Uncovering the Mystery of Tax Collection and Money Supply in Targeting Industrial Success: A Case Study of Singapore

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Abstract

The economic vitality or momentum of any economy is contingent upon the success of the industrial sector. The rise in industrial production indicates economic progress, improved livelihoods, enhanced access to necessities and increased domestic investments. Economic strength transforms into economic weakness if the industrial sector is not producing the desired outcome. This study investigates how tax revenue and money supply relate to Singapore's industrial production in order to understand more about the shifting trends in the country's industrial output. This study takes into account FDI inflows, domestic listed companies and electric power consumption as controlling factors of industrial production function. The ARDL bounds test has been employed over the period from 1980-2022. The empirical findings provide evidence of cointegrating relation between industrial production and its regressors in the long run. The results further demonstrate that tax revenue as an instrument for fiscal policy and money supply as an instrument for monetary policy are significantly escalating industrial production but between both, money supply has a stronger impact on industrial production. This study suggests that expansionary monetary policy and expansionary fiscal policy may be adopted to accelerate industrial production in Singapore while keeping the cost of conducting these policies in mind. Furthermore, FDI inflows and domestic listed companies are also advised to be encouraged as these give a boost to industrial production.

Keywords: Industrial Production; Tax Revenue; Money Supply; FDI Inflows; Domestic Listed Companies; Singapore.

Introduction

Industry refers to International Standard Industrial Classification (ISIC) divisions five to forty-three and includes ISIC divisions ten to thirty-three. The value added of industry is the sum of the value added from mining, water and gas, electricity, construction and manufacturing sectors. Moreover, when we reduce semi manufactured inputs from the overall output then we are able to obtain net output which is actually value added. Industrial production is among important pillars which may expand economic activities. The size of economic activities grows when industrial production is stimulating in a country. Among various principles of economics, we witness the dependence of standard of living upon a

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country's level of production abilities. As industrial production expands, it enhances level of incomes of the people and provides people to access fundamental requirements of their lives which help them improving their living standards. This study is an attempt to explore the important factors which determine the pattern of industrial production for Singapore economy. Among various factors, we have explored tax collection, quantity of money, foreign investments, domestic listed firms and electric power consumption. The contribution of Chen et al. (2023); Hanif et al. (2014); Hassan et al. (2023); Nazli et al. (2018); Hanif and Gago-de Santos (2017); Satti et al. (2014); Hanif et al. (2020); Hassan et al. (2018); Huang et al. (2020); Hassan and Kalim (2012); Hassan and Siddiqi (2010) and Alharthi and Hanif (2020) suggests the role of multiple macroeconomic indicators which help in determining production level in any country.

Tax collection is an instrument of fiscal policy. More tax collection is collected through the conduct of tight fiscal policy. This actually tights the economic agents – households and businesses to pay more taxes to the government and as a result people expects governments to return these taxes in the form of providing improved value-added services through public service delivery. Receiving better health facilities, quality of education, improved infrastructure, safe and clean drinking water, better law and order facilities etc will make people confident that their taxes are actually utilized for their welfare. When taxes are used for developing infrastructure and maintaining law and order then it expand investments and increase industrial production. Among the various tools of monetary policy, money supply is an important quantitative tool. Increasing money supply refers to conduct of easy monetary policy while vice versa in case of tight monetary policy. Expansionary monetary policy stimulates size of cash flow among economic agents and as result households raises consumptions while businesses expand investments. High consumption puts pressure upon the suppliers to increase supply of goods and services while high investments raise level of production and hence ensure increasing supply in the country. This will help in increasing industrial production in the country. The foreign investments and domestic listed companies are also important indicators of boosting industrial production. These drivers give boost to gross investments in case when both are increasing and vice versa otherwise. Higher foreign investments encourage transfer of advanced technology and R&D facilities from abroad to destination economies while expanding size of domestic listed companies also refers to participation of domestic investors in the production activities. The quality of production expands in the country due to availability of both domestic and foreign investors because it ensures sense of competition between both. Another important factor which may help in targeting industrial production is electric power consumption. The more consumption of electric power can increase cost of electricity as a result, cost of production may increase. The higher cost of production may leave adverse impact on industrial production. Following this debate, we have designed this study to capture the impact of tax collection, money supply, foreign investments, domestic listed companies and electric power consumption on industrial production while taking into account the case of Singapore economy.

As far as the remaining study is concerned, the next part will present a review of past studies conducted on similar topic. In the third section, details about data, model and methodology will be disclosed. Results and their interpretation will be highlighted afterwards. The last section will throw light upon conclusion and suggestions.

Literature Review

The literature section is going to shed light on the various studies which have been conducted by many scholars on the proposed topic of this research. The role of various macroeconomic factors on economic performance of selected developed economies was tested by Chenhui et al. (2024). Their findings suggested that FDI inflows have significant and positive effect on

economic growth. Afterwards, we find Onyele et al. (2024) who disclosed that government regulatory quality and real effective exchange rate were adversely impacting industrial production while balance of trade and terms of trade were significantly increasing industrial production in Sub-Saharan African economies. The contribution of Okere et al. (2023) suggested that industrial output significantly increased due to increase in money supply in Nigerian economy. In another research, Hassan et al. (2023) disclosed significantly positive impact of electric power consumption on economic growth in Finland and Portugal economies. In another research we witnessed Amri (2022) who reported significantly increasing response of manufacturing industry towards increase in money supply in Indonesia. Afterwards, Pekçağlayan (2021) disclosed that the electricity consumption was significantly leaving positive effects on Turkish industrial production. Furthermore; the FDI was significantly accelerating the pace of economic growth in developed and developing economies as found by Hassan et al. (2019) in their study. According to Ozturk and Agan (2017) there existed unidirectional causality running from exports and investments towards industrial production while interest rate and industrial production reported feedback effect between each other for Turkey's case. In another research we witnessed Hassan and Kalim (2017) who disclosed an insignificant impact of money supply on economic growth in market capitalization and turnover ratio cases while for traded stocks case, they uncovered significantly adverse impact on economic growth in low HDI listed economies. After this, we witnessed Kutu and Ngalawa (2016) who explored significantly positive impact of exports on industrial production of BRICS economies. During the similar period we found the contribution of Ejaz et al. (2016) who disclosed significantly increasing role of FDI in boosting industrial production of selected South Asian countries. In a study by Ebong et al. (2014), FDI was significantly increasing the performance of industrial sector in Nigerian economy. Following the discussion of the past studies, now the new section is going to be shared which will provide discussion of data, model and methodological understanding.

Sample, Model and Method

This research takes into account various macroeconomic indicators such as tax revenue; money supply, FDI inflows, domestic listed companies and electric power consumption as determining factors for industrial production for Singaporean economy. The annual data series is taken over the time span from 1980 to 2022 using data bank of World Bank (2024). The proposed equation and variable construction are provided as below:

$$\ln IP_t = f\ (\ln TC_t, \ln M_t, \ln FI_t, \ln DLC_t, \ln EPC_t)$$

Whereas;

Table 1: Names of the Variables & their Demonstration

Indicators	Representation
Industrial Value Added as share of GDP	$\ln IP_t$
Tax Revenue as share of GDP	$\ln TC_t$
Money Supply as share of GDP	$\ln M_t$
Net Inflows of Direct Foreign Investment as share of GDP	$\ln FI_t$
Total Listed Firms in the Domestic Economy	$\ln DLC_t$
Per Capita Electric Power Consumption	$\ln EPC_t$

The various steps are considered to find out empirical results. Firstly, we will present the discussion of descriptive stats to get a summary of our proposed model. This summary will shed some light on the mean value, standard deviation and normality status of the selected variables of this study. Secondly, in order to assess the presence of multicollinearity between explanatory variables, VIF stat will be applied. The value of VIF test will determine whether the correlation between two explanatory variables is insignificant or significant. The 10 or above value of VIF suggest the two explanatory variables are significantly correlated and hence confirm the evidence of multicollinearity between them. Below 10 value of value reports insignificant correlation between two explanatory variables and conclude absence of multicollinearity issue. The unit root status will be checked by using KPSS (1992) stationarity test. This will help us to conclude about the order of integration which suggests that how many variables have stationary status at level and how many variables have stationary status at first difference. Later on, ARDL bounds test will be used to investigate long-term relation between industrial production and its determinants like tax collection, money supply, foreign investment, listed companies, and electric power consumption. The consistency of the results will be confirmed by using various diagnostic tests like serial correlation test, functional form test, normality test, heteroskedasticity test and stability test which carries two graphical representations like CUSUM and CUSUM square. The results are shared as below:

Results and Discussion

This section will provide discussion of the results of our proposed model. The averages; variation in variables from their corresponding averages, and the normality status of the selected variables are shared in table 2. The results reveal that electric power consumption has the largest average which is at 8.7525%, while FDI inflows signify the minimum average which is at -0.1983%. Moreover, for checking the normality status, we have considered the Jarque-Bera (JB) test which shows that other than industrial production and electric power consumption all the selected indicates satisfies the assumptions of normal distribution because the results of the suggested test report insignificant probability values. While for the industrial production and electric power consumption, the JB test provide significant probability values. The results are provided in the following table 2:

Table 2: Variables Summary Statistics

Variables	$\ln IP_t$	$\ln TC_t$	$\ln M_t$	$\ln FI_t$	$\ln DLC_t$	$\ln EPC_t$
Mean	3.2700	2.6527	-0.0427	-0.1983	5.6425	8.7525
Standard Deviation	0.0569	0.1285	0.2249	0.0508	0.5813	0.3880
Jarque-Bera Test	7.3622	2.6099	4.4710	1.9326	5.0622	6.9862
Probability Value	0.0252	0.2712	0.1069	0.3805	0.0796	0.0304
Sample Size	43	43	43	43	43	43

In order to identify the potential presence of multicollinearity between regressors, we have applied Variance Inflation Factor (VIF) test. The VIF magnitude of 10 or greater between any two regressors suggests significant correlation between them, indicating evidence of presence of multicollinear regressors. On the contrary, when values of VIF witness to be below than 10 between any pair of independent variables then this indicates the insignificant correlation between to regressors or it also suggests the absence of multicollinearity issue between two regressors. The results of table 3 highlight that there is no pair of regressors for which value of VIF is 10 or above rather all values of VIF remain less than 10. This helps us to conclude

that multicollinearity issue does not appear in this study. The results are shared as below in table 3:

Table 3: VIF Matrix

Variables	$lnTC_t$	lnM_t	$lnFI_t$	$lnDLC_t$	$lnEPC_t$
$lnTC_t$	-				
lnM_t	2.1654	-			
$lnFI_t$	1.5077	1.6037	-		
$lnDLC_t$	2.0964	4.9107	1.7939	-	
$lnEPC_t$	1.1325	1.7444	1.1411	1.6297	-

After discussing multicollinearity issue, we are now going to examine the status of stationary data series by applying KPSS (1992) stationarity test. The data series is stationary as suggested by null hypothesis while data series is non-stationary as indicated by alternate hypothesis. The value of LM-stats if becomes greater than the 1% tabulated value of 0.739 then we will fall in the critical region or rejection zone of null hypothesis. In this case, we will conclude that the null hypothesis is rejected and data series is non-stationary. Our results are provided in Table 4 which demonstrate that tax collection and electric power consumption have LM-stats less than the 1% tabulated value of 0.739 at zero difference therefore, we fall in the acceptance zone of null hypothesis and would like to conclude that both series are stationary series. The rest variables like industrial production, money supply, FDI inflows, and domestic listed companies have value of LM statistics greater than the corresponding 1% tabulated value. All these indicators are non-stationary data series because LM-stats for all these indicators fall in the rejection zone of null hypothesis. The results for the status of unit root are provided in the following table 4:

Table 4: KPSS Unit Root Test

At Level		At First Difference	
Variables	**LM-Test**	**Variables**	**LM-Test**
$lnIP_t$	1.1583	$\Delta lnIP_t$	0.1593
$lnTC_t$	0.6679	$\Delta lnTC_t$	0.0520
lnM_t	1.0279	ΔlnM_t	0.1887
$lnFI_t$	0.9849	$\Delta lnFI_t$	0.0663
$lnDLC_t$	1.0550	$\Delta lnDLC_t$	0.3426
$lnEPC_t$	0.4282	$\Delta lnEPC_t$	0.3964

At first difference all the indicators have LM stats less than the 1% critical value which indicates that all these series are stationary at first difference. If we sum up our discussion then we may conclude that tax collection and electric power consumption are stationary series at level while the rest like industrial production, money supply, domestic listed companies and FDI inflows have stationary status when these series are tested at first difference. Therefore, the results suggest presence of mixed order of integration. Based on this finding, the literature guides us to use Pesaran et al. (2001) proposed method of ARDL

bounds test to investigate the long-term linkage between industrial production and its determinants. The following Table 5 provides the status of long-term linkage between industrial production and its determinants like tax collection, money supply, FDI inflows, domestic listed companies and electric power consumption. A long-term linkage is said to be significant if the value of F-stats exceeds 10% or 5% UCV (upper critical value). In this study, the value of F-stats is found to be 7.9338 and it surpasses UCV of 4.3020 at 5% significance level, as a result we confirm that long-term linkage between industrial production and its indicators is significant. This result can further be validated by using different diagnostic tests like serial correlation test, functional form test, normality test and heteroskedasticity test. The insignificant probability values all these suggested tests help us to conclude the absence of these issues. From the results of below given Table 5, we can see that all these tests have insignificant probability values therefore, this research confirms the absence of serially correlated errors, mis-specified functional form, abnormality of errors and heteroskedastic variance of errors. In short, we reject the alternate hypotheses of all the above stated four diagnostics because these tests report insignificant p. values. The findings are provided as under:

Table 5: Pesaran et al. (2001) Estimates

Proposed -Function	$\ln IP_t = f\ (\ln TC_t, \ln M_t, \ln FI_t, \ln DLC_t, \ln EPC_t)$	
Lag-Order	(1 , 0 , 1 , 1 , 1 , 1)	
F –Test	7.9338	
Significance-Level	**Critical Bounds**	
	Lower	**Upper**
5 –percent	2.9591	4.3020
10 –percent	2.4575	3.6766
DIAGNOSTIC -TESTS		
Serial -Correlation	1.5664 [0.211]	
Functional –Form	0.7684 [0.381]	
Normality	0.2015 [0.904]	
Heteroscedasticity	0.7529 [0.386]	

"[]" carries probability values.

After establishing the long-term linkage between industrial production and its explanatory factors, the long-term impact of each explanatory factor is going to be examined now and results are presented in Table 6. The results of Table suggest that tax collection as an instrument of fiscal policy has positive and statistically significant effect on industrial production while money supply as a tool of monetary policy has also positive and significant impact on industrial production. This indicates that both factors have expansionary effects on industrial activities, which result in strengthening industrialization process. Explicitly, industrial production increases by 0.2770% due to a 1% increase in tax collection while it increases by 0.7549% due to a 1% increase in money supply. This helps us to conclude that between both policy instruments, money supply as a tool of monetary policy has stronger impact than tax collection as an instrument of fiscal policy in boosting industrial production in Singapore. Additionally, the findings further highlight that foreign investments and size of domestic listed companies have significant and positive impact on industrial production. By increasing a 1% increase in both explanatory factors, industrial production significantly increases by 0.5637% and 0.2373% respectively. Both indicators are industry friendly in long-term. Lastly, when we look at the impact of electric power consumption on industrial

production, then we find that it has negative but significant impact. This means that utilization of electricity is not industry friendly. May be the proportion of fossil fuels in producing electricity is greater which in turn harming the industrial production in Singapore in the long run. The coefficient is suggesting that by increasing one percent consumption of electric power, industrial production declines significantly by 0.7464 percent. The empirical results are provided in the following Table 6:

Table 6: Parameters for Long Run

Dependent Variable = $\ln IP_t$

Regressors	**Coefficients**	**Standard Error**	**t-test**	**P. Value**
$\ln TC_t$	0.2770	0.1133	2.4454	0.0203
$\ln M_t$	0.7549	0.2452	3.0790	0.0043
$\ln FI_t$	0.5637	0.3003	1.8771	0.0699
$\ln DLC_t$	0.2373	0.0862	2.7532	0.0098
$\ln EPC_t$	-0.7464	0.2070	-3.6056	0.0011
C	7.8260	1.3620	5.7459	0.0000

Besides discussing the results of long-term, now we are going to throw light upon the short-term coefficients. The explanatory indicators of industrial production have provided their impact in short-term and results in Table 7 disclose that revenue from taxes and spreading quantity of money in the economy have statistically significant and accelerating effects on industrial production even in short-term in Singapore. Particularly, after increasing tax collection by 1%, we witness 0.1198% increase in industrial production while industrial production stimulates by 0.1668% due to 1% acceleration in quantity of money. Among both indicators, like long-term the impact of money supply as compared to tax collection appear to be stronger on industrial production. Besides the discussion of both policy instruments, we witness that foreign investments and domestic listed companies remain insignificant in the short run to influence industrial production. However, the impact of electric power consumption appears to be positive and significant in short run in boosting industrial production. By increasing one percent electric power consumption, industrial output finds upward trajectory by 0.5855%. The empirical results further highlight that lag of one year of error term is found to be negative and statistically significant. This shows that the proposed model of this research follows convergence hypothesis which means that long term and stable equilibrium will always be attained if any macroeconomic shock disturbs our long run equilibrium point. The coefficient of lag of one year of error term is -0.4325 which reveals that each year error will be corrected at an adjustment speed of 43.25% and we will be able to attain long run equilibrium in about 2.31 years. The estimates for short-run period are shared as under:

Table 7: Short-Run Estimates

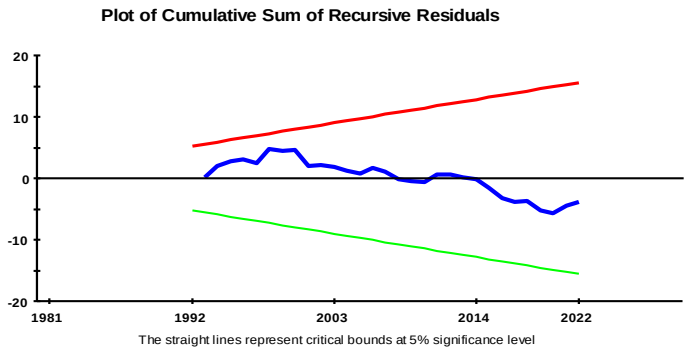
Dependent Variable = $\Delta \ln IP_t$

Regressors	**Coefficients**	**Standard Error**	**t-test**	**P.Value**
$\Delta \ln TC_t$	0.1198	0.0447	2.6784	0.0117
$\Delta \ln M_t$	0.1668	0.0700	2.3837	0.0234
$\Delta \ln FI_t$	0.0605	0.0918	0.6592	0.5146
$\Delta \ln DLC_t$	-0.0110	0.0367	-0.2986	0.7672
$\Delta \ln EPC_t$	0.5855	0.1661	3.5242	0.0013
CointEq(-1)	-0.4325	0.1052	-4.1135	0.0003
Diagnostic Tests				
$\bar{R}^2$			0.5536	
F-Test (Probability Value)			10.1405 (0.000)	
DW-Test			2.2502	

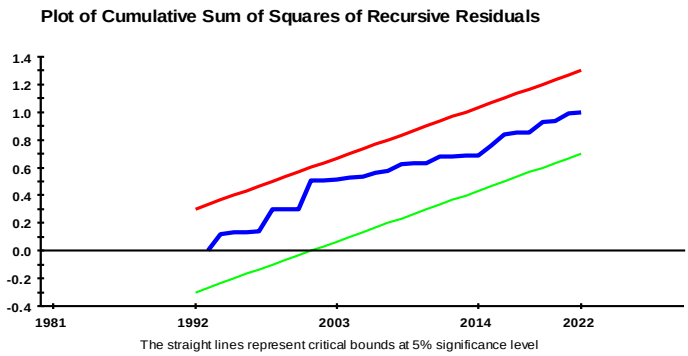
By following the debate on short-run results, let us shed some light on the stability of error term's variance and mean. The stability can be tested by taking into account the graphs of Cumulative Sum (CUSUM) and Cumulative Sum of Squares (CUSUM square). In case if thick blue line appears within the critical limits, it will guide us to conclude that the calculated coefficients for both periods remain stable with the selected period of time. As witnessed in the below presented figures, the graphs of Cumulative Sum (CUSUM) and Cumulative Sum of Squares (CUSUM square) appear to be stable because these meet the above suggested guideline. Therefore, we conclude that both variance and mean of stochastic term is structurally stable. Hence, our estimated model for both time spans is stable during the study period of 1980 to 2022. The below graphs are sharing the above discussion:

Figure 1: CUSUM and CUSUM Square

CUSUM



CUSUM Square



Conclusion

This research examines the mystery of tax collection and quantity of money in targeting industrial success in case of Singapore economy. Foreign investment, domestic listed companies and electric power consumption are considered as controlling indicators of industrial production. For finding unit root, KPSS (1992) unit root test is applied and findings report mixed order of integration of the given data series. The cointegrating linkage between industrial production and its determinants is found by using Pesaran et al. (2001) proposed method and results confirm the evidence of long-term linkage between both. This research provides evidence of significantly accelerating impact of tax collection and quantity of money in boosting industrial production, with highlighting the stronger effect of money supply in achieving industrial success than tax collection. The results further uncover that foreign investments and domestically listed firms significantly accelerate industrial production in the long-run and consumption of electric power reports similar results for short-term period. Expansionary monetary policy can be more effective than expansionary fiscal policy in boosting industrial production however; the cost of conducting these policies must be assessed carefully before implementing these policies. Additionally, both foreign investments and expansion of domestic companies may be expanded to retrieve their positive effects for industrial production.

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