**ECON 303 MS Word Document**

**The Path of the U.S. Economy**

Figure 1 presents U.S. real gross domestic product (GDP) from 1948 to 2023. In 2023, the size of the U.S. economy, as measured in constant year 2017 dollars, was 22,376.9 billion dollars. The economy today is about twice the size it was in 1994 and more than nine times what it was in 1948.

To characterize the path followed by the economy, we fit a first order exponential model to the real GDP data shown in Figure 1. This is useful because this model captures the path of a variable that is growing at a constant rate. Letting denote the level of real GDP in period . Our variable starts at zero for the year 1948 and increments by one each year up to 75 for the year 2023. The first order exponential model we use is

1. ,

where is the value of real GDP for 1948, is the special exponential number 2.718…, and is the average growth rate of real GDP over the 1948-2023 time period.

Linear relationship

To linearize , take the natural log

We want to fit our data to this model:

Model:

To estimate this model, we regress on . Doing so, we obtain

|  |
| --- |
| 0.016789721 |
| 0.000386456 |

Estimated Model

Statistical Significance Criteria

 at least 99 percent confidence

 at least 95 percent confidence but not 99 percent

 at least 90 percent confidence but not 95 percent

 No \* less than 90 percent confidence

Second Order Exponential Model

Linearized Second Order Exponential Model

To estimate this model, we regress on and . Doing so, we obtain

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**U.S. Business Cycles**

**Forecasting Future U.S. Production Levels**

**Modeling and Forecasting the Growth Rates of U.S. Production, Employment, and Capital**

This implies

Log Difference

Second Order Exponential Model

Nth Order Polynomial Model

First Order Polynomial Model

We want to model the growth rate of , not the level. So, our first order polynomial model is

If , then . For us, for the year 1949. Consequently, is our model estimate for the 1948-49 growth rate.

To estimate this model, we regress on . Doing so, we obtain

,

Dummy Variable Model

To estimate this model, we regress on and . Doing so, we obtain

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**Explaining Economic Growth**

 is the level of technology.

 is the employment level

 is the capital level

 the effective labor level employed

When capital increases by 10%, U.S. output increases by 2.4%.

Converting the Cobb Douglas production function “in the levels” to a Cobb Douglas production function “in the growth rates.”

 *\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\**

The time derivative of a natural log is a growth rate.

Estimate this model by regressing on and . Doing so, we obtain

,

Growth Accounting

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Growth Accounting |  0.0305  | 0.0180 |  0.0062  |  0.0063  |
|  |  | 100% | 59% | 20% | 21% |

Elasticities

Elasticity of output with respect to capital input:

Set , then reduces to . Therefore, we find

Set , then reduces to . Therefore, we find

Model with Variable Technical Change

We want to replace in our equation , where we model the level of technology using the second order exponential model .

In a footnote

Therefore

Estimate this Cobb Douglas model with variable technical change by regressing on , , and .

Estimated model

This estimated model indicates the growth rate of U.S. technical change is given by[[1]](#footnote-1)

(Describe the new figure with technological improvement and note that the rate is decreasing.)

(Describe how you obtain your forecasts and discuss what you learn.)

**Using Economic Theory to Refine the Structural Model**

Profit function with production function implies

To maximize profit, employers optimally choose the labor level . If there is a maximum profit level, then the derivative .

Taking that derivative

 at the optimum

An exponent rule

Since we know

Therefore

Since we find

So our model becomes

We can rewrite this as

Estimate this model by regressing on and

1. Using $g\_{Y}=βg\_{A}+βg\_{L}+αg\_{K}$, we find $βg\_{A}=γ\_{0}+γ\_{1}t$, which implies $βg\_{A}=0.024 - 0.0002t$, which implies $g\_{A}=\frac{0.024}{β} - \frac{0.0002}{β}t$, which implies $g\_{A}=\frac{0.024}{.41} - \frac{0.0002}{.41}t.$

$$g\_{A}=\frac{0.024}{.41} - \frac{0.0002}{41}t$$

 [↑](#footnote-ref-1)