

Discussion of
“A Next-generation Agent-based Model for Canada
(CAN-ABM)”

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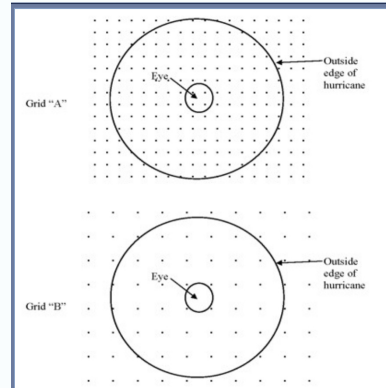
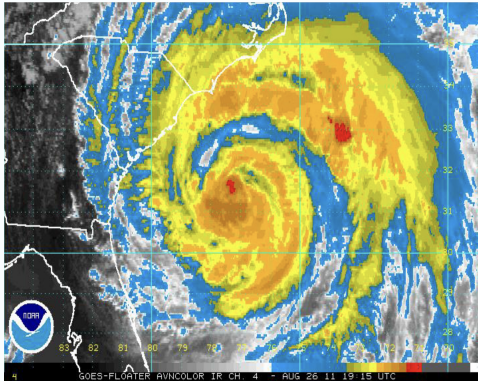
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Kudos to the Bank of Canada

- ... for pursuing *model diversity* and building an **agent based model** (ABM) of the Canadian economy
- In the remainder of my discussion I will provide some (constructive) criticism—but the criticism is aimed at some specific modeling or expositional choices. Not at the ultimate goal, which is to build an alternative to ToTem—the BoC DSGE model—for understanding the Canadian economy

The ABM approach to modeling the economy

- “We use a scale of 1:100 between model and data, so that each agent in the model represents a thousand individuals or businesses of the Canadian economy.”



Schematic showing a top-down view of a hurricane on two model grids with different horizontal resolutions. Grid "A" (top) has higher resolution than Grid "B" (bottom) because the grid points are closer to each other.

“Realistic agent behavior”

- “... the realistic agent behavior in CAN-ABM also makes the model an ideal candidate to predict the effects of ... macroeconomic policies.”
- Let's have a look at the household **consumption-savings** decision:

$$(1 - \tau^{\text{VAT}})C_h(t) = \psi Y_h(t)$$

total consumption (including taxes) for hh h is a fraction ψ of their disposable income

- The *same* fraction ψ whether rich or poor, employed or unemployed, ...?
- The *same* fraction ψ over time?
- Households' residential investment is also assumed to be a constant fraction of income
- Nothing wrong with using heuristics ... but wouldn't it be a good idea to **base these heuristics on the (growing) household finance literature**? ABM models, precisely because they use heuristics, could get a lot close to replicating some of the findings of this literature than, say, HANK models

Expectations

- Only *two* expectations matter in this model: the *nowcasts* for output growth $\gamma^e(t)$ and inflation $\pi^e(t)$
- They are obtained by re-estimating in each period t an AR(1) on available $(t - 1)$ time series for output growth and inflation and projecting forward one period

$$\pi^e(t) = \exp\{\alpha^\pi(t)\pi(t - 1) + \beta^\pi(t) + \varepsilon^\pi(t)\} - 1$$

$$\gamma^e(t) = \exp\{\alpha^\gamma(t)\gamma(t - 1) + \beta^\gamma(t) + \varepsilon^\gamma(t)\} - 1$$

- Expectations are a key determinant in price setting and production decisions:

$$Q_i(t) = Q_i(t - 1)(1 + \gamma_i^d(t))(1 + \gamma^e(t))$$

- The *same* expectations for all households, firms? In recent months not only average expected inflation, but also [disagreement](#), is record high in the US
- Nobody (including financial markets as far as I can tell) is using expectations *past the current period* for their decisions. Why are we collecting these expectations?
- Given that expectations follow an AR(1), and that these expectations play an important role in determining inflation/growth, how surprising is it that the model's forecasting performance is close to that of an AR(1)?

Inspecting (and validating) the mechanism

- How does the transmission of monetary policy work in the model?
- Does it resemble that obtained from VARs?
- Section 6.1: Simulating the Macroeconomic Impact of the 2020 Containment
“Our analysis showed how ABM models can provide insights into likely trajectories of an open economy when confronted with varieties of macroeconomic shocks.”
- Where *are* these shocks in the model? How do they propagate?

Validating the model and choosing the parameters

- Pseudo out-of-sample exercise is useful ...
- But model parameters and initial conditions are re-calibrated *in each forecasting period* in ways that are far from transparent (at least in the current draft). Replicability?
- Approach (testing the model; picking the parameters) is at the moment completely disconnected from econometric practice ...
- But DSGE models were adopted by central banks when they became *time series* models

CAN-ABM vs ToTem?

Table 6: Out-of-sample forecast performance

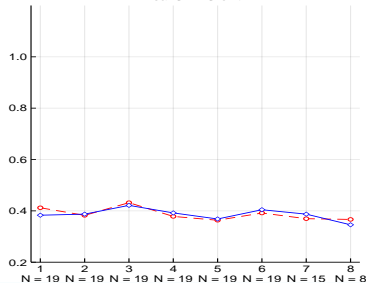
	GDP	Inflation	Consumption	Investment	Exports	Imports
VAR(1)	<i>RMSE-statistic for different forecast horizons</i>					
1q	0.55	0.67	0.34	1.43	2.34	1.6
2q	0.83	0.61	0.54	2.78	3.04	2.48
4q	1.37	0.61	0.99	5.56	3.81	4.72
8q	1.98	0.7	1.62	10.43	4.73	9.34
12q	2.21	0.72	1.98	15.21	4.72	13.83
AR(1)	<i>Percentage gains (+) or losses (-) relative to VAR(1) model</i>					
1q	2.6 (0.35)	15.6 (0.02)	17.7 (0.06)	-0.3 (0.51)	-1.6 (1.00)	12.5 (0.03)
2q	1.6 (0.40)	1.9 (0.33)	7.1 (0.23)	9.6 (0.19)	4.4 (0.99)	29.9 (0.05)
4q	11.2 (0.00)	0.7 (0.42)	10.9 (0.12)	18.6 (0.05)	1.6 (1.00)	47.3 (0.04)
8q	10.3 (0.00)	3.8 (0.15)	11.6 (0.24)	21.8 (0.01)	-6.3 (0.99)	61.8 (0.05)
12q	19.3 (0.03)	2.8 (0.12)	8.8 (0.36)	26 (0.00)	-14.1 (0.99)	68.6 (0.28)
ToTEM	<i>Percentage gains (+) or losses (-) relative to VAR(1) model</i>					
1q	-23.3 (0.86)	-41.7 (0.97)	-117.3 (1.00)	-92.4 (0.96)	-3.1 (0.56)	14.1 (0.16)
2q	-29.5 (0.83)	-80 (0.99)	-128 (1.00)	-42.2 (0.93)	3.9 (0.41)	17.3 (0.05)
4q	-5.7 (0.60)	-71.2 (1.00)	-74.5 (0.96)	-6.6 (0.56)	-11.2 (0.63)	17.5 (0.17)
8q	32.8 (0.00)	-11.8 (0.86)	-24.8 (0.86)	35.2 (0.24)	51.7 (0.01)	71.6 (0.00)
12q	46.3 (0.00)	-6.5 (0.64)	6.2 (0.32)	26.5 (0.17)	51.3 (0.00)	83.6 (0.02)
ABM	<i>Percentage gains (+) or losses (-) relative to VAR(1) model</i>					
1q	3 (0.32)	13.5 (0.06)	-19 (0.87)	-4.7 (0.83)	5.6 (0.15)	14 (0.12)
2q	2.9 (0.29)	-2.6 (0.66)	-17.4 (0.83)	11 (0.02)	11.1 (0.06)	33.6 (0.03)
4q	12 (0.06)	-4.8 (0.77)	12.4 (0.29)	23.1 (0.05)	7.4 (0.09)	49.5 (0.01)
8q	17.3 (0.02)	9.3 (0.06)	19.3 (0.34)	33 (0.04)	2.8 (0.38)	65.6 (0.01)
12q	27.1 (0.00)	3.1 (0.36)	33.4 (0.32)	43.2 (0.00)	2.7 (0.41)	77.7 (0.03)

NY Fed DSGE's real out-of-sample forecasting performance

RMSEs: Jan 2011-Jan 2016

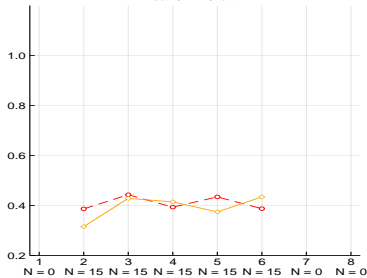
Blue Chip

Real GDP Growth



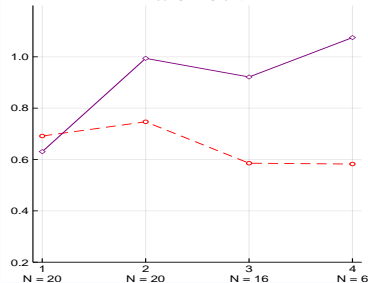
SPF

Real GDP Growth

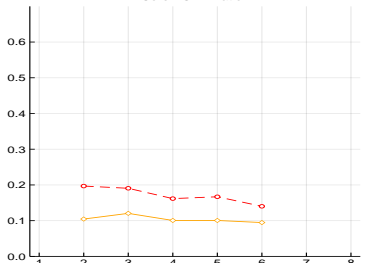


SEP

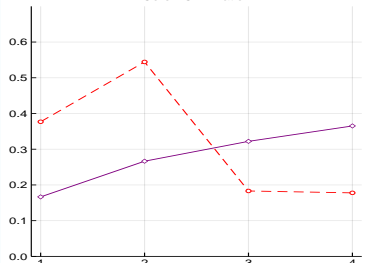
Real GDP Growth



Core PCE Inflation



Core PCE Inflation



THANK YOU!