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# Modelling opportunity cost effects in money demand due to openness

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**Abstract**

We apply a novel model-based approach to constructing composite international financial indices (CIFIs) as measures of opportunity cost effects that arise due to openness in money demand models. These indices are tested on the People's Republic of China (PRC) and Taiwan Province of China (TPC), two economies which differ substantially in size and degree of financial openness. Results show that (a) stable money demand equations can be identified if accounting for foreign opportunity costs through CIFIs, (b) the monetary policy intervention in the PRC over the global financial crisis period temporarily mitigated disequilibrating foreign shocks to money demand, (c) CIFIs capture opportunity costs due to openness more adequately than commonly used US interest rates and (d) CIFI construction provides valuable insights into the channels through which foreign financial markets affect domestic money demand.

**KEYWORDS**

Composite measurement, money demand, open economy, opportunity cost

## 1 | INTRODUCTION

The lack of appropriate measures of opportunity costs in conventional money demand models is a widely acknowledged problem for empirically establishing a stable relationship between money demand and the domestic interest rate (e.g., Calza et al. 2001). Financial deepening renders interest rate variables increasingly inadequate as measures of opportunity costs that arise from speculative and precautionary motives. The problem is complicated by financial openness, as opportunity costs from foreign assets must be considered alongside domestic assets. Emerging market economies that have deepened their financial sectors and heightened financial integration over recent decades are particularly vulnerable to instability in the money demand equation. This is because the increased availability of assets potentially alters the sensitivity of money holdings to domestic interest rates, undermining the interest rate as an effective policy tool (e.g., Gurley & Shaw, 1955; Poole, 1970; Darrat & Webb, 1986). However, historical evidence, mainly from the US and the UK, suggests that a stable relationship can be found if opportunity costs are adequately accounted for (e.g., Friedman & Schwartz, 1982; Hendry & Ericsson, 1991). Taking as case studies the People's Republic of China (PRC) and Taiwan Province of China (TPC), two export-oriented economies which differ substantially in size and degree of financial openness,

this paper develops composite international financial indices (CIFIs) as measures of opportunity costs in conventional money demand equations, to test whether stability can be maintained by inclusion of such measures.

The PRC's financial opening was initiated with the establishment of the Shanghai Stock Exchange, major reforms of the banking system, and the official recognition of monetary aggregates as a policy target by the People's Bank of China (PBC) in the mid-1990s (El-Shagi & Zheng, 2017; Chen & Werner, 2011). Recent reforms such as the gradual and measured opening of the capital account and the abandonment of the exchange rate peg in July 2005 made the PRC more susceptible to international financial shocks (Glick & Hutchison, 2009). Throughout the global financial crisis (GFC) period, the PBC intervened heavily by reverting to the dollar peg between November 2008 and June 2010, reintroducing strict capital controls and releasing a 4 trillion RMB fiscal stimulus package combined with an expansionary monetary policy (Yu, 2010; Han, 2012). In 2011, the PBC gradually returned to a more prudent monetary policy and the continuation of the pre-crisis liberalization agenda achieved its goal of establishing the RMB as an international reserve currency in December 2015 (Berkelmans, Kelly, & Sadeghian, 2016).

Financial liberalization started much earlier in TPC, with the establishment of the Taipei Foreign Exchange Market in 1979 and the implementation of a flexible exchange rate regime in the same year (Shieh, Liu, & Lee, 2017). In late 2003, domestic stock markets were fully opened to foreign investors completing financial liberalization (Wu et al., 2005; Lee & Chang, 2008). In contrast to the PRC case, the central bank of TPC did not intervene during the GFC which triggered large scale capital inflow as domestic investors retreated from international financial markets (Wu et al., 2014). Given the differences between the two economies in terms of financial integration and experiences during and after the GFC, we expect different conclusions in the search for an adequate measure of opportunity costs due to openness.

Increasingly interactive asset price movements across financial markets globally require empirical strategies that adequately capture those movements in money demand models. However, empirical strategies often rely on a few foreign (predominantly US) interest rate variables (and exchange rates) (e.g., Chowdhury, 1995; Calza et al., 2001). These variables are inadequate measures of the openness effects for two key reasons. First, bilateral interest rate parity conditions that underlie opportunity cost arbitrage in the money demand equation are frequently found to not hold empirically (e.g., Froot & Thaler, 1990). Second, it is precisely the interactive nature of asset prices across financial markets and the banking sector that underlies opportunity costs that arise from speculative and precautionary motives for money holding. Hence, these motives cannot be captured adequately by interest rate variables alone.

Instead of relying on interest rate variables from a small number of individual economies, we suggest constructing country specific CIFIs as aggregate measures of international opportunity costs that arise from a broad set of foreign financial markets. CIFIs are inspired by a wider literature that addresses the construction of financial condition indices (FCIs) to be used as measures of financial market conditions in macroeconomic models. FCIs are commonly constructed by principle component-based (PC-based) factor analysis following the seminal work of Stock and Watson (1990, 2002). However, PC-based FCIs suffer from a lack of the concatenation operation, the imposition of synchronized dynamics among financial input variables, and the inability to capture country specific effects; see Qin et al. (2018) for a literature review and discussion. Evading these shortcomings, Qin et al. (2018) propose a novel algorithmic modelling approach to FCI construction that imposes the concatenation operation as a fundamental measurement property, provides for dynamic dis-synchronization among input indicators and employs unsupervised and supervised learning methods for a country (target) specific index construction. We adapt this novel approach for CIFI construction to augment conventional money demand models.

Our choice of input indicators for CIFI construction is guided by the existing literature that addresses opportunity costs in money demand equations. Friedman and Schwartz (1982) argue for the inclusion of money, stock and bond markets. Friedman (1988) and Choudhry (1996) show that money demand equations that exclude stock market prices are mis-specified. McNown and Wallace (1992) further demonstrate the importance of including exchange rates. Since the GFC, banking sector characteristics such as ease of credit and risk perception have increasingly been recognized for their role in money demand (Gambacorta & Marques-Ibanez, 2011). These considerations are also reflected in the more recent empirical literature that investigates money demand for the economies of TPC and the PRC (Wu et al., 2005; 2014; Shieh et al., 2017; Baharumshah et al., 2009). Following this literature, we include input indicators from stock, foreign exchange, futures, bond and money markets and the banking sector.

Our key findings can be summarized in four points: (a) stable money demand models can be found if they account for foreign opportunity costs through CIFIs during times of financial openness; (b) the PBC's policy intervention over the GFC period temporarily mitigated

disequilibrating foreign shocks to money demand; (c) CIFIs capture opportunity costs due to openness more adequately than US interest rates; and (d) CIFI construction provides valuable insights into the channels through which foreign financial markets affect domestic money demand.

The remainder of the paper is structured as follows. The next section outlines a money demand model that accounts for opportunity cost effects due to openness in the form of latent variables. The next section also outlines the algorithm for the construction of CIFIs as measures of these latent variables. The third section presents and discusses empirical results for the economies of the PRC and TPC. The fourth section concludes with some consideration of the methodological implications.

## 2 | METHOD AND DATA

We start from a standard money demand equation with $M$ being narrow money (M1), $R$ being the domestic interest rate or opportunity cost of holding money balances and $Y$ being economic expenditure or output approximated by GDP:

$$M = f(Y, R) \tag{1}$$

In an open economy context, foreign opportunity costs $R^*$ arise alongside domestic opportunity costs due to the possibility of domestic investors investing abroad or foreign investors investing domestically. If $Cov(R, R^*) \neq 0$, the omission of $R^*$ from (1) results in a biased estimate of the sensitivity of money demand to the domestic interest rate $R$. Amending (1) accordingly yields (2).

$$M = f(Y, R, R^*) \tag{2}$$

Following the seminal work of Hendry and Ericsson (1991), we choose an error-correction model (ECM) as the model form for (1), with $m_t = \ln(M_t)$ and $y_t = \ln(Y_t)$ as our baseline model:

$$\begin{aligned} \Delta m_t &= \alpha_0 + \sum_{i=1}^{q} \alpha_i \Delta m_{t-i} + \sum_{i=0}^{q} \beta_i \Delta y_{t-i} \\ &\quad + \sum_{i=0}^{q} \theta_i \Delta R_{t-i} - \gamma e_{t-1} + u_t, \\ e_{t-1} &= m_{t-1} - k_1 y_{t-1} - k_2 R_{t-1}, \end{aligned} \tag{3}$$

where $\Delta$ denotes a one-period difference, $q$ is the lag length, $e_{t-1}$ is the error-correction term and $u_t$ is the model residual term. Correspondingly, the ECM on the basis of (2) can be written as:

$$\begin{aligned} \Delta m_t &= \alpha_0 + \sum_{i=1}^{q} \alpha_i \Delta m_{t-i} + \sum_{i=0}^{q} \beta_i \Delta y_{t-i} \\ &\quad + \sum_{i=0}^{q} \theta_i \Delta R_{t-i} + \sum_{i=0}^{q} \delta_i \Delta R^*_{t-i} - \gamma e^*_{t-1} + \varepsilon_t, \\ e^*_{t-1} &= m_{t-1} - k_1 y_{t-1} - k_2 R_{t-1} - k_3 R^*_{t-1}, \end{aligned} \tag{4}$$

Our key postulate is that $R^*$ is latent and can be measured by CIFIs. The latency of $R^*$ arises over the availability of a large variety of potentially highly correlated assets as alternative to money. Denoting the CIFIs as measures of opportunity costs by $f^*_t$, the above model becomes:

$$\begin{aligned} \Delta m_t &= \alpha_0 + \sum_{i=1}^{q} \alpha_i \Delta m_{t-i} + \sum_{i=0}^{q} \beta_i \Delta y_{t-i} \\ &\quad + \sum_{i=0}^{q} \theta_i \Delta R_{t-i} + \sum_{i=0}^{q} \delta_i \Delta f^*_{t-i} - \gamma e^*_{t-1} + \varepsilon_t, \\ e^*_{t-1} &= m_{t-1} - k_1 y_{t-1} - k_2 R_{t-1} - k_3 f^*_{t-1}. \end{aligned} \tag{5}$$

The CIFI construction algorithm is outlined in Figure 1, whereby the construction of $f^S_t$ as a measure of $\Delta f^*_t$ and $f^L_t$ as a measure of $f^*_t$ differs in choice of targets; see also Appendix A.

Over 180 raw financial series are collected in preparation for the CIFI construction. See Appendix B, Table B1 for the full set of financial variables used and their data sources. These series cover the money, foreign exchange, futures, stock and bond markets as well as banking sectors of the 21 economies that constitute the major trading partners of the PRC and TPC. Briefly, the first step involves constructing financial input indicators as disequilibrium indicators (spreads and ratios). The use of disequilibrium indicators is motivated by the growing recognition that financial imbalances or frictions drive cross-border capital flows in a highly financially integrated world (Drehmann et al., 2012; Borio, 2013, 2014; Vines & Wills, 2018). Arbitrage and risk perception underlying speculative and precautionary motives for money holding are hence best captured by disequilibrium indicators (Borio, 2015). Roughly, 115 such indicators are constructed, and their categorization is summarized in Table 1. See Appendix B, Table B2 for the full set of input indicators and their construction.

Where appropriate, we aggregate groups of input indicators from each market category listed in Table 1 into composite financial indicators as reflective measures of common shocks for redundancy reduction in the second step. Appropriate groups are identified by means of clustering methods which classify as unsupervised learning . The third step involves supervised dimension reduction. We aggregate the composite and individual financial input indicators into CIFIs by means of partial

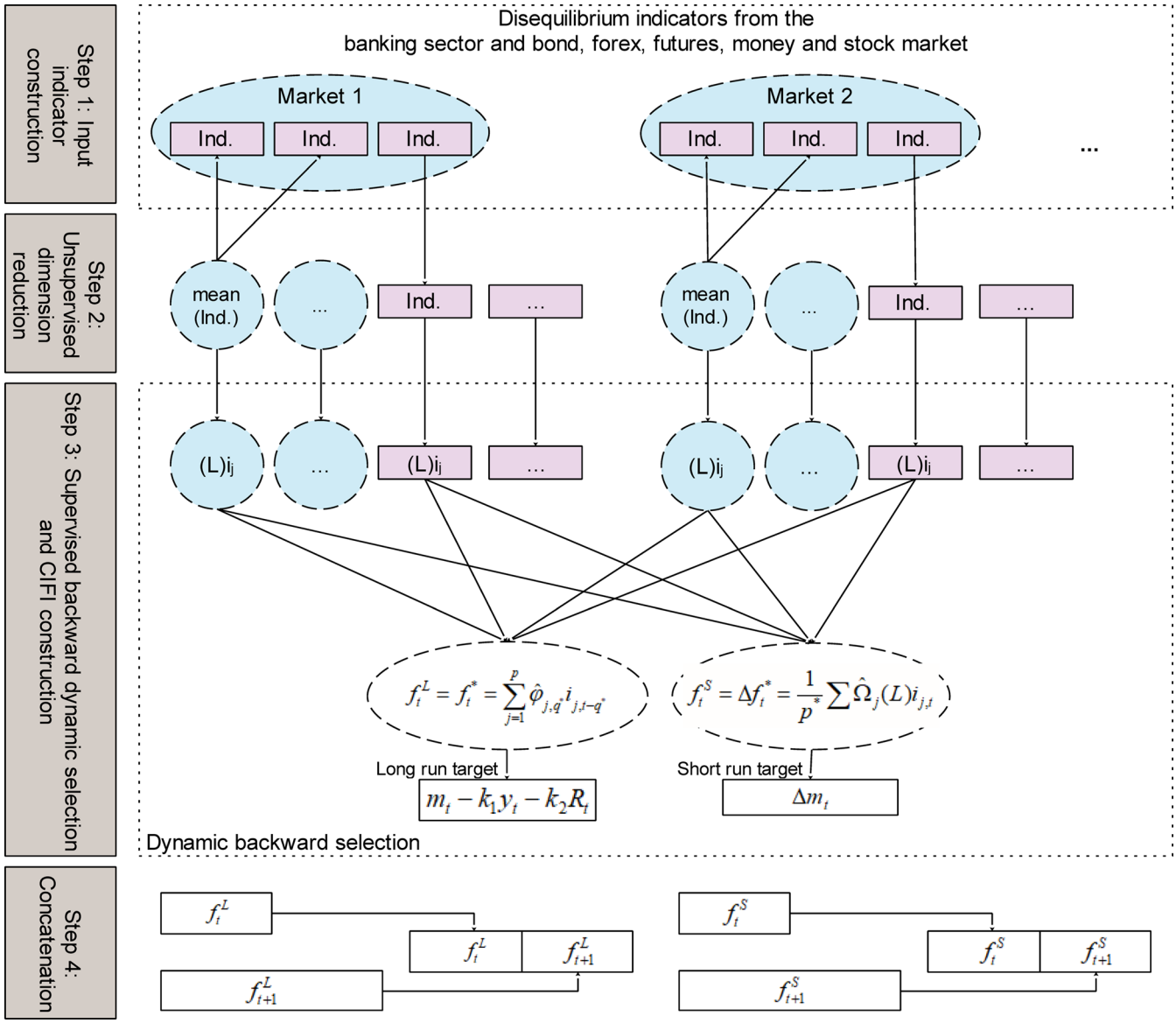



**FIGURE 1** CIFI construction algorithm.
Dashed lined circles/eclipses indicate measurements of latent constructs. Solid lined boxes indicate observed variables. Arrows indicate measurement constructs: reflective (upward) and formative/composite (downward) [Colour figure can be viewed at wileyonlinelibrary.com]

regression analysis based on the principles of partial least square (PLS) regression (Wold, 1966, 1975, 1980) and dynamic backward selection. CIFIs are formative measures in that they represent different facets of financial markets and as such require more than one criterion (Howell, Breivik, & Wilcox, 2013). PLS adds a predictive target as an additional criterion to the common variance criterion underlying standard PCA, making it a supervised learning method. From (4), two targets are identified, a short-run target $\Delta m_t$ and a long-run target $m_t - k_1 y_t - k_2 R_t$ for the construction of $f_t^S = \Delta f_t^*$ and $f_t^L = f_t^*$ respectively. With the combination of unsupervised and supervised learning methods in steps 2 and 3, the CIFI construction process becomes akin to multi-path PLS. Qin et al. (2018) confirm the contribution of step 2 by showing that CIFIs constructed with multi-path PLS consistently outperform CIFIs that are constructed with simple PLS. We hence include the unsupervised dimension reduction step throughout. The fourth step comprises regular updating and concatenating of the CIFIs. A detailed description of the CIFI construction algorithm is given in Appendix A.

Our sample data is in monthly frequency from 1993: M9 to 2015:M6. The exception is GDP which is only available in quarterly frequency. Its monthly series is interpolated using monthly industrial production. We select 1994:M6 to 2005:M6 as the model training period which ensures a decent level of composite reliability

**TABLE 1** Summary of input disequilibrium indicators

| Market category | Indicators | Coverage |
|---|---|---|
| Banking sector | Total lending-to-deposit ratio of the banking sector | 2 |
| | Interest rate spread (lending-to-deposit rate) | 7 |
| | Debt to liquidity ratio (M1 to liabilities) | 5 |
| Bond market | 10 years to 1 (or 2) year(s) government bond spread | 11 |
| | 30 (or 20) years to 10 years government bond spread | 7 |
| | 30 (or 20) years to 1 (or 2) year(s) government bond spread | 7 |
| Foreign exchange market | PPP as foreign over domestic CPI | 20 |
| Futures market | Calendar spread commodity futures | 8 |
| | Calendar spread stock futures | 7 |
| Money market | 3-to-6 months T-bill spread | 6 |
| | TED spread | 7 |
| | Overnight to 3-months interbank rate spread | 8 |
| Stock market | Cross-market ratio foreign over domestic | 20 |

*Notes*: Input indicators are identical for the PRC and the TPC experiments except for the cross-market ratios (stock market) and PPP (foreign exchange market) where the domestic base variable changes. Further, some indicators in the money market category are excluded if they become domestic indicators.

(Terry & Kelley, 2012). The months before 1994:M6 are used for lag length selection. This leaves us with a 10-year period for model testing with annual model updates. The model testing period is further sub-divided into two periods: the pre-crisis period up to 2007:M6 and the crisis and post-crisis period for the remaining years.

## 3 | RESULTS AND DISCUSSION

Our evaluation of the CIFIs is presented in four sub-sections. The first sub-section is dedicated to model training and testing over the pre-crisis period. We evaluate the CIFI-augmented model (5) against the closed economy baseline (3) and a version of (4) in which we adopt the use of US interest rates $R_t^{US}$ as a proxy for foreign opportunity costs, as is prominent in the literature.[1] In the second sub-section, we search for the conditions under which parameter invariance can be maintained during the turbulent period of the GFC. In the third sub-section, we unpack the disaggregate financial shocks to money demand constituting the CIFIs. The exercise enables us to identify transmission channels of disaggregate foreign shocks to domestic money demand and thereby potential sources of foreign risk. The fourth section presents robustness checks of our findings against remaining redundancies in the set of input indicators.

### 3.1 | Model training and pre-crisis testing

Parsimonious model versions of Equations (3) to (5) are obtained over the training period by the LSE general-to-specific dynamic model reduction approach akin to dynamic backward selection in the statistical learning literature (Hendry, 1995). The initial maximum lag length is set as $q = 6$. These parsimonious models are referred to as "MD0" for the baseline model (3), "MD1" for the CIFI-augmented model (5) and "MD2" for the US interest rate augmented model version of (4) hereafter. During the model reduction search, we settle on the specification of quarterly, instead of monthly, differences for both the M1 and GDP growth variables.

Table 2 summarizes the model search results over the training period. We impose a unit long-run income elasticity $k_1 = 1$ for both the PRC and TPC for all three model versions, as it is shown to be data permissive and in line with the existing literature; see Sriram (1999) for a discussion of the role of $y_t$ as scale variable. In the baseline model version, the long-run interest rate coefficient is found to be $k_2 = 0.05$ for the PRC and $k_2 = 0.3$ for TPC respectively; see details on the EC term of MD0 in Table 2.

Potential collinearity problems between $k_3$ and $k_2$ arise when accounting for foreign opportunity costs in the open economy models MD1 and MD2. In the case of MD1, we handle this problem by iterative calibration of $k_2$. The domestic interest rate coefficient shrinks (in absolute measures) for both economies with the inclusion of long-run CIFIs indicating substitution effects. The effect is stronger for TPC suggesting greater openness of the economy, and the coefficient on the domestic interest rate becomes similar in size to the PRC. Similarly, we find a strong substitution effect between US and domestic interest rates in the long run of MD2. For TPC, the inclusion of US interest rates causes the coefficient sign of the domestic interest rate to switch, suggesting wealth effects when controlling for foreign interest rates.

**TABLE 2** Model search results over the training period 1994:M6-2005:M6

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **PRC** | | | | | | | | |
| MD0 | | $\Delta_3 m_{t-1}$ | $\Delta_3 y_t$ | $\Delta_3 y_{t-1}$ | $\Delta_2 R_t$ | $e_{t-3}$ † | | |
| | Coef. | 0.585 | 0.078 | 0.113 | 0.009 | −0.060 | | |
| | s.e. | 0.057 | 0.021 | 0.017 | 0.004 | 0.018 | | |
| | Part. $R^2$ | 0.456 | 0.101 | 0.276 | 0.047 | 0.079 | | |
| | Adj. $R^2$ | 0.787 | | | | † $e_t = m_t - y_t + 0.05\, R_t$ | | |
| MD1 | | $\Delta_3 m_{t-1}$ | $\Delta_3 y_t$ | $\Delta_3 y_{t-1}$ | $\Delta_2 R_t$ | $e^*_{t-3}$ † | $f^S_t$ | |
| | Coef. | 0.435 | 0.094 | 0.056 | 0.008 | −0.099 | 2.968 | |
| | s.e. | 0.059 | 0.021 | 0.018 | 0.003 | 0.024 | 0.474 | |
| | Part. $R^2$ | 0.306 | 0.145 | 0.073 | 0.041 | 0.126 | 0.242 | |
| | Adj. $R^2$ | 0.826 | | | | † $e^*_t = m_t - y_t + 0.02\, R_t - f^L_t$ | | |
| MD2 | | $\Delta_3 m_{t-1}$ | $\Delta_3 y_t$ | $\Delta_3 y_{t-1}$ | $\Delta_2 R_t$ | $e^*_{t-3}$ † | $\Delta R^{US}_{t-3}$ | $\Delta_2 R^{US}_{t-4}$ |
| | Coef. | 0.507 | 0.090 | 0.110 | 0.013 | −0.097 | 0.018 | −0.012 |
| | s.e. | 0.062 | 0.020 | 0.016 | 0.004 | 0.021 | 0.008 | 0.005 |
| | Part. $R^2$ | 0.354 | 0.142 | 0.285 | 0.093 | 0.145 | 0.039 | 0.045 |
| | Adj. $R^2$ | 0.805 | | | | † $e^*_t = m_t - y_t + 0.03\, R_t + 0.02\, R^{US}_t$ | | |
| TPC | | | | | | | | |
| MD0 | | $\Delta_3 m_{t-1}$ | $\Delta_3 y_{t-1}$ | $\Delta R_{t-2}$ | $e_{t-3}$ † | | | |
| | Coef. | 0.254 | 0.268 | −0.037 | −0.023 | | | |
| | s.e. | 0.079 | 0.110 | 0.039 | 0.009 | | | |
| | Part. $R^2$ | 0.077 | 0.045 | 0.007 | 0.051 | | | |
| | Adj. $R^2$ | 0.417 | | | | † $e_t = m_t - y_t + 0.3\, R_t$ | | |
| MD1 | | $\Delta_3 m_{t-1}$ | $\Delta_3 y_{t-1}$ | $\Delta R_{t-2}$ | $e^*_{t-3}$ † | $f^S_t$ | $\Delta_2 f^S_t$ | |
| | Coef. | 0.189 | 0.095 | −0.007 | −0.164 | 3.217 | 2.177 | |
| | s.e. | 0.065 | 0.085 | 0.030 | 0.051 | 0.595 | 0.554 | |
| | Part. $R^2$ | 0.063 | 0.010 | 0.000 | 0.077 | 0.191 | 0.111 | |
| | Adj. $R^2$ | 0.677 | | | | † $e^*_t = m_t - y_t + 0.05\, R_t - f^L_t$ | | |
| MD2 | | $\Delta_3 m_{t-1}$ | $\Delta_3 y_{t-1}$ | $\Delta R_{t-2}$ | $e^*_{t-3}$ † | $\Delta_2 R^{US}_{t-1}$ | | |
| | Coef. | 0.196 | 0.190 | −0.049 | −0.142 | 0.043 | | |
| | s.e. | 0.076 | 0.105 | 0.044 | 0.034 | 0.014 | | |
| | Part. $R^2$ | 0.051 | 0.026 | 0.010 | 0.122 | 0.070 | | |
| | Adj. $R^2$ | 0.478 | | | | † $e^*_t = m_t - y_t - 0.05\, R_t + 0.1\, R^{US}_t$ | | |

*Note*: Constant and seasonal dummies are not reported here. Seasonal dummies for PRC: January, July and November. Seasonal dummies for TPC: April, May, September. Part. $R^2$ is partial R-square. Adj. $R^2$ is adjusted R-square.

The inclusion of CIFIs in MD1 further results in a drop in the own lag coefficient and an increase in the speed of adjustment coefficient (in absolute measures). This demonstrates omitted variable bias in MD0 and strengthens our argument about the importance of incorporating opportunity costs due to openness in money demand equations. Changes in the partial r-squares indicate a substitutive effect on the own lag and a complementary effect on the speed of adjustment coefficient. These effects are similar in direction for the MD2 model, which includes US interest rates, but the effects are more muted than in MD1.

Model comparison results via Cox (1961) encompassing tests over the training and pre-crisis testing period are summarized in Table 3. The null hypothesis of the CIFI model MD1 outperforming the default model MD0 and the US interest rate augmented model MD2 cannot be rejected for both the PRC and TPC. Test results clearly favour MD1 over both MD0 and MD2.

**TABLE 3** Pre-crisis model testing 1994:M6-2007:M6

| | Null hypothesis | Cox test | [p-value] | Null hypothesis | Cox test | [*p*-value] |
|---|---|---|---|---|---|---|
| PRC | | | | | | |
| 1 | MD0 > MD1 | −12.14 | [0.0000][a] | MD0 < MD1 | −2.508 | [.0121][b] |
| 2 | MD2 > MD1 | −9.740 | [0.0000][a] | MD2 < MD1 | −1.929 | [.0537] |
| 3 | MD0 > MD2 | −4.852 | [0.0000][a] | MD0 < MD2 | −0.784 | [.4329] |
| TPC | | | | | | |
| 4 | MD0 > MD1 | −36.05 | [0.0000][a] | MD0 < MD1 | 0.672 | [.5015] |
| 5 | MD2 > MD1 | −27.48 | [0.0000][a] | MD2 < MD1 | 0.185 | [.8536] |
| 6 | MD0 > MD2 | −4.092 | [0.0000][a] | MD0 < MD2 | −5.536 | [.0000][a] |

*Note*: Cox (1961) encompassing test with test statistic following standard normal under the Null. *P*-values in brackets.
[a]Significance at the 1%.
[b]Significance at the 5% level.

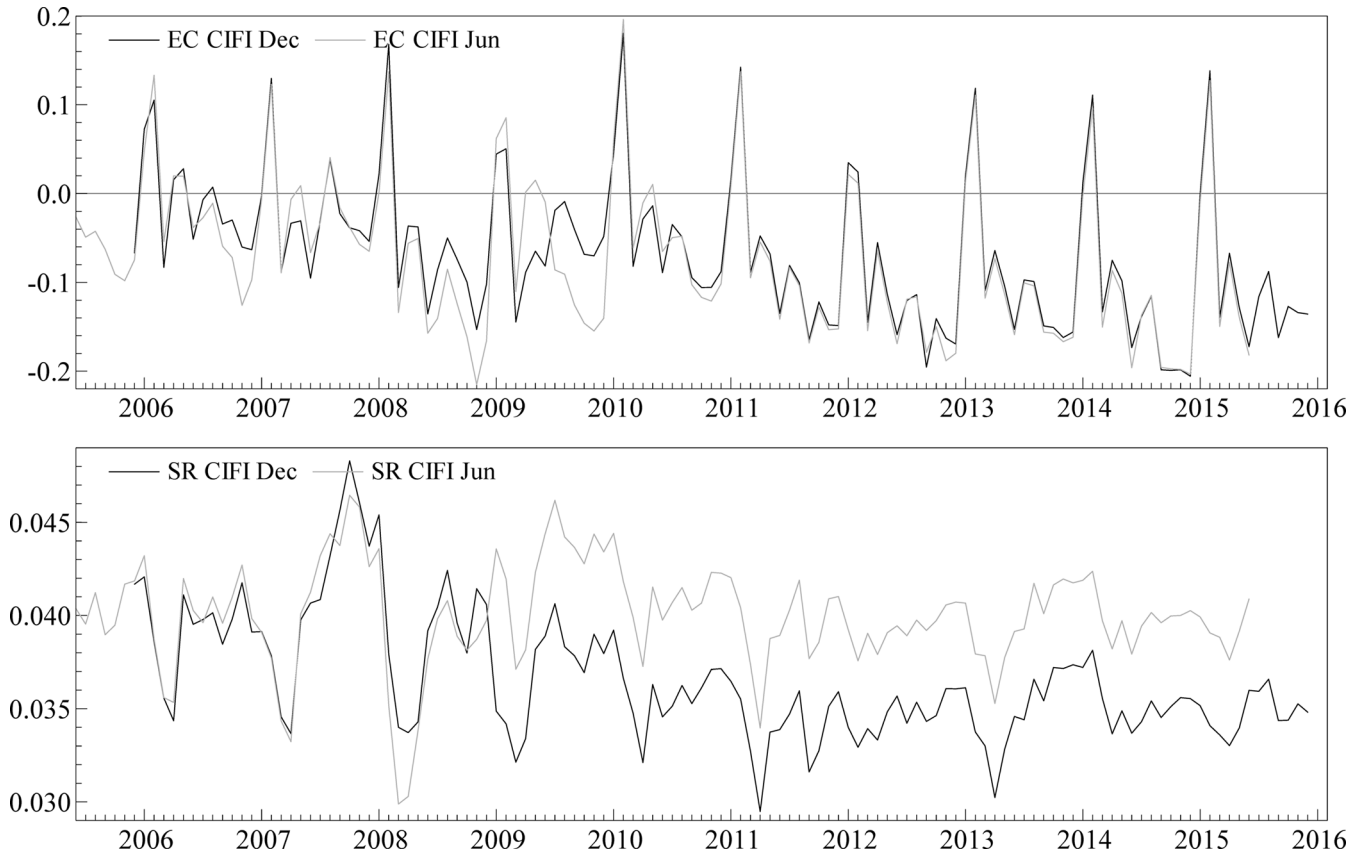
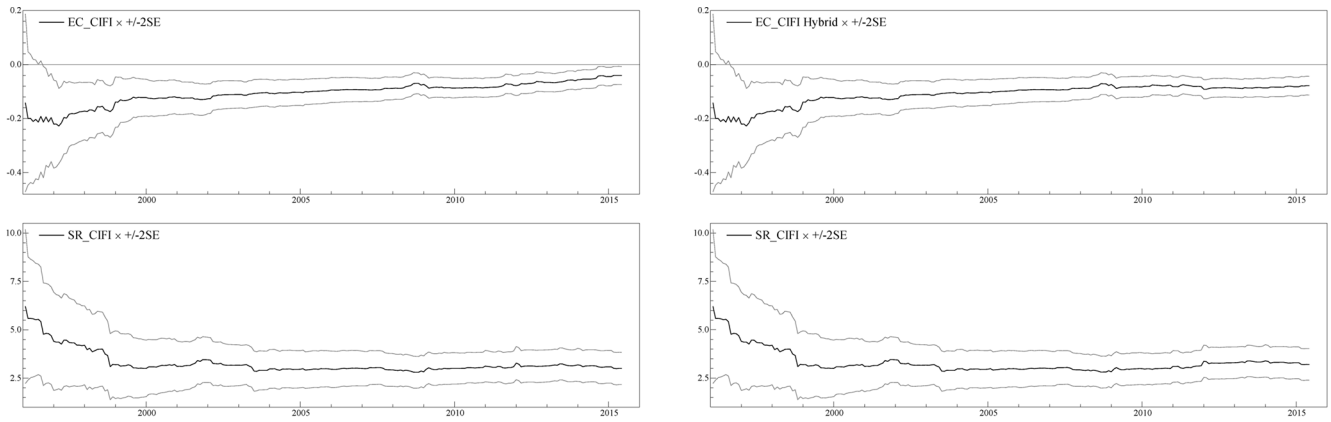



**FIGURE 2** PRC CIFIs with different updating months, 2005:M6 to 2015:M12.
The top tile depicts $e_t^*$ of (5) with December update (EC CIFI Dec) and June update (EC CIFI Jun). The bottom tile depicts $f_t^S$ with December update (SR CIFI Dec) and June update (SR CIFI Jun). The training period is excluded

## 3.2 | Crisis and post-crisis testing

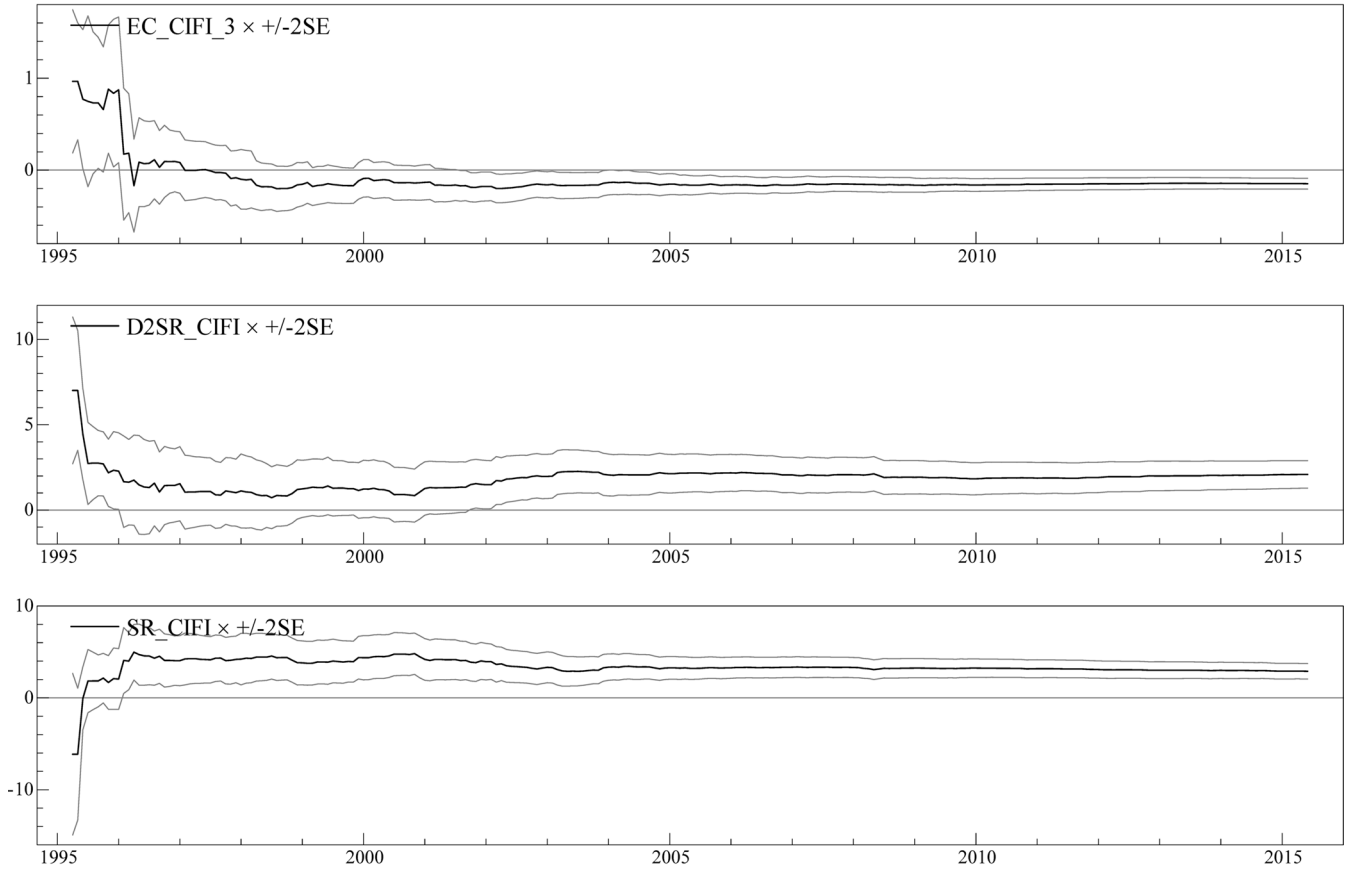
The GFC poses a severe challenge to the models shown in Table 2. At the same time, it offers an opportunity to investigate whether parameter constancy of the CIFIs in MD1 can be maintained over this turbulent period. If confirmed, the CIFIs exhibit properties akin to super exogeneity—conditional invariance of an exogenous variable with a time-varying marginal process—underscoring their empirical robustness (Engle et al., 1983). The investigation is carried out in separate steps for the short-run and long-run CIFIs, with the aim of finding which CIFIs,




(a) PRC CIFI model MD1

(b) PRC hybrid CIFI model MD1

Hansen† $e_t^*$ 1.9958** $f_t^s$ 0.8366** Hansen† $e_t^{h,*}$ 0.2668 $f_t^s$ 0.3153




(c) TPC CIFI model MD1

Hansen† $e_t^*$ 0.1724 $\Delta_2 f_t^s$ 0.3744 $f_t^s$ 0.3105

**FIGURE 3** Recursive estimation of MD1 and Hansen parameter instability tests over testing and training period 1994:M6-2015:M6. Figures show recursive coefficient estimates +/− 2 times the SE in light grey. Estimates are for the June update. † Hansen parameter instability test statistic below figures. ** indicating 1% significance level

if any, can help retain the models' parameter constancy during this turbulent period. Two observations are made. First, we find that synchronization of CIFI updating with the GFC shock is a key condition for the parameter constancy of the short-run CIFIs. Second, re-calibration of the long-run EC terms is required in the presence of policy induced location shifts to ensure co-breaking in the EC terms (Hendry & Massmann, 2007).

While short-run CIFIs and long-run CIFI-augmented EC terms are almost congruent before the 2008 update, the point at which the crisis shock is incorporated into the CIFIs differs with the choice of update point. For the short-run CIFI, the shock results in a permanent location shift. In Figure 2, we demonstrate this by experimenting with two updating points, mid-year (June) as in previous experiments and end-of-year (December) using the PRC data. We find that the end-of-year update results in instability in the short-run CIFI coefficient in MD1 for the PRC at the onset of the GFC, while stability is retained if the updating month is selected mid-year. This shows us that while the GFC shock remains visible in the marginal process of CIFI construction as discussed in the next section, by synchronizing the update point with the time point of shock to the target, an invariant short-run relationship between the CIFI and the money aggregate can be found.

The shock to the long run in MD1 is more permanent, with the speed of adjustment coefficient shrinking steadily from the crisis period onwards, regardless of the updating month (see Figure 3(a)). With the PBC's policy intervention during the GFC, the economy became relatively insulated from the instability induced by the external long-run disequilibrium shocks, resulting in a location shift of the EC term. To accommodate the insulation period, we build a hybrid EC term $e_t^{h,*}$ for the PRC, which shifts between the CIFI-augmented EC term and the default EC term, see (6).

$$e_t^{h,*} = \begin{cases} m_t - y_t + 0.02\,R_t - \mathrm{f}_t^L, t < 2008M6 \\ m_t - y_t + 0.05\,R_t, 2008M6 \le t < 2014M6 \\ m_t - y_t + 0.02\,R_t - f_t^L, 2014M6 \le t \end{cases} \quad (6)$$

With the policy intervention of 2008, we shift to the EC term of MD0, excluding opportunity costs due to openness. Foreign influences fully reappear in 2014 and we shift back to the EC term of MD1. By accounting for the PBC's policy response to the GFC through re-calibration of the EC term, parameter stability is retained with long-run variables co-breaking for the PRC model (see Figure 3(b)).

In contrast to the PRC case, we find that parameter invariance of MD1 remains undisturbed during and after the GFC period for the TPC case. This corresponds to the choice of the TPC central bank, which opted against policy intervention during and after the GFC (see Figure 3 (c)). We conclude that the instability in the PRC model stems from the decisive interventions by the PBC that shielded the domestic economy from long-run disequilibrium foreign shocks. The different performance of short-run and long-run CIFIs in MD1 reveals the value of a targeted approach to CIFI construction. Despite identical sets of input indicators, the two different targets result in two uncorrelated CIFIs reflecting distinct information useful for modelling money demand.

Model comparison results over the GFC and post-GFC period using Cox (1961) and Sargan (1964) model-encompassing tests with repeated 12-month updates are summarized in Table 4. Following the insights gained previously, we use the hybrid EC term $e_t^{h,*}$ for the PRC MD1. In the case of TPC, the CIFI model clearly outperforms the baseline model throughout the testing period. In the case of the PRC, we also find that MD1 generally outperforms the baseline model.

### 3.3 | Tracing sources of disaggregate financial risks via weight analysis

The previous two sub-sections clearly establish MD1 as the favoured model design over MD0 and MD2, confirming the conjecture of omitted variable bias in MD0 and supporting CIFIs as measures of latent opportunity costs due to openness. The supervised learning component in the CIFI construction algorithm enables us to evaluate the weights and dynamic forms with which different input indicators enter the CIFIs. The weights of individual input indicators provide valuable insights into the sensitivity of aggregate money demand to opportunity costs and risks arising from disaggregate foreign financial conditions. The weight structure of short-run CIFIs and long-run CIFIs is different by construction, as explained in section 2 and Appendix A. Specifically, short-run CIFIs capture positive (pro-cyclical) or negative (counter-cyclical) shocks, while long-run CIFIs capture long-run equilibrium conditions. We will analyse the disaggregate evidence for the short-run and long-run CIFIs in turn.

Short-run CIFI weights and lag structures are summarized in Tables C2,C3,C4,C5 in Appendix C. Shocks from banking sector liquidity and foreign exchange markets enter with the largest weights. Results for the foreign exchange markets are unsurprising, but the large weight on excess liquidity from the banking sector is not yet a prominent feature in the literature in the context of narrow money and suggests some spill-over effects from expansionary monetary policy in the US and Euro area.

**TABLE 4** In-sample Cox and Sargan encompassing test over repeated 12-month updates

| | PRC | | | | TPC | | | |
|---|---|---|---|---|---|---|---|---|
| | MD0 > MD1 | | MD1 > MD0 | | MD0 > MD1 | | MD1 > MD0 | |
| | Cox | Sargan | Cox | Sargan | Cox | Sargan | Cox | Sargan |
| 2008:M6 | −11.630 | 31.956 | −3.246 | 4.9873 | −35.200 | 65.521 | 0.417 | 0.284 |
| | [0.0000][a] | [0.0000][a] | [0.0012][a] | [0.0255][b] | [0.0000][a] | [0.0000][a] | [0.6769] | [0.8677] |
| 2009:M6 | −12.800 | 33.505 | −2.634 | 3.7038 | −37.070 | 71.028 | 0.466 | 0.588 |
| | [0.0000][a] | [0.0000][a] | [0.0084][a] | [0.0543] | [0.0000][a] | [0.0000][a] | [0.6416] | [0.7452] |
| 2010:M6 | −15.170 | 37.661 | −1.683 | 1.8277 | −37.040 | 76.425 | 0.571 | 0.770 |
| | [0.0000][a] | [0.0000][a] | [0.0924] | [0.1764] | [0.0000][a] | [0.0000][a] | [0.5682] | [0.6804] |
| 2011:M6 | −14.200 | 39.773 | −1.680 | 1.9278 | −37.740 | 80.193 | 0.623 | 1.184 |
| | [0.0000][a] | [0.0000][a] | [0.0929] | [0.1650] | [0.0000][a] | [0.0000][a] | [0.5331] | [0.5533] |
| 2012:M6 | −13.510 | 42.333 | −1.979 | 2.6520 | −39.040 | 84.485 | 0.537 | 1.107 |
| | [0.0000][a] | [0.0000][a] | [0.0478][b] | [0.1034] | [0.0000][a] | [0.0000][a] | [0.5912] | [0.5749] |
| 2013:M6 | −14.100 | 45.954 | −1.905 | 2.5390 | −40.340 | 89.036 | 0.580 | 1.138 |
| | [0.0000][a] | [0.0000][a] | [0.0568] | [0.1111] | [0.0000][a] | [0.0000][a] | [0.5619] | [0.5661] |
| 2014:M6 | −13.100 | 44.768 | −2.362 | 3.660 | −42.470 | 94.309 | 0.517 | 0.986 |
| | [0.0000][a] | [0.0000][a] | [0.0182][b] | [0.0557] | [0.0000][a] | [0.0000][a] | [0.6052] | [0.6109] |
| 2015:M6 | −12.02 | 41.957 | −2.541 | 4.1313 | −44.130 | 99.001 | 0.360 | 0.662 |
| | [0.0000][a] | [0.0000][a] | [0.0111][b] | [0.0421][b] | [0.0000][a] | [0.0000][a] | [0.7186] | [0.7182] |

*Note*: MD0 is default and MD1 is the CIFI model. *P*-values in brackets.
[a]1% significance level.
[b]5% significance level.

Further, shocks from stock markets and money markets are of counter-cyclical nature, while liquidity shocks from the banking sectors are pro-cyclical, indicating potential risks from the latter. Input indicators from the bond markets appear to have slower dynamics than the target which causes them to drop out of the short-run CIFIs. Further, disequilibrium shocks from the US enter with the largest weights compared to the remaining trading partners, making it the most important economy to watch for both the PRC and TPC case. Commodity futures and money market indicators, in particular interbank rate spreads, contain the most leading information with respect to the short-run targets, with input indicators entering with longer lags than for the remaining financial markets.

Comparing results between the PRC and TPC, weights are overall more stable for TPC than for the PRC. Money market input indicator weights for the PRC are especially interrupted following the policy intervention in late 2008, implying that interventions have shielded against shocks originating from money markets but not the remaining markets. No such break is detectable in the TPC case.

Turning to long-run CIFIs, weights and lag structures are summarized in Tables C6-C9 in Appendix C. We find remarkable heterogeneity in signs of weights, with input indicators from the same markets but different geographic locations frequently entering with both negative and positive signs. Considering the different market segments separately, disaggregate effects from different economies seem to offset each other, making the aggregate market impact within different financial markets relatively neutral. The finding demonstrates the composite nature of disaggregate financial market pricing impacts.

For the PRC, only weights from the foreign exchange and the stock futures market are consistent in their direction across geographic locations; positive for foreign exchange indicators and negative for stock futures indicators. The negative sign for stock futures is in line with opportunity cost theory. Investment in futures becomes more attractive with an increase in calendar spreads, which suggests an expected increase in the value of the stock. The opportunity cost channel seems to outweigh the inflation channel as commodity futures enter with only a small positive coefficient. Regarding the foreign exchange input indicators, an increase in purchasing power parity implies appreciation pressure and expansion of the money base, hence the positive sign is expected. For TPC, weights from the money markets are consistent in their direction;

however, signs differ across categories. Interbank rate spreads enter with a negative sign, while T-bill spreads enter with a positive sign, suggesting substitution effects for interbank rates and wealth effects for T-bill rates, with different investor types being active in these markets.

Weights of the PRC long-run CIFI are overall more constant than those of the TPC case and weight shifts occur later in the PRC case as compared to the TPC case. For instance, sign switches of indicator weights in the TPC long-run CIFI are observed across foreign exchange, bond and money market input indicators from the US, Canada and Japan. The switch in sign for indicators associated with markets in the US and Canada is opposite to those in Japan reflecting the reversal of flows during and after the GFC (Wu et al., 2014).

Interestingly, despite the shifting weights, coefficient estimates in the CIFI augmented model MD1 for TPC are stable. However, the domestic policy shift in the form of PBC's intervention during and after the GFC period cannot be mitigated by weight shifts in the CIFI construction. Instead, model stability requires re-calibration for the model to reflect the domestic policy shift.

### 3.4 | Sensitivity analysis

Based on the structure of weights observed, we conduct two rounds of sensitivity analysis with respect to the dimension reduction steps outlined in Figure 1. First, the original short-run CIFI for the PRC is dominated by weights of the input indicator from the first foreign exchange market group in 2005 and 2006. Weights are large and highly significant for the training period and the first update, and turn insignificant for all consecutive updates. The turn to insignificance coincides with a shift in the exchange rate regime from fixed to a managed float, suggesting that the shift made the indicators irrelevant. We hence conduct additional experiments by constructing the short-run CIFI without the first forex market group included. Results show that the two CIFI versions are almost identical and PRC MD1 model results are robust to the exclusion of this one composite input indicator. Further, observations of the weights from the bond market for both the PRC and TPC show us that individual input indicators from the same geographic locations; Canada, Spain and Japan, enter with the same weight. In order to examine if these indicators are repetitively over-representative, we exclude, in a second sensitivity analysis, one of the two input indicators from Canada, Spain and Japan and re-construct the long-run and short-run CIFI. Results show that CIFIs are insensitive to dropping these input indicators.

Two insights for future research are gained by these sensitivity analyses. First, prolonged significance of weights over several updates could be a valuable additional criterion for input indicator selection for the construction of the short-run CIFIs. Second, the unsupervised dimension reduction step prior to aggregation might require additional criteria as some redundancies remain undetected. With these points in mind, some iterative procedure for input indicator selection and redundancy reduction is needed to further refine our CIFI construction in the future.

## 4 | CONCLUSION

We explore a novel model-based approach to constructing measures of opportunity cost due to openness, referred to as CIFIs, in money demand equations for two foreign-trade oriented economies, the PRC and TPC. The approach is motivated by the observation that economic openness poses challenges to the stability of conventional money demand models which omit or inadequately represent opportunity cost effects from abroad. Existing evidence suggests that the main cause of instability is indeed the lack of an appropriate measure for such effects in an open economy context. The PRC and TPC differ substantially in terms of size, financial integration and response to the GFC. Appropriate measures for opportunity costs are hence expected to differ between these two economies.

Our algorithm for CIFI construction combines reflective and formative modelling methods for measurement. CIFIs are constructed as an aggregate of a broad set of dissynchronized financial disequilibrium input indicators, each of which represents a distinct facet of financial market frictions. Dimension reduction is achieved in two stages via redundancy reduction using unsupervised learning methods (reflective) and via backward dynamic selection using supervised learning methods (formative). Based on an error-correction specification of the money demand model, we exploit two possible targets for the CIFIs, the change in narrow money as a short-run target and the closed economy EC term as the long-run target. The weights found for each input indicator differ between the two economies thereby revealing the specific sensitivities of money demand in the PRC and TPC to disequilibria in the international financial markets and different dynamic forms of the long-run and short-run targets. The concatenation operation is imposed through regular updates, allowing for the composition of the CIFIs to update without altering past values and thereby making them comparable to non-model-based composites.

Two periods are considered for testing the CIFIs, the relatively tranquil pre-crisis period and the period including the GFC and its aftermath. In the case of TPC, where the central bank did not intervene during the crisis

period, a stable money demand relationship is found across testing periods by augmenting a standard closed economy money demand equation by the constructed CIFIs. Looking more closely into the disaggregate composition of the CIFIs reveals that the volatility of the GFC period is reflected in the instability of weights with which input indicators enter the CIFIs. In the case of the PRC, a stable money demand equation is found when constructing a hybrid EC term for the CIFI-augmented model. Specifically, the EC term switches to a closed economy version during the PRC's policy intervention period, which included temporarily pegging the exchange rate to the US dollar and reinstating capital controls. These findings firstly underscore the importance of regular data updating and concatenation of the CIFIs to allow for the incorporation of foreign structural shifts, and secondly reveal the need for model calibration if the structural shift is domestic in the form of policy interventions.

Evaluating disaggregate financial shocks through input indicator weights reveals the relative importance of disequilibria in the money markets as transmission channels of foreign shocks to the domestic money demand and the risk of pro-cyclical shocks from foreign banking sectors. Our findings demonstrate the potential of the CIFIs to identify sources of foreign risk to domestic money demand providing valuable insights to policy makers.

Sensitivity analysis through alteration of the sets of financial input indicators used for CIFI construction shows us that additional criteria for the selection of input indicator and redundancy reduction are desirable for further improvement of the CIFI construction algorithm. Moreover, the current CIFI construction disregards the possibility of dynamic interactions among formative input indicators. Allowing for interaction effects should be considered for future research.

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## DATA AVAILABILITY STATEMENT

Data and R code available on request from the authors.

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## ENDNOTES

[1] On the specific cases of the PRC and TPC see for instance Baharumshah et al. (2009) and Arize (1994).

[2] The evaluation indicators are kl, ch, hartigan, cindex, db, silhouette, duda, pseudot2, ratkowsky, ball, tbiserial, gap, mcclain, gamma, gplus, tau, dunn, sdindex, and sdbw; see Charrad et al. (2014) for details.

## REFERENCES

Arize, A. C. (1994). An econometric analysis of money demand in Taiwan, 1950-1989. *The American Economist*, *38*(1), 27–35.

Baharumshah, A. Z., Mohd, S. H., & Masih, A. M. M. (2009). The stability of money demand in China: Evidence from the ARDL model. *Economic Systems*, *33*(3), 231–244.

Berkelmans, L., Kelly, G., & Sadeghian, D. (2016). Chinese monetary policy and the banking system. *Journal of Asian Economics*, *46*, 38–55.

Borio, C. (2013). The great financial crisis: setting priorities for new statistics. *Journal of Banking Regulation*, *14*(3-4), 306–317. http://dx.doi.org/10.1057/jbr.2013.9.

Borio, C. (2014). The international monetary and financial system: its achilles heel and what to do about it. *Federal Reserve Bank of Dallas, Globalization and Monetary Policy Institute Working Papers*, *2014*(203). http://dx.doi.org/10.24149/gwp203.

Borio, C. (2015). *Revisiting three intellectual pillars of monetary policy received wisdom*. Luncheon address, Cato Institute. Washington DC, November 12, 2015.

Calza, A., Gerdesmeier, D., & Levy, J. V. F. (2001). Euro area money demand: measuring the opportunity costs appropriately. *IMF Working Papers*, *1*(179), 1. http://dx.doi.org/10.5089/9781451859034.001.

Charrad, M., Ghazzali, N., Boiteau, V., & Niknafs, A. (2014). NbClust: An R package for determining the relevant number of clusters in a data set. *Journal of Statistical Software*, *61*(6). http://dx.doi.org/10.18637/jss.v061.i06.

Chen, Y., & Werner, R. A. (2011). The role of monetary aggregate in Chinese monetary policy implementation. *Journal of the Asia Pacific Economy*, *16*(3), 464–488.

Choudhry, T. (1996). Real stock prices and the long-run money demand function: Evidence from Canada and the USA. *Journal of International Money and Finance*, *15*(1), 1–17.

Chowdhury, A. R. (1995). The demand for money in a small open economy: The case of Switzerland. *Open Economic Review*, *6*(2), 131–144.

Cox, D. R. (1961). Tests of separate families of hypotheses. *Proceedings of the Fourth Berkeley Symposium on Mathematical Statistics*, *1*, 105–123.

Darrat, A. F., & Webb, M. A. (1986). Financial changes and interest elasticity of money demand: Further tests of the Gurley and Shaw thesis. *The Journal of Development Studies*, *22*(4), 724–730.

Drehmann, M., Borio, C., & Tsatsaronis, K. (2012). *Characterising the financial cycle: Don't lose sight of the medium term!* BIS Working Papers, No. 380.

El-Shagi, M., & Zheng, Y. (2019). Money demand in China: A meta study. *Emerging Markets Finance and Trade*, 1–19. http://dx.doi.org/10.1080/1540496x.2019.1643317.

Engle, R. F., Hendry, D. F., & Richard, J.-F. (1983). Exogeneity. *Econometrics*, *51*(2), 277–304.

Friedman, M. (1988). Money and the stock market. *Journal of Political Economy*, *96*(2), 221–245.

Friedman, M., & Schwartz, A. J. (1982). *Monetary trends in the United States and the United Kingdom: Their relations to income, price and interest rates*. Chicago: National Bureau of Economic Research Monograph, University of Chicago Press.

Froot, K. A., & Thaler, R. H. (1990). Anomalies: Foreign exchange. *The Journal of Economic Perspectives*, *4*(3), 179–192.

Gambacorta, L., Marques-Ibanez, D. (2011). The bank lending channel: lessons from the crisis. *Economic Policy*, *26*(66), 135–182. http://dx.doi.org/10.1111/j.1468-0327.2011.00261.x.

Glick, R., & Hutchison, M. (2009). Navigating the trilemma: Capital flows and monetary policy in China. *Journal of Asian Economics*, *20*(3), 205–224.

Gurley, J. G., & Shaw, E. S. (1955). Financial aspects of economic development. *American Economic Review*, *45*(4), 515–538.

Han, M. (2012). The People's Bank of China during the global financial crisis: Policy responses and beyond. *Journal of Chinese Economic and Business Studies*, *10*(4), 361–390.

Hendry, D. F. (1995). *Dynamic econometrics*. Oxford: Oxford University Press.

Hendry, D. F., & Massmann, M. (2007). Co-breaking: Recent advances and a synopsis of the literature. *Journal of Business & Economic Statistics*, *25*(1), 33–51.

Hendry, D. F., & Ericsson, N. R. (1991). Modeling the demand for narrow money in the United Kingdom and the United States. *European Economic Review*, *35*(4), 833–886.

Howell, R. D., Breivik, E., & Wilcox, J. (2013). Formative measurement: A critical perspective. *ACM SIGMIS Database: The DATABASE for Advances in Information Systems*, *44*(4), 44–55.

Lee, C.-C., & Chang, C.-P. (2008). Long-run money demand in Taiwan revisited: Evidence from a cointegration STR approach. *Applied Economics*, *40*(8), 1061–1071.

McNown, R., & Wallace, M. S. (1992). Cointegration tests of a long-run relation between money demand and the effective exchange rate. *Journal of International Money and Finance*, *11*(1), 107–114.

Poole, W. (1970). The optimal choice of monetary policy instruments in a simple macro model. *Quarterly Journal of Economics*, *84*(2), 197–216.

Qin, D., & He, X. (2012). *Modelling the impact of aggregate financial shocks external to the Chinese economy*. BOFIT Discussion Paper No. 25/2012.

Qin, D., van Huellen, S., Wang, Q. C., & Moraitis, T. (2018). *Algorithmic modelling of financial conditions for macro predictive purposes: Pilot application on the USA*. London: SOAS Department of Economics Working Paper No. 212.

Qin, D., Lu, S., Wang, H-W., van Huellen, S. & Wang, Q-C. (2018). *Openness and money demand: Measurement of opportunity cost effects from international financial markets* [经济开放与货币需求: 国际金融风险及持币成本的测度]. Working paper (unpublished).

Sargan, J. D. (1964). Wages and prices in the United Kingdom: A study in econometric methodology. In *Econometric analysis for national economic planning, volume 16 of Colston papers*, by P. E. Hart, G. Mills and J. K. Whitaker, 25–54. London: Butterworths.

Shieh, C.-H., Liu, S.-H., & Lee, C.-C. (2017). How stable is money demand in Taiwan? *International Journal of Economics and Financial Research*, *3*(5), 54–64.

Sokal, R. R., & Michener, C. D. (1958). *A statistical method for evaluating systematic relationship*, (Vol. 28, pp. 1409–1438). Kansas: University of Kansas 399 Science Bulletin.

Sriram, S. S. (1999). Survey of literatureon demand for money: theoretical and empirical work with special reference to error-correction models. *IMF Working Papers*, *99*(64), 1. http://dx.doi.org/10.5089/9781451848540.001.

Stock, J. H., & Watson, M. W. (2002). Macroeconomic forecasting using diffusion indexes. *Journal of Business & Economic Statistics*, *20*(2), 147–162.

Stock, J. H., & Watson, M. W. (1989). New indexes of coincident and leading economic indicators. *NBER Macroeconomics Annual*, *4*, 351–394. http://dx.doi.org/10.1086/654119.

Terry, L., & Kelley, K. (2012). Sample size planning for composite reliability coefficients: Accuracy in parameter estimation via narrow confidence intervals. *The British Journal of Mathematical and Statistical Psychology*, *65*(3), 371–401.

Vines, D., & Wills, S. (2018). The rebuilding macroeconomic theory project: An analytical assessment. *Oxford Review of Economic Policy*, *34*(1–2), 1–42.

Wang, Q. C. (2017). *Testing a new approach to constructing international financial market indices: An application to Asian-Pacific economies*. London: PhD Thesis, SOAS University of London.

Wold, H. (1966). Estimation of principal components and related models by iterative least squares. In *Multivariate analysis, by Krishnajah, P. R. (ed.)* (pp. 391–420). NewYork: Academic Press.

Wold, H. (1980). Model construction and evaluation when theoretical knowledge is scarce. In *Evaluation of econometric models*, by Kmenta, J. & Ramsey, J. B. (eds.), 47–74. New York: Academic Press.

Wold, H. (1975). Path models with latent variables: The NIPALS approach. In *Quantitative sociology: International perspectives on mathematical and statistical modeling*, by Blalock, H. M., Aganbegian, A., Borodkin, F. M., Boudon, R., & Capecchi, V. (eds.), 307–357. New York: Academic Press.

Wu, C.-S., Lin, J.-L., Peng, C.-N., & Chin, H.-Y. (2014). *Capital flows and unconventional monetary policy*, Tokyo: . The Canon Institute for Global Studies.

Wu, C.-S., Lin, J.-L., Tiao, G. C., & Cho, D. D. (2005). Is money demand in Taiwan stable? *Economic Modelling*, *22*(2), 327–346.

Yu, Y. (2010). The impact of the global financial crisis on the Chinese economy and China's policy response. In *TWN global economic series 25: Financial crisis and Asian developing countries*. Penang, Malaysia: Third World Network.

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## APPENDIX A.: Algorithm for CIFI Construction

The CIFI construction algorithm is designed (a) to produce a composite aggregate from a set of input indicators that has adequate financial market coverage with each indicator representing a different facet of financial markets, (b) to allow for dis-synchronization among financial markets, (c) to fulfil the fundamental measurement attribute of time-wise concatenation, and (d) to produce targeted CIFIs (see Qin et al., 2018). The algorithm achieves these objectives with a combination of unsupervised and supervised learning strategies. Recalling Figure 1, the algorithm for CIFI construction can be presented in four steps: (1) input indicators construction, (2) unsupervised dimension reduction, (3) supervised dynamic backward selection, (4) updating and concatenation.

### Step 1: Input indicator construction

We select and construct financial input indicators as input features from different financial market categories including the banking sector, bond market, foreign exchange market, money market, futures market and stock market as disequilibrium indicators. Disequilibrium indicators are ratios or spreads representing financial market frictions. By use of ratios or spreads we follow insights from Qin and He (2012), Wang (2017) and Qin et al. (2018), who show that indicators constructed by differencing financial variables largely capture noise or everyday volatility with little relevance for macro variables which exhibit substantially slower dynamics and inertia, while disequilibrium indicators which capture features of imbalances or disequilibria across different financial markets are a better match. By using disequilibrium indicators, we also follow recent calls for greater emphasis on financial frictions in empirical macroeconomics (e.g., Drehmann et al., 2012; Borio, 2013, 2014; Vines & Wills, 2018).

### Step 2: Unsupervised dimension reduction

A plethora of highly colinear input indicators requires unsupervised dimension reduction before (target specific) supervised dynamic selection since multiple indicators with similar or identical (redundant) information could result in weight unduly being given to a single information shock. Hence, indicators are grouped with the aim to reduce redundancy among input indicators by capturing common shocks (or information) in single composite input indicators. The grouping algorithm is based on a correlation distance measure. Take Pearson correlation coefficient:

$$COR\left(i_{jt}, i_{kt}\right) = \frac{\sum_{t=1}^{T}\left(i_{jt}-\bar{i_{jt}}\right)\left(i_{kt}-\bar{i_{kt}}\right)}{\sqrt{\sum_{t=1}^{T}\left(i_{jt}-\bar{i_{kt}}\right)^2}\sqrt{\sum_{t=1}^{T}\left(i_{kt}-\bar{i_{kt}}\right)^2}} \tag{A1}$$

The distance is calculated:

$$d_{cor}\left(i_{jt}, i_{kt}\right) = \sqrt{2\left(1-COR\left(i_{jt}, i_{kt}\right)\right)} \tag{A2}$$

We first pre-group the indicators according to the six financial market categories as shown in Table 1. We then run the grouping algorithm on each category separately for four different sub-samples for robustness: 1992–2007 and over the same period with the 1997–1999 Asian financial crisis excluded, and 2003–2017 and over the same period with the 2007–2010 GFC excluded. We apply hierarchical clustering based on the distance matrix obtained from the indicators (Sokal & Michener, 1958). Multiple criteria are used to determine the optimal number of groups.[2] If identified groups are consistent across all four sub-samples or for three out of four sub-samples and the grouping makes economic sense, indicators are combined into a single group. Input indicators in each group are averaged as a reflective measure of one common financial shock (blue circles in Figure 1). The average is then used as an input indicator in the CIFI construction instead of the individual input indicators. Indicators that are not consistently grouped or are not allocated to a group by the algorithm enter as individual input indicators (pink boxes in Figure 1).

The contribution of redundancy reduction via the grouping stage to model performance has been evaluated in Qin et al. (2018). The authors run extensive experiments to evaluate the unsupervised dimension reduction step and find that CIFIs that include grouped input indicators strongly and consistently outperform CIFIs that only contain individual input indicators. Considering these findings, we impose the unsupervised dimension reduction step for CIFI construction. Grouping results are summarized in Table C1 in Appendix C.

### Step 3: Supervised backward dynamic selection

Recalling (3), two possible targets come to mind for the CIFI construction, the differenced money demand $\Delta m_t$, which we refer to as the short-run target and the disequilibrium error term $e_t$ which we refer to as the long-run

target. The composite constructs of the short-run and long-run type appear in (5) as measures of $\Delta f_t^*$ and $f_t^*$ respectively. Let us consider the construction of the long-run CIFI first.

### Long-run target

For the long-run target, we exploit the Engle-Granger two-step procedure in the estimation of ECMs and the common finding that narrow money, total expenditure and domestic interest rate are co-trending, such that $(m_t - k_1 y_t - k_2 R_t)$ in (3) is detrended. The long-run disequilibrium is utilized as target in the partial regression of (A3) which takes the form of a finite distributed lag model to allow for dis-synchronization among input indicators, whereby $i_{j,\,t}$ are composite and individual financial disequilibrium input indicators, $p$ is the total number of indicators and $q$ is the maximum lag length considered:

$$(m_t - k_1 y_t - k_2 R_t) = \sum_{i=0}^{q} \varphi_{j,i} i_{j,t-i} + \epsilon, j = 1, \ldots, p \qquad \text{(A3)}$$

Only one lag $q^*$ among $q$ is chosen per input indicator for the construction of the long-run CIFI $f_t^L$ as a measure of $f_t^*$ in (A4) to enforce a match with the slow dynamics of the target. The choice falls on the largest estimated weight $\hat{\varphi}_{j,q^*}$ in absolute value that emerges from the estimation of (A3) by the PLS algorithm with component equal to 1.

$$f_t^L = f_t^* = \sum_{j=1}^{p} \hat{\varphi}_{j,q^*} i_{j,t-q^*} \qquad \text{(A4)}$$

The long-run CIFI is then used to construct $e_t^*$ in (5) whereby $k_3 = 1$ as implicit in the CIFI construction.

### Short-run target

An obvious target from (3) for the short-run CIFI construction is $\Delta m_t$. Similar to (A3), estimation of weights for CIFI construction is based on a partial regression formulated in (A5) which also takes on the form of a finite distributed lag model with maximum lag length $q$. However, contemporaneous terms are excluded from (A5) while considered in (A3), and (A5) is estimated via OLS and dynamic backward selection.

$$\Delta m_t = \sum_{i=1}^{q} \Omega_{i,j} i_{j,t-i} + \vartheta, \mathrm{j} = 1, \ldots, p \qquad \text{(A5)}$$

In contrast to (A4), all significant lags $q^*$ from (A5) are used for the construction of the short-run CIFI in (A6), whereby $L$ denotes the lag operator. Indicators with no significant lag drop out so that $p^* < p$, with $p^*$ being the number of indicators with at least one significant lag.

$$f_t^S = \Delta f_t^* = \frac{1}{p^*} \sum \hat{\Omega}_j(L) i_{j,t} \qquad \text{(A6)}$$

The lag structure in $f_t^S$ is hence more complex than in $f_t^L$ which opens the possibility for non-linear input in the form of differences in the short-run CIFI. Despite the use of contemporaneous terms in the construction of the long-run CIFI, both $f_t^L$ and $f_t^S$ when included in (5) contain only leading information, since $e_t^*$ which incorporates $f_t^L$ enters as a leading indicator by construction.

### Step 4: Updating and concatenation

Using monthly data, we set data updating at a 12-month interval for the model testing period. After each data update the CIFIs are concatenated; see Table A1.

**TABLE A1** Time-wise concatenation operation

| | 1994:M6 | 2005:M6 | 2006:M6 | 2007:M6 |
|---|---|---|---|---|
| Training period | CIFI 2005 | | | |
| First update | CIFI 2006 | | | |
| | CIFI 2005 | CIFI 2006 | | |
| Second update | CIFI 2007 | | | |
| | CIFI 2005 | CIFI 2006 | CIFI 2007 | |

The CIFI is first constructed over the training period. The training period is then extended by 12 months and the CIFI re-estimated. The training period CIFI and the updated index are then combined as shown below. This way, historical invariance of indices is ensured during updating.

## APPENDIX B: Data

**TABLE B1** Variables and data sources

| | Description | Source | Series title |
|---|---|---|---|
| O1 | Overnight market interest rate of Australia | OECD, Main economic indicators | Overnight market interest rate of Australia |
| O2 | Overnight market interest rate of Belgium | Thomson Reuters | BG EU—FRANC T/N DEPOSIT (FT/TR) |
| O3 | Overnight market interest rate of Canada | CANSIM—statistics Canada | CANADA OVERNIGHT MNY MARKET FINANCING |
| O4 | Overnight market interest rate of Italy | A.D.B. Analisi Dati Borsa S.p.A. | ITALY INTERBANK O/N ATIC |
| O5 | Overnight market interest rate of Japan | Bank of Japan | JAPAN UNCOLLATER. OVERNIGHT |
| O6 | Overnight market interest rate of Spain | Banco de Espana | SPAIN INTERBANK O/N |
| O7 | Overnight market interest rate of TPC | TEJ—the TPC economic journal | TPC INTERBANK SWAP OVERNIGHT |
| O8 | Overnight market interest rate of US | OECD, Main economic indicators | US: Overnight interbank rate |
| O9 | 3-month market interest rate of Australia | Barclays Bank PLC | AUSTRALIAN $ TO US $ 3 M FWD (BBI)—EXCHANGE RATE |
| O10 | 3-month market interest rate of Belgium | National bank of Belgium | BELGIUM TREASURY BILL 3 MONTH |
| O11 | 3-month market interest rate of Canada | CANSIM—statistics Canada | CANADA TREASURY BILL 3 MONTH |
| O12 | 3-month market interest rate of France | Thomson Reuters Datastream | FR 3 M INTBK DELAYED SEE EIBOR3M |
| O13 | 3-month market interest rate of Italy | Ministry of economy and finance, Italy | ITALY T-BILL AUCT. GROSS 3 MONTH |
| O14 | 3-month market interest rate of Japan | ICE benchmark administration ltd. | IBA JPY IBK. LIBOR 3 M DELAYED |
| O15 | 3-month market interest rate of Spain | ICE benchmark administration ltd. | ES IBK.3 M IBA DUP USE BBEUR3M |
| O16 | 3-month market interest rate of TPC | TEJ—the TPC economic journal | TPC MONEY MARKET 90 DAYS |
| O17 | 3-month market interest rate of UK | Bank of England | UK BOE LIBID/LIBOR 3 MONTH |
| O18 | 3-month market interest rate of US | Thomson Reuters Datastream | US INTERBANK RATE—3 MONTH |
| O19 | Exchange rate of Australia | MSCI | MSCI AUD TO 1 USD—EXCHANGE RATE |
| O20 | Exchange rate of Belgium | GTIS—FTID/TR | BELGIAN FRANC CM. TO US $ (GTIS DISC)—EXCHANGE RATE |
| O21 | Exchange rate of Brazil | GTIS—FTID/TR | BRAZILIAN REAL TO US $ (GTIS/TR)—EXCHANGE RATE |
| O22 | Exchange rate of Canada | GTIS—FTID/TR | CANADIAN $ TO US $ (GTIS/TR)—EXCHANGE RATE |
| O23 | Exchange rate of PRC | GTIS—FTID/TR | CHINESE RENMINBI TO US $(GTIS/TR)—EXCHANGE RATE |
| O24 | Exchange rate of France | GTIS—FTID/TR | FRENCH FRANC TO US $ (GTIS DISC)—EXCHANGE RATE |
| O25 | Exchange rate of Germany | Barclays Bank PLC | GERMAN MARK TO US $ (BBI)—EXCHANGE RATE |
| O26 | Exchange rate of India | GTIS—FTID/TR | INDIAN RUPEE TO US $ (GTIS/TR)—EXCHANGE RATE |

**TABLE B1** (Continued)

| | Description | Source | Series title |
|---|---|---|---|
| O27 | Exchange rate of Indonesia | GTIS—FTID/TR | INDONESIAN RUPIAH TO US $(GTIS/TR)—EXCHANGE RATE |
| O28 | Exchange rate of Italy | GTIS—FTID/TR | ITALIAN LIRA TO US $ (GTIS DISC)—EXCHANGE RATE |
| O29 | Exchange rate of Japan | Barclays Bank PLC | JAPANESE YEN TO US $ (BBI)—EXCHANGE RATE |
| O30 | Exchange rate of Malaysia | GTIS—FTID/TR | MALAYSIAN RINGGIT TO US $ (GTIS/TR)—EXCHANGE RATE |
| O31 | Exchange rate of Netherlands | GTIS—FTID/TR | NETH. GUILDER TO US $ (GTIS) DISC—EXCHANGE RATE |
| O32 | Exchange rate of Philippines | GTIS—FTID/TR | PHILIPPINE PESO TO US $ (GTIS/TR)—EXCHANGE RATE |
| O33 | Exchange rate of South Korea | GTIS—FTID/TR | SOUTH KOREAN WON TO US $ (GTIS/TR)—EXCHANGE RATE |
| O34 | Exchange rate of Singapore | GTIS—FTID/TR | SINGAPORE $ TO US $ (GTIS/TR)—EXCHANGE RATE |
| O35 | Exchange rate of Spain | GTIS—FTID/TR | SPANISH PESETA TO US $ (GTIS DISC)—EXCHANGE RATE |
| O36 | Exchange rate of TPC | GTIS—FTID/TR | TPC NEW $ TO US $ (GTIS/TR)—EXCHANGE RATE |
| O37 | Exchange rate of Thailand | GTIS—FTID/TR | THAI BAHT TO US $ (GTIS/TR)—EXCHANGE RATE |
| O38 | Exchange rate of UK | GTIS—FTID/TR | UK POUND TO US $ (GTIS/TR)—EXCHANGE RATE |
| O39 | Stock market index of Australia | MSCI | MSCI AUSTRALIA—PRICE INDEX |
| O40 | Stock market index of Belgium | MSCI | MSCI BELGIUM—PRICE INDEX |
| O41 | Stock market index of Brazil | MSCI | MSCI BRAZIL—PRICE INDEX |
| O42 | Stock market index of Canada | MSCI | MSCI CANADA—PRICE INDEX |
| O43 | Stock market index of PRC | MSCI | MSCI PRC—PRICE INDEX |
| O44 | Stock market index of France | MSCI | MSCI FRANCE—PRICE INDEX |
| O45 | Stock market index of Germany | MSCI | MSCI GERMANY—PRICE INDEX |
| O46 | Stock market index of India | MSCI | MSCI INDIA—PRICE INDEX |
| O47 | Stock market index of Indonesia | MSCI | MSCI INDONESIA—PRICE INDEX |
| O48 | Stock market index of Italy | MSCI | MSCI ITALY—PRICE INDEX |
| O49 | Stock market index of Japan | MSCI | MSCI JAPAN—PRICE INDEX |
| O50 | Stock market index of Malaysia | MSCI | MSCI MALAYSIA—PRICE INDEX |
| O51 | Stock market index of Netherlands | MSCI | MSCI NETHERLANDS—PRICE INDEX |
| O52 | Stock market index of Philippines | MSCI | MSCI PHILIPPINES—PRICE INDEX |
| O53 | Stock market index of Singapore | MSCI | MSCI SINGAPORE—PRICE INDEX |
| O54 | Stock market index of Spain | MSCI | MSCI SPAIN—PRICE INDEX |
| O55 | Stock market index of South Korea | MSCI | MSCI KOREA—PRICE INDEX |
| O56 | Stock market index of TPC | MSCI | MSCI TPC—PRICE INDEX |
| O57 | Stock market index of Thailand | MSCI | MSCI THAILAND—PRICE INDEX |
| O58 | Stock market index of UK | MSCI | MSCI UK—PRICE INDEX |
| O59 | Stock market index of US | MSCI | MSCI USA—PRICE INDEX |

(Continues)

**TABLE B1** (Continued)

| | Description | Source | Series title |
|---|---|---|---|
| O60 | 1-year government bond of Belgium | National bank of Belgium | BELGIUM TREASURY BILL 1 YEAR |
| O61 | 1-year government bond of Canada | CANSIM—statistics Canada | CANADA TREASURY BILL 1 YEAR |
| O62 | 1-year government bond of France | Banque de France | FRANCE TREASURY BILL 12 MONTHS |
| O63 | 1-year government bond of Germany | Thomson Reuters Datastream | TR GERMANY GVT BMK BID YLD 2Y (E) |
| O64 | 1-year government bond of Italy | Thomson Reuters Datastream | TR ITALY GVT BMK BID YLD 2Y (E) |
| O65 | 1-year government bond of Malaysia | Bank Negara Malaysia | Government securities Yield: 1 year |
| O66 | 1-year government bond of Spain | Banco de Espana | SPAIN TREASURY BILL 1 YEAR |
| O67 | 1-year government bond of US | Thomson Reuters Datastream | United States GVT BMK bid Yield 1 year |
| O68 | 2-year government bond of Australia | Thomson Reuters Datastream | TR AUSTRALIA GVT BMK BID YLD 2Y (A$) |
| O69 | 2-year government bond of Japan | Thomson Reuters Datastream | TR JAPAN GVT BMK BID YLD 2Y (Y)—RED. YIELD |
| O70 | 2-year government bond of UK | Thomson Reuters Datastream | TR UK GVT BMK BID YLD 2Y (£) |
| O71 | 10-year government bond of Australia | Reserve bank of Australia | AUSTRALIA BOND YIELD 10 Y |
| O72 | 10-year government bond of Belgium | Thomson Reuters Datastream | BELGIUM BENCHMARK BOND 10 YR (DS) |
| O73 | 10-year government bond of Canada | CANSIM—statistics Canada | CANADA GOVT. BNCHMK. BOND 10 YEAR |
| O74 | 10-year government bond of France | Banque de France | FRANCE TREASURY BILL 10 YEARS |
| O75 | 10-year government bond of Germany | Thomson Reuters Datastream | GERMANY BENCHMARK BOND 10 YR (DS) |
| O76 | 10-year government bond of Italy | Thomson Reuters Datastream | ITALY BENCHMARK BOND 10 YR (DS)—RED. YIELD |
| O77 | 10-year government bond of Japan | Thomson Reuters Datastream | TR JAPAN GVT BMK BID YLD 10Y (Y) |
| O78 | 10-year government bond of Malaysia | Bank Negara Malaysia | Government securities Yield: 10 years |
| O79 | 10-year government bond of Spain | Banco de Espana | SPAIN GOVERNMENT BOND 10 YEAR |
| O80 | 10-year government bond of UK | Thomson Reuters Datastream | UK BENCHMARK BOND 10 YR (DS) |
| O81 | 10-year government bond of US | OECD, Main economic indicators | US Yield 10-year FED GVT SECS NADJ |
| O82 | 20-year government bond of Canada | CIBC world markets | CANADA BENCHMARK BOND 20 YEAR |
| O83 | 20-year government bond of Japan | Thomson Reuters Datastream | TR JAPAN GVT BMK BID YLD 20Y (Y) |
| O84 | 20-year government bond of UK | Thomson Reuters Datastream | TR UK GVT BMK BID YLD 20Y (£) |
| O85 | 20-year government bond of US | Thomson Reuters Datastream | TR US GVT BMK BID YLD 30Y (U$) |
| O86 | 30-year government bond of Germany | Deutsche Bundesbank | BUBA YIELD—LISTD FEDRL SEC 15-30Y |
| O87 | 30-year government bond of Spain | Thomson Reuters Datastream | TR SPAIN GVT BMK BID YLD 30Y (E) |
| O88 | 30-year government bond of France | Banque de France | FRANCE TREASURY BILL 30 YEARS |
| O89 | 30-year government bond of US | Thomson Reuters Datastream | TR US GVT BMK BID YLD 30Y (U $)—RED. YIELD |
| O90 | 3-month T bill of Belgium | National bank of Belgium | BELGIUM TREASURY BILL 3 MONTH |
| O91 | 3-month T bill of Canada | Thomson Reuters Datastream | CANADA TREASURY BILL 3 MONTH |
| O92 | 3-month T bill of France | Banque de France | FRANCE TREASURY BILL 3 MONTHS |

**TABLE B1** (Continued)

| | Description | Source | Series title |
|---|---|---|---|
| O93 | 3-month T bill of Italy | Ministry of economy and finance, Italy | ITALY T-BILL AUCT. GROSS 3 MONTH |
| O94 | 1-3-month T bill of Spain | Banco de Espana | SPAIN TREASURY BILL 1–3 MONTH |
| O95 | 3-month T bill of UK | United Kingdom debt management office | UK TREASURY BILL TENDER 3 M. |
| O96 | 3-month T bill of US | Federal Reserve | US T-BILL 3 month (W) |
| O97 | 6-month T bill of Belgium | National bank of Belgium | BELGIUM TREASURY BILL 6 MONTH |
| O98 | 6-month T bill of Canada | CANSIM—statistics Canada | CANADA TREASURY BILL 6 MONTH |
| O99 | 6-month T bill of France | Banque de France | FRANCE TREASURY BILL 6 MONTHS |
| O100 | 6-month T bill of Italy | Ministry of economy and finance, Italy | ITALY T-BILL AUCT. GROSS 6 MONTH |
| O101 | 6-month T bill of Spain | Banco de Espana | SPAIN TREASURY BILL 6 MONTH |
| O102 | 6-month T bill of US | Federal Reserve | US T-BILL 3 month (W) |
| O103 | Deposit rate of Australia | International monetary fund | AU: Deposit rate |
| O104 | Deposit rate of Canada | International monetary fund | CA: Deposit rate |
| O105 | Deposit rate of Indonesia | International monetary fund | ID: Deposit rate |
| O106 | Deposit rate of Japan | International monetary fund | JP: Deposit rate |
| O107 | Deposit rate of Malaysia | International monetary fund | MY: Deposit rate |
| O108 | Deposit rate of South Korea | International Monetary Fund | KR: Deposit rate |
| O109 | Deposit rate of Thailand | International monetary fund | TH: Deposit rate |
| O110 | Lending rate of Australia | International monetary fund | AU: Lending rate |
| O111 | Lending rate of Canada | International monetary fund | CA: Lending rate |
| O112 | Lending rate of Indonesia | International monetary fund | ID: Lending rate |
| O113 | Lending rate of Japan | International monetary fund | JP: Lending rate |
| O114 | Lending rate of Malaysia | International monetary fund | MY: Lending rate |
| O115 | Lending rate of South Korea | International Monetary Fund | KR: Lending rate |
| O116 | Lending rate of Thailand | International monetary fund | TH: Lending rate |
| O117 | Stock market derivatives market FTSE100 rate nearest to maturity | NYSE Euronext Liffe via Thomson Reuters Datastream | LIFFE-FTSE 100 index TRC1 |
| O118 | Stock market derivatives market HANG_SENG rate nearest to maturity | Hong Kong futures exchange via Thomson Reuters Datastream | HKFE-Hang Seng index TRC1 |
| O119 | Stock market derivatives market TOPIX rate nearest to maturity | Osaka via Thomson Reuters Datastream | TSE-TOPIX index TRC1 |
| O120 | Stock market derivatives market S&P 500 rate nearest to maturity | Chicago mercantile exchange via Thomson Reuters Datastream | CME-S&P 500 index TRC1 |
| O121 | Stock market derivatives market EUREX-DAX rate nearest to maturity | EUREX Deutschland via Thomson Reuters Datastream | EUREX-DAX index TRC1 |
| O122 | Stock market derivatives market AEX rate nearest to maturity | Euronext.Liffe Amsterdam via Thomson Reuters Datastream | AEX-AEX index TRC1 |
| O123 | Stock market derivatives market EUREX-SMI rate nearest to maturity | EUREX Deutschland via Thomson Reuters Datastream | EUREX-SMI TRC1 |
| O124 | Stock market derivatives market FTSE100 rate next nearest to maturity | NYSE Euronext Liffe via Thomson Reuters Datastream | LIFFE-FTSE 100 index TRC4 |
| O125 | Stock market derivatives market HANG_SENG rate next nearest to maturity | Hong Kong futures exchange via Thomson Reuters Datastream | HKFE-Hang Seng index TRC4 |

(Continues)

**TABLE B1** (Continued)

| | Description | Source | Series title |
|---|---|---|---|
| O126 | Stock market derivatives market TOPIX rate next nearest to maturity | Osaka via Thomson Reuters Datastream | TSE-TOPIX index TRC4 |
| O127 | Stock market derivatives market S&P 500 rate next nearest to maturity | Chicago mercantile exchange via Thomson Reuters Datastream | CME-S&P 500 index TRC4 |
| O128 | Stock market derivatives market EUREX-DAX rate next nearest to maturity | EUREX Deutschland via Thomson Reuters Datastream | EUREX-DAX index TRC4 |
| O129 | Stock market derivatives market AEX rate next nearest to maturity | Euronext.Liffe Amsterdam via Thomson Reuters Datastream | AEX-AEX index TRC4 |
| O130 | Stock market derivatives market EUREX-SMI rate next nearest to maturity | EUREX Deutschland via Thomson Reuters Datastream | EUREX-SMI TRC4 |
| O131 | Oil futures rate nearest to maturity | NYMEX via Thomson Reuters Datastream | NYMEX-crude oil futures TRC1 |
| O132 | Gas future rate nearest to maturity | NYMEX via Thomson Reuters Datastream | NYMEX-Henry hub natural gas futures TRC1 |
| O133 | Gold future rate nearest to maturity | NYMEX COMEX division via Thomson Reuters Datastream | CMX-gold 100 oz TRC1 |
| O134 | Copper future rate nearest to maturity | NYMEX COMEX division via Thomson Reuters Datastream | CMX-high grade copper TRC1 |
| O135 | Soybeans future rate nearest to maturity | eCBOT via Thomson Reuters Datastream | CBT-soybeans composite TRC1 |
| O136 | Wheat future rate nearest to maturity | eCBOT via Thomson Reuters Datastream | CBT-wheat composite TRC1 |
| O137 | Corn future rate nearest to maturity | eCBOT via Thomson Reuters Datastream | CBT-corn composite TRC1 |
| O138 | Aluminium future rate nearest to maturity | London metal exchange via Thomson Reuters Datastream | LME-Aluminium TRC1 |
| O139 | Oil future next nearest to maturity | NYMEX via Thomson Reuters Datastream | NYMEX-crude oil futures TRC4 |
| O140 | Gas future next nearest to maturity | NYMEX via Thomson Reuters Datastream | NYMEX-Henry hub natural gas futures TRC4 |
| O141 | Gold future next nearest to maturity | NYMEX COMEX division via Thomson Reuters Datastream | CMX-gold 100 oz TRC4 |
| O142 | Copper future next nearest to maturity | NYMEX COMEX division via Thomson Reuters Datastream | CMX-high grade copper TRC4 |
| O143 | Soybeans future next nearest to maturity | eCBOT via Thomson Reuters Datastream | CBT-soybeans composite TRC4 |
| O144 | Wheat future next nearest to maturity | eCBOT via Thomson Reuters Datastream | CBT-wheat composite TRC4 |
| O145 | Corn future next nearest to maturity | eCBOT via Thomson Reuters Datastream | CBT-corn composite TRC4 |
| O146 | Aluminium future next nearest to maturity | London metal exchange via Thomson Reuters Datastream | LME-Aluminium TRC4 |
| O147 | Deposit volume of the banking sector of South Korea | The Bank of Korea | Deposits: Commercial and specialized banks (CSB): Total |
| O148 | Deposit volume of the banking sector of US | Federal Reserve | Domestic banks: Sa: Deposits |

**TABLE B1** (Continued)

| | Description | Source | Series title |
|---|---|---|---|
| O149 | Loan volume of the banking sector of South Korea | The Bank of Korea | Loans of commercial and specialized banks (CSB): Total |
| O150 | Loan volume of the banking sector of US | Federal Reserve | Domestic banks: Credit: Loans and lease (LL) |
| O151 | Total liabilities of the banking sector of Canada | Statistics Canada | Chartered Bank: Month end: Liabilities |
| O152 | Total liabilities of the banking sector of France | Bank of France | MFIs: Liabilities: Total |
| O153 | Total liabilities of the banking sector of India | Reserve bank of India | Commercial banks: Liabilities: Banking system (BS) |
| O154 | Total liabilities of the banking sector of UK | Bank of England | MFIs: Liabilities |
| O155 | Total liabilities of the banking sector of US | Federal Reserve | US commercial Bank liabilities—Total |
| O156 | M1 of Canada | Bank of Canada | CN MONEY SUPPLY M1 PLUS GROSS CURN |
| O157 | M1 of France | Banque de France | France, money Supply money Supply M1, euro |
| O158 | M1 of India | Reserve bank of India | India, money Supply money Supply M1 (EP), INR |
| O159 | M1 of UK | Bank of England | Money Supply M1 |
| O160 | M1 of US | Federal Reserve | US money supply M1 |
| O161 | Consumer Price index of Belgium | OECD, Main economic indicators | BG CPI ALL ITEMS NADJ |
| O162 | Consumer Price index of Brazil | OECD, Main economic indicators | BR CPI ALL ITEMS NADJ |
| O163 | Consumer Price index of Canada | OECD, Main economic indicators | CN CPI ALL ITEMS NADJ |
| O164 | Consumer Price index of PRC | OECD, Main economic indicators | CH CONSUMER PRICES: ALL ITEMS NADJ |
| O165 | Consumer Price index of France | OECD, Main economic indicators | FR ALL ITEMS NADJ |
| O166 | Consumer Price index of Germany | OECD, Main economic indicators | BD DEU CPI ALL ITEMS NADJ |
| O167 | Consumer Price index of India | OECD, Main economic indicators | IN CONSUMER PRICES: ALL ITEMS NADJ |
| O168 | Consumer Price index of Indonesia | OECD, Main economic indicators | ID CONSUMER PRICES: ALL ITEMS NADJ |
| O169 | Consumer Price index of Italy | OECD, Main economic indicators | IT CPI ALL ITEMS NADJ |
| O170 | Consumer Price index of Japan | OECD, Main economic indicators | JP CPI ALL ITEMS NADJ |
| O171 | Consumer Price index of Malaysia | DEPARTMENT OF STATISTICS, MALAYSIA | MY CPI NADJ |
| O172 | Consumer Price index of Netherlands | OECD, Main economic indicators | NL CPI ALL ITEMS NADJ |
| O173 | Consumer Price index of Philippines | OECD, Main economic indicators | PH CPI NADJ |
| O174 | Consumer Price index of Russia | OECD, Main economic indicators | RS CPI ALL ITEMS NADJ |
| O175 | Consumer Price index of South Korea | OECD, Main economic indicators | KO CPI ALL ITEMS NADJx |
| O176 | Consumer Price index of Singapore | STATISTICS SINGAPORE | SP CPI NADJ |
| O177 | Consumer Price index of Spain | OECD, Main economic indicators | ES CPI ALL ITEMS NADJ |
| O178 | Consumer Price index of TPC | DGBAS, TPC | TW CPI NADJ |
| O179 | Consumer Price index of Thailand | BUREAU OF TRADE & ECON. INDICES,THAILAND | TH CPI NADJ |

(Continues)

**TABLE B1** (Continued)

| | Description | Source | Series title |
|---|---|---|---|
| O180 | Consumer Price index of UK | OECD, Main economic indicators | UK CPI ALL ITEMS NADJ |
| O181 | Consumer Price index of US | OECD, Main economic indicators | US CPI all items NADJ |
| O182 | GDP of PRC (quarterly) | National Bureau of statistics of PRC | Gross domestic product, current quarter (100 million yuan) |
| O183 | Industrial production of PRC | National Bureau of statistics of PRC | Real growth rate of value added of industry year-on-year |
| O184 | M1 of PRC | The People's Bank of PRC | Narrow money |
| O185 | 1-year deposit rate | The People's Bank of China | Time deposit rate: 1Y (lump-sum deposit and withdrawal) |
| O186 | GDP of TPC | Ministry of Economic Affairs. TPC | TW GDP |
| O187 | Industrial production of TPC | Ministry of Economic Affairs. TPC | TW IP |
| O188 | M1 of TPC | Central Bank of the Republic of China (TPC) | TW MONEY SUPPLY—M1A (end of period) |
| O189 | TPC discount rate | Central Bank of the Republic of China (TPC) | TW, policy rates, discount rate (end of period) |

**TABLE B2** Input indicator construction

| | Ind. | Indicator description | Construction |
|---|---|---|---|
| **Stock market*** | **I1** | Ratio of SMI: Australia/PRC | O19*O39/O43*O23 |
| | **I2** | Ratio of SMI: Belgium/PRC | O20*O40/O43*O23 |
| | **I3** | Ratio of SMI: Brazil/PRC | O21*O41/O43*O23 |
| | **I4** | Ratio of SMI: Canada/PRC | O22*O42/O43*O23 |
| | **I5** | Ratio of SMI: France/PRC | O24*O44/O43*O23 |
| | **I6** | Ratio of SMI: Germany/PRC | O25*O45/O43*O23 |
| | **I7** | Ratio of SMI: India/PRC | O26*O46/O43*O23 |
| | **I8** | Ratio of SMI: Indonesia/PRC | O27*O47/O43*O23 |
| | **I9** | Ratio of SMI: Italy/PRC | O28*O48/O43*O23 |
| | **I10** | Ratio of SMI: Japan/PRC | O29*O49/O43*O23 |
| | **I11** | Ratio of SMI: Malaysia/PRC | O30*O50/O43*O23 |
| | **I12** | Ratio of SMI: Netherlands/PRC | O31*O51/O43*O23 |
| | **I13** | Ratio of SMI: Philippines/PRC | O32*O52/O43*O23 |
| | **I14** | Ratio of SMI: Singapore/PRC | O33*O53/O43*O23 |
| | **I15** | Ratio of SMI: Spain/PRC | O34*O54/O43*O23 |
| | **I16** | Ratio of SMI: South Korea/PRC | O35*O55/O43*O23 |
| | **I17** | Ratio of SMI: TPC/PRC*** | O36*O56/O43*O23 |
| | **I18** | Ratio of SMI: Thailand/PRC | O37*O57/O43*O23 |
| | **I19** | Ratio of SMI: UK/PRC | O38*O58/O43*O23 |
| | **I20** | Ratio of SMI: US/PRC | O59/O43*O23 |
| **Futures market** | **I21** | Derivatives market: FTSE100 | O124-O117 |
| | **I22** | Derivatives market: HANG SENG | O125-O118 |
| | **I23** | Derivatives market: TOPIX | O126-O119 |
| | **I24** | Derivatives market: S&P 500 | O127-O120 |
| | **I25** | Derivatives market: EUREX-DAX | O128-O121 |

**TABLE B2** (Continued)

| | Ind. | Indicator description | Construction |
|---|---|---|---|
| | **I26** | Derivatives market: AEX | O129-O122 |
| | **I27** | Derivatives market: EUREX-SMI | O130-O123 |
| | **I28** | Derivatives market: Oil | O139-O131 |
| | **I29** | Derivatives market: Gas | O140-O132 |
| | **I30** | Derivatives market: Gold | O141-O133 |
| | **I31** | Derivatives market: Copper | O142-O134 |
| | **I32** | Derivatives market: Soybeans | O143-O135 |
| | **I33** | Derivatives market: Wheat | O144-O136 |
| | **I34** | Derivatives market: Corn | O145-O137 |
| | **I35** | Derivatives market: Aluminium | O146-O138 |
| **Bond market** | **I36** | TB spread: 10-to-2 years of Australia | O71-O68 |
| | **I37** | TB spread: 10-to-1 years of Belgium | O72-O60 |
| | **I38** | TB spread: 10-to-1 years of Canada | O73-O61 |
| | **I39** | TB spread: 10-to-1 years of France | O74-O62 |
| | **I40** | TB spread: 10-to-1 years of Germany | O75-O63 |
| | **I41** | TB spread: 10-to-1 years of Italy | O76-O64 |
| | **I42** | TB spread: 10-to-2 years of Japan | O77-O69 |
| | **I43** | TB spread: 10-to-1 years of Malaysia | O78-O65 |
| | **I44** | TB spread: 10-to-1 years of Spain | O79-O66 |
| | **I45** | TB spread: 10-to-2 years of UK | O80-O70 |
| | **I46** | TB spread: 10-to-1 years of US | O81-O68 |
| | **I47** | TB spread: 20-to-10 years of Canada | O82-O73 |
| | **I48** | TB spread: 30-to-10 years of France | O88-O74 |
| | **I49** | TB spread: 20-to-10 years of Japan | O83-O77 |
| | **I50** | TB spread: 20-to-10 years of UK | O84-O80 |
| | **I51** | TB spread: 30-to-10 years of Germany | O86-O75 |
| | **I52** | TB spread: 30-to-10 years of Spain | O87-O79 |
| | **I53** | TB spread: 30-to-10 years of US | O89-O81 |
| | **I54** | TB spread: 20-to-1 years of Canada | O82-O61 |
| | **I55** | TB spread: 20-to-1 years of US | O85-O67 |
| | **I56** | TB spread: 30-to-1 years of France | O88-O62 |
| | **I57** | TB spread: 30-to-1 years of Germany | O86-O63 |
| | **I58** | TB spread: 30-to-1 years of Spain | O87-O66 |
| | **I59** | TB spread: 20-to-2 years of Japan | O83-O69 |
| | **I60** | TB spread: 20-to-2 years of UK | O84-O70 |
| Money market | **I61** | TED spread: Interbank loan to TB rates of Belgium | O90-O10 |
| | **I62** | TED spread: Interbank loan to TB rates of Canada | O91-O11 |
| | **I63** | TED spread: Interbank loan to TB rates of France | O92-O12 |
| | **I64** | TED spread: Interbank loan to TB rates of Italy | O93-O13 |
| | **I65** | TED spread: Interbank loan to TB rates of Spain | O94-O15 |
| | **I66** | TED spread: Interbank loan to TB rates of UK | O95-O17 |
| | **I67** | TED spread: Interbank loan to TB rates of US | O96-O18 |

(Continues)

**TABLE B2** (Continued)

| | Ind. | Indicator description | Construction |
|---|---|---|---|
| | **I68** | IR spread: Overnight to 3-month interbank of Australia | O9-O1 |
| | **I69** | IR spread: Overnight to 3-month interbank of Belgium | O10-O2 |
| | **I70** | IR spread: Overnight to 3-month interbank of Canada | O11-O3 |
| | **I71** | IR spread: Overnight to 3-month interbank of Italy | O13-O4 |
| | **I72** | IR spread: Overnight to 3-month interbank of Japan | O14-O5 |
| | **I73** | IR spread: Overnight to 3-month interbank of Spain | O15-O6 |
| | **I74** | IR spread: Overnight to 3-month interbank of TPC** | O16-O7 |
| | **I75** | IR spread: Overnight to 3-month interbank of US | O18-O8 |
| | **I76** | TB spread: 6-to-3 months of Belgium | O97-O90 |
| | **I77** | TB spread: 6-to-3 months of Canada | O98-O91 |
| | **I78** | TB spread: 6-to-3 months of France | O99-O92 |
| | **I79** | TB spread: 6-to-3 months of Italy | O100-O93 |
| | **I80** | TB spread: 6-to-3 months of Spain | O101-O94 |
| | **I81** | TB spread: 6-to-3 months of US | O102-O96 |
| Banking sector | **I82** | Total lending-to-deposit ratio of the banking sector of US | O150-O148 |
| | **I83** | Total lending-to-deposit ratio of the banking sector of South Korea | O149-O147 |
| | **I84** | IR spread: Lending-to-deposit rates of Australia | O110-O103 |
| | **I85** | IR spread: Lending-to-deposit rates of Canada | O111-O104 |
| | **I86** | IR spread: Lending-to-deposit rates of Indonesia | O112-O105 |
| | **I87** | IR spread: Lending-to-deposit rates of Japan | O113-O106 |
| | **I88** | IR spread: Lending-to-deposit rates of Malaysia | O114-O107 |
| | **I89** | IR spread: Lending-to-deposit rates of South Korea | O115-O108 |
| | **I90** | IR spread: Lending-to-deposit rates of Thailand | O116-O109 |
| | **I91** | Debt to liquidity ratio: M1 to liabilities of Canada | O156-O151 |
| | **I92** | Debt to liquidity ratio: M1 to liabilities of France | O157-O152 |
| | **I93** | Debt to liquidity ratio: M1 to liabilities of India | O158-O153 |
| | **I94** | Debt to liquidity ratio: M1 to liabilities of UK | O159-O154 |
| | **I95** | Debt to liquidity ratio: M1 to liabilities of US | O160-O155 |
| Foreign exchange market* | **I96** | PPP: Belgium/PRC | O161/O164 |
| | **I97** | PPP: Brazil/PRC | O162/O164 |
| | **I98** | PPP: Canada/PRC | O163/O164 |
| | **I99** | PPP: France/PRC | O165/O164 |
| | **I100** | PPP: Germany/PRC | O166/O164 |
| | **I101** | PPP: India/PRC | O167/O164 |
| | **I102** | PPP: Indonesia/PRC | O168/O164 |

**TABLE B2** (Continued)

| | Ind. | Indicator description | Construction |
|---|---|---|---|
| | **I103** | PPP: Italy/PRC | O169/O164 |
| | **I104** | PPP: Japan/PRC | O170/O164 |
| | **I105** | PPP: Malaysia/PRC | O171/O164 |
| | **I106** | PPP: Netherlands/PRC | O172/O164 |
| | **I107** | PPP: Philippines/PRC | O173/O164 |
| | **I108** | PPP: Russia/PRC | O174/O164 |
| | **I109** | PPP: South Korea/PRC | O175/O164 |
| | **I110** | PPP: Singapore/PRC | O176/O164 |
| | **I111** | PPP: Spain/PRC | O177/O164 |
| | **I112** | PPP: TPC/PRC*** | O178/O164 |
| | **I113** | PPP: Thailand/PRC | O179/O164 |
| | **I114** | PPP: UK/PRC | O180/O164 |
| | **I115** | PPP: US/PRC | O181/O164 |

*Note*: Stock market indices (SMI), treasury bond (TB), interest rate (IR). The corresponding variables used for the indicator construction can be found in Table B1. *Construction differs for TPC with PRC Stock Market and CPI being replaced by TPC Stock Market and CPI. **Dropped from the TPC input indicator set. ***Ratio inverted for TPC.

## APPENDIX C.: Grouping results and weights

**TABLE C1** Grouping results

| | | PRC | | TPC | |
|---|---|---|---|---|---|
| | **Indicators** | **Construction** | **Grouped input indicators** | **Construction** | **Grouped input indicators** |
| **Money market** | **I76** | Average | g1 | Average | g1 |
| | **I78** | Average | | Average | |
| | **I79** | Average | | Average | |
| | **I81** | Average | g2 | Average | g2 |
| | **I74**** | Average | | Dropped | |
| | **I61** | Average | g3 | Average | g3 |
| | **I62** | Average | | Average | |
| | **I63** | Average | | Average | |
| | **I65** | Average | | Average | |
| | **I66** | Average | | Average | |
| | **I69** | Average | g4 | Average | g4 |
| | **I73** | Average | | Average | |
| | **I77** | Full | g5 | Full | g5 |
| | **I64** | Full | g6 | Full | g6 |
| | **I67** | Full | g7 | Full | g7 |
| | **I68** | Full | g8 | Full | g8 |
| | **I70** | Full | g9 | Full | g9 |
| | **I71** | Full | g10 | Full | g10 |
| | **I72** | Full | g11 | Full | g11 |

(Continues)

**TABLE C1** (Continued)

| | | PRC | | TPC | |
|---|---|---|---|---|---|
| | **Indicators** | **Construction** | **Grouped input indicators** | **Construction** | **Grouped input indicators** |
| | **I75** | Full | g12 | Full | g12 |
| | **I80** | Full | g13 | Full | g13 |
| **Bond market** | **I37** | Average | g1 | Average | g1 |
| | **I39** | Average | | Average | |
| | **I40** | Average | | Average | |
| | **I44** | Average | | Average | |
| | **I48** | Average | | Average | |
| | **I51** | Average | | Average | |
| | **I56** | Average | | Average | |
| | **I57** | Average | | Average | |
| | **I45** | Average | g2 | Average | g2 |
| | **I50** | Average | | Average | |
| | **I60** | Average | | Average | |
| | **I46** | Average | g3 | Average | g3 |
| | **I53** | Average | | Average | |
| | **I55** | Average | | Average | |
| | **I42** | Average | g4 | Average | g4 |
| | **I59** | Average | | Average | |
| | **I38** | Average | g5 | Average | g5 |
| | **I54** | Average | | Average | |
| | **I36** | Full | g6 | Full | g6 |
| | **I41** | Full | g7 | Full | g7 |
| | **I43** | Full | g8 | Full | g8 |
| | **I47** | Full | g9 | Full | g9 |
| | **I49** | Full | g10 | Full | g10 |
| | **I52** | Full | g11 | Full | g11 |
| | **I58** | Full | g12 | Full | g12 |
| **Banking sector** | **I85** | Average | g1 | Average | g1 |
| | **I82** | Average | | Average | |
| | **I89** | Average | g2 | Average | g2 |
| | **I90** | Average | | Average | |
| | **I91** | Average | g3 | Average | g3 |
| | **I95** | Average | | Average | |
| | **I84** | Full | g4 | Full | g4 |
| | **I83** | Full | g5 | Full | g5 |
| | **I93** | Full | g6 | Full | g6 |
| | **I86** | Full | g7 | Full | g7 |
| | **I87** | Full | g8 | Full | g8 |
| | **I88** | Full | g9 | Full | g9 |
| | **I94** | Full | g10 | Full | g10 |
| | **I92** | Full | g11 | Full | g11 |

**TABLE C1** (Continued)

| | | | | | |
|---|---|---|---|---|---|
| **Foreign exchange market*** | **I96** | Average | g1 | Average | g1 |
| | **I101** | Average | | Average | |
| | **I102** | Average | | Average | |
| | **I107** | Average | | Average | |
| | **I108** | Average | | Average | |
| | **I96** | Average | g2 | Average | |
| | **I98** | Average | | Average | |
| | **I99** | Average | | Average | |
| | **I100** | Average | | Average | |
| | **I103** | Average | | Average | |
| | **I105** | Average | | Average | |
| | **I106** | Average | | Average | |
| | **I109** | Average | | Average | |
| | **I111** | Average | | Average | |
| | **I112** | Average | | Average | |
| | **I113** | Average | | Average | |
| | **I114** | Average | | Average | |
| | **I115** | Average | | Average | |
| | **I104** | Average | | Full | g2 |
| | **I110** | Average | | Full | g3 |
| **Stock market*** | **I1** | Average | g1 | Average | g1 |
| | **I3** | Average | | Average | |
| | **I4** | Average | | Average | |
| | **I7** | Average | | Average | |
| | **I14** | Average | | Average | |
| | **I16** | Average | | Average | |
| | **I2** | Average | | Average | g2 |
| | **I5** | Average | | Average | |
| | **I6** | Average | | Average | |
| | **I9** | Average | | Average | |
| | **I12** | Average | | Average | |
| | **I15** | Average | | Average | |
| | **I19** | Average | | Average | |
| | **I10** | Average | | Full | g4 |
| | **I20** | Average | | Full | g5 |
| | **I17** | Average | | Average | g3 |
| | **I11** | Average | | Average | |
| | **I8** | Full | g2 | Average | |
| | **I18** | Full | g3 | Average | |
| | **I13** | Full | g4 | Average | |
| **Futures market** | **I28** | Average | g1 | Average | g1 |
| | **I29** | Average | | Average | |
| | **I30** | Average | g2 | Average | g2 |
| | **I32** | Average | | Average | |

(Continues)

**TABLE C1** (Continued)

| | | | | |
|---|---|---|---|---|
| **I34** | Average | | Average | |
| **I21** | Average | g3 | Average | g3 |
| **I24** | Average | | Average | |
| **I25** | Average | | Average | |
| **I27** | Average | | Average | |
| **I22** | Full | g4 | Full | g4 |
| **I31** | Full | g5 | Full | g5 |
| **I33** | Full | g6 | Full | g6 |
| **I35** | Full | g7 | Full | g7 |
| **I23** | Full | g8 | Full | g8 |
| **I26** | Full | g9 | Full | g9 |

*Note*: The corresponding input indicators can be found in Appendix B, Table B2. *Definition of indicators differs between PRC and TPC. **Dropped for TPC.

**TABLE C2** PRC short-run CIFI weights

| | | | | | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bank | g4 | Total liability to Equity Ratio & Interest Spread Lending-to-deposit rate | AU | 1 | | | | | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 |
| | | | | 2 | | | | | | 0.01 | 0.01 | | | | 0.01 |
| | g2 | | Kr,TH | 1 | | 0.01 | 0.01 | | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | |
| | | | | 2 | −0.02 | −0.02 | −0.02 | −0.02 | −0.02 | −0.01 | −0.01 | −0.01 | −0.02 | −0.01 | −0.01 |
| | g8 | | JP | 1 | 0.04 | 0.04 | 0.03 | 0.03 | 0.03 | | 0.03 | | 0.02 | 0.02 | 0.02 |
| | | | | 2 | −0.03 | −0.03 | −0.03 | | −0.02 | | | | | | |
| | g9 | | MY | 1 | | | | | | | | | | −0.01 | −0.01 |
| | | | | 2 | | | | | | | | | | 0.02 | 0.02 |
| | g3 | M1–liquidity ratio | Us,ca | 1 | 0.04 | 0.07 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.05 | 0.05 | 0.05 |
| | | | | 2 | −0.04 | −0.06 | −0.05 | −0.06 | −0.05 | −0.06 | −0.06 | −0.05 | −0.05 | −0.05 | −0.04 |
| | g10 | | UK | 1 | −0.02 | −0.02 | −0.01 | | −0.01 | −0.01 | −0.01 | −0.01 | | | |
| | | | | 2 | 0.02 | 0.01 | | | | | | | | | |
| | g11 | | FR | 1 | 0.01 | 0.01 | 0.01 | 0.02 | 0.02 | 0.03 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 |
| | | | | 2 | −0.02 | −0.02 | −0.02 | −0.02 | −0.02 | −0.03 | −0.02 | −0.02 | −0.02 | −0.02 | −0.02 |
| | | | | 3 | | | | | −0.02 | −0.03 | −0.03 | | | | |
| | g6 | | IN | 1 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | | | |
| | | | | 2 | | | | | | | | −0.01 | −0.01 | −0.01 | |
| Bond | g3 | Government bond spread (10–1 year, 30–10 years, 30–1 year) | US | 1 | −0.02 | | | −0.02 | | | | | | | |
| | | | | 2 | 0.02 | 0.02 | 0.02 | 0.02 | | | | | | | |
| | g5 | | CA | 1 | | | | | | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| | g2 | | UK | 1 | | | | −0.02 | | | | | | | |
| | | | | 2 | | | | 0.02 | | | | | | | |
| | g7 | | IT | 1 | | | | | | | 0.01 | | | | |
| | g11 | | ES | 1 | −0.03 | −0.03 | −0.03 | −0.03 | −0.03 | −0.02 | −0.02 | −0.03 | −0.03 | −0.03 | −0.02 |
| | | | | 2 | 0.03 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 |
| | | | | 3 | | | | | | | | −0.02 | | | −0.01 |
| | g6 | | AU | 1 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| | g4 | | JP | 1 | | | | | | | | | | 0.01 | |
| FX | g2 | PPP | Others * | 1 | | | | 0.04 | | 0.03 | 0.03 | | | | 0.01 |
| Futures | g1 | Commodities calendar spread | Oil, gas | 1 | 0.01 | | | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| | g2 | | Gold,soy,Corn | 1 | 0.01 | 0.01 | 0.02 | 0.02 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |

(Continues)

**TABLE C2** (Continued)

| | | | | | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 2 | −0.02 | −0.02 | −0.02 | −0.02 | −0.02 | −0.02 | −0.01 | −0.01 | −0.01 | 0.00 | |
| | g5 | | Copper | 1 | −0.01 | −0.01 | | | | | | | | | |
| | | | | 2 | 0.01 | 0.01 | | | | | | | | | |
| | g6 | | Wheat | 1 | −0.02 | −0.02 | −0.02 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 |
| | | | | 2 | 0.02 | 0.02 | 0.02 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| | g7 | | Aluminium | 1 | | | 0.01 | | | | | 0.01 | 0.01 | 0.01 | 0.01 |
| | g3 | Stocks calendar spread | FTSE,S&P,EUR | 1 | | | | | | | | | | | 0.01 |
| | g4 | | Hang Seng | 1 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| | | | | 2 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | 0.00 | |
| | g9 | | AEX | 1 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.01 | 0.01 |
| | | | | 2 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 |
| Money | g2 | 3 month–6 months T-bill spread | Us,TW | 1 | −0.02 | −0.02 | −0.02 | −0.02 | −0.02 | −0.02 | −0.02 | −0.02 | −0.02 | −0.02 | −0.02 |
| | | | | 2 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.03 | 0.03 | 0.03 | 0.03 |
| | g5 | | CA | 1 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| | g1 | | Be,FR,it | 1 | | | | | | | | | | | 0.00 |
| | g13 | | ES | 1 | 0.01 | 0.01 | 0.01 | 0.01 | | 0.01 | 0.01 | −0.01 | −0.01 | −0.01 | −0.01 |
| | g7 | TED spread | US | 1 | −0.02 | −0.02 | −0.01 | −0.01 | | | −0.03 | −0.02 | −0.03 | −0.03 | −0.03 |
| | | | | 2 | 0.01 | 0.01 | 0.01 | 0.01 | | | 0.03 | 0.02 | 0.02 | 0.02 | |
| | g3 | | Ca,be,FR,ES,UK | 1 | −0.01 | −0.01 | −0.01 | | | | | | | | |
| | | | | 2 | 0.01 | 0.01 | 0.01 | 0.01 | | | | | | | |
| | g6 | | IT | 1 | −0.01 | −0.01 | −0.01 | −0.01 | | 0.00 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 |
| | | | | 2 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | | |
| | g12 | Overnight–3 month interbank rate spread | US | 1 | −0.02 | −0.01 | −0.01 | −0.01 | | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 |
| | | | | 2 | 0.01 | 0.01 | 0.01 | 0.01 | | | | | | | |
| | g4 | | Be,ES | 1 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | 0.01 | 0.01 | 0.01 | |
| | | | | 2 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | | | −0.01 | −0.01 | −0.01 | −0.01 |
| | g10 | | IT | 1 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 |
| | | | | 2 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| | g8 | | AU | 1 | | | −0.01 | | | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 |
| | | | | 2 | | | | | | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| | g11 | | JP | 1 | 0.01 | 0.01 | 0.01 | 0.01 | | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | |

**TABLE C2** (Continued)

| | | | | | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 2 | −0.01 | −0.01 | −0.01 | −0.01 | | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | |
| Stock | g1 | Cross market ratio | Others ** | 1 | −0.03 | −0.02 | −0.02 | −0.02 | −0.02 | −0.02 | −0.02 | −0.02 | −0.02 | −0.02 | −0.02 |
| | | | | 2 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.01 |
| | g2 | | ID | 1 | | | | −0.01 | −0.01 | | | −0.01 | −0.01 | −0.01 | −0.01 |
| | | | | 2 | | | | 0.01 | 0.01 | 0.01 | | | | | |
| | g3 | | TH | 1 | | | | | | | | −0.02 | −0.02 | | −0.02 |
| | | | | 2 | | | | | | | | 0.02 | 0.02 | | 0.02 |
| | g4 | | PH | 1 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.02 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 |
| | | | | 2 | 0.01 | 0.01 | 0.01 | 0.02 | 0.02 | 0.01 | 0.01 | 0.02 | 0.02 | 0.01 | 0.01 |

*Note*: Input indicators with no significant weights have been excluded from the table. Number of lags indicates whether the input indicator enters as a difference or a level. Input indicator references, for example, g1, and g2, correspond to the grouping results in Table C1.* CA, DE, IT, JP, MY, NL, KR, SG, ES, TW, TH, UK, US. ** AU, BR, CA, DE, IN, IT, JP, MY, NL, SG, ES, KR, TW, UK, US. See Table C10 for country shorthand.

**TABLE C3** PRC short-run CIFI lags

| | | | | | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bank | g4 | Total liability to Equity Ratio & Interest Spread Lending to Deposite rate | AU | 1 | | | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | | | | 2 | | | | | | 6 | 6 | | | | 6 |
| | g2 | | Kr,TH | 1 | | 1 | 1 | | 1 | 1 | 1 | 1 | 1 | 1 | |
| | | | | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| | g8 | | JP | 1 | 3 | 3 | 4 | 4 | 4 | | 5 | | 4 | 4 | 4 |
| | | | | 2 | 6 | 6 | 6 | | 6 | | | | | | |
| | g9 | | MY | 1 | | | | | | | | | | 1 | 1 |
| | | | | 2 | | | | | | | | | | 4 | 4 |
| | g3 | M1−liquidity ratio | Us,ca | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | | | | 2 | 6 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 4 |
| | g10 | | UK | 1 | 1 | 1 | 6 | | 6 | 6 | 6 | 6 | | | |
| | | | | 2 | 3 | 3 | | | | | | | | | |
| | g11 | | FR | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | | | | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 4 | 3 | 3 |

(Continues)

**TABLE C3** (Continued)

| | | | | | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 | | | | | 4 | 4 | 4 | | | | |
| | g6 | | IN | 1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | | | |
| | | | | 2 | | | | | | | | 5 | 6 | 5 | |
| Bond | g3 | Government bond spread (10–1 year, 30–10 years, 30–1 year) | US | 1 | 2 | | | 2 | | | | | | | |
| | | | | 2 | 4 | 4 | 4 | 4 | | | | | | | |
| | g5 | | CA | 1 | | | | | | 4 | 4 | 4 | 4 | 4 | 4 |
| | g2 | | UK | 1 | | | | 2 | | | | | | | |
| | | | | 2 | | | | 4 | | | | | | | |
| | g7 | | IT | 1 | | | | | | | 6 | | | | |
| | g11 | | ES | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | | | | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| | | | | 3 | | | | | | | | 5 | | | 5 |
| | g6 | | AU | 1 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 5 | 6 |
| | g4 | | JP | 1 | | | | | | | | | | 1 | |
| FX | g2 | PPP | Others * | 1 | | | | 2 | | 2 | 2 | | | | 2 |
| Futures | g1 | Commodities calendar spread | Oil, gas | 1 | 3 | | | 3 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| | g2 | | Gold,soy,Corn | 1 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 1 | 1 | 1 |
| | | | | 2 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | |
| | g5 | | Copper | 1 | 1 | 1 | | | | | | | | | |
| | | | | 2 | 4 | 4 | | | | | | | | | |
| | g6 | | Wheat | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | | | | 2 | 5 | 5 | 5 | 5 | 5 | 5 | 6 | 5 | 5 | 5 | 5 |
| | g7 | | Aluminium | 1 | | | 3 | | | | | 3 | 3 | 3 | 3 |
| | g3 | Stocks calendar spread | FTSE,S&P,EUR | 1 | | | | | | | | | | | 2 |
| | g4 | | Hang Seng | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | | | | 2 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | |
| | g9 | | AEX | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | | | | 2 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| Money | g2 | 3 month–6 months T-bill spread | Us,TW | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | | | | 2 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| | g5 | | CA | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

**TABLE C3** (Continued)

| | | | | | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | g1 | | Be,FR,it | 1 | | | | | | | | | | | 1 |
| | g13 | | ES | 1 | 1 | 1 | 1 | 1 | | 1 | 1 | 5 | 3 | 4 | 4 |
| | g7 | TED spread | US | 1 | 1 | 1 | 1 | 2 | | | 3 | 2 | 2 | 2 | 2 |
| | | | | 2 | 6 | 6 | 6 | 6 | | | 5 | 5 | 5 | 5 | |
| | g3 | | Ca,be,FR,ES,UK | 1 | 1 | 1 | 1 | | | | | | | | |
| | | | | 2 | 3 | 3 | 3 | 6 | | | | | | | |
| | g6 | | IT | 1 | 1 | 1 | 1 | 1 | | 1 | 1 | 1 | 1 | 1 | 1 |
| | | | | 2 | 4 | 4 | 4 | 4 | 5 | 4 | 4 | 5 | 4 | | |
| | g12 | Overnight–3 month interbank rate spread | US | 1 | 2 | 2 | 2 | 2 | | 6 | 6 | 6 | 6 | 6 | 6 |
| | | | | 2 | 5 | 5 | 5 | 4 | | | | | | | |
| | g4 | | Be,ES | 1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | |
| | | | | 2 | 6 | 6 | 6 | 6 | 6 | | | 3 | 3 | 3 | 3 |
| | g10 | | IT | 1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| | | | | 2 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| | g8 | | AU | 1 | | | 2 | | | 2 | 2 | 2 | 2 | 2 | 1 |
| | | | | 2 | | | | | | 4 | 4 | 4 | 4 | 4 | 4 |
| | g11 | | JP | 1 | 3 | 3 | 3 | 3 | | 3 | 3 | 3 | 3 | 3 | |
| | | | | 2 | 6 | 6 | 6 | 6 | | 6 | 6 | 6 | 6 | 6 | 6 |
| Stock | g1 | Cross market ratio | Others ** | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | | | | 2 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| | g2 | | ID | 1 | | | | 2 | 2 | | | 2 | 2 | 2 | 2 |
| | | | | 2 | | | | 6 | 6 | 6 | | | | | |
| | g3 | | TH | 1 | | | | | | | | 2 | 2 | | 2 |
| | | | | 2 | | | | | | | | 4 | 4 | | 4 |
| | g4 | | PH | 1 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| | | | | 2 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |

*Note*: Input indicators with no significant weights have been excluded from the table. Number of lags indicates whether the input indicator enters as a difference or a level. Input indicator references, for example, g1, and g2, correspond to the grouping results in Table C1.* CA, DE, IT, JP, MY, NL, KR, SG, ES, TW, TH, UK, US. ** AU, BR, CA, DE, IN, IT, JP, MY, NL, SG, ES, KR, TW, UK, US. See Table C10 for country shorthand.

**TABLE C4** TPC short-run CIFI weights

| | | | | | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bank | g4 | Total liability to Equity Ratio & Interest Spread Lending-to-deposit rate | AU | 1 | | | | | | | 0.02 | | | | |
| | g8 | | JP | 1 | −0.04 | | | | | | | | | | |
| | g5 | | KR | 1 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |
| | | | | 2 | −0.04 | −0.04 | −0.04 | −0.04 | −0.04 | −0.03 | −0.03 | −0.03 | −0.03 | −0.03 | −0.03 |
| | g9 | | MY | 1 | −0.03 | −0.03 | −0.03 | −0.02 | −0.02 | −0.02 | −0.02 | −0.03 | −0.03 | −0.03 | −0.03 |
| | | | | 2 | 0.03 | 0.03 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.03 | 0.03 | 0.03 | 0.03 |
| | g3 | M1–liquidity ratio | Us,ca | 1 | | | 0.11 | 0.10 | | 0.10 | 0.10 | 0.05 | 0.04 | 0.04 | |
| | | | | 2 | | | −0.11 | −0.10 | | −0.10 | −0.10 | −0.04 | −0.04 | −0.04 | |
| | g11 | | FR | 1 | 0.02 | 0.02 | 0.02 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.04 | 0.04 | 0.04 |
| | | | | 2 | −0.04 | −0.04 | −0.04 | −0.04 | −0.06 | −0.06 | −0.06 | −0.06 | −0.04 | −0.04 | −0.04 |
| | | | | 3 | 0.03 | 0.03 | 0.03 | 0.03 | 0.04 | 0.03 | 0.03 | 0.03 | 0.04 | 0.04 | 0.04 |
| | g6 | | IN | 1 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | | 0.02 | 0.02 | 0.02 | 0.02 |
| | | | | 2 | −0.02 | −0.02 | −0.02 | −0.02 | −0.02 | −0.02 | | −0.02 | −0.02 | −0.02 | −0.02 |
| Bond | g3 | Government bond spread (10–1 year, 30–10 years, 30–1 year) | US | 1 | 0.02 | 0.02 | | | | | | | | | |
| | g5 | | CA | 1 | | | | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.02 |
| | | | | 2 | | | | −0.02 | −0.02 | −0.02 | −0.02 | −0.02 | −0.02 | −0.02 | −0.02 |
| | g2 | | UK | 1 | −0.02 | −0.02 | −0.02 | −0.03 | | | | | | | |
| | | | | 2 | 0.03 | 0.03 | 0.02 | 0.04 | 0.01 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.01 |
| | g7 | | IT | 1 | | | | | 0.01 | 0.02 | 0.02 | 0.02 | | | |
| | | | | 2 | | | | | | | | −0.01 | | | |
| | g11 | | ES | 1 | −0.03 | | −0.04 | −0.04 | −0.03 | | | −0.03 | −0.03 | −0.03 | −0.02 |
| | | | | 2 | 0.04 | | 0.04 | 0.04 | 0.04 | | | 0.03 | 0.03 | 0.03 | 0.03 |
| | g6 | | AU | 1 | −0.02 | −0.02 | −0.02 | −0.02 | −0.02 | −0.01 | −0.01 | −0.01 | −0.01 | | |
| | | | | 2 | 0.02 | 0.02 | 0.03 | 0.03 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.01 | 0.01 |
| | g8 | | MY | 1 | | | | | | 0.01 | | | | | |
| Forex | g1 | PPP | Others* | 1 | −0.11 | | | | | | | −0.11 | −0.11 | −0.11 | −0.12 |
| | | | | 2 | 0.12 | | | | | | | 0.12 | 0.11 | 0.12 | 0.12 |
| | g2 | | JP | 1 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.07 | 0.07 | 0.07 |
| | | | | 2 | −0.06 | −0.06 | −0.06 | −0.06 | −0.06 | −0.06 | −0.07 | −0.07 | −0.07 | −0.07 | −0.07 |
| | g3 | | SG | 1 | 0.01 | | | | | 0.01 | 0.03 | 0.04 | 0.04 | 0.05 | 0.06 |
| | | | | 2 | | | | | | | −0.03 | −0.04 | −0.04 | −0.05 | −0.05 |

**TABLE C4** (Continued)

| | | | | | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Futures | g2 | Commodities calendar spread | Gold, soy, corn | 1 | | | | 0.02 | 0.02 | | | | | | |
| | | | | 2 | −0.01 | −0.01 | | −0.03 | −0.02 | | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 |
| | g5 | | Copper | 1 | −0.02 | −0.02 | −0.02 | −0.02 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 |
| | | | | 2 | 0.02 | 0.02 | 0.02 | 0.02 | 0.01 | 0.02 | 0.02 | 0.01 | 0.01 | 0.01 | 0.01 |
| | g6 | | Wheat | 1 | −0.03 | −0.03 | −0.03 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 |
| | | | | 2 | 0.03 | 0.03 | 0.02 | 0.01 | 0.01 | 0.02 | 0.02 | 0.01 | 0.01 | 0.02 | 0.02 |
| | g7 | | Aluminium | 1 | | | −0.01 | −0.01 | | | | −0.01 | −0.01 | −0.01 | −0.01 |
| | | | | 2 | | | | | | | | | | 0.01 | 0.01 |
| | g3 | Stocks calendar spread | FTSE,S&P,EUR | 1 | −0.02 | −0.02 | −0.02 | −0.02 | −0.02 | −0.02 | −0.02 | −0.02 | −0.02 | −0.02 | −0.02 |
| | | | | 2 | | | | | | | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| | g4 | | Hang Seng | 1 | 0.01 | 0.02 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| | | | | 2 | −0.02 | −0.02 | −0.02 | −0.02 | −0.01 | −0.02 | −0.02 | −0.02 | −0.01 | −0.01 | −0.01 |
| | g9 | | AEX | 1 | 0.03 | 0.03 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 |
| | | | | 2 | −0.02 | −0.02 | −0.01 | 0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 |
| Money | g2 | 3 month–6 months T-bill spread | US | 1 | 0.03 | 0.03 | 0.03 | 0.03 | 0.04 | 0.05 | 0.06 | 0.06 | 0.06 | 0.07 | 0.07 |
| | | | | 2 | −0.02 | −0.02 | −0.02 | −0.03 | −0.04 | −0.05 | −0.06 | −0.06 | −0.07 | −0.07 | −0.07 |
| | g5 | | CA | 1 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| | | | | 2 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 |
| | g13 | | ES | 1 | | | | | | | 0.01 | | | | |
| | | | | 2 | −0.02 | −0.02 | −0.02 | −0.02 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 |
| | g7 | TED spread | US | 1 | −0.02 | −0.02 | −0.02 | −0.02 | −0.02 | | | | | | |
| | | | | 2 | 0.03 | 0.03 | 0.03 | 0.02 | 0.03 | | | | | | |
| | g6 | | IT | 1 | −0.02 | −0.02 | −0.02 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 |
| | | | | 2 | 0.01 | 0.01 | 0.01 | 0.01 | | | | | | | |
| | g12 | Overnight–3 month interbank rate spread | US | 1 | −0.03 | −0.03 | −0.03 | −0.02 | −0.02 | −0.02 | −0.02 | −0.02 | −0.01 | −0.01 | −0.01 |
| | | | | 2 | 0.03 | 0.03 | 0.03 | 0.02 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| | g4 | | Be,ES | 1 | | | | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 |
| | | | | 2 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| | g10 | | IT | 1 | | | | | 0.02 | 0.02 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| | | | | 2 | −0.02 | −0.02 | −0.02 | −0.02 | −0.02 | −0.02 | −0.02 | −0.02 | −0.02 | −0.02 | −0.01 |
| | | | | 3 | | | | | −0.02 | −0.02 | −0.02 | −0.01 | −0.01 | −0.01 | −0.01 |

(Continues)

**TABLE C4** (Continued)

| | | | | | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 4 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.01 | 0.01 | |
| | g8 | | AU | 1 | −0.02 | −0.01 | −0.01 | −0.01 | | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 |
| | | | | 2 | 0.02 | 0.02 | 0.02 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| | g11 | | JP | 1 | 0.02 | 0.02 | 0.02 | 0.01 | | | | | | | |
| | | | | 2 | | | −0.01 | | | | | | | | |
| Stock | g1 | Cross market ratio | Au,BR,ca,in,sg,KR | 1 | | −0.03 | −0.05 | −0.04 | | | | | | | |
| | | | | 2 | 0.03 | 0.04 | 0.05 | 0.04 | 0.04 | 0.04 | | | | | |
| | g2 | | Be,FR,de,it,NL,ES,UK | 1 | | −0.02 | −0.03 | −0.02 | −0.03 | −0.03 | −0.03 | −0.03 | −0.03 | −0.03 | −0.03 |
| | | | | 2 | | 0.03 | 0.03 | 0.02 | 0.04 | 0.04 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |
| | g3 | | CH,id,my,PH,TH | 1 | | | | | | | 0.02 | | 0.02 | 0.02 | 0.02 |
| | g4 | | JP | 1 | −0.03 | −0.03 | −0.03 | −0.02 | −0.02 | −0.02 | −0.02 | −0.02 | −0.02 | −0.02 | −0.02 |
| | | | | 2 | 0.03 | 0.03 | 0.03 | 0.03 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 |
| | g5 | | US | 1 | −0.03 | −0.03 | −0.03 | −0.03 | −0.03 | −0.03 | −0.03 | −0.02 | −0.02 | −0.02 | −0.02 |
| | | | | 2 | 0.03 | 0.04 | 0.04 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |

*Note*: Input indicators with no significant weights have been excluded from the table. Number of lags indicates whether the input indicator enters as a difference or a level. Input indicator references, for example, g1, and g2, correspond to the grouping results in Table C1.* BE, BR, CA, FR, DE, IN, ID, IT, MY, NL, PH, RU, KR, ES, TH, UK, US, CH. See Table C10 for country shorthand.

**TABLE C5** TPC Short-run CIFI Lags

| | | | | | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bank | g4 | Total liability to Equity Ratio & Interest Spread Lending-to-deposit rate | AU | 1 | | | | | | | 6 | | | | |
| | g8 | | JP | 1 | 1 | | | | | | | | | | |
| | g5 | | KR | 1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| | | | | 2 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| | g9 | | MY | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | | | | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| | g3 | M1–liquidity ratio | Us,ca | 1 | | | 2 | 2 | | 1 | 1 | 1 | 1 | 1 | |
| | | | | 2 | | | 5 | 5 | | 3 | 3 | 2 | 2 | 2 | |
| | g11 | | FR | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | | | | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| | | | | 3 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| | g6 | | IN | 1 | 3 | 3 | 3 | 3 | 3 | 1 | | 3 | 3 | 2 | 2 |
| | | | | 2 | 5 | 5 | 5 | 5 | 5 | 5 | | 5 | 5 | 5 | 5 |
| Bond | g3 | Government bond spread (10–1 year, 30–10 years, 30–1 year) | US | 1 | 3 | 3 | | | | | | | | | |
| | g5 | | CA | 1 | | | | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| | | | | 2 | | | | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| | g2 | | UK | 1 | 1 | 1 | 1 | 1 | | | | | | | |
| | | | | 2 | 6 | 6 | 6 | 4 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| | g7 | | IT | 1 | | | | | 2 | 2 | 2 | 2 | | | |
| | | | | 2 | | | | | | | | 4 | | | |
| | g11 | | ES | 1 | 1 | | 2 | 2 | 2 | | | 1 | 1 | 1 | 1 |
| | | | | 2 | 4 | | 4 | 4 | 4 | | | 4 | 4 | 4 | 4 |
| | g6 | | AU | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | |
| | | | | 2 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| | g8 | | MY | 1 | | | | | | 3 | | | | | |
| Forex | g1 | PPP | Others* | 1 | 2 | | | | | | | 2 | 2 | 2 | 2 |
| | | | | 2 | 5 | | | | | | | 5 | 5 | 5 | 5 |
| | g2 | | JP | 1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| | | | | 2 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| | g3 | | SG | 1 | 1 | | | | | 1 | 1 | 1 | 1 | 1 | 1 |
| | | | | 2 | | | | | | | 2 | 2 | 2 | 2 | 2 |

(Continues)

**TABLE C5** (Continued)

| | | | | | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Futures | g2 | Commodities calendar spread | Gold, soy, corn | 1 | | | | 4 | 4 | | | | | | |
| | | | | 2 | 6 | 6 | | 6 | 6 | | 6 | 6 | 6 | 6 | 6 |
| | g5 | | Copper | 1 | 1 | 2 | 2 | 3 | 2 | 3 | 3 | 2 | 2 | 2 | 2 |
| | | | | 2 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| | g6 | | Wheat | 1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 4 | 4 |
| | | | | 2 | 5 | 5 | 5 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| | g7 | | Aluminium | 1 | | | 1 | 1 | | | | 1 | 1 | 1 | 1 |
| | | | | 2 | | | | | | | | | | 5 | 5 |
| | g3 | Stocks calendar spread | FTSE,S&P,EUR | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | | | | 2 | | | | | | | 5 | 5 | 5 | 5 | 5 |
| | g4 | | Hang Seng | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| | | | | 2 | 4 | 4 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| | g9 | | AEX | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | | | | 2 | 5 | 5 | 5 | 2 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| Money | g2 | 3 month–6 months T-bill spread | US | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| | | | | 2 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| | g5 | | CA | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | | | | 2 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| | g13 | | ES | 1 | | | | | | | 1 | | | | |
| | | | | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 5 | 5 | 5 | 5 | 5 |
| | g7 | TED spread | US | 1 | 3 | 3 | 3 | 3 | 3 | | | | | | |
| | | | | 2 | 6 | 6 | 6 | 6 | 6 | | | | | | |
| | g6 | | IT | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | | | | 2 | 4 | 4 | 4 | 4 | | | | | | | |
| | g12 | Overnight–3 month interbank rate spread | US | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| | | | | 2 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| | g4 | | Be,ES | 1 | | | | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| | | | | 2 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| | g10 | | IT | 1 | | | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | | | | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| | | | | 3 | | | | | 4 | 4 | 4 | 4 | 4 | 4 | 4 |

**TABLE C5** (Continued)

| | | | | | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 4 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| | g8 | | AU | 1 | 2 | 2 | 2 | 2 | | 2 | 2 | 2 | 2 | 2 | 2 |
| | | | | 2 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| | g11 | | JP | 1 | 3 | 3 | 5 | 3 | | | | | | | |
| | | | | 2 | | | 6 | | | | | | | | |
| Stock | g1 | Cross market ratio | Au,BR,ca,in,sg,KR | 1 | | 1 | 1 | 1 | | | | | | | |
| | | | | 2 | 3 | 3 | 3 | 3 | 3 | 3 | | | | | |
| | g2 | | Be,FR,de,it,NL,ES,UK | 1 | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | | | | 2 | | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| | g3 | | CH,id,my,PH,TH | 1 | | | | | | | 3 | | 3 | 3 | 3 |
| | g4 | | JP | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | | | | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| | g5 | | US | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | | | | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

*Note*: Input indicators with no significant weights have been excluded from the table. Number of lags indicates whether the input indicator enters as a difference or a level. Input indicator references, for example, g1 and g2, correspond to the grouping results in Table C1.* BE, BR, CA, FR, DE, IN, ID, IT, MY, NL, PH, RU, KR, ES, TH, UK, US, CH. See Table C10 for country shorthand.

**TABLE C6** PRC long-run CIFI weights

| | | | | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bank | g1 | Total liability to Equity Ratio & Interest Spread Lending-to-deposit rate | Us,ca | 0.07 | 0.07 | 0.08 | 0.09 | 0.08 | 0.04 | 0.02 | −0.01 | −0.02 | −0.02 | −0.02 |
| | g4 | | AU | 0.04 | 0.05 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.05 | 0.05 | 0.06 |
| | g2 | | Kr,TH | 0.09 | 0.09 | 0.09 | 0.09 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 |
| | g5 | | KR | −0.05 | −0.04 | −0.03 | 0.01 | 0.02 | 0.03 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 |
| | g8 | | JP | −0.11 | −0.10 | −0.10 | −0.10 | −0.11 | −0.11 | −0.11 | −0.11 | −0.11 | −0.11 | −0.11 |
| | g9 | | MY | −0.01 | −0.02 | −0.02 | −0.02 | −0.02 | −0.04 | −0.05 | −0.06 | −0.06 | −0.06 | −0.06 |
| | g3 | M1–liquidity ratio | Us,ca | −0.08 | −0.08 | −0.09 | −0.10 | −0.10 | −0.10 | −0.09 | −0.09 | −0.08 | −0.08 | −0.08 |
| | g10 | | UK | 0.11 | 0.11 | 0.11 | 0.11 | 0.10 | 0.08 | 0.07 | 0.06 | 0.06 | 0.06 | 0.05 |
| | g11 | | FR | 0.11 | 0.11 | 0.10 | 0.07 | 0.04 | −0.02 | −0.03 | −0.04 | −0.04 | −0.03 | −0.03 |
| | g6 | | IN | −0.06 | −0.06 | −0.05 | −0.04 | −0.04 | 0.03 | 0.05 | 0.05 | 0.06 | 0.06 | 0.06 |
| Bond | g3 | Government bond spread (10–1 year, 30–10 years, 30–1 year) | US | 0.08 | 0.07 | 0.05 | 0.06 | 0.06 | 0.08 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 |
| | g5 | | CA | 0.02 | 0.02 | 0.00 | −0.01 | 0.00 | 0.02 | 0.03 | 0.03 | 0.02 | 0.03 | 0.03 |
| | g2 | | UK | −0.03 | −0.03 | −0.04 | −0.04 | −0.03 | 0.03 | 0.05 | 0.05 | 0.06 | 0.06 | 0.06 |
| | g1 | | Be,FR,de,ES | −0.03 | −0.04 | −0.05 | −0.05 | −0.05 | −0.02 | 0.00 | 0.01 | 0.01 | 0.02 | 0.02 |
| | g7 | | IT | −0.02 | −0.02 | −0.03 | −0.04 | −0.03 | 0.01 | 0.02 | 0.04 | 0.04 | 0.04 | 0.04 |
| | g11 | | ES | 0.09 | 0.09 | 0.09 | 0.10 | 0.10 | 0.11 | 0.11 | 0.11 | 0.11 | 0.11 | 0.11 |
| | g6 | | AU | −0.08 | −0.08 | −0.09 | −0.09 | −0.08 | −0.06 | −0.05 | −0.05 | −0.05 | −0.04 | −0.04 |
| | g4 | | JP | −0.09 | −0.09 | −0.09 | −0.10 | −0.10 | −0.10 | −0.10 | −0.10 | −0.10 | −0.10 | −0.10 |
| | g8 | | MY | 0.07 | 0.07 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.05 | 0.05 | 0.05 |
| FX | g1 | PPP | Br,in,id,PH,RU | 0.12 | 0.12 | 0.12 | 0.12 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.12 |
| | g2 | | Others * | 0.06 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.06 | 0.05 | 0.04 | 0.04 | 0.04 |
| Futures | g1 | Commodities calendar spread | Oil, gas | −0.05 | −0.03 | 0.00 | −0.02 | 0.01 | 0.03 | 0.04 | 0.04 | 0.04 | 0.03 | 0.03 |
| | g2 | | Gold, soy, corn | −0.04 | −0.01 | 0.03 | 0.05 | 0.05 | 0.00 | −0.01 | −0.02 | −0.03 | −0.03 | −0.03 |
| | g5 | | Copper | 0.07 | 0.03 | 0.02 | 0.02 | 0.03 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.05 |
| | g6 | | Wheat | 0.04 | 0.04 | 0.05 | 0.03 | 0.03 | 0.04 | 0.05 | 0.06 | 0.06 | 0.06 | 0.06 |
| | g7 | | Alu | −0.08 | −0.08 | −0.08 | −0.06 | −0.06 | −0.04 | −0.04 | −0.03 | −0.03 | −0.02 | −0.02 |
| | g3 | Stocks calendar spread | FTSE,S&P,EUR | −0.03 | −0.04 | −0.03 | −0.02 | −0.04 | −0.06 | −0.07 | −0.07 | −0.07 | −0.08 | −0.08 |
| | g4 | | Hang Seng | −0.08 | −0.07 | −0.06 | −0.06 | −0.07 | −0.08 | −0.08 | −0.08 | −0.08 | −0.08 | −0.08 |
| | g8 | | TOPIX | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 |
| | g9 | | AEX | −0.05 | −0.05 | −0.05 | −0.04 | −0.05 | −0.05 | −0.05 | −0.05 | −0.05 | −0.05 | −0.05 |
| Money | g2 | | Us,TW | 0.07 | 0.08 | 0.08 | 0.08 | 0.06 | 0.01 | −0.04 | −0.05 | −0.05 | −0.06 | −0.06 |

**TABLE C6** (Continued)

| | | | | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | g5 | 3 month–6 months T-bill spread | CA | −0.06 | −0.06 | −0.07 | −0.07 | −0.08 | −0.08 | −0.07 | −0.07 | −0.07 | −0.07 | |
| | g1 | | Be,FR,it | −0.03 | −0.02 | −0.01 | −0.02 | −0.02 | −0.01 | 0.03 | 0.04 | 0.04 | 0.04 | 0.04 |
| | g13 | | ES | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | −0.01 | 0.03 | 0.04 | 0.04 | 0.04 | 0.04 |
| | g7 | TED spread | US | 0.08 | 0.08 | 0.07 | 0.05 | 0.05 | 0.08 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 |
| | g3 | | Ca,be,FR,ES,UK | 0.05 | 0.05 | 0.05 | 0.00 | −0.03 | −0.03 | −0.03 | −0.04 | −0.03 | −0.03 | −0.03 |
| | g6 | | IT | −0.05 | −0.05 | −0.06 | −0.06 | −0.07 | −0.07 | −0.06 | −0.06 | −0.04 | −0.04 | −0.04 |
| | g12 | Overnight–3 month interbank rate spread | US | 0.04 | 0.04 | 0.04 | 0.04 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |
| | g9 | | CA | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.03 | 0.02 | 0.02 | 0.02 | 0.02 |
| | g4 | | Be,ES | 0.05 | 0.05 | 0.04 | 0.02 | −0.02 | −0.04 | −0.04 | −0.05 | −0.05 | −0.04 | −0.04 |
| | g10 | | IT | −0.02 | −0.02 | −0.03 | −0.03 | −0.04 | −0.05 | −0.05 | −0.05 | −0.05 | −0.05 | −0.05 |
| | g8 | | AU | −0.01 | −0.01 | −0.02 | −0.02 | −0.01 | −0.03 | −0.03 | −0.03 | −0.02 | −0.02 | −0.02 |
| | g11 | | JP | 0.02 | 0.02 | 0.01 | −0.03 | −0.04 | −0.05 | −0.04 | −0.04 | −0.03 | −0.03 | −0.03 |
| Stock | g1 | Cross market ratio | Others ** | 0.11 | 0.12 | 0.12 | 0.12 | 0.12 | 0.10 | 0.08 | 0.07 | 0.07 | 0.06 | 0.06 |
| | g2 | | ID | 0.01 | 0.02 | 0.02 | 0.03 | 0.03 | 0.04 | 0.05 | 0.06 | 0.06 | 0.06 | 0.06 |
| | g3 | | TH | 0.00 | 0.01 | 0.00 | −0.02 | −0.03 | −0.04 | −0.04 | −0.04 | −0.04 | −0.04 | −0.04 |
| | g4 | | PH | −0.07 | −0.07 | −0.08 | −0.08 | −0.09 | −0.10 | −0.10 | −0.10 | −0.10 | −0.09 | −0.10 |

*Note*: Input indicator references, for example, g1 and g2, correspond to the grouping results in Table C1. * CA, DE, IT, JP, MY, NL, KR, SG, ES, TW, TH, UK, US. ** AU, BR, CA, DE, IN, IT, JP, MY, NL, SG, ES, KR, TW, UK, US. See Table C10 for country shorthand.

**TABLE C7** PRC long-run CIFI lags

| | | | | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bank | g1 | Total liability to Equity Ratio & Interest Spread Lending-to-deposit rate | Us,ca | 3 | 3 | 3 | 2 | 3 | 6 | 6 | 0 | 0 | 0 | 0 |
| | g4 | | AU | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | g2 | | Kr,TH | 4 | 5 | 5 | 5 | 4 | 5 | 5 | 5 | 5 | 5 | 5 |
| | g5 | | KR | 5 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | g8 | | JP | 1 | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | g9 | | MY | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| | g3 | M1–liquidity ratio | Us,ca | 0 | 0 | 0 | 0 | 0 | 6 | 6 | 6 | 6 | 6 | 6 |
| | g10 | | UK | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 5 |
| | g11 | | FR | 2 | 1 | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 6 | 6 |
| | g6 | | IN | 6 | 6 | 6 | 6 | 6 | 0 | 0 | 0 | 0 | 0 | 0 |
| Bond | g3 | Government bond spread (10–1 year, 30–10 years, 30–1 year) | US | 0 | 4 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | g5 | | CA | 4 | 4 | 1 | 1 | 0 | 3 | 4 | 4 | 4 | 4 | 4 |
| | g2 | | UK | 6 | 6 | 6 | 6 | 6 | 0 | 0 | 0 | 0 | 0 | 0 |
| | g1 | | Be,FR,de,ES | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 4 | 4 | 4 | 4 |
| | g7 | | IT | 0 | 0 | 0 | 0 | 6 | 4 | 2 | 2 | 2 | 2 | 2 |
| | g11 | | ES | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| | g6 | | AU | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 |
| | g4 | | JP | 4 | 4 | 4 | 4 | 4 | 5 | 5 | 5 | 5 | 5 | 5 |
| | g8 | | MY | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| FX | g1 | PPP | Br,in,id,PH,RU | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| | g2 | | Others * | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| Futures | g1 | Commodities calendar spread | Oil, gas | 2 | 5 | 0 | 2 | 0 | 6 | 6 | 6 | 6 | 6 | 6 |
| | g2 | | Gold, soy, corn | 0 | 0 | 5 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 0 |
| | g5 | | Copper | 6 | 6 | 6 | 6 | 5 | 5 | 5 | 5 | 5 | 5 | 6 |
| | g6 | | Wheat | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | g7 | | Alu | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 |
| | g3 | Stocks calendar spread | FTSE,S&P,EUR | 2 | 3 | 4 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| | g4 | | Hang Seng | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| | g8 | | TOPIX | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| | g9 | | AEX | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Money | g2 | | Us,TW | 6 | 6 | 6 | 6 | 6 | 6 | 2 | 2 | 2 | 2 | 2 |

**TABLE C7** (Continued)

| | | | | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | g5 | 3 month–6 months T-bill spread | CA | 0 | 0 | 0 | 0 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| | g1 | | Be,FR,it | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 6 | 6 | 6 | 6 |
| | g13 | | ES | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 6 | 6 | 6 |
| | g7 | TED spread | US | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | g3 | | Ca,be,FR,ES,UK | 0 | 0 | 0 | 0 | 4 | 5 | 5 | 5 | 5 | 5 | 5 |
| | g6 | | IT | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| | g12 | Overnight–3 month interbank rate spread | US | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | g9 | | CA | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| | g4 | | Be,ES | 1 | 1 | 1 | 1 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| | g10 | | IT | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| | g8 | | AU | 2 | 2 | 2 | 2 | 0 | 1 | 2 | 2 | 2 | 2 | 2 |
| | g11 | | JP | 5 | 5 | 5 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Stock | g1 | Cross market ratio | Others ** | 1 | 1 | 1 | 1 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| | g2 | | ID | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | g3 | | TH | 0 | 0 | 0 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| | g4 | | PH | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |

*Note*: Input indicator references, for example, g1 and g2, correspond to the grouping results in Table C1. * CA, DE, IT, JP, MY, NL, KR, SG, ES, TW, TH, UK, US. ** AU, BR, CA, DE, IN, IT, JP, MY, NL, SG, ES, KR, TW, UK, US. See Table C10 for country shorthand.

**TABLE C8** TPC long-run CIFI weights

| | | | | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bank | g1 | Total liability to Equity Ratio & Interest Spread Lending-to-deposit rate | Us,ca | −0.09 | −0.09 | −0.07 | −0.05 | −0.03 | −0.05 | −0.06 | −0.07 | −0.08 | −0.09 | −0.09 |
| | g4 | | AU | 0.04 | 0.05 | 0.07 | 0.08 | 0.09 | 0.08 | 0.07 | 0.06 | 0.06 | 0.05 | 0.04 |
| | g2 | | Kr,TH | −0.09 | −0.10 | −0.10 | −0.10 | −0.08 | −0.05 | −0.04 | −0.02 | −0.02 | −0.01 | 0.00 |
| | g5 | | KR | 0.09 | 0.10 | 0.12 | 0.12 | 0.12 | 0.12 | 0.11 | 0.10 | 0.09 | 0.08 | 0.08 |
| | g8 | | JP | 0.07 | 0.05 | 0.02 | 0.00 | −0.02 | −0.03 | −0.05 | −0.05 | −0.06 | −0.07 | −0.07 |
| | g9 | | MY | −0.03 | −0.04 | −0.04 | −0.04 | −0.05 | −0.06 | −0.07 | −0.08 | −0.08 | −0.09 | −0.09 |
| | g3 | M1–liquidity ratio | Us,ca | 0.10 | 0.10 | 0.10 | 0.08 | 0.05 | 0.03 | 0.03 | 0.02 | 0.03 | 0.03 | 0.03 |
| | g10 | | UK | −0.08 | −0.09 | −0.09 | −0.10 | −0.10 | −0.10 | −0.09 | −0.08 | −0.06 | 0.00 | 0.03 |
| | g11 | | FR | −0.03 | −0.03 | −0.04 | −0.06 | −0.08 | −0.08 | −0.08 | −0.08 | −0.07 | −0.06 | −0.03 |
| | g6 | | IN | 0.09 | 0.10 | 0.11 | 0.12 | 0.12 | 0.12 | 0.11 | 0.11 | 0.11 | 0.11 | 0.11 |
| Bond | g3 | Government bond spread (10–1 year, 30–10 years, 30–1 year) | US | −0.04 | −0.05 | −0.06 | −0.06 | −0.04 | 0.00 | 0.03 | 0.04 | 0.05 | 0.05 | 0.06 |
| | g5 | | CA | 0.00 | −0.01 | −0.03 | −0.04 | −0.02 | 0.01 | 0.02 | 0.02 | 0.01 | 0.01 | 0.01 |
| | g2 | | UK | 0.05 | 0.06 | 0.05 | 0.04 | 0.05 | 0.07 | 0.08 | 0.08 | 0.09 | 0.09 | 0.09 |
| | g1 | | Be,FR,de,ES | 0.02 | 0.01 | −0.02 | −0.03 | −0.04 | 0.00 | 0.01 | 0.02 | 0.03 | 0.04 | 0.04 |
| | g7 | | IT | 0.06 | 0.06 | 0.04 | 0.03 | 0.03 | 0.05 | 0.06 | 0.07 | 0.07 | 0.07 | 0.06 |
| | g11 | | ES | −0.08 | −0.08 | −0.08 | −0.08 | −0.07 | −0.04 | −0.02 | −0.01 | 0.00 | 0.01 | 0.02 |
| | g6 | | AU | 0.06 | 0.05 | 0.03 | −0.02 | −0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.02 | 0.02 |
| | g4 | | JP | 0.07 | 0.07 | 0.06 | 0.04 | 0.02 | 0.01 | 0.00 | −0.01 | −0.02 | −0.03 | −0.05 |
| | g8 | | MY | −0.03 | −0.03 | −0.05 | −0.05 | −0.05 | −0.03 | −0.03 | −0.03 | −0.03 | −0.03 | −0.03 |
| FX | g1 | PPP | Others* | −0.07 | −0.06 | −0.04 | −0.02 | 0.01 | 0.03 | 0.05 | 0.06 | 0.07 | 0.08 | 0.08 |
| | g2 | | JP | 0.08 | 0.07 | 0.05 | 0.03 | −0.01 | −0.03 | −0.04 | −0.06 | −0.07 | −0.07 | −0.08 |
| | g3 | | SG | 0.08 | 0.08 | 0.07 | 0.07 | 0.08 | 0.09 | 0.10 | 0.10 | 0.10 | 0.10 | 0.11 |
| Futures | g1 | Commodities calendar spread | Oil, gas | 0.02 | 0.03 | 0.05 | 0.04 | 0.05 | 0.06 | 0.06 | 0.05 | 0.05 | 0.04 | 0.03 |
| | g2 | | Gold, soy, corn | 0.02 | 0.03 | 0.05 | 0.06 | 0.06 | 0.04 | 0.03 | 0.02 | −0.02 | −0.03 | −0.03 |
| | g5 | | Copper | −0.07 | −0.07 | −0.07 | −0.06 | −0.05 | −0.03 | −0.02 | 0.00 | 0.01 | 0.01 | 0.01 |
| | g6 | | Wheat | −0.05 | −0.05 | −0.04 | −0.05 | −0.03 | 0.00 | 0.02 | 0.03 | 0.03 | 0.03 | 0.03 |
| | g7 | | Alu | 0.03 | 0.03 | 0.02 | 0.03 | 0.04 | 0.05 | 0.04 | 0.04 | 0.05 | 0.05 | 0.05 |
| | g3 | Stocks calendar spread | FTSE,S&P,EUR | −0.04 | −0.04 | −0.04 | −0.02 | −0.03 | −0.05 | −0.06 | −0.06 | −0.07 | −0.08 | −0.08 |
| | g4 | | Hang Seng | 0.03 | 0.03 | 0.03 | 0.03 | 0.01 | −0.02 | −0.02 | −0.03 | −0.04 | −0.04 | −0.04 |
| | g8 | | TOPIX | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 |
| | g9 | | AEX | 0.01 | −0.01 | −0.02 | −0.02 | −0.02 | −0.02 | −0.03 | −0.03 | −0.03 | −0.03 | −0.03 |

**TABLE C8** (Continued)

| | | | | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Money | g2 | 3 month–6 months T-bill spread | US | 0.05 | 0.06 | 0.07 | −0.03 | −0.06 | −0.08 | −0.09 | −0.09 | −0.09 | −0.10 | −0.10 |
| | g5 | | CA | 0.06 | 0.07 | 0.06 | 0.06 | 0.05 | 0.04 | 0.03 | 0.02 | 0.01 | 0.00 | −0.01 |
| | g1 | | Be,FR,it | 0.02 | 0.03 | 0.04 | 0.04 | 0.03 | 0.03 | 0.05 | 0.05 | 0.05 | 0.04 | 0.03 |
| | g13 | | ES | 0.04 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.06 | 0.07 | 0.07 | 0.06 | 0.05 |
| | g7 | TED spread | US | −0.03 | −0.03 | −0.03 | 0.02 | 0.05 | 0.07 | 0.09 | 0.09 | 0.09 | 0.10 | 0.10 |
| | g3 | | Ca,be,FR,ES,UK | −0.02 | −0.01 | −0.01 | −0.04 | −0.06 | −0.06 | −0.05 | −0.05 | −0.04 | −0.03 | −0.03 |
| | g6 | | IT | 0.05 | 0.05 | 0.04 | 0.03 | 0.00 | −0.01 | −0.01 | 0.01 | 0.03 | 0.03 | 0.04 |
| | g12 | Overnight–3 month interbank rate spread | US | −0.07 | −0.08 | −0.09 | −0.08 | −0.09 | −0.07 | −0.06 | −0.05 | −0.04 | −0.03 | −0.02 |
| | g9 | | CA | −0.05 | −0.05 | −0.05 | −0.05 | −0.05 | −0.05 | −0.04 | −0.04 | −0.04 | −0.04 | −0.04 |
| | g4 | | Be,ES | −0.04 | −0.05 | −0.06 | −0.07 | −0.08 | −0.08 | −0.08 | −0.08 | −0.06 | −0.05 | −0.04 |
| | g10 | | IT | −0.04 | −0.05 | −0.06 | −0.07 | −0.08 | −0.09 | −0.08 | −0.07 | −0.06 | −0.05 | −0.04 |
| | g8 | | AU | −0.04 | −0.05 | −0.05 | −0.06 | −0.05 | −0.05 | −0.05 | −0.04 | −0.02 | −0.02 | −0.02 |
| | g11 | | JP | 0.04 | 0.00 | −0.01 | −0.03 | −0.05 | −0.05 | −0.04 | −0.03 | −0.02 | −0.02 | −0.01 |
| Stock | g1 | Cross market ratio | Au,BR,ca,in,sg,KR | −0.03 | 0.00 | 0.03 | 0.05 | 0.07 | 0.08 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 |
| | g2 | | Be,FR,de,it,NL,ES,UK | −0.08 | −0.07 | −0.05 | −0.03 | −0.02 | −0.01 | −0.01 | −0.02 | −0.02 | −0.01 | −0.01 |
| | g3 | | CH,id,my,PH,TH | 0.09 | 0.10 | 0.10 | 0.11 | 0.10 | 0.10 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 |
| | g4 | | JP | 0.05 | 0.05 | 0.06 | 0.07 | 0.06 | 0.05 | 0.03 | 0.00 | −0.01 | −0.01 | −0.02 |
| | g5 | | US | −0.10 | −0.10 | −0.09 | −0.09 | −0.07 | −0.06 | −0.05 | −0.04 | −0.02 | −0.01 | 0.01 |

*Note*: Input indicator references, for example, g1, and g2, correspond to the grouping results in Table C1. * BE, BR, CA, FR, DE, IN, ID, IT, MY, NL, PH, RU, KR, ES, TH, UK, US, CH. See Table C10 for country shorthand.

**TABLE C9** TPC long-run CIFI lags

| | | | | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bank | g1 | Total liability to Equity Ratio & Interest Spread Lending to Deposite rate | Us,ca | 6 | 6 | 6 | 6 | 6 | 3 | 1 | 1 | 1 | 1 | 1 |
| | g4 | | AU | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| | g2 | | Kr,TH | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| | g5 | | KR | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| | g8 | | JP | 5 | 6 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | g9 | | MY | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | g3 | M1–liquidity ratio | Us,ca | 6 | 6 | 6 | 6 | 6 | 2 | 0 | 0 | 0 | 0 | 0 |
| | g10 | | UK | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 |
| | g11 | | FR | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 5 | 5 |
| | g6 | | IN | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 4 | 3 | 4 |
| Bond | g3 | Government bond spread (10–1 year, 30–10 years, 30–1 year) | US | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 6 | 6 | 6 | 6 |
| | g5 | | CA | 0 | 0 | 0 | 0 | 1 | 5 | 6 | 6 | 6 | 6 | 6 |
| | g2 | | UK | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| | g1 | | Be,FR,de,ES | 3 | 4 | 0 | 0 | 6 | 0 | 0 | 0 | 0 | 2 | 6 |
| | g7 | | IT | 6 | 6 | 6 | 6 | 0 | 0 | 0 | 0 | 0 | 6 | 6 |
| | g11 | | ES | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 4 |
| | g6 | | AU | 6 | 6 | 6 | 0 | 6 | 3 | 6 | 6 | 3 | 0 | 0 |
| | g4 | | JP | 4 | 4 | 5 | 4 | 0 | 0 | 6 | 6 | 1 | 0 | 0 |
| | g8 | | MY | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 |
| FX | g1 | PPP | Others* | 0 | 0 | 2 | 2 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| | g2 | | JP | 6 | 6 | 6 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | g3 | | SG | 6 | 6 | 6 | 6 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Futures | g1 | Commodities calendar spread | Oil, gas | 6 | 0 | 6 | 6 | 0 | 1 | 6 | 6 | 6 | 6 | 1 |
| | g2 | | Gold,soy,Corn | 1 | 1 | 1 | 1 | 4 | 3 | 5 | 5 | 0 | 0 | 6 |
| | g5 | | Copper | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 0 | 6 | 6 |
| | g6 | | Wheat | 3 | 3 | 3 | 4 | 4 | 0 | 0 | 0 | 6 | 6 | 6 |
| | g7 | | Alu | 4 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 5 |
| | g3 | Stocks calendar spread | FTSE,S&P,EUR | 6 | 6 | 6 | 6 | 2 | 2 | 4 | 2 | 2 | 2 | 2 |
| | g4 | | Hang Seng | 1 | 1 | 1 | 2 | 2 | 5 | 5 | 5 | 5 | 0 | 5 |
| | g8 | | TOPIX | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 1 | 1 |
| | g9 | | AEX | 2 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |

**TABLE C9** (Continued)

| | | | | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Money | g2 | 3 month–6 months T-bill spread | US | 6 | 6 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | g5 | | CA | 2 | 2 | 2 | 2 | 4 | 2 | 2 | 4 | 4 | 0 | 0 |
| | g1 | | Be,FR,it | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| | g13 | | ES | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| | g7 | TED spread | US | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 6 | 6 | 6 |
| | g3 | | Ca,be,FR,ES,UK | 6 | 6 | 6 | 1 | 3 | 3 | 3 | 3 | 6 | 6 | 3 |
| | g6 | | IT | 0 | 0 | 0 | 3 | 0 | 2 | 2 | 0 | 0 | 0 | 0 |
| | g12 | Overnight–3 month interbank rate spread | US | 3 | 3 | 3 | 6 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| | g9 | | CA | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | g4 | | Be,ES | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | g10 | | IT | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| | g8 | | AU | 1 | 1 | 2 | 1 | 6 | 2 | 2 | 4 | 5 | 2 | 4 |
| | g11 | | JP | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Stock | g1 | Cross market ratio | Au,BR,ca,in,sg,KR | 0 | 0 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| | g2 | | Be,FR,de,it,NL,ES,UK | 4 | 2 | 4 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| | g3 | | CH,id,my,PH,TH | 6 | 6 | 4 | 4 | 4 | 4 | 0 | 0 | 0 | 0 | 0 |
| | g4 | | JP | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 1 | 1 | 0 | 0 |
| | g5 | | US | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 5 | 0 |

*Note*: Input indicator references, for example, g1, and g2, correspond to the grouping results in Table C1. * BE, BR, CA, FR, DE, IN, ID, IT, MY, NL, PH, RU, KR, ES, TH, UK, US, CH. See Table C10 for country shorthand.

**TABLE C10** Country shorthand

| COUNTRIES | SHORTHAND |
|---|---|
| Australia | AU |
| Belgium | BE |
| Brazil | BR |
| Canada | CA |
| PRC | CH |
| France | FR |
| Germany | DE |
| India | IN |
| Indonesia | ID |
| Italy | IT |
| Japan | JP |
| Malaysia | MY |
| Netherlands | NL |
| Philippines | PH |
| Russia | RU |
| Saudi Arabia | SA |
| Singapore | SG |
| South Korea | KR |
| Spain | ES |
| TPC | TW |
| Thailand | TH |
| UK | UK |
| US | US |