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On the permanent effect of an aggregate demand shock: Evidence from the G-7 countries

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ABSTRACT

This paper extends the work of Cover, Enders and Hueng (2006) to examine the idea that an aggregate demand shock may have permanent effect on the output level by indirectly shifting the aggregate supply curve. We utilize the bivariate SVAR modeling and adopt an identification scheme, which allows for the possibility that a shift in the aggregate demand curve may induce the long-run aggregate supply curve to shift. We have shown that aggregate supply shocks are positively affected by the demand shocks in each of the G-7 countries. It is found that a one-time positive aggregate demand shock increases the output level permanently in these industrialized economies. We have also shown that our decomposition strategy can help resolve anomalies in the responses of inflation to a positive aggregate supply shock observed in a simple Blanchard–Quah decomposition.

1. Introduction

Do aggregate demand shocks affect the output level permanently? Conventional macroeconomic analysis suggests ‘No’, and as a matter of fact, many previous prominent empirical studies were based on the assumption that an aggregate demand shock has only a temporary effect on the aggregate output level. The classic paper by Blanchard and Quah (1989) first applied this assumption within the SVAR framework in order to isolate the demand shocks from supply shocks. To date we can find a huge amount of literature that applied the Blanchard–Quah (BQ, henceforth) approach in identifying macroeconomic shocks. The main assumption in this approach is that the long run aggregate supply curve is vertical, and a shift in the aggregate demand curve will increase the inflation (or the price level) proportionately, but will not alter the output level.

The BQ technique further assumes that the shocks are uncorrelated. Recently Cover et al. (2006) questioned this assumption. Using the US data, they showed that this assumption leads to a complete isolation in the dynamics of inflation and output. With demand and supply shocks being uncorrelated, changes in output were found to be driven mainly by the supply shocks and inflation by the demand shocks. Cover et al. (2006) showed that this finding can be reversed if we allow the supply shock to be affected by the demand shock. In the current paper, we move forward a step further and basically address the question: can a demand shock affect the supply shock, which in turn, may cause a permanent effect on the output level?

There indeed exist a few significant literatures that draw attention to the role of demand in affecting innovation in technology in the production process and point to the fact that changes in demand that raise the level of output in the short-run can, through a number of channels, exert a permanent influence on the supply side. For example, Stadler (1990) states that “*….changes in the utilization of factor inputs when demand changes can result in reorganization and the acquisition of new skills; or a higher level of output may make innovation more profitable and result in the allocation of more resources to R&D*”. With the use of theoretical models with endogenous technology, this study essentially shows that “*Changes in the supply side of the economy are not independent of changes on the demand side*”. The empirical work of Utterback (1974) also points to the same idea, which shows that majority of the innovations in industry takes place in response to market demand conditions.

Lucas (1972, 1973) shows how an unanticipated change in money (an aggregate demand shock) could affect output. This effect occurs because firms misperceive the aggregate demand shock for the relative demand shock. However, this effect should not be persistent, as firms would have perfect information about the demand shock over time. Blanchard (1987) surveyed the literature on the effects of money on output and observed that if the initial misperception about the shock led firms or workers to change a state variable, which affect their decision in subsequent periods, then the initial changes in money or demand would have persistent effect. For instance, if the initial misperception leads the firms to invest in productivity enhancing technology, then we may expect a shift in the long run aggregate supply curve, which in turn will change the output level permanently.

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The induced shift in the long run aggregate supply curve can also be explained by the concept of 'hysteresis in unemployment'.[1] The main idea is that the cyclical movement in unemployment rate, which is mainly caused by demand shocks, may in fact cause the natural rate of unemployment to change. As the natural level of unemployment rate is related to an economy's long run employment, this in turn will shift the long run aggregate supply curve. Ball (1999), using the data from OECD countries shows that monetary policy and other determinants of aggregate demand have long run effects on unemployment.

Building on the work of Cover et al. (2006), the current paper utilizes the bivariate SVAR modeling and adopts an identification scheme, which allow for the possibility that a shift in the aggregate demand curve may induce the long-run aggregate supply curve to shift. Essentially, we have used a bivariate SVAR model with long run restriction. However, unlike BQ strategy, we assume that aggregate demand shock does not have any long run effect on output as long as the shifting of aggregate demand curve does not induce the long run aggregate supply curve to shift. In other words, following Cover et al. (2006), we have allowed the causality running from demand to supply shocks while imposing the long run neutrality restriction.

This paper has three major contributions over Cover et al. (2006). First, this paper explicitly shows the long-run effects of an aggregate demand shock on the aggregate output level, which was not addressed by Cover et al. (2006).[2] Second, this paper shows that the identification scheme that allows the correlation running from demand to supply shocks may help resolve the anomalies in the responses of inflation to a positive aggregate supply shock observed in a simple Blanchard–Quah decomposition. Third, this study applied the model of Cover et al. (2006) using G-7 country data. Looking beyond the US data to several other industrialized economies will provide us clear conclusions regarding the dynamics and interrelation of the aggregate demand and supply shocks.

Rest of this paper is organized as follows. In Section 2, for the purpose of comparison, we report basic results using the Blanchard–Quah model. The data description and a few econometric issues involving VAR analysis are also explained in this section. Section 3, using the AD–AS model introduced in Cover et al. (2006), explains how this model can be converted to a bivariate SVAR model where the demand and supply shocks are allowed to be correlated. Then the results of this modified model are discussed. Section 4 concludes the paper.

2. Output and inflation dynamics in the BQ model

2.1. The BQ decomposition

Consider the following bivariate Structural VAR Model:

$$\mathbf{A}_0\mathbf{X_t} = \mathbf{A}_1(\mathbf{L})\mathbf{X_t} + \mathbf{B}\boldsymbol{\varepsilon}_\mathbf{t} \tag{1}$$

where $\mathbf{X_t} = (\Delta y_t, \Delta\pi_t)$, and y and π are measures of real output and inflation, respectively.[3] Here $\boldsymbol{\varepsilon}_\mathbf{t} = (\varepsilon^s_t, \varepsilon^d_t)$, with ε^s_t and ε^d_t being one standard deviation supply and demand shocks, respectively. A_0 is a 2×2 matrix, $\mathbf{A}_1(\mathbf{L}) = \sum_{i=1}^{q} \mathbf{A}_{1i}\mathbf{L}^i$ shows matrices of lag coefficients of the SVAR system. The BQ approach assumes that two shocks are not correlated, and hence, B is a diagonal matrix. Let us denote the diagonal elements in B by b_{11} and b_{22}, which essentially are the standard deviations of the two shocks.

The structural shocks in Eq. (1) are not directly observable. It is the usual practice to estimate the reduced form VAR and use the estimated parameters and residuals in the reduced form VAR to retrieve the structural shocks. The reduced form VAR has the following form

$$\mathbf{X_t} = \mathbf{C}(\mathbf{L})\mathbf{X_t} + \mathbf{e_t} \tag{2}$$

with $\mathbf{C}(\mathbf{L}) = \sum_{i=1}^{q} \mathbf{C}_i\mathbf{L}^i$ being the matrices of estimated lag coefficients and $\mathbf{e_t}$ being the vector of two residual series. Equivalently, this reduced form VAR can be expressed in more simple way as

$$\begin{aligned} \Delta y_t &= \sum_{i=1}^{q} c^i_{11}\Delta y_{t-i} + \sum_{i=1}^{q} c^i_{12}\Delta\pi_{t-i} + e^y_t \\ \Delta\pi_t &= \sum_{i=1}^{q} c^i_{21}\Delta y_{t-i} + \sum_{i=1}^{q} c^i_{22}\Delta\pi_{t-i} + e^\pi_t \end{aligned} \tag{3}$$

The relation between the structural shocks and the reduced form VAR-residuals is crucial in identifying the structural shocks. This relation can be expressed as

$$\mathbf{e_t} = \mathbf{G}_0\boldsymbol{\varepsilon}_\mathbf{t} \tag{4}$$

where $\mathbf{G}_0 = \mathbf{A}_0^{-1}\mathbf{B}$ is a 2×2 matrix representing the contemporaneous effects of the one standard deviation shocks on the two variables.

It is straightforward to see that for above specifications, one cannot make a distinction between the supply and demand equations, and hence the two shocks, unless we impose some qualification(s) for defining the shocks. In order to separate out the demand shocks from the supply shocks, the BQ method defines a demand shock as the one that does not have any long run effect on the output level. If we denote G_0 as

$$\mathbf{G}_0 = \begin{bmatrix} g^0_{11} & g^0_{12} \\ g^0_{21} & g^0_{22} \end{bmatrix}$$

then the long run restriction essentially implies that

$$g^0_{12} = -\frac{\sum_i c^i_{12}}{1 - \sum_i c^i_{22}} g^0_{22}. \tag{5}$$

Imposition of this restriction makes the structural VAR system exactly identified, and one will now be able to identify the structural shocks, ε^s and ε^d, by using the information from the estimated reduced form VAR.

2.2. VAR specification and data description

Bivariate SVAR models have been estimated separately for each of the G-7 countries. The variables included in the VAR models are:

dly	Growth rate of real GDP. This variable is defined as $dly = 100[log(y_t) - log(y_{t-1})]$, where y denotes real GDP volume (2000 = 100).
dinfl	First difference of the inflation rate. The inflation rate is defined as $infl = 100[log(P_t) - log(P_{t-1})]$, where P denotes the Consumer Price Index (2000 = 100) except for Germany. For Germany we use GDP Deflator instead of the CPI as unified CPI data are not available for the periods prior to 1991. The variable $dinfl$ is defined as $dinfl = infl_t - infl_{t-1}$.

International Financial Statistics online database was the main source of data. Where it was possible, seasonally adjusted data for y and P have been collected from the source. However, for some countries seasonally adjusted data is not available, and we applied Census X12 method on y and P for these countries. We applied a number of unit root tests including ADF, DF-GLS and Ng-Perron tests

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[1] This term was first used formally by Blanchard and Summers (1987)

[2] Cover et al. (2006) shows dynamic responses of the changes in output rather than the levels of output to the demand (and supply) shocks in the US economy, which are not much useful in analyzing the issue of long-run neutrality of an aggregate demand shock.

[3] Here y and π are assumed to be I(1) and hence the VAR model uses first differences of the respective variables.