Short-run and long-run causality between monetary policy and asset prices

Jean-Marie Dufour [1] David Tessier [2]

December 7, 2015

[1] McGill University
[2] Université du Québec en Outaouais

Price stability and monetary policy

Under the period of the great moderation, central banks have been very successful in achieving sustained growth, with a low and stable inflation rate.

Over that same period, however, the financial markets were not characterized by the same moderation.

The asset markets (stock and housing), especially in the US, have been subject to various periods of booms and bust, which has led to many episodes of financial turmoil.

Price stability and monetary policy

William White, former Chief Economist of the BIS, was one of the first to warn of the potential effects of the new monetary policy framework on a sustained macroeconomic stability.

More specifically, he argued that achieving near term price stability might sometimes not be sufficient to avoid financial imbalances and serious macroeconomic downturns in the medium term.

The core of the problem is that persistently easy monetary conditions can lead to a cumulative build-up over time of significant deviations from historical norms.

Price stability and monetary policy

In the specific case of the US economy, some authors [Shiller (2009), Taylor (2012), White (2012)] have argued that the accommodating monetary policy preceding the recent financial crisis, essentially to avoid the threat of deflation [Bernanke 2003)], may have fuelled financial imbalances.

For example, Taylor (2012) reported that short-term interest rates were almost systematically below the level a standard Taylor rule would have prescribed.

This view is consistent with the classic explanation that financial crises are caused by excesses, and most frequently monetary excesses.

Our objectives

Given the increasing impact of financial developments on the real economy, we think that it would be important to re-evaluate the conduct of monetary policy.

More precisely, our objective is to examine the potential links connecting monetary policy instruments and the evolution of asset prices (stock and housing).

While most empirical studies on causality have examined this issue using Granger's (1969) original definition, we examine the causality relations through the generalization proposed in Dufour and Renault (1998, Econometrica).

Our objectives

This distinction is particularly relevant in view of the fact that monetary policy actions affect the economy with possibly long lags.

For example, an interest rate cut may not have its maximum impact on real output for 4 or even 6 quarters, and the effects on inflation may take longer.

Furthermore, under inflation forecast targeting, the emphasis is on responding to forecasts of future inflation eight quarters ahead.

Results

- Applied to the American economy, our methodology allows us to infer that monetary aggregates may have significant predictive power for income and prices at longer horizons.
- This finding contrasts with Sims (1980) in which the effect of money tends to evaporate in models that incorporate a measure of interest rate. Policy rate–Fed Funds–turn out to remain the only key monetary measure.

Consequences of the Sims conclusion

- This has led the monetary authorities to develop a new framework for the conduct of monetary policy.
- The monetary systems that have been adopted by numerous advanced countries resemble Knut Wicksells (1898) model of the ”pure credit economy”, in which the concept of neutral interest rate turns out to be the key factor.
- Central banks use a short-term interest rate as its policy instrument, within a decision-making framework in which the role of monetary aggregates in the transmission mechanism is by-passed.
- The recent US financial crisis, with the subsequent quantitative easing, invalidate to some extent that position.

Results

- Monetary aggregates tend to incorporate significant information for future changes in stock prices, which suggests that equity investors are inclined to show some responsiveness to the money stock.

- In contrast, monetary aggragates have no predictive power on housing prices, while policy rate–Fed Funds– turns out to remain the main determinant.

Results

- House prices seem to have predictive information about future changes of monetary aggregate $M1$.
- This result supports the role of collateralized household debt in the dynamics of personal credit.
- The rise in house prices can induce households to increasingly extract equity from their accumulated assets, thereby encouraging further borrowing.

Multiple horizons causality tests

The inference procedures to test the non-causality conditions proposed in Dufour and Renault (1998) are provided by Dufour, Pelletier, and Renault (2006, J. of Econometrics).

Consider a $\mathrm{VAR}(p)$ process of the form:

$$W(t) = \mu(t) + \sum_{k=1}^{p} \pi_k W(t-k) + a(t)\ , \quad t = 1, \ldots, T, \tag{1}$$

where $W(t) = (w_{1t}, w_{2t}, \ldots, w_{mt})'$ is a random vector, and $a(t)$ is a white-noise process of order two with a non-singular variance-covariance matrix Ω.

Multiple horizons causality tests

This autoregressive form can be generalized to allow for projection at any horizon h given the information available at time t:

$$W(t+h) = \mu^{(h)}(t) + \sum_{k=1}^{p} \pi_k^{(h)} W(t+1-k) + \sum_{j=0}^{h-1} \psi_j a(t+h-j) \ , \tag{2}$$

where $\psi_0 = I_m$ and $h < T$.

The latter equation is called an "autoregression of order p at horizon h" or a "(p, h)-autoregression."

Multiple horizons causality tests

In this paper, we consider the hypothesis that a variable w_{jt} does not cause another one, w_{it}, at horizon h, and the restrictions related to that hypothesis take the form:

$$H_0^{(h)} : \pi_{ijk}^{(h)} = 0\,,\ k = 1, \ldots, p\,, \tag{3}$$

where $\pi_k^{(h)} = \left[\pi_{ijk}^{(h)}\right]_{i,\ j=1,\ldots,m}$ comes from

the "$(p,\ h)$-autoregression" just defined.

Multiple horizons causality tests

Under the hypothesis $H_0^{(h)}$ of non-causality at horizon h from w_{jt} to w_{it}, Dufour, Pelletier, and Renault (2006) have shown that the asymptotic distribution of the Wald statistic $\mathcal{W}[H_0^{(h)}]$ is $\chi^2(p)$.

In order to get an appropriate distribution, we have to take into account that the prediction error $\hat{u}(t+h)$ follows an MA$(h-1)$ process.

To that end, we use the Newey-West procedure.

Multiple horizons causality tests

The Gaussian asymptotic distribution provided may not be very reliable in finite samples.

An alternative to using the asymptotic chi-square distribution of $\mathcal{W}[H_0^{(h)}]$ consists in using Monte Carlo test techniques [Dufour(2006)] or bootstrap methods.

Such methods yield asymptotically valid tests when applied to $\mathcal{W}[H_0^{(h)}]$, and typically provide a much better control of the test level in finite samples.

Multiple horizons causality tests

In the empirical study presented below, p-values are computed using a parametric bootstraps:

1. an unrestricted VAR(p) model is fitted for the horizon one, yielding the estimates $\hat{\Pi}^{(1)}$ and $\hat{\Omega}$ for $\Pi^{(1)}$ and Ω ;
2. an unrestricted (p, h)-autoregression is fitted by least squares, yielding the estimate $\hat{\Pi}^{(h)}$ of $\Pi^{(h)}$;
3. the test statistic $\mathcal{W}$ for testing non-causality at the horizon h is computed;
4. N simulated samples are drawn by Monte Carlo methods, using $\Pi^{(h)} = \hat{\Pi}^{(h)}$ and $\Omega = \hat{\Omega}$ (and the hypothesis that $a(t)$ is Gaussian); we then impose to $\hat{\Pi}^{(h)}$ the constraints of non-causality;
5. the simulated p-value is obtained by calculating the rejection frequency.

Data and Model Specification

The following variables are considered:

- the logarithm of real GDP (GDP);
- the logarithm of the consumer price index (P);
- the logarithm of the monetary base (B);
- the logarithm of M1 ($M1$);
- the federal funds rate (r).
- the logarithm of the S&P500 (SP),
- as a measure of house prices, we consider the logarithm of the house price index provided by the U.S. Federal Finance Agency (HP).

These series are quarterly and the sample goes from 1965Q1 to 2014Q4, for a total of 200 observations.

Table: Causality tests at horizons 1 to 8; 4-variable model [ΔGDP,Δ^2P, Δr, ΔM1]; 1965Q1-2014Q4; 4 lags; p-values not larger than 5.00, in percentages.

h	1	2	3	4	5	6	7	8
$P \nrightarrow GDP$								
$r \nrightarrow GDP$	0.00	0.10			1.34	0.74	4.48	
$M1 \nrightarrow GDP$					1.26			
$GDP \nrightarrow P$	3.08	2.54		1.72				4.36
$r \nrightarrow P$					4.82			
$M1 \nrightarrow P$								
$GDP \nrightarrow r$	0.00	0.68	4.24				3.68	4.22
$P \nrightarrow r$								
$M1 \nrightarrow r$		2.08	2.44					
$GDP \nrightarrow M1$								
$P \nrightarrow M1$								
$r \nrightarrow M1$	0.12			1.52				

Table: Causality tests at horizons 1 to 8; 4-variable model [ΔGDP,ΔP, Δr, ΔM1]; 1965Q1-2014Q4; 4 lags; p-values not larger than 5.00, in percentages.

h	1	2	3	4	5	6	7	8
$P \nrightarrow GDP$								
$r \nrightarrow GDP$	0.00	0.18			0.52	0.54	0.78	
$M1 \nrightarrow GDP$					0.96			
$GDP \nrightarrow P$				0.70				
$r \nrightarrow P$	0.36							
$M1 \nrightarrow P$								
$GDP \nrightarrow r$	0.00	0.28	2.14					
$P \nrightarrow r$								
$M1 \nrightarrow r$		2.14	2.20					
$GDP \nrightarrow M1$								
$P \nrightarrow M1$								
$r \nrightarrow M1$	0.00	3.64		0.06				

Table: Causality tests at horizons 1 to 8; 5-variable model [ΔGDP,Δ^2P, Δr, ΔM1, ΔSP]; 1965Q1-2014Q4; 4 lags; p-values not larger than 5.00, in percentages.

	h		1	2	3	4	5	6	7	8
P	$\nrightarrow$	GDP								
r	$\nrightarrow$	GDP	0.02	0.02			1.26	0.64	1.94	
$M1$	$\nrightarrow$	GDP					0.70			
SP	$\nrightarrow$	GDP	0.60	2.40						
GDP	$\nrightarrow$	P	1.74	1.86		2.20				2.86
r	$\nrightarrow$	P								
$M1$	$\nrightarrow$	P								
SP	$\nrightarrow$	P								
GDP	$\nrightarrow$	r	0.32	1.40	2.52					4.02
P	$\nrightarrow$	r								
$M1$	$\nrightarrow$	r		2.46	1.64					
SP	$\nrightarrow$	r								
GDP	$\nrightarrow$	$M1$								
P	$\nrightarrow$	$M1$								
r	$\nrightarrow$	$M1$	0.10			3.36				
SP	$\nrightarrow$	$M1$								
GDP	$\nrightarrow$	SP								
P	$\nrightarrow$	SP		2.78						
r	$\nrightarrow$	SP	2.68							
$M1$	$\nrightarrow$	SP	2.44	1.46						

Table: Causality tests at horizons 1 to 8; 5-variable model [$\Delta GDP, \Delta^2 P$, Δr, $\Delta M1$, ΔSP]; 1965Q1-2007Q2; 4 lags; p-values not larger than 5.00, in percentages.

h	1	2	3	4	5	6	7	8
$P \nrightarrow GDP$								
$r \nrightarrow GDP$	0.00	0.04	0.36	1.42	0.08	1.00		
$M1 \nrightarrow GDP$					2.68			
$SP \nrightarrow GDP$								
$GDP \nrightarrow P$	1.34	3.30		0.92	2.50		2.00	0.84
$r \nrightarrow P$				1.64	3.62	0.40	0.34	3.08
$M1 \nrightarrow P$								
$SP \nrightarrow P$								
$GDP \nrightarrow r$	1.36	1.44	2.74				4.50	3.76
$P \nrightarrow r$								
$M1 \nrightarrow r$			1.18					
$SP \nrightarrow r$								
$GDP \nrightarrow M1$								
$P \nrightarrow M1$								
$r \nrightarrow M1$	1.54							
$SP \nrightarrow M1$								
$GDP \nrightarrow SP$								
$P \nrightarrow SP$								
$r \nrightarrow SP$		1.82						
$M1 \nrightarrow SP$		3.68	3.88	2.24				

Table: Causality tests at horizons 1 to 8; 6-variable model [ΔGDP,Δ^2P, Δr, ΔB, Δ(M1/B), ΔSP]; 1965Q1-2014Q4; 4 lags; p-values not larger than 5.00, in percentages.

	h		1	2	3	4	5	6	7	8
P	$\nrightarrow$	GDP								
r	$\nrightarrow$	GDP	0.02	0.04			2.26	1.44	2.98	
B	$\nrightarrow$	GDP					0.50			
$M1/B$	$\nrightarrow$	GDP					0.64			
SP	$\nrightarrow$	GDP	0.50	1.76						
GDP	$\nrightarrow$	P	0.44	1.16	3.96	3.64			3.28	1.60
r	$\nrightarrow$	P					2.56		3.68	
B	$\nrightarrow$	P								
$M1/B$	$\nrightarrow$	P								
SP	$\nrightarrow$	P								
GDP	$\nrightarrow$	r	0.18	0.72	2.18				4.86	4.90
P	$\nrightarrow$	r								
B	$\nrightarrow$	r		0.50	0.60					
$M1/B$	$\nrightarrow$	r			3.90					
SP	$\nrightarrow$	r								
GDP	$\nrightarrow$	B								
P	$\nrightarrow$	B	3.50							
r	$\nrightarrow$	B								
$M1/B$	$\nrightarrow$	B								
SP	$\nrightarrow$	B								
GDP	$\nrightarrow$	$M1/B$								
P	$\nrightarrow$	$M1/B$								
r	$\nrightarrow$	$M1/B$								
B	$\nrightarrow$	$M1/B$								
SP	$\nrightarrow$	$M1/B$								
GDP	$\nrightarrow$	SP								
P	$\nrightarrow$	SP		4.02						
r	$\nrightarrow$	SP	4.50							
B	$\nrightarrow$	SP	2.36	0.96						
$M1/B$	$\nrightarrow$	SP	3.62	1.70						

Table: Causality tests at horizons 1 to 8; 5-variable model [ΔGDP,Δ^2P, Δr, ΔM1, ΔHP]; 1970Q1-2014Q4; 4 lags; p-values not larger than 5.00, in percentages.

	h		1	2	3	4	5	6	7	8
P	$\nrightarrow$	GDP								
r	$\nrightarrow$	GDP	0.00	0.00				4.00		
$M1$	$\nrightarrow$	GDP								
HP	$\nrightarrow$	GDP								
GDP	$\nrightarrow$	P		3.20	3.30	2.38				
r	$\nrightarrow$	P	0.56							
$M1$	$\nrightarrow$	P								
HP	$\nrightarrow$	P								
GDP	$\nrightarrow$	r	1.26							
P	$\nrightarrow$	r								
$M1$	$\nrightarrow$	r		1.98						
HP	$\nrightarrow$	r								
GDP	$\nrightarrow$	$M1$								
P	$\nrightarrow$	$M1$								
r	$\nrightarrow$	$M1$	0.12			2.64				
HP	$\nrightarrow$	$M1$			4.94	1.64	0.94			
GDP	$\nrightarrow$	HP	1.54	4.36						
P	$\nrightarrow$	HP	0.12							
r	$\nrightarrow$	HP			1.04	0.38	0.62	0.36	0.74	
$M1$	$\nrightarrow$	HP								

Table: Causality tests at horizons 1 to 8; 5-variable model [ΔGDP,Δ^2P, Δr, ΔM1, ΔHP]; 1970Q1-2007Q2; 4 lags; p-values not larger than 5.00, in percentages.

h	1	2	3	4	5	6	7	8
$P \nrightarrow GDP$								
$r \nrightarrow GDP$	0.02	0.04	0.40	2.08	1.00	4.76		
$M1 \nrightarrow GDP$								
$HP \nrightarrow GDP$								
$GDP \nrightarrow P$	1.94	1.98	4.24	2.32			1.94	4.52
$r \nrightarrow P$	0.08	3.64	1.74	0.46	0.80	0.02	0.00	
$M1 \nrightarrow P$								
$HP \nrightarrow P$	3.16			0.08				
$GDP \nrightarrow r$	0.14							
$P \nrightarrow r$								
$M1 \nrightarrow r$			2.12					
$HP \nrightarrow r$								
$GDP \nrightarrow M1$								
$P \nrightarrow M1$								
$r \nrightarrow M1$								
$HP \nrightarrow M1$				0.84	3.20			
$GDP \nrightarrow HP$								
$P \nrightarrow HP$								
$r \nrightarrow HP$	2.38		0.60	0.00	0.02	0.10	2.16	
$M1 \nrightarrow HP$								

Table: Causality tests at horizons 1 to 8; 6-variable model [ΔGDP,Δ^2P, Δr, ΔM1, ΔSP, ΔHP]; 1970Q1-2014Q4; 4 lags; p-values not larger than 5.00, in percentages.

h	1	2	3	4	5	6	7	8
$P \nrightarrow GDP$								
$r \nrightarrow GDP$	0.04	0.00	0.68	4.18		2.96	4.40	
$M1 \nrightarrow GDP$				4.68				
$SP \nrightarrow GDP$	0.14	2.20						
$HP \nrightarrow GDP$								
$GDP \nrightarrow P$			1.34	2.86				
$r \nrightarrow P$	1.26							
$M1 \nrightarrow P$								
$SP \nrightarrow P$								
$HP \nrightarrow P$								
$GDP \nrightarrow r$	4.46							
$P \nrightarrow r$								
$M1 \nrightarrow r$		2.30						
$SP \nrightarrow r$								
$HP \nrightarrow r$								
$GDP \nrightarrow M1$								
$P \nrightarrow M1$								
$r \nrightarrow M1$	0.12							
$SP \nrightarrow M1$								
$HP \nrightarrow M1$				1.90	0.94			
$GDP \nrightarrow SP$								
$P \nrightarrow SP$								
$r \nrightarrow SP$								
$M1 \nrightarrow SP$	0.78	4.46						
$HP \nrightarrow SP$								
$GDP \nrightarrow HP$								
$P \nrightarrow HP$	0.28							
$r \nrightarrow HP$	4.84		1.54	0.62	1.96	2.84	2.26	
$M1 \nrightarrow HP$								
$SP \nrightarrow HP$								

Table: Causality tests at horizons 1 to 8; 4-variable model [ΔP, Δr, ΔM1, ΔSP]; 1934Q1-2014Q4; 4 lags; p-values not larger than 5.00, in percentages.

h	1	2	3	4	5	6	7	8
$r \nrightarrow P$	0.06	3.94	4.66	4.90		4.56	3.36	
$M1 \nrightarrow P$	0.62							
$SP \nrightarrow P$								
$P \nrightarrow r$								
$M1 \nrightarrow r$								
$SP \nrightarrow r$	1.58	1.72						
$P \nrightarrow M1$								
$r \nrightarrow M1$	0.00	0.02		0.58				
$SP \nrightarrow M1$								
$P \nrightarrow SP$	0.14							
$r \nrightarrow SP$								
$M1 \nrightarrow SP$	0.38							

Table: Causality tests at horizons 1 to 8; 5-variable model [ΔP, Δr, ΔM1, ΔSP, ΔHP]; 1934-2014; one lag; p-values not larger than 5.00, in percentages.

h	1	2	3	4	5	6	7	8
$r \nrightarrow P$	0.72							
$M1 \nrightarrow P$			1.43				4.89	
$SP \nrightarrow P$								
$HP \nrightarrow P$		3.47				2.80		
$P \nrightarrow r$								
$M1 \nrightarrow r$								
$SP \nrightarrow r$								
$HP \nrightarrow r$		2.45						
$P \nrightarrow M1$								
$r \nrightarrow M1$	0.08							
$SP \nrightarrow M1$		1.85	3.85					
$HP \nrightarrow M1$		0.03	0.00	1.13				
$P \nrightarrow SP$								
$r \nrightarrow SP$								
$M1 \nrightarrow SP$								
$HP \nrightarrow SP$			2.05	2.12				3.84
$P \nrightarrow HP$								
$r \nrightarrow HP$	3.85							
$M1 \nrightarrow HP$								
$SP \nrightarrow HP$								

Conclusion

- Applied to the American economy, our methodology allows us to infer that monetary aggregates may have significant predictive power for income and prices at longer horizons.
- Monetary aggregates tend to incorporate significant information for future changes in stock prices, which suggests that equity investors are inclined to show some responsiveness to the money stock.
- In contrast, monetary aggragates have no predictive power on housing prices, while policy rate–Fed Funds– turns out to remain the main determinant.

Conclusion

- Housing prices seem to have predictive information about future changes of monetary aggregate $M1$.
- This result supports the role of collateralized household debt in the dymamics of personal credit.