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Introductory econometrics for finance 3rd edition ppt

1 Introductory Econometrics for FinanceChapter 8 Modelling long-run relationship in finance ‘Introductory Econometrics for Finance’ © Chris Brooks 2013 Copyright 2013, Chris Brooks 2 Introductory Econometrics for FinanceStationarity and Unit Root Testing Why do we need to test for Non-Stationarity? The stationarity or otherwise of a series can strongly influence its behaviour and properties - e.g. persistence of shocks will be infinite for nonstationary series Spurious regressions. If two variables are trending over time, a regression of one on the other could have a high R2 even if the two are totally unrelated If the variables in the regression model are not stationary, then it can be proved that the standard assumptions for asymptotic analysis will not be valid. In other words, the usual “t-ratios” will not follow a t-distribution, so we cannot validly undertake hypothesis tests about the regression parameters. ‘Introductory Econometrics for Finance’ © Chris Brooks 2013 Copyright 2002, Chris Brooks 3 Examples (from Gujarati book: Econometrics by Example)‘Introductory Econometrics for Finance’ © Chris Brooks 2013 4 Examples (from Gujarati book: Econometrics by Example)‘Introductory Econometrics for Finance’ © Chris Brooks 2013 5 Introductory Econometrics for FinanceValue of R2 for 1000 Sets of Regressions of a Non-stationary Variable on another Independent Non-stationary Variable ‘Introductory Econometrics for Finance’ © Chris Brooks 2013 Copyright 2002, Chris Brooks 6 Introductory Econometrics for FinanceValue of t-ratio on Slope Coefficient for 1000 Sets of Regressions of a Non-stationary Variable on another Independent Non-stationary Variable ‘Introductory Econometrics for Finance’ © Chris Brooks 2013 Copyright 2002, Chris Brooks 7 Two types of Non-StationarityIntroductory Econometrics for Finance Two types of Non-Stationarity Various definitions of non-stationarity exist In this chapter, we are really referring to the weak form or covariance stationarity There are two models which have been frequently used to characterise non-stationarity: the random walk model with drift: yt = + yt-1 + ut (1) and the deterministic trend process: yt = + t + ut (2) where ut is iid in both cases. ‘Introductory Econometrics for Finance’ © Chris Brooks 2013 Copyright 2002, Chris Brooks 8 Stochastic Non-StationarityIntroductory Econometrics for Finance Stochastic Non-Stationarity Note that the model (1) could be generalised to the case where yt is an explosive process: yt = + yt-1 + ut where > 1. Typically, the explosive case is ignored and we use = 1 to characterise the non-stationarity because > 1 does not describe many data series in economics and finance. > 1 has an intuitively unappealing property: shocks to the system are not only persistent through time, they are propagated so that a given shock will have an increasingly large influence. ‘Introductory Econometrics for Finance’ © Chris Brooks 2013 Copyright 2002, Chris Brooks 9 Stochastic Non-stationarity: The Impact of ShocksIntroductory Econometrics for Finance Stochastic Non-stationarity: The Impact of Shocks To see this, consider the general case of an AR(1) with no drift: yt = yt-1 + ut (3) Let take any value for now. We can write: yt-1 = yt-2 + ut-1 yt-2 = yt-3 + ut-2 Substituting into (3) yields: yt = (yt-2 + ut-1) + ut = 2yt-2 + ut-1 + ut Substituting again for yt-2: yt = 2(yt-3 + ut-2) + ut-1 + ut = 3 yt-3 + 2ut-2 + ut-1 + ut T successive substitutions of this type lead to: yt = T y0 + ut-1 + 2ut-2 + 3ut Tu0 + ut ‘Introductory Econometrics for Finance’ © Chris Brooks 2013 Copyright 2002, Chris Brooks 10 The Impact of Shocks for Stationary and Non-stationary SeriesIntroductory Econometrics for Finance The Impact of Shocks for Stationary and Non-stationary Series We have 3 cases: 1. 1. Now given shocks become more influential as time goes on, since if >1, 3>2> etc. ‘Introductory Econometrics for Finance’ © Chris Brooks 2013 Copyright 2002, Chris Brooks 11 Detrending a Stochastically Non-stationary SeriesIntroductory Econometrics for Finance Detrending a Stochastically Non-stationary Series Going back to our 2 characterisations of non-stationarity, the r.w. with drift: yt = + yt-1 + ut (1) and the trend-stationary process yt = + t + ut (2) The two will require different treatments to induce stationarity. The second case is known as deterministic non-stationarity and what is required is detrending. The first case is known as stochastic non-stationarity. If we let yt = yt - yt-1 and L yt = yt-1 so (1-L) yt = yt - L yt = yt - yt-1 If we take (1) and subtract yt-1 from both sides: yt - yt-1 = + ut yt = + ut We say that we have induced stationarity by “differencing once”. ‘Introductory Econometrics for Finance’ © Chris Brooks 2013 Copyright 2002, Chris Brooks 12 Detrending a Series: Using the Right MethodIntroductory Econometrics for Finance Detrending a Series: Using the Right Method Although trend-stationary and difference-stationary series are both “trending” over time, the correct approach needs to be used in each case. If we first difference the trend-stationary series, it would “remove” the non-stationarity, but at the expense on introducing an MA(1) structure into the errors. Conversely if we try to detrend a series which has stochastic trend, then we will not remove the non-stationarity. We will now concentrate on the stochastic non-stationarity model since deterministic non-stationarity does not adequately describe most series in economics or finance. ‘Introductory Econometrics for Finance’ © Chris Brooks 2013 Copyright 2002, Chris Brooks 13 Sample Plots for various Stochastic Processes: A White Noise ProcessIntroductory Econometrics for Finance Sample Plots for various Stochastic Processes: A White Noise Process ‘Introductory Econometrics for Finance’ © Chris Brooks 2013 Copyright 2002, Chris Brooks 14 Introductory Econometrics for FinanceSample Plots for various Stochastic Processes: A Random Walk and a Random Walk with Drift ‘Introductory Econometrics for Finance’ © Chris Brooks 2013 Copyright 2002, Chris Brooks 15 Introductory Econometrics for FinanceSample Plots for various Stochastic Processes: A Deterministic Trend Process ‘Introductory Econometrics for Finance’ © Chris Brooks 2013 Copyright 2002, Chris Brooks 16 Autoregressive Processes with differing values of (0, 0.8, 1)Introductory Econometrics for Finance Autoregressive Processes with differing values of (0, 0.8, 1) ‘Introductory Econometrics for Finance’ © Chris Brooks 2013 Copyright 2002, Chris Brooks 17 Definition of Non-StationarityIntroductory Econometrics for Finance Definition of Non-Stationarity Consider again the simplest stochastic trend model: yt = yt-1 + ut or yt = ut We can generalise this concept to consider the case where the series contains more than one “unit root”. That is, we would need to apply the first difference operator, , more than once to induce stationarity. Definition If a non-stationary series, yt must be differenced d times before it becomes stationary, then it is said to be integrated of order d. We write yt I(d). So if yt I(d) then dyt I(0). An I(0) series is a stationary series An I(1) series contains one unit root, e.g. yt = yt-1 + ut ‘Introductory Econometrics for Finance’ © Chris Brooks 2013 Copyright 2002, Chris Brooks 18 Characteristics of I(0), I(1) and I(2) SeriesIntroductory Econometrics for Finance Characteristics of I(0), I(1) and I(2) Series An I(2) series contains two unit roots and so would require differencing twice to induce stationarity. I(1) and I(2) series can wander a long way from their mean value and cross this mean value rarely. I(0) series should cross the mean frequently. The majority of economic and financial series contain a single unit root, although some are stationary and consumer prices have been argued to have 2 unit roots. ‘Introductory Econometrics for Finance’ © Chris Brooks 2013 Copyright 2002, Chris Brooks 19 How do we test for a unit root? Introductory Econometrics for Finance How do we test for a unit root? The early and pioneering work on testing for a unit root in time series was done by Dickey and Fuller (Dickey and Fuller 1979, Fuller 1976). The basic objective of the test is to test the null hypothesis that =1 in: yt = yt-1 + ut against the one-sided alternative

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