APPENDIX

Figure 1. Nominal GDP and Adjusted Gross Income are highly correlated

<table>
<thead>
<tr>
<th>Correlation</th>
<th>GDP</th>
<th>AGI</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP</td>
<td>1</td>
<td>0.97</td>
</tr>
<tr>
<td>AGI</td>
<td>0.97</td>
<td>1</td>
</tr>
</tbody>
</table>

Source: BEA and IRS

For all the Illinois data used in this report, the sample period is 1976 to 2017. Data on nominal GDP were collected from the Bureau of Economic Analysis. Data for inflation were taken from the Bureau of Labor Statistics regional consumer price index. Data for unemployment rates were also collected from the BLS.

The yearly change in GDP in state $s$ has been measured by:

$$\Delta GDP = \frac{GDP_t^s}{GDP_{t-1}^s} - 1$$

Where $\Delta GDP$ is the change in GDP between time $t$ and $t - 1$.

Several authors (Robertson and Tallman, 1999) have suggested that a vector autoregression (VAR) model is the most accurate for forecasting GDP growth.

Forecasts are made one-step-ahead (horizon $t + 1$) and iterates forward. The first forecast for $t + 1$ is based on the primary estimated parameters and the information available at time $t$. Then the updated estimated parameters are used to make one-step-ahead forecasts for the desired number of periods, until $t + h$. A one-step horizon ($t + 1$) show that the forecast is made for one year ahead. Forecasts are performed for horizons up to $t + 4$, which is 4 years ahead. Forecasts start in 2017 and end in 2020. The performance of the forecast has been evaluated by a comparison of real observed GDP and forecasted values between 2016 and 2017.

Similar to Marcellino, Stock and Watson (2003) a three variable VAR model is used. This model also uses GDP, unemployment and inflation. Adding more variables does not necessarily give better results since simple models are frequently only marginally less precise than forecasts made by complex models.

We use a reduced form of VAR to forecast future values of GDP. A reduced VAR model express each variable used for the forecast as a linear function of its own historical values. This way all previous data for all the variables are taken into account and the error term is said to include all omitted variables that affect a change in GDP. The error term is said to explain shocks and other unexpected
movements in the variables that occur when previous values are taken in to account (Stock & Watson, 2001).

\[
\text{GDP}_{1t} = \alpha + \beta_1 \text{GDP}_{t-1} + \beta_2 \text{GDP}_{t-2} + \beta_j \text{GDP}_{t-j} + \gamma_1 \text{P}_{t-1} + \gamma_2 \text{P}_{t-2} + \gamma_j \text{P}_{t-j} + \delta_1 \text{UN}_{t-1} + \delta_2 \text{UN}_{t-2} + \delta_j \text{UN}_{t-j} + \mu_t
\]

Which implies:

\[
\text{GDP}_{1t} = \alpha + \sum_{j=1}^{k} \beta_j \text{GDP}_{t-j} + \sum_{j=1}^{k} \gamma_j \text{P}_{t-j} + \sum_{j=1}^{k} \delta_j \text{UN}_{t-j} + \mu_t
\]

Where \( \beta, \gamma, \delta \) are coefficients that represent the contributions of each variable to \( \text{GDP} \). Two other similar equations, which set \( \text{P} \) and \( \text{UN} \) as dependent variables complete the model setup. We choose four lags after the Akaike and Schwarz criterions (Gujarati, 2004).

Figure 2. VAR model accurately predicts past GDP growth

*Actual and forecasted GDP, 2011-2020 (dollars in millions)*