On the Reliability of Chinese Output Figures

Technical Appendix

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This technical appendix explains the estimation method used in FRBSF Economic Letter 2013-08, "On the Reliability of Chinese Output Figures" by John Fernald, Israel Malkin and Mark M. Spiegel. The text below describes our methodology and displays our results. Estimation was done in STATA and the program output for the three sets of estimations reported is included at the back of the appendix. Data used in this study are available online at:
http://www.frbsf.org/publications/economics/letter/2013/el2013-07-data-appendix.xlsx

Data sources

- Chinese proxy data:
  - CEIC database and Bloomberg
  - Samples are series specific
  - Chinese trade data includes flows through Hong Kong
- US trade data: Census Bureau data obtained from Haver Analytics (Jan 1999-Dec 2012)
- EU trade data: Eurostat ,"EU27 trade since 1988 by CN8" database (Jan 1999-Oct 2012)
- Japan trade data: Ministry of Finance (Jan 1999-Dec 2012)
- World trade data: Direction of Trade Statistics (Jan 1991-Aug 2012)
- For data and other regression results, including samples for various Chinese series and our calculations of the Chinese export deflators, please see data appendix.

Evidence from domestic Chinese Data

We compare Chinese data with two sets of alternative domestic indicators. The first set is based on the reported preferences of Vice Premier Li and includes electricity production, rail cargo shipments, and loan disbursements. The second set includes an index of consumer sentiment, construction of new floor space, an index of raw materials usage, air passenger volume, and the nominal value of new residential real estate construction.

Baseline model

Our baseline model satisfies

$$\Delta^4 y_t = \rho \Delta^4 y_{t-4} + \beta X_t + \upsilon_t$$

where $\Delta^4 y_t$ is reported quarterly GDP growth, measured year-over-year, X_t is a vector of contemporaneous and/or lagged values of the first principal component of growth from the aforementioned alternative indicators of economic activity, and υ_t is an i.i.d. error term. We estimate using ordinary least squares, with heteroskedasticity-corrected standard errors. For our out-of-sample

exercises, we truncate the sample at 2009 Q3 and then use the point estimates of our specification to predict through 2012:Q4.

Our fitted results are shown in the following tables

Dependent Variable: Year-over-Year Growth in Chinese GDP		
	Li	Broad
4th lag of China GDP Growth	0.61***	0.61***
	(0.13)	(0.15)
1st prinicpal component of alt. indicators	1.24***	1.06***
	(0.21)	(0.28)
Constant	3.84***	4.01***
	(1.17)	(1.42)
Obs	36	36
R^2	0.57	0.47
Prediction:		
Mean Forecast error	-0.06	-0.59
RMSE in sample	1.52	1.7
RMSE out-of-sample	0.85	1.65

Note: Robust standard errors in parentheses. Significance at 1 percent level = ***; 5 percent level = **; 10 percent level =. Estimation period is 2000Q4-2009Q3. Out-of-sample root mean squared error (RMSE) is calculated from 2009Q4-2012Q4.

Consistency with Data Reported Outside China

Our methodology using the externally-reported Trio and World data is similar. We use the above equation, fitted to the first principal component of export and import data vis-à-vis China as reported by the International Monetary Fund in the case of the world trade series, and the individual country and region reported data for the TRIO set of the US, Japan, and the EU. We then again conduct our out-of-sample specifications using our fitted point estimates.

Dependent Variable: Year-over-Year Growth in Chinese GDP		
	Trio	World
4th lag of China GDP Growth	0.70***	0.63***
	(0.16)	(0.16)
1st prinicpal component of trade flows	0.84***	0.74***
	(0.21)	(0.17)
Constant	2.98***	3.62***
	(1.41)	(1.44)
Obs	36	36
R^2	0.5	0.49
Prediction:		
Mean Forecast error	0	-0.16
RMSE in sample	1.65	1.67
RMSE out-of-sample	1.73	1.72

Note: Robust standard errors in parentheses. Significance at 1 percent level = ***; 5 percent level = **; 10 percent level = *. Estimation period is 2000Q4-2009Q3. Out-of-sample root mean squared error (RMSE) is calculated from 2009Q3-2012Q4 for the Trio group, and 2009Q3-2012Q3 for the World group.

Finally, we use the same methodology for industrial production (IP) growth using the Trio and World import and export data. Our results satisfy:

Dependent Variable: Year-over-Year Growth in Chinese IP		
	Trio	World
12th lag of China IP Growth	0.44***	0.38***
	(0.05)	(0.06)
1st prinicpal component of trade flows	2.54***	2.55***
	(0.24)	(0.26)
Constant	7.81***	8.36***
	(0.74)	(0.74)
Obs	117	117
R^2	0.63	0.64
Prediction:		
Mean Forecast error	0.1	-0.05
RMSE in sample	2.2	2.16
RMSE out-of-sample	3.3	3.65

Note: Robust standard errors in parentheses. Significance at 1 percent level = ***; 5 percent level = **; 10 percent level =. Estimation period is 2000M1-2009M9. Out-of-sample root mean squared error (RMSE) is calculated from 2009M10-2012M12 for the Trio group, and 2009M10-2012M9 for the World group.

The STATA output from the regression results is presented below

Evidence from domestic Chinese Data

Regression with Li PC

```
Linear regression                               Number of obs =        36
                                                F(  2,    33) =     23.96
                                                Prob > F      =    0.0000
                                                R-squared     =    0.5711
                                                Root MSE      =    1.5276

------------------------------------------------------------------------------
             |               Robust
        RGDP |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        RGDP |
         L4. |   .6069279   .1275011     4.76   0.000     .3475249    .8663309
             |
         pca |   1.241588   .2093855     5.93   0.000     .8155896    1.667586
       _cons |   3.838885   1.167681     3.29   0.002     1.463221    6.214549
------------------------------------------------------------------------------
```

Regression Sample: 2000Q4-2009Q3
Forecast: 2009Q4-2012Q4

Regression with Broad PC

```
Linear regression                               Number of obs =        36
                                                F(  2,    33) =     12.64
                                                Prob > F      =    0.0001
                                                R-squared     =    0.4707
                                                Root MSE      =     1.697

------------------------------------------------------------------------------
             |               Robust
        RGDP |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        RGDP |
         L4. |   .6104606   .1539807     3.96   0.000     .2971845    .9237366
             |
         pca |   1.064067   .2785852     3.82   0.001     .4972815    1.630853
       _cons |   4.006627   1.417933     2.83   0.008     1.121821    6.891433
------------------------------------------------------------------------------
```

Regression Sample: 2000Q4-2009Q4
Forecast: 2009Q4-2012Q4

Consistency with Data Reported Outside China

Regression with Trio group (US, EU, Japan)

```
Linear regression                               Number of obs =      36
                                                F(  2,    33) =   16.92
                                                Prob > F      =  0.0000
                                                R-squared     =  0.4978
                                                Root MSE      =   1.653

------------------------------------------------------------------------------
             |               Robust
        RGDP |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        RGDP |
         L4. |   .6993734   .1561529     4.48   0.000     .3816779    1.017069
             |
    Trio_pca |   .8417955   .1816196     4.63   0.000     .4722876    1.211303
       _cons |   2.979949   1.410319     2.11   0.042     .1106331    5.849265
------------------------------------------------------------------------------
```

Regression Sample: 2000Q4-2009Q3

Forecast: 2009Q4-2012Q4

Regression with World aggregate

```
Linear regression                               Number of obs =      36
                                                F(  2,    33) =   14.33
                                                Prob > F      =  0.0000
                                                R-squared     =  0.4857
                                                Root MSE      =  1.6728

------------------------------------------------------------------------------
             |               Robust
        RGDP |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        RGDP |
         L4. |   .6345891   .1593951     3.98   0.000     .3102973    .9588808
             |
   World_pca |   .7413288   .1726745     4.29   0.000     .3900198    1.092638
       _cons |   3.619597   1.436988     2.52   0.017     .6960239     6.54317
------------------------------------------------------------------------------
```

Regression Sample: 2000Q4-2009Q3

Forecast: 2009Q4-2012Q3

Consistency with Data Reported Outside China (Industrial Production)

Regression with Trio group (US, EU, Japan)

```
Linear regression                                       Number of obs =     117
                                                        F(  2,   114) =   89.44
                                                        Prob > F      =  0.0000
                                                        R-squared     =  0.6295
                                                        Root MSE      =  2.2025

------------------------------------------------------------------------------
             |               Robust
          IP |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          IP |
         L12. |   .4407423   .0546835     8.06   0.000     .3324147    .5490699
             |
    Trio_pca |   2.540679   .2440485    10.41   0.000     2.057221    3.024137
       _cons |   7.810949   .7428489    10.51   0.000     6.339371    9.282527
------------------------------------------------------------------------------
```

Regression Sample: 2000M1-2009M9
Forecast: 2009M10-2012M12

Regression with World aggregate

```
Linear regression                                       Number of obs =     117
                                                        F(  2,   114) =   78.18
                                                        Prob > F      =  0.0000
                                                        R-squared     =  0.6446
                                                        Root MSE      =  2.1571

------------------------------------------------------------------------------
             |               Robust
          IP |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          IP |
         L12. |   .3842456   .0552908     6.95   0.000      .274715    .4937761
             |
   World_pca |   2.551904   .2550401    10.01   0.000     2.046671    3.057136
       _cons |   8.360662    .738352    11.32   0.000     6.897992    9.823331
------------------------------------------------------------------------------
```

Regression Sample: 2000M1-2009M9
Forecast: 2009M10-2012M9