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Understanding India's Industrial output through labour economy:

An Empirical study

By

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Abstract

The study examined India's Industrial output through various labour indicators such as labour regulations, unemployment, wages and salaries and net exports. The study covered 1980 to 2015, keeping 1991 to demarcate pre and post-liberalization. The study tested the hypotheses through multiple linear regression, using different forms like log-log and log-linear models. The study showed an inverse relationship between labour regulations and Industry output. Net exports, wages and salaries, and unemployment are positively related to output. The output was enhanced in Post LPG era. The study is restricted to fundamental regression analysis and not extended to time series based econometrics analysis considered a limitation.

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1 Introduction

The Indian economy has unique characteristics. Are started as a socialistic, centrally planned economy under erstwhile Prime Minister Nehru; a paradigm shift occurred in the year 1991-92 under the duo of Rao-Singh towards embracing liberalization, privatization and globalization (LPG), and the current regime continues the neo-liberalism. All these decades, service output has drastically increased, but the growth of Industrial Output has declined. Besides this, unemployment figures are also drastically increased. However, labor regulation is a proxy for employment protection law. The labour regulation of India is much constant, ranging between .40 to .50 in the last four decades; nations like the US are below .20 and France is .80. Higher the score rigidity in labour reforms and lower the score in more flexible labour reforms. Advanced countries showed that labour reforms could enhance employment opportunities and production output. However, there is no evidence that Pro-workers labor laws lead to unemployment and industrial stagnation [Sarkar & Deakin \(2011a\)](#). Past literature showed, especially in the Indian context, [Besley & Burgess \(2002\)](#) research result showed that Indian states that enacted pro-labour regulations experienced a decline in Output, investment, Productivity and employment. A scholar like Bhattacharjea refuted, and further many other scholars questioned the methodology followed by Besley.

1.1 Labour Regulations and Unemployment

One of the world bank reports says ‘laws created to protect workers often hurt them.’ Many studies from developing nations showed that strong labour laws deter investment, and more pro-workers showed less Productivity. On the one hand, government policy is pro-business to enhance the business organization’s investment, export, and Productivity. On the other hand, labour laws do not have much chance for a longer time. The researcher wants to find the relationship between Output, labor regulations, and unemployment in this study. The causal link between Output, unemployment, and labour regulations can be a vicious cycle. A virtuous cycle depends on how the government frames the policy to address Output and unemployment. [Sarkar \(2013\)](#) study used panel data analysis of OECD countries to prove the hypothesis that there is a relationship between employment protection law and unemployment; however, this hypothesis is not proven. It showed no short and long-run relationship between employment protection and long term unemployment. Sarkar suggested that the policymakers look into an alternative to neo-liberal policy to generate employment opportunities. [Sarkar & Deakin \(2011b\)](#) result showed that there is an inverse relationship between labour law and unemployment in the long run, and low unemployment leads to the adoption of pro-workers labour laws.

1.2 Net Exports contributing to Output

Many studies proved that government EXIM policy played a vital role in enhancing the industrial Output. [Saltarelli et al. \(2020\)](#) used World Input-Output Database to show the relationship between domestic production and export at cross country level. Their study outcome showed that export mirror the domestic production level of the country in the manufacturing sector but not in the service sector. There is a significant relationship between exports and domestic production in the manufacturing sectors.

1.3 Wages and Output

[Sabia \(2015\)](#) Previous literature showed a mixed outcome in the relationship between wages and Output. Increasing the minimum wages may increase the Output at a certain level, especially if it is for low skilled workers segments. However, no evidence that increasing minimum wages reduce poverty during the recession. [Strain \(2019\)](#) has the view that there is a strong relationship has existed between wages and Productivity. Further, he suggested that public policymakers attempt to make low skilled workers more productive through vocational education and training, strengthening the relationship between wages and Output.

1.4 Research Question

This study wants to examine the relationship between Output, labour regulations and unemployment. The study covered the data from the license raj regime to the LPG era from 1980 to 2015. The study is interested in addressing the following questions and trying to find convincing answers through econometric techniques.

- Does employment protection affects the Industrial Output?
- Does wages and salaries of employees Increase the Industrial Output?
- Is any relationship between net exports and Industrial Output?
- Is any relationship between unemployment and Industrial Output?

1.5 Objective of the study

The study objective is

- Examine the relationship between Industrial Output and key labor economy variables such as labor regulations, unemployment and wages and salaries.
- To understand the role of net exports on Output

- LPG era (post-1992) made any significant changes compared to the license raj era (1980-1991)

2 Research Methodology and Data

A study used an empirical quantitative method to comprehensively examine the relationship among the selected phenomena. The research question and objective of the study demanded an econometrics based research method. The study used standard linear regression analysis to test the various forms or links between the variables. The study collected data from 1980 to 2015. A dummy variable is used to differentiate between the pre and post LPG era. Pre period coded as 0 and post-period coded as 1. The secondary data sources have been taken from COMTRADE, ILO and RBI bulletin.

2.1 Research Hypothesis

To examine the relationship between the Industrial output and other variables such as unemployment, labour regulations, wages and salaries and net exports. The study formulated the hypothesis. They are given below:

- H1: There is a relationship between unemployment and the Industrial output of the Indian economy
- H2: There is a relationship between labour regulations and the Industrial output of the Indian economy
- H3: There is a relationship between Net Exports and the Industrial output of the Indian economy
- H4: There is a relationship between Wages and Salaries and the Industrial output of the Indian economy
- H5: Unemployment, labour regulations, Net Exports and Wages & Salaries enacted as predictors of the Industrial output of the Indian economy

2.2 Data Analysis approach

The study followed econometrics techniques suggested by [Gujarati et al. \(2012\)](#). Firstly, the researcher explored the distribution of each variable using a line graph. It helps to understand the trends or patterns. Secondly, all the absolute figures are transformed into logarithmic form, and this helps reduce the variance between the data points, which is usual practice in an econometric study. Thirdly, to address the time factor of one lag, data is different for lag 1. Fourthly, OLS regression is employed in various forms: linear model, log-log model, and linear-log model. At last, assumptions of regression are tested on residuals of each form. Critical assumption tests are normality, autocorrelation and

homoscedasticity. The data analysis approach is given below in the form of a flow chart.

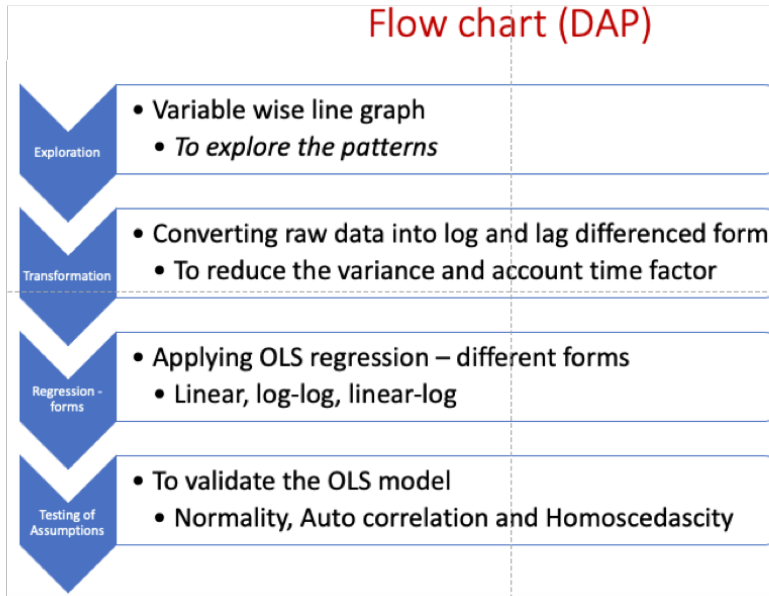


Figure 1: DAP Flow chart

3 Empirical Results

3.1 Descriptive statistics

Data analysis is carried out to test the research hypothesis. The below table 1 and 2 showed basic summary statistics of the selected variables between pre and post LPG period. Dummy variable is created period 1980 to 1991 indicated as 0 and post 1991 indicated as 1. Labour regulation is normalized score ranged between 0 to 1. Unemployment, Output, Wages & salaries, Net export are (INR in millions) units and Productivity (value added/No. of employees). Variables such as Output, Net exports, Wages and salaries and Unemployment are transformed into log form. Except labour regulations all other variables are increased over the period. (Refer Annexure for graphs)

Table 1: Descriptitve statistics Pre LPG 1980-91

	mean	sd	min	max
Lab_Reg	0.49	0.04	0.43	0.53
UNEMP	20014.50	9887.09	6900.00	36300.00
Output	5593921.75	2053568.28	2922405.00	9982810.00
Wages_Salaries	515790.15	119865.89	345065.00	745032.00
Net_Export	498747.75	216221.08	229942.00	1026726.00
LN_UNEMP	9.77	0.55	8.84	10.50
LN_Output	15.47	0.37	14.89	16.12
LN_W.S	13.13	0.24	12.75	13.52
LN_Net_Export	13.04	0.40	12.35	13.84

Table 2: Descriptitve statistics Post LPG 1992-2015

	mean	sd	min	max
Lab_Reg	0.51	0.02	0.49	0.53
UNEMP	40293.91	3062.52	36280.00	48260.00
Output	28646353.44	16431227.20	9647617.00	54644815.00
Wages_Salaries	1201576.96	449243.63	714346.00	2114872.00
Net_Export	6077527.96	4902487.49	1205963.00	17453924.00
LN_UNEMP	10.60	0.07	10.50	10.78
LN_Output	17.01	0.59	16.08	17.82
LN_W.S	13.94	0.35	13.48	14.56
LN_Net_Export	15.31	0.81	14.00	16.68

3.2 Regression Analysis

OLS regression is used to test the hypothesis. Three models are employed. Model 1 - linear, Model 2 - Log and Model 3 - Differences log. The Output of three models are discussed below:

=====			
Dependent variable:			
	Output	LN_Output	diff_LN_Output
	(1)	(2)	(3)

Constant	21,987,510.000** (9,567,604.000)	0.678 (0.777)	0.003 (0.142)
Lab_Reg	-64,907,274.000*** (22,646,742.000)	-2.726*** (0.879)	0.066 (0.287)
UNEMP	92.442 (90.510)		
Net_Export	1.046*** (0.378)		
Wages_Salaries	25.538*** (3.688)		
LN_UNEMP		0.318*** (0.080)	
LN_Net_Export		0.464*** (0.047)	
LN_W.S		0.531*** (0.107)	
diff_LN_UNEMP			0.005 (0.005)
diff_LN_Net_Export			0.088 (0.077)
diff_LN_WS			0.529*** (0.126)
Pre_vs_Post	-366,149.900 (1,319,273.000)	-0.156*** (0.048)	0.002 (0.017)

Observations	43	43	45
R2	0.983	0.995	0.384
Adjusted R2	0.981	0.994	0.305
Residual Std. Error	2,104,009.000 (df = 37)	0.070 (df = 37)	0.053 (df = 39)
F Statistic	435.515*** (df = 5; 37)	1,338.715*** (df = 5; 37)	4.869*** (df = 5; 39)
=====			
Note:	*p<0.1; **p<0.05; ***p<0.01		

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$$\widehat{\text{Output}} = 21987510.23 - 64907274.27(\text{Lab_Reg}) + 92.44(\text{UNEMP}) + 1.05(\text{Net_Export}) + 25.54(\text{Wages_Salaries}) - 366149.86(\text{Pre_vs_Post}) \quad (1)$$

Model 1 showed, **labor regulations, net export, and wages are statistically significant with output**, Adj R sqr = .981, F= 435.1 and P <.01. The output showed that the model established a linear relationship between output and selected predictors

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$$\widehat{\text{LN_Output}} = 0.68 - 2.73(\text{Lab_Reg}) + 0.32(\text{LN_UNEMP}) + 0.46(\text{LN_Net_Export}) + 0.53(\text{LN_W.S}) - 0.16(\text{Pre_vs_Post}) \quad (2)$$

Model 2 showed **labor regulations, unemployment, net export, wages and dummy variable all are statistically significant with output**, Adj R sqr = .994, F= 1338.7 and P <.01. Labour regulation and output are inversely related; through the dummy, it is understood that output is enhanced in the post LPG era by 15.6%. Unemployment, net exports, and wages are positively related to output. Net export can enhance output by 46% and wage by 53%.

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$$\widehat{\text{diff_LN_Output}} = 0 + 0.07(\text{Lab_Reg}) + 0.01(\text{diff_LN_UNEMP}) + 0.09(\text{diff_LN_Net_Export}) + 0.53(\text{diff_LN_WS}) + 0(\text{Pre_vs_Post}) \quad (3)$$

Model 3, differenced log of output regressed with predictors. **wages and salaries are statistically significant with output, rest are non significant**, Adj R sq = .305, F= 4.86 and P <.01. All three models are statistically significant. However, a violation of the assumption test is required to validate all models.

3.3 Assumptions of Regression Test

3.3.1 Normality test

- H0 (null hypothesis): There is normal distribution in residuals
- HA (alternative hypothesis): There is non normal distribution in residuals

Table 3 shows the result of the normality test using Jarque Bera. since all the p values are >.05, all three models attained normality. Models satisfied the criteria of normality.

Table 3: Normality Test

	statistic	p.value	parameter	method
linear	2.394	0.302	2	Jarque Bera Test
log	1.504	0.471	2	Jarque Bera Test
diff	0.596	0.742	2	Jarque Bera Test

3.3.2 Homoscedasticity Test

- H0 (null hypothesis): There is homoscedascity among the residuals.
- HA (alternative hypothesis): There is no homoscedascity among the residuals.

Table 4 shows whether the error is distributed equally or not across the different data points of predictors. Breusch-Pagan test result showed that the linear model failed to satisfy the criteria. However, the log and diff model obtained a p-value > .05, which do not violate the linear model's assumptions.

Table 4: Homoscedascity Test

	statistic	p.value	parameter	method
linear	18.585	0.002	5	studentized Breusch-Pagan test
log	8.785	0.118	5	studentized Breusch-Pagan test

	statistic	p.value	parameter	method
diff	5.150	0.398	5	studentized Breusch-Pagan test

3.3.3 Autocorrelation Test

- H0 (null hypothesis): There is no correlation among the residuals.
- HA (alternative hypothesis): The residuals are autocorrelated.

Table 5 shows the autocorrelation result through the Durbin-Watson (DW) test. Both linear and log models violated the assumptions because it does not account for the time factor, but the diff model indirectly accounted for the time factor. Model 3 satisfied the criteria.

Table 5: Autocorrelation Test

	statistic	p.value	autocorrelation	method	alternative
linear	0.598	0.00	0.588	Durbin-Watson Test	two.sided
log	0.948	0.00	0.416	Durbin-Watson Test	two.sided
diff	2.033	0.77	-0.045	Durbin-Watson Test	two.sided

4 Findings and Discussion

4.1 Discussion

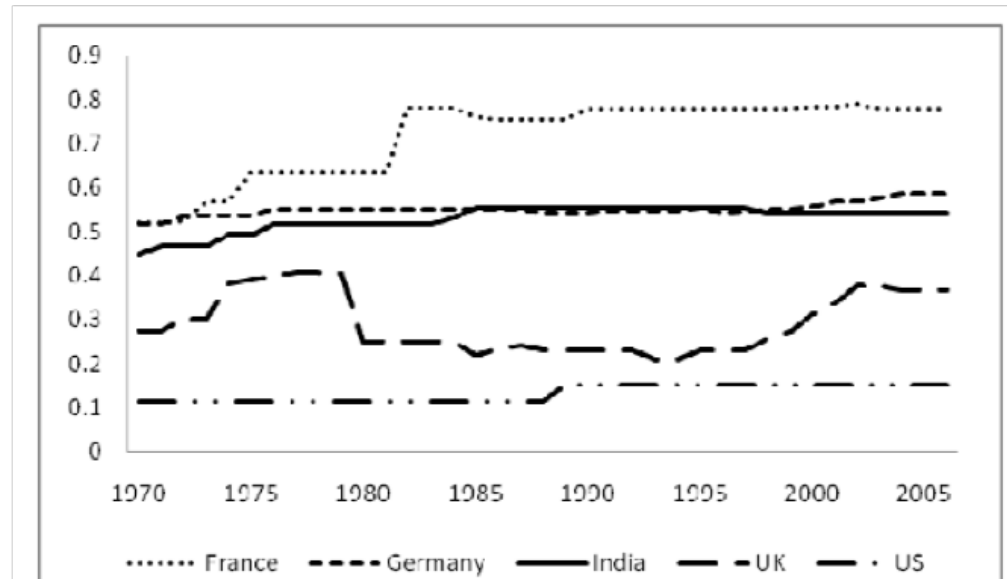
The study tested the three linear models to determine the relationship between output and the set of predictors. Among the three models, model 2 - log-log model seems to be more aligned with the result of prior literature. The relationship between labour regulation and output is inverse; net exports and wages and salaries positively relate to output. The other two models are not well established. Even in terms of the assumption test, model 2 looks better, though autocorrelation is not satisfied. **For the policymakers, the model 2 result echoes the previous literature. Labour reforms are needed to enhance the output in the Indian manufacturing sector, and It is time for India to make labour regulations more flexible. In turn, it may accelerate the economic output**

4.2 Limitations

Though the current study followed OLS and econometric techniques, still statistical rigour is missing, especially since all the economic variables such as output, net export, and unemployment are in the non-stationary data. It is better to use stationary data after differences, and also, the application of the cointegration and vector error correction model may be most suitable than fundamental analysis. Besides this, literature supported output can be independent, and other predictors can be turned into a dependent variable. It is better to use typical time series analysis to understand the phenomena better than fundamental regression analysis.

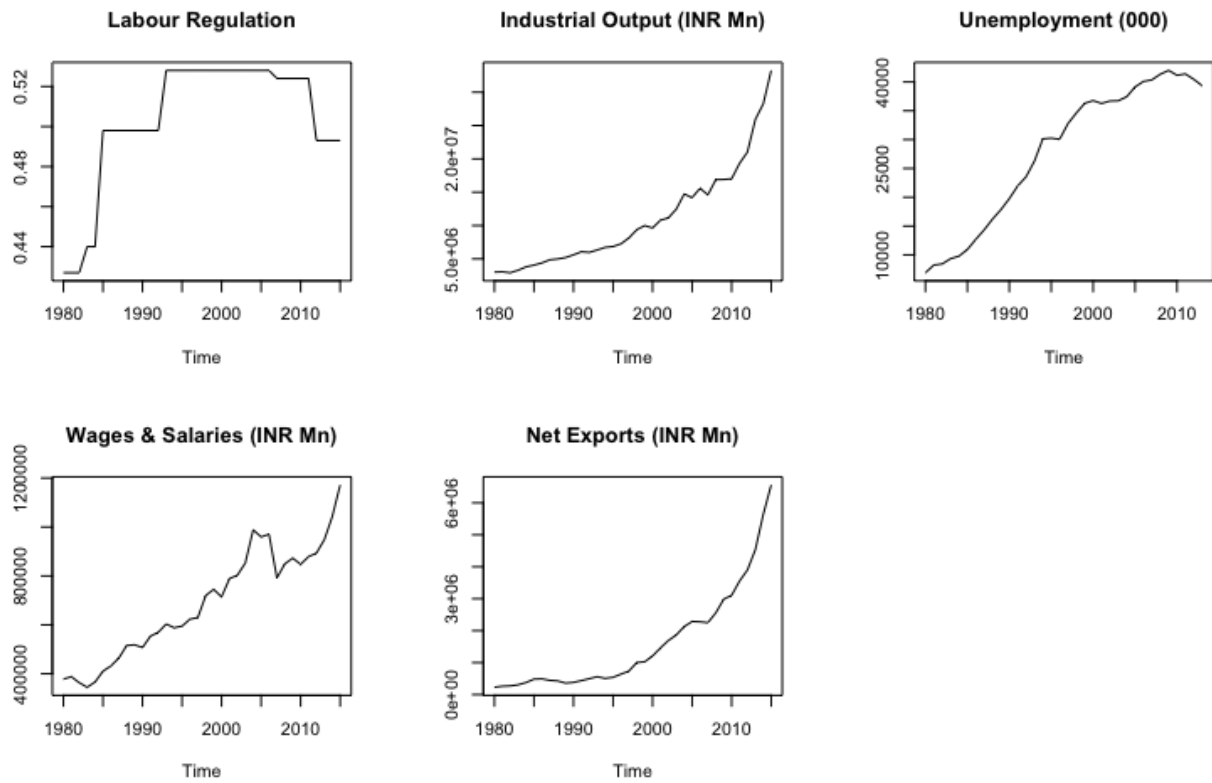
5 Appendix

5.1 Appendix A: Labour Regulations - different countries

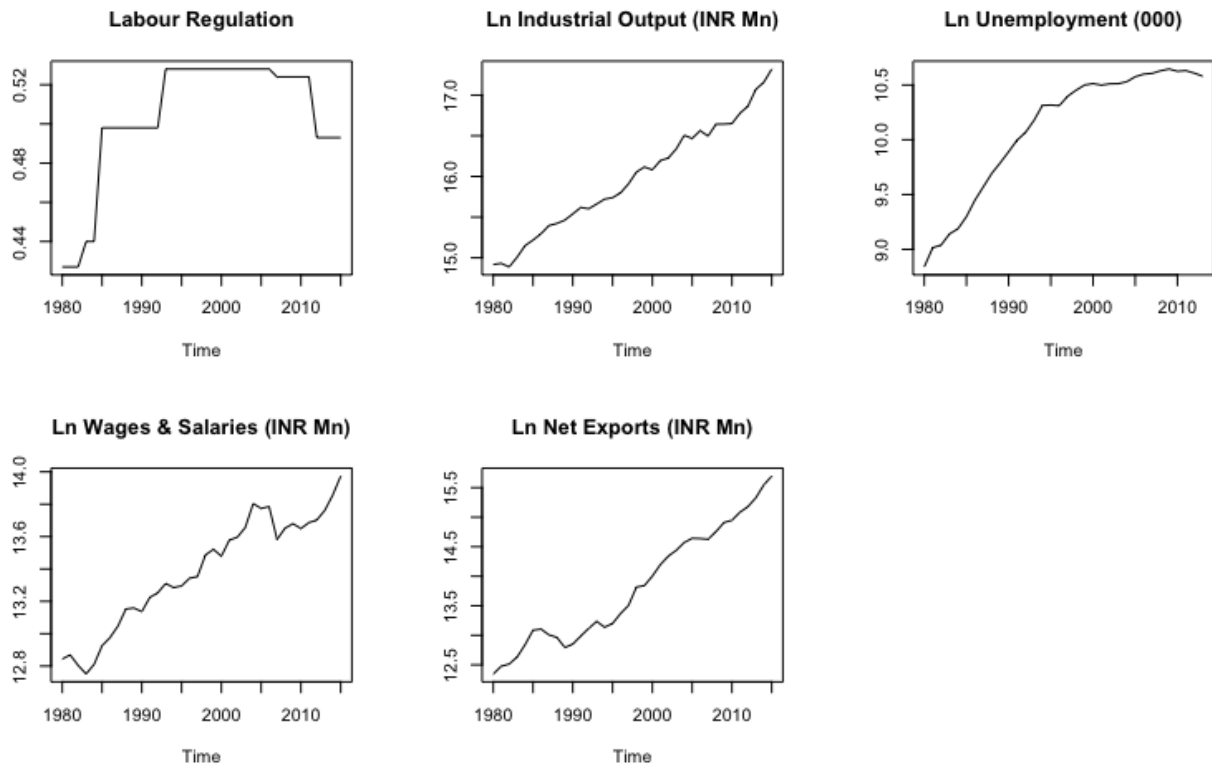


5.2 Appendix B: Key variables used in the study

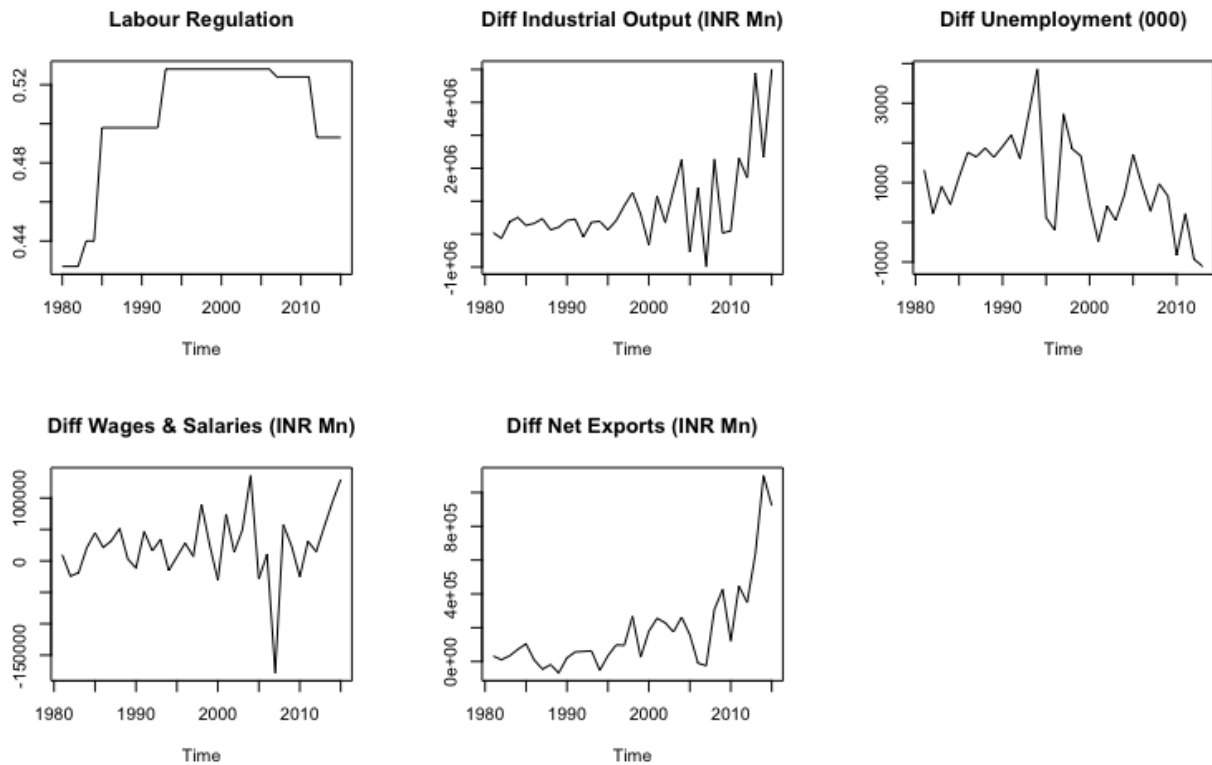
5.2.1 Graph 1 - Raw data



5.2.2 Graph 2 - Transformed data



5.2.3 Graph 3 - Differenced data



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