

When Should History Start?

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Why This Topic?

É It is E, and Ultimately, FE

- ó Almost all cases involve projecting future losses and discounting them to the present.
- ó Interest rates and expectations for inflation and real growth are linked.
 - É Fisher equation: $(1+i) = (1+r) \cdot (1+\pi^e)$
 - É Real interest rate is determined by the supply of capital (savings) and the demand for capital (investment). Because expected future economic growth is a determinant of both savings and investment, the real rate of interest and expected real growth rates are positively correlated.
- ó The expectations and the ultimate values are driven, to a large extent, by the macro economy.

É Of interest whether you rely on

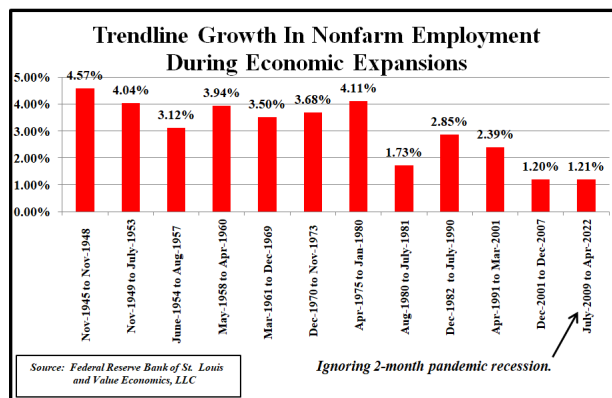
- ó A historical average for the growth forecast.
- ó An outside forecast of growth.
- ó A net discount rate.

Answer to “When Should History Start?”

No earlier than 2000

**Main Reason:
Starting in the late 1990’s, economic growth
slowed appreciably.**

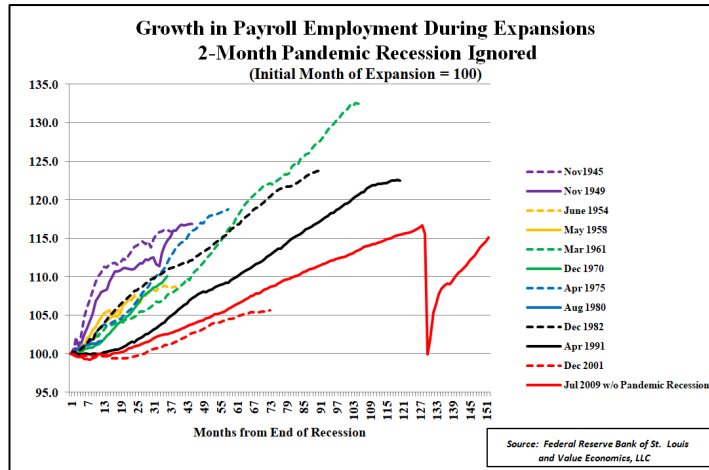
Trendline Employment Growth During Expansions



Last two
are below
the rest.

Growth from
July-2009 to
Feb-2020 is
1.67%

Growth Since End of 2-Month Pandemic Recession Distorted by Depth of Decline



Growth since end of 2-month pandemic recession due to the nature and depth of the decline.

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Long-Term Growth Depends on Increases in the Labor Force and in Productivity

É Labor force growth depends on

- ó LF Participation
- ó Population Growth

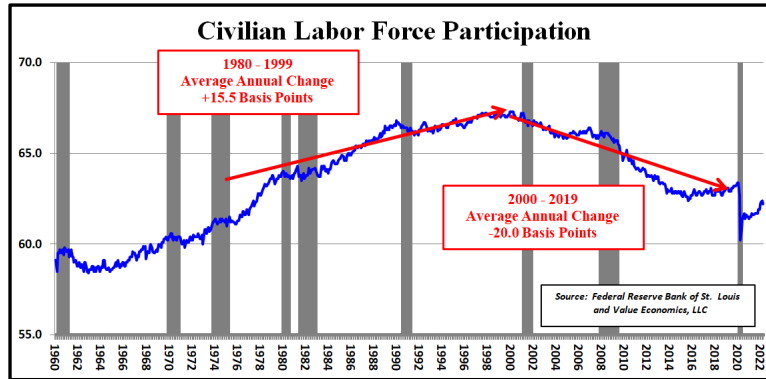
É Productivity is the wild card.

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One Reason for the Decline in Growth

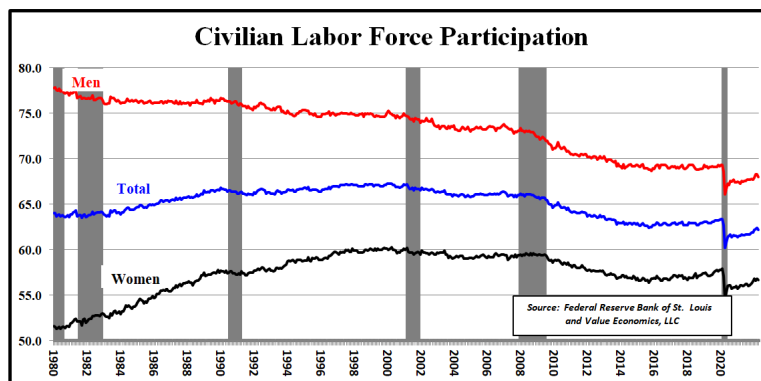


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One Reason for the Decline in Growth



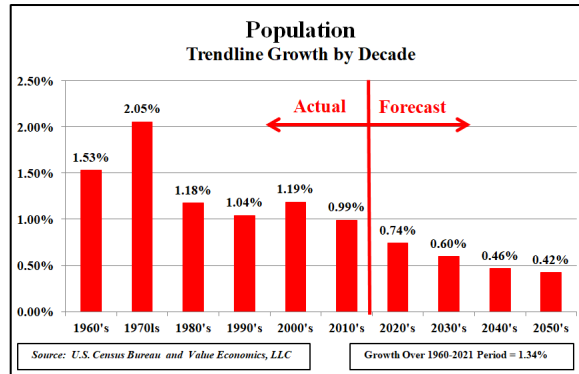
Until the late 1990's, the decline in participation by men was offset by the increase in participation by women, which has declined since then. The increase in the participation by women will likely not be repeated.

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Population Growth is Expected to Decline



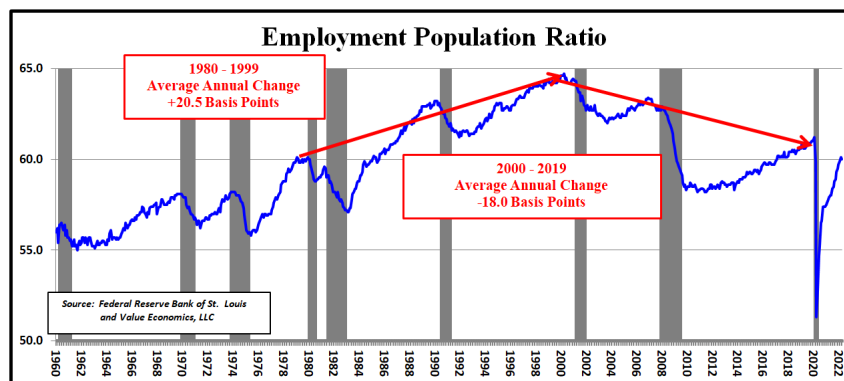
In terms of past experience, the growth rate shifted in the 1980's.

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Net Result of LF Participation and Population Growth

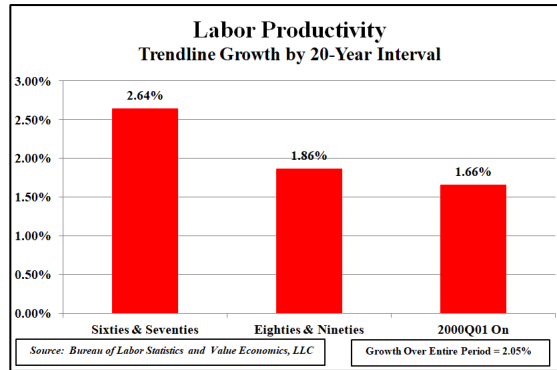


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Productivity Growth is the Wild Card



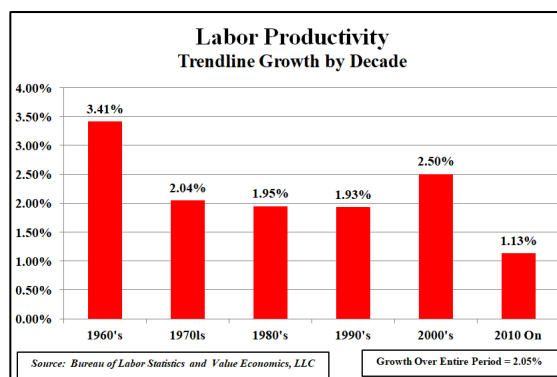
Over long periods, productivity growth has drifted downwards, but . . .

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Productivity Growth is the Wild Card



Over long periods, productivity growth has drifted downwards, but
the decline has not been steady.

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“No Earlier than 2000” Other Reasons

É Significant events

- ó China granted MFN status and enters WTO in Oct/Dec 2000.
- ó Amazon posted first profit in 2000 and survived the dot-com bust.

É In the late 1990’s, monetary policy shifted from a less interventionist, more predictable and systematic rules-based approach to a more interventionist, less predictable, discretionary approach with a short-term focus.*

*“The Cycle of Rules and Discretion in Economic Policy”, John B. Taylor, 2011, *National Affairs* (7), pp. 55-65.

*“Macroeconomic Lessons from the Great Deviation”, John B. Taylor, Remarks at the 25th NBER Macro Annual Meeting, May-2010.

What About the Future?

É LF participation not likely to increase and population growth is expected to decline, but productivity is the wild card.

É Current significant events

- ó Covid 19 pandemic
- ó War in Ukraine
- ó Inflation spike in the U.S. and elsewhere
- ó Possible long-term decoupling from China

É End of QE (aka QT) and a shift in monetary policy emphasis to inflation from employment. (**Recession?**)

What About the Future?

- É LF part growth card.
- É Current
 - ó Covid
 - ó War
 - ó Inflat
 - ó Possi
- É End of QE and a shift in monetary policy emphasis to inflation from employment. **(Recession?)**

It depends on how you deal with growth.

Historical Growth Rate

- É Not reasonable to assume growth will immediately revert to the mean if recent growth has been above or below trend.
- É How to forecast reversion to the mean is problematic.
 - ó If recent growth is below trend, subsequent growth must be above the trend growth rate for the series to revert to mean.
 - ó If recent growth is above trend, subsequent growth must be below the trend growth rate for the series to revert to mean.
 - ó What is the basis for determining how much above and below the trend is correct?
 - ó Has there been a structural change in the economy? **(No way to tell until time has passed.)**

Outside Forecast of Growth

- É If all you do is take the forecast as given, there is no problem.
- É If you are offering a professional opinion on the validity of the forecast, then there are questions to be answered.
 - ó Have the underlying model estimates been updated?
 - ó What assumptions have been made about
 - É Timing and effect of QT
 - É Persistence of inflation
 - É .War in Ukraine and accompanying supply disruptions
 - ó Are there significant alternative forecast scenarios?
 - ó Has there been a structural change in the economy? **(No way to tell until time has passed.)**

NDR Approach

- É Because any NDR you use is a forecast of the future, whether or not it is stationary is always an issue.
- É In the current environment this is problematic ó has there been a structural shift in the long-run NDR?
- É Impossible to tell until time passes. **(Nieswiadomy insight.)**
- É My solution:
 - ó Test for stationarity through Dec-2019 and through current month (March-2022).
 - ó If stationary, estimate an autoregressive model to determine long run NDR and the path to get there from current level.

Testing for Stationarity

É Testing for stationarity is not like testing to see if a coin is fair due to uncertainty about the underlying process.

É Can't just perform one test and accept or reject the null at some binding predetermined confidence level.

É My approach:

- ó Exam correlogram
- ó Run four tests for stationarity. (Augmented Dickey-Fuller, 2 Phillips-Perron tests, and Kwiatkowski-Phillips-Schmidt-Shin).
- ó Estimate $Y_t = \alpha + \rho Y_{t-1}$ and correct OLS estimate ρ for bias. (Corrected value should be less than 1). (First Order Autoregression: Inference, Estimation, and Prediction, Guy H. Orcutt and Herbert S. Winokur, Jr., Jan., 1969, *Econometrica*, Vol. 37(1), pp. 1-14.)

Testing for Stationarity

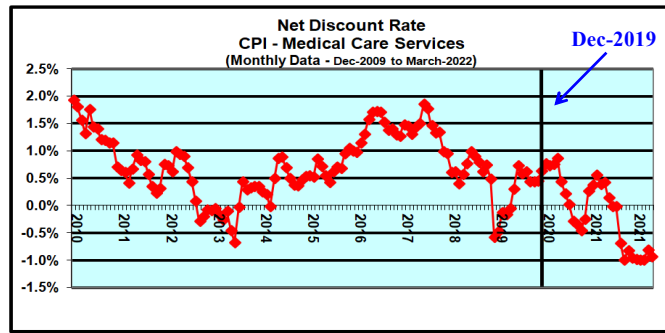
É Testing for stationarity is not like testing to see if a coin is fair due to uncertainty about the underlying process.

É Can't just perform one test and accept or reject the null at some binding predetermined confidence level.

É My approach:

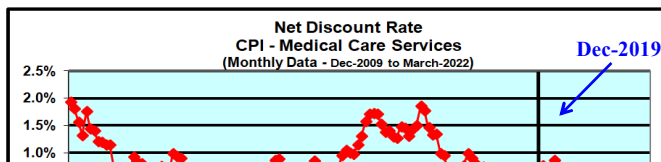
- ó **For Augmented Dickey-Fuller and Phillips-Perron tests,**
 H_0 : NDR has a unit root
 (How high is the confidence level at which the null is rejected?)
- ó **For KPSS test.**
 H_0 : NDR is stationary
 (How low must confidence level be in order to not reject the null?)

Testing for Stationarity - Example



(Medical Care Services CPI is too broad to use in an LCP)

Testing for Stationarity - Example



NDR based on 10-year growth rate in the CPI for Medical Care Services and the 10-year Treasury rate at the start of the period.

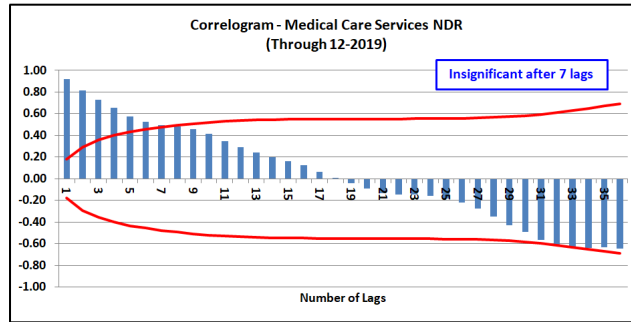
(NDR for Dec-2009 is based on the log-linear trendline growth from Jan-2000 through Dec-2009 and the Jan-2000 10-year Treasury rate.)

Growth rate period and interest rate term should match if possible.

(See "Net Interest Rates: History and Measurement", Edward Foster, *Journal of Forensic Economics* (2015) 26 (1): 99-114).

Growth rate should follow the point in time corresponding to the interest rate.
(Private communication with Ed Foster.)

Testing for Stationarity - Example

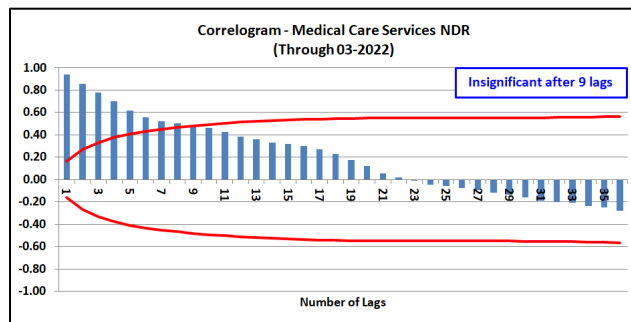


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Testing for Stationarity - Example



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Testing for Stationarity - Example

| | ADF p Value | PP #1 p Value | PP #2 p Value | KPSS LM-Stat. | |
|-----------------|---------------------------|--------------------------------|-------------------------------------------------------|----------------------------|--------------------------------------------------------|
| 2009M12 2019M12 | 0.0339 | 0.0687 | 0.0287 | 0.1430 | For KPSS test: Fail to reject null at $p > 0.10$ |
| 2009M12 2022M03 | 0.1399 | 0.2035 | 0.1128 | 0.3666 | |
| | Corrected $\hat{\rho}$ | Corrected $SE_{\hat{\rho}}$ | $(1 - \hat{\rho})$ divided by $SE_{\hat{\rho}}$ | OLS AR R-BAR Squared | |
| 2009M12 2019M12 | 0.9340 | 0.0429 | 1.5374 | 0.8442 | |
| 2009M12 2022M03 | 0.9697 | 0.0311 | 0.9747 | 0.8837 | |

| KPSS Asymptotic Critical Values | |
|---------------------------------|-------|
| 1% level | 0.739 |
| 5% level | 0.463 |
| 10% level | 0.347 |

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Testing for Stationarity - Example

| | AR Model Specification | Long Run NDR | t-Statistic Long Run NDR | p-Value Long Run NDR | AR Model R-Squared | AR Model R-BAR Squared | AR Model D-W Statistic | ***** p-Values AR(1) Term | ***** p-Values AR(2) Term | ***** p-Values AR(3) Term |
|-----------------|---------------------------|-----------------|--------------------------------|----------------------------|-----------------------|------------------------------|------------------------------|---------------------------------|---------------------------------|---------------------------------|
| 2009M12 2019M12 | AR(1) | 0.84% | 3.83 | 0.00021 | 0.84538 | 0.84276 | 1.643 | 0.00000 | -- | -- |
| " | AR(1), AR(2) | 0.81% | 2.07 | 0.00003 | 0.85160 | 0.84780 | 1.958 | 0.00000 | 0.02418 | -- |
| " | AR(1), AR(2), AR(3) | 0.83% | 3.94 | 0.00014 | 0.85413 | 0.84910 | 1.991 | 0.00000 | 0.02688 | 0.25510 |
| 2009M12 2022M03 | AR(1) | 0.56% | 1.55 | 0.12386 | 0.88447 | 0.88288 | 1.610 | 0.00000 | -- | -- |
| " | AR(1), AR(2) | 0.56% | 2.07 | 0.04054 | 0.88954 | 0.88723 | 1.966 | 0.00000 | 0.00672 | -- |
| " | AR(1), AR(2), AR(3) | 0.56% | 2.05 | 0.04220 | 0.88954 | 0.88645 | 1.966 | 0.00000 | 0.00830 | 0.93794 |

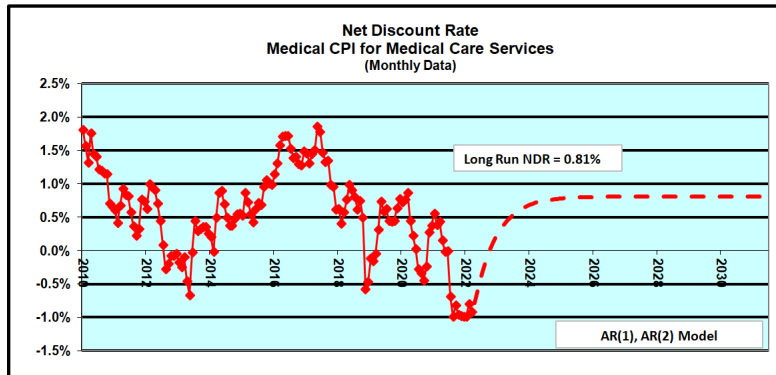
Note that, if the NDR is stationary, the t-Statistics and p-Values from the AR model estimates are valid even if the NDR fails the stationarity tests based on 2009M12-2022M03 estimate.

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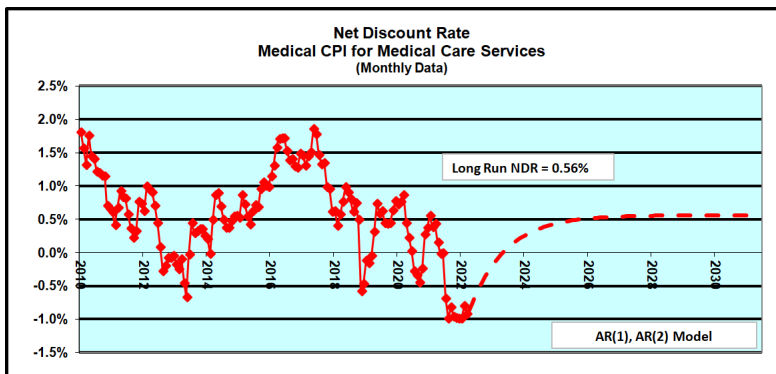
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Testing for Stationarity – Example (Estimate through 12-2019)



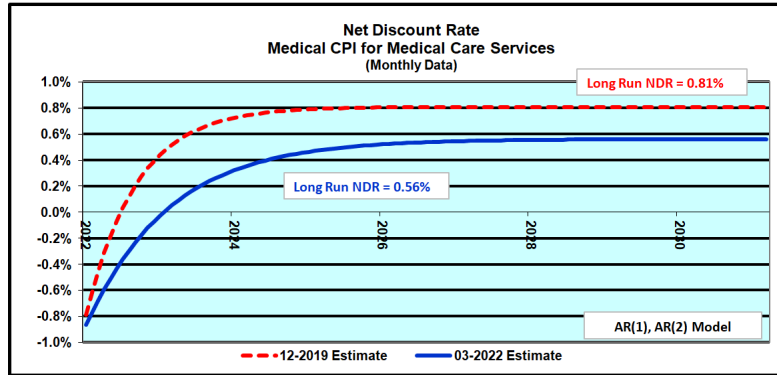
Long-run NDR reached after about 3 years. Remains negative for about 1 year.

Testing for Stationarity – Example (Estimate through 03-2022)



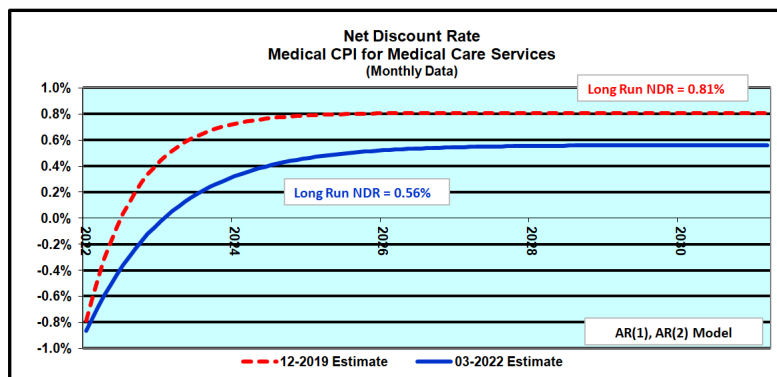
Long-run NDR reached after about 4 years. Remains negative for about 1 year.

Testing for Stationarity – Example Forecast Comparison



Both the long-run values and the paths to get there are different.

Testing for Stationarity – Example Forecast Comparison



What would you do?