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On the (de)stabilizing effects of news shocks*

Roland Winkler and Hans-Werner Wohltmann

Abstract: This paper analyzes the impacts of news shocks on macroeconomic volatility. Whereas anticipation amplifies volatility in any purely forward-looking model, such as the baseline New Keynesian model, the results are ambiguous when including a backward-looking component. In addition to these theoretical findings, we use the estimated model of Smets and Wouters (2003) to provide numerical evidence that news shocks increase the volatility of key macroeconomic variables in the euro area when compared to unanticipated shocks.

Keywords: Anticipated Shocks, Business Cycles, Volatility

JEL classification: E32

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1 Introduction

Does the anticipation of a future shock dampen macroeconomic volatility? In a very insightful paper, Fève, Matheron, and Sahuc (2009) (FMS henceforth) argue that exactly the opposite may be true. They consider a one-dimensional purely forward-looking rational expectations model with a news shock and demonstrate that the variance (or volatility) of the endogenous variable is an increasing function of the length of the time period between the anticipation and the realization of the shock, henceforth denoted as q. Notably, this implies that the anticipation of a future disturbance destabilizes the model economy when compared to an unanticipated disturbance of equal magnitude. FMS state robustness for the hybrid case, where the dynamics of the endogenous variable is described both by a forward-looking and a backward-looking component.

In the first part of this paper we, however, demonstrate that in the hybrid case, the correlation between anticipation and the variance of the endogenous variable is ambiguous. Then, we seek to get insights about the volatility effects of anticipated shocks in a realistic model of the business cycle. To do so, we use the estimated Euro area model developed by Smets and Wouters (2003) (SW henceforth). As suggested by our theoretical findings for the one-dimensional hybrid case, the results for the SW model are ambiguous. The variances of all macroeconomic variables are increasing functions of q only in the case of cost-push shocks. For other disturbances such as shocks to productivity or to government spending, there always exist some endogenous variables whose volatility is dampened through anticipation, whereas the volatility of the other variables is amplified.

The paper is organized as follows. Section 2 considers a multidimensional forward-looking systems with news shocks. Furthermore, we solve for the variance in the case of a one-dimensional hybrid system. In Section 3, we present numerical results for the SW model with news shocks. Section 4 provides concluding remarks.

2 Volatility and news: Some new theoretical results

Consider the following forward-looking model

$$Y_t = A\,\mathrm{E}_t\,Y_{t+1} + c \cdot x_t\,, \tag{1}$$

where x_t is an exogenous disturbance, described by the stochastic process

$$x_t = \rho x_{t-1} + \varepsilon_{t-q}\,. \tag{2}$$

with the autocorrelation parameter, $0 \leq \rho < 1$. ε_t is an i.i.d.-normal error term with zero mean and unit variance. If $q > 0$, an innovation to x_t is anticipated q periods in advance. If $q = 0$, we have an unanticipated shock to x_t. Y_t is a $n \times 1$ vector of endogenous variables, E_t is the expectation operator conditional on information up to date t, and c is a $n \times 1$ vector of constants. To obtain a unique and stable solution, we assume that the n eigenvalues of the $n \times n$ system matrix, A, lie inside the unit circle. The following extension of FMS is straightforward:

Result 1. *In any purely forward-looking model, the variance of all endogenous variables is a strictly increasing function of q.*

An implication of this result is that in the baseline New Keynesian model, anticipated shocks lead to higher volatility than unanticipated shocks of equal magnitude. Since in the New Keynesian literature welfare is often measured in terms of a weighted average of the variance of inflation and the output gap, it is worthwhile to mention that our finding implies that agents are better off when they are faced with unanticipated rather than anticipated shocks.

Next, consider the hybrid model economy, also discussed in FMS

$$y_t = \frac{b}{1+ab} y_{t-1} + \frac{a}{1+ab}\,\mathrm{E}_t\,y_{t+1} + \frac{1}{1+ab}\varepsilon_{t-q}\,, \tag{3}$$

where y_t is the only endogenous variable and it is assumed that $|a| < 1$, $|b| < 1$. It can be shown that the variance of y_t is given by

$$\mathrm{Var}_q\, y_t = \frac{1}{1-b^2}\left(\frac{1-(ab)^{q+1}}{1-ab}\right)^2 + \sum_{n=0}^{q-1} a^{2(q-n)}\left(\frac{1-(ab)^{n+1}}{1-ab}\right)^2 . \tag{4}$$

Result 2. *In a hybrid (one-dimensional) model, the variance of y_t is an increasing function of q if $\mathrm{sgn}(a) = \mathrm{sgn}(b)$. For $\mathrm{sgn}(a) \neq \mathrm{sgn}(b)$, the correlation between the variance of y_t and q is ambiguous.*

To demonstrate that $\mathrm{Var}_q\, y_t$ may not be a strictly increasing function of q if $\mathrm{sgn}(a) \neq \mathrm{sgn}(b)$, it suffices to compare the variance of an unanticipated shock, i.e. $q = 0$, to the variance of a one-period anticipated innovation, i.e. $q = 1$. Then, $\mathrm{Var}_{q=1}\, y_t > \mathrm{Var}_{q=0}\, y_t$, if and only if $a^2 + 2ab > 0$. This inequality is violated if, for example, $a = -b$. Thus, in a hybrid model, the volatility effect of anticipations crucially depends on the parametrization of the model. This result carries over when we consider a multidimensional hybrid model such as the SW model analyzed in the next section.

3 Volatility and news in the Smets-Wouters model for the Euro area

As pointed out by Woodford (2009), a dynamic stochastic general equilibrium model with a number of real and nominal frictions such as the SW model reflects the current state of the art in studying business cycle fluctuations. However, the role of anticipated shocks as a driving force in explaining business cycles is neglected. This paper seeks to close this gap by assuming that the exogenous disturbances are not solely driven by unanticipated stochastic innovations but also by q-period anticipated changes in the exogenous processes. We restrict attention to exogenous shocks to total factor productivity (TFP), government spending, the monetary policy rule, the inflation objective, as well as to price and wage markups. We then explore the change in the volatility of the endogenous variables caused by these shocks when changing q.

Technically, we proceed as follows. We calibrate the SW model using the estimated posterior modes of the parameters including the variances of the shocks and the autoregressive parameters of the exogenous disturbances. We reproduce the results of SW by simulating the model for the above mentioned set of unanticipated shocks. We then analyze the same shocks (identical with respect to variance and autocorrelation) but assume that agents learn about the exogenous disturbances 1, 2, 3, 4, or 8 quarters in advance. Finally, we normalize the variances of each endogenous variable in the case of a q-period anticipated shock by the variance in the case of an unanticipated shock.

Table 1 displays these ratios, denoted as relative variances, for output, $\hat{Y}$, consumption, $\hat{C}$, investment, $\hat{I}$, hours worked, $\hat{L}$, inflation, $\hat{\pi}$, the nominal interest rate, $\hat{R}$, the real price of installed capital, $\hat{Q}$, the rental rate on capital, $\hat{r}^k$, and the real wage, $\hat{w}$.[1] As usual, the potential (or natural) level of a variable, denoted by superscript p, is defined as its equilibrium level without nominal rigidities and constant price and wage markups. The deviation of the actual level of output from its potential level is denoted as output gap. Table 1 also displays the relative variance of $\hat{Y}^p$, $\hat{C}^p$, $\hat{I}^p$, $\hat{L}^p$, and $\hat{Y} - \hat{Y}^p$.

A value of the relative variance larger than one means that anticipation has a destabilizing effect on the particular variable. A value smaller than one indicates that the opposite holds.

– Table 1 about here –

Table 1 shows that we obtain unambiguous results for price and wage markup shocks. The anticipation of these typical cost-push shocks greatly amplifies the volatility of all variables in question. Moreover, our numerical results indicate that, in these cases, the variance of all key macroeconomic variables is a strictly increasing function of q.

For all other shocks under consideration, the results are ambiguous. In the case of a shock to TFP, the volatility of output, consumption, investment, the real wage, and the rental rate on capital increases when $q > 0$, whereas the opposite is true for hours worked, the nominal interest rate, and the output gap. Notice that the variances are mostly not strictly increasing (or decreasing) functions in q. For inflation and the real price of

[1] The notation follows that of SW. A hat above a variable denotes the log deviation from its steady state.

capital, a destabilizing effect of anticipation only exists for small (empirically relevant) q. The destabilizing anticipation effect vanishes at long horizons.

Turning to policy shocks, it is worth emphasizing that an announced change in government spending dampens the volatility of a number of key macroeconomic variables. Exceptions can be found for consumption, investment, and the rental rate on capital. A similar finding is true when we consider an inflation objective shock. Except for inflation and the nominal interest rate, the announcement of a (temporary) change in the central bank's inflation objective has a stabilizing effect. A totally different picture emerges when we explore the effects of a different type of monetary policy shock, namely an interest rate shock. Except for the real price of capital, all variables under consideration are much more volatile when the change in the nominal interest rate is anticipated in advance. However, the relative variances of output, consumption, investment, and hours worked behave in a hump-shaped manner with increasing q.

It is worth mentioning that anticipation can also amplify the volatility of key macroeconomic variables, if we consider a version of the model without nominal rigidities. An anticipated TFP shock increases the volatility of output and investment when compared to an unanticipated innovation in TFP, whereas an announced government spending shock increases the variance of investment.

Finally, since macroeconomic volatility plays a major role in the measurement of overall welfare, it should be pointed out that agents in the estimated model of the Euro area are potentially better off when they are faced with unanticipated rather than anticipated shocks.[2]

4 Conclusion

To conclude, we relate our work to the recent empirical literature that emphasizes the role of anticipated shocks as the most important source of macroeconomic fluctuations (e.g., Beaudry and Portier, 2006, Schmitt-Grohé and Uribe, 2008, Beaudry and Lucke, 2009).

[2] An analysis of the welfare effects of news shocks within models such as the SW model, in which a microfounded welfare measure is not a simple weighted average of the variances of some macroeconomic variables, would be a fruitful area for future research.

Our exploration of news shocks within an estimated model of the Euro area offers a novel insight into these findings by demonstrating that news shocks by itself may amplify the volatility of key macroeconomic variables.

In this paper, our objective was not to put forth any explanation, but merely to demonstrate the potentially destabilizing effects of news shocks. To achieve a deeper economic understanding, we leave for future research.

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Table 1: Relative variances in the Smets-Wouters Euro area model for different q-period ahead anticipated shocks

q	$\hat{Y}$	$\hat{C}$	$\hat{I}$	$\hat{L}$	$\hat{\pi}$	$\hat{R}$	$\hat{Q}$	$\hat{r}^k$	$\hat{w}$	$\hat{Y}-\hat{Y}^p$	$\hat{Y}^p$	$\hat{C}^p$	$\hat{I}^p$	$\hat{L}^p$
Productivity Shock														
1 quarter	1.4227	1.3157	1.4632	0.7860	1.1818	0.9267	1.1813	1.2188	1.6134	0.8593	1.1156	0.8444	1.3610	0.8475
2 quarters	1.8623	1.5682	1.9789	0.6792	1.2955	0.8425	1.2542	1.5289	2.3881	0.7382	1.1970	0.7499	1.6616	0.7895
3 quarters	2.2919	1.7491	2.5174	0.6394	1.3182	0.7692	1.2483	1.8967	3.3105	0.6505	1.2540	0.6960	1.8946	0.7720
1 year	2.6901	1.8659	3.0483	0.6385	1.2727	0.7143	1.1941	2.3009	4.3455	0.5974	1.2933	0.6667	2.0656	0.7713
2 years	3.7539	1.9529	4.6555	0.7350	0.9091	0.6447	0.9384	3.7538	8.6210	0.6090	1.3543	0.6411	2.3417	0.7885
Government Spending Shock														
1 quarter	0.8429	1.0938	1.1142	0.8494	0.9655	0.8766	0.9867	1.0759	0.9735	0.7933	0.8860	0.9197	1.0908	0.9120
2 quarters	0.7468	1.1683	1.2199	0.7677	0.8966	0.7857	0.9097	1.1521	0.8959	0.6655	0.8264	0.8767	1.1538	0.8689
3 quarters	0.6904	1.2245	1.3134	0.7271	0.7931	0.7338	0.8098	1.2252	0.8079	0.6083	0.7955	0.8558	1.1934	0.8484
1 year	0.6598	1.2652	1.3920	0.7106	0.7241	0.7143	0.7172	1.2919	0.7398	0.6071	0.7803	0.8471	1.2150	0.8395
2 years	0.6465	1.3320	1.5456	0.7226	0.4483	0.8182	0.6943	1.4571	0.8231	0.8399	0.7804	0.8448	1.2170	0.8383
Interest Rate Shock														
1 quarter	1.0690	1.0433	1.0764	1.0642	1.0793	0.9910	0.9977	1.0735	1.0762	1.0690	–	–	–	–
2 quarters	1.1254	1.0521	1.1475	1.1109	1.1585	1.2703	0.9444	1.1403	1.1484	1.1254	–	–	–	–
3 quarters	1.1663	1.0316	1.2090	1.1376	1.2378	1.7117	0.8612	1.1957	1.2135	1.1663	–	–	–	–
1 year	1.1905	0.9897	1.2572	1.1443	1.3170	2.2252	0.7639	1.2387	1.2688	1.1905	–	–	–	–
2 years	1.1348	0.7403	1.2895	1.0130	1.5851	4.2432	0.4053	1.2590	1.3646	1.1348	–	–	–	–
Inflation Objective Shock														
1 quarter	0.9791	0.9562	0.9856	0.9659	1.0283	1.0956	0.8952	0.9870	0.9987	0.9791	–	–	–	–
2 quarters	0.9514	0.9064	0.9644	0.9244	1.0543	1.1932	0.7887	0.9675	0.9917	0.9514	–	–	–	–
3 quarters	0.9178	0.8536	0.9366	0.8771	1.0777	1.2872	0.6874	0.9419	0.9792	0.9178	–	–	–	–
1 year	0.8794	0.8004	0.9031	0.8257	1.0986	1.3745	0.5956	0.9109	0.9615	0.8794	–	–	–	–
2 years	0.7031	0.6139	0.7323	0.6107	1.1566	1.6369	0.3480	0.7536	0.8516	0.7031	–	–	–	–
Wage Markup Shock														
1 quarter	3.9260	3.9626	3.9197	3.3853	3.8873	3.9574	4.1001	3.2112	3.1220	3.9260	–	–	–	–
2 quarters	8.6200	8.8089	8.5861	6.6228	8.3699	8.8723	9.4069	5.9217	5.6095	8.6200	–	–	–	–
3 quarters	14.8714	15.4008	14.7715	10.3786	14.0694	15.6809	16.8690	8.7127	8.0409	14.8714	–	–	–	–
1 year	22.4365	23.5244	22.2174	14.4269	20.5780	24.3404	26.2539	11.3541	10.2015	22.4365	–	–	–	–
2 years	60.7923	65.1859	59.5807	30.9596	48.3006	76.1489	73.8727	19.0154	15.2695	60.7923	–	–	–	–
Price Markup Shock														
1 quarter	3.6929	3.3257	3.8280	3.6455	2.6108	3.4444	4.0020	3.6574	3.5167	3.6929	–	–	–	–
2 quarters	7.5952	6.4627	8.0930	7.4471	4.2200	6.8333	8.9432	7.5278	7.0671	7.5952	–	–	–	–
3 quarters	12.2580	10.2116	13.3198	11.9788	5.6210	10.9444	15.5479	12.1389	11.2435	12.2580	–	–	–	–
1 year	17.3060	14.4544	19.0465	16.9180	6.7733	15.5000	23.4266	17.1111	15.7114	17.3060	–	–	–	–
2 years	37.1295	33.5871	40.9631	37.5291	9.5008	38.2222	58.3542	36.0463	32.3171	37.1295	–	–	–	–

Note: The relative variance is defined as the ratio of the variance of a variable x in the case of a $q-$ period anticipated shock to the variance of x in the case of an unanticipated shock of equal magnitude.