

## SUPPLEMENT

(Intended for Referees Information and not for Publication)

for

# Country Heterogeneity and Long-Run Determinants of Inflation in the Gulf Arab States

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Table 1: Collinearity diagnostics

Series	VIF	SQRT VIF	Tolerance	R-squared
$m_{it}$	14.29	3.78	0.0700	0.9300
$y_{it}$	14.36	3.79	0.0696	0.9304
$p_t^*$	1.31	1.14	0.7645	0.2355
$e_{it}$	1.26	1.12	0.7924	0.2076
$m_{it}$	6.82	2.61	0.1467	0.8533
$g_{it}$	6.74	2.60	0.1483	0.8517
$p_t^*$	1.30	1.14	0.7701	0.2299
$e_{it}$	1.26	1.12	0.7915	0.2085
$m_{it}$	9.96	3.16	0.1004	0.8996
$pc_{it}$	10.33	3.21	0.0968	0.9032
$p_t^*$	1.36	1.17	0.7341	0.2659
$e_{it}$	1.43	1.20	0.7001	0.2999

Notes:  $m$  (money supply);  $y$  (non-hydrocarbon GDP);  $g$  (government spending),  $p^*$  (foreign CPI);  $e$  (nominal effective exchange rate); and  $pc$  (private consumption). All variables are expressed in natural logarithm. Variance inflation factor (VIF) measures the inflation in the variances of the parameter estimates due to collinearities that exist among the regressor (independent) variables. The  $VIF_i$  are given by  $(1 - R_i^2)^{-1}$  where  $R_i^2$  is the  $R^2$  from regressing the  $i$ th independent variable on all other independent variables. A  $VIF_i > 10$  indicates harmful collinearity (Kennedy, 2003). Tolerance =  $1 - R^2$ , VIF =  $1/\text{tolerance}$ .

Table 2: Panel unit root tests — constant and trend

Series	Pesaran (2007)	Breitung and Das (2005)
$p_{it}$	-2.030 [0.770]	2.787 [0.997]
$e_{it}$	-1.678 [0.952]	-0.959 [0.168]
$m_{it}$	-2.894 [0.062]	3.473 [0.999]
$y_{it}$	-3.162 [0.012]	1.991 [0.976]
$g_{it}$	-2.131 [0.682]	3.018 [0.998]
$pc_{it}$	-2.597 [0.225]	2.135 [0.983]

Notes:  $p$  (domestic CPI);  $e$  (nominal effective exchange rate);  $m$  (money supply);  $y$  (non-hydrocarbon GDP);  $g$  (government spending) and  $pc$  (private consumption). All variables are expressed in natural logarithm. All tests test the null hypothesis of a unit root. P-values are reported in [ ]. P-value greater than 0.05 indicates that the null hypothesis of a unit root cannot be rejected at the 5% significance level.

Table 3: Panel non-cointegration tests  
(Government spending as a measure of aggregate demand)

Tests	Test statistics	Robust P-value
Westerlund (2007)	$G_\tau$ : -1.733	0.500
	$G_\alpha$ : -3.255	0.484
	$P_\tau$ : -3.468	0.524
	$P_\alpha$ : -2.333	0.556
Di Iorio and Fachin (2009)	Median ( $ADF$ ): -3.880	0.019
	Mean ( $ADF$ ): -3.950	0.012

Note: The panel cointegration tests are conducted on the following specification:

$$y_{it} = \alpha_i + \beta_i x_{it} + \epsilon_{it}$$

where  $y_{it}$  is the domestic consumer price index (CPI);  $x_{it}$  is a  $k \times 1$  vector of explanatory variables including foreign prices, nominal effective exchange rate, money supply and a measure of aggregate demand;  $\alpha_i$  is the country-specific effect;  $\beta_i$  are the  $k \times 1$  coefficient vectors and  $\epsilon_{it}$  are disturbances. All variables are expressed in natural logarithm. All tests are designed to test the null hypothesis of no cointegration. P-value greater than 0.05 indicates that the null hypothesis of no cointegration cannot be rejected at the 5% significance level. P-values are robust to cross-section dependence.

Table 4: Panel non-cointegration tests  
(Private consumption as a measure of aggregate demand)

Tests	Test statistics	Robust P-value
Westerlund (2007)	$G_\tau$ : -1.594	0.596
	$G_\alpha$ : -3.616	0.354
	$P_\tau$ : -3.301	0.544
	$P_\alpha$ : -2.774	0.434
Di Iorio and Fachin (2009)	Median ( $ADF$ ): -4.120	0.015
	Mean ( $ADF$ ): -4.290	0.007

Note: See Table 3.

Table 5: Panel non-cointegration tests — constant and trend  
(Non-hydrocarbon GDP as a measure of aggregate demand)

Tests	Test statistics	Robust P-value
Westerlund (2007)	$G_\tau$ : -1.240	0.910
	$G_\alpha$ : -2.933	0.668
	$P_\tau$ : -2.809	0.772
	$P_\alpha$ : -3.343	0.302
Di Iorio and Fachin (2009)	Median ( $ADF$ ): -4.180	0.055
	Mean ( $ADF$ ): -4.310	0.036

Note: See Table 3.

Table 6: Panel non-cointegration tests — constant and trend  
(Government spending as a measure of aggregate demand)

Tests	Test statistics	Robust P-value
Westerlund (2007)	$G_\tau$ : -2.019	0.426
	$G_\alpha$ : -2.233	0.792
	$P_\tau$ : -4.741	0.278
	$P_\alpha$ : -2.580	0.476
Di Iorio and Fachin (2009)	Median ( $ADF$ ): -3.790	0.082
	Mean ( $ADF$ ): -3.840	0.071

Note: See Table 3.

Table 7: Panel non-cointegration tests — constant and trend  
(Private consumption as a measure of aggregate demand)

Tests	Test statistics	Robust P-value
Westerlund (2007)	$G_\tau$ : -1.748	0.696
	$G_\alpha$ : -2.655	0.702
	$P_\tau$ : -3.411	0.670
	$P_\alpha$ : -1.554	0.840
Di Iorio and Fachin (2009)	Median ( $ADF$ ): -4.090	0.034
	Mean ( $ADF$ ): -4.210	0.018

Note: See Table 3.

Table 8: Time series tests of non-cointegration  
(Government spending as a measure of aggregate demand)

Country	Engle-Granger	Johansen	Engle-Granger & Johansen combination test
Bahrain	-3.091	58.967***	56.548***
Kuwait	-2.238	57.220***	55.494***
Oman	-3.560	62.701***	57.778***
Qatar	-2.497	46.525***	14.445**
Saudi Arabia	-2.342	34.217**	6.546
U.A.E.	-3.130	45.676***	14.663**

Note: Individual or combine cointegration tests are conducted on the specification:

$$y_t = \alpha + \beta x_t + \epsilon_t$$

where  $y_t$  is the domestic CPI;  $x_t$  is a  $k \times 1$  vector of explanatory variables including foreign prices, nominal effective exchange rate, money supply and a measure of aggregate demand;  $\alpha$  is the deterministic component (constant);  $\beta$  is the  $k \times 1$  coefficient vectors and  $\epsilon_t$  are disturbances. All variables are expressed in natural logarithm. The Engle-Granger & Johansen combination test is the Fisher  $\chi^2$  test developed by Bayer and Hanck (2009). All tests test the null of no cointegration. \*\*\*, \*\* and \* denote statistical significant at the 1%, 5% and 10% level, respectively.

Table 9: Time series tests of non-cointegration  
(Private consumption as a measure of aggregate demand)

Country	Engle-Granger	Johansen	Engle-Granger & Johansen combination test
Bahrain	-3.343	60.281***	57.141***
Kuwait	-2.007	35.831**	7.238
Oman	-3.446	47.479***	16.699***
Qatar	-2.297	36.786**	7.938
Saudi Arabia	-2.813	63.102***	56.054***
U.A.E.	-3.235	48.867***	17.253***

Note: See Table 8.

Table 10: Time series tests of non-cointegration — constant and trend  
(Non-hydrocarbon GDP as a measure of aggregate demand)

Country	Engle-Granger	Johansen	Engle-Granger & Johansen combination test
Bahrain	-2.371	46.367***	11.506**
Kuwait	-2.758	48.037***	12.705**
Oman	-3.742	55.872***	20.555***
Qatar	-3.161	38.369**	7.503
Saudi Arabia	-2.718	37.601**	6.548
U.A.E.	-2.725	52.247***	15.549**

Note: See Table 8.

Table 11: Time series tests of non-cointegration — constant and trend  
(Government spending as a measure of aggregate demand)

Country	Engle-Granger	Johansen	Engle-Granger & Johansen combination test
Bahrain	-2.659	59.980***	55.559***
Kuwait	-3.497	56.939***	56.761***
Oman	-3.501	61.844***	56.769***
Qatar	-3.864	45.982***	13.653**
Saudi Arabia	-2.540	59.484***	55.481***
U.A.E.	-2.747	44.079***	10.260*

Note: See Table 8.

Table 12: Time series tests of non-cointegration — constant and trend  
(Private consumption as a measure of aggregate demand)

Country	Engle-Granger	Johansen	Engle-Granger & Johansen combination test
Bahrain	-2.780	63.165***	55.655***
Kuwait	-3.358	37.578**	7.392
Oman	-3.282	57.484***	56.316***
Qatar	-3.791	39.932**	9.777*
Saudi Arabia	-2.852	58.501***	55.723***
U.A.E.	-2.747	44.951***	12.604**

Note: See Table 8.

Table 13: Mean group (MG) estimation of long- and short-run equations

Series	Model 2a	Model 3a	Model 3b	Model 4
$\ln p_{t-1}^*$	0.491**	0.427***	0.485**	0.152*
$\ln e_{it-1}$	-0.739***	-0.529***	-0.656***	-0.627***
$\ln m_{it-1}$	0.245**	0.252***	0.250***	0.083
$\ln gc_{it-1}$	0.030	0.252***	0.250***	
$\ln gi_{it-1}$	-0.009	0.252***	0.250***	
$\ln pc_{it-1}$				0.128***
$\phi_i$	-0.209***	-0.219***	-0.218***	-0.248**
$\Delta \ln p_{t-1}^*$	-0.122	-0.132	-0.109	-0.110
$\Delta \ln e_{it-1}$	0.008	0.003	-0.007	-0.001
$\Delta \ln m_{it-1}$	0.028	0.069***	0.042	0.027
$\Delta \ln gc_{it-1}$	0.018*	0.069***	0.042	
$\Delta \ln gi_{it-1}$	-0.002	0.069***	0.042	
$\Delta \ln pc_{it-1}$				-0.018
$\Delta \ln em_{it-1}$		-0.063		
$\Delta \ln ed_{it-1}$			0.063***	
Constant	0.566**	0.516***	0.590***	0.906***
LR statistic	69.824***	52.062***	55.510***	59.044***
Log-likelihood	459.549	448.467	447.433	463.184
SBIC	-893.479	-871.314	-869.246	-900.748
$N \times T$	168	168	168	168

Note: The dependent variable is domestic CPI.  $p_t^*$  represents foreign prices;  $e_{it}$  is the nominal effective exchange rates;  $m_{it}$  denotes money supply;  $gc_{it}$  and  $gi_{it}$  respectively denotes government consumption and government investment;  $pc_{it}$  refers to private consumption;  $em_{it}$  denotes excess money supply and  $ed_{it}$  represents excess demand.  $\phi_i$  is the error correction speed of adjustment term.  $\Delta$  denotes the first difference operator. All variables are expressed in natural logarithm. Model 2a decomposes government spending into government consumption and government investment. Models 3a and 3b are variations of Model 3 including excess money supply and excess demand measures, respectively. Model 4 estimates Equation (1) with private consumption as a measure of aggregate demand. \*\*\*, \*\* and \* denote statistical significant at the 1%, 5% and 10% level, respectively.