Note on Beaudry-Willems, "On the macroeconomic consequences of over-optimism"

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Paul Beaudry and Tim Willems (BW, 2021) examine how forecasting errors affect macroeconomic performance. They argue that over-optimism about growth prospects on the part of government or private sector agents may result in excessive expenditure or over-investment with the adverse consequences for debt levels. The result may then be that short term stimulus is offset by negative longer term consequences. This note argues that these claims are not supported by the authors' econometric analysis.

The IMF forecasts GDP growth rates over a 1-4 year horizon for 189 member countries. These are published in the annual *World Economic Outlook* (WEO) review. Write the WEO j-period ahead forecast for country c in year t as $g^f_{c,t+j|t}$ and the realized growth rate in year as $t+j$ is $g_{c,t+j}$. BW average these forecast errors over h periods to get an average year error for forecasts made in year t for country c of

$$F_{cht} = \frac{1}{h}\sum_{j=1}^{h}\left(g^f_{c,t+j|t} - g_{c,t+j}\right) \tag{1}$$

This is equation (1) in BW (2021). The variable F is defined as "forecast minus actual". It is based on the h year t forecasts and so is a measure of the *ex post* over-optimism of those forecasts. It is used to calculate the country manager fixed effects.

The variable used in the BW dataset is backward looking and is defined on an "actual minus forecast" basis. It measures the average accuracy of the h previous WEO forecasts of year t growth.

$$E_{cht} = \frac{1}{h}\sum_{j=1}^{h}\left(g_{c,t-j+1} - g^f_{c,t-j+1|t-h}\right) = \bar{g}_{cht} - \bar{g}^f_{c,t-h} = \frac{1}{h}\sum_{j=1}^{h} e_{c,t-j+1|t-h} \tag{2}$$

is the average country c growth rate over the previous h years; $\bar{g}^f_{c,t-h}$ is the average of the 1 to h year growth forecasts for country c made in year t-h.[2]

The dataset made available in connection with BW gives the over the horizon WEO forecast errors $e_{c,t|t-1}$ and the three year averages E_{cht} but does not provide the separate components of E_{cht}: $e_{c,t|t-3}$, $e_{c,t-1|t-3}$ and $e_{c,t-2|t-3}$. I have reproduced the BW average forecast

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[2] The average WEO 3 year forecast errors E_{c3t} are given by the variable `yr3_fe` in the BW dataset, the "over the horizon" one year errors E_{c1t} are given by the variable `yr1_fe`.

errors from the WEO historical database[3] and also computed the missing one, two and three year forecast errors. In so doing, I have also updated the growth rates so as to be compatible with the revised forecast errors. Exhibit 1 reports the correlations between the BW and revised growth rates (0.835), one year (0.936) and three year forecast errors (0.952).

BW report a large number of estimates which include different controls to ensure robustness. In what follows, I look at their two most simple specifications, those in Table 3 and Appendix C of their paper. I focus first on the estimates reported in column 1 of Table 3B of BW (2021) which relate growth to the average forecast error made three years previously. The generic version of the estimating equation is

$$g_{ct} = \beta E_{cht} + \mu_c + \eta_t + \varepsilon_{cht} \tag{3}$$

E_{cht} is as defined in equation (2), μ_c is a country fixed effect and η_t is a time dummy. Estimation is by the Fixed Effects (FE) panel estimator. BW (2021) report Instrumental Variables (IV) estimates for h = 3 converting back to a "forecast minus actual" basis. This result is reproduced in column 1 of Exhibit 2. I report all results on the more standard "actual minus forecast" basis. My results, which use the same instrument set, therefore reproduce the BW results but with the sign reversed. Column 2 of Exhibit 2 reports the same equation on the revised data where the changes are minor.

The startling feature of the estimates reported in columns 1 and 2 of Exhibit 2 is the near unit coefficient on the forecast error: a 1% (average) negative forecast error results in a 1% reduction in growth. It is difficult to believe an impact of this order ("sizable" according to BW, page 50). This suggests that there may be an error either in the BW estimates on their interpretation. In what follows, I argue that the latter is the case. To see this clearly, it is useful to simplify equation (3). Column 3 of Exhibit 2, reports an equation in which E_{c3t} is disaggregated as

$$E_{c3t} == \tfrac{1}{3}\left[e_{c,t-2|t-3} + e_{c,t-1|t-3} + e_{c,t|t-3} \right] \tag{4}$$

See equation (2) . Only the variable $e_{t|t\text{-}3}$ requires instrumentation. Fit, as measured by both the AIC, is inferior to that in the column 2 estimates but these show that the explanation is entirely due to the three year ahead forecast error $e_{t|t\text{-}3}$. Accordingly, equation (3) is reformulated as

$$g_{ct} = \beta e_{c,t|t-3} + \mu_c + \eta_t + \varepsilon_{c3t} \tag{5}$$

This gives an improved fit which is also superior to that in the column 5 equation that substitutes $e_{t\text{-}1|t\text{-}3}$ for $e_{t|t\text{-}3}$. Note that the estimate of β does not differ significantly from unity in any of the estimated equations.

[3] https://www.imf.org/external/pubs/weo/data (accessed 1/5/2022).

I turn now to the causal implications of the estimates focusing on column 4 of Exhibit 2. BW (page 53) assert "a causal link from overly optimistic growth forecasts to future growth slowdowns and recessions". Looking specifically at the Exhibit 2, column 4, estimates, the thought experiment that authors are asking us to carry out is that of reducing the three year ahead forecast $f_{t|t\text{-}3}$ for a country in which $f_{t|t\text{-}3} > g_t$, i.e. in which $e_{t|t\text{-}3} > 0$. Consider a unit reduction in $f_{t|t\text{-}3}$. Taking $\beta = 1$, in line with the regression results, this will result in a unit reduction in the growth rate g_t and hence also in $e_{t|t\text{-}3}$. The intervention will therefore have zero impact on the over-optimism of the forecasts. The problem arises because setting $\beta = 1$ allows equation (5) to be simplified to

$$f_{c,t|t-3} = \mu_c + \eta_t + \varepsilon_{c3t} \tag{6}$$

Equation (6) has no causal content. I conclude that the BW estimates have absolutely no implications for growth.

In Appendix C of their paper, BW offer an alternative set of estimates in which growth is affected by lagged forecasting errors. The equation is

$$g_{ct} = \beta E_{c3,t-k} + \mu_c + \eta_t + \varepsilon_{cht} \tag{7}$$

Equation (7) is estimable by OLS. Appendix Table C2 in BW reports estimates for k =1, 2 and 3. Their results are reproduces in the odd-numbered columns of Exhibit 3. (My results differ very slightly from the BW results due to small differences in the number of observations included in the regressions). Their estimates appear to show a statistically and quantitively significant impact from over-optimistic WEO forecasts for one and two year lags (k = 1 and 2).[4]

Equation (2) shows that the average forecast errors can be split into two components – the k period average growth rate, $\overline{g}_{c3,t-1}$, and the average of the three growth forecasts made in the years prior to this, $\overline{g}^{f}_{c3,t-3-k}$. We can separate the impacts of these two components by expanding the regression (7) to include $\overline{g}_{c3,t-1}$:

$$g_{ct} = \beta E_{c3,t-k} + \gamma \overline{g}_{c3,t-1} + \mu_c + \eta_t + \varepsilon_{cht} \tag{8}$$

Estimation results, reported in the even-numbered columns of Exhibit 3, show that in the coefficient β of the forecast errors is no longer statistically significant in the presence of the lagged growth variable.

[4] The Exhibit 3 regressions are estimated using the original BW data.

There are perhaps other ways in that the BW conclusions may be supported. One possibility is through Granger (non-)causality analysis. I perform Granger-causality tests for each of the one, two and three year ahead forecast residuals. The test equation is

$$g_{ct} = \kappa + \sum_{j=1}^{p} \alpha_j g_{c,t-j} + \sum_{j=1}^{p} \gamma_j e_{c,t-j|t-j-q} + \mu_c + \eta_t + \varepsilon_{c3t} \quad (q = 1,2,3) \tag{9}$$

Test results are reported in Exhibit 4. In all six cases, the test fails to reject non-causality – lagged forecast errors have no predictive power for growth rates. Note that equation (9) may be rewritten as

$$g_{ct} = \kappa + \sum_{j=1}^{p} \left(\alpha_j + \gamma_j\right) g_{c,t-j} - \sum_{j=1}^{p} \gamma_j f_{c,t-j|t-j-q} + \mu_c + \eta_t + \varepsilon_{c3t} \quad (q = 1,2,3) \tag{10}$$

It follows that lagged forecasts have no predictive power for growth rates.

An alternative thought experiment would be to look at the variance of the WEO forecasts across countries. The BW argument suggests that increased accuracy of WEO forecasts should raise growth rates. Exhibit 5 graphs the cross-sectional growth and forecast error standard deviations from 1994 – 2016. There is a high correlation between the growth dispersion in any year and the dispersion of the forecasts for that year's growth. I again look at Granger (non-)causality and ask whether the dispersion of lagged forecast accuracy predicts growth dispersion. A single lag is sufficient so the test equation is

$$gsd_t = \kappa + \alpha gsd_{t-1} + \beta esd_{t-1}^{q} + \varepsilon_t \tag{11}$$

where *gsd* is the cross-sectional standard deviation of growth rates and esd^q is the cross-sectional standard deviation of the *q* period ahead forecast errors $e_{c,t-1|t-q-1}$. The test statistics reported in Exhibit 6 fail to reject non-causality.[5]

I conclude that there is no evidential basis for the claim in BW (2021) that GDP growth is affected by the accuracy of the IMF's WEO forecasts.

Reference

Beaudry, P., and R. Willems (2021). "On the macroeconomic consequences of over-optimism". *American Economic Journal: Macroeconomics*, 14, 38-59.

[5] The same conclusion results if equation (9) is expressed in differences. However, differencing is not required since the standard deviations all appear stationary. ADF(1) statistics are -3.46 for *gsd*, -4.75 for esd^1, -3.77 for esd^2 and 3.126 for esd^3 against a 5% critical value of -3.02).

Exhibit 1 (Correlations)

```
. correl rgdp_gr rgdp_gr_rv yr1_fe yr1_fe_rv yr3_fe yr3_fe_rv
(obs=3,714)
             |  rgdp_gr rgdp_g~v   yr1_fe yr1_fe~v   yr3_fe yr3_fe~v
-------------+------------------------------------------------------
     rgdp_gr |   1.0000
  rgdp_gr_rv |   0.8354   1.0000
      yr1_fe |   0.5589   0.7007   1.0000
   yr1_fe_rv |   0.6188   0.7650   0.9358   1.0000
      yr3_fe |   0.4454   0.5271   0.4442   0.4308   1.0000
   yr3_fe_rv |   0.4796   0.5597   0.4015   0.4498   0.9518   1.0000
```

Variable names are as in BW; `_rv` indicates the revised values.

Exhibit 2
BW Table 3 regression results

	BW data	Revised data		
Forecast error (*h*=3) E_{c3t}	1.008 (4.23)	0.965 (4.18)	-	-
Forecast error (*h*=1) $e_{t-2\|t-3}$	-	-	0.022 (0.62)	-
Forecast error (*h*=2) $e_{t-1\|t-3}$	-	-	-0.298 (0.84)	-
Forecast error (*h*=3) $e_{t\|t-3}$	-	-	1.705 (1.61)	1.313 (3.23)
Hansen *J* test χ^2_1 [p-value]	0.043 [0.8362]	0.862 [0.3533]	0.001 [0.9691]	0.001 [0.9821]
AIC	9,319	8,567	9,336	8,030

1,947 observations over 127 countries
Estimation by IV-FE. Heteroscedasticity-robust t statistics in (.) parentheses.
Equations include year dummies.

Exhibit 3 **BW Table C2 regression results**						
k	Column 1 3		Column 2 2		Column 3 1	
Forecast error $E_{c3,t-k}$	0.142 (1.79)	0.041 (0.71)	0.193 (2.45)	0.071 (1.35)	0.286 (4.94)	0.066 (1.26)
Average lagged growth rate $\bar{g}_{ck,t-1}$	-	0.267 (1.97)	-	0.251 (1.55)	-	0.302 (9.10)
Observations	3,525		3,707		3,887	
AIC	21,095	21,013	22,173	22,082	21,932	21,671
Equations estimated by OLS-FE using the original BW dataset. Heteroscedasticity-robust t statistics in (.) parentheses. Equations include year dummies.						

Exhibit 4 **Granger causality tests**			
	$q = 1$	$q = 2$	$q = 3$
$p = 1$	$t_{188} = -1.60$ [0.1106]	$t_{185} = -0.19$ [0.3051]	$t_{185} = -0.94$ [0.3475]
$p = 2$	$F_{2,185} = 1.10$ [0.3358]	$F_{2,185} = 0.62$ [0.5416]	$F_{2,185} = 1.27$ [0.2830]
F and t statistics calculated on the basis of heteroskedasticity-robust standard errors. Tail probabilities in [.] parentheses. Estimation by OLS-FE without year dummies.			

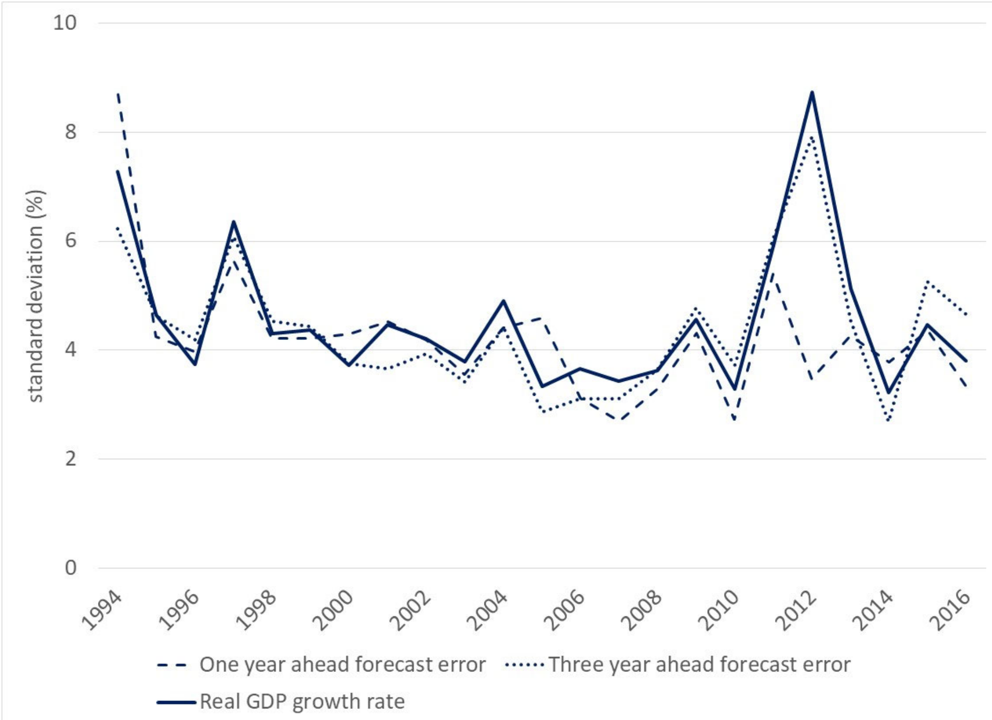

Exhibit 5: Growth and forecast error standard deviations across countries

Exhibit 6 **Granger causality tests – cross-sectional standard deviations**		
$q = 1$	$q = 2$	$q = 3$
$t_{21} = 0.63$ [0.5324]	$t_{20} = -0.53$ [0.6006]	$t_{19} = 0.23$ [0.8230]
t statistics calculated on the basis of heteroskedasticity-robust standard errors. Tail probabilities in [.] parentheses.		