

Predicting Recoveries

and the Importance of Using Enough Information

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Abstract

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Popular univariate time series models for GDP are being used to forecast the long-term impact of the current crisis. These models tend to predict that the current crisis will have long lasting negative effects on economic growth. We document that these models are unnecessarily pessimistic, because their specification is too restrictive. Using richer models, we obtain a much less negative long-term outlook.

Key Words: unit root, great recession

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1 Introduction

The sharp economic downturn has spurred discussions on what the long-term consequences of the current crisis will be. Medium and long-term forecasts of the effects of the current financial crisis differ widely. According to Figure 12 in CBO (2009), the U.S. economy would be back to its pre-crisis trend around 2015. Chapter 4 in IMF (2009) points out that countries have experienced widely different growth patterns after financial crises, ranging from medium-term declines in GDP of 26% to *increases* of +6%. On his blog,¹ Greg Mankiw questioned positive forecasts by the Council of Economic Advisors (CEA) by reminding the reader of the analysis in Campbell and Mankiw (1987) that reaches the following conclusion:

The data suggest that an unexpected change in real GNP of 1 percent should change one's forecast by over 1 percent over a long horizon.

This claim is based on the following law of motion for (the logarithm) of output:

$$y_t = a_0 + y_{t-1} + e_t, \tag{1}$$

where e_t is an unexpected shock. We want to point out that the statement of Greg Mankiw could but does *not* necessarily follow from this law of motion. That is, one can write down time series models for y_t for which for which the specification in Equation (1) is correct even though some shocks have purely transitory effects. The problem with specifications like the one in Equation (1) is that they are not rich enough to distinguish between shocks with transitory and permanent effects if both happen to be present.

To determine whether an unexpected change in GDP will have transitory or permanent effects (or both), one needs more informative models and in this paper we enrich the analysis by using a multi- instead of a univariate model.

The importance of the richer structure is documented by evaluating the long-term forecasts made with the multi- and the univariate model at the troughs of NBER recessions. We find that during past economic downturns the univariate specification was in general

¹See <http://gregmankiw.blogspot.com/2009/03/team-obama-on-unit-root-hypothesis.html>.

far too pessimistic, that is, it underestimated the ability of the economy to bounce back. The multivariate model, which allows for shocks to have both transitory and permanent effects, predicted that a substantial part of the reduction in GDP would be quite quickly regained, which is the typical observed recovery pattern.

We use the two models to make forecasts with the currently available information. Predictions made in the middle of 2009, when U.S. GDP had reached its trough, display a pattern similar to those of most other recessions. That is, the long-term predictions made by the univariate model are substantially below those made by the multivariate model. At the end of 2009, after two quarters of economic growth, the long-term predictions of the two models have become closer to each other but there is still a gap; the univariate model predicts that GDP will be in 2020 8% below its trend value, whereas the multivariate model predicts only a 3.5% gap.

Expectations are likely to be important for future economic growth and it is, therefore, important that economists are not unnecessarily pessimistic. We show in this paper that the views expressed in the literature based on the univariate specification is unnecessarily pessimistic about the long-term outlook.

2 Random walks and shocks with transitory level effects

Univariate time series models are too restrictive to detect whether a shock will have a transitory, a permanent effect, or both. To see why consider the following data generating process (*dgp*) for y_t :

$$y_{t+1} = y_t + e_{t+1}, \quad \mathbb{E}[e_{t+1}] = 0, \quad \mathbb{E}[e_{t+1}, e_{t-j}] = 0 \text{ for } j \geq 0. \quad (2)$$

Our point applies to other linear univariate laws of motion as well, but is possibly most surprising for this special case. That is, one would think that the specification in Equation (2) implies that—as argued by Greg Mankiw—an unexpected 1 percent reduction in y_t should lead to a 1% reduction in the long-run forecast, but we will argue that there still can be unexpected shocks for which this is *not* true.

Consider the following *dgp* for y_t :²

$$\begin{aligned} y_t &\equiv x_t + z_t \\ x_t &= \rho_x x_{t-1} + \sigma_{e,x} e_{x,t} \\ \Delta z_t &= \rho_z \Delta z_{t-1} + \sigma_{e,z} e_{z,t} \end{aligned} \tag{3}$$

$$\mathbf{E}_t [e_{x,t}] = \mathbf{E}_t [e_{z,t}] = \mathbf{E}_t [e_{x,t} e_{z,t}] = 0, \mathbf{E}_t [e_{x,t}^2] = 1 = \mathbf{E}_t [e_{z,t}^2]$$

If

$$\rho_x = \rho_z = \rho, \sigma_{e,x}^2 = \rho \sigma_e^2, \sigma_{e,z}^2 = (1 - \rho)^2 \sigma_e^2, \text{ and } \rho \in [0, 1] \tag{4}$$

then

$$\text{COV} [\Delta y_t \Delta y_{t-j}] = 0 \text{ for } j \geq 1, \tag{5}$$

that is, Δy_t is white noise.³

If $\Delta y_t < 0$ because $e_{x,t} < 0$, then there is a *predictable* growth in y_t . If $\Delta y_t < 0$ because $e_{z,t} < 0$, then there is a *predictable* further deterioration. If one only observes that $\Delta y_t < 0$, then one has to weigh the two possible cases and in this example the two opposing effects exactly offset each other, leading the forecaster to predict that the drop in output is permanent.

Suppose one would observe one other variable affected by x_t and z_t , i.e., $\tilde{y}_t = \alpha_x x_t + \alpha_z z_t$. Then $e_{x,t}$ and $e_{z,t}$ can be solved from

$$\begin{bmatrix} e_{x,t} \\ e_{z,t} \end{bmatrix} = \begin{bmatrix} 1 & 1 \\ \alpha_x & \alpha_z \end{bmatrix}^{-1} \begin{bmatrix} y_t \\ \tilde{y}_t \end{bmatrix}, \tag{6}$$

and one could correctly identify the transitory and the permanent component.

3 Past U.S. recessions and forecasting recoveries

The purpose of this section is *not* to construct the best possible forecasting model, but to document (i) that linear univariate time series models have been completely inadequate

²This time series specification is from Blanchard, L'Huillier, and Lorenzoni (2009).

³

$$\text{VAR}(\Delta y_t) = \frac{2\sigma_{e,x}^2}{1+\rho} + \frac{\sigma_{e,z}^2}{1-\rho^2} = \sigma_e^2, \text{COV}(\Delta y_t, \Delta y_{t-j}) = -\frac{\rho^{j-1}(1-\rho)\sigma_{e,x}^2}{1+\rho} + \frac{\rho^j \sigma_{e,z}^2}{1-\rho^2} = 0 \text{ for } j \geq 1.$$

If all autocovariances are zero, then the spectrum is flat and Δy_t is white noise.

in predicting the observed recoveries, because they tend to predict that shocks have permanent effects even when the impact of the shock is short lived and (ii) that multivariate models typically do much better.

Data set. Our sample runs from 1947Q1 to 2009Q4. The forecasts made in each recession are based on models estimated using only the observations up to the forecasting point. To ensure that a somewhat reasonable number of observation is used to construct the forecast, we start with the 1973-75 recession. We focus on five past recessions and the current recession.

Estimation. The univariate model is given by

$$\ln(y_t) = a_0 + \sum_{j=1}^4 a_j \ln(y_{t-j}) + e_t. \quad (7)$$

and the multivariate by the following VAR:

$$\begin{aligned} \ln(s_t) &= b_0 + \sum_{j=1}^4 B_j \ln(s_{t-j}) + e_{s,t}, \\ s_t &= [c_t, i_t, g_t, e_t, m_t]' \text{ and } y_t = c_t + i_t + g_t + e_t + m_t \end{aligned} \quad (8)$$

where c_t , i_t , g_t , e_t , and m_t stand for consumption, investment, government expenditures, exports, and imports, respectively. The advantage of the multivariate specification is that it allows for both transitory and permanent shocks.^{4,5}

Graphical presentation of forecasts. Figures 1, 2, and 3 plot for the six recessions considered the actual time path of GDP, the deterministic trend, and the forecasts made by the two models at the trough of the recession (indicated by the vertical line).

⁴Cai and Den Haan (2009) contains a more detailed discussion on this, gives details on the data sources, and the estimation procedure.

⁵Another advantage is that (7) is more likely to be misspecified. Granger and Morris (1976) and Granger (1980) point out that the sum of ARMA processes typically has a complex dynamic structure, which may be difficult to capture with a low-order ARMA process.

Past recessions and predicted recoveries. The 1973-75, the 1980, the 1981-82, and the 1990-91 are "typical" in that GDP drops substantially below its deterministic trend during the recession and it reverts towards the deterministic trend fairly quickly when the recession has ended. In contrast, the level of GDP moves towards the deterministic trend *from above* during the 2001 recession and it closely follows the deterministic trend in the post-recession period.

During the four typical recessions, the univariate model is too pessimistic about the long-term outlook, systematically underestimating future levels of GDP with more than 10%. The forecasts made by the multivariate model are much more optimistic, although except for the forecasts made during the 1973-75 still not optimistic enough. It is remarkable that the multivariate model is capable of predicting a substantial movement towards the deterministic trend even though there is no deterministic trend in the VAR.

The 2001 recession is the only recession when the forecasts made by the univariate model turned out to be better than those made by the multivariate model. The univariate model predicts—as it always does—that output will not recoup some of the losses, which turns out to be correct in this case and is likely to be related to the fact that during this recession the economy always remained *above* the deterministic trend.

Current recession and predicted recovery. The bottom panel of Figure 3 plots the results for the current recession. The bold lines indicate the forecasts made at 2009Q4, the most recent observation, and the thin lines indicate the forecasts made using data up to 2009Q2, which at this point seems to be the trough of the downturn.

The disparity between the 2009Q2 forecasts exactly mimics the forecasts made in past recessions. The univariate model predicted no recouping of the losses, a prediction proven incorrect by the faster than average growth in the second half of 2009. The multivariate model predicted only a small long-term loss. In particular, the 2009Q2 forecast for 2020 is 1.4% (11.0%) below the deterministic trend according to the multivariate (univariate) model.

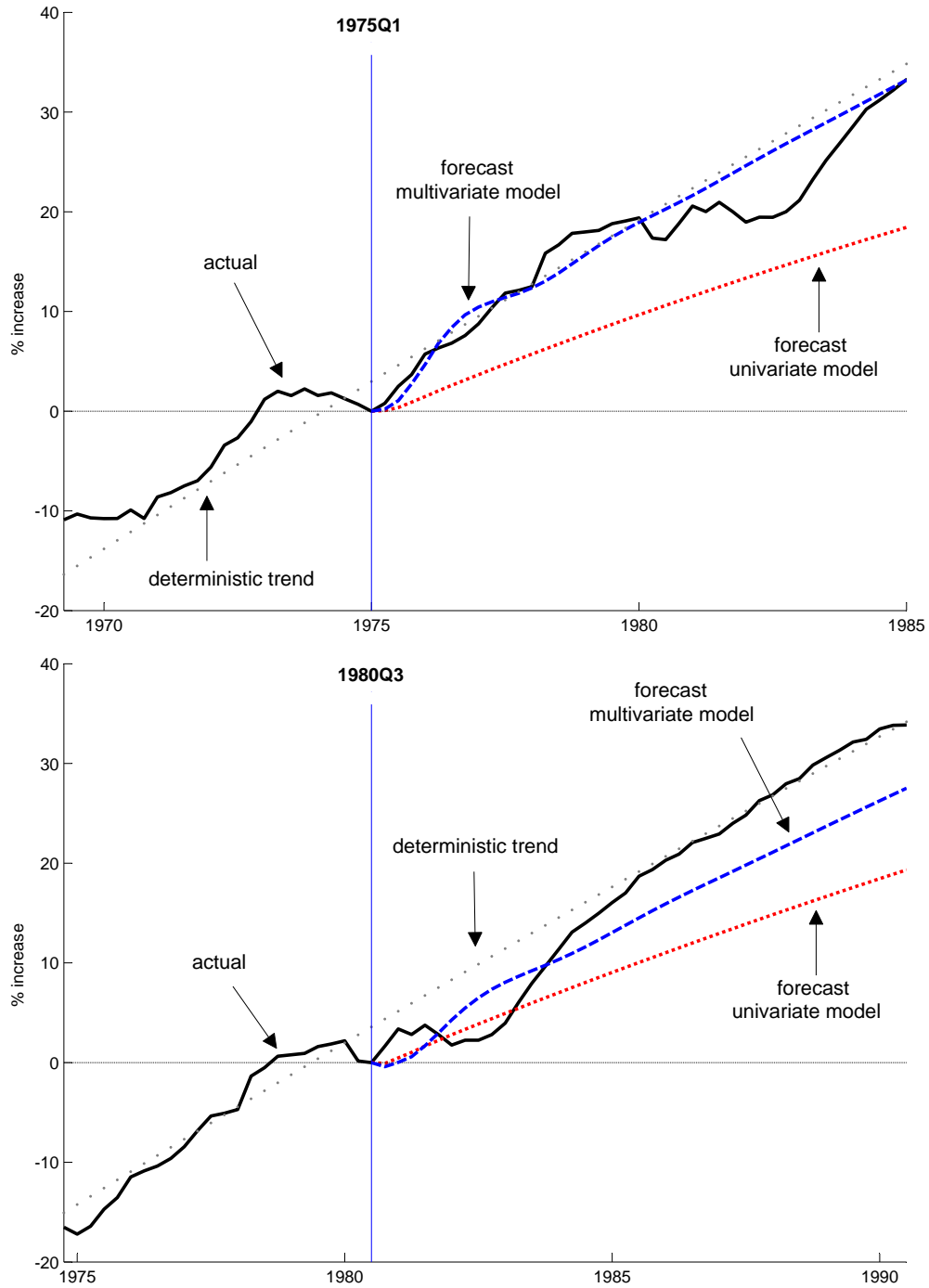
The two quarters of positive growth have narrowed the gap between the two forecasts. The good news is that the long-term forecasts according to the univariate model has

increased and the forecast for 2020 is now "only" 8% below the deterministic trend. The bad news is that the corresponding forecasts of the multivariate model has dropped and is now 3.5% below the deterministic trend, which is still substantially more optimistic than the forecast of the univariate model.

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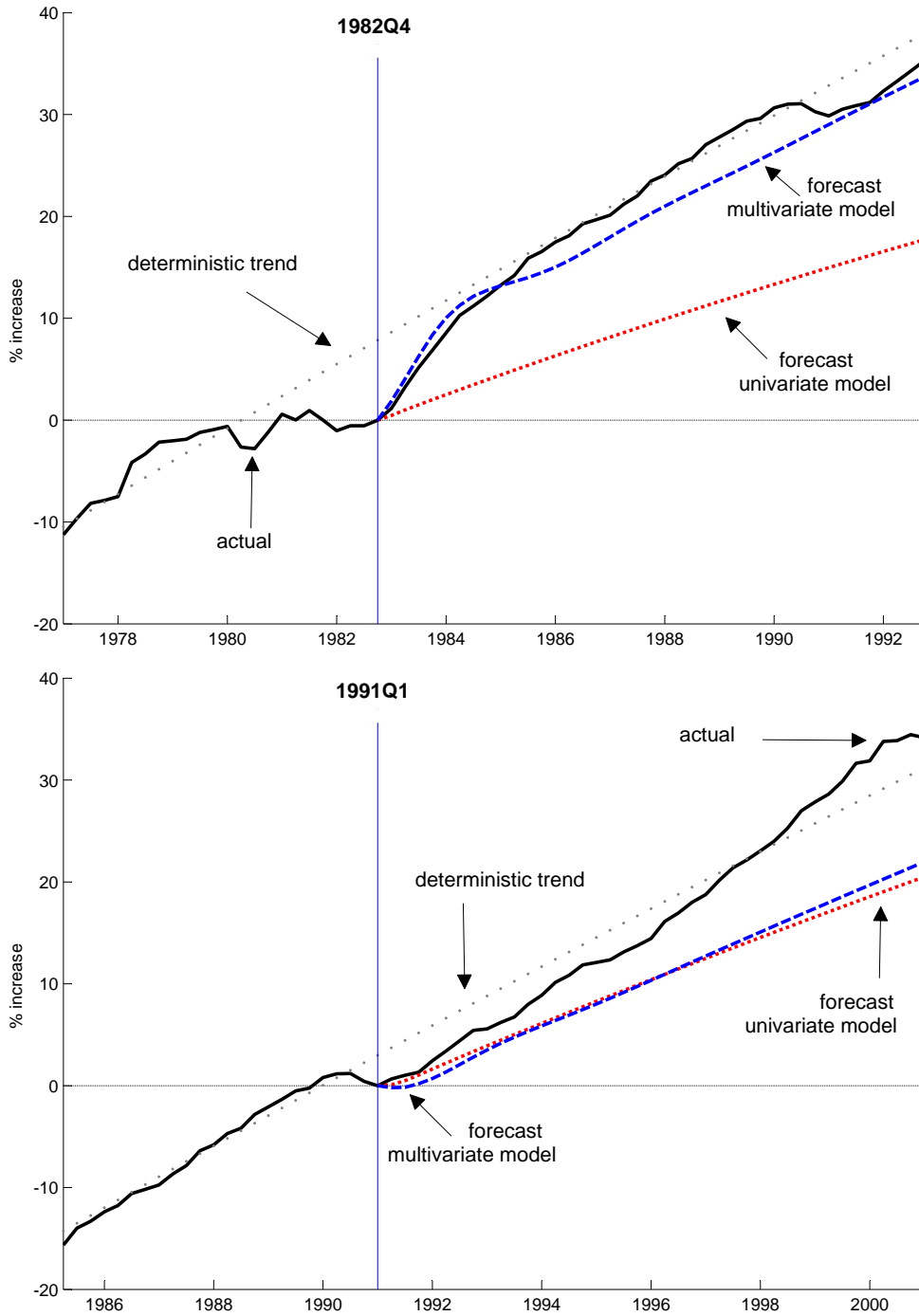
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Figure 1: The 1973-75 and the 1980 recession



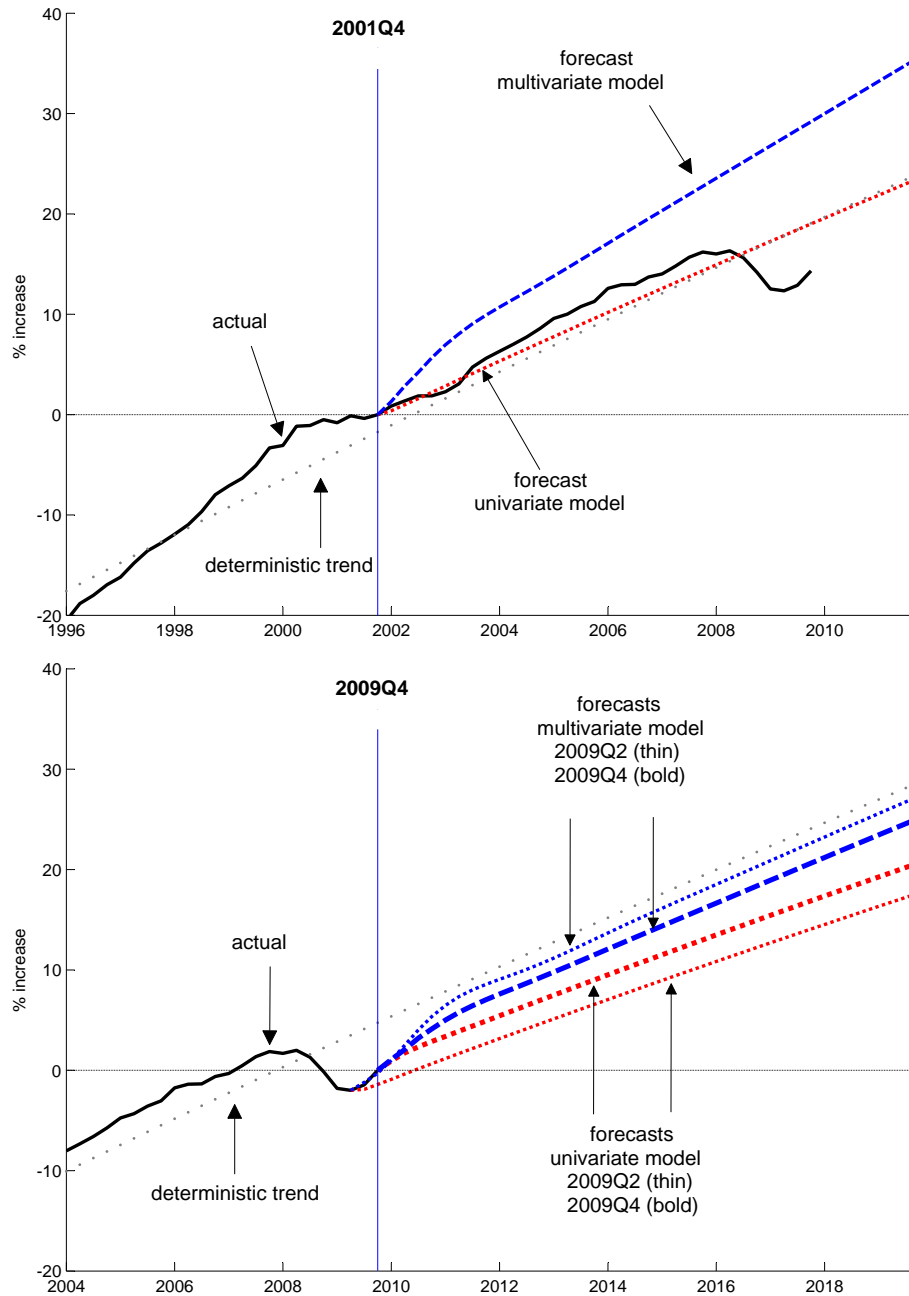
Notes: This figure plots the actual time path of GDP relative to the forecasting point, the deterministic trend, and the forecasts.

Figure 2: The 1981-82 and the 1990-91 recession



Notes: This figure plots the actual time path of GDP relative to the forecasting point, the deterministic trend, and the forecasts.

Figure 3: The 2001 and the current recession



Notes: This figure plots the actual time path of GDP relative to the forecasting point, the deterministic trend, and the forecasts.