Corn Future Spreads

Econometric Analysis of Seasonality

Georg Lehecka

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Introduction

Aim of this empirical analysis

- Estimation and forecast of corn futures spreads based on the fact of seasonal time series
- Application of different seasonal models to the time series

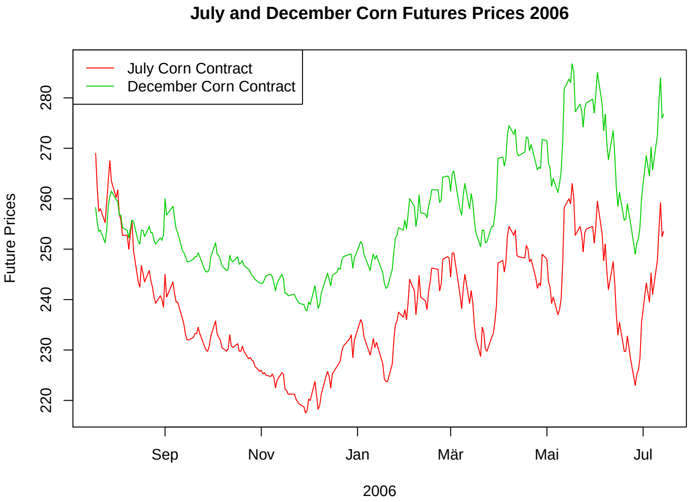
Introduction

Futures Contracts

A futures contract is an agreement between two parties to buy or sell an asset at a certain time in the future for a certain price.

Suppose that, on June 8, the July futures price of corn at the Chicago Merantile Exchange (CME) is quoted as 350 *\$Cents per bushel (contract size is 5,000 bushels ∼127 t.). This is the price, exclusive of commissions, at which traders can agree to buy or to sell Corn for December delivery.*

Introduction



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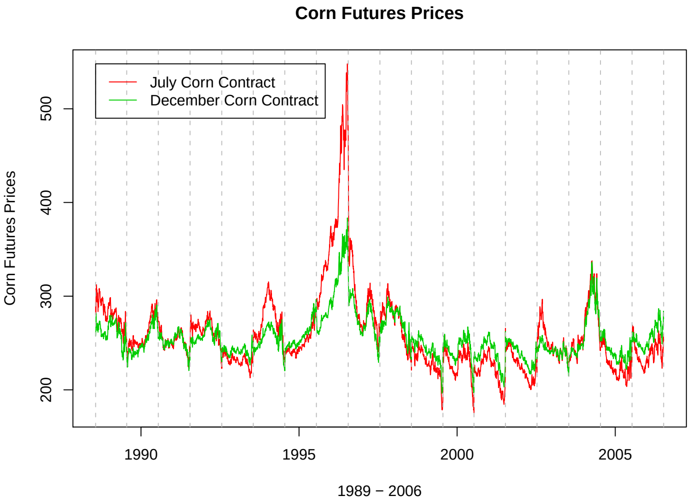


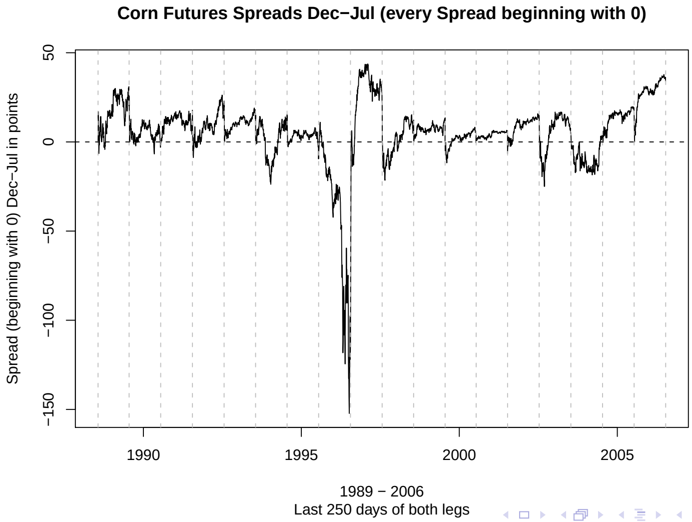
Introduction

Futures Spread

A futures spread is a technique in which a trader buys one contract and sells another contract of the same commodity with another delivery date.

Suppose that, on June 8, the July futures price of corn at the Chicago Merantile Exchange (CME) is quoted as 350 *$Cents per bushel and the December futures price of corn is quoted as* 360 *$Cents per bushel. A trader sells July Corn and buys December Corn. The spread has as value* $360 - 350 = 10$ *$Cents per bushel. The goal for the trader is that the July contract declines and that the December contract increases in order to increase the spread value.*

Introduction



Introduction

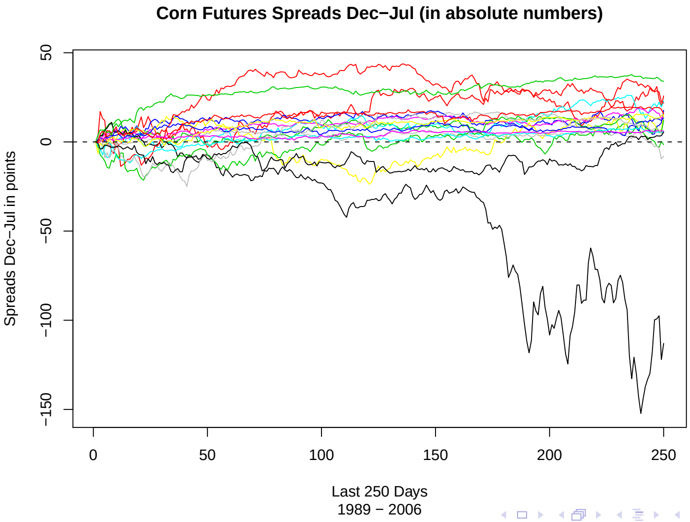
Economic Reasons for Seasonality in Agricultural Markets

There is obviously seasonality in the underlying agricultural business. For example the bulk of the US corn crop is planted April/May and harvested October/November.The seasonal pattern for the corn market should assume therefore a specific path. Price and perceptions of supply tend to be inversely related, with price often lowest when supply is greatest, at harvest and with price often highest in May when the market is anxious about the potential for new production.

Description of Data

- Data are the July and December Corn Futures Contracts
- At the Chicago Merantile Exchange (CME)
- During the years 1989 - 2006
- Unit of measurement: $Cents per bushel (contract size is 5,000 bushels $\sim$127 t.)
- Relevant time series are the last 250 days of the Dec - July Spread

Description of Data



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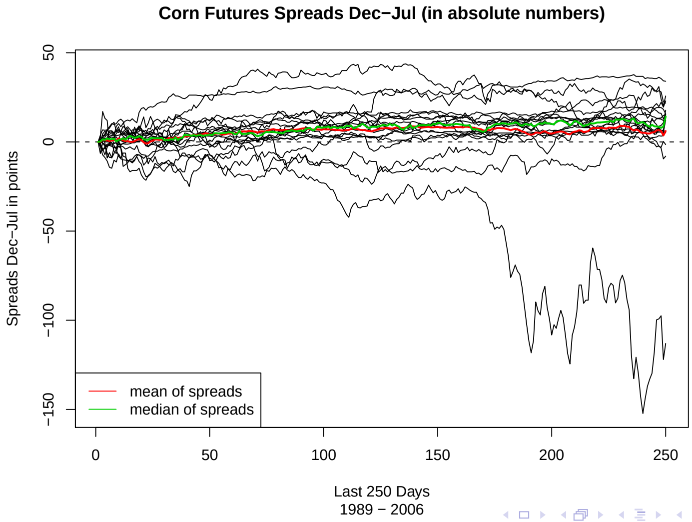

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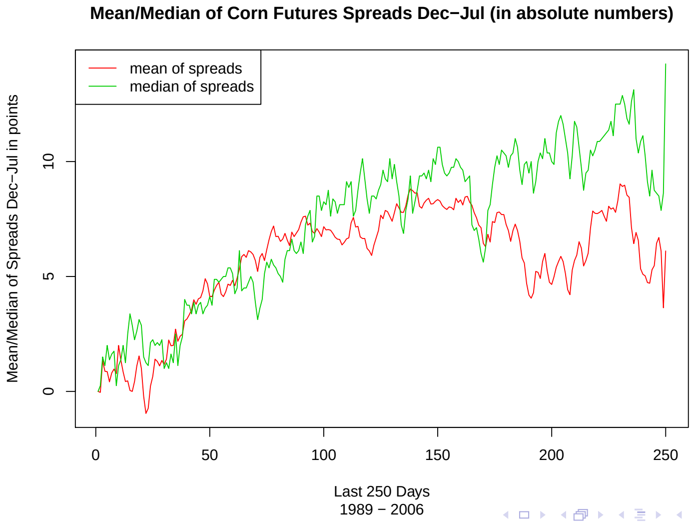

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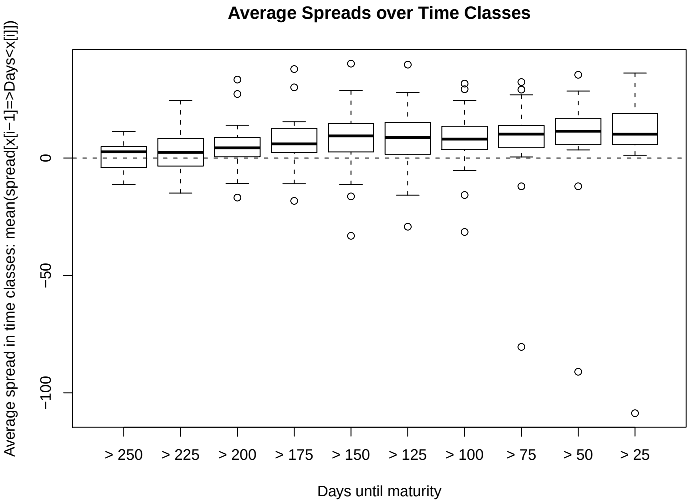

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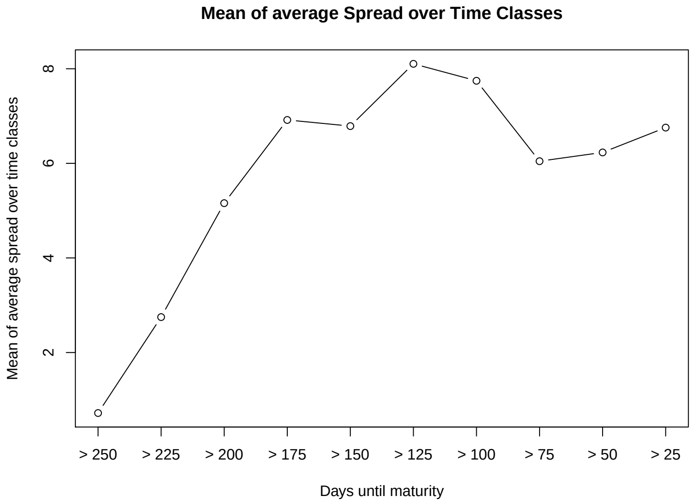

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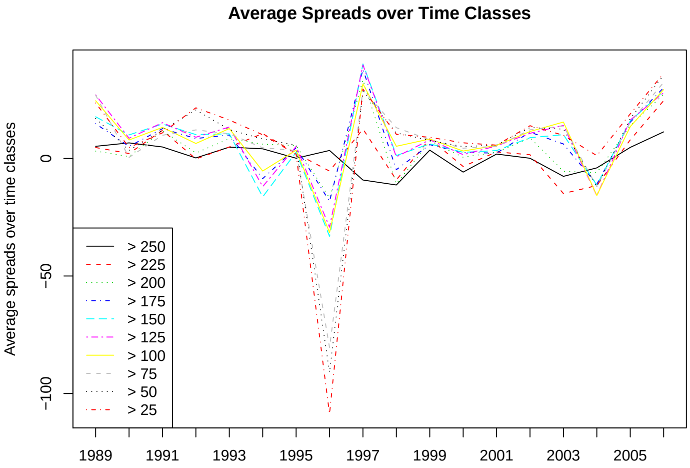


Application of Seasonal Models

Discussion on useful Seasonal Model Classes

Data follow a 'deterministic' seasonality ('summer remains summer') and are non-stationary.

- Deterministic model class: non-stationary $\rightarrow$ maybe a good model for data
- Linear stationary model class: stationary $\rightarrow$ not such a good model for data
- Unit-root model class: non-stationary but 'summer may become winter' $\rightarrow$ maybe only a good model with deterministic parts

Application of Seasonal Models: Deterministic Model

Simple Model for Deterministic Seasonality

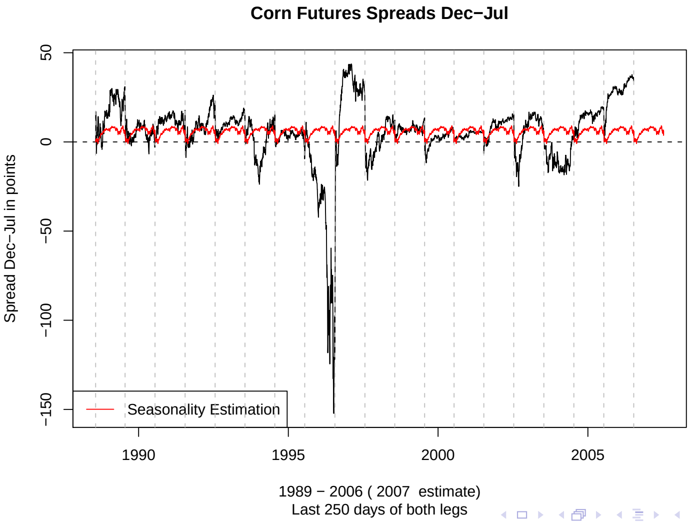
$$y_t = \sum_{s=1}^{S} \delta_{st} m_s + \epsilon_t$$

$\delta_{st} = 1$ if t falls to season s, and $\delta = 0$ otherwise; m_s is the mean for season s; S is the numer of seasons and in the example 250; ϵ_t is zero-mean stationary; $t = 1, ..., T = 4500$

Estimation:

SSE	$1.508 \cdot 10^6$

Application of Seasonal Models: Deterministic Model



Simple Stationary Seasonal Model

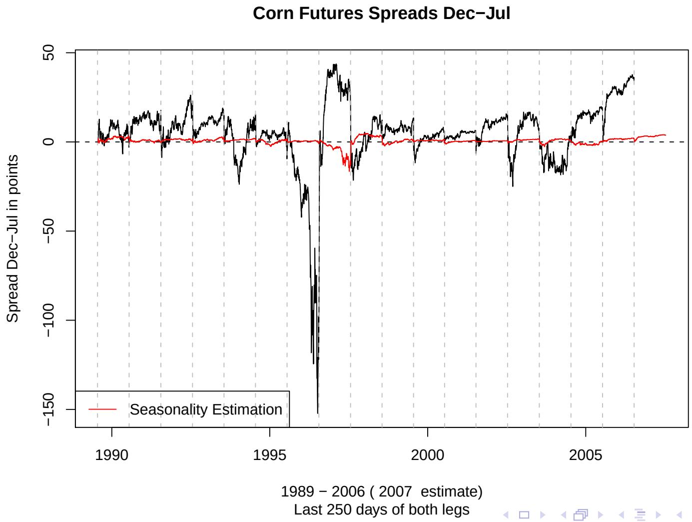
$$y_t = \phi_S y_{t-S} + \epsilon_t, \ |\phi_S| < 1$$

S is the numer of seasons and in the example 250; ϵ_t is zero-mean stationary; $t = 1, ..., T = 4500$

Estimation:

	Estimate	t value	p-value
$\hat{\phi}_S$	0.10872	-6.846	$< 10^{-3}$
AIC	37,197	SSE	$1.642 \cdot 10^6$

Application of Seasonal Models: Linear Stationary Model



Application of Seasonal Models: Linear Stationary Model

Another Stationary Seasonal Model

$$y_t = \sum_{i=1}^{5} \phi_{iS} y_{t-iS} + \epsilon_t$$

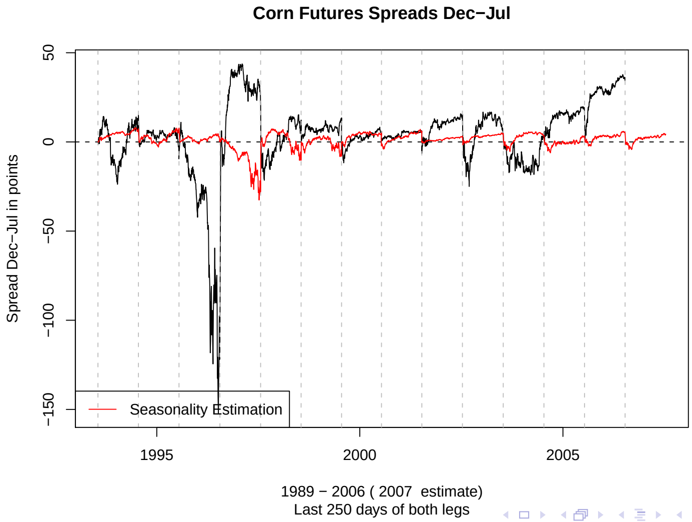
S is the numer of seasons and in the example 250; ϵ_t is zero-mean stationary; $t = 1, ..., T = 4500$; $|\phi_{iS}| < 1$ for each i

Another Stationary Seasonal Model

Estimation:

	Estimate	t value	p-value
$\hat{\phi}_{1S}$	0.22493	-11.808	$< 10^{-3}$
$\hat{\phi}_{2S}$	0.11821	-6.039	$< 10^{-3}$
$\hat{\phi}_{3S}$	0.09586	-5.007	$< 10^{-3}$
$\hat{\phi}_{4S}$	0.01669	-0.865	0.387
$\hat{\phi}_{5S}$	-0.01464	0.790	0.429
AIC	$28,957$	SSE	$1.695 \cdot 10^6$

Application of Seasonal Models: Linear Stationary Model



Application of Seasonal Models: Unit-Root Model

Seasonal Unit-Root Model (SWR)

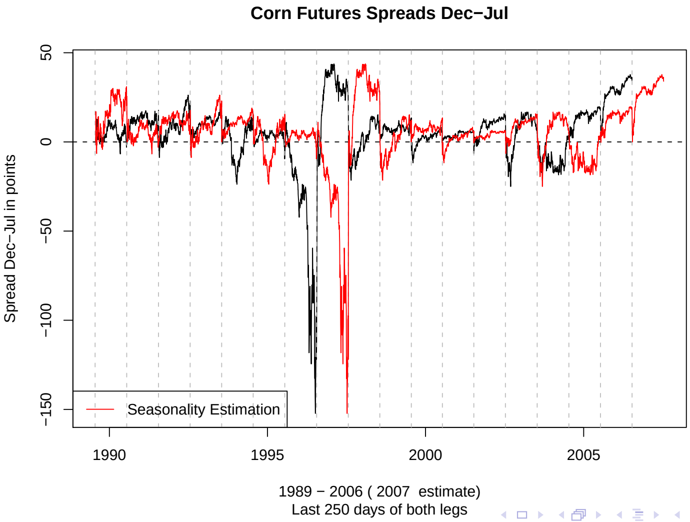
$$y_t = y_{t-S} + \epsilon_t$$

S is the numer of seasons and in the example 250; ϵ_t is zero-mean stationary; $t = 1, ..., T = 4500$

Estimation:

SSE	$3.376 \cdot 10^6$

Application of Seasonal Models: Unit-Root Model



Another more general seasonal unit-root model

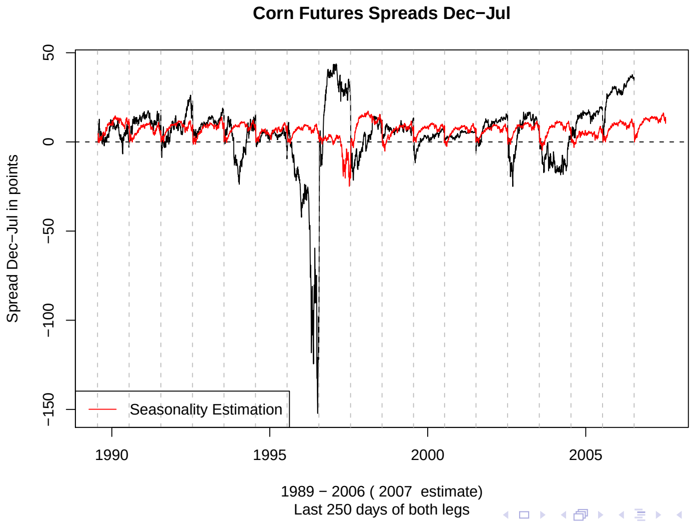
$$y_t = \phi y_{t-S} + \sum_{s=1}^{S} \delta_{st} m_s + \epsilon_t,$$

assuming ϕ to be well behaved (all roots outside unit circle). S is the numer of seasons and in the example 250; m_s is the mean for season s; ϵ_t is zero-mean stationary; $t = 1, ..., T = 4500$

Estimation:

	Estimate	t value	p-value
$\hat{\phi}$	0.19682	-13.11	$< 10^{-3}$
AIC	$36,721$	SSE	$1.632 \cdot 10^6$

Application of Seasonal Models: Unit-Root Model



Application of Seasonal Models: Unit-Root Model

A third general seasonal unit-root model

$$y_t = \sum_{i=1}^{5} \phi_{iS} y_{t-iS} + \sum_{s=1}^{S} \delta_{st} m_s + \epsilon_t,$$

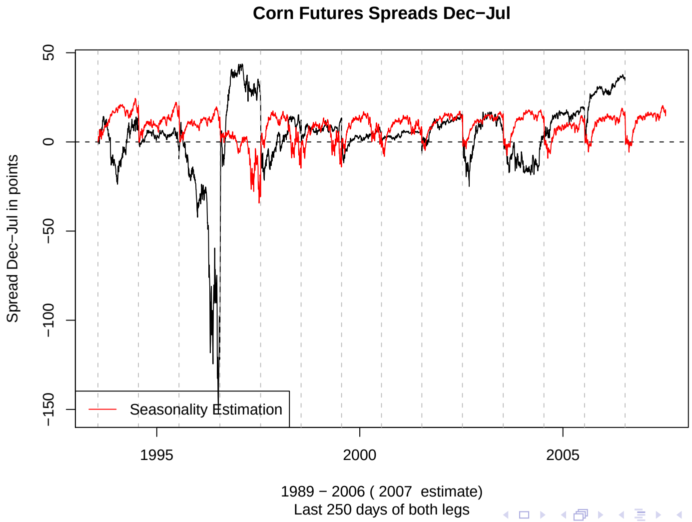
assuming ϕ_{iS} to be well behaved (all roots outside unit circle). S is the numer of seasons and in the example 250; m_s is the mean for season s; ϵ_t is zero-mean stationary; $t = 1, ..., T = 4500$

A third general seasonal unit-root model

Estimation:

	Estimate	t value	p-value
$\hat{\phi}_{1S}$	0.30125	-16.678	$< 10^{-3}$
$\hat{\phi}_{2S}$	0.20608	-11.104	$< 10^{-3}$
$\hat{\phi}_{3S}$	0.19126	-10.535	$< 10^{-3}$
$\hat{\phi}_{4S}$	0.12277	-6.708	$< 10^{-3}$
$\hat{\phi}_{5S}$	0.07595	-4.325	$< 10^{-3}$
AIC	$28,612$	SSE	$1.920 \cdot 10^3$

Application of Seasonal Models: Unit-Root Model



Model comparison

Model	AIC	SSE
Simple Deterministic Model		
$y_t = \sum_{s=1}^{S} \delta_{st} m_s + \epsilon_t$	-	$1.508 \cdot 10^6$
Simple Stationary Seasonality Model		
$y_t = \phi_S y_{t-S} + \epsilon_t$	$37,197$	$1.642 \cdot 10^6$
Another Stationary Seasonality Model		
$y_t = \sum_{i=1}^{5} \phi_{iS} y_{t-iS} + \epsilon_t$	$28,957$	$1.695 \cdot 10^6$
Seasonal Unit-Root Model(SRW)		
$y_t = y_{t-S} + \epsilon_t$	-	$3.376 \cdot 10^6$
Another Seasonal Unit-Root Model		
$y_t = \phi y_{t-S} + \sum_{s=1}^{S} \delta_{st} m_s + \epsilon_t$	$36,721$	$1.632 \cdot 10^6$
A third Seasonal Unit-Root Model		
$y_t = \sum_{i=1}^{5} \phi_{iS} y_{t-iS} + \sum_{s=1}^{S} \delta_{st} m_s + \epsilon_t$	$28,612$	$1.920 \cdot 10^6$

Thank you for the attention!