The MAS: a DSGE Model for Chile Implementation and Forecasting

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Motivation

- Inflation targeting framework in Chile since early 90s
- Monetary policy design relies heavily on forecasts
- Original motivation for developing a DSGE model: to improve upon our current medium-size (semi-structural) macro model
- DSGE models are better equipped to deal with counterfactual analysis
- DSGE models include simultaneously first and second round effects in a coherent manner

The Road in the model development

- Dominant view of a one-for-all model
- Initial requirements from senior management focused on forecasting
- Introduction of new concepts (e.g. natural output) and new paradigm regarding the policy response to certain shocks
- Structural interpretation of various shocks (current macro model is a reduced form one)
- Interaction with semi-structural macro model: IRFs, Transmission Mechanisms, Forecasting

Model features

- Ricardian households, non-Ricardian households, firms, fiscal authority, monetary authority, foreign agents
- Sticky prices and wages (á la Calvo). Imperfect exchange rate pass-through to both import and export prices
- Habit formation in consumption, adjustment cost for investment, price and wage indexation
- Stochastic trend in productivity
- Oil (energy) consumed by households and used as an input in production
- Exogenous endowment of a commodity good owned by the government foreign agents who's international price is stochastic
- Distinction between food and non food core inflation
- *Structural balance* rule for the fiscal policy; simple feedback rule for the interest rate

Estimation and calibration

- Model parameters estimated using a Bayesian approach with quarterly data for the period 1987:Q1 to 2005:Q4
- A subset of the parameters are calibrated to match the steady-state of the model with some long-run trend data in the Chilean economy
- Baseline estimation uses as observable variables (among others): real GDP, commodity production, short-run interest rate, *core* inflation, the real exchange rate, current account/GDP ratio, labor and the international prices of copper and oil
- Given the presence of a stochastic productivity trend, we use first difference for real variables

Estimation: Results

- Nominal rigidities are relevant in the case of Chile
- Some key parameters not well identified in the data
- Productivity shocks play a mayor role in explaining the business cycle. Foreign shocks are also important

Posterior distributions of time variant parameters
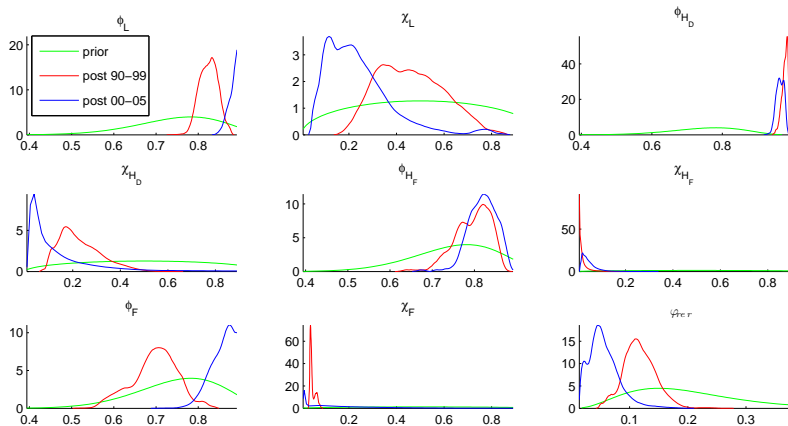
Variance Decomposition

	Domestic Shocks						External Shocks	
	Supply		Demand		Monet Pol			
Year	1987-99	2000-05	1987-99	2000-05	1987-99	2000-05	1987-99	2000-05
GDP growth								
1	42.3	39.8	11.6	11.4	2.4	3.0	43.7	45.8
2	50.9	45.9	27.7	28.5	8.9	10.4	12.5	15.2
3	57.4	54.0	18.8	14.0	7.0	3.8	16.9	28.1
4	45.8	45.3	9.7	5.4	4.2	1.7	40.3	47.6
***Core* Inflation**								
1	22.4	20.2	6.1	9.9	15.8	21.3	55.6	48.7
2	42.2	18.1	21.9	34.0	17.1	19.9	18.8	28.0
3	61.6	43.3	31.5	22.5	1.4	0.5	5.5	33.7
4	55.4	62.0	29.3	30.0	0.8	0.1	14.6	7.9
Real exchange rate								
1	21.4	21.3	2.1	1.5	7.1	7.0	69.4	70.1
2	29.4	30.9	8.0	5.6	3.4	1.7	59.3	61.7
3	26.9	28.5	11.4	8.5	3.2	1.7	58.4	61.3
4	20.5	22.4	10.0	7.7	2.8	1.6	66.7	68.3
Labor input								
1	20.4	20.1	24.6	22.3	13.9	12.2	41.1	45.4
2	2.3	5.0	13.0	7.0	17.4	7.9	67.2	80.1
3	4.1	8.6	3.0	0.7	13.6	4.5	79.3	86.1
4	12.3	10.4	0.7	1.3	13.0	5.2	74.0	83.1
Current Account to GDP ratio								
1	4.2	4.1	39.0	37.6	4.8	4.9	52.0	53.4
2	8.0	9.3	8.5	6.4	2.3	1.2	81.3	83.1
3	9.5	11.2	0.9	1.2	0.3	0.1	89.2	87.6
4	14.2	15.1	11.9	12.9	0.2	0.5	73.7	71.5

Historical decomposition of GDP growth
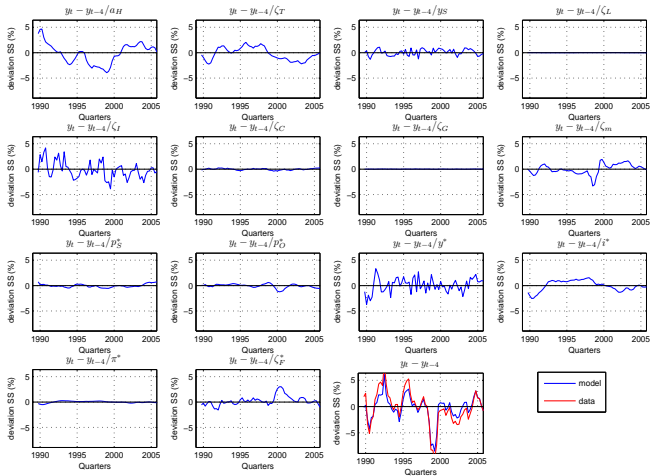
Historical Decomposition

Period	Domestic Shocks			External Shocks	Total
	Supply	Demand	Monet Pol		
GDP growth					
90-93	1.55	0.25	-0.10	-0.37	1.34
94-97	0.02	0.09	-0.39	2.08	1.81
98-01	-3.29	-0.38	-0.10	0.20	-3.56
02-05	-0.87	0.00	0.60	-0.27	-0.54
***core* inflation**					
90-93	-1.25	0.09	-0.45	1.90	0.29
94-97	-0.17	0.38	-1.27	0.39	-0.67
98-01	1.79	0.36	-2.40	-0.18	-0.42
02-05	-0.75	-0.18	0.43	-0.65	-1.15
Real exchange rate					
90-93	8.27	-0.43	-0.94	3.09	9.99
94-97	4.76	-0.69	-2.22	-9.34	-7.49
98-01	-2.76	-0.48	-5.28	0.06	-8.46
02-05	-2.34	0.40	-1.05	9.26	6.26
Labor input					
90-93	2.31	0.05	-0.93	-6.75	-5.32
94-97	0.87	0.24	-2.34	2.36	1.12
98-01	1.60	0.27	-5.69	4.40	0.59
02-05	-1.23	-0.39	-0.31	1.60	-0.33
Current Account to GDP ratio					
90-93	-3.50	-0.19	0.13	2.41	-1.15
94-97	-0.52	-0.22	0.44	-0.87	-1.18
98-01	2.43	-0.05	0.97	-3.60	-0.25
02-05	2.40	0.32	-0.57	0.05	2.20

Forecasting with MAS

- Fluctuations in observable variables is used to infer the sequences of shocks hitting the Chilean economy through the lens of the model
- This inference plus the estimated persistence of these shocks allow us to forecast
- We add back constants removed from detrending
- We started in 2007 to carry out formal forecasts in parallel to the semi-strcutural macro model as inputs for our Inflation Report
- Some questions arisen:
    - How do the MAS forecasts compare to the one performed with the semi-structural macro model?
    - How is the quality of these forecasts?
    - How to explain their results?

Forecasting: Comparable to the semi-structural macro model (core inflation)
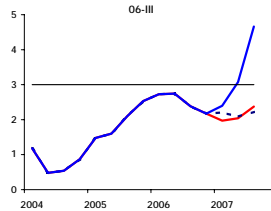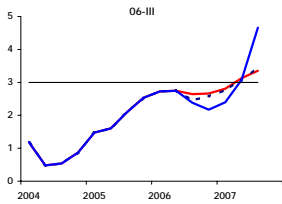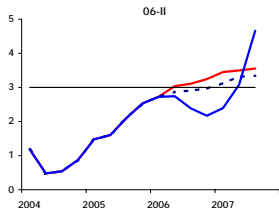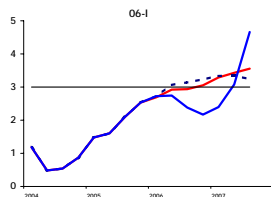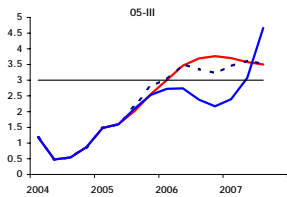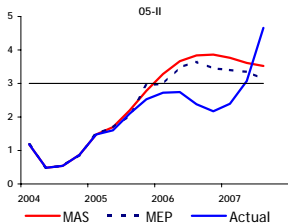
Forecasts of the model are as good as time series models

RMSE over different horizons

	Horizon	MAS	VAR(1)	VAR(2)	VAR(3)	VAR(4)	BVAR(1)	BVAR(2)	BVAR(3)	BVAR(4)
GDP	1	1.029	1.058	1.101	1.127	1.178	0.937	0.940	0.971	0.965
growth	4	0.737	0.722	0.719	0.820	0.891	0.832	0.815	0.911	0.873
	8	0.678	0.798	0.824	0.842	0.966	0.854	0.837	0.941	0.894
	12	0.537	0.786	0.806	0.810	1.029	0.903	0.886	1.052	0.993
Infla-	1	0.282	0.314	0.355	0.370	0.418	0.342	0.343	0.353	0.358
tion	4	0.448	0.370	0.392	0.396	0.448	0.383	0.382	0.397	0.403
	8	0.445	0.439	0.421	0.418	0.427	0.418	0.412	0.423	0.413
	12	0.390	0.469	0.431	0.413	0.442	0.409	0.398	0.408	0.396
RER	1	3.485	6.494	6.646	6.420	6.563	6.354	6.400	6.204	6.192
	4	6.495	8.452	8.718	8.267	8.426	8.877	9.161	8.802	8.616
	8	7.243	11.393	12.307	11.878	12.096	12.907	13.455	13.218	12.716
	12	6.474	14.360	15.401	15.324	16.109	16.540	17.337	17.338	16.490
Interest	1	0.248	0.382	0.370	0.400	0.379	0.398	0.400	0.415	0.420
Rate	4	0.304	0.617	0.584	0.734	0.578	0.610	0.607	0.679	0.699
	8	0.345	0.784	0.772	0.841	0.749	0.790	0.798	0.826	0.827
	12	0.411	0.887	0.885	0.891	0.887	0.891	0.916	0.913	0.912

Explaining forecasts

- The structure of the model allows us to perform a historical decomposition of forecasts
- However, the structure of model challenges the proper identification of shocks. Example: Food prices increase in 2007.
    - We adapt the model to include explicitly (exogenously) the behavior of food prices in the model

Decomposition of forecast: Inflation
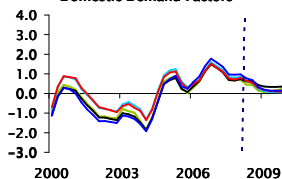
Decomposition: Core Inflation
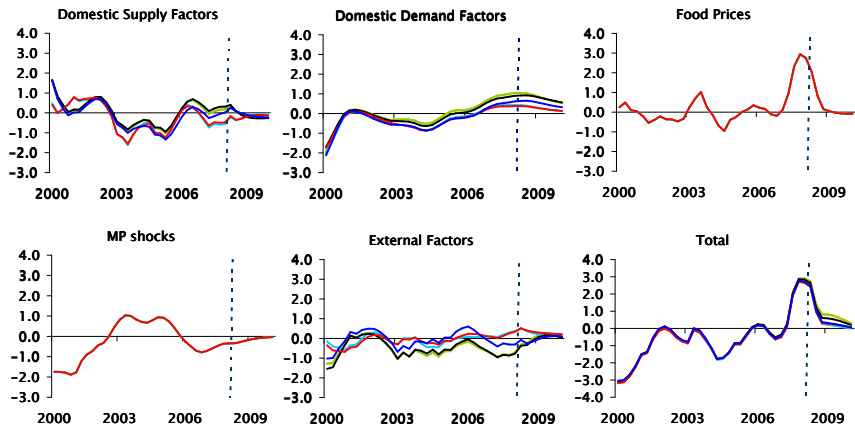
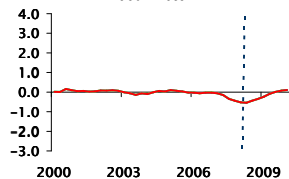# Decomposition of forecast: Output

Decomposition: Output (w/o NNRR)
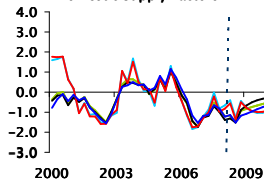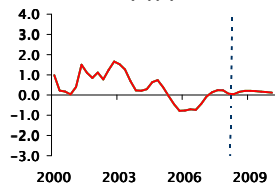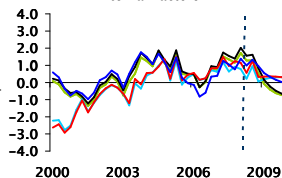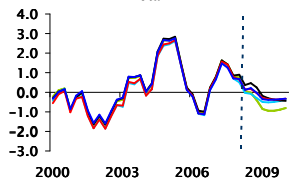
Further Issues on Forecasting with MAS

- Some judgement introduced by adjusting constant terms in detrending
- Risk analysis scenarios:
  - We use the IRFs to construct alternatives scenarios. Example: changes in terms of trade
  - We modify the model to include elements that are part of the policy discussions. Example: Transmission oil price shocks and lack of MP credibility

Copper price shock

Oil price shock
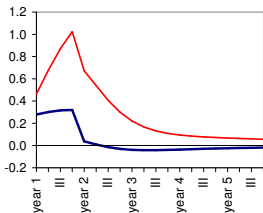

CPI Inflation (y/y %)
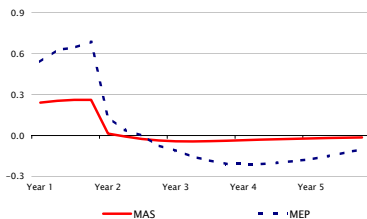
GDP (y/y %)
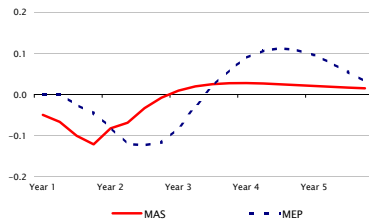
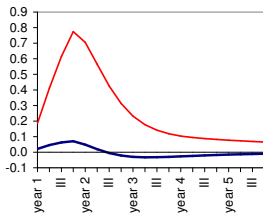Interes Rate

Real Exchange Rate
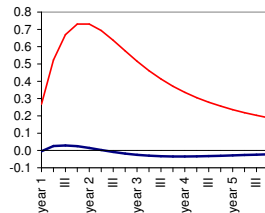
MAS   MEP
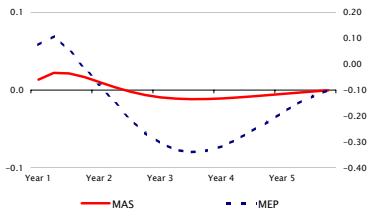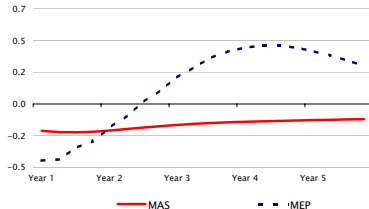
Imperfect Credibility: Oil price shock
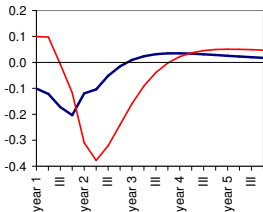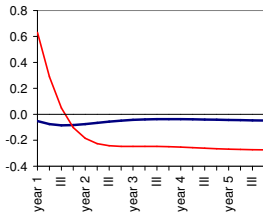
Headline Inflation

Core Inflation
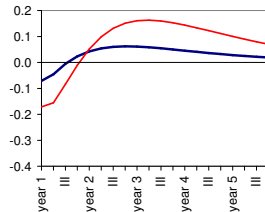
Nominal Interest Rate

Output growth

Real Exchange Rate

Current Account (% of GDP)

Perfect Credibility   Imperfect Credibility

Conclusions and Challenges

- MAS offers a coherent framework to perform policy analysis
- Communication of MAS results: General equilibrium v/s sequential thinking
- Forecasts of MAS are comparable to the semi-structural model and time series models. More on statistical inference of the quality of forecasts
- Benefits of the DSGE structure for the analysis of alternative/risk scenarios of the macroeconomic forecast
- Secular trends and relevant stationary ratios
- Observable variables and historical decomposition
- Challenges with structure of model:
    - Role of relative price adjustments (particularly relevant for an open economy where exchange rate fluctuations play a central role)
    - Labor market and exchange rate disconnection
    - MP rule and the implementation of the inflation forecast target in the policy horizon