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Survey Forecasts and Money Demand Functions: Some International Evidence

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Abstract

We derive a money demand function from a dynamic macroeconomic general equilibrium model to analyze the correlations between professional economists' forecasts of the growth rate of money supply, the inflation rate, the growth rate of real output, and the nominal interest rate. Upon estimating the money demand function on survey data of professional economists' forecasts for fourteen Asian-Pacific and Central and South-Eastern European countries, we find that the correlations between professional economists' forecasts are broadly consistent with the money demand function implied by the macroeconomic model.

Keywords: Money demand function, Forecasts

JEL Classification: E41, E47

1. Introduction

Much research has been done in earlier literature to study money demand functions. Recent contributions to this literature include Lucas (2000), Coenen and Vega (2001), Brand and Cassola (2004), Teles and Zhou (2005), Belke and Czudaj (2010), and Uhlig and Teles (2011), to name just a few. Money demand functions render it possible to study such important issues as the potential link between the growth rate of money supply and the inflation rate, the interest-rate sensitivity of money demand, and the welfare gains of lowering the inflation rate. In order to ad-

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dress such issues, earlier literature mainly focused on studying whether *actual* macroeconomic data fit a postulated money demand function.

We go beyond earlier literature in that we study whether professional economists' *forecasts* are consistent with a postulated money demand function. To this end, we derive a money demand function from a standard dynamic macroeconomic general equilibrium model. We then estimate the money demand function on survey data of professional economists' forecasts of the growth rate of money supply, the inflation rate, the growth rate of real output, and the nominal interest rate. We use survey data for fourteen Asian-Pacific and Central and South-Eastern European countries to analyze whether the correlations between the forecasts are consistent with the predictions of the macroeconomic model. Our estimation results indicate that the correlations between professional economists' forecasts are indeed broadly consistent with the money demand function implied by the macroeconomic model.

Our research contributes to a recent literature that analyzes whether professional economists' forecasts are consistent with widely studied macroeconomic models. In a recent contribution to this literature, Mitchell and Pearce (2010) analyze whether professional economists' forecasts are consistent with Okun's law and an interest-rate rule. Gorter et al. (2010) use professional economists' forecasts to analyze interest-rate rules. Pierdzioch et al. (forthcoming) study whether professional economists' forecasts are consistent with the quantity theory of money, Okun's law, and variants of the Phillips curve. Our contribution to this literature is that we use data for several Asian-Pacific and Central and South-Eastern European countries to study the consistency of professional economists' forecasts with a standard money demand function.

In order to analyze the consistency of professional economists' forecasts with a standard money demand function, we briefly sketch the macroeconomic model that we use to derive a money demand function in Section 2. We describe our data and our empirical results in Section 3. We offer some concluding remarks in Section 4.

2. The Model

In order to derive a money demand function, we consider a standard dynamic macroeconomic general equilibrium model similar to the one described by Walsh (2010, Chapter 2). Money enters into the model via a money-in-the-utility-function assumption. Recent applications of variants of the money-in-the-utility-function model to the study of money demand functions include Inagakia (2009) and Setzer and Guntram (2009). In the model, a representative infinitively-lived household maximizes expected lifetime utility given by

(1) $$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left(\sigma/(\sigma-1)C_t^{(\sigma-1)/\sigma} + (M_t/P_t)^{(1-\epsilon)}/(1-\epsilon) - \kappa N_t^{\mu}/\mu\right),$$

where $0 < \beta < 1, \sigma > 0, \epsilon > 0, \kappa > 0$, and $\mu > 1$ (and with log utility as a special case), and $\mathbb{E}_t$ = conditional expectations operator, C_t = real consumption, M_t = nominal money supply, P_t = price level, N_t = labor supply. The household forms rational expectations and faces the following sequence of budget constraints:

(2) $$B_t = (1 + i_{t-1})B_{t-1} + M_{t-1} - M_t + W_t N_t - P_t C_t + P_t T_t \ ,$$

where B_t = holdings in a risk-free nominal one-period bond, W_t = the nominal wage rate, T_t = real transfers from the government, and i_t = nominal interest rate. The first-order conditions for the households' problem are

(3) $$C_t^{-1/\sigma} = \lambda_t P_t,$$

(4) $$(M_t/P_t)^{-\epsilon} = \lambda_t P_t + \beta P_t \mathbb{E}_t \lambda_{t+1} \ ,$$

(5) $$\kappa N_t^{\mu-1} = \lambda W_t \ ,$$

(6) $$\lambda_t = (1 - i_t)\beta \mathbb{E}_t \lambda_{t+1} \ ,$$

where λ_t = Lagrange multiplier. In a macroeconomic rational-expectations equilibrium, households maximize utility subject to their budget constraint, nominal bonds are in zero net supply, the goods market and the labor market clear, profit maximizing competitive firms operate under a zero profit condition, and the government budget constraint holds. Competitive firms produce output, Y_t, according to the production function $Y_t = AN_t$. The budget constraint of the government is given by $(M_t - M_{t-1})/P_t = T_t$.

Upon combining the household's first-order conditions with the goods-market equilibrium condition, $Y_t = C_t$, one may derive the following macroeconomic money demand function:

(7) $$(M_t/P_t)^{-\epsilon} = Y_t^{-1/\sigma} i_t/(1 + i_t) \, .$$

Because professional economists forecast the growth rates, rather than the levels of, money supply, the price level, and output, we compute a loglinear approximation of the money demand function around the deterministic steady state. We get

(8) $$-\epsilon m_t = -\epsilon \pi_t - y_t/\sigma + \Delta \ln(i_t/1 + i_t) \ ,$$

where m_t = growth rate of money supply, π_t = inflation rate, y_t = growth rate of output, and Δ = first-difference operator. Because we have in the steady state $\beta = 1/(1 + \bar{r})$, where $\bar{r}$ = constant steady-state real interest rate, we can rewrite Equation (8) as

(9) $$m_t = \beta/\epsilon + \pi_t + y_t/(\sigma\epsilon) - \beta i_t/(\bar{r}\epsilon) \, .$$

Equation (9) can be interpreted as the specific money demand function (or money market equilibrium condition) implied by our simple money-in-the-utility-function model. The general structure of the money demand function, however, does not change much when one considers other dynamic general equilibrium monetary models. Equation (9), thus, should be interpreted to represent a broad class of money demand functions typically used in empirical research to study money demand functions. For this reason, we henceforth neglect the details of the money demand function and postulate the following general format of the money demand function

$$m_t = b_0 + b_1 \pi_t + b_2 y_t + b_3 i_t \,, \tag{10}$$

where $b_j, j = 0, 1, 2, 3$, are coefficients. In order to transform Equation (10) into our empirical money demand function, we lead the equation one period. We then take expectations on both sides of the equation and add a stochastic disturbance term to obtain

$$\mathbb{E}_t m_{t+1} = b_0 + b_1 \mathbb{E}_t \pi_{t+1} + b_2 \mathbb{E}_t y_{t+1} + b_3 \mathbb{E}_t i_{t+1} + u_{t+1} \,, \tag{11}$$

where the signs of the coefficients to be estimated are $b_0 > 0$, $b_1 = 1$, $b_2 > 0$, and $b_3 < 0$ and u_{t+1} denotes a zero mean stochastic disturbance term. Equation (11) allows the link between the expected growth rate of money supply, $\mathbb{E}_t m_{t+1}$, the expected inflation rate, $\mathbb{E}_t \pi_{t+1}$, the expected growth rate of output, $\mathbb{E}_t y_{t+1}$, and the expected nominal interest rate, $\mathbb{E}_t i_{t+1}$, to be studied. Because we use survey data on professional economists forecasts to estimate Equation (11), we capture the panel-data structure of our survey data by means of a forecaster index, i. The money demand function that we shall analyze in our empirical analysis, thus, is given by

$$\mathbb{E}_{t,i} m_{t+1} = b_0 + b_1 \mathbb{E}_{t,i} \pi_{t+1} + b_2 \mathbb{E}_{t,i} y_{t+1} + b_3 \mathbb{E}_{t,i} i_{t+1} + u_{t+1,i} \,. \tag{12}$$

3. Empirical Analysis

In order to measure $\mathbb{E}_{t,i} m_{t+1}$, $\mathbb{E}_{t,i} \pi_{t+1}$, $\mathbb{E}_{t,i} y_{t+1}$, and $\mathbb{E}_{t,i} i_{t+1}$, we use survey data of professional economists' forecasts compiled by Consensus Economics. Our empirical analysis covers ten Asian-Pacific countries: China, Hong Kong, India, Indonesia, Malaysia, New Zealand, Singapore, South Korea, Taiwan, and Thailand. Data are available for the sample period from December 1994 to December 2010, where the data for China start only in 2003. In addition, we study data for four Central and South-Eastern European countries: the Czech Republic, Hungary, Poland, and Turkey. For these four countries, the sample period ranges from May 1998 to December 2010. Data are available for a total of 494 forecasters, providing for more than 15,000 forecasts.[1] Because Consensus Economics publishes the forecasts for two

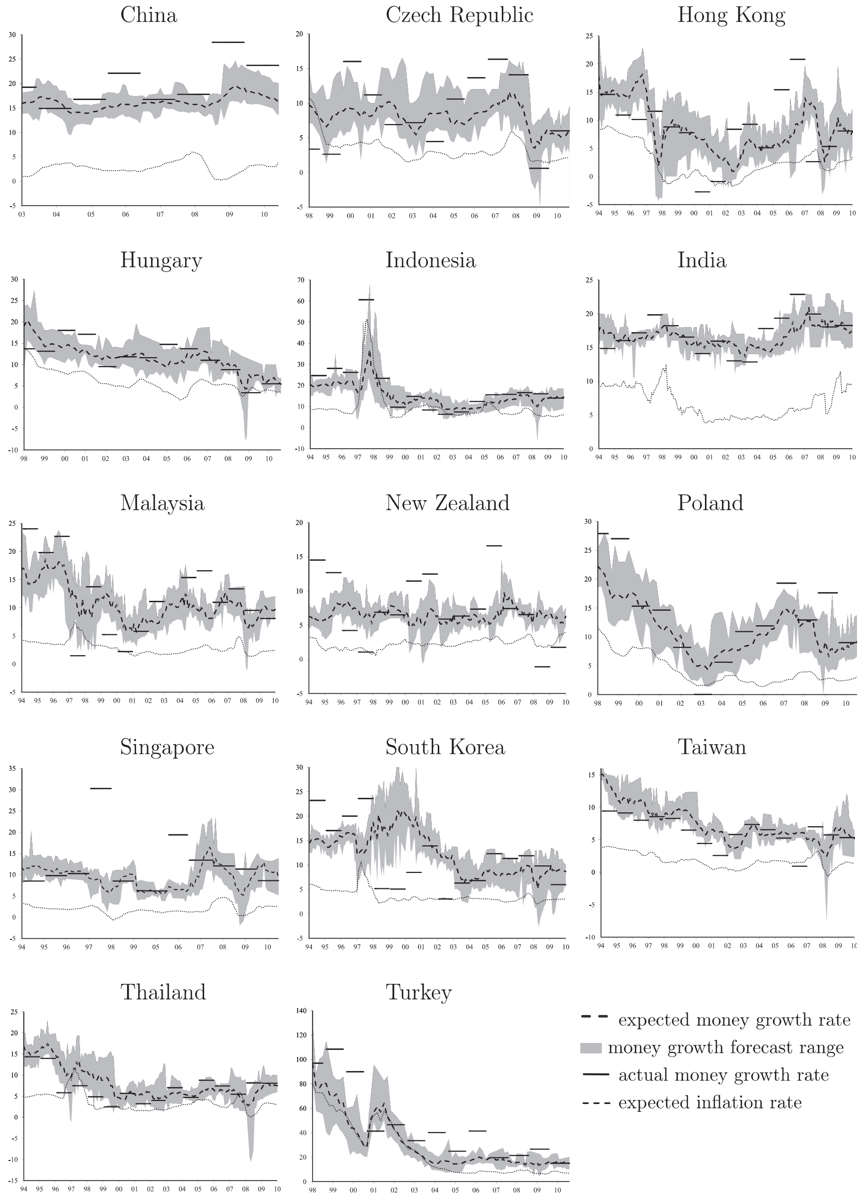
[1] The forecasters work with the private sector in the country for which they form forecasts. The forecasters are professional economists working for universities and financial institutions

different time horizons, namely for the current year and for the next year, we follow Gorter et al. (2008) and weigh both forecasts to obtain a fixed-horizon forecast. For example, we weigh current-year forecast of the inflation rate made in August with with the factor 5 / 12 and the contemporaneous next-year forecast of the inflation rate also made in August with the factor 7 / 12 to obtain, for every forecaster, a time series of forecasts that consists of forecasts for a fixed forecast horizon of twelve months.

Figure 1 plots the time series of (i) the cross-sectional mean values of the forecasts of the money growth rate (dashed line) and the inflation rate (thin dashed line), (ii) the actual money growth rate (solid line), and (iii) the cross-sectional heterogeneity of money growth forecasts as measured in terms of the cross-sectional range of forecasts (shaded area). Figure 1 illustrates substantial fluctuations over time in the actual and expected growth rate of money supply. It is also evident from Figure 1 that the countries in our sample can be classified into two groups, namely the group of countries that experienced on average relatively high inflation rates of about 10 percent p a. (like India and Indonesia), and the group of countries that experienced on average relatively low inflation rates of about 3 percent p.a. Finally, Figure 1 highlights the substantial cross-sectional heterogeneity of forecasts across forecasters. The cross-sectional heterogeneity of forecasts is important for our analysis as it is this dimension of the data that facilitates a within-country analysis of our money demand equation. Our within-country analysis of money demand functions is complementary to recent research of other researchers who have explored cross-country data to study money demand functions (for example, Teles and Uhlig 2011).

Table 1 summarizes the results of estimating Equation (12) by means of the panel Newey-West estimator with time-fixed effects. The Newey-West estimator accounts for heteroscedasticity, and for autocorrelation arising due to the overlapping structure of the data. The fit of the estimated equations, as measured in terms of the coefficient of determination, R^2, ranges from 0.42 in the case of New Zealand to 0.91 for Turkey. The constant and the coefficient b_1 are positive and significant in all countries. The hypothesis that the magnitude of the coefficient b_1 is equal to unity, as in the theoretical model, can be rejected in the cases of China, India, Indonesia, and Taiwan at the 1% level of significance, at the 5% level of significance in the cases of the Czech Republic and Thailand, and at the 10% level of significance in the case of Poland. In all other countries, the prediction of the macroeconomic model that the coefficient b_1 should equal unity is supported by the data. Also in line with the macroeconomic model is the result that the coefficient b_2 is positive and significant in all countries. In six countries, the hypothesis that this coefficient, which captures the impact of expected real output growth on money demand, is equal to unity cannot be rejected at the 5% level of significance. Finally, the coefficient b_3, which captures the dependence of money demand on the nominal interest rate, is negative in ten countries (point estimates) and negative and significant in

such as international economic research institutes, investment banks, and commercial banks. Further information concerning the survey data can be found on the website: www.consensus economics.com.



Note: This figure shows the mean of the current-year inflation forecasts (fine dashed line) and of the forecasts of the growth rate of money supply (dashed line), the actual growth rate of money supply (solid line), and the range of forecasts (shaded area). The (forecast of the) growth rate of money supply refers to $M3$ for Hungary, India, New Zealand, and Poland, and to $M2$ otherwise. Actual values are taken from the central banks' data bases. All variables are expressed in percent p.a.

Figure 1: Expected and Actual Money Growth Rate and Expected Inflation Rate

seven countries. The point estimate of the coefficient b_3 is smaller than the point estimates of the other two coefficients in all but one country (China). It is interesting to note that in the cases of Hungary, New Zealand, Poland, and Turkey both hypotheses, $b_1 = 1$ and $b_2 = 1$, cannot be rejected. In addition, in the latter two countries the coefficient b_3 is not significantly different from zero. It follows that professional economists' forecasts in the cases of Poland and Turkey seem to be consistent with a money demand equation that resembles the quantity theory of money.

Table 1

Estimation results (survey data)

Country	China	Czech Republic	Hong Kong	Hungary	India	Indonesia	Malaysia
b_0	10.12***	5.96*	9.83***	8.82***	16.65***	25.91***	4.92***
	(3.63)	(1.75)	(21.46)	(3.07)	(18.21)	(3.57)	(3.69)
b_1	.25**	.64***	.95***	.86***	.21***	.31**	.73***
	(1.99)	(3.39)	(5.49)	(3.18)	(3.12)	(2.24)	(3.52)
b_2	.51*	.88***	.39***	.77*	.25*	.81***	.60***
	(1.87)	(4.94)	(2.53)	(1.78)	(1.68)	(3.14)	(3.97)
b_3	.64	–.36**	–.25***	–.29**	–.05	–.14**	–.41*
	(1.61)	(1.91)	(2.52)	(2.16)	(1.05)	(1.97)	(1.88)
$H_0 : b_1 = 1$	.00	.05	.79	.60	.00	.00	.19
$H_0 : b_2 = 1$	.07	.51	.00	.59	.00	.45	.00
Observations	654	961	1,690	550	1,056	1,215	1,616
Forecasters	20	31	41	27	39	43	47
R^2	.46	.56	.85	.79	.62	.79	.76

Country	New Zealand	Poland	Singapore	South Korea	Taiwan	Thailand	Turkey
b_0	1.04	4.23	.90	7.04**	6.69***	4.87**	8.81
	(.75)	(.87)	(.86)	(2.42)	(9.96)	(1.92)	(.73)
b_1	.95***	.64***	.98***	.92***	.49***	.65***	.83***
	(4.18)	(3.16)	(4.25)	(3.46)	(3.77)	(3.80)	(3.31)
b_2	.82***	1.06***	.41***	.94***	.25*	.38**	1.02**
	(3.72)	(3.46)	(2.82)	(3.58)	(1.90)	(2.20)	(1.97)
b_3	–.01	–.18	–.20**	–.28**	.05	.10	.20
	(.08)	(.95)	(2.04)	(2.06)	(.34)	(1.03)	(1.60)
$H_0 : b_1 = 1$	.84	.08	.93	.75	.00	.05	.51
$H_0 : b_2 = 1$	.41	85	.00	.83	.00	.00	.98
Observations	1,005	946	1,055	1,494	1,550	1358	78
Forecasters	23	34	39	37	34	43	36
R^2	.42	.80	.68	.78	.87	.83	.91

Note: This table reports the estimation results based on the Newey-West panel estimator for the equation $\mathbb{E}_{t,i}m_{t+1} = b_0 + b_1\mathbb{E}_{t,i}\pi_{t+1} + b_2\mathbb{E}_{t,i}\Delta y_{t+1} + b_3\mathbb{E}_{t,i}i_{t+1} + \epsilon_{t,i}$. The forecasting horizon is one year. Autocorrelation and heteroscedasticity robust t-statistics are given in parentheses. $H_0 : b_1 = 1$ $(b_2 = 2)$reports the p-value of the null hypothesis that the inflation rate coefficient is unity. *** (**,*) denotes significance at the 1 (5,10) percent level.

Table 2

Estimation results (actual data)

Country	China	Czech Republic	Hong Kong	Hungary	India	Indonesia	Malaysia
a_0	9.87**	6.02**	6.34***	6.96**	17.52***	22.21***	4.62**
	(2.42)	(1.91)	(2.82)	(2.08)	(4.21)	(4.05)	(2.44)
a_1	.19*	.58**	.86**	.72**	.28**	.28*	.68***
	(1.85)	(2.45)	(2.49)	(2.15)	(2.32)	(2.14)	(2.83)
a_2	.22	.93*	.24**	.05	.15	.65***	.52**
	(1.40)	(2.05)	(2.41)	(.48)	(1.42)	(2.68)	(2.43)
a_3	.42	–.12*	–.32*	–.35*	.12	–.08	.25
	(.85)	(1.81)	(1.66)	(2.06)	(.48)	(.52)	(.45)
Observations	32	52	68	52	68	68	68
Since	2003Q1	1998Q1	1994Q1	1998Q1	1994Q1	1994Q1	1994Q1
R^2	.25	.42	.55	.45	.38	.46	.34
Country	New Zealand	Poland	Singapore	South Korea	Taiwan	Thailand	Turkey
a_0	1.52	3.45	2.15	6.25*	5.64***	3.63*	7.82**
	(.80)	(.12)	(.63)	(1.58)	(5.22)	(1.85)	(2.43)
a_1	.65***	.58***	.52*	.48**	.35*	.58**	.73**
	(3.35)	(2.96)	(2.08)	(2.52)	(1.96)	(2.53)	(2.54)
a_2	.42**	.85**	.32*	.66*	.15	.49**	.63*
	(2.19)	(2.58)	(2.29)	(1.98)	(.56)	(2.48)	(1.92)
a_3	.56	–.26	.15	–.34*	.34	–.08	.53
	(.68)	(.53)	(.15)	(1.86)	(.56)	(.63)	(.15)
Observations	68	52	68	68	68	68	52
Since	1994Q1	1998Q1	1994Q1	1994Q1	1994Q1	1994Q1	1998Q1
R^2	.28	.46	.34	.56	.17	.39	.51

Note: This table reports the estimation results based on the Newey-West estimator for the equation $m_t = a_0 + a_1\pi_t + a_2\Delta y_t + a_3 i_t + \epsilon_t$. Autocorrelation robust t-statistics are given in parentheses. *** (**,*) denotes significance at the 1 (5,10) percent level.

As a plausibility check, we examine whether the magnitudes of the estimated coefficients make sense. To this end, we use *actual* data to estimate the equation $m_t = a_0 + a_1\pi_t + a_2\Delta y_t + a_3 i_t + u_t$, where the notation for the coefficients a_j, $j = 0, 1, 2, 3$ underlines that the equation measures the correlations between the *actual* data (measured at a quarterly frequency). We estimate this equation separately for every country over the sample period for which we also have available data on professional economists' forecasts. Table 2 summarizes the results. Because of the limited number of observations, the interpretation of the results for the actual data should not be stretched too far. Notwithstanding, it is interesting to note that, in terms of the point estimates, the magnitudes of the estimated coefficients, b_j, are in general not much different from the magnitudes of the corresponding coefficients, a_j. Relatively large differences between the point estimates of the coefficients, b_j and a_j, can be observed, for example, in the cases of New Zealand and South Korea. We conclude that the money demand functions estimated on survey data are not only broadly consistent with the money-in-the-utility-function model outlined in Section 2, but they are also roughly consistent with the corresponding money demand functions estimated on actual data.

4. Concluding Remarks

The general message conveyed by the results of our empirical analysis is that, for fourteen Asian-Pacific and Central and South-Eastern European countries, the correlations between professional' economists forecasts of key macroeconomic variables are consistent with money demand functions implied by widely studied dynamic macroeconomic general equilibrium models. Dynamic macroeconomic general equilibrium models have not only been studied extensively in the economics literature, but such models have also been used by policymakers to analyze and to predict the effects and the propagation of monetary policy. Policymakers may find the results of our empirical analysis useful because our results shed light on the correlations of forecasts of macroeconomic variables that play a key role in theoretical and empirical studies of the effects and the propagation of monetary policy. In future research, studying the correlations of forecasts of macroeconomic variables along the lines we have described in this paper should help to develop a deeper understanding of the propagation of monetary policy.

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