

Forecasting Growth After the Pandemic

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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

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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.

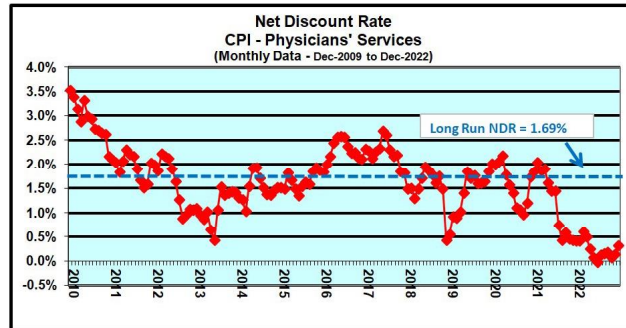
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- **Consider all (or some) post-2019 data.**
 - Assumes great disruption is not transitory and will have an impact on the future.
 - How to transition from current situation to the future?
 - Nothing more than *ipse dixit* without an explanation of how not transitory conclusion is reached or transition path is determined.

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 - 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”.

Sidetrip: The Transition Issue



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

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Sidetrip: 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.)

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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.)**

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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.**

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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.)

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11

Things to Consider When Testing for Stationarity

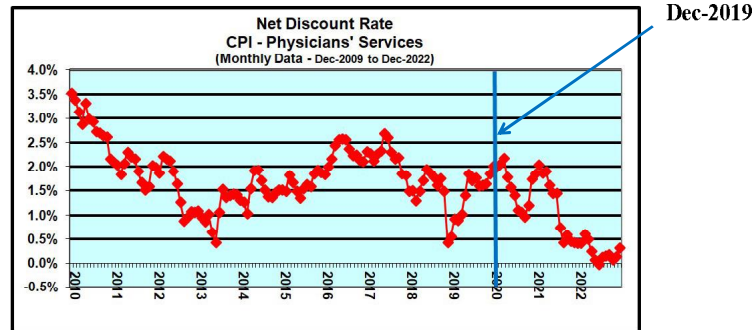
- Testing for stationarity is not like testing to see if a coin is fair due to uncertainty about the underlying process.
- Can't just perform one test and accept or reject the null at some binding predetermined confidence level.
- My approach:
 - For Augmented Dickey-Fuller and Phillips-Perron tests,
 - 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?)

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12

Testing for Stationarity - Example

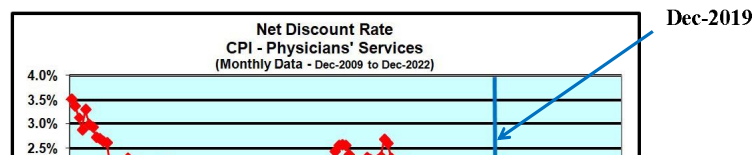


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Testing for Stationarity - Example



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.

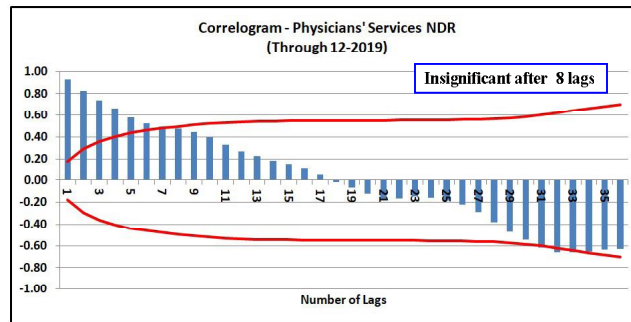
(Private communication with Ed Foster.)

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14

Testing for Stationarity - Example

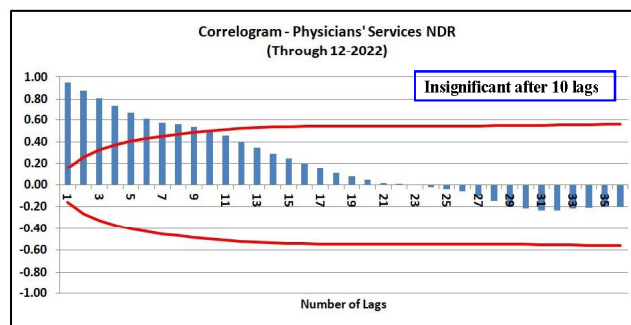


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Testing for Stationarity - Example



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Testing for Stationarity - Example

	ADF p Value	PP #1 p Value	PP #2 p Value	KPSS LM-Stat.	
2009M12 2019M12	0.0140	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

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Testing for Stationarity - Example

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Hits on all cylinders for shortened sample.

Not as conclusive for the entire sample, but does support stationarity of the NDR.

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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	***** AR(1) Term	p-Values AR(2) Term	***** 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	0.85257	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.)

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19

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	***** AR(1) Term	p-Values AR(2) Term	***** AR(3) Term
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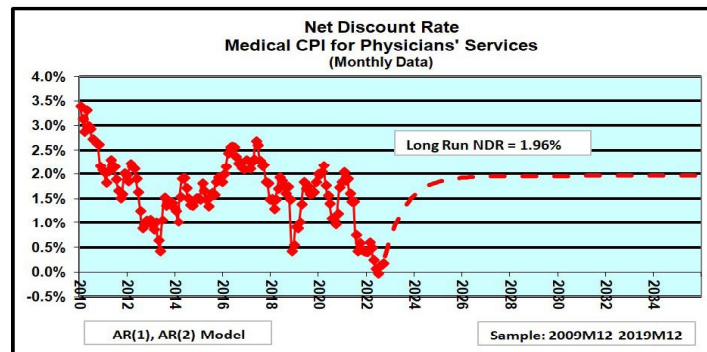
Note that, if the NDR is stationary, the t-Statistics and p-Values from the AR model estimates are valid even if the NDR fails the stationarity tests based on 2009M12-2022M12 sample period.

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20

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



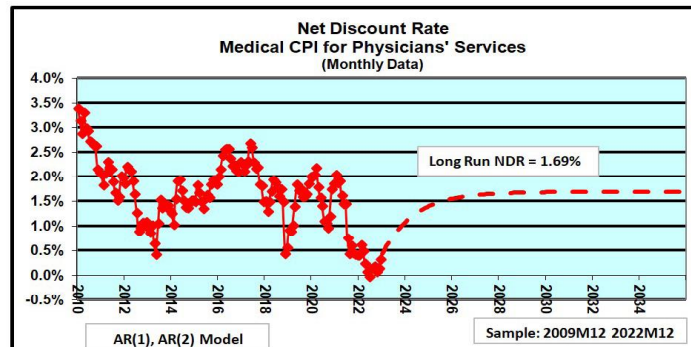
Long-run NDR reached after about 7 years. Reaches 1.5% after about 1 year.

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



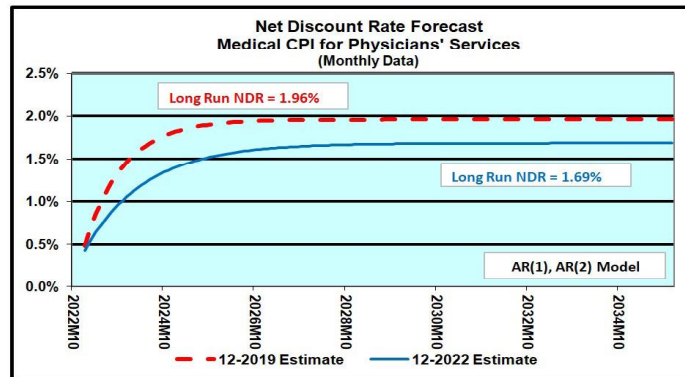
Long-run NDR reached after about 10 years. Reaches 1.0% after about 1 year.

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22

Testing for Stationarity – Example Forecast Comparison



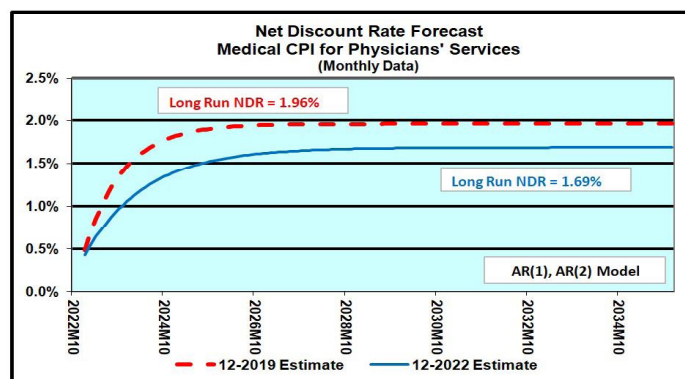
Both the long-run values and the paths to get there are different.

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Testing for Stationarity – Example Forecast Comparison



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

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Why Use an NDR Approach Combined With an Autoregressive Model?

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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.**

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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?

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Forecasting Future Growth and Investment Returns



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

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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.

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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.**

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34