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### Working Paper

## Risk preferences, global market conditions and foreign debt: Is there any role for the currency composition of FX reserves?

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# **Online Appendix:** Risk preferences, global market conditions and foreign debt: Is there any role for the currency composition of FX reserves?

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## **1 Appendix B: South Africa - FX reserves returns statistics**

This section reports two normality tests, namely the Jarque-Bera test and the Kolmogorov-Smirnov tests for the individual returns on FX reserves for South Africa using the perfect foresight (PF) model for short-term returns (Table B1), for Mexico using the PF model for long-term returns (Table C1), for India using the Purchasing Power Parity (PPP) model for short-term returns (Table D1) and for Turkey using the PPP model for long-term returns (Table E1). For all the countries, the tests consistently reject normality at all relevant levels of significance and thus showing that it is appropriate to incorporate higher return moments . Furthermore, this section reports the covariance and co-skewness matrices associated with each country and the relevant method of computing expected FX reserves returns.

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Table B1: Variance-covariance matrix of short-term FX reserves returns using perfect foresight model for South Africa

| 2010:01-2018:12         | U.S. dollar     | Euro            | British pound   | Japanese yen    | Swiss franc     |
|-------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Mean return (%)         | 0.99            | 0.61            | 0.80            | 0.40            | 0.34            |
| Variance                | 9.68            | 9.91            | 11.66           | 13.56           | 9.35            |
| Skewness                | 5.52            | 7.77            | -15.62          | 18.46           | 10.88           |
| Jarque-Bera stat        | 1.31<br>(0.44)  | 1.69<br>(0.35)  | 5.29<br>(0.053) | 3.08<br>(0.14)  | 3.71<br>(0.10)  |
| Kolmogorov-Smirnov stat | 0.39<br>(0.000) | 0.33<br>(0.000) | 0.35<br>(0.000) | 0.29<br>(0.000) | 0.27<br>(0.000) |
| Variance-covariance     |                 |                 |                 |                 |                 |
| U.S. dollar             | 9.68            |                 |                 |                 |                 |
| Euro                    | 7.14            | 9.91            |                 |                 |                 |
| British pound           | 8.40            | 8.89            | 11.66           |                 |                 |
| Japanese yen            | 9.01            | 8.11            | 8.23            | 13.56           |                 |
| Swiss franc             | 6.24            | 8.08            | 7.68            | 7.57            | 9.35            |

Notes: Values in parentheses are p-values of the associated test statistic

Table B2: Co-Skewness U.S. dollar matrix of short-term FX returns using perfect foresight model for South Africa

|               | U.S. dollar | Euro  | British pound | Japanese yen | Swiss franc |
|---------------|-------------|-------|---------------|--------------|-------------|
| U.S. dollar   | 5.52        | 6.11  | 1.16          | 12.03        | 2.57        |
| Euro          | 6.11        | 6.48  | 2.76          | 12.59        | 4.31        |
| British pound | 1.16        | 2.76  | -4.17         | 7.81         | 0.80        |
| Japanese yen  | 12.03       | 12.59 | 7.81          | 18.92        | 8.17        |
| Swiss franc   | 2.57        | 4.31  | 0.80          | 8.17         | 6.81        |

Table B3: Co-Skewness Euro matrix of short-term FX returns using perfect foresight model for South Africa

|               | U.S. dollar | Euro  | British pound | Japanese yen | Swiss franc |
|---------------|-------------|-------|---------------|--------------|-------------|
| U.S. dollar   | 6.11        | 6.48  | 2.76          | 12.59        | 4.31        |
| Euro          | 6.48        | 7.77  | 4.18          | 14.42        | 8.17        |
| British pound | 2.76        | 4.18  | -2.42         | 10.75        | 4.22        |
| Japanese yen  | 12.59       | 14.42 | 10.75         | 19.74        | 11.32       |
| Swiss franc   | 4.31        | 8.17  | 4.22          | 11.32        | 9.12        |

Table B4: Co-Skewness British Pound matrix of short-term FX returns using perfect foresight model for South Africa

|               | U.S. dollar | Euro  | British pound | Japanese yen | Swiss franc |
|---------------|-------------|-------|---------------|--------------|-------------|
| U.S. dollar   | 1.16        | 2.76  | -4.17         | 7.80         | 0.80        |
| Euro          | 2.76        | 4.18  | -2.42         | 10.75        | 4.22        |
| British pound | -4.17       | -2.42 | -15.62        | 3.38         | -2.67       |
| Japanese yen  | 7.80        | 10.75 | 3.38          | 16.59        | 8.81        |
| Swiss franc   | 0.80        | 4.22  | -2.67         | 8.81         | 5.71        |

Table B5: Co-Skewness Japanese yen matrix of short-term FX returns using perfect foresight model for South Africa

|               | U.S. dollar | Euro  | British pound | Japanese yen | Swiss franc |
|---------------|-------------|-------|---------------|--------------|-------------|
| U.S. dollar   | 12.03       | 12.59 | 7.80          | 18.92        | 8.17        |
| Euro          | 12.59       | 14.42 | 10.75         | 19.74        | 11.32       |
| British pound | 7.80        | 10.75 | 3.38          | 16.59        | 8.81        |
| Japanese yen  | 18.92       | 19.74 | 16.59         | 18.46        | 14.79       |
| Swiss franc   | 8.17        | 11.32 | 8.81          | 14.79        | 16.04       |

Table B6: Co-Skewness Swiss franc matrix of short-term FX returns using perfect foresight model for South Africa

|               | U.S. dollar | Euro  | British pound | Japanese yen | Swiss franc |
|---------------|-------------|-------|---------------|--------------|-------------|
| U.S. dollar   | 2.57        | 4.31  | 0.80          | 8.17         | 6.81        |
| Euro          | 4.31        | 8.17  | 4.22          | 11.32        | 9.12        |
| British pound | 0.80        | 4.22  | -2.67         | 8.81         | 5.71        |
| Japanese yen  | 8.17        | 11.32 | 8.81          | 14.79        | 16.04       |
| Swiss franc   | 6.81        | 9.12  | 5.71          | 16.04        | 10.88       |

## 2 Appendix C: Mexico - FX reserves returns statistics

Table C1: Variance-covariance matrix of long-term FX reserves returns using perfect foresight model for Mexico

| 2010:01-2018:12         | U.S. dollar     | Euro            | British pound   | Japanese yen    | Swiss franc     |
|-------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Mean return (%)         | 2.85            | 2.53            | 2.36            | 0.73            | 0.998           |
| Variance                | 6.78            | 8.32            | 9.32            | 11.86           | 9.02            |
| Skewness                | 1.19            | -1.78           | -16.86          | 2.75            | 7.85            |
| Jarque-Bera stat        | 0.17<br>(0.50)  | 0.14<br>(0.50)  | 9.18<br>(0.019) | 0.10<br>(0.50)  | 4.91<br>(0.06)  |
| Kolmogorov-Smirnov stat | 0.66<br>(0.000) | 0.60<br>(0.000) | 0.63<br>(0.000) | 0.35<br>(0.000) | 0.38<br>(0.000) |
| Variance-covariance     |                 |                 |                 |                 |                 |
| U.S. dollar             | 6.78            |                 |                 |                 |                 |
| Euro                    | 4.72            | 8.32            |                 |                 |                 |
| British pound           | 5.67            | 6.83            | 9.32            |                 |                 |
| Japanese yen            | 6.76            | 6.21            | 6.00            | 11.86           |                 |
| Swiss franc             | 4.88            | 6.98            | 6.37            | 6.53            | 9.02            |

Notes: Values in parentheses are p-values of the associated test statistic

Table C2: Co-Skewness U.S. dollar matrix of long-term FX returns using perfect foresight model for Mexico

|               | U.S. dollar | Euro  | British pound | Japanese yen | Swiss franc |
|---------------|-------------|-------|---------------|--------------|-------------|
| U.S. dollar   | 1.19        | -1.19 | -3.47         | 1.92         | -3.44       |
| Euro          | -1.19       | -2.10 | -4.06         | 1.96         | -3.21       |
| British pound | -3.47       | -4.06 | -7.85         | -2.21        | -4.72       |
| Japanese yen  | 1.92        | 1.96  | -2.21         | 5.02         | -1.52       |
| Swiss franc   | -3.44       | -3.21 | -4.72         | -1.52        | 1.03        |

Table C3: Co-Skewness Euro matrix of long-term FX returns using perfect foresight model for Mexico

|               | U.S. dollar | Euro  | British pound | Japanese yen | Swiss franc |
|---------------|-------------|-------|---------------|--------------|-------------|
| U.S. dollar   | -1.19       | -2.09 | -4.06         | 1.96         | -3.21       |
| Euro          | -2.09       | -1.78 | -2.54         | 4.19         | 1.06        |
| British pound | -4.06       | -2.54 | -7.00         | 1.22         | -0.93       |
| Japanese yen  | 1.96        | 4.19  | 1.22          | 7.40         | 2.28        |
| Swiss franc   | -3.21       | 1.06  | -0.93         | 2.28         | 3.62        |

Table C4: Co-Skewness British Pound matrix of long-term FX returns using perfect foresight model for Mexico

|               | U.S. dollar | Euro  | British pound | Japanese yen | Swiss franc |
|---------------|-------------|-------|---------------|--------------|-------------|
| U.S. dollar   | -3.47       | -4.06 | -7.85         | -2.21        | -4.72       |
| Euro          | -4.06       | -2.54 | -7.00         | 1.22         | -0.93       |
| British pound | -7.85       | -7.00 | -16.86        | -4.68        | -5.39       |
| Japanese yen  | -2.21       | 1.22  | -4.68         | 3.25         | 0.30        |
| Swiss franc   | -4.72       | -0.93 | -5.39         | 0.30         | 2.45        |

Table C5: Co-Skewness Japanese yen matrix of short-term FX returns using perfect foresight model for Mexico

|               | U.S. dollar | Euro | British pound | Japanese yen | Swiss franc |
|---------------|-------------|------|---------------|--------------|-------------|
| U.S. dollar   | 1.92        | 1.96 | -2.21         | 5.02         | -1.52       |
| Euro          | 1.96        | 4.19 | 1.22          | 7.40         | 2.28        |
| British pound | -2.21       | 1.22 | -4.68         | 3.25         | 0.30        |
| Japanese yen  | 5.02        | 7.40 | 3.25          | 2.75         | 2.81        |
| Swiss franc   | -1.52       | 2.28 | 0.30          | 2.81         | 9.14        |

Table C6: Co-Skewness Swiss franc matrix of long-term FX returns using perfect foresight model for Mexico

|               | U.S. dollar | Euro  | British pound | Japanese yen | Swiss franc |
|---------------|-------------|-------|---------------|--------------|-------------|
| U.S. dollar   | -3.44       | -3.21 | -4.72         | -1.52        | 1.03        |
| Euro          | -3.21       | 1.06  | -0.93         | 2.28         | 3.62        |
| British pound | -4.72       | -0.93 | -5.40         | 0.30         | 2.45        |
| Japanese yen  | -1.52       | 2.28  | 0.30          | 2.81         | 9.14        |
| Swiss franc   | 1.03        | 3.62  | 2.45          | 9.14         | 7.85        |

### 3 Appendix D: India - FX reserves returns statistics

Table D1: Variance-covariance matrix of short-term FX reserves returns using PPP model for India

| 2010:01-2018:12         | U.S. dollar     | Euro           | British pound   | Japanese yen    | Swiss franc     |
|-------------------------|-----------------|----------------|-----------------|-----------------|-----------------|
| Mean return (%)         | 0.005           | 0.68           | 0.80            | 0.52            | 0.26            |
| Variance                | 1.24            | 1.08           | 0.79            | 0.78            | 1.13            |
| Skewness                | 0.56            | 0.29           | 0.21            | 0.20            | 0.58            |
| Jarque-Bera stat        | 4.05<br>(0.086) | 1.68<br>(0.35) | 19.28<br>(0.00) | 3.82<br>(0.095) | 4.20<br>(0.081) |
| Kolmogorov-Smirnov stat | 0.11<br>(0.15)  | 0.27<br>(0.00) | 0.41<br>(0.00)  | 0.27<br>(0.00)  | 0.12<br>(0.08)  |
| Variance-covariance     |                 |                |                 |                 |                 |
| U.S. dollar             | 1.24            |                |                 |                 |                 |
| Euro                    | -0.97           | 1.08           |                 |                 |                 |
| British pound           | -0.68           | 0.72           | 0.79            |                 |                 |
| Japanese yen            | -0.74           | 0.78           | 0.71            | 0.78            |                 |
| Swiss franc             | -1.02           | 1.03           | 0.79            | 0.84            | 1.13            |

Notes: Values in parentheses are p-values of the associated test statistic

Table D2: Co-Skewness U.S. dollar matrix of short-term FX returns using PPP model for India

|               | U.S. dollar | Euro  | British pound | Japanese yen | Swiss franc |
|---------------|-------------|-------|---------------|--------------|-------------|
| U.S. dollar   | 0.56        | -0.16 | 0.1           | 0.05         | -0.06       |
| Euro          | -0.16       | -0.09 | -0.14         | -0.14        | -0.17       |
| British pound | 0.1         | -0.14 | -0.1          | -0.12        | -0.22       |
| Japanese yen  | 0.05        | -0.14 | -0.12         | -0.17        | -0.24       |
| Swiss franc   | -0.06       | -0.17 | -0.22         | -0.24        | -0.30       |

Table D3: Co-Skewness Euro matrix of short-term FX returns using PPP model for India

|               | U.S. dollar | Euro  | British pound | Japanese yen | Swiss franc |
|---------------|-------------|-------|---------------|--------------|-------------|
| U.S. dollar   | -0.16       | -0.09 | -0.14         | -0.14        | -0.17       |
| Euro          | -0.09       | 0.29  | 0.181         | 0.21         | 0.32        |
| British pound | -0.14       | 0.18  | 0.180         | 0.18         | 0.30        |
| Japanese yen  | -0.14       | 0.21  | 0.183         | 0.22         | 0.31        |
| Swiss franc   | -0.17       | 0.32  | 0.30          | 0.31         | 0.42        |

Table D4: Co-Skewness British pound matrix of short-term FX returns using PPP model for India

|               | U.S. dollar | Euro  | British pound | Japanese yen | Swiss franc |
|---------------|-------------|-------|---------------|--------------|-------------|
| U.S. dollar   | 0.10        | -0.14 | -0.10         | -0.12        | -0.22       |
| Euro          | -0.14       | 0.181 | 0.18          | 0.18         | 0.30        |
| British pound | -0.10       | 0.18  | 0.21          | 0.20         | 0.29        |
| Japanese yen  | -0.12       | 0.183 | 0.20          | 0.21         | 0.294       |
| Swiss franc   | -0.22       | 0.30  | 0.29          | 0.29         | 0.43        |

Table D5: Co-Skewness Japanese yen matrix of short-term FX returns using PPP model for India

|               | U.S. dollar | Euro  | British pound | Japanese yen | Swiss franc |
|---------------|-------------|-------|---------------|--------------|-------------|
| U.S. dollar   | 0.05        | -0.14 | -0.12         | -0.17        | -0.24       |
| Euro          | -0.14       | 0.21  | 0.18          | 0.22         | 0.31        |
| British pound | -0.12       | 0.18  | 0.20          | 0.21         | 0.29        |
| Japanese yen  | -0.17       | 0.22  | 0.21          | 0.20         | 0.34        |
| Swiss franc   | -0.24       | 0.31  | 0.29          | 0.34         | 0.44        |

Table D6: Co-Skewness Swiss franc matrix of short-term FX returns using PPP model for India

|               | U.S. dollar | Euro  | British pound | Japanese yen | Swiss franc |
|---------------|-------------|-------|---------------|--------------|-------------|
| U.S. dollar   | -0.06       | -0.17 | -0.22         | -0.24        | -0.30       |
| Euro          | -0.17       | 0.32  | 0.30          | 0.31         | 0.42        |
| British pound | -0.22       | 0.30  | 0.29          | 0.294        | 0.43        |
| Japanese yen  | -0.24       | 0.31  | 0.294         | 0.34         | 0.44        |
| Swiss franc   | -0.30       | 0.42  | 0.43          | 0.44         | 0.58        |

#### 4 Appendix E: Turkey - FX reserves returns statistics

Table E1: Variance-covariance matrix of long-term FX reserves returns using PPP model for Turkey

| 2010:01-2018:12         | U.S. dollar      | Euro           | British pound   | Japanese yen     | Swiss franc     |
|-------------------------|------------------|----------------|-----------------|------------------|-----------------|
| Mean return (%)         | 3.07             | 3.01           | 2.78            | 1.26             | 1.33            |
| Variance                | 1.37             | 2.07           | 1.52            | 1.04             | 1.26            |
| Skewness                | 2.34             | 1.69           | 1.41            | 1.32             | 1.24            |
| Jarque-Bera stat        | 170.78<br>(0.00) | 7.09<br>(0.03) | 21.88<br>(0.00) | 109.70<br>(0.00) | 40.96<br>(0.00) |
| Kolmogorov-Smirnov stat | 0.90<br>(0.00)   | 0.82<br>(0.00) | 0.83<br>(0.00)  | 0.52<br>(0.00)   | 0.49<br>(0.00)  |
| Variance-covariance     |                  |                |                 |                  |                 |
| U.S. dollar             | 1.37             |                |                 |                  |                 |
| Euro                    | 1.08             | 2.07           |                 |                  |                 |
| British pound           | 1.19             | 1.52           | 1.52            |                  |                 |
| Japanese yen            | 0.99             | 1.20           | 1.08            | 1.04             |                 |
| Swiss franc             | 1.10             | 1.47           | 1.30            | 1.04             | 1.26            |

Notes: Values in parentheses are p-values of the associated test statistic

Table E2: Co-Skewness U.S. dollar matrix of long-term FX returns using PPP model for Turkey

|               | U.S. dollar | Euro | British pound | Japanese yen | Swiss franc |
|---------------|-------------|------|---------------|--------------|-------------|
| U.S. dollar   | 2.34        | 1.86 | 1.87          | 1.96         | 1.88        |
| Euro          | 1.86        | 1.53 | 1.61          | 1.55         | 1.52        |
| British pound | 1.87        | 1.61 | 1.61          | 1.59         | 1.58        |
| Japanese yen  | 1.96        | 1.55 | 1.59          | 1.62         | 1.55        |
| Swiss franc   | 1.88        | 1.52 | 1.58          | 1.55         | 1.51        |

Table E3: Co-Skewness Euro matrix of short-term FX returns using PPP model for Turkey

|               | U.S. dollar | Euro | British pound | Japanese yen | Swiss franc |
|---------------|-------------|------|---------------|--------------|-------------|
| U.S. dollar   | 1.86        | 1.53 | 1.61          | 1.55         | 1.52        |
| Euro          | 1.53        | 1.69 | 1.41          | 1.43         | 1.40        |
| British pound | 1.61        | 1.41 | 1.39          | 1.30         | 1.35        |
| Japanese yen  | 1.55        | 1.43 | 1.30          | 1.37         | 1.30        |
| Swiss franc   | 1.52        | 1.40 | 1.35          | 1.30         | 1.29        |

Table E4: Co-Skewness British pound matrix of short-term FX returns using PPP model for Turkey

|               | U.S. dollar | Euro | British pound | Japanese yen | Swiss franc |
|---------------|-------------|------|---------------|--------------|-------------|
| U.S. dollar   | 1.87        | 1.61 | 1.61          | 1.60         | 1.58        |
| Euro          | 1.61        | 1.41 | 1.39          | 1.30         | 1.35        |
| British pound | 1.61        | 1.39 | 1.41          | 1.30         | 1.36        |
| Japanese yen  | 1.59        | 1.30 | 1.30          | 1.32         | 1.28        |
| Swiss franc   | 1.58        | 1.35 | 1.36          | 1.28         | 1.30        |

Table E5: Co-Skewness Japanese yen matrix of long-term FX returns using PPP model for Turkey

|               | U.S. dollar | Euro | British pound | Japanese yen | Swiss franc |
|---------------|-------------|------|---------------|--------------|-------------|
| U.S. dollar   | 1.96        | 1.55 | 1.59          | 1.62         | 1.55        |
| Euro          | 1.55        | 1.43 | 1.30          | 1.37         | 1.30        |
| British pound | 1.59        | 1.30 | 1.30          | 1.32         | 1.28        |
| Japanese yen  | 1.62        | 1.37 | 1.32          | 1.324        | 1.31        |
| Swiss franc   | 1.55        | 1.30 | 1.28          | 1.31         | 1.25        |

Table E6: Co-Skewness Swiss franc matrix of long-term FX returns using PPP model for Turkey

|               | U.S. dollar | Euro | British pound | Japanese yen | Swiss franc |
|---------------|-------------|------|---------------|--------------|-------------|
| U.S. dollar   | 1.88        | 1.52 | 1.58          | 1.55         | 1.51        |
| Euro          | 1.52        | 1.40 | 1.35          | 1.30         | 1.29        |
| British pound | 1.58        | 1.35 | 1.36          | 1.28         | 1.30        |
| Japanese yen  | 1.55        | 1.30 | 1.28          | 1.31         | 1.25        |
| Swiss franc   | 1.51        | 1.29 | 1.30          | 1.25         | 1.24        |