estimated +5% and -5% shock to energy price inflation. The grey shaded areas are 70% probability bands. Regime 1 corresponds to the low energy inflation regime and regime 2 corresponds to the high energy inflation regime.

Figure A1.3: Cumulative Response of Durable Consumption to +10% Energy Shock (upper panel) and -10% Energy Shock (lower panel)



Notes: The figure shows the impulse response functions from the linear VAR and threshold VAR starting in either regime 1 or regime 2 estimated with monthly data over February 1959 to June 2014. The responses represent the cumulative posterior median responses of durable consumption to a one-time estimated +10% and -10% shock to energy price inflation. The grey shaded areas are 70% probability bands. Regime 1 corresponds to the low energy inflation regime and regime 2 corresponds to the high energy inflation regime.

A.2 Results for Nondurable Consumption, Using Full Sample

	Linear VAR	TVAR
Marginal likelihood	346.4	394.4
Estimated threshold		0.37% [0.36, 0.38]

Table A2.1: Marginal Likelihood Values and Estimated Threshold

Notes: The estimated threshold is the posterior mean of the retained draws; the numbers in the brackets correspond to the 70% interval. The reported marginal likelihood values correspond to the log of the expected posterior likelihood. The estimation sample is February 1959 to June 2014.

Figure A2.1: Cumulative Response of Nondurable Consumption to +1% Energy Shock (upper panel) and -1% Energy Shock (lower panel)



Notes: The figure shows the impulse response functions from the linear VAR and threshold VAR starting in either regime 1 or regime 2 estimated with monthly data over February 1959 to June 2014. The responses represent the cumulative posterior median responses of nondurable consumption to a one-time estimated +1% and -1% shock to energy price inflation. The grey shaded areas are 70% probability bands. Regime 1 corresponds to the low energy inflation regime and regime 2 corresponds to the high energy inflation regime.

Figure A2.2: Cumulative Response of Nondurable Consumption to +5% Energy Shock (upper panel) and -5% Energy Shock (lower panel)



Notes: The figure shows the impulse response functions from the linear VAR and threshold VAR starting in either regime 1 or regime 2 estimated with monthly data over February 1959 to June 2014. The responses represent the cumulative posterior median responses of nondurable consumption to a one-time estimated +5% and -5% shock to energy price inflation. The grey shaded areas are 70% probability bands. Regime 1 corresponds to the low energy inflation regime and regime 2 corresponds to the high energy inflation regime.

Figure A2.3: Cumulative Response of Nondurable Consumption to +10% Energy Shock (upper panel) and -10% Energy Shock (lower panel)



Notes: The figure shows the impulse response functions from the linear VAR and threshold VAR starting in either Regime 1 or Regime 2 estimated with monthly data over February 1959 to June 2014. The responses represent the cumulative posterior median responses of nondurable consumption to a one-time estimated +10% and -10% shock to energy price inflation. The grey shaded areas are 70% probability bands. Regime 1 corresponds to the low energy inflation regime and Regime 2 corresponds to the high energy inflation regime.

A.3 Results for Services Consumption, Using Full Sample

	Linear VAR	TVAR
Marginal likelihood	915.6	960.4
Estimated threshold		0.36% [0.34, 0.38]

Table A3.1: Marginal Likelihood Values and Estimated Threshold

Notes: The estimated threshold is the posterior mean of the retained draws; the numbers in the brackets correspond to the 70% interval. The reported marginal likelihood values correspond to the log of the expected posterior likelihood. The estimation sample is February 1959 to June 2014.

Figure A3.1: Cumulative Response of Services Consumption to +1% Energy Shock (upper panel) and -1% Energy Shock (lower panel)



Notes: The figure shows the impulse response functions from the linear VAR and threshold VAR starting in either regime 1 or regime 2 estimated with monthly data over February 1959 to June 2014. The responses represent the cumulative posterior median responses of services consumption to a one-time estimated +1% and -1% shock to energy price inflation. The grey shaded areas are 70% probability bands. Regime 1 corresponds to the low energy inflation regime and regime 2 corresponds to the high energy inflation regime.

Figure A3.2: Cumulative Response of Services Consumption to +5% Energy Shock (upper panel) and -5% Energy Shock (lower panel)



Notes: The figure shows the impulse response functions from the linear VAR and threshold VAR starting in either regime 1 or regime 2 estimated with monthly data over February 1959 to June 2014. The responses represent the cumulative posterior median responses of services consumption to a one-time estimated +5% and -5% shock to energy price inflation. The grey shaded areas are 70% probability bands. Regime 1 corresponds to the low energy inflation regime and regime 2 corresponds to the high energy inflation regime.

Figure A3.3: Cumulative Response of Services Consumption to +10% Energy Shock (upper panel) and -10% Energy Shock (lower panel)



Notes: The figure shows the impulse response functions from the linear VAR and threshold VAR starting in either regime 1 or regime 2 estimated with monthly data over February 1959 to June 2014. The responses represent the cumulative posterior median responses of services consumption to a one-time estimated +10% and -10% shock to energy price inflation. The grey shaded areas are 70% probability bands. Regime 1 corresponds to the low energy inflation regime and regime 2 corresponds to the high energy inflation regime.

A.4 Results Using Post-1985 Sample

	Linear VAR	TVAR
Marginal likelihood	290.9	305.1
Estimated threshold		0.07%
		[-0.03, 0.30]

Notes: The estimated threshold is the posterior mean of the retained draws; the numbers in the brackets correspond to the 70% interval. The reported marginal likelihood values correspond to the log of the expected posterior likelihood. The estimation sample is January 1985 to June 2014.

Cumulative Consumption Responses after 6 Months							
	Size of Energy Price Shock						
	+1% -1% +5% -5% +10% -10%						
Linear VAR	-0.01	+0.01	-0.07	+0.07	-0.14	+0.14	
TVAR, Regime 1	-0.04	+0.04	-0.24	+0.13	-0.46	+0.15	
TVAR, Regime 2	-0.03	+0.03	-0.18	+0.12	-0.35	+0.13	

Table A4.2: Cumulative Response of Consumption to Energy Price Shocks, Post-1985 Sample

Cumulative Consumption Responses after 12 Months							
+1% -1% +5% -5% +10% -10%							
Linear VAR	-0.02	+0.02	-0.09	+0.09	-0.18	+0.18	
TVAR, Regime 1	-0.05	+0.05	-0.27	+0.19	-0.51	+0.25	
TVAR, Regime 2	-0.04	+0.04	-0.21	+0.17	-0.41	+0.23	

Cumulative Consumption Responses after 18 Months							
+1% -1% +5% -5% +10% -10%							
Linear VAR	-0.02	+0.02	-0.09	+0.09	-0.19	+0.19	
TVAR, Regime 1	-0.05	+0.05	-0.27	+0.18	-0.50	+0.24	
TVAR, Regime 2 -0.04 +0.04 -0.21 +0.16 -0.40 +0.22							



Figure A4.1: Estimated Thresholds under Two Regimes, Post-1985 Sample

Notes: The figure plots the threshold variable (one period lagged 9-month moving average of real energy price inflation), estimated threshold (posterior mean), and identified regimes based on the posterior mean. The system is in regime 1 (declining real energy price inflation) when the threshold variable is less than or equal to 0.07% (indicated by pink shaded area). The system is in regime 2 (increasing real energy price inflation) when the threshold variable exceeds 0.07% (indicated by yellow shaded area). The estimation sample is January 1985 to June 2014.

Figure A4.2: Cumulative Response of Aggregate Consumption to +1% Energy Shock (upper panel) and -1% Energy Shock (lower panel), Post-1985 Sample



Notes: The figure shows the impulse response functions from the linear VAR and threshold VAR starting in either regime 1 or regime 2 estimated with monthly data over January 1985 to June 2014. The responses represent the cumulative posterior median responses of consumption to a one-time estimated +1% and -1% shock to energy price inflation. The grey shaded areas are 70% probability bands. Regime 1 corresponds to the low energy inflation regime and regime 2 corresponds to the high energy inflation regime.

Figure A4.3: Cumulative Response of Aggregate Consumption to +5% Energy Shock (upper panel) and -5% Energy Shock (lower panel), Post-1985 Sample



Notes: The figure shows the impulse response functions from the linear VAR and threshold VAR starting in either regime 1 or regime 2 estimated with monthly data over January 1985 to June 2014. The responses represent the cumulative posterior median responses of consumption to a one-time estimated +5% and -5% shock to energy price inflation. The grey shaded areas are 70% probability bands. Regime 1 corresponds to the low energy inflation regime and regime 2 corresponds to the high energy inflation regime.

Figure A4.4: Cumulative Response of Aggregate Consumption to +10% Energy Shock (upper panel) and -10% Energy Shock (lower panel), Post-1985 Sample



Notes: The figure shows the impulse response functions from the linear VAR and threshold VAR starting in either regime 1 or regime 2 estimated with monthly data over January 1985 to June 2014. The responses represent the cumulative posterior median responses of consumption to a one-time estimated +10% and -10% shock to energy price inflation. The grey shaded areas are 70% probability bands. Regime 1 corresponds to the low energy inflation regime and regime 2 corresponds to the high energy inflation regime.