



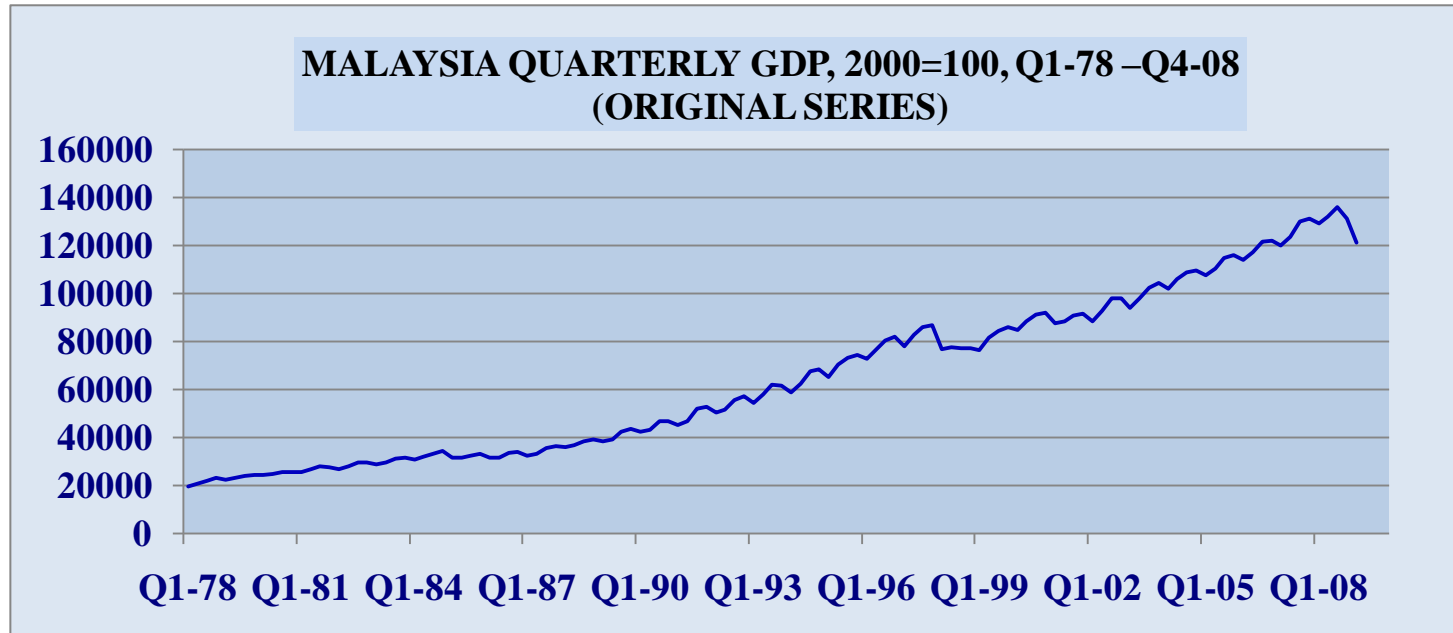
## Time Series Decomposition



- First Day
  - Overview of BCI
  - Malaysia BCI
  - **Time series Decomposition**
  - Seasonal Adjustment
- Second Day
  - Indicators selection
  - The Composite Index
  - The Diffusion Index



# Decomposition of Economic Time Series



Consider the above time series, can you identified the actual economic turning points?

Can someone predict if the above series meet the requirements of “conformity to business cycle”? Why?



## The Usual components of Time Series

- The raw series  $z_t$  contains five basic components which are mutually exclusive and collectively exhaustive
  - Trend-cycle (TC)
  - Seasonal (S)
  - Trading-day (TD)
  - Moving festival (H)
  - Irregular (I)



Those components are in the form of multiplicative or additive decomposition of series. The both models assume the components integrate of each other to generate the raw series:

The multiplicative decomposition series,

$$\bullet Z_t = TC_t \times S_t \times TD_t \times H_t \times I_t = 1 (100\%) \quad (1a)$$

The additive decomposition series

$$\bullet Z_t = TC_t + S_t + TD_t + H_t + I_t = 1 (100\%) \quad (1b)$$



The unnecessary elements need to be removed from the series.

$$O_t = TC_t, S_t, I'_t, I''_t, TD_t$$

Seasonal Variations, Moving Holiday, Trading Day should be removed.

and

The remaining components in the adjusted series are:

$$\check{O}_t = TC_t, I'_t$$



## Trend-Cycle Component

- ❖ Trend is the gradual shifting or movements (overall upward or downward pattern) of the time series over a long period of time.
- ❖ In economic time series, this is typically due to influences such as: Population growth; Price inflation; and General economic development.
- ❖ The trend-cycle is the component that represents variations of low frequency in a time series, the high frequency fluctuations having been filtered out. This component can be viewed as those variations with a period longer than a chosen threshold (usually  $1\frac{1}{2}$  years is considered as the minimum length of the business cycle). (OECD)



## Difficulty of Estimating Trend in Practice

It is often futile to estimate trends which by definition are long-term phenomena

In principle the cycle is a smooth movement in the series around the long term trend

In practice, since the trend is hard to meaningfully estimate, the trend and the cycle components are merged into one component: the trend-cycle





In business cycle analysis, our main target is to decompose the trend-cycle component ( $TC_t$ ) into two separate components: the trend ( $T_t$ ) and the Cycle ( $C_t$ ).

- Trend-cycle (TC)  $\Rightarrow$  Classical cycle
- Cycle (C)  $\Rightarrow$  Growth cycle

The decomposition of ( $TC_t$ ) will be discussed in detail later.



For the moment the trend is estimate separately from the trend –cycle components

Trend is long-term evolution of variable over several decades

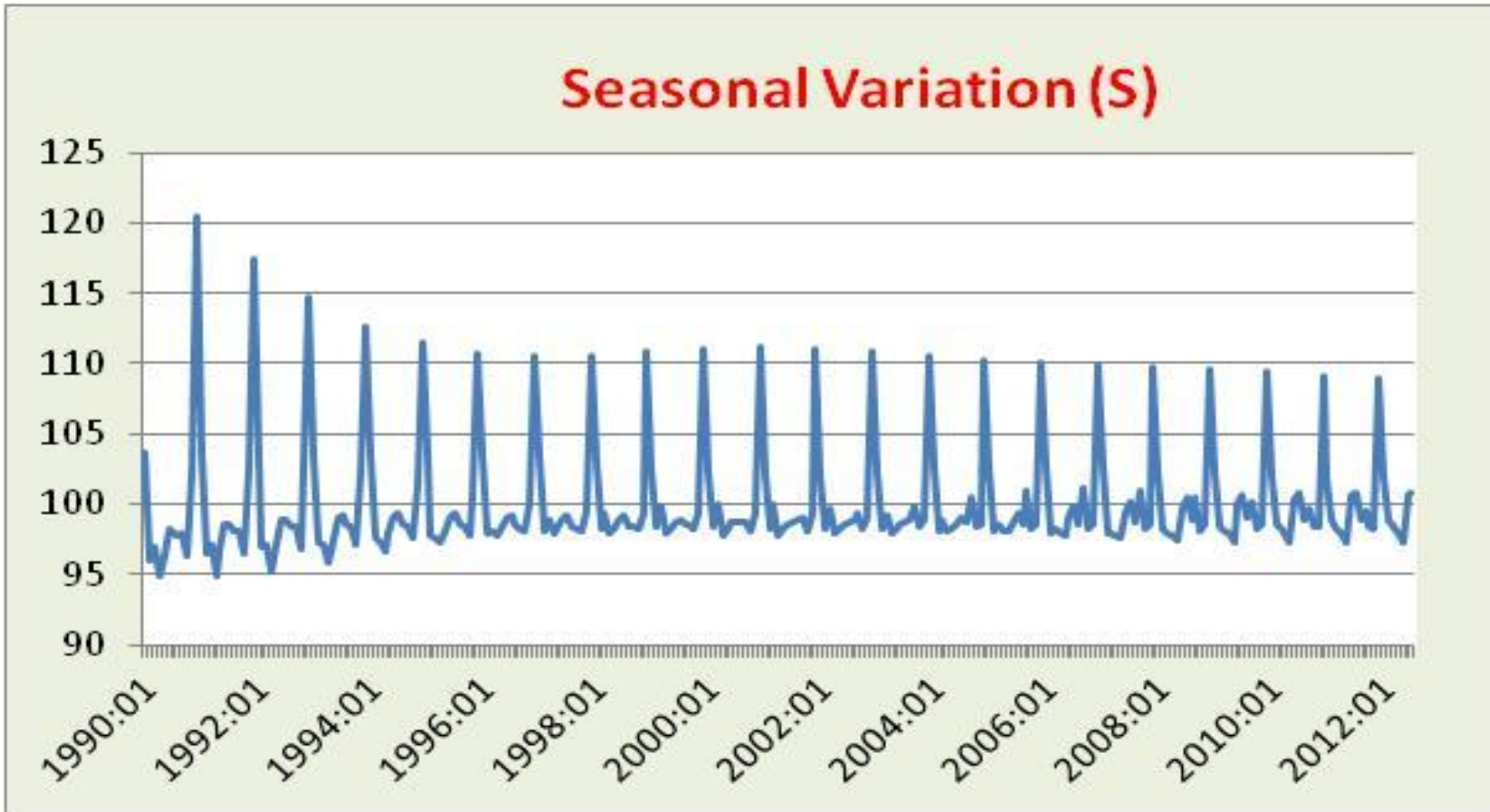
Note: In the context of time series components, the trend does not refer to month-to-month or period-to-period movement



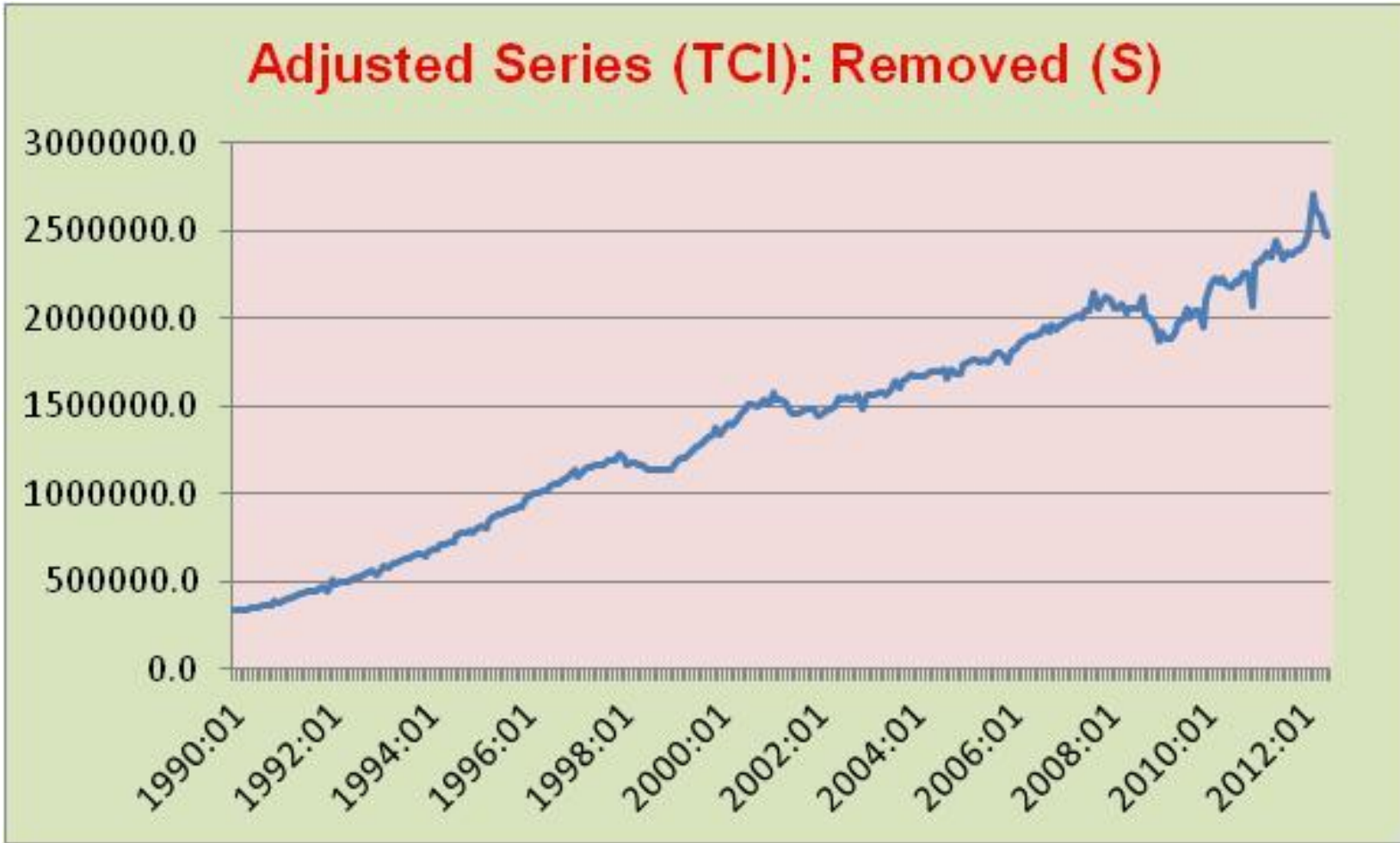
# Decomposition of Economic Time Series



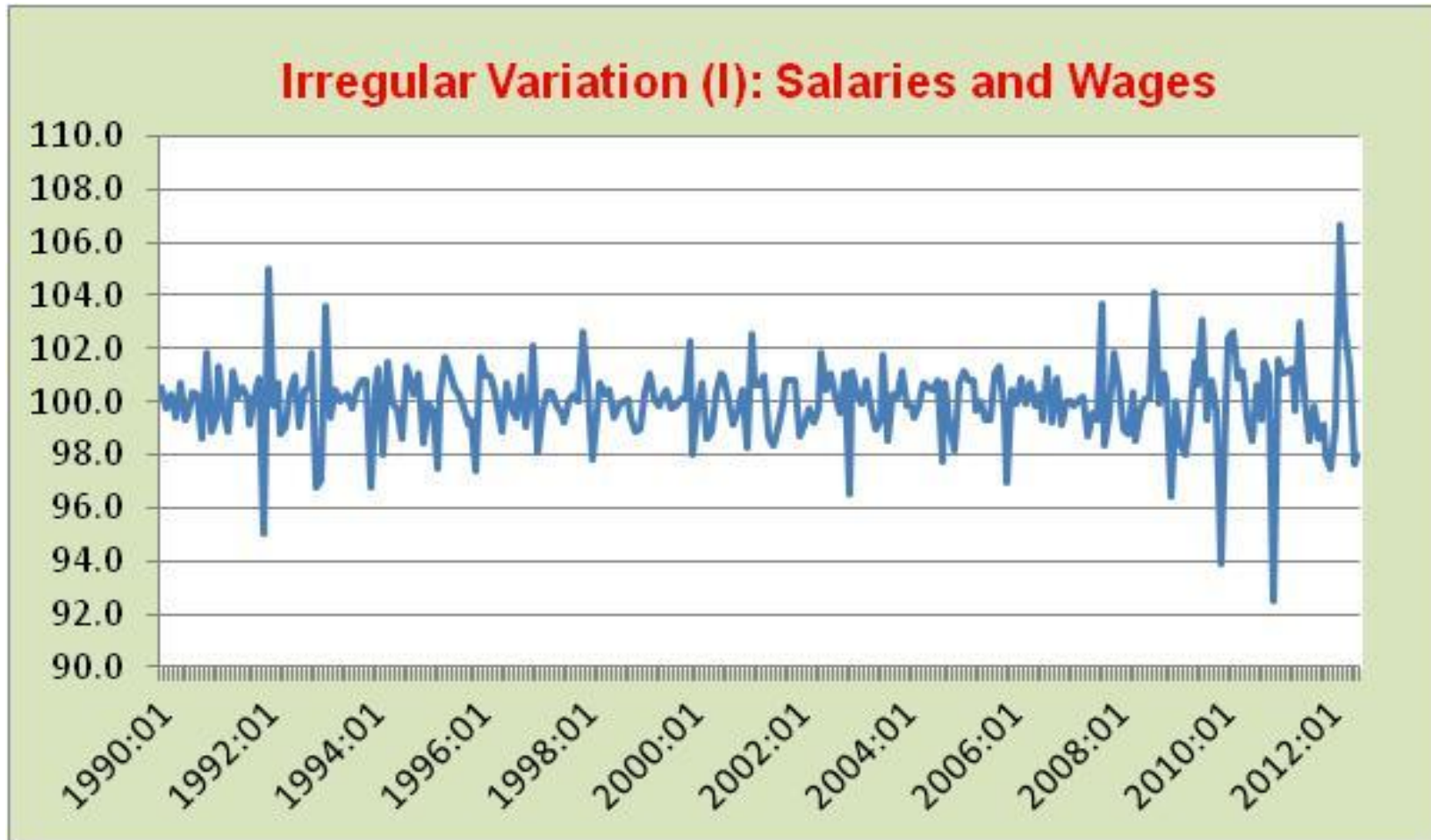
What is the significant element that influence the above time series?



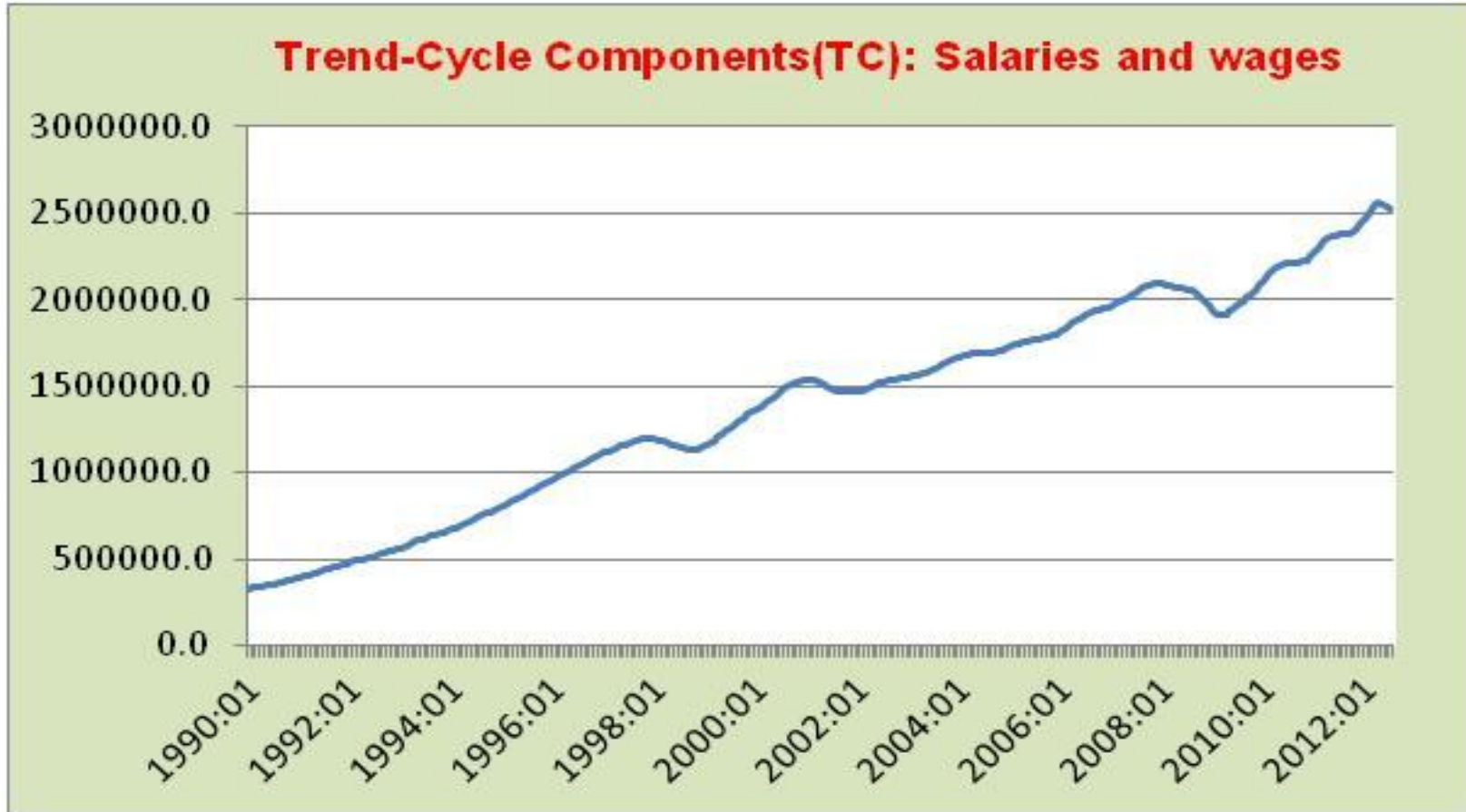
Pattern of Seasonal element after extracted from the SW series?



The SW series without seasonal variation



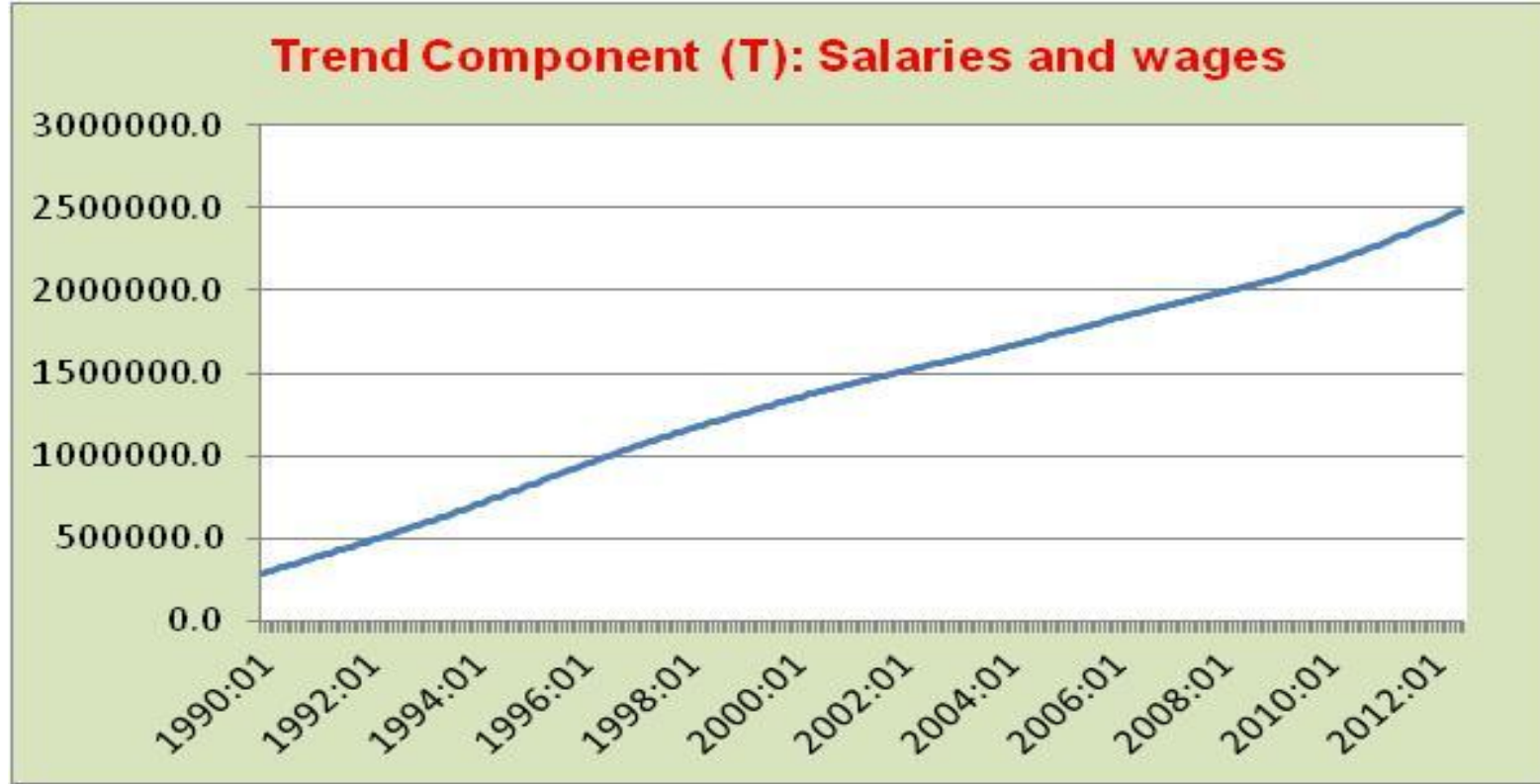




The SW series without Seasonal and irregular variations



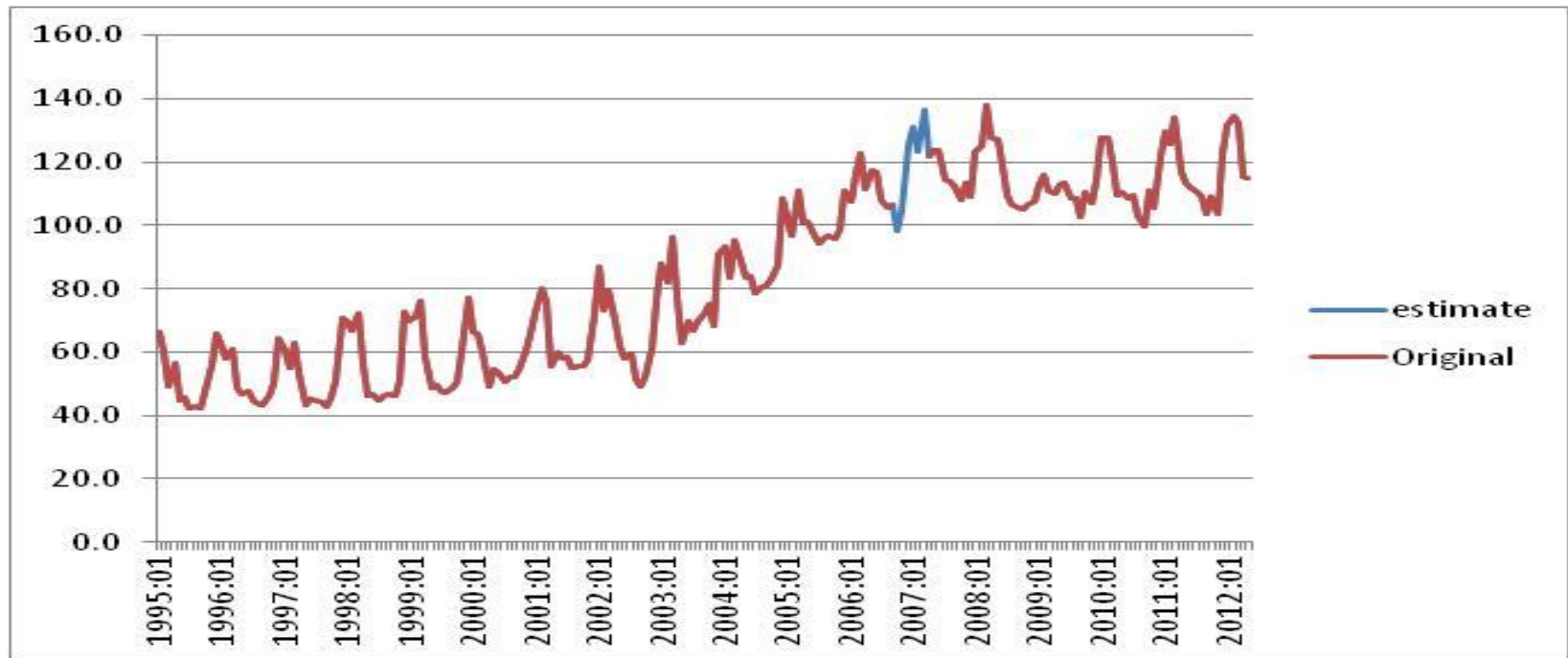
# Decomposition of Economic Time Series







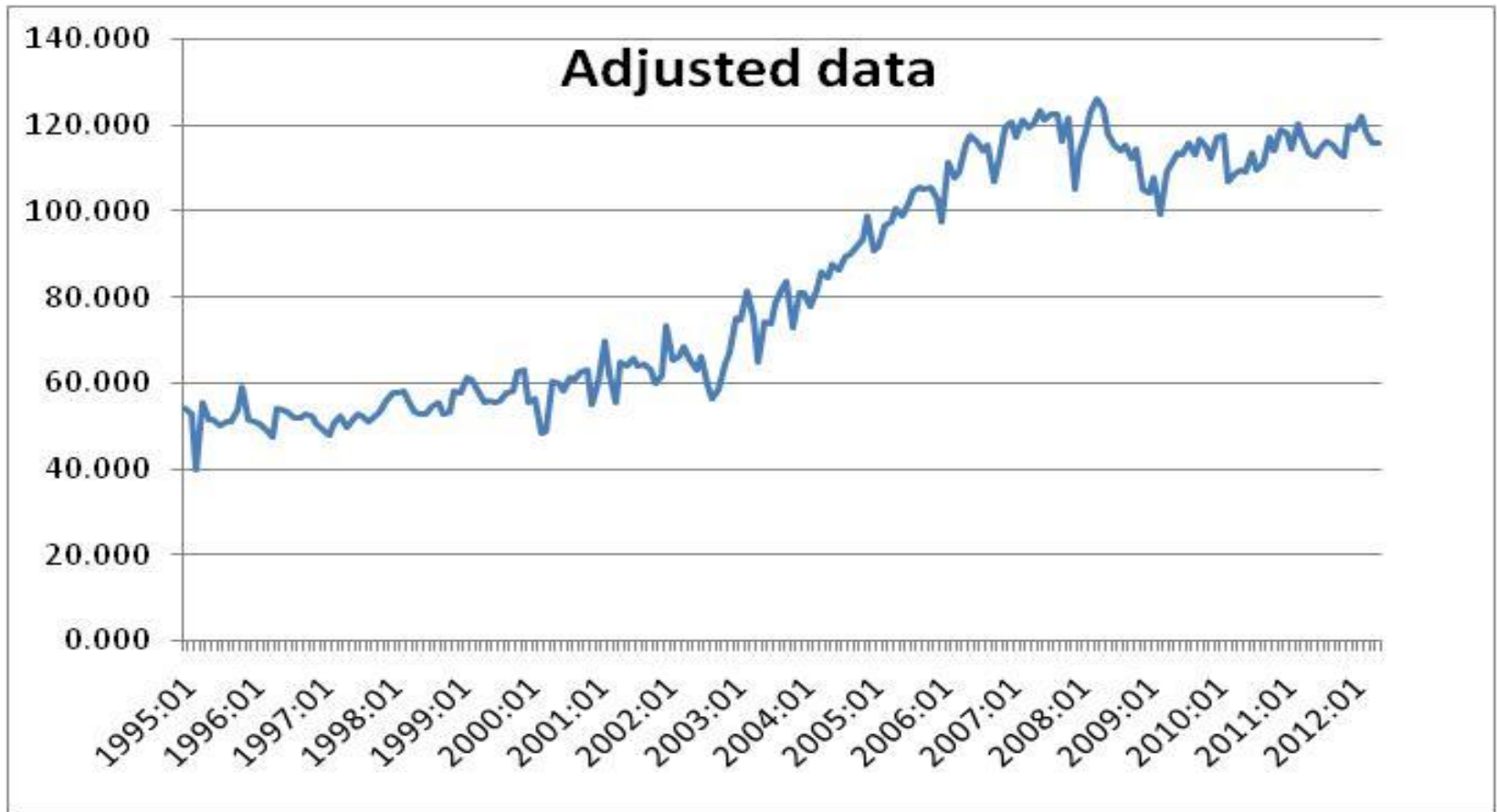
## Pakistan Monthly Manufacturing Production Index, Jan 1995 – May 2012



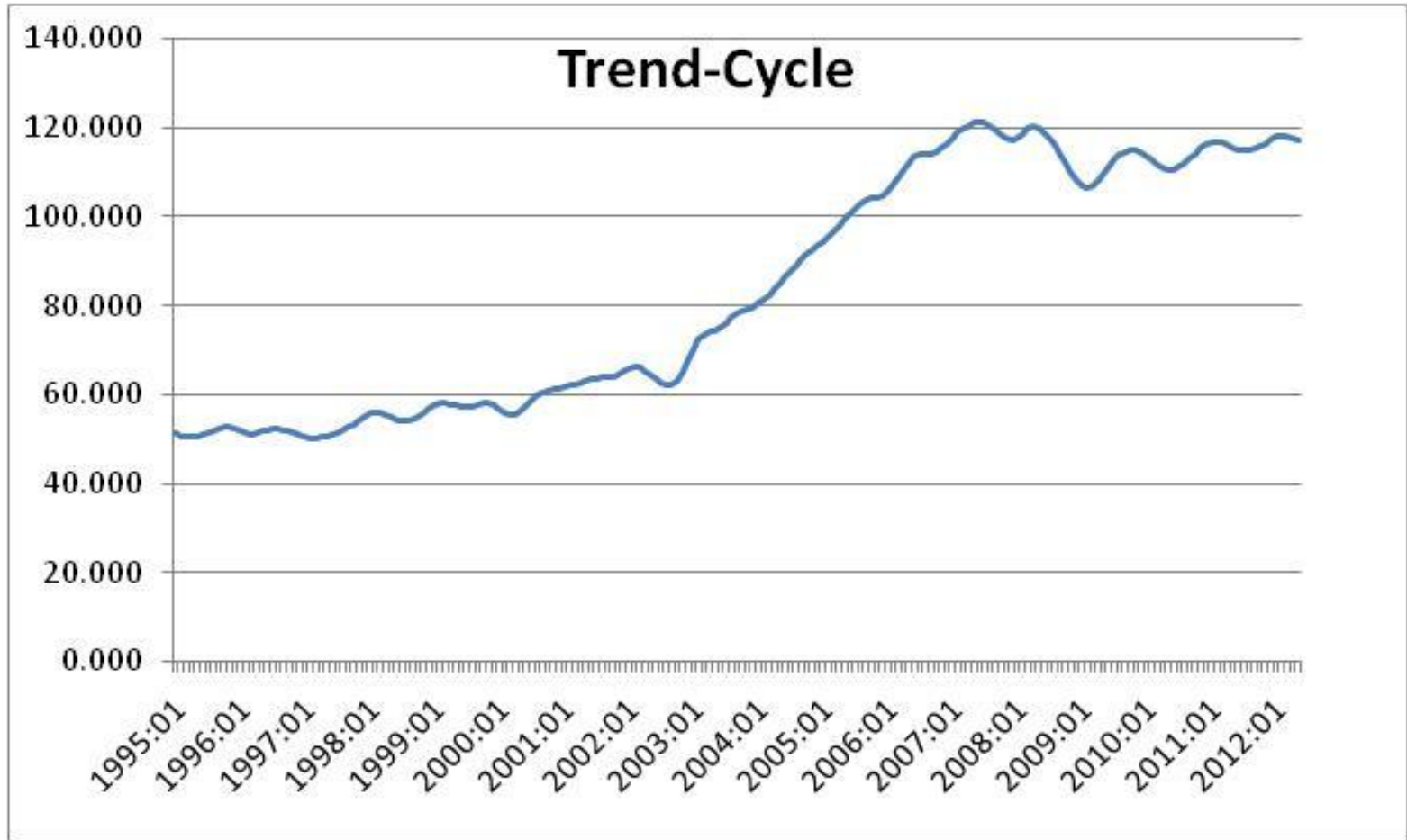
In practice how do we decompose the above time series to estimate trend, cycle, seasonal, irregular elements?

Note: The missing value “blue in colour” was estimated using “one year ahead seasonal factors estimation”.

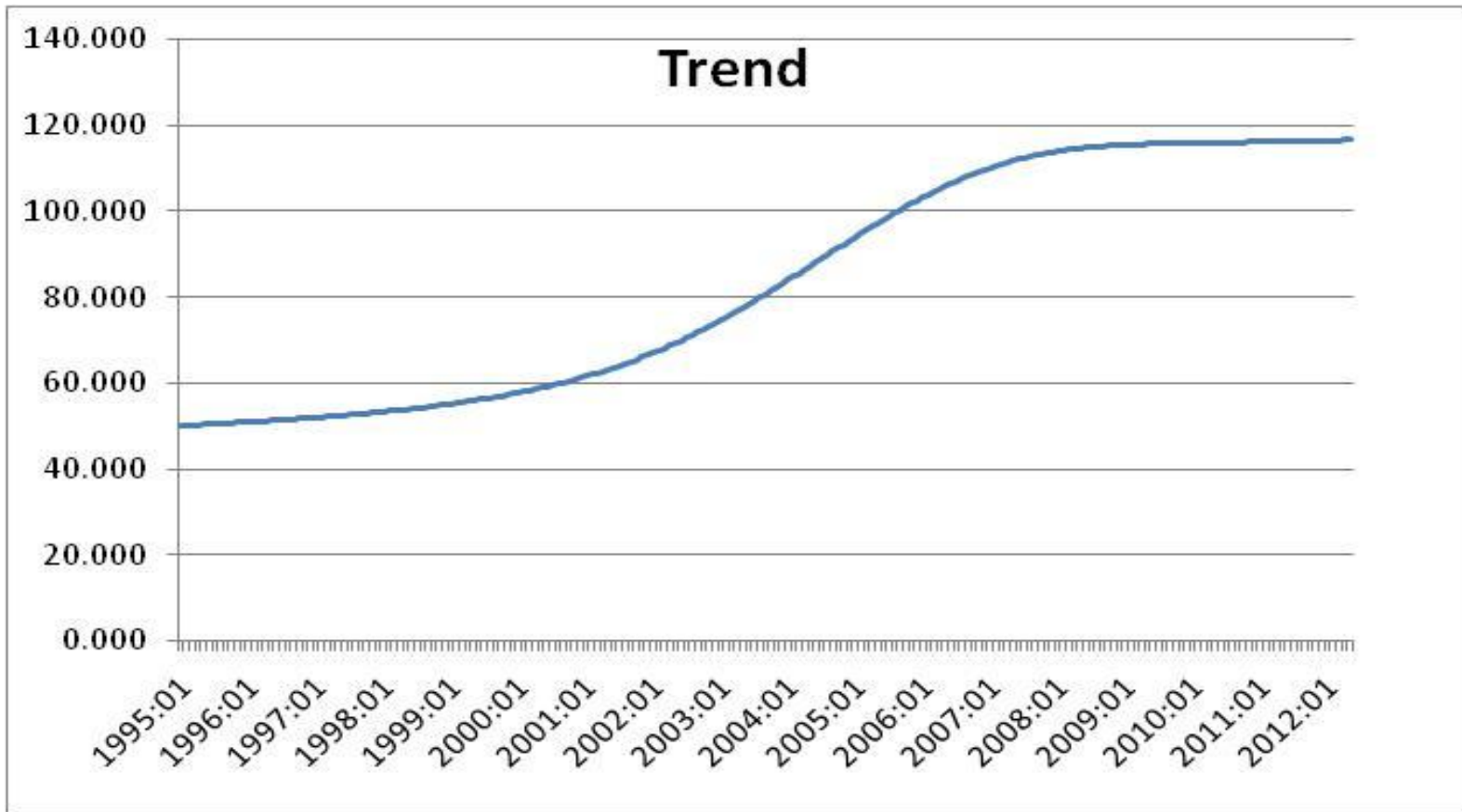
## Pakistan Monthly Manufacturing Production Index, Seasonally Adjusted, Jan 1995 – May 2012



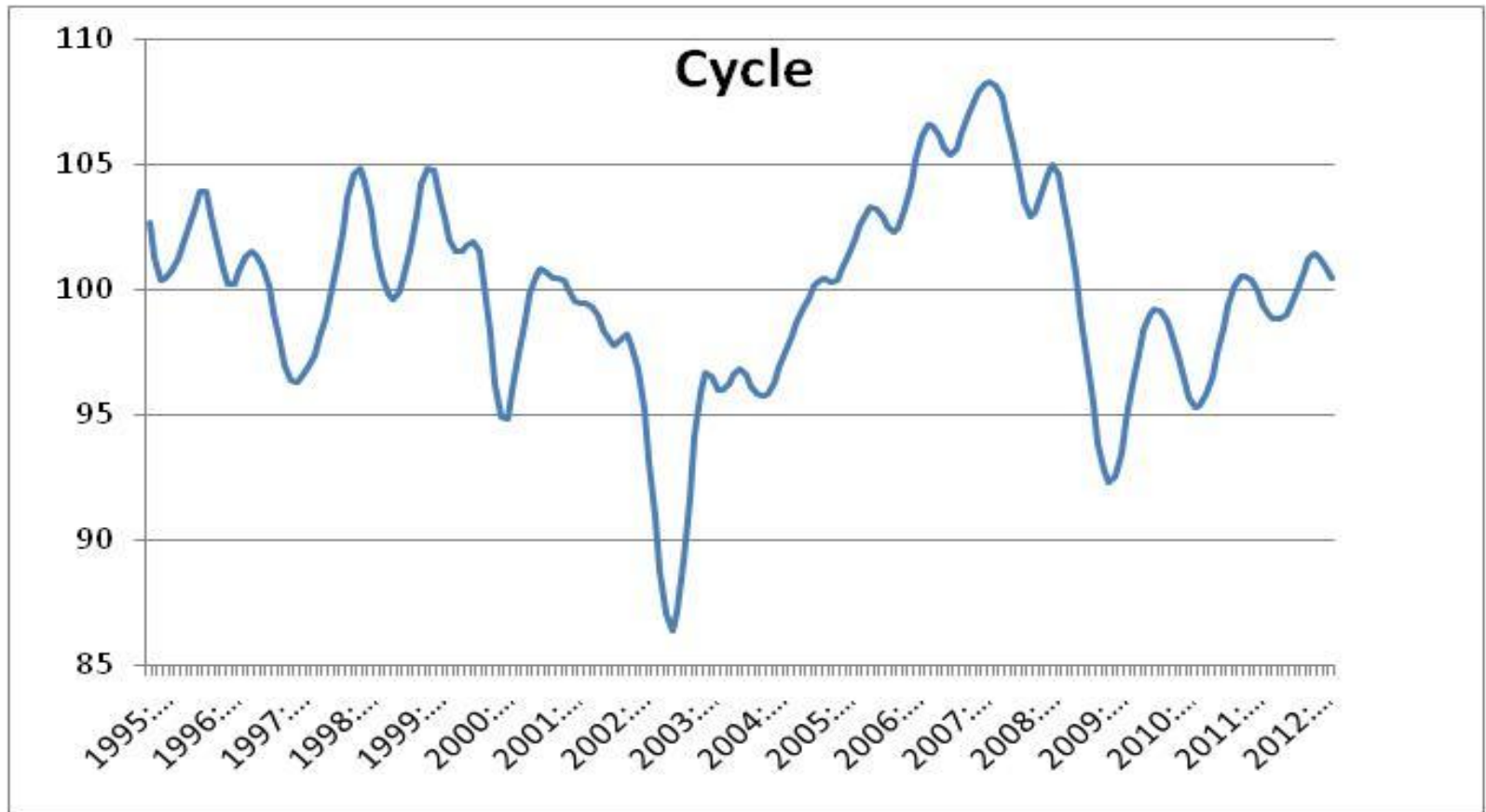
## Trend-Cycle: Pakistan Monthly Manufacturing Production Index, Jan 1995 – May 2012



## Trend:Pakistan Monthly Manufacturing Production Index, Jan 1995 – May 2012



## Cyclical Component: Pakistan Monthly Manufacturing Production Index, Jan 1995 – May 2012





## Issues to be considered for time series decomposition

- Missing Values
- Trend/Structural Break
- Seasonal Adjustment/Moving holiday effects



# THANK YOU

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