Systemic Risk of Dual Banking Systems

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September 2016

Summary

Context

Dual Banking systems - countries where different bank types operate:

- Conventional
- Islamic
- Hybrids - conventional banks with islamic windows

Aim

Measuring systemic risk contributions of different bank types in dual banking systems

Methods

Systemic risk measures, powered with correlation network models, applied to GCC countries

Background

- The 2007-2008 financial crisis had a negative effect on both Islamic banks (IB) and conventional banks (CB).
- Some differences were found between the IB and CB risk and performance level in terms of the crisis impact, eg a time lagged profitability deterioration effect for IB.
- No direct comparison available between IB and CB in terms of systemic risk. No analysis of hybrid type effects

Research Aim

- To investigate the systemic importance of CB, IB and hybrid bank types, at the aggregate level.
- The systemic risk contribution of each banking sector (country X type) is determined using market based systemic measures: MES, SRISK and ΔCoVaR, powered with correlation networks
- Data on banking systems of GCC countries, which:
  - Are key players with nearly 38% of IB assets (IFSB, 2014)
  - Have economies that are oil dependent.
  - Have relatively homogeneous economic and financial development.

Literature and Contribution

Systemic risk measures based on market prices:

- Adrian and Brunnermeier (2010), Acharya et al. (2010), Brownlees and Engle (2012)

Correlation networks in finance:

- Ahelegby, Billio (JAE 2015), Giudici and Spelta (JBES 2015), Giudici, Sarlin and Spelta (This conference: capital flows), Giudici and Parisi (This conference: sovereign risk)

Financial risks in dual banking systems:

- Abedifar et al. (RF, 2013), Bourkhis and Nabi (RFE, 2013). Beck et al. (JBF, 2013), Cihak and Hesse (JFSR, 2010), Imam and Kpodar (EM, 2013)

Our contribution:

- A novel partial correlation based measure (NetMES).
- Systemic risk contributions in dual banking systems.

The Systemic Risk Measures

MES (Acharya et al., 2010)

- Acharya et al. (2010) Marginal Expected Shortfall: bank market loss expected if market returns are less than a given threshold C (C =-2%).

$$MES_{it}(C) = \sigma_{it}\,\rho_{it}\,\mathbb{E}_{t-1}(\varepsilon_{mt}|\varepsilon_{mt} < \frac{C}{\sigma_{mt}}) + \sigma_{it}\sqrt{1-\rho_{it}^2}\,\mathbb{E}_{t-1}(\xi_{it}|\varepsilon_{mt} < \frac{C}{\sigma_{mt}})$$

- MES is expressed as a weighted function of the tail expectation of the standardized market residual and the tail expectation of the standardized idiosyncratic firm residual

Systemic Risk Measures

SRISK (Brownlees and Engle, 2012).

- SRISK: expected capital shortfall of a given financial institution, conditional on a crisis affecting the whole financial system.
- The average of the future expected loss of the system due to a crisis over the next six months is approximated using daily MES as $LRMES \simeq 1 - exp(-180 \times MES_{it})$

$$\begin{aligned} SRISK_{it} &= ((k(Debt_{it} + Equity_{it}) - Equity_{it})|C_{it}) \\ &= max\left(\left[kL_{it} - 1 + (1-k)LRMES_{it}\right]W_{it}\right) \end{aligned}$$

- W_{it} is the market value of the institution, (quasi) leverage is defined as $L_{it} = (D_{it} + W_{it})/W_{it}$, and $k = 8\%$ is the minimum fraction of the capital ratio that each bank needs to hold.

Systemic Risk Measures

ΔCoVaR (Adrian and Brunnermeier, 2011)

- *CoVaR* is the *VaR* of the market portfolio return *m* conditional on a tail event $C(r_{st})$ observed for banking sector *s* as it becomes under financial distress.
- The ΔCoVaR of a sector *s* reflects its contribution to systemic risk by assessing the difference between the *VaR* of the financial system conditional on banking sector *s* being under financial distress and the *VaR* of the system conditional on banking sector *s* being in its median state.

$$\Delta CoVaR_{st}(\alpha) = CoVaR_t^{m|r_{st}=VaR_{st}(\alpha)} - CoVaR_t^{m|r_{st}=Median(r_{st})}$$

Dynamic conditional correlations

Dynamic Conditional Correlation model: DCC

- Following Brownlees and Engle (2012) we use a bivariate GARCH model for the demeaned returns process:

$$r_t = H_t^{1/2} \epsilon_t$$

  - $r_t = (r_{mt}\ r_{st})'$ represents the vector of market and banking sector returns.
  - $\epsilon_t = (\varepsilon_{mt}\ \xi_{st})'$ represents a vector of $i.i.d.$ standardized innovations, assumed to be unknown with no assumptions regarding the bivariate distributions.
  - ϵ_t has a mean $\mathbb{E}(\epsilon_t) = 0$ and an identity covariance matrix of $\mathbb{E}(\epsilon_t \epsilon_t') = I_2$.
- The time varying conditional variance-covariance matrix H_t is defined as:

$$H_t = \begin{pmatrix} \sigma_{mt}^2 & \sigma_{mt}\ \sigma_{it}\ \rho_{it} \\ \sigma_{mt}\ \sigma_{it}\ \rho_{it} & \sigma_{it}^2 \end{pmatrix}$$

- where σ_{mt} and σ_{it} represent the conditional standard deviation for the system and the firm respectively, and ρ_{it} represents the time varying conditional correlation.

Partial correlations

We improve the DCC implementation of systemic risk measures replacing correlations with partial correlations, obtained from correlation networks.

Operationally, the partial correlation coefficient ρ_{ijV} is obtained from the correlation of the residuals from the regression of X_i on all other variables (excluding X_j) with the residuals from the regression of X_j on all other variables (excluding X_i)as in the following:

$$\rho_{ijV} = \left(\varepsilon_{X_i|X_{V\setminus\{j\}}}, \varepsilon_{X_j|X_{V\setminus\{i\}}} \right)$$

ρ_{ijV} measures the additional contribution of variable X_j to the variability of X_i not already explained by the others, and vice versa.

Data description

- 16 banking sectors constructed from 79 publicly traded deposit-taking institution, in 6 GCC countries: Bahrain (BH), Kuwait (KW), Qatar (QA), United Arab Emirates (AE), Saudi Arabia (SA) and Oman (OM).
- daily stock market returns for financial institutions and country specific market indexes.
- Extends over 10 years, with three periods: Pre-crisis (Jan 2005−Dec 2006), Crisis (Jan 2007−Dec 2008), Post-Crisis (Jan 2009−Dec 2014)
- Aggregated per banking sector type at country level using market capitalization weights to construct the sectorial returns $r_{st} = \sum_{i=1}^{n_s} w_{it} r_{it}$ where $w_{it} = mv_{it} / \sum_{i=1}^{n_s} mv_{it}$ represents the weight of the i-th bank in the specified banking sector s at time t, given by its market capitalization mv_{it} relative to the sector aggregate capitalization $\sum_{i=1}^{n_s} mv_{it}$.

Methods

We consider the following implementations:

- First, we use the standard method with the stock market return index for each dual banking system (country)
- Second, we replace partial correlations with correlations. The advantage of doing so is to use the true direct correlation between two sectors, rather than on correlation that contains also indirect (spurios) effects.
- Third, we repeat the first standard method but with the crude oil return index, instead of the market index.

Methods

We use two aggregation levels for banking sectors' MES:

- Aggregate country level
- Aggregate GCC level

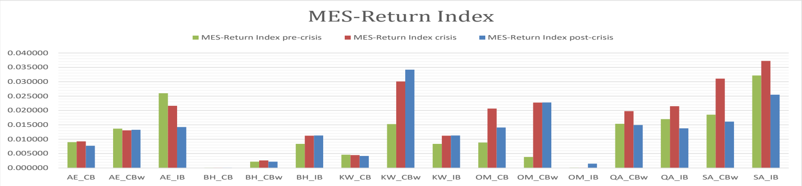
For the aggregation we follow the concept of the CES measure provided by Banulescu and Dumitrescu (2015), and refer to this as the global marginal expected shortfall $GMES_{jt}$, as follows:

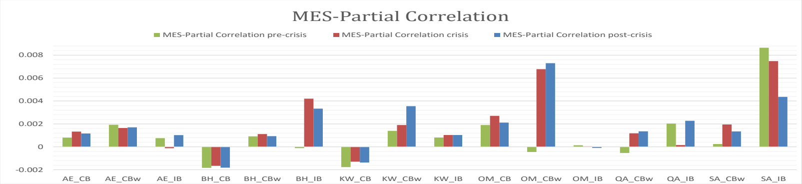
$$GMES_{jt} = \sum_{s=1}^{n_s} w_{st} MES_{st},$$

in which j denotes the country, $w_{st} = mv_{st} / \sum_{s=1}^{n_j} mv_{st}$ represents the weight of the banking sector s at time t, given by its market capitalization mv_{st} relative to the aggregate banking capitalization of that sector $\sum_{i=1}^{n_s} mv_{jt}$.

The same construction is repeated at the GCC overall level.

Figure: Countries Comparison of MES





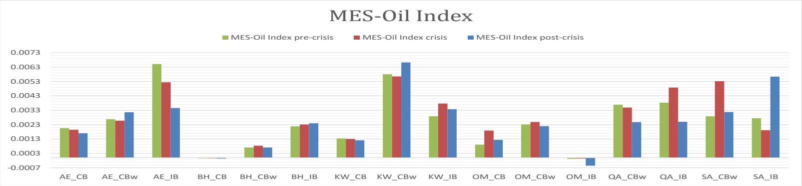
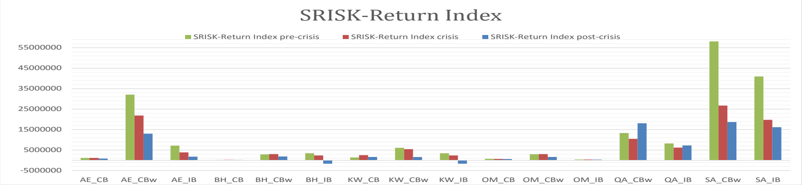
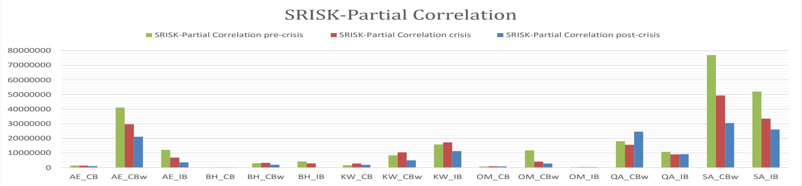


Figure: Countries Comparison of SRISK





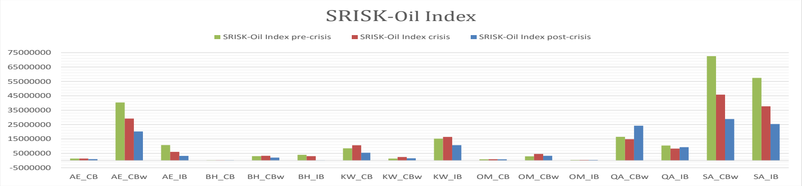


Figure: Countries Comparison of ΔCoVaR

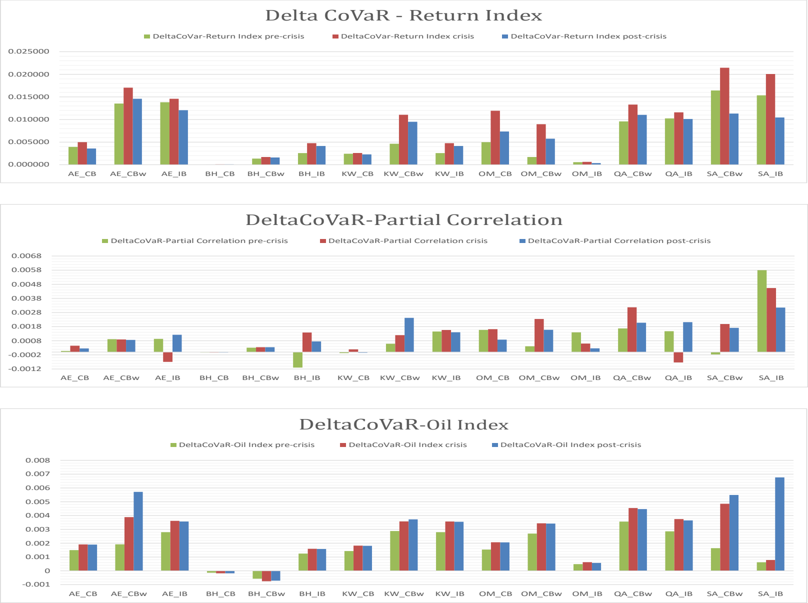
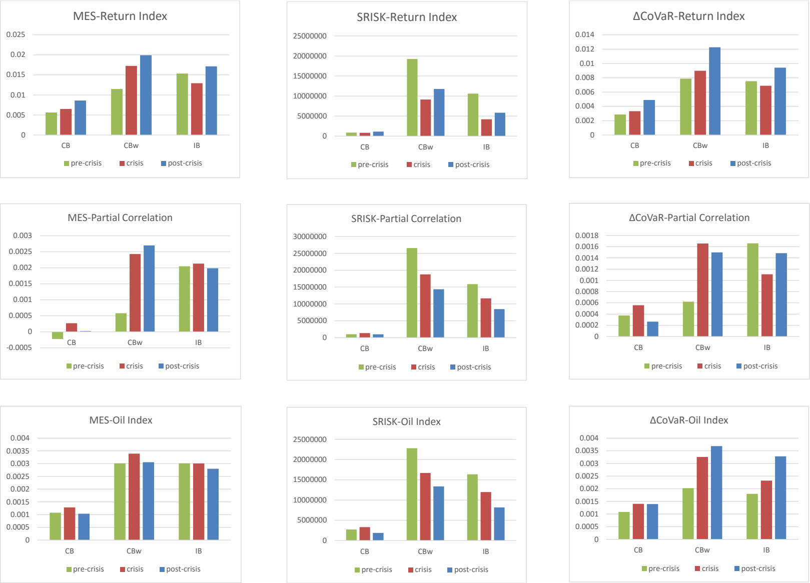


Figure: Global Gulf Risk Measure



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