Price transmission and asymmetric adjustment: the case of three West African rice markets

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Motivation

- January 2007 - April 2008: 37 countries across the globe experienced food riots caused by the rapid rise in food prices revealing the high degree of dependency of many poor countries on global food markets.
- The large majority of West African countries are net food importers, of especially rice and wheat
- The impact of increasing world food prices depends on the world price increases pass trough to domestic prices

=> Objective: assessment of magnitude, speed and asymmetry of price transmission to assess efficiency of the chain

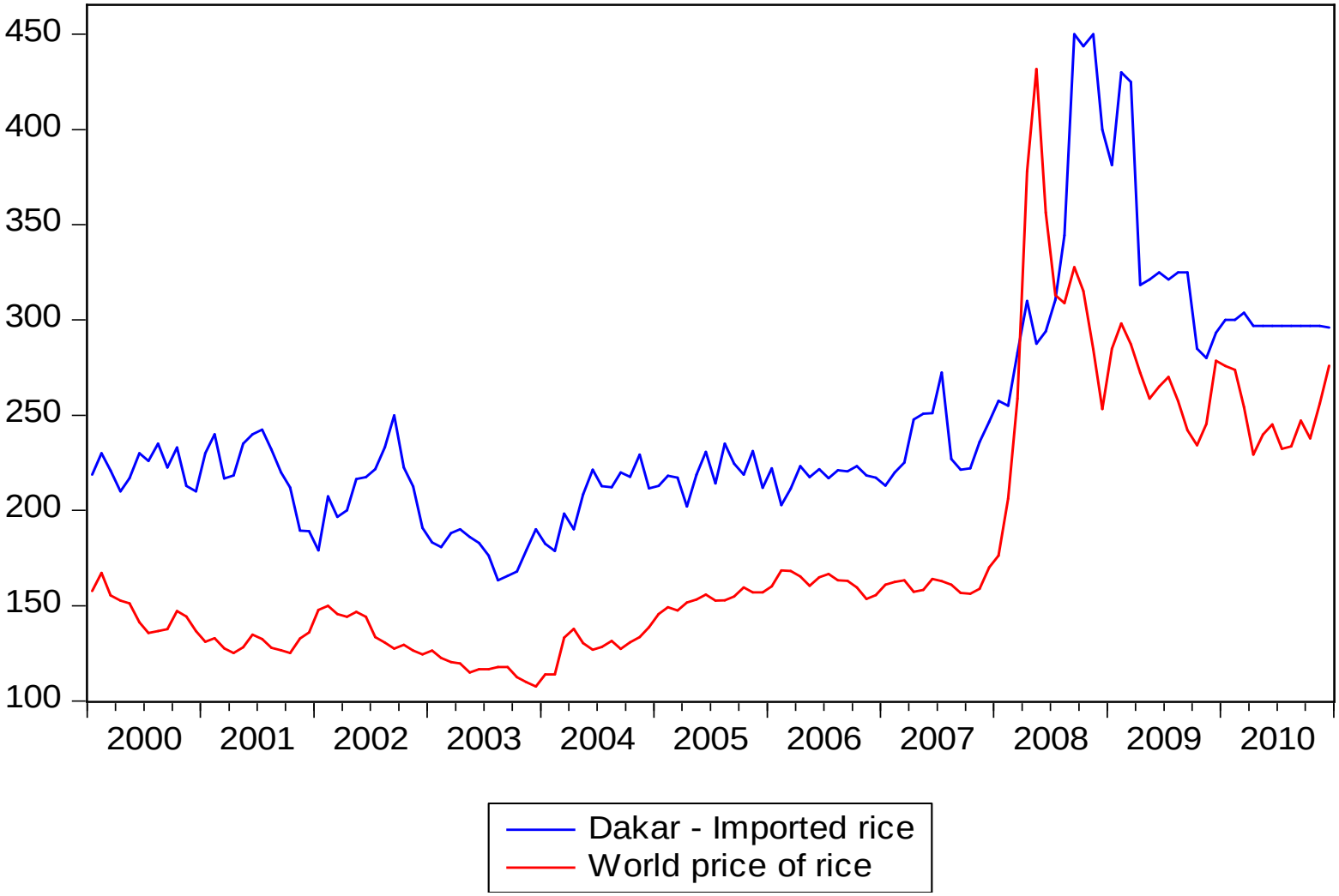
Sample

Senegal: - rice accounts for 31% of caloric intake
- 12% of regional rice imports
- only 30 percent of domestic rice is sold in urban centers
- rice imports make up 80% of domestic rice consumption

Mali: - rice accounts for 22% of caloric intake
- 90% of rice consumption is covered by domestic production

Chad: - rice accounts for 5% of caloric intake
- 90% of rice consumption is covered by domestic production and 88% of the domestic supply of rice is consumed in urban centers

World price of rice and domestic price of imported rice in Dakar 2000 – 2010
CFA Francs / kg (monthly prices)



Two types of asymmetry

1) Asymmetry in the transmission of positive and negative shocks may be due to imperfect competition in the import chain.

- Importers/wholesalers may enjoy local market power (Meyer and von Cramon-Taubadel, 2004)
- Market power may lead to positive or negative asymmetry (Bailey and Brorsen, 1989)
- The 3 main importers make up two-third of all imports in Mali while 70 percent of all rice imports flow through only 4 importers in Senegal
- Political interventions such as VAT exoneration in periods of high world price of rice

2) Asymmetry in transmission of large and small shocks

- Wholesalers/retailers respond to “small” input price fluctuations by increasing or reducing their margins
- Cost of informing market partners
- Risk to the retailer’s reputation if its price changes are too frequent
- No adjustment when price changes are perceived as temporary

Non-competitive market structure, adjustment costs and political interventions may result in nonlinear price dynamic. Two hypotheses are tested:

- The domestic prices of rice only adjust to large shocks in the international price of rice
- World price of rice increases are more fully transmitted to domestic prices than decreases.

Model of price transmission

In the standard cointegration framework:

- The long run relationship between the two prices is given by:

$$P^D{}_t = \alpha_0 + \alpha_1 P^W{}_t + \mu_t \qquad (1)$$

- The short run dynamic is given by the error-correction model (ECM):

$$\Delta P^D{}_t = \beta_0 + \beta_1 \mu_{t-1} + \sum_{i=1}^{p} \lambda_i \Delta PW\,t\_i + \sum_{i=1}^{p} \delta_i \Delta PDt\_i + \varepsilon_t \qquad (2)$$

- β_1 reflects the speed of adjustement. β_1 is constant

Non linear cointegration model

Error correction model with 3 regimes:

$$\Delta P^{D}_{t} \begin{cases} \nu_3 + \beta_3 \mu_{t-1} + \sum_{i=1}^{p} \lambda_{3,i} \Delta P^{W}_{t-i} + \sum_{i=1}^{p} \delta_{3,i} \Delta P^{D}_{t-i} + \varepsilon_{3,t} & \text{if } \mu_{t-d} > \theta_2 \\ \nu_2 + \beta_2 \mu_{t-1} + \sum_{i=1}^{p} \lambda_{2,i} \Delta P^{W}_{t-i} + \sum_{i=1}^{p} \delta_{2,i} \Delta P^{D}_{t-i} + \varepsilon_{2,t} & \text{if } \theta_1 < \mu_{t-d} \leq \theta_2 \\ \nu_1 + \beta_1 \mu_{t-1} + \sum_{i=1}^{p} \lambda_{1,i} \Delta P^{W}_{t-i} + \sum_{i=1}^{p} \delta_{1,i} \Delta P^{D}_{t-i} + \varepsilon_{1,t} & \text{if } \mu_{t-d} \leq \theta_1 \end{cases}$$

θ_1 and θ_2 are the thresholds

The speed of adjustment differs according to the size of the past disequilibrium (μ_{t-d}).

Regime switching occurs, with a delay d, when the error term goes above or below the threshold

Hypotheses: $\beta_2 = 0$ and $\beta_3 < \beta_1 < 0$

Testing strategy

A two-step approach based on Engle and Granger methodology

1. Estimate the long run equilibrium relationship between the world price of rice and the domestic prices of rice and apply cointegration tests to the equilibrium error.

2. Test for nonlinear threshold behaviour and identify the best fit model, then estimate the asymmetric error correction models.

Results

Johansen cointegration tests:

		Hyp	Trace statistic	Critical value 5%	Maximum Eigen Value	Critical value 5%
Dakar	Imported rice	None	68,18***	15,49	67,26***	14,26
		At most 1	0,92	3,84	0,92	3,84
	Local rice	None	24,03*	25,87	17,72*	19,39
		At most 1	6,31	12,52	6,31	12,52
Bamako	Imported rice	None	25,49*	25,87	18,99*	19,39
		At most 1	6,49	12,52	6,49	12,52
	Local rice	None	50,64***	25,87	45,68***	19,39
		At most 1	4,97	12,52	4,96	12,52
N'Djamena	Imported rice	None	19,93**	15,49	16,94**	14,26
		At most 1	2,99	3,84	2,99	3,84
	Local rice	None *	31,22***	25,87	25,96***	19,39
		At most 1	5,26	12,52	5,26	12,52

Hansen's tests of linearity

		Testing SETAR(1) against SETAR(2)					Testing SETAR(1) against SETAR(3)				Testing SETAR(2) against SETAR(3)			
		p	d	F12	P.Value	θ	F13	P.Value	θ_1	θ_2	F23	P.Value	θ_1	θ_2
Dakar	Imp.	4	3	30,92	0,01	18,68	73,70	0,00	-15,98	18,68	34,46	0,00	-15,98	18,68
	Loc.	6	4	36,81	0,01	5,39	67,85	0,00	-7,93	5,39	23,66	0,13		
Bamako	Imp.	3	1	22,19	0,00	9,80	26,38	0,13	-18,11	9,80	3,79	0,96		
	Loc.	3	3	34,05	0,00	10,55	76,75	0,00	-14,53	10,55	36,18	0,00	-14,53	10,55
N'Djamena	Imp.	3	2	22,14	0,02	-10,66	37,60	0,10	-23,03	-0,82	12,53	0,35		
	Loc.	3	3	29,34	0,02	12,24	52,45	0,02	12,24	33,74	17,66	0,12		

Asymmetric error correction model

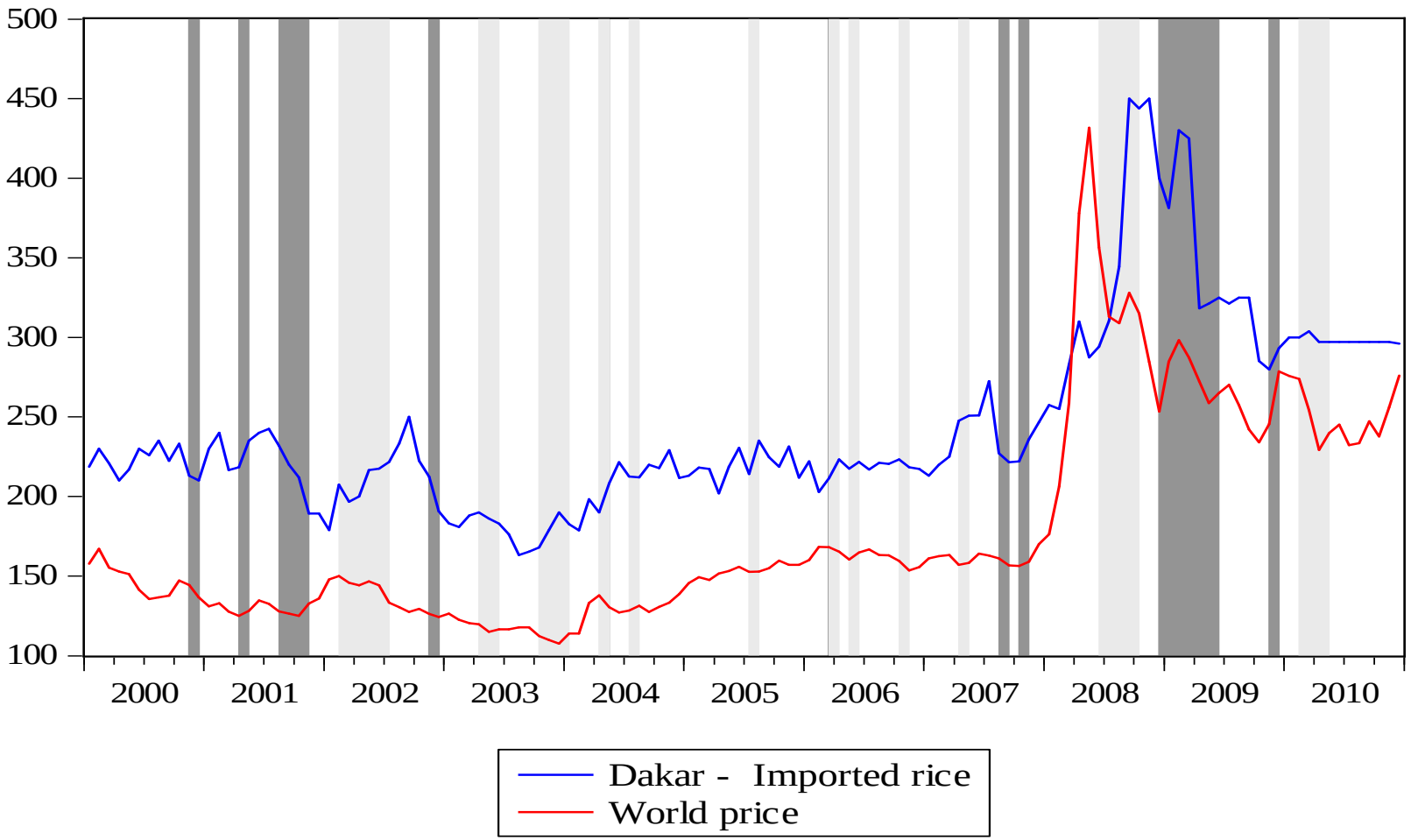
		Error correction terms			Wald tests of equality of the coefficients		
		β_1	β_2	β_3	$\beta1 = \beta2 (=\beta3) = 0$	$\beta1 = \beta2 (= \beta3)$	$\beta1 = \beta3$
Dakar	Imported rice	-0.90***	-0.05	-0.16**	16.94	13.26	23.71
		(0.13)	(0.16)	(0.07)	[0.00]	[0.00]	[0.00]
	Local rice	-0.18	-0.36*		1.70	1.71	
		(0.13)	(0.20)		[0.18]	[0.19]	
Bamako	Imported rice	-0.11**	-0.14		6.40	0.07	
		(0.05)	(0.1)		[0.00]	[0.79]	
	Local rice	-0.19***	0.07	-0.54***	13.95	11.91	8.76
		(0.07)	(0.08)	(0.10)	[0.00]	[0.00]	[0.00]
N'Djamena	Imported rice	-0.39***	-0.29		4.28	0.49	
		(0.13)	(0.18)		[0.02]	[0.49]	
	Local rice	-0.21	-0.56***		8.08	1.82	
		(0.13)	(0.19)		[0.00]	[0.18]	

White Heteroscedasticity-consistent Standard errors between round brackets and p.values between square brackets.

Transmission of world price of rice to domestic markets

				Speed of adjustment			
				Linear adjustment	Non-linear adjustment		
Location	Commodity	Long term relationship?	Asymmetric transmission?		Down	Middle	Up
Senegal - Dakar	Imported rice	Yes	Yes		-0.90***	-0.05	-0.16***
Senegal - Dakar	Local rice	No	No				
Mali - Bamako	Imported rice	Yes	Yes	-0.13***			
Mali - Bamako	Local rice	Yes	No		-0.19***	0.07	-0.54***
Chad - N'Djamena	Imported rice	Yes	No	-0.33***			
Chad - N'Djamena	Local rice	Yes	No	-0.42***			

Timing of regime switching : Dakar Imported rice

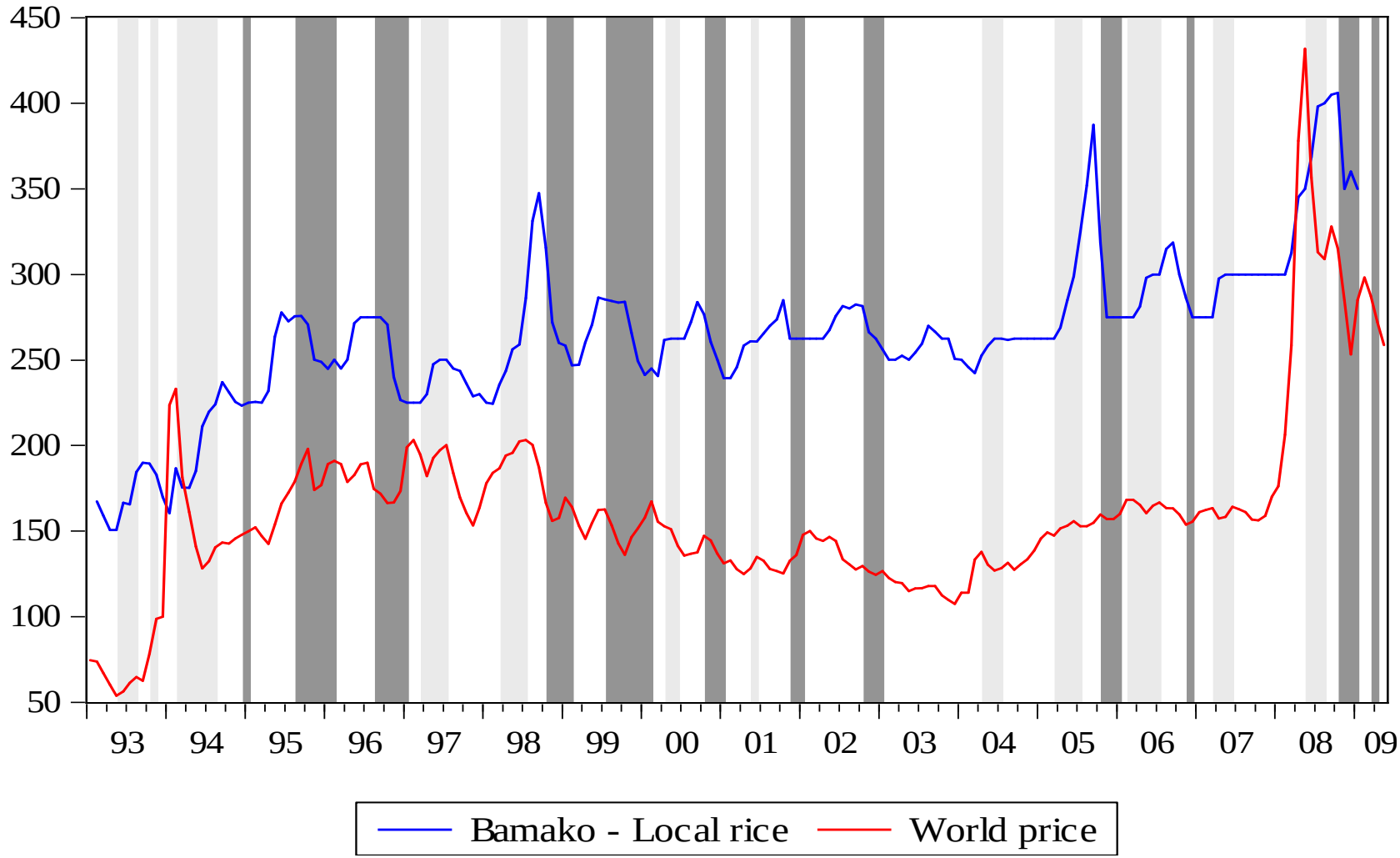


Conclusion

- The international price of rice and the domestic prices of imported and local rice in Mali, Senegal and Chad are integrated in the long-run, with the exception of the local rice in Dakar.
- The domestic price of imported rice in Dakar and the price of local rice in Bamako adjusts only to large disequilibrium.
- The price of local rice in Bamako and the price of imported rice in Dakar respond asymmetrically to large changes from the long term equilibrium.
- The price of imported rice in Dakar corrects quickly disequilibrium following large price increase in the rice market but reverts back more slowly when the world price of rice decline.
- On the opposite the price of local rice in Bamako adjusts more rapidly to the world price decline than to the world price rise.

Thank you for your attention

Timing of regime switching : Bamako Local rice



Testing for linearity

Hansen sup-F test based on nested hypothesis tests. Test the null of a TAR(*i*) model, against the alternative of TAR(*j*) model:

$$F(ij) = n\left(\frac{S_i - S_j}{S_j}\right)$$

S_i is the sum of squared residuals under the null of *i* regimes.

S_j is the sum of squared residuals under the alternative hypothesis of a *j*-regime TAR(*j*)

We use Hansen (1996) bootstrap procedure to approximate the asymptotic distribution of *F* correcting *for* heteroskedascity