BOFIT Discussion Papers
22 • 2008

Juuso Kaaresvirta and Aaron Mehrotra

Business surveys and inflation forecasting in China

Bank of Finland, BOFIT
Institute for Economies in Transition

BOFIT Discussion Papers
Editor-in-Chief Iikka Korhonen

BOFIT Discussion Papers 22/2008
22.11.2008

Juuso Kaaresvirta and Aaron Mehrotra: Business surveys and inflation forecasting in China

ISBN 978-952-462-935-5
ISSN 1456-5889
(online)

Suomen Pankki
Helsinki 2008

Contents

All opinions expressed are those of the authors and do not necessarily reflect the views of the Bank of Finland.

Juuso Kaaresvirta and Aaron Mehrotra*

Business surveys and inflation forecasting in China

Abstract

We use business survey data collected by the People's Bank of China for inflation forecasting. Some survey indicators lead to enhanced forecasting performance relative to the univariate benchmark model, especially for a period of moderate inflation. However, the estimated models do not do a good job of tracking the recent pickup in Chinese inflation, due to increases in food prices.

Keywords: inflation forecasting; business surveys; China.
JEL classification: C53; E31.

Bank of Finland, Institute for Economies in Transition (BOFIT)
Bank of Finland, PO Box 160, FI-00101 Helsinki, Finland.

*Corresponding author. Email: aaron.mehrotra@bof.fi

Juuso Kaaresvirta and Aaron Mehrotra*

Business surveys and inflation forecasting in China

Tiivistelmä

Tutkimuksessa käytetään Kiinan keskuspankin keräämää yritysbarometridataa inflaation ennustamiseen. Joidenkin barometrimuuttujien käyttö johtaa parempiin ennusteisiin suhteessa yhden muuttujan autoregressiiviseen malliin erityisesti hitaan inflaation aikana. Estimoidut mallit eivät kuitenkaan ennusta hyvin Kiinan inflaation viimeaikaista kiihtymistä.

Asiasanat: inflaation ennustaminen, yritysbarometrit, Kiina

1 Introduction

The stated objective of the Chinese central bank, the People's Bank of China (PBoC), is to "maintain the stability of the value of the currency and thereby promote economic growth".[1] While there is still no formal inflation target, China includes an annual target for CPI growth among the country's annual targets for social and economic development (see e.g. PBoC 2005). Moreover, for a transition economy where a major share of public wealth is held in cash or stored in bank accounts, price stability is an important determinant of social and economic stability.

The literature is notably sparse on forecasting inflation in China. Mehrotra and Sánchez-Fung (2008) consider 15 different models for forecasting Chinese inflation, and find that only those summarizing information from a large dataset by principal components beat the univariate benchmark. Both Gerlach and Kong (2005) and Burdekin and Siklos (2008) use the real money gap to provide out-of-sample forecasts for inflation. Qin et al. (2006) compare the forecast performance of an automatic leading indicator (based on dynamic factor analysis) with a macroeconometric structural method in terms of CPI and GDP growth in three economies, including China.

Inflation forecasting exercises for developed countries using surveys on inflation expectations have been found to forecast inflation well (see e.g. Ang et al. 2007, for the US). However, for China, long time series of inflation expectation surveys do not exist, as the People's Bank of China has compiled a quarterly index of future price expectations only during the current decade (see PBoC 2007). Therefore, we use published surveys on industrial firms' assessment of the economic situation collected by the People's Bank in order to obtain information about future price pressures. Nevertheless, empirical evidence suggests a close relationship between inflation expectations and business sentiment surveys.[2]

For China, Mehrotra and Rautava (2008) argue that "soft" business survey data exhibit the same trends as "hard" data on industrial production, and the former can be used to forecast the latter, which is of interest given the concerns about quality of Chinese hard data. Overall, however, the literature on using survey data for forecasting has focused on

[1] http://www.pbc.gov.cn/english/huobizhengce/objective.asp on September 17, 2008.
[2] For the time period 2001Q1-2008Q2 where data for China are available in the CEIC database, we find a contemporaneous correlation coefficient of 0.88 between the survey of general business condition and infla-

advanced economies, and to our knowledge only Mehrotra and Rautava (2008) have used Chinese business surveys for forecasting.

This study uses Chinese business survey data from the PBoC to study inflation forecasting performance. We find that our bivariate vector autoregressive models, comprised of one diffusion index and an inflation rate, in many cases produce an enhanced forecasting performance compared to a univariate process. However, the pickup in inflation in late 2006 and 2007 originating in food prices is not captured well by our models.

2 Data and methodology

We use quarterly business survey data provided by the PBoC on 5,000 principal industrial enterprises in China. Most of the firms surveyed are state-owned large and medium-size enterprises, and a total of 27 industries are covered. The business survey produces 15 diffusion indices, which are quantitative indicators based on qualitative answers given by firms. Their values range from –100 to 100. Figure 1 displays the annualized change in CPI, together with the diffusion index for domestic order level and fixed assets investment. Other diffusion indices that may capture demand-side pressures are correlated with these two diffusion indices with a contemporaneous correlation coefficient exceeding 0.8.[3] The remaining diffusion indices that may capture supply-side factors instead are inventory level, raw materials supply, and energy supply. The two former series are depicted in Figure 2, together with our second inflation measure, the annualized change in corporate goods prices (CGPI, formerly known in China as the wholesale price index). Regarding the final remaining diffusion index, energy supply is contemporaneously correlated with raw material supply with a coefficient of 0.79.

In order to examine the forecasting performance of the business survey indicators, we estimate bivariate vector autoregressions (VARs) comprised of one diffusion index and the inflation rate. These VARs take the form

tion expectations. This provides support for our approach of using business survey data for inflation forecasting.

[3] These are cash inflow from sales, equipment investment, funds turnover, general business condition, lending attitude of bank, overseas order level, price level of sales, production capacity, products sales, and profitability.

$$x_t = A_1 x_{t-1} + ... + A_p x_{t-p} + CD_t + u_t, \quad (1)$$

where p denotes the order of the model. $x_t = (x_{1t}, x_{2t})'$ is a (2×1) random vector, the A_i are fixed (2×2) coefficient matrices and D_t is a vector of deterministic terms. C is the coefficient matrix associated with the deterministic terms. $u_t = (u_{1t}, u_{2t})'$ is assumed to follow a 2-dimensional white noise process with $E(u_t) = 0$. The autoregressive models are estimated for a sample spanning 1996Q1-2006Q4. We then provide out-of-sample forecasts 1, 2 and 4 quarters ahead, covering 2007Q1-2007Q4. Formally, we write an h-step forecast as:

$$\hat{x}_{T+h|T} = \hat{A}_1 \hat{x}_{T+h-1|T} + ... + \hat{A}_p \hat{x}_{T+h-p|T}, \quad (2)$$

where $\hat{x}_{T+j|T} = x_{T+j}$ for $j \leq 0$ and the $\hat{A}_i$'s (i = 1, …, p) are estimated parameters. As is standard, the forecasting performance of the VARs is evaluated by comparing the root mean squared forecast error (RMSE) to that from a simple univariate AR-process.

Given that inflation in China in 2007 originated in food prices that may be difficult to capture using business survey data, we also forecast for a period of moderate inflation, 2006Q1-2006Q4. Cheung et al. (2008) discuss the impact of rising food prices in Asian economies on general price inflation and monetary policy. Moreover, Stock and Watson (2008) document that the performance of inflation forecasts using an activity variable is episodic, thus varying from one period to another. Because business survey data may be more closely related to producer prices than the CPI, we forecast both consumer prices and corporate goods prices. China does not publish a series for core inflation, nor are the weights of the items in the consumer price index publicized.

As previous research has modelled the inflation process in China using variants of the Phillips-curve (see e.g. Gerlach and Peng 2006; Funke 2006), we also estimate a backward-looking Phillips curve including lags of output gap and inflation. Our measure of output gap is constructed by applying the Hodrick-Prescott filter to the monthly industrial production series in levels, with a standard smoothing parameter of 14,400. The use of industrial production as a measure of output can be justified, as Holz (2004) notes the regular statistical data reporting system in China to be most developed for the industrial sector. Additionally, we estimate the first principal component, obtained from an orthogonalization of the sample correlation matrix as a linear combination of the 15 diffusion indices, and include that in the bivariate VAR setup together with inflation (see Johnson and Wichern 2002, for a formal description of the principal component analysis). For the US

economy, Stock and Watson (2002) find that forecasts from a dynamic factor model based on principal components outperform univariate autoregressions, small vector autoregressions, and leading indicator models. Our first estimated principal component explains 53% of the total variance of the diffusion indices, of which it has the highest weights on general business condition, cash inflow from sales and fixed asset investment. The final model in our analysis is a trivariate backward-looking Phillips curve comprising the output gap, inflation, and the estimated first principal component.

A logarithmic transformation is applied to the price indices. All variables are included in the estimation in first-differences, to ensure stationarity. Lag length is based on the Akaike information criterion when no residual autocorrelation is detected. Otherwise another suitable lag order is used. In the case of CPI inflation, the estimated systems include a constant, and a trend is also included in the models with the CGPI index. The TRAMO-SEATS procedure was used to seasonally adjust the price data.

3 Results

The results are presented in Table 1 (forecasts for 2006Q1-2006Q4) and Table 2 (2007Q1-2007Q4). For the period of moderate inflation considered in Table 1, the RMSE ratio is less than one for 8 of the 15 estimated bivariate models including CPI inflation and one diffusion index. This suggests that many models that include a survey indicator outperform univariate inflation forecasts. Also the models including the output gap and the principal component forecast inflation well. Mehrotra and Rautava (2008) similarly find general business condition, overseas order level and lending attitude of bank to have forecasting power for real economic activity in China. For the CGPI, only inventory level and domestic order level turn out to be useful predictors.

For the recent period of higher inflation (Table 2), the forecasting ability of the diffusion indices deteriorates. We find RMSE ratios lower but very close to one at all forecasting horizons for four models with diffusion indices and CPI, and for the model with CPI inflation and the first principal component. The situation is worse for the CGPI, where no estimated model outperforms the univariate benchmark at all forecast horizons. This suggests that the recent pickup in inflation in China, mainly due to food price inflation, is not captured well by our models. Even for the naïve AR-process, the actual values for in-

flation fall outside the confidence intervals for the forecasts. Yet, comparing the results in Table 1 and 2, we do find three bivariate models that outperform or equal the univariate benchmark for the CPI for both forecasting periods (moderate and high inflation). These models include as predictors domestic order level, general business condition, and the first principal component, respectively.

The impact of food prices on the forecasting performance of the models can be further examined by including the IMF's world food price index as an exogenous variable in the models with diffusion indices. When this variable is included, the AR-process is outperformed at all forecast horizons in 9 models for CPI and 2 models for CGPI, when forecasting for 2007. This provides further evidence that the poorer forecasting performance of the models in the later period is indeed due to food price inflation.

4 Conclusion

We used business survey data from the People's Bank of China to forecast consumer and corporate goods price inflation. We find that some survey indicators are useful predictors of inflation pressures during a period of moderate inflation, especially for consumer prices. However, the forecasting performance of the survey data is weak for the more recent pickup in inflation. Nevertheless, the survey indicators domestic order level, general business condition, and the first estimated principal component from all survey variables maintain some of their forecasting power even during the recent forecasting period characterized by higher inflation.

Our results suggest that business survey data can be used to obtain information about price pressures in China, at least given the absence of major supply side disturbances such as food price increases. Our approach also has relevance for other emerging economies, where no formal surveys on inflation expectations may yet exist but business confidence indicators can be used to analyze future inflation developments.

References

Ang A, Bekaert G, Wei M (2007) Do macro variables, asset markets, or surveys forecast inflation better? J. Monet. Econ. 54:1163–1212.

Burdekin R, Siklos P (2008) What has driven Chinese monetary policy since 1990? Investigating the People's Bank's policy rule. J. Int. Money Finance 27:847–859.

Cheung L, Szeto J, Tam C-S, Chan S (2008) Rising food prices in Asia and implications for monetary policy. Hong Kong Monetary Authority Quarterly Bulletin September 2008, Hong Kong Monetary Authority.

Funke M (2006) Inflation in China: Modelling a roller coaster ride. Pacific Econ. Rev. 11:413–429.

Gerlach S, Kong J (2005) Money and inflation in China. Research Memorandum 04/2005, Hong Kong Monetary Authority.

Gerlach S, Peng W (2006) Output gaps and inflation in Mainland China. China Econ. Rev. 17:210–225.

Holz C (2004) China's Statistical System in Transition: Challenges, Data Problems, and Institutional Innovations. Rev. Income Wealth 50(3):381-409.

Johnson RA, Wichern DW (2002) Applied multivariate statistical analysis. Prentice Hall, New Jersey.

Mehrotra A, Rautava J (2008) Do sentiment indicators help to assess and predict actual developments of the Chinese economy? J. Chinese Econ. Bus. Stud. 6:225–239.

Mehrotra A, Sánchez-Fung JR (2008) Forecasting inflation in China. China Econ. J., forthcoming.

PBoC (2005) China Monetary Policy Report, Quarter Four, 2005. Monetary Policy Analysis Group of the People's Bank of China.

PBoC (2007) China Monetary Policy Report, Quarter Three, 2007. Monetary Policy Analysis Group of the People's Bank of China.

Qin D, Cagas MA, Ducanes G, Magtibay-Ramos N, Quising P (2006) Forecasting Inflation and GDP Growth: Automatic Leading Indicator (ALI) Method versus Macroeconometric Structural Models (MESMs). ERD Technical Note Series 18, Asian Development Bank, Economics and Research Department.

Stock JH, Watson MW (2002) Macroeconomic forecasting using diffusion indexes. J. Bus. Econ. Statist. 20(2):147–162.

Stock JH, Watson MW (2008) Phillips curve inflation forecasts. Paper prepared for Federal Reserve Bank of Boston Conference "Understanding Inflation and the Implications for Monetary Policy: A Phillips Curve Retrospective".

Tables and figures

Table 1 Inflation forecasts, 2006Q1-2006Q4

Predictor	CPI			CGPI		
	$h = 1$	$h = 2$	$h = 4$	$h = 1$	$h = 2$	$h = 4$
Capacity utilization	1.08	1.02	1.00	1.37	1.48	1.47
Cash inflow from sales	1.06	1.03	1.01	1.17	1.33	1.39
Domestic order level	0.83	0.88	0.95	0.94	0.92	0.94
Energy supply	3.23	2.56	1.67	1.60	1.81	1.92
Equipment investment	1.00	1.00	1.00	1.25	1.37	1.41
Fixed asset investment	0.52	0.79	0.92	1.34	1.46	1.50
Funds turnover	0.71	0.62	0.87	1.17	1.35	1.42
General business condition	0.90	0.94	0.98	1.03	1.05	1.06
Inventory level	0.69	0.86	0.97	0.93	0.95	0.98
Lending attitude of bank	0.68	0.73	0.91	1.12	1.26	1.31
Overseas order level	0.94	0.95	0.98	1.04	1.02	1.03
Price level of sales	1.44	1.45	1.30	1.28	1.42	1.47
Product sales	0.91	0.94	0.98	1.07	1.15	1.17
Profitability	0.86	1.24	1.00	1.30	1.39	1.45
Raw materials supply	1.98	1.64	1.26	1.06	1.16	1.18
Output gap	0.17	0.13	0.62	0.15	1.11	1.91
Principal comp.	0.96	0.97	0.98	1.03	1.06	1.07
Output gap & principal comp.	0.22	0.16	0.60	0.11	1.09	1.78

Note: RMSE relative to AR process. *h* denotes forecast horizon.

Table 2 Inflation forecasts, 2007Q1-2007Q4

Predictor	CPI			CGPI		
	$h = 1$	$h = 2$	$h = 4$	$h = 1$	$h = 2$	$h = 4$
Capacity utilization	0.98	0.99	1.00	1.69	0.99	1.07
Cash inflow from sales	1.01	1.01	1.00	0.90	1.00	1.07
Domestic order level	0.96	0.99	1.00	1.60	0.93	1.02
Energy supply	1.99	1.39	1.19	3.00	1.25	1.22
Equipment investment	1.09	0.97	0.93	3.73	1.16	1.16
Fixed asset investment	1.16	1.07	0.92	3.47	1.18	1.17
Funds turnover	1.09	0.98	0.95	0.36	1.04	1.10
General business condition	0.95	0.98	0.99	0.50	1.00	1.01
Inventory level	1.13	0.93	0.98	1.38	0.90	0.96
Lending attitude of bank	1.02	1.01	1.00	1.22	0.98	1.07
Overseas order level	1.05	1.04	1.02	1.54	0.68	0.91
Price level of sales	0.90	0.97	0.93	1.25	0.93	1.00
Product sales	1.10	1.05	0.93	3.13	0.90	1.00
Profitability	1.02	1.00	0.91	1.22	0.93	1.03
Raw materials supply	1.54	1.27	1.11	2.78	1.16	1.13
Output gap	1.68	1.34	1.01	5.65	1.35	1.15
Principal comp.	0.98	0.99	1.00	1.25	0.98	1.06
Output gap & principal comp.	1.06	0.97	0.86	3.28	1.27	1.12

Note: RMSE relative to AR process. *h* denotes forecast horizon.

Figure 1 CPI inflation and two diffusion indices.

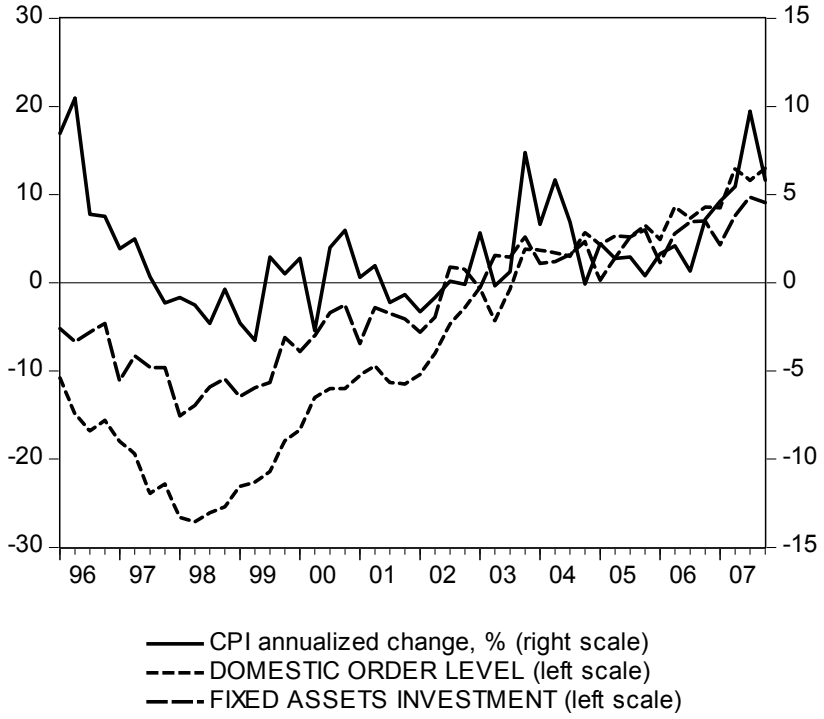
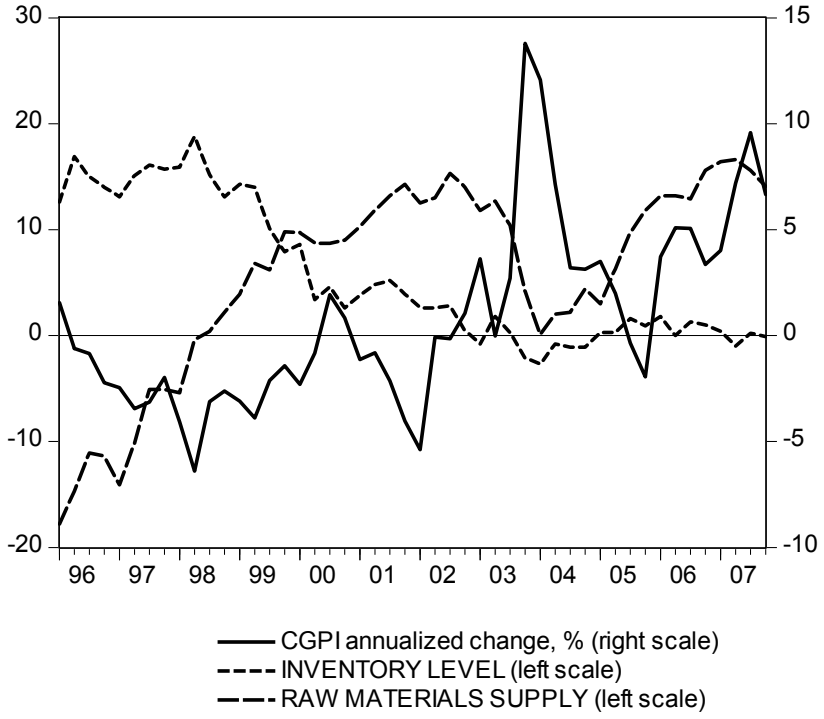


Figure 2 CGPI inflation and two diffusion indices.



Earlier BOFIT Discussion Papers

For a complete list of Discussion Papers published by BOFIT, see www.bof.fi/bofit

2007
- No 3 Barry Harrison and Yulia Vymyatnina: Currency substitution in a de-dollarizing economy: The case of Russia
- No 4 Jesús Crespo Cuaresma and Tomas Slacik: An "almost -too-late" warning mechanism for currency crises
- No 5 Andrei V. Vernikov: Russia's banking sector transition: Where to?
- No 6 Alicia García-Herrero and Tuuli Koivu: Can the Chinese trade surplus be reduced through exchange rate policy?
- No 7 Nienke Oomes and Katerina Kalcheva: Diagnosing Dutch disease: Does Russia have the symptoms?
- No 8 Iikka Korhonen and Tuuli Juurikkala: Equilibrium exchange rates in oil-dependent countries
- No 9 Balázs Égert and Carol S. Leonard: Dutch disease scare in Kazakhstan: Is it real?
- No 10 Mikael Mattlin: The Chinese government's new approach to ownership and financial control of strategic state-owned enterprises
- No 11 Aaron Mehrotra and Jouko Rautava: Do sentiment indicators help to assess and predict actual developments of the Chinese economy?
- No 12 Pertti Haaparanta and Tuuli Juurikkala: Bribes and local fiscal autonomy in Russia
- No 13 Ian Babetskii and Nauro F.Campos: Does reform work? An econometric examination of the reform – growth puzzle
- No 14 Iikka Korhonen and Aaron Mehrotra: Money demand in post-crisis Russia: De-dollarisation and re-monetisation
- No 15 Svetlana Ledyaeva: Spatial econometric analysis of determinants and strategies of FDI in Russian regions in pre- and post-1998 financial crisis periods
- No 16 David G Mayes and Vesa Korhonen: The CIS – does the regional hegemon facilitate monetary integration?
- No 17 Roberta Colavecchio and Michael Funke: Volatility dependence across Asia-pacific on-shore and off-shore U.S. dollar futures markets
- No 18 William Pyle: Organized business, political regimes and property rights across the Russian Federation
- No 19 Aaron Mehrotra, Tuomas Peltonen and Alvaro Santos Rivera: Modelling inflation in China – a regional perspective
- No 20 Michael Funke and Marc Gronwald: The undisclosed renminbi basket: Are the markets telling us something about where the renminbi - US dollar exchange rate is going?
- No 21 Declan Curran, Michael Funke and Jue Wang: Economic growth across space and time: Subprovincial evidence from mainland China
- No 22 Xiaoqiang Cheng and Hans Degryse: The impact of banks and non-bank financial institutions on local economic growth in China

2008
- No 1 Tuuli Koivu: Has the Chinese economy become more sensitive to interest rates? Studying credit demand in China
- No 2 Aaron Mehrotra and José R. Sánchez-Fung: Forecasting inflation in China
- No 3 Alexei Karas, Koen Schoors and Laurent Weill: Are private banks more efficient than public banks? Evidence from Russia
- No 4 Tomasz Koźluk: Global and regional links between stock markets - the case of Russia and China
- No 5 Tomasz Koźluk and Aaron Mehrotra: The impact of Chinese monetary policy shocks on East Asia
- No 6 Rajeev K. Goel and Michael A. Nelson: Causes of Corruption: History, geography, and government
- No 7 Jarko Firdmuc, Iikka Korhonen and Ivana Bátorová: China in the world economy: Dynamic correlation analysis of business cycles
- No 8 Kashif Saleem: International linkage of the Russian market and the Russian financial crisis: A multivariate GARCH analysis
- No 9 K.C. Fung, Iikka Korhonen, Ke Li and Francis Ng: China and Central and Eastern European Countries: Regional networks, global supply chain or international competitors?
- No 10 Rajeev K. Goel: Regulatory bottlenecks, transaction costs and corruption: A cross-country investigation
- No 11 Alicia García-Herrero and Daniel Santabárbara: Does the Chinese banking system benefit from foreign investors?
- No 12 John Bonin, Iftekar Hasan and Paul Wachtel: Banking in transition countries
- No 13 Maria Ritola: Price convergence and geographic dimension of market integration: Evidence from China
- No 14 Anatoly Peresetsky: Market discipline and deposit insurance in Russia
- No 15 Tuuli Koivu, Aaron Mehrotra and Riikka Nuutilainen: McCallum rule and Chinese monetary policy
- No 16 Iikka Korhonen and Svetlana Ledyaeva: Trade linkages and macroeconomic effects of the price of oil
- No 17 Anatoly Peresetsky and Alexander Karminsky: Models for Moody's bank ratings
- No 18 Laurent Weill: How corruption affects bank lending in Russia
- No 19 Alexei Karas, Koen Schoors and Gleb Lanine: Liquidity matters: Evidence from the Russian interbank market
- No 20 Pierre-Guillaume Méon and Laurent Weill: Is corruption an efficient grease?
- No 21 Zuzana Fungáčová and Laura Solanko: Risk-taking by Russian Banks:Do Location, Ownership and Size Matter?
- No 22 Juuso Kaaresvirta and Aaron Mehrotra: Business surveys and inflation forecasting in China

Bank of Finland
BOFIT – Institute for Economies in Transition
PO Box 160
FIN-00101 Helsinki

☎ + 358 10 831 2268
bofit@bof.fi
http://www.bof.fi/bofit