

A study in panel cointegration and poolability: Long-run money demand equations for Gulf Cooperation Council countries

Syed Basher, Francesca Di Iorio and Stefano Fachin

Abstract We model demand for money in the Gulf Cooperation Council (GCC) countries (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates) and test poolability (a key policy question in view of a planned monetary union) through a new bootstrap test. The results suggest that the welfare cost of inflation is different across GCC countries.

Key words: Money demand, panel cointegration, poolability, Gulf Cooperation Council.

1 Introduction

Our aim is modelling the demand for money in the Gulf Cooperation Council (GCC) countries (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates). Empirical money demand estimations are used by central banks as a major tool in designing policies to influence real and monetary balances. Since GCC countries have been working to create a monetary union¹ a key policy question is the ho-

Syed Basher
Dept. of Research & Monetary Policy, Qatar Central Bank, P.O. Box 1234, Doha, Qatar e-mail: bashers@qcb.gov.qa

Stefano Fachin
Dip.di Scienze Statistiche Università di Roma La Sapienza, P.le A. Moro 5 - 00185, Roma, Italy e-mail: s.fachin@caspur.it

Francesca Di Iorio
Dip. TEOMESUS, Università di Napoli Federico II e-mail: fdiiorio@unina.it

¹ On money demand in GCC countries and the GCC monetary union see Crockett and Evans (1980) and AlKholifey and Alreshan (2009).

mogeneity of their money demand functions. To test this hypothesis we shall apply a new bootstrap test.

The specification of a money equation can be derived from a standard money-in-utility model where a representative consumer maximizes his lifetime utility allocating real income among consumption goods, bonds and real money balances. Solving the model in standard fashion leads to the empirical specification of our money demand function:

$$m_{it} - p_{it} = \alpha_i + \beta_{1i}y_{it} + \beta_{2i}oc_{it} + e_{it}, \quad (1)$$

where $i = 1, 2, \dots, N$ indexes the countries ($N = 6$), $t = 1980, \dots, 2009$, and the variables, all in logs, are: $m_{it} - p_{it}$, real money balances; y_{it} aggregate income, here non-oil GDP² (GDP-NO); oc_{it} , a measure of opportunity cost, here the three-month US Treasury bill rate, as (i) available time series of country-specific interest rates are too short, and (ii) GCC countries generally maintain a fixed exchange rate peg with the U.S. dollar, and due to the extremely free movement of capital, lack independent monetary policies.

All variables in (1) are found to be non-stationary by the ADF-GLS unit root test (Table 1) except GDP-NO in Kuwait, where the large fall caused by the 1991 Gulf War and the following recovery makes the series to appear stationary. On the other hand, the GDP-NO series corrected for a Transitory Change (TC) outlier in 1991 is non stationary. Since in Kuwait M2 shrunk only marginally in the early 1990's, it is obvious that a long-run money demand function for this country might obtained only taking as a scale variable the outlier-corrected GDP-NO series.

We can then proceed to testing for the existence of stable long-run money demand functions for each of the GCC countries, and estimating their parameters. In view of the small sample size (30 observations) we are forced to apply parsimonious single equation methods. We thus computed standard static Engle-Granger regressions and no cointegration tests. The results, reported in Tables 2 and panel A of Table 3, are mixed. Although the estimated elasticities are all reasonable (the averages are 0.70 for GDP-NO and -0.31 for the interest rate) the p -values of the Engle-Granger tests clearly reject the null hypothesis of no cointegration only for half of the countries (Bahrein, Oman and Saudi Arabia), while they are borderline in Kuwait (11%) and definitely large for Qatar and UAE (respectively, 34% and 16%). However we should not forget that these results are obtained from a very small sample, so that no rejections can be the mere consequence of inadequate power. Enhanced power can be obtained from panel cointegration tests, which however need to be chosen with some care, as very strong cross-section dependence is to be expected. The bootstrap tests developed by Di Iorio and Fachin (2011a), which enjoy good size and power properties even in strongly dependent panels, provide an adequate answer to this need. Exploiting this procedure the hypothesis of no cointegration in a panel sense can be tested through three different summary statistics of the individual tests: mean, median and maximum (*i.e.*, the value most favourable to the null hypothesis

² All GCC economies are strongly dependent on oil, with hydrocarbon resources accounting for nearly 50% of Gross Domestic Product (GDP).

of no cointegration). As it can be appreciated from panel B of Table 3, all p -values are of the panel cointegration tests are significant, suggesting the failed rejections in individual countries to be due to low power.

Having concluded in favour of the existence of a long-run equilibrium in all countries we proceed to the final step, testing the hypothesis of homogeneity across countries. The key point is again accounting for cross-section dependence. Recently Di Iorio and Fachin (2011b) proposed a test based on the range of the coefficients across units, with inference carried out through the sieve bootstrap. The null hypothesis of homogeneity of the coefficients across units is expressed as the hypothesis that range of the estimates across units is zero. Given the short time sample available we opt for a parsimonious implementation of the procedure, replacing the VAR with separate AR models for the equation residuals and the two right-hand side variables.

The results, reported in Table 4, are that the poolability (or homogeneity) hypothesis cannot be rejected for DGP-NO (p -values over 65% for both OLS and FM-OLS estimates) but it is rejected for the interest rate (p -values smaller than 4% for both estimates). The latter result has important policy bearings, as it implies that the welfare cost of inflation is different across the members of the planned GCC monetary union.

Table 1 Unit root ADF-GLS tests

	<i>Bahrain</i>	<i>Kuwait</i>	<i>Oman</i>	<i>Qatar</i>	<i>KSA</i>	<i>UAE</i>
<i>M2</i>	-1.83	-1.34	-2.13	-0.42	-1.71	-1.54
<i>Y</i>	-1.18	-3.64 ^{a,*}	-2.24 ^b	-1.19	-1.86	-3.01
<i>r</i>			-0.52 [82.8]			

*,** : significant at 5%, 1%; r : p -value $\times 100$ in brackets.

^a : originary series; ^b : series corrected for TC outlier in 1991.

Table 2 Money demand functions, 1980-2009

	<i>Bahrain</i>	<i>Kuwait</i>	<i>Oman</i>	<i>Qatar</i>	<i>KSA</i>	<i>UAE</i>	<i>mean</i>
<i>Y</i>	0.74	0.17	1.04	0.75	0.60	0.88	0.70
<i>r</i>	-0.45	-0.19	-0.27	-0.15	-0.39	-0.39	-0.31

OLS estimates; Kuwait: *Y* corrected for TC outlier in 1991

Table 3 No cointegration tests

A. Individual countries						B. Panel		
<i>Bahrain</i>	<i>Kuwait</i>	<i>Oman</i>	<i>Qatar</i>	<i>KSA</i>	<i>UAE</i>	<i>Mean</i>	<i>Median</i>	<i>Max</i>
-2.63	-3.41	-3.98	-2.78	-4.81	-3.22	-3.47	-3.31	-2.63
(0.0)	(11.0)	(2.6)	(34.4)	(0.2)	(16.1)	(6.0)	(10.2)	(3.9)

individual countries: asymptotic p -values $\times 100$ in brackets;
Panel: bootstrap p -values $\times 100$, 5000 bootstrap redrawings.

Table 4 Range Poolability test, Bootstrap p -values

	OLS	FM-OLS
Y	67.4	70.2
r	0.2	3.6

bootstrap redrawings: 5000

References

1. AlKholifey, A., Alreshan, A: GCC monetary union , in Proceedings of the SARB/IFC seminar on Economic and financial convergence en route to regional economic integration: experience, prospects and statistical issues amidst global financial turmoil *IFC Bulletin No. 32*, Bank of International Settlements (2009) <http://www.bis.org/ifc/publ/ifcb32.htm>
2. Crockett, A.D., Evans, O.J.: Demand for money in Middle Eastern countries. *IMF Staff Papers* **27**, 543–577(1980).
3. Di Iorio, F., Fachin, S.: A Panel Cointegration study of the long-run relationship between Savings and Investments in the OECD economies, 1970-2007. Working Papers **n. 3/2011** Department of the Treasury, Ministry of Economy and Finance (2011a).
4. Di Iorio, F., Fachin, S. : A Sieve Bootstrap range test for poolability in dependent cointegrated panels. *DSS Empirical Economics and Econometrics Working Papers Series n. 2011* (2011b)