Financial Econometrics 1 - M2 FTD

Empirical Applications

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Introduction

something, probably describe how all applications make sense one after the other and what is the research question we could have made ourselves when doing the applications, try to give a coherent look to the whole thing.

This document compiles all our applications of the Financial Econometrics course. Each section represents a specific application, but we tried to make them coherent across them around a broad question:

1 Series Dynamics

Note: Depending on each exercise along these applications we might use different series. In this first section, we performed the stationarity and component analysis of all of them to be able to use them rapidly without having to worry about seasonality or the presence of UR. Therefore, this section encompasses more than the 3 series that were asked in the exercise.

1.1 Seasonality

Table 1: Estimation of the seasonality of each series

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
infl_e	-0.104	-0.108	0.031	0.078	0.149	0.1	0.017	0.088	0.031	0.006	-0.116	-0.17
deflator	0.018	0.035	0.053	0.072	0.06	0.045	0.03	-0.024	-0.078	-0.128	-0.072	-0.01
unempl	0.464	0.327	0.132	-0.045	-0.074	0.296	0.284	0.007	-0.257	-0.406	-0.379	-0.34
rate	-0.042	-0.05	-0.046	-0.059	-0.03	0.025	0.048	0.067	0.074	0.025	0.008	-0.02
splong	0.003	0.002	-0.005	0.003	0.007	0.006	0.007	0.002	-0.007	-0.017	-0.003	0.003
corp_debt	0.003	0.001	-0.006	-0.007	-0.007	-0.004	0.001	0.006	0.006	0.002	0.001	0.003

1.2 Unit root and trends

1.2.1 ADF - Test jointly for deterministic and stochastic trend (with drift)

We first run the following specification to the ADF test to *jointly* investigate the presence of a stochastic and a determinist trend for each series $(X_t)_t$:

$$\Delta X_t = \alpha + \beta tt + \gamma X_{t-1} + \sum_{i=1,2,..} \rho_i \Delta X_{t-i} + \varepsilon_t \tag{1}$$

As per usual, the ADF test assumes H0: $\gamma = 0$ i.e. a unit root exists and the series is non-stationary and that inference is non-standard (uses special critical values for unilateral test). We use R's built-in function *ur.df* with *type='trend'* to get this estimation. This function gives us (i) a regression table per series and (ii) a summary table with the following test statistics:

- tau3 refers to the t-statistic associated to $\gamma = 0$

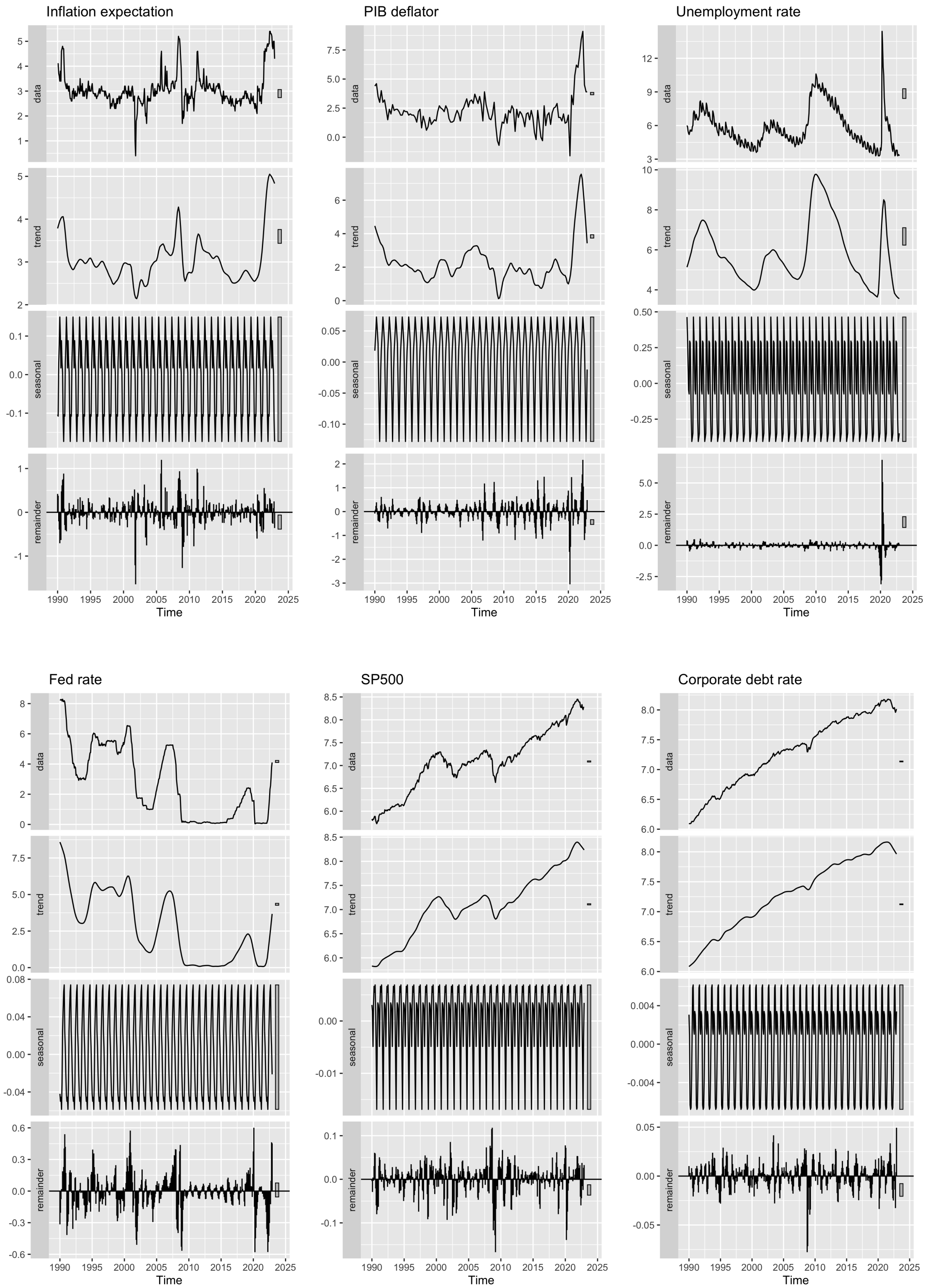

Figure 1: Time series decomposition

- phi2 refers to the F-statistic associated to $\alpha = \beta = \gamma = 0$

- phi3 is also an F-statistic, now associated to $\beta = \gamma = 0$

Let us examine each series' results:

Inflation expectation We find $t_\gamma = -4.490 < -3.43$ [1] we can reject H0 ie we can't say that the series has a UR. We then compare the t-statistics associated to α and β to the standard interest threshold (the values below Table 3 are conditional on having an UR). While we fail to reject that $\beta = 0$ ($|t_\beta| = 1.35 < 1.95$ i.e. we don't have evidence of the existence of a deterministic trend), we can reject the nullity of α suggesting that we have a drift.

GDP deflator

Unemployment Since $t_\gamma > -3.43$, we fail to reject H0. We then test the significance of β with respect to the non-standard threshold 2.79 (bilateral test). Since we fail to reject its nullity we need to use the second specification of the ADF test on this series.

Unemployment rate

Fed fund rate $t_\gamma = -1.709$

Table 2: ADF test - 1st regression with drift, deterministic trend and stochastic trend

	infl_e	deflator	unempl	rate	splong	corp_debt	CV 1pct	CV 5pct	CV 10pct
tau3	-4.490	-5.166	-3.346	-1.672	-1.949	-1.759	-3.980	-3.420	-3.130
phi2	6.945	8.984	3.786	2.022	3.926	10.602	6.150	4.710	4.050
phi3	10.416	13.475	5.665	2.927	1.953	4.228	8.340	6.300	5.360

Table 3: ADF test - 1st regression t statistics

	infl_e	deflator	unempl	rate	splong	corp_debt
alpha	3.829	2.584	3.016	0.649	2.078	1.882
gamma	-4.490	-5.166	-3.346	-1.672	-1.949	-1.759
beta	1.366	1.154	-0.488	-0.127	1.696	1.407
rho	-0.558	14.221	1.072	15.797	4.100	6.757

Notes: With N=396, critical values at 5%: alpha = 3.09 ; gamma= -3.43 ; beta = 2.79

1.2.2 ADF - Test jointly for stochastic trend and drift

The second specification of the test models $\forall (X_t)_t$:

$$\Delta X_t = \alpha + \gamma X_{t-1} + \sum_{i=1,2,..} \rho_i \Delta X_{t-i} + \varepsilon_t \tag{2}$$

The null hypothesis still refers to H0: $\gamma = 0$ the presence of a unit root. We use now *type='trend'* in the *ur.df* function to get this estimation. The output to the test is similar to the previous specification but now the test

[1] Remark that the critical value in both tables can be a little different. This is because they are sensitive to the number of observations in each series. In Table 2, the critical values correspond to those provided directly by R and are associated to $N = 500$, while in Table 3 we give the values for $N = 250$. Since we have 396 data points per series we prefer to refer to the higher critical values but it does not change the analysis done.

statistics reported refer to:

- tau2 refers to the t-statistic associated to $\gamma = 0$
- phi1 refers to the F-statistic associated to $\alpha = \gamma = 0$

Table 4: ADF test - 2nd regression with drift and stochastic trend

	infl_e	rate	corp_debt	deflator	unempl	splong	CV 1pct	CV 5pct	CV 10pct
tau2	-4.527	-2.412	-1.005	-2.480	-5.090	-3.752	-3.440	-2.870	-2.570
phi1	10.246	3.014	4.300	14.279	12.953	7.057	6.470	4.610	3.790

Table 5: ADF test - 2nd regression t statistics

	infl_e	deflator	unempl	rate	splong	corp_debt
alpha	4.268	4.279	3.153	1.513	1.270	2.934
gamma	-4.350	-5.059	-3.334	-2.419	-1.013	-2.542
rho	-0.538	14.258	1.079	16.076	3.982	6.605

Notes: With N=396, critical values at 5%: alpha = 2.53 ; gamma= -2.88

1.2.3 ADF - Test for stochastic trend only

The last specification of the test keeps only the stochastic trend, $\forall (X_t)_t$:

$$\Delta X_t = \gamma X_{t-1} + \sum_{i=1,2,..} \rho_i \Delta X_{t-i} + \varepsilon_t \tag{3}$$

The null hypothesis still refers to H0: $\gamma = 0$ the presence of a unit root and we use *type='none'*. The output of the test is similar to the previous ones but now there is only one test statistic reported referring to the null (tau1).

Table 6: ADF test - 3rd regression with stochastic trend

	infl_e	deflator	unempl	rate	splong	corp_debt	CV 1pct	CV 5pct	CV 10pct
tau1	-0.826	-2.642	-1.083	-1.940	2.690	4.554	-2.580	-1.950	-1.620

Table 7: ADF test - 3rd regression t statistics

	infl_e	deflator	unempl	rate	splong	corp_debt
gamma	-0.826	-2.642	-1.083	-1.940	2.690	4.554
rho	-1.585	13.581	0.557	16.044	3.982	7.167

Notes: With N=396, critical values at 5%: gamma= -1.95

DECOMPOSITION SERIES IN DELTAS

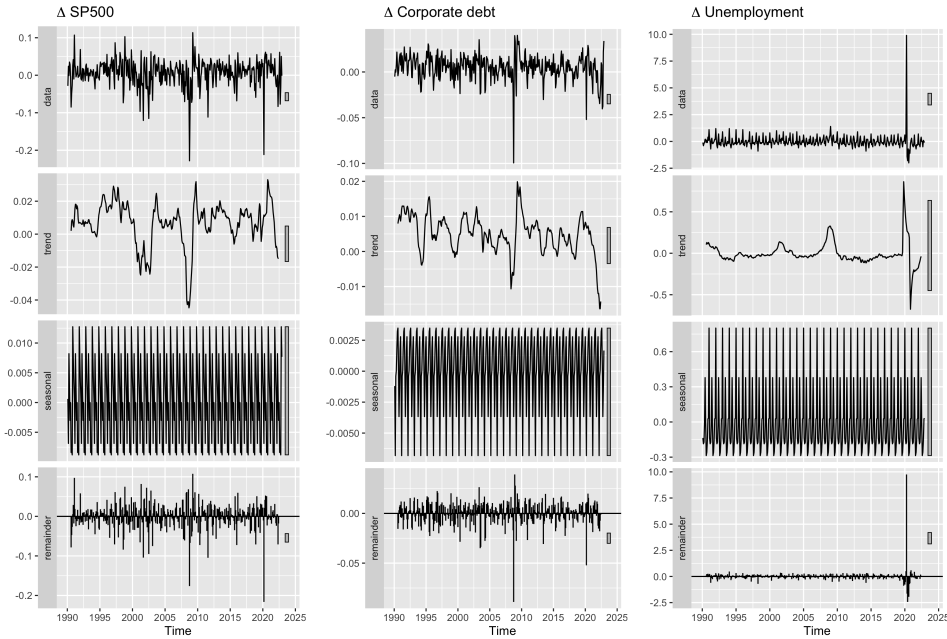

Figure 2: Decomposition of the series in deltas

1.3 Cyclical component

2 Canonical VAR model application

Table 8: Canonical VAR in levels - Identify order

	1	2	3	4	5	6	7	8	9	10
AIC(n)	-10.01	-10.56	-10.59	-10.73	-10.88	-10.87	-10.93	-11.01	-11.00	-10.98
HQ(n)	-9.96	-10.48	-10.47	-10.57	-10.68	-10.64	-10.66	-10.71	-10.66	-10.60
SC(n)	-9.89	-10.35	-10.29	-10.33	-10.38	-10.29	-10.25	-10.25	-10.14	-10.03
FPE(n)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 9: Level VAR - Estimation

	Dependent variable:		
	deflator	unempl	splong
deflator.l1	1.830***	−0.199	0.026***
	(0.051)	(0.124)	(0.008)
unempl.l1	0.120***	0.956***	0.003
	(0.022)	(0.053)	(0.004)
splong.l1	0.556*	−4.968***	1.174***
	(0.321)	(0.786)	(0.053)
deflator.l2	−0.819***	−0.317	−0.042**
	(0.101)	(0.246)	(0.017)
unempl.l2	−0.117***	−0.131*	−0.004
	(0.031)	(0.075)	(0.005)
splong.l2	−0.553	5.816***	−0.246***
	(0.506)	(1.237)	(0.083)
deflator.l3	−0.894***	1.008***	0.010
	(0.108)	(0.264)	(0.018)
unempl.l3	0.014	0.182**	0.002
	(0.031)	(0.076)	(0.005)
splong.l3	0.149	−0.992	0.137
	(0.521)	(1.275)	(0.085)
deflator.l4	1.526***	−0.716**	0.019
	(0.113)	(0.277)	(0.019)
unempl.l4	−0.013	−0.150**	0.003
	(0.031)	(0.076)	(0.005)
splong.l4	0.428	−0.516	−0.012
	(0.523)	(1.278)	(0.086)
deflator.l5	−0.653***	−0.130	−0.021
	(0.111)	(0.271)	(0.018)
unempl.l5	0.001	0.092	−0.008*
	(0.031)	(0.076)	(0.005)
splong.l5	−0.027	1.417	0.063
	(0.527)	(1.288)	(0.086)
deflator.l6	−0.498***	0.609**	−0.003
	(0.107)	(0.262)	(0.018)
unempl.l6	0.004	−0.105	0.006
	(0.031)	(0.075)	(0.005)
splong.l6	−1.048**	−1.069	−0.302***
	(0.527)	(1.290)	(0.086)
deflator.l7	0.834***	−0.476*	0.019
	(0.103)	(0.252)	(0.017)
unempl.l7	0.081***	0.088	−0.0004
	(0.030)	(0.073)	(0.005)
splong.l7	0.954*	−0.455	0.261***
	(0.526)	(1.287)	(0.086)
deflator.l8	−0.350***	0.153	−0.010
	(0.054)	(0.131)	(0.009)
unempl.l8	−0.075***	0.039	−0.001
	(0.021)	(0.052)	(0.004)
splong.l8	−0.428	0.746	−0.078
	(0.340)	(0.832)	(0.056)
const	−0.268*	0.490	0.015
	(0.149)	(0.365)	(0.024)
Adjusted R^2	0.977	0.913	0.997
Residual Std. Error (df = 363)	0.210	0.515	0.034
F Statistic (df = 24; 363)	684.697***	170.695***	5,592.560***
Note:			*p<0.1; **p<0.05; ***p<0.01

3 Cointegration theory

4 Impulse Response Analysis

4.1 Canonical IRF

4.2 Structural IRF

5 Introduce non-linearities

5.1 Markov-switching model

5.2 STR model

6 Difference-in-Difference

https://www.tidy-finance.org/r/difference-in-differences.html