

Determinants of Economic Growth in Illinois: An Empirical Analysis

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Abstract

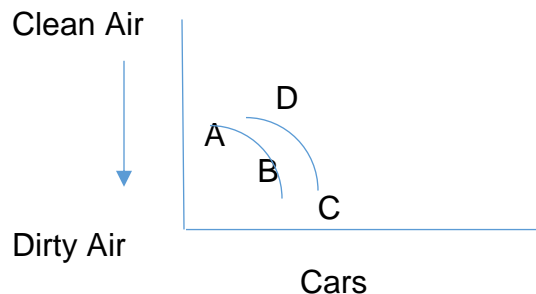
This paper presents growth-accounting results for Illinois. It is shown that growth in GDP is mainly driven by labor and capital. The role of technology in GDP growth is minimal or none.

Keywords: Growth accounting, GDP, Illinois, Production function

Introduction

Assume that an economy produces two goods, clean air and cars; with technology constant, manufacturing more cars will make the air dirtier (points A to B in Figure 1).

Figure 1: Air Quality and Cars, Production Possibility Frontier (PPF)



As technology improves the production possibility frontier shifts outward (Blanchard and Johnson, 2012). This gives a choice for the region: manufacture more cars and make the air much dirtier (B to C), or make a smaller increase in number of cars manufactured and keep the air cleaner (B to D). The conclusion of this argument: environmental problem is not caused by economic laws, it is the choices that people make that cause ecological problems.

With this in mind, let's focus on the "facts" of economic growth for the state of IL. Table 1 shows Illinois' real GDP growth for the period 1977 to 2017. The strongest growth was in the 1980s and the 1990s, 3.3%. The growth was negative during the great

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recession, the 2007 to 2010 period, and in recent years the growth rate has become positive, 0.56% during 2013 to 2017.

If we zoom-out of the “trees” of economic fluctuations in Table 1 and focus on the overall economic health of Illinois, we notice that economic growth surpass economic fluctuations, from 1997 to 2017 the economy grew at a rate of 1.7%. To gain insights into the sources of this growth² we make use of an aggregate production function of the Cobb-Douglas form (Berck and Sydsaeter, 1993):

$$Y_t = A_t K_t^\alpha L_t^\beta, \tag{1}$$

where Y_t is output, K_t is physical capital, L_t is labor, and A_t is technological progress. Increases in A_t result in increases to the productiveness of other inputs so it is called Total Factor Productivity (TFP).

Table 1: The Stability of Illinois Growth

| Time Period | Annual Compound Growth Rate (%) | Time Period | Annual Compound Growth Rate (%) |
|-------------|---------------------------------|-------------|---------------------------------|
| 1979 - 1984 | 0.38 | 2001 – 2007 | 1.4 |
| 1985 - 1990 | 2.3 | 2007 – 2009 | -1.4 |
| 1981 - 1997 | 3.3 | 2010 – 2012 | 1.2 |
| | | 2013 – 2017 | 0.56 |
| | | 2001 - 2017 | 0.86 |

Source: BEA, Table SAGDP9N; growth rates are author’s computations.

Our interest is in the determination of per worker output in the region so we divide both sides of Eq. 1 by L_t (Eq. 2):

$$\frac{Y_t}{L_t} = A_t K_t^\alpha L_t^{\beta-1} \tag{2}$$

This can be rewritten as:

$$\frac{Y_t}{L_t} = A_t \left(\frac{K_t}{L_t}\right)^\alpha L_t^{\alpha+\beta-1} \tag{3}$$

² This is the natural level of real output.

Eq. 3 suggests that productivity growth can be attained by technological progress (A_t), increases in capital per worker (capital deepening), and/or increases in the number of workers.

The Determinants of Growth

Most growth theories assume constant returns to scale. Hence changes in output in Eq. 1 with $\beta=1-\alpha$ can be modeled as:

$$\frac{dY_t}{dt} = K_t^\alpha L_t^{1-\alpha} \frac{dA_t}{dt} + \alpha A_t K_t^{\alpha-1} L_t^{1-\alpha} \frac{dK_t}{dt} + (1-\alpha) A_t K_t^\alpha L_t^{-\alpha} \frac{dL_t}{dt} \quad (4)$$

For Eq. 4, the growth rate of output is:

$$\frac{1}{Y_t} \frac{dY_t}{dt} = \frac{1}{A_t} \frac{dA_t}{dt} + \alpha \frac{1}{K_t} \frac{dK_t}{dt} + (1-\alpha) \frac{1}{L_t} \frac{dL_t}{dt} \quad (5)$$

Since our interest is on output per worker we make use of the identity in Eq. 6 to deduce how much GDP growth over a certain period comes from growth in number of workers, growth in the stock of capital, and from improvements in TFP.

$$\frac{1}{Y_t} \frac{dY_t}{dt} - \frac{1}{L_t} \frac{dL_t}{dt} = \frac{1}{A_t} \frac{dA_t}{dt} + \alpha \left(\frac{1}{K_t} \frac{dK_t}{dt} - \frac{1}{L_t} \frac{dL_t}{dt} \right) \quad (6)$$

Results and Discussion

Table 2 highlights the per worker output in the region caused by the infusion of capital, labor, and TFP. This cross-sectional analysis covers three points in time: 1997, the great recession of 2008, and 2016. Overtime, the contribution of labor on output remains steady, the impact of technology has diminished, and the role of capital on output has increased.

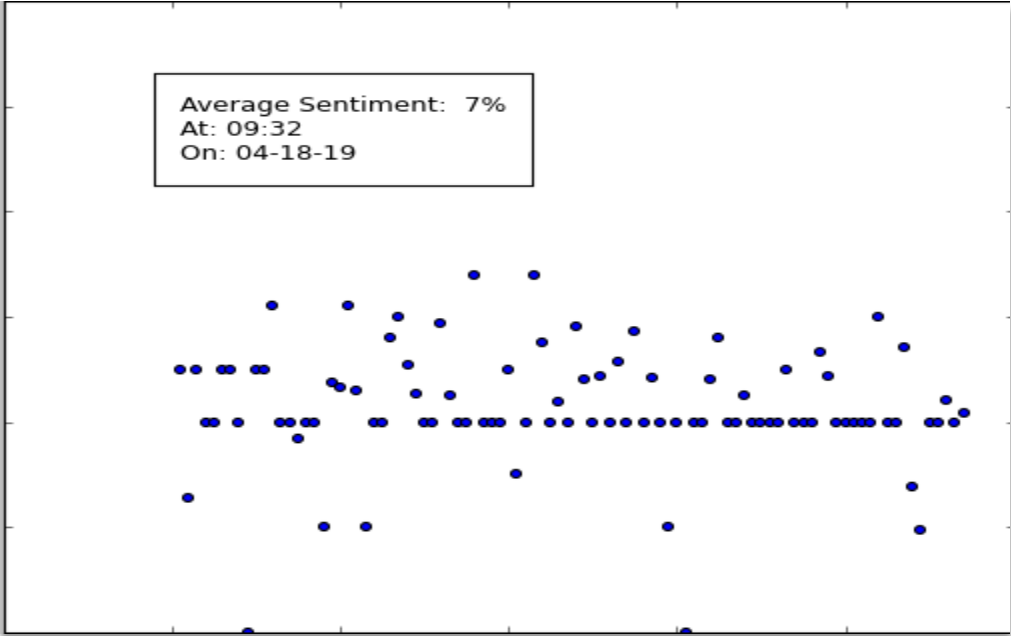
Table 2: Impacts of Capital, Labor, and TFP on Nominal GDP

| Time Period | Impacts on GDP | | | Output per Worker |
|-------------|----------------|-------|-----|-------------------|
| | Capital | Labor | TFP | |
| 1997 | 16% | 65% | 18% | \$1,756 |
| 2008 | 15 | 100 | -15 | \$1,722 |
| 2016 | 23 | 65 | 12 | \$1,833 |

Note that capital and technology are not enhancing labor productivity. This fact, coupled with the declining population in the state, have resulted in little or no optimism

about the state’s economy among social media users (Figure 2; also see Athiyaman, 2019).

Figure 2: Sentiment Analysis of Tweets about the Illinois Economy



Note: Tweepy Twitter API was used to retrieve Tweets posted during April 2019.

Table 3 shows that growth in output per hour is mostly driven by labor. Rise in educational attainment of the workforce, shift from manufacturing to services, and the increased labor force participation of women contribute on average 0.46% per year to growth.

Table 3: Growth Accounting for Illinois

| Period | Output per Worker | Capital | Labor | TFP |
|------------|-------------------|---------|-------|-------|
| 1997-2016 | 0.45 | 0.15 | 0.46 | -0.13 |
| 2001-2016 | 0.32 | 0.23 | 0.33 | -0.21 |
| -2007-2009 | -0.07 | -0.04 | 0.03 | -0.06 |
| 2010-2012 | 0.07 | 0.05 | 0.08 | -0.05 |
| 2013-2016 | 0.10 | 0.02 | 0.1 | -0.01 |

Note: Author’s calculations based on BLS Multifactor Productivity Measures.

Summary and Conclusion

Based on growth accounting computations we conclude that Illinois lacks technology to drive economic growth. In terms of the hypothetical production-possibility frontier discussed earlier, we believe that more output will come at the expense of air quality. Future research will explore growth accounting for different regions (county) and industry.

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