GLOBAL SEMICONDUCTOR SHORTAGE

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ECONOMY

Shortage of semiconductors, dubbed the 'new oil,' could dent GDP growth, boost inflation

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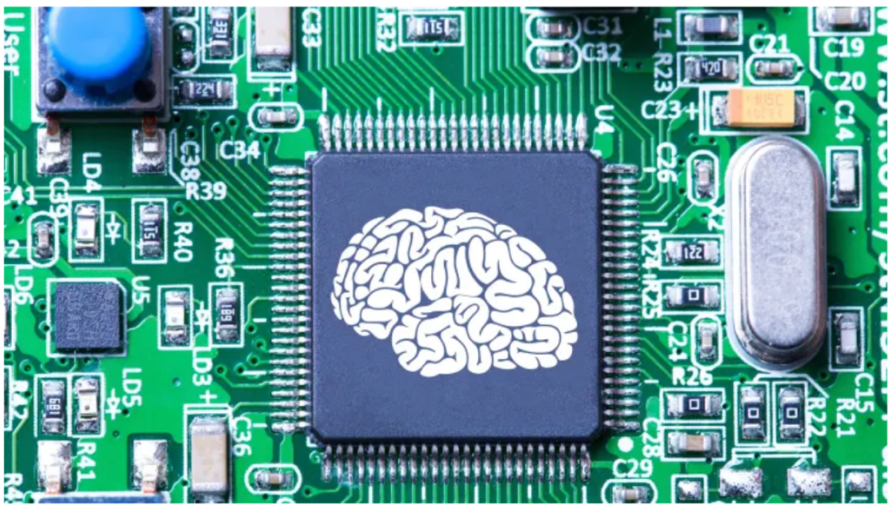
KEY POINTS

- A variety of factors have converged to make coveted semiconductors scarce.
- Goldman Sachs says the GDP hit from the shortage could be 0.5% this year while price increases could hit 3% for affected goods.
- TS Lombard economist Rory Green calls semis the "new oil" for the global impact that disruptions can cause.



China laid out seven "frontier" technologies in its 14th Five Year Plan. These are areas that China will focus research on and include semiconductors and brain-computer fusion.

Yuichiro Chino | Moment | Getty Images

INTRODUCTION: A variety of factors have converged to make the coveted computer chips scarce. Soaring demand coupled with supply bottlenecks have led to a situation in which orders for everything from cars to televisions to touch-screen computers and more are on backup for six months or more. The market for semiconductors has been volatile in the last 2 years and experts predict supply chain challenges across the semiconductor industry will extend to late 2023 and early 2024.

In this statistical analysis, we will analyse the current semiconductor market scenario from a financial perspective using various statistical tools. This analysis is done using a secondary dataset named "Semiconductor shortage" provided by kaggle. The dataset carries semiconductor market data from 1985 to 2021.

THE DATASET HAS 10 COLUMNS Each one is as follows
Date: given in dd/mm/yy format.
Producer Price Index(By Industry in $): It is a group of indexes that calculates and represents the average movement in selling prices from domestic production over time.
Import and Export Price Index: measure the change in prices of goods and services purchased from abroad by U.S. consumers and businesses (imports) and sold to foreign buyers
No. of employed peoples in the semiconductor industry: employment indicator.
Export Price Index (End-use excluding without semiconductors): measure the change in prices of goods and services purchased from abroad by U.S. consumers and businesses (imports) and sold to foreign buyers but without including semiconductor.
Relative Importance Weights : (Contribution to the Total Industrial Production Index % WISE)
Import Price Index(End Use): Capital Goods, Excluding Computers, Peripherals, and Semiconductors.
Export Price Index(End Use): Capital Goods, Excluding Computers, Peripherals, and Semiconductors
Industrial Production: Non-Energy Excluding Motor Vehicles & Parts, Computers, Communications Equipment, and Semiconductors
Intel share price: Maximum share price of Intel each year

OBJECTIVE 1: Study the change in average movement in selling prices from domestic production over time, over a period of 36 years.

PROCEDURE:
- Keeping the cursor within the dataset go to insert
- Insert pivot table
- Select date for rows
- Select producer price in value
- Click on "i", and change value to average
- Now pivot table is generated
- Go to data tab
- Go to data analysis
- Select summary statistics
- Select input range
- Select output range
- Click OK

- Summary statistics is generated
- Select the desired column
- Go to insert
- Select 2D line graph
- Graph is generated

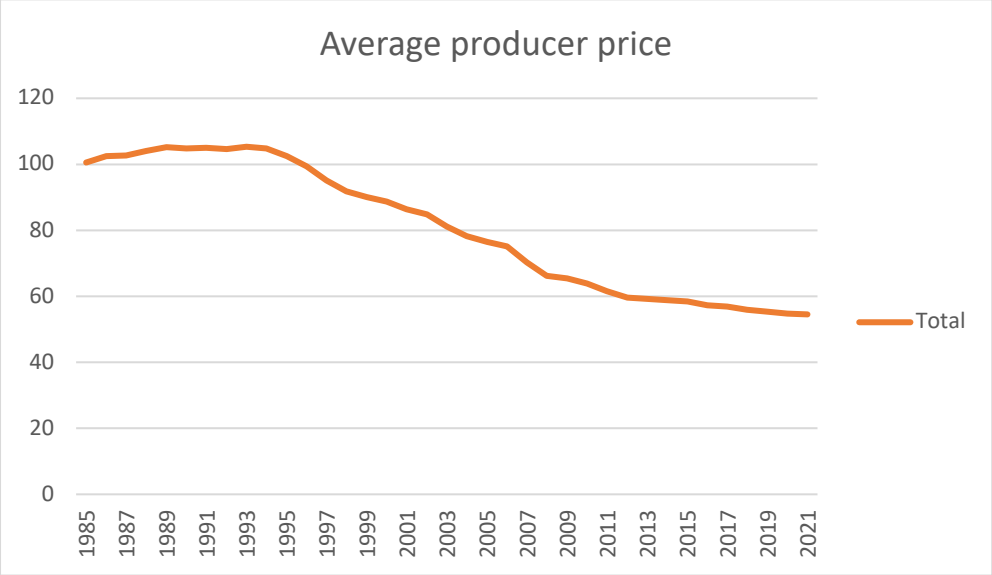
RESULT:

Row Labels	Average of Producer Price Index(By Industry in $)
1985	100.525
1986	102.4416667
1987	102.6333333
1988	104.0333333
1989	105.1083333
1990	104.8916667
1991	104.9333333
1992	104.6083333
1993	105.325
1994	104.7666667
1995	102.55
1996	99.30833333
1997	95.13333333
1998	91.85
1999	90.09166667
2000	88.75833333
2001	86.38333333
2002	84.85833333
2003	81.08333333
2004	78.26666667
2005	76.49166667
2006	75.14166667
2007	70.2
2008	66.26666667
2009	65.39166667
2010	63.85833333
2011	61.55
2012	59.51666667
2013	59.23333333
2014	58.775
2015	58.38333333
2016	57.33333333
2017	56.80833333
2018	55.975
2019	55.34166667

2020	**54.76666667**
2021	**54.5222**
Grand Total	**80.851181**

Producer Price Index(By Industry in $)

Mean	80.851181
Standard Error	0.91353317
Median	82.25
Mode	105.3
Standard Deviation	19.2059349
Sample Variance	368.867937
Kurtosis	-1.6217461
Skewness	-0.0290287
Range	51.9
Minimum	53.8
Maximum	105.7
Sum	35736.222
Count	442



INFERENCE:
The above analysis indicates that for the past 35 years the producer price, which is essentially the selling price for semiconductors has been decreasing, while the average producer price for the past 35 years is 80.85.

OBJECTIVE 2: Study the change in industrial production of non-energy semiconductors over a period of 36 years.

PROCEDURE:

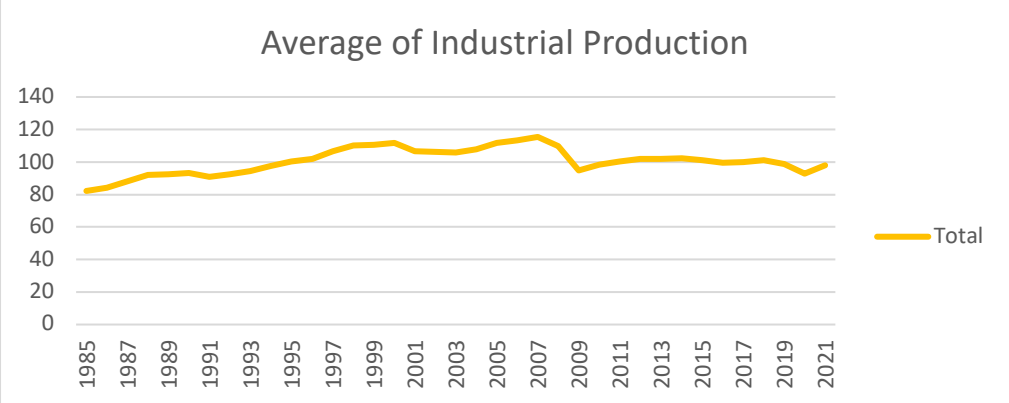
- Keeping the cursor within the dataset go to insert
- Insert pivot table
- Select date for rows
- Select industrial production, in value
- Click on “i”, and change value to average
- Now pivot table is generated
- Go to data tab
- Go to data analysis
- Select summary statistics
- Select input range
- Select output range
- Click OK
- Summary statistics is generated
- Select the desired column
- Go to insert
- Select 2D line graph
- Graph is generated

RESULT:

Row Labels	Average of Industrial Production: Non-Energy Excluding Motor Vehicles & Parts, Computers, Communications Equipment, and Semiconductors
1985	82.19283333
1986	84.1911
1987	88.15076667
1988	92.01890833
1989	92.59428333
1990	93.191175
1991	90.89070833
1992	92.57068333
1993	94.41559167
1994	97.74721667
1995	100.1887
1996	101.7829833
1997	106.6155167
1998	110.366625
1999	110.7131667
2000	111.6729417
2001	106.779125
2002	106.087875
2003	105.7138667
2004	107.9435833
2005	111.5686917
2006	113.4969667
2007	115.4312917

2008	**109.7288**
2009	**94.8584**
2010	**98.257825**
2011	**100.2446667**
2012	**101.8611083**
2013	**101.7720417**
2014	**102.31865**
2015	**101.1579083**
2016	**99.64334167**
2017	**99.99999167**
2018	**100.9291917**
2019	**98.77105**
2020	**93.01331667**
2021	**97.91566**
Grand Total	**100.4654464**

Industrial Production: Non-Energy Excluding Motor Vehicles & Parts, Computers, Communications Equipment, and Semiconductors	
Mean	100.4654464
Standard Error	0.387685538
Median	100.4375
Mode	#N/A
Standard Deviation	8.15062167
Sample Variance	66.4326336
Kurtosis	-0.454907465
Skewness	-0.175513804
Range	34.6931
Minimum	81.43
Maximum	116.1231
Sum	44405.7273
Count	442



INFERENCE:
From the above statistic we can conclude that the average industrial production of semiconductors has been almost constant for the past 35 years, which might be a reason for the shortage because it is evident, with time the demand for semiconductors has been increasing but since the production has been constant, a shortage was evident.

SUGGESTIONS: The industrial production should be increased with increasing demand, else we might have to face more of such shortages in future.

OBJECTIVE 3: Study the change in number of employees over a period of 36 years.

PROCEDURE:

- Keeping the cursor within the dataset go to insert
- Insert pivot table
- Select date for rows
- Select number of employees in value
- Click on "i", and change value to average
- Now pivot table is generated
- Go to data tab
- Go to data analysis
- Select summary statistics
- Select input range
- Select output range
- Click OK
- Summary statistics is generated
- Select the desired column
- Go to insert
- Select 2D line graph
- Graph is generated

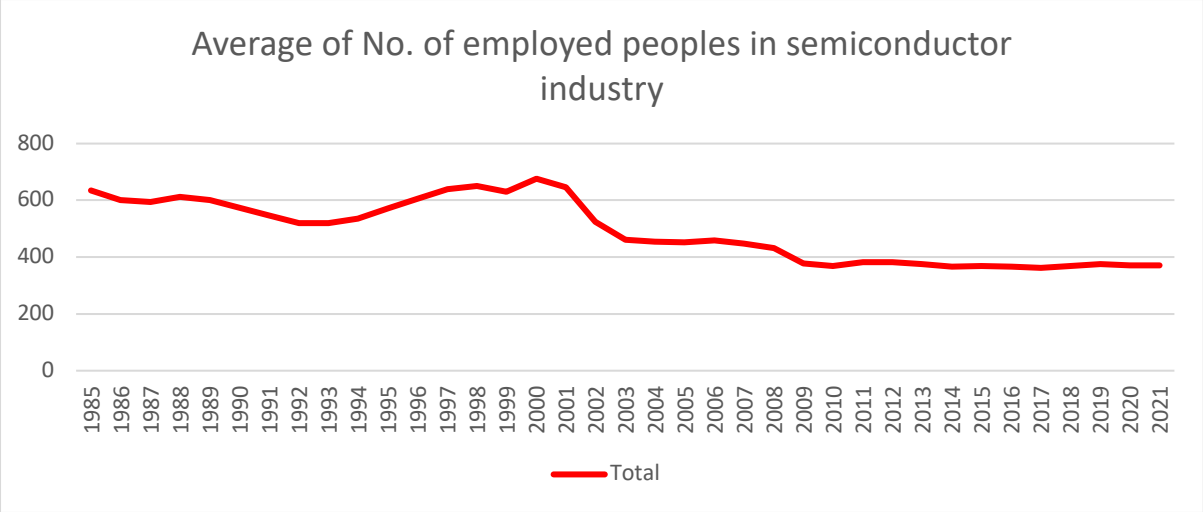
RESULT:

Row Labels	Average of No. of employed peoples in semiconductor industry
1985	635.7583333
1986	601.55
1987	593.2166667
1988	611.575
1989	601.4333333
1990	573.85
1991	546.475
1992	519.575
1993	519.5083333
1994	535.2166667
1995	570.9666667
1996	606.6
1997	639.8333333
1998	650.025

1999	**630.6083333**
2000	**676.225**
2001	**645.225**
2002	**524.4166667**
2003	**461.0583333**
2004	**454.1416667**
2005	**451.875**
2006	**457.85**
2007	**447.5**
2008	**431.75**
2009	**378.25**
2010	**369.4416667**
2011	**383.1**
2012	**383.05**
2013	**374.9**
2014	**367.3083333**
2015	**369.5833333**
2016	**367.1583333**
2017	**362.1583333**
2018	**369.125**
2019	**375.975**
2020	**370.1666667**
2021	**371.98**
Grand Total	**493.2063348**

No. of employed peoples in semiconductor industry

Mean	493.2063348
Standard Error	5.12230305
Median	462.65
Mode	374.7
Standard Deviation	107.6902546
Sample Variance	11597.19093
Kurtosis	-1.429685823
Skewness	0.190605791
Range	354.7
Minimum	359.8
Maximum	714.5
Sum	217997.2
Count	442



INFERENCE:
From the above visualization we can say that the number of employees in the semiconductor industry has been decreasing from 1985 to 2008. After that till 2021 the number of employees has hardly changed, this indicates due to some factors the human labour required was reducing till 2008 but after that the effect of the factor has reduced.

OBJECTIVE 4: Visualise impact of semiconductor market on major manufacturer Intel's share price.

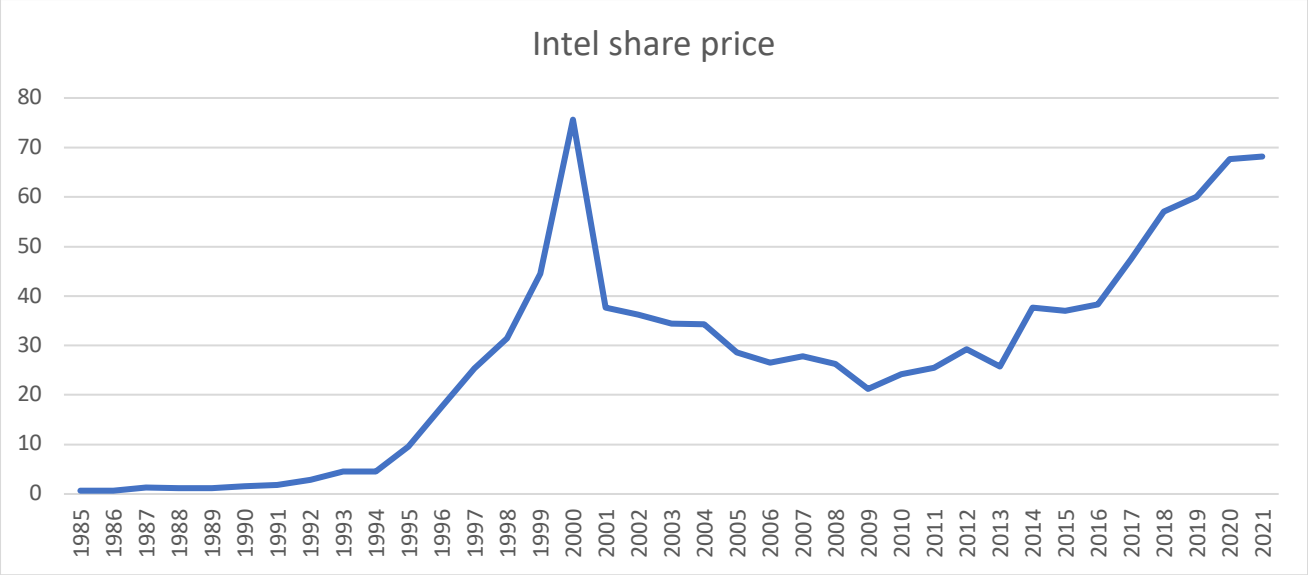
PROCEDURE:

- Keeping the cursor within the dataset go to insert
- Insert pivot table
- Select date for rows
- Select number of employees in value
- Click on "i", and change value to average
- Now pivot table is generated
- Go to data tab
- Go to data analysis
- Select summary statistics
- Select input range
- Select output range
- Click OK
- Summary statistics is generated
- Select the desired column
- Go to insert
- Select 2D line graph
- Graph is generated

RESULT:

Row Labels	Max. of Intel share price
1985	0.666667
1986	0.666667

1987	1.302083
1988	1.148438
1989	1.117188
1990	1.609375
1991	1.851563
1992	2.835938
1993	4.59375
1994	4.546875
1995	9.640625
1996	17.640625
1997	25.375
1998	31.421875
1999	44.5
2000	75.625
2001	37.671875
2002	36.200001
2003	34.419998
2004	34.330002
2005	28.620001
2006	26.48
2007	27.790001
2008	26.280001
2009	21.26
2010	24.200001
2011	25.450001
2012	29.26
2013	25.809999
2014	37.68
2015	36.959999
2016	38.25
2017	47.540001
2018	57.009998
2019	59.990002
2020	67.629997
2021	68.199997
Grand Total	75.625



INFERENCE: From the past two years i.e. from 2019 to 2021 the growth in share price can be seen stabilizing this could be a result of the semiconductor shortage in the global market creating fear amongst investors.

OBJECTIVE 5: Pie chart to visualize for what part of the time over a period of 42 years shows what level of contribution to the global market has been made by the US.

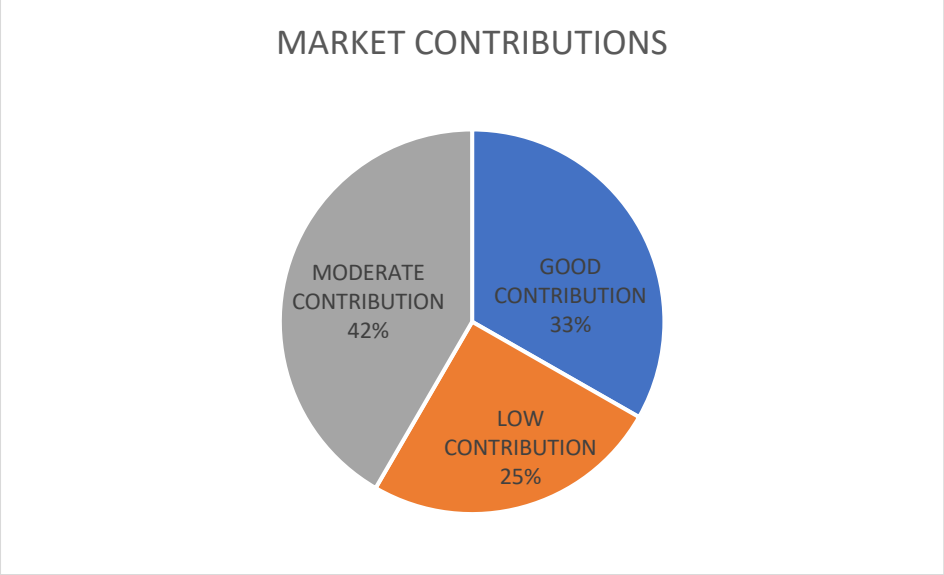
PROCEDURE:

- Keeping the cursor within the dataset go to insert
- Insert pivot table
- Select date for rows
- Select number of employees in value
- Click on “i”, and change value to average
- Now pivot table is generated
- Go to data tab
- Go to data analysis
- Select summary statistics
- Select input range
- Select output range
- Click OK
- Summary statistics is generated
- Select the desired column
- Go to insert
- Select pie chart
- Pie chart is generated

RESULT:

Row Labels	Count of Contribution remark
GOOD CONTRIBUTION	147
LOW CONTRIBUTION	111
MODERATE CONTRIBUTION	184

Grand Total	442



OBJECTIVE 6: Regression analysis model where number of employees is a dependent variable and producer price, export price and import price are independent variables.

INFERENCE: For most part of time there has been a moderate contribution made by the US.

PROCEDURE:

- Go to data tab
- Go to data analysis
- Select regression
- Select Y range as the number of employees
- Select X range as the producer price, export price and import price which are independent variables
- Select output range
- Click OK

RESULT:

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.929300225
R Square	0.863598908
Adjusted R Square	0.862664654
Standard Error	39.90869861
Observations	442

ANOVA

c	*df*	*SS*	*MS*	*F*	*Significance F*
Regression	3	4416756.752	1472252.251	924.372666	5.21E-189
Residual	438	697604.4505	1592.704225		
Total	441	5114361.202			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-48.73038297	13.71810863	-3.552266883	0.00042338	-75.69188331	-21.768883	-75.691883	-21.768883
Producer Price Index(By Industry in $)	10.83127776	0.42305 5927	25.60247252	4.7218E-89	9.99980 5807	11.662 7497	9.9998 0581	11.662 7497
Export Price Index(End Use of semiconductors)	1.364010539	0.19295 0602	7.069221474	6.1873E-12	0.98478 6415	1.7432 3466	0.9847 8642	1.7432 3466
Import Price Index(in $ End Use of semiconductors)	-4.582987382	0.24522 578	-18.688 84821	9.718E-58	-5.06495 2873	-4.1010 219	-5.0649 529	-4.1010 219

INFERENCE:

- Since p value of producer price is less than 0.05, producer price is significant in determining the number of employees.
- Since p value of export price is less than 0.05, export price is significant in determining the number of employees.
- Since p value of import price is less than 0.05, import price is significant in determining the number of employees.
- This means 86.35% of the proportion variance of no. of employees can be explained by the independent variables producer price, export price and import price.
- Since the value of significance F is lesser than 0.05, we can conclude that overall model is a good fit.

- R square value indicates that 86.35% of the proportion variance of no. of employees can be explained by the independent variables producer price, export price and import price.

OBJECTIVE 7: Correlation between number of employees and the export price

PROCEDURE:

- Go to data tab
- Go to data analysis
- Select correlation
- Select input range
- Select output range
- Click OK

RESULT:

	No. of employees in industry	*Export Price Index*
No. of employees in industry	1	
Export Price Index	0.74643827	1

INFERENCE:
There is a strong positive correlation between number of employees in the semiconductor industry, and the export price of semiconductors. Which means if the number of employees in the industry is less than the export price also is down and vice-verse.
SUGGESTION: To lower the export price automation or other techniques to reduce human workforce can be applied.

OBJECTIVE 8: F- test between import price and export price

H0 : The variance export price and the variance import price are equal.
H1 : The variance export price and the variance import price are not equal.

PROCEDURE:

- Go to data tab
- Go to data analysis
- Select F-test for two sample variance
- Select input range variable 1
- Select input range variable 2
- Select output range
- Click OK

RESULT:

	Import Price Index (End Use): Capital Goods, Excluding Computers, Peripherals, and Semiconductors	*Export Price Index (End use excluding without semiconductors)*
Mean	105.0104072	110.6447964

Variance	104.5594379	3774.836129
Observations	442	442
df	441	441
F	0.027699067	
P(F<=f) one-tail	0	
F Critical one-tail	0.854856424	

INFERENCE: Since P value is less than 0.05, hence we accept the null hypothessi that variance of the two variables is same.

OBJECTIVE 9: t-test between export price and the import price.
H0 : The mean export price and the mean import price are equal.
H1 : The mean export price and the mean import price are not equal.

RESULT:

	Export Price Index(End Use of semiconductors)	*Import Price Index(in $ End Use of semiconductors)*
Mean	98.4040724	102.1187783
Variance	1429.258441	1358.511551
Observations	442	442
Pearson Correlation	0.961975245	
Hypothesized Mean Difference	0	
df	441	
t Stat	-7.55460549	
P(T<=t) one-tail	1.2229E-13	
t Critical one-tail	1.6483162	
P(T<=t) two-tail	2.44579E-13	
t Critical two-tail	1.965357827	

INFERENCE:
Since p value for two tail is 2.44579E-13 < 0.05, we reject the null hypothesis, hence we can say, that the mean export and import price are not equal.

CONCLUSION:

******THANKYOU******