

Forecasting Growth After the Pandemic

David G. Tucek
Value Economics, LLC
<http://www.valueeconomics.com/>
314 434 8633
david.tucek@valueeconomics.com

© 2023

Tucek - March 2, 2023

AAEFE - Las Vegas, NV

1

Why This Topic?

- **Short Answer: The Great Disruption**
 - Covid 19 pandemic
 - China's zero-Covid policy and subsequent relaxation
 - Supply chain disruptions
 - War in Ukraine
 - Inflation spike in the U.S. and elsewhere
 - Monetary tightening in the U.S. and elsewhere
 - Uncertainty surrounding the impact of QT

Tucek - March 2, 2023

AAEFE - Las Vegas, NV

2

Why This Topic?

- **Short Answer: The Great Disruption**

The ship has hit the sand.

- **Two possible options:**
 - Ignore all (or some) post-2019 data.
 - Consider all (or some) post-2019 data.

Why This Topic?

- **Ignore all (or some) post-2019 data.**
 - Assumes great disruption is transitory and has no effect on the future.
 - No transition from current situation and long-run growth.
 - Nothing more than *ipse dixit* without an explanation of how transitory conclusion is reached or transition path is determined.

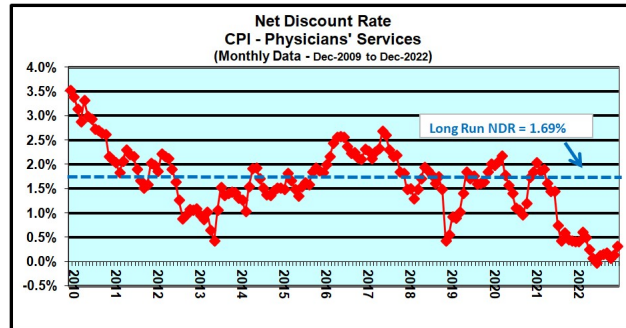
Why This Topic?

- **Ignore all (or some) post-2019 data.**
 - Assumes great disruption is transitory and has no effect on the future.
 - No transition from current situation and long-run growth.
 - Nothing more than *ipse dixit* without an explanation of how transitory conclusion is reached or transition path is determined.
- **Consider all (or some) post-2019 data.**
 - Assumes great disruption is not transitory and will have an impact on the future.
 - How to transition from current situation to the future?
 - Nothing more than *ipse dixit* without an explanation of how not transitory conclusion is reached or transition path is determined.

Why This Topic?

- **Ignore all (or some) post-2019 data.**
 - Assumes great disruption is transitory and has no effect on the future.
 - No transition from current situation and long-run growth.
 - Nothing more than *ipse dixit* without an explanation of how transitory conclusion is reached or transition path is determined.
 - **Consider all (or some) post-2019 data.**
 - Assumes great disruption is not transitory and will have an impact on the future.
 - How to transition from current situation to the future?
 - Nothing more than *ipse dixit* without an explanation of how not transitory conclusion is reached or transition path is determined.
- This presentation is a detailed look at my approach using net discount rates to overcome these drawbacks. Both the “How” and the “Why”.

Sidetriop: The Transition Issue



How do we get from here

to the long run NDR?

(Could have used a graph of the growth in the Physicians' Services CPI).

Tucek - March 2, 2023

AAEFE - Las Vegas, NV

7

Sidetriop: How I Define a NDR

- I don't use data prior to 2000.
- I base my NDRs on the 10-year Treasury rate and 10-year growth rates, provided sufficient data exist.
(Analysis of Ibbotson total return data suggests 10-year Treasury rate is correlated with the return of a wide range of Treasury bond portfolios.)
- 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.)

Tucek - March 2, 2023

AAEFE - Las Vegas, NV

8

Most Important Thing to Consider When Using an NDR

- **Because any NDR you use is a forecast of the future, whether or not it is stationary is always an issue.**
 - In the current environment this is problematic – has there been a structural shift in the long-run NDR?
 - Impossible to tell until time passes. (Nieswiadomy insight.)

My Approach to Forecasting Growth After the Pandemic

- **Test for stationarity in the NDR through Dec-2019 and through current month (Dec-2022).**
- **If stationary, estimate an autoregressive model to determine both the long run NDR and the path to get there from current level.**

Things to Consider When Testing for Stationarity

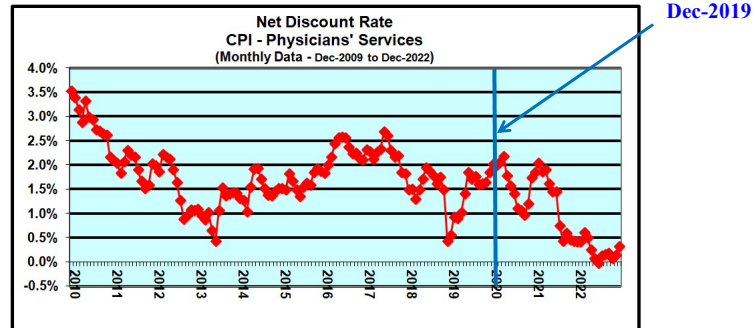
- Testing for stationarity is not like testing to see if a coin is fair due to uncertainty about the underlying process.
- Can't just perform one test and accept or reject the null at some binding predetermined confidence level.
- My approach:
 - Exam the correlogram – if correlations decline and become insignificant, stationarity conclusion is supported.
 - Run four tests for stationarity. (Augmented Dickey-Fuller, 2 Phillips-Perron tests, and Kwiatkowski-Phillips-Schmidt-Shin).
 - Estimate $Y_t = \alpha + \rho Y_{t-1}$ and correct OLS estimate $\hat{\rho}$ 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.)

Things to Consider When Testing for Stationarity

- Testing for stationarity is not like testing to see if a coin is fair due to uncertainty about the underlying process.
- Can't just perform one test and accept or reject the null at

- My approach:
 - 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?)
 - For KPSS test,
 - H_0 : NDR is stationary
 - (How low must confidence level be in order to reject the null?)

Testing for Stationarity - Example

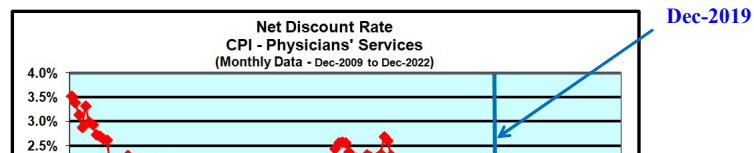


Tucek - March 2, 2023

AAEFE - Las Vegas, NV

13

Testing for Stationarity - Example



NDR based on 10-year growth rate in the CPI for Physicians' 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).

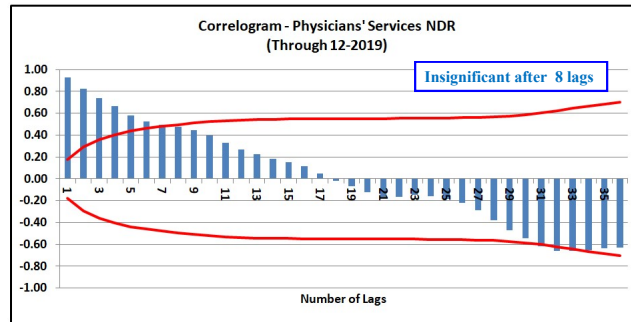
Growth rate should follow the point in time corresponding to the interest rate.
(Private communication with Ed Foster.)

Tucek - March 2, 2023

AAEFE - Las Vegas, NV

14

Testing for Stationarity - Example

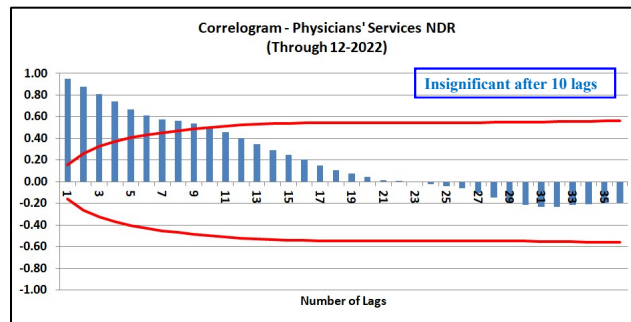


Tucek - March 2, 2023

AAEFE - Las Vegas, NV

15

Testing for Stationarity - Example



Tucek - March 2, 2023

AAEFE - Las Vegas, NV

16

Testing for Stationarity - Example

	ADF p Value	PP #1 p Value	PP #2 p Value	KPSS LM-Stat.	
2009M12 2019M12	0.0140	0.0202	0.0134	0.2404	For KPSS test: Fail to reject null at $p > 0.10$ Fail to reject null at $0.01 < p < 0.05$
2009M12 2022M12	0.0549	0.1164	0.0507	0.5950	
	Corrected \hat{p}	Corrected $SE_{\hat{p}}$	(1 - \hat{p}) divided by $SE_{\hat{p}}$	OLS AR R-BAR Squared	
2009M12 2019M12	0.9244	0.0444	1.7020	0.8532	
2009M12 2022M12	0.9618	0.0312	1.2257	0.8991	

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

Tucek - March 2, 2023

AAEFE - Las Vegas, NV

17

Testing for Stationarity - Example

	ADF p Value	PP #1 p Value	PP #2 p Value	KPSS LM-Stat.	
2009M12 2019M12	0.0140	0.0202	0.0134	0.2404	For KPSS test: Fail to reject null at $p > 0.10$ Fail to reject null at $0.01 < p < 0.05$
2009M12 2022M12	0.0549	0.1164	0.0507	0.5950	
	Corrected \hat{p}	Corrected $SE_{\hat{p}}$	(1 - \hat{p}) divided by $SE_{\hat{p}}$	OLS AR R-BAR Squared	
2009M12 2019M12	0.9244	0.0444	1.7020	0.8532	
2009M12 2022M12	0.9618	0.0312	1.2257	0.8991	

Hits on all cylinders for shortened sample.	
Not as conclusive for the entire sample, but does support stationarity of the NDR.	

Tucek - March 2, 2023

AAEFE - Las Vegas, NV

18

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)	2.03%	7.73	0.00000	0.85442	0.85196	1.656	0.00000	--	--
"	AR(1), AR(2)	1.96%	9.31	0.00000	0.86001	0.85642	1.972	0.00000	0.02283	--
"	AR(1), AR(2), AR(3)	2.00%	8.06	0.00000	0.86257	0.85783	2.004	0.00000	0.02289	0.21944
2009M12 2022M12	AR(1)	1.71%	3.82	0.00019	0.89975	0.89845	1.605	0.00000	--	--
"	AR(1), AR(2)	1.69%	5.38	0.00000	0.90437	0.90250	1.977	0.00000	0.00347	--
"	AR(1), AR(2), AR(3)	1.69%	4.42	0.00002	0.90528	0.90279	2.000	0.00000	0.00800	0.28715

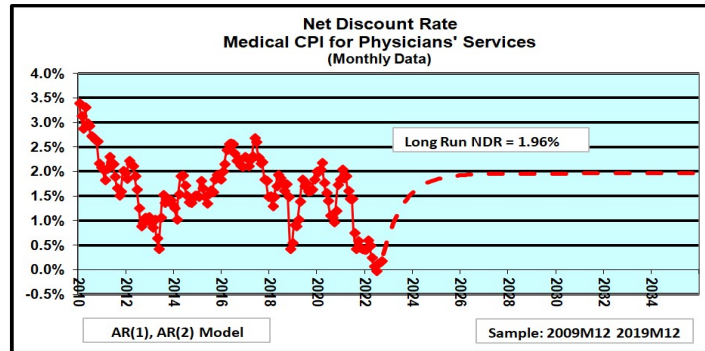
Rule out AR(1), AR(2), AR(3) model based on p-Value for AR(3) term.
Pick AR(1), AR(2) model based on R-BAR Squared and D-W Statistic.
(Defer choice between sample periods for now.)

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)	2.03%	7.73	0.00000	0.85442	0.85196	1.656	0.00000	--	--
"	AR(1), AR(2)	1.96%	9.31	0.00000	0.86001	0.85642	1.972	0.00000	0.02283	--
"	AR(1), AR(2), AR(3)	2.00%	8.06	0.00000	0.86257	0.85783	2.004	0.00000	0.02289	0.21944
2009M12 2022M12	AR(1)	1.71%	3.82	0.00019	0.89975	0.89845	1.605	0.00000	--	--
"	AR(1), AR(2)	1.69%	5.38	0.00000	0.90437	0.90250	1.977	0.00000	0.00347	--
"	AR(1), AR(2), AR(3)	1.69%	4.42	0.00002	0.90528	0.90279	2.000	0.00000	0.00800	0.28715

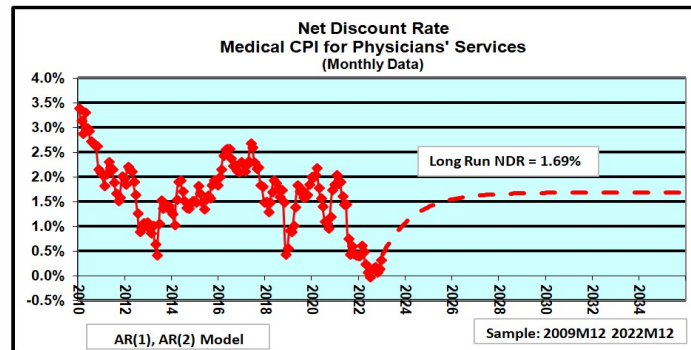
Note that, if the NDR is stationary, the t-Statistics and p-Values from the AR model estimates are valid even if the NDR fails the stationarity tests based on 2009M12-2022M12 sample period.

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



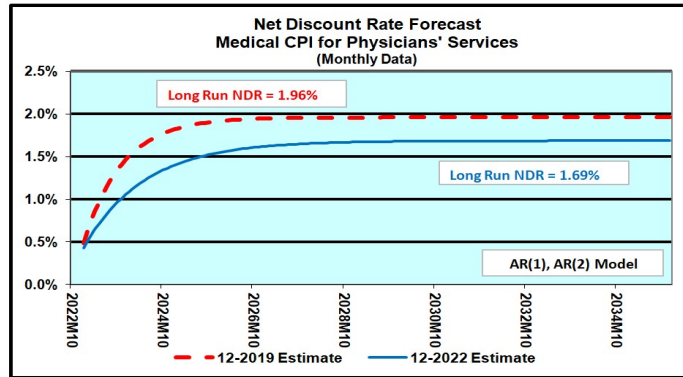
Long-run NDR reached after about 7 years. Reaches 1.5% after about 1 year.

Testing for Stationarity – Example (Estimate through 12-2022)



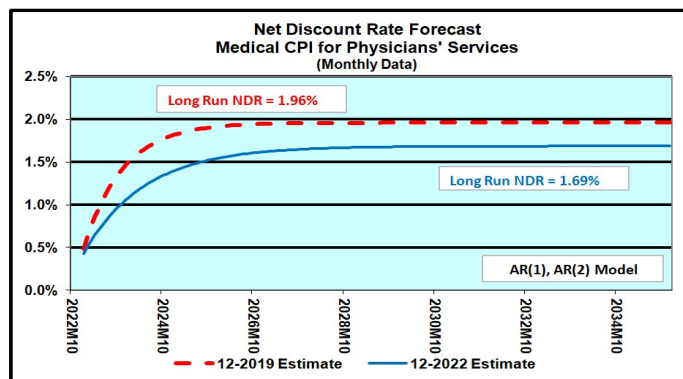
Long-run NDR reached after about 10 years. Reaches 1.0% after about 1 year.

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



**12-2019 Estimate; 12-2022 Estimate; or Somewhere in Between?
What would you do?**

Forecasting Growth After the Pandemic

Why Use an NDR Approach Combined With an Autoregressive Model?

Main Alternatives to the NDR Approach

- **Historical growth rates and**
 - Historical interest rates. **(This is the NDR approach.)**
 - Current interest rates.
- **Forecasted growth rates and current interest rates.**

Historical Growth Rate and Current Rates

- **Produces biased results.** (See “Argument for Use of the Net Discount Rate: The Flaw in Relying on Separate Growth and Discount Rates to Estimate the Expected Present Value of a Future Loss”, *The Forecast*, Volume 36, Numbers 1 & 2, May 2022)
- **Transition issue (for growth rate) must still be addressed.**
- **Implicit assumption that plaintiff will invest in a fixed portfolio – typically a bond ladder or very short term Treasuries. (Contradicts plaintiff’s expected behavior.)**
- **Has there been a structural change in the economy? (No way to tell until time has passed.)**

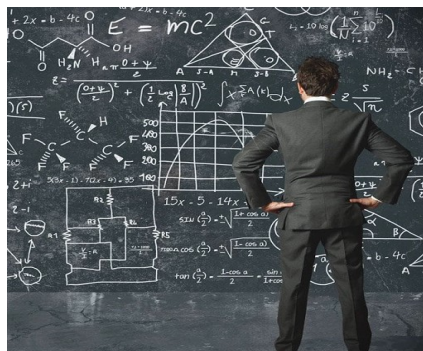
Forecasted Growth Rate and Current Rates

- **If all you do is take the forecast as given:**
 - Still produces biased results.
 - Transition issue is addressed (for most forecasts).
 - **Implicit assumption that plaintiff will invest in a fixed portfolio. (Contradicts plaintiff’s expected behavior.)**
 - **Has there been a structural change in the economy? (No way to tell until time has passed.)**

Forecasted Growth Rate and Current Rates

- **If all you do is take the forecast as given:**
 - Still produces biased results.
 - Transition issue is addressed (for most forecasts).
 - Implicit assumption that plaintiff will invest in a fixed portfolio. (Contradicts plaintiff's expected behavior.)
 - Has there been a structural change in the economy? **(No way to tell until time has passed.)**
- **If you are offering a professional opinion on the validity of the forecast, then there are more questions to be answered:**
 - Has the underlying model estimate been updated?
 - What assumptions have been made about (1) timing and effect of QT; (2) persistence of inflation; (3) war in Ukraine . . . and the list goes on
 - Are there significant alternative forecast scenarios? If so, shouldn't you have an opinion on their likelihood of occurring?

Forecasting Future Growth and Investment Returns



**Another Confounding Consideration:
Lots of moving parts.**

Lots of Moving Parts

- **Historical Growth and Current Rates:**
 - Problem reduced to two inputs.
 - Transition issue must still be addressed (with respect to the growth rate).
 - Implicit assumption that plaintiff will invest in a fixed portfolio.
 - Structural change issue still not addressed.

Lots of Moving Parts

- **Historical Growth and Current Rates**
- **Forecasted Growth and Current Rates**
 - Underlying model considers more than just one input, but there are always exogenous variables and assumptions. (More variables is not necessarily better.)
 - Baseline outlook may not match the outlook underlying current rates.
 - Implicit assumption that plaintiff will invest in a fixed portfolio.
 - Structural change issue still not addressed.

Lots of Moving Parts

- **Historical Growth and Current Rates**
- **Forecasted Growth and Current Rates**
- **NDR and autoregressive model.**
 - Problem reduced to two inputs.
 - Transition problem is resolved.
 - Have a basis for professional opinion on the forecasted NDR, if stationarity conclusion reached.
 - Stationarity conclusion resolves the structural change issue and AR model forecast includes an impact of the Great Disruption.

Forecasting Growth After the Pandemic: Conclusion

- **Given stationarity, NDR approach combined with an autoregressive model to forecast the NDR is the best approach.**
- **Provides a transition from current situation to the long-run NDR.**
- **Addresses the many moving parts problem.**
- **Avoids the bias inherent in relying on separate growth and interest rates.**
- **Does not assume plaintiff will invest in a fixed-portfolio – recognizes plaintiff's expected behavior.**
- **For both the truncated and complete sample periods, the Great Disruption has an impact – better than just ignoring it.**