

Financial Information and Macroeconomic Forecasts

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Forecasting Issues in Developing Economies

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Overview

- Motivation: macro-financial linkages in recent crises
- We study macro-financial linkages in the context of macroeconomic forecasts
 - 62 countries between 1980 and 2013 (33 in EM)
- Results: incorporating financial variables in a simple model significantly improves the accuracy of macroeconomic forecasts

Motivations

- Rationale for using financial variables in macro forecasts
 - With imperfect financial markets, credit, and asset prices affect macro outcomes
 - Financial variables incorporate information about future macro conditions
 - Macro data are usually collected with time lags while some financial variables are available in real time

Model

$$\nabla^h Y_{c,t+h} = \alpha + \sum_{i=1}^p \beta_i \nabla Y_{c,t-i} + \gamma X_{ct} + \mu_c + \varepsilon_{c,t+h},$$

where $\nabla^h Y_{c,t+h} \equiv z / (h+1) \ln(Y_{t+h} / Y_{t-1})$ is the annual growth rate of quarterly macro indicator.

X_{ct} is a vector of predictors.

We include lagged values as predictors and use AIC to determine lag length.

We correct for autocorrelation and heteroskedasticity of the error term.

Model (cont.)

- We predict real GDP, consumption, and investment growth, and CPI inflation.
- Our financial predictors including private sector credit growth, stock prices, and house prices, bank prime loan rate, deposit rate.
- We include sovereign bond yields and corporate bond yields in the extended model (AE)
- We use two policy controls: government consumption and short term interest rate

Model (cont.)

- Advantages of our model
 - Applicable country-by-country or cross-country
 - Applicable to countries with very limited financial data
 - Private sector credit growth
 - Can be augmented for countries with additional financial data
- Caveats
 - Does not capture the difference between normal time and times of crisis
 - Does not capture global factors

Findings

- Credit growth is significantly associated with current and future macro conditions in 1-4 quarters horizon
 - GDP growth, consumption growth, investment growth, and inflation
- Stock prices and house prices also have strong predictive power
- Results are robust in AE and EM. Results in EM tend to be stronger.

Headline results for EM: GDP

Panel A: GDP Growth

	Nowcasting			1 quarter ahead forecast			4 quarters ahead forecast		
Credit growth	4.539***	5.390***	5.073***	2.398***	3.568***	3.224***	0.552	0.815	1.022
	[0.634]	[0.936]	[0.994]	[0.538]	[0.792]	[0.805]	[0.417]	[0.663]	[0.674]
Stock price		1.767***	1.638***		2.142***	2.122***		1.192***	1.171***
		[0.538]	[0.561]		[0.450]	[0.475]		[0.324]	[0.326]
House price		0.532	0.023		-4.173***	-1.652		-5.360***	1.411
		[0.561]	[0.459]		[1.316]	[3.833]		[1.512]	[4.626]
Deposit rate			-254.799**			-0.156			0.051
			[125.273]			[0.352]			[0.348]
Lending rate			26.840			-190.540			-49.181
			[26.495]			[133.586]			[160.038]
Government consumption growth	1.945***	1.948*	2.816***	1.354***	0.634	1.632**	0.388	0.259	0.633
	[0.583]	[1.122]	[1.043]	[0.481]	[0.955]	[0.732]	[0.325]	[0.444]	[0.393]
Policy rate	-1.725***	-2.809***	-0.917	-2.085***	-2.930***	-1.555	-1.919***	-2.761***	-4.186**
	[0.496]	[0.578]	[1.275]	[0.626]	[0.567]	[1.109]	[0.621]	[0.616]	[1.804]
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,043	468	444	1,032	464	440	973	441	419
Adjusted R ²	0.107	0.143	0.153	0.103	0.218	0.234	0.155	0.277	0.292

Headline results for EM: GDP

Panel A: GDP Growth

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Stock price		1.767*** [0.538]	1.638*** [0.561]		2.142*** [0.450]	2.122*** [0.475]		1.192*** [0.324]	1.171*** [0.326]
House price		0.532 [0.561]	0.023 [0.459]		-4.173*** [1.316]	-1.652 [3.833]		-5.360*** [1.512]	1.411 [4.626]
Deposit rate			-254.799** [125.273]			-0.156 [0.352]			0.051 [0.348]
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Government consumption growth	1.945*** [0.583]	1.948* [1.122]	2.816*** [1.043]	1.354*** [0.481]	0.634 [0.955]	1.632** [0.732]	0.388 [0.325]	0.259 [0.444]	0.633 [0.393]
Policy rate	-1.725*** [0.496]	-2.809*** [0.578]	-0.917 [1.275]	-2.085*** [0.626]	-2.930*** [0.567]	-1.555 [1.109]	-1.919*** [0.621]	-2.761*** [0.616]	-4.186** [1.804]
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
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Adjusted R ²	0.107	0.143	0.153	0.103	0.218	0.234	0.155	0.277	0.292

Headline results for AE: GDP

Panel A: GDP Growth

	Nowcasting			1 quarter ahead forecast			4 quarters ahead forecast		
Credit growth	1.000**	0.517	0.543	0.728***	0.477**	0.236*	0.369**	0.156	-0.025
	[0.404]	[0.363]	[0.336]	[0.279]	[0.194]	[0.124]	[0.178]	[0.135]	[0.106]
Stock price		0.470**	0.390**		0.950***	0.645***		0.721***	0.556***
		[0.185]	[0.155]		[0.099]	[0.124]		[0.071]	[0.093]
House price		1.336***	1.180***		1.380***	1.206***		1.160***	1.063***
		[0.258]	[0.314]		[0.217]	[0.260]		[0.177]	[0.204]
Deposit rate			-4.772			-4.904			-1.684
			[3.563]			[3.136]			[2.499]
Lending rate			7.451			6.784			1.916
			[6.394]			[5.436]			[4.605]
Government consumption growth	0.461	1.012***	0.710	0.355*	0.563***	0.280*	0.153*	0.226**	0.050
	[0.295]	[0.383]	[0.464]	[0.212]	[0.172]	[0.153]	[0.087]	[0.100]	[0.084]
Policy rate	0.064	0.043	-0.799	0.035	0.096	-0.542	0.137	0.234	-0.391
	[0.215]	[0.200]	[0.732]	[0.194]	[0.173]	[0.595]	[0.191]	[0.174]	[0.456]
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,335	1,793	1,103	2,334	1,790	1,104	2,299	1,764	1,101
Adjusted R ²	0.136	0.132	0.098	0.219	0.256	0.160	0.313	0.287	0.231

Headline results for AE: GDP

Panel A: GDP Growth

		Nowcasting		1 quarter ahead forecast			4 quarters ahead forecast		
Credit growth	1.000** [0.404]	0.517 [0.363]	0.543 [0.336]	0.728*** [0.279]	0.477** [0.194]	0.236* [0.124]	0.369** [0.178]	0.156 [0.135]	-0.025 [0.106]
Stock price		0.470** [0.185]	0.390** [0.155]		0.950*** [0.099]	0.645*** [0.124]		0.721*** [0.071]	0.556*** [0.093]
House price		1.336*** [0.258]	1.180*** [0.314]		1.380*** [0.217]	1.206*** [0.260]		1.160*** [0.177]	1.063*** [0.204]
Deposit rate			-4.772 [3.563]			-4.904 [3.136]			-1.684 [2.499]
Lending rate			7.451 [6.394]			6.784 [5.436]			1.916 [4.605]
Government consumption growth	0.461 [0.295]	1.012*** [0.383]	0.710 [0.464]	0.355* [0.212]	0.563*** [0.172]	0.280* [0.153]	0.153* [0.087]	0.226** [0.100]	0.050 [0.084]
Policy rate	0.064 [0.215]	0.043 [0.200]	-0.799 [0.732]	0.035 [0.194]	0.096 [0.173]	-0.542 [0.595]	0.137 [0.191]	0.234 [0.174]	-0.391 [0.456]
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,335	1,793	1,103	2,334	1,790	1,104	2,299	1,764	1,101
Adjusted R ²	0.136	0.132	0.098	0.219	0.256	0.160	0.313	0.287	0.231

Headline results for EM: Investment

Panel C: Investment Growth

	Nowcasting			1 quarter ahead forecast			4 quarters ahead forecast		
Credit growth	13.229*** [1.878]	7.069*** [2.424]	5.338* [2.920]	6.575*** [1.375]	4.484** [1.995]	3.114 [2.068]	2.584** [1.099]	0.590 [1.556]	-0.356 [1.710]
Stock price		2.394* [1.363]	2.438* [1.392]		2.957*** [1.005]	3.109*** [1.080]		2.343*** [0.718]	2.440*** [0.716]
House price		2.984** [1.338]	2.642* [1.452]		2.095* [1.192]	2.087 [1.280]		1.239 [0.849]	1.296 [0.891]
Deposit rate			- 1,019.597*** [296.588]			-668.876** [291.995]			-616.427** [262.830]
Lending rate			44.151 [68.932]			46.204 [63.868]			99.554* [56.346]
Government consumption growth	3.970* [2.040]	-1.812 [3.032]	-0.755 [3.513]	2.696** [1.281]	-0.573 [1.504]	0.201 [1.672]	2.415*** [0.920]	1.282 [0.967]	1.969* [1.013]
Policy rate	-7.568*** [1.769]	-11.091*** [2.328]	0.511 [4.740]	-7.097*** [1.574]	-11.730*** [2.129]	-4.832 [5.419]	-6.417*** [1.422]	-11.138*** [2.014]	-7.149** [2.874]
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,491	639	614	1,467	634	610	1,393	611	588
Adjusted R ²	0.126	0.111	0.123	0.123	0.219	0.230	0.177	0.341	0.362

Headline results for EM: Consumption

	Nowcasting			1 quarter ahead forecast			4 quarters ahead forecast		
Credit growth	5.788***	0.354	0.107	2.875***	0.939	0.942	1.034*	0.573	0.684*
	[1.522]	[1.519]	[1.544]	[0.791]	[0.852]	[0.738]	[0.575]	[0.457]	[0.388]
Stock price		-0.026	0.171		0.653*	0.810**		0.608**	0.640**
		[0.543]	[0.528]		[0.385]	[0.387]		[0.283]	[0.304]
House price		1.367**	1.379**		1.102**	1.246***		0.448	0.484
		[0.530]	[0.574]		[0.438]	[0.477]		[0.278]	[0.302]
Deposit rate			67.860			180.565			127.158
			[130.166]			[113.188]			[91.924]
Lending rate			-78.655*			-72.865**			-34.282*
			[40.073]			[36.535]			[19.574]
Government consumption growth	-0.068	1.584	1.398	2.529**	0.640	0.528	2.271**	0.567	0.616
	[1.736]	[1.746]	[1.973]	[1.202]	[0.706]	[0.806]	[0.885]	[0.348]	[0.387]
Policy rate	-4.128***	-2.223***	0.300	-4.288***	-1.862**	-1.123	-3.543***	-1.551***	-1.820
	[1.398]	[0.670]	[2.104]	[1.419]	[0.753]	[1.447]	[1.027]	[0.590]	[1.365]
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,527	639	614	1,502	634	610	1,425	611	588
Adjusted R ²	0.184	0.071	0.075	0.214	0.113	0.123	0.287	0.182	0.189

Headline results for EM: Inflation

	Nowcasting			1 quarter ahead forecast			4 quarters ahead forecast		
Credit growth	-10.123**	-2.411***	-2.288***	-4.665**	-0.284	-0.034	-1.527	1.208***	1.515***
	[4.668]	[0.527]	[0.544]	[2.239]	[0.538]	[0.576]	[1.116]	[0.382]	[0.482]
Stock price		-0.081	-0.036		0.103	0.088		0.116	0.092
		[0.267]	[0.289]		[0.234]	[0.241]		[0.246]	[0.262]
House price		-1.334**	-1.288*		-1.259*	-1.251*		-0.661	-0.570
		[0.650]	[0.708]		[0.701]	[0.729]		[0.406]	[0.379]
Deposit rate			95.768			209.292			306.391
			[125.152]			[160.210]			[247.152]
Lending rate			-36.362			-39.737			-24.131
			[24.489]			[29.972]			[32.522]
Government consumption growth	7.865	0.142	0.376	5.279	0.565	0.760	1.888	0.262	0.446
	[5.621]	[0.528]	[0.608]	[3.738]	[0.606]	[0.720]	[1.469]	[0.243]	[0.290]
Policy rate	6.532***	4.234***	4.661*	7.874***	4.357***	3.689	9.361***	3.920**	1.627
	[1.843]	[1.320]	[2.522]	[2.442]	[1.487]	[2.325]	[2.815]	[1.517]	[1.554]
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,662	662	628	1,638	658	627	1,561	636	606
Adjusted R ²	0.583	0.572	0.578	0.568	0.516	0.528	0.571	0.480	0.500

Findings (cont.)

- Cross-country information helps improve individual country forecasts
 - The out-of-sample forecast of panel country model outperforms individual country model
 - For 100 percent of the countries (9 total) in EM
 - For 83 percent of the countries (23 total) in AE

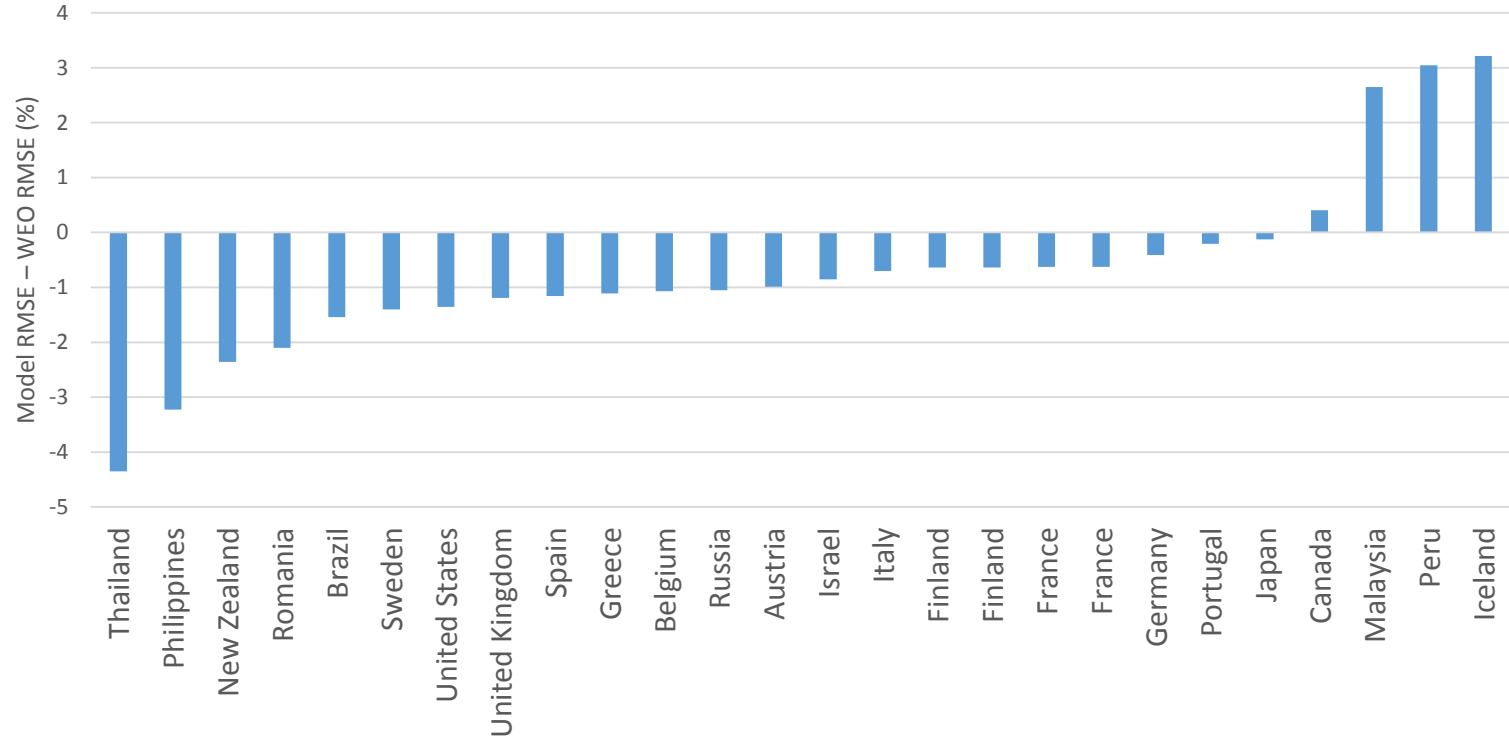
Model performance: Individual country model vs. panel model (EM, 2004-2013 Q1)

Country	Model 1 (AR)			Model 2 (AR and Credit)		
	Individual RMSE	Panel RMSE	1 if Panel outperforms	Individual RMSE	Panel RMSE	1 if Panel outperforms
Turkey	14.752	10.411	1	22.197	9.432	1
Brazil	8.879	5.863	1	8.879	5.099	1
Colombia	16.349	6.715	1	19.428	5.636	1
Peru	19.225	9.181	1	43.486	8.766	1
Indonesia	13.260	6.984	1	14.539	6.318	1
Malaysia	14.515	10.304	1	13.002	9.465	1
Philippines	5.529	5.379	1	6.442	5.082	1
Thailand	8.760	5.465	1	38.981	4.965	1
Hungary	11.239	8.648	1	20.567	8.826	1
Panel model outperforms (%)			100***	100***		

Model Performance

- Compared to WEO forecasts (32 countries with quarterly WEO forecasts, 2004-2013)
 - One financial variable model: outperforms WEO forecasts in 69% of the countries
 - 67% in EM
 - Three financial variable model: outperforms WEO forecasts in 85% of the countries
 - 75% in EM

Forecasting Errors (Extended Financial Model Compared to WEO)



Conclusion

- We offer a model easily applicable to many countries.
- We provide evidence on the strong connection between financial market conditions and macroeconomic outcomes, especially for developing economies.
- We find cross-country data can help improve individual country forecasts.