Erasmus University Rotterdam

Erasmus School of Economics

Political Interventions in Production Sectors: A Case of The Indian Electronics Industry

Student Name: Philippe Eshak

Student Number: 526941

Supervisor: Joaquim Vidiella-Martin

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Abstract

The National Policy on Electronics, a policy put in place by the Indian government has been long awaited in order to help attract investments and grow the country's local electronics production. This research measures and tests the policy's effects when it was first introduced in 2011 by gathering data from the period between 2006 and 2021. The method used is synthetic controls which would be key to create a balanced control group of neighbouring countries with similar economic and production factors. We observe in this research that, although the country has had large growth in electronics production, it was not significant when compared to the control group and the growth rate other countries have managed to achieve. The paper also shows that the policy has had no effect whatsoever on entrepreneurship in the electronics sector and business ownership, which was important to understand more about innovation in the Indian markets.

I. Introduction

Innovation is a key factor in driving demand and supply for markets. It is through innovation that humans managed to reach higher levels of development and productivity. Nevertheless, innovation has led some countries to become more developed and more competitive than others. This has led those countries to become more advanced during the current technological era, and become leaders in the race of technological advancement. One important and interesting case, however, is that of India.

India has been long one of the largest countries to exist through the course of history by several factors. It has been a key player in cultural exchange with western countries and an important area with great resources and an important geographic position. The country has been an important player in understanding the history of the world and how western civilisation was able to get linked to its eastern counterpart. However, over the decades the country has suffered in several ways, from corruption and colonisation to lack of sufficient education and productivity. This has led the country to become more independent on foreign imports and production, especially in the electronics industry, in order to satisfy its large consumer market that reached $71.2 Billion in 2021 (Grand View Research, 2022).

For many, India is still considered a developing country even when considered that it is a very big economic and markets player. The country has the fifth largest Nominal GDP (IMF, 2023), making it one of the biggest financial countries globally. India has a great diversity in its economic performance, namely in Agriculture, Manufacturing, Services, Retail and Tourism. Furthermore, the country is also well known for its diverse and advanced Electronics and Information sector. India has a very large IT and Business Process Outsourcing (BPO) sector, with sector contribution for the GDP of 7.5% in 2012 and exports revenue of $99 Billion (NASSCOM, 2016). The sector also employs more than 5 million people, and with IT export services of more than $227 Billion (IBEF, 2022).

Regarding its Electronics sector, India has seen a 2.3 times increase in its domestic production from 2015 to 2021. The country has a 3.6% share in the global manufacturing of industry (Invest India, 2021).

Exploring its attractive technological situation, India still has a lot of room to develop and expand its Electronic sector. The country has formulated a new policy, entitled “The National Policy on Electronics” or NPE, mainly to assist the sector become more developed and skilled, while ensuring its expansion and growth. The policy’s aim was to make of India a bigger sector player, it has been introduced first in 2011 and then it was updated by the government in 2019. One of the main goals were to make of India a global hub for Electronic Systems Design and Manufacturing (ESDM) (Drishtiias 2019). The policy has also been upgraded to include further developing ideas and reforms, for example a complete and secure cybersecurity ecosystem, E-Waste rules implementation and provide preferential market access for local producers and start-ups to increase competition and local independence in electronics production (Aspire IAS 2022).

In the past and during the period of the 1970s and 1980s, India has been very dependent on imports of components and ready-to-use electronic appliances for its local markets (Das 2004). Nevertheless, the country has undergone many reforms and policies in order to reduce the number of imports and increase its electronics FDI and R&D investments (Majumdar 2010). However, a problem remains for the Indian industry is importing cheaper, more quality component parts that go into the manufacturing process from neighbouring countries like China and the South-East Asia region. This remains a problem as it leaves India more dependent on foreign production, and less able to accumulate the needed knowledge to create and control its own production chain.

It is important to research the extent of which the NPE is effective, by measuring how it assisted the electronics sector grow and become more competitive globally. It is the goal of this proposal to shed light on how such nation-wide policies could attract investments, help markets grow, increase competition and by turn help the rise of entrepreneurship in the electronics sector.

It will also be important to research if the policy could be externalised to other developing countries, and how valid it would be for application abroad in order to evaluate its external validity.

If the policy is a success in India and did indeed help the country become more advanced in electronic production, then it could set a stone to help many developing countries in becoming more independent in electronic production and more experienced by setting their own policies. The development of knowledge and technology would immensely help the local production sectors.

That is why the purpose of this paper to measure the effectiveness of the policy on a national level and the role it plays in the local economy of India.

In this research paper, we propose to answer and discuss the following question:

How did the National Policy on Electronics Help India Become a Global Manufacturing Competitor?

H1: The NPE has a positive effect the Indian electronics industry to grow and become more competitive

H2: The NPE has a positive effect on entrepreneurship and Business Ownership in India

In order to answer such question, two hypotheses will be tested that are believed to be key to reaching an answer for the question proposed. The two hypotheses would each answer a question of its own, and would be helpful in measuring and taking a deeper dive into the policy's effectiveness.

For the first hypothesis, the aim would be to measure if the NPE has actually helped India grab a larger share of the electronic manufacturing global market and Sector-specific FDIs, and consequently increase its share of contribution for the nation's GDP. For this hypothesis, the goal is to show how the policy has positively affected India's electronics sector and helped it become a global competitor.

The second hypothesis will be more focused on how sector-specific entrepreneurship has been affected by such policy, with the prediction that since the implementation of the NPE there is positive effect on technological entrepreneurship. This hypothesis will be important to evaluate the strategic effect of the policy on the country's start-up and entrepreneurial intentions, which is often linked to electronic and technological innovation in a general manner.

The aim of the two hypotheses is to measure the NPE's role in helping India become more competitive and increase the country's skills and knowledge in such sector.

II. Background

Several works have been written regarding the electronics industry in India and it was important to review them in order to understand more about the policy, electronic sector in India and the role of innovation in its production.

Khan (1996) highlighted in his paper how India has a long way to come to become more globally competitive when compared to South Korea. The paper concludes how India has the ability to compete in the software and electronics industries with the right policies and investment regulations. The paper was important to understand the past of Indian electronics production and how big it was in the past, compared to South Korea which is often considered as one of the biggest sector players.

In a more recent analysis, Raju & Saradhi (2020) researched how India's electronic skills are still not fully achieved. The paper discusses how this affects firm productivity and in turn does not help in unlocking the full potential of the Indian electronics industry, implying that it is still yet to peak in the near future. Nevertheless, the paper also argues that the Indian electronics industry has grown very rapidly over the past years, yet it is still less attractive than importing finished goods which would pose a problem for further industry growth.

Wei & Balasubramanyam (2015) demonstrate that India's manufacturing sector has not yet become as developed as China's, stating many shortcomings such as corruption, lack of educational abilities and skilled labor. The paper discusses that the Indian government should focus more on IT and Electronics sectors, which would give it a better advantage and catch up economically to China. This paper was written before the National Policy on Electronics was updated and in its full current level, thus it would be interesting to use it as a comparison between the past and current levels of electronics industry level.

Majumdar (2010) found in his study for the electronics sector between 1993 and 2004, that despite an increase in calls for market liberalisation and less import dependence for the industry, a large number of electronic firms has still decided to depend on imports rather than invest in the market. This has long created a problem for India's need to liberalise the market as big firms prefer, from a cost-benefit point of view, to import from well-known and higher-quality sources than to take the risk of revamping and investing in the local market.

According to Paul & Awasthi (2019), The consumer electronics sector of India has been growing rapidly over the years. The paper has mainly contributed this rapid growth to an increase in average disposable income, urbanisation of consumers and overall population. The authors also contribute the increase of local manufacturing to the "Make in India" initiatives of the government, by investing in infrastructure, tax incentives and electronic policies that help grow the industry's influence and to draw in more investors.

The topic is important to explore as it will be able to establish precedent on the impact of policies that enhance electronic manufacturing and knowledge transfer. Researching this topic will be important in order to give more insight and knowledge to readers, and help to evaluate how effective such policies could be. The purpose is to conduct research in a developing nation setting, and India's NPE had a sophisticated policy with clear aims and goals, which was very useful in locating a comparable policy.

This could help other developing policies understand more about such regulations and be able to draft their own policies in the future, thus having the ability to grow and have a larger market presence.

In this thesis, I intend to contribute to the academic community by attempting to demonstrate the impact of policies on a nation's global competitiveness and innovation growth. Discussing policies and their effect for competitiveness and growth (Ul Haq Padda & Akram 2009) is a usual topic to be found in scientific papers. However, there no papers, after a thorough research, were found discussing the topic of the National Policy on Electronics in India and its effect over the country's output and the goals it is set tor each. Furthermore, in this paper I will apply the synthetic controls method, which is a method first introduced in the early 2000s (Abadie et al. 2010). The method thus is a pivotal tool to my research as through it I will be able to measure the policy and create a well-balanced control group.

As the hypotheses have been presented, and a brief introduction was given to the paper's goal, the paper's structure will be as the following. Section two will discuss the data used, the rationale behind them and the databases used to gather our data. Section three will be regarding the methodology used and it will explain it in a more thorough manner to explain the choice of methods. It will also present the formulas used for our analyses. Section four will present the analyses results, with all the tables and graphs generated to support our analyses. Section five will conclude the paper, the findings and any further discussions or advices necessary for the paper's plausibility.

III. Data

A. Sources

Multiple data sources were discovered in order to able to build the database needed in our research. However, it is important to note that the trustworthiness of the source is important in order to ensure that all the data provided is real and up to date with the current metrics.
All data regarding the variables could be found in several sources including the IMF database, the World Bank database, the Global Entrepreneurship Monitor Consortium, the UNESCO and the United Nations Comtrade Database. The data is gathered from all the above sources and will be accumulated in one data file, in order to create a database that will help in measuring and regressing over the model and the variables of choice. The choice of the data sources is important as it helps provide credibility for the reader as they are all provided by prestigious and well-known institutions, this is to ensure no biases in the numbers and data are present.

B. Key Variables and Sample

1. Outcome Variable

For the outcome variable, this paper focuses on measuring how effective is the NPE on the Indian electronics sector and if the policy was of success. Thus, it would be most convenient to have, as an outcome variable, the electronics market output, or production, in India. That is because the growth in output, or supply, would be an insightful determinant into the effect of the policy. This variable is not to be confounded with the rate of growth variable used as a regressor, to compare between the three different periods stated above.
For the second hypothesis, we will use the same outcome variable but with different regressors to our model.

2. Key Regressors

Regarding the regression variables and to successfully measure the policy and its effectiveness, it is important to mention that this policy was mainly aimed to attract R&D investments and FDIs for the sector, thus making it attractive to foreign investments and eventually grow the electronics production sector.
That is why two important variables will be the amount of R&D investments per year and the amount of FDIs per year, both in the electronics sector. Both variables would be helpful to regress over in order to understand more about the overall growth, and consequently the ability of the National Policy on Electronics to increase attracted investments.
The third variable will be the electronic manufacturing sector output growth in numbers per year, important to measure the effect on the output of electronics. This growth will be a rate that is relative to total production growth. Next to that, we will use population and GDP amount in USD to continue with building our synthetic unit controls vector. One last regression variable is total output, as it will provide a better insight on the electronics rate and the overall output growth for each unit.
For the second hypothesis, two variables will be used. The variables will be the Total Early Stage Entrepreneurial Activity and Established Business Ownership in India.

The last two variables will be key to our second hypothesis, as this will help define how entrepreneurship has increased with the introduction of the new policy. This in turn will help us evaluate and observe how the policy helped in increasing competition in the sector, and consequently increasing innovation in the manufacturing of electronics.

3. Main Sample

In order to test for the policy effectiveness and ultimately answer the question proposed below, we need to measure and compute data related to the policy's success. The policy was first introduced in 2011, and had undergone an official reform update in 2019. That is why the aim is to measure the data over multiple periods, namely between 2006 and 2021.

Mehta (2011) presented a similar analysis to economic and political reforms in India during the 1990s to help the electronics sector growth. In his paper, the author has divided the data into a two periods: pre reform(1980 to 1992) and post reform (1993-2006). The author presented empirical evidence that, although the reforms were very ambitious and had plans to help the sector become more advanced, there were no significant reformations for the sector. It is a way to look into how complex structural reforms can become, in developing countries, to be able to have a significant effect on manufacturing.

The data chosen will be for India as a treatment group, and similarly for South Korea, China, Pakistan, Laos and the tiger cubs in order to use as a control group. The tiger cubs consists of developing ASEAN countries with significant economic progress, namely the ones used in our research will be Thailand, Vietnam, Indonesia and Malaysia.

It is important to note that the countries mentioned above would make a very good synthetic controls group as they have similar structures to India, in terms of production and exports, substantial electronic markets and technological development.This will be helpful in evaluating how the policy is affecting India as a treatment group, compared to the countries mentioned above that will form the synthetic control group. Each country of the control group has a large electronics manufacturing industry, and are either developed or developing in the region, thus a similar atmosphere to India in terms of production and economic levels. This is important for the research as it will help give a more clarified overlook into the policy's effectiveness and contribution to rapid production and growth in the industry, while also being effective to use when measuring through a synthetic controls group.

For the period pre 2011, this will be used as the point where the policy was not in motion, thus to measure how rapid the growth was before the policy, thus it will be helpful to analyse the situation pre-policy. A second period will be between 2011 and 2019, a way to measure the effectiveness of the first implemented policy and its effects. The third period will be after the update was put in motion, an update that was set to make the policy more attractive and profitable.

This way, it would be important to measure the effectiveness of the update on the industry and whether it was better than its predecessor or not. Our mean point of treatment however will be in 2011, as this was considered the pivotal moment for the policy and its effect on the sector.

The variables stated above will be used first to create a synthetic control group similar to India in its electronics output in USD. Furthermore, after building a good synthetic controls group, the data will be used to measure our policy thus provide a better insight into it, in order to finish

measuring the data and complete our research. Consequently, this will hopefully help in answering the first hypothesis. We will also do a placebo test to measure how significant are the variables regarding our test and the overall success of the synthetic controls method
The choice of three variables was made to ensure that the omitted variables bias is as little to inexistent as possible, thus ensure a full coverage of the economic effectiveness of the NPE.
The electronic markets sector growth will be used as a rate from the overall production and export market growth, in order to convey a full image of the relative expansion of the electronics market specifically.

C. Descriptive Statistics

Table 3.1: Descriptive statistics for the first hypothesis

Variables	Observations	Mean	Min	Max
Electronic Output in USD	144	9.03e+10	0	8.99e+11
Year	144	2013	2006	2021
GDP in USD	144	1.67e+12	3.46e+09	1.77e+13
FDIs	144	3.51e+10	1.15e+08	3.34e+11
Research & Development	144	3.91e+11	3455031	4.47e+12
Population	144	3.74e+08	5946593	1.41e+09
Total Output in USD	144	3.96e+11	0	3.36e+12
Electronic Output Rate	144	0.15	0	0.39

Sources: UN Comtrade, The World Bank and the UNESCO. The e+ represents a power of 10, so if e+10 it will be 10^10.

The sample that will be used in the research consists of 144 observations as described in table 3.1. the observations are between the period of 2006 to 2021. Unfortunately, an amount of 0 dollars have been recorded for Laos for variables Electronic Output in USD, Total Output in USD and Electronic Output Rate. This null value is due to the country not recording or documenting its own data in an efficient manner during the period pre-2008.
For the sake of simplicity while analysing the data, the variables Electronic Output in USD, GDP in USD, FDIs, Research & Development and Total Output in USD will all be divided by 1000000000.
Table 3.2 below describes the statistics for the second hypothesis. Regarding the data gathered from the Global Entrepreneurship Monitor (GEM), there were multiple missing values for India between 2009 and 2012, hence why there is a minimum value of 0 for both TEA and EBO.

Nevertheless, the data at hand could be important for the sake of the research and helpful in testing the hypothesis presented.

The TEA and EBO rates are both in percentage, however the data they correspond to are described in absolute numbers. For example, in Table 3.2 the TEA for India has a mean of 7.70, which would mean that on average, for the Indian population of 18-64 years old, 7.7% are either nascent entrepreneurs or owner-manager of new businesses (GEM, 2022).

Similarly, for the EBO rate, a mean of 5.73 would translate to 5.73% of the Indian population of 18-64 years old currently either manage or own established businesses.

Table 3.2: Descriptive statistics for the second hypothesis

Variables	*Observations*	*Mean*	*Min*	*Max*
Electronic Output in USD	*16*	*1.00e+10*	*3.75e+09*	*1.88e+10*
Year	*16*	*2013*	*2006*	*2021*
TEA	*16*	*7.70*	*0*	*14.9*
EBO	*16*	*5.73*	*0*	*6.5*

Sources: UN Comrade and the Global Entrepreneurship Monitor. The e+ represents a power of 10, so if e+10 it will be 10^10

Figure 3.1 below was drawn to describe and show the increase in India's electronic output sector over the years. We can observe from the graph that electronics output in the country has increased by around four times its original number in 2006.

The figure gives an insight onto the electronics sector in India and how it grew over the years to reach its current levels.

Figure 3.2 describes the linearity of Early Stage Total Entrepreneurial Activity(TEA), where we can observe a more constant relationship overall. From this figure we can observe that the TEA for India hasn't increased significantly from its 2006 level.

Figure 3.3 however shows the levels of Established Business Ownership(EBO), and unlike TEA, we can se an overall increase over the years for this rate. The EBO is an indicator of established business ownership in a sense that individuals have managed to establish their own start-ups and businesses in a country for a specific year.

The two figures (3.2 and 3.3) present the two rates, each deemed necessary by the Global Entrepreneurship Consortium(GEM) to measure the entrepreneurial activity in a country and to understand more about the sector's activities.The second hypothesis is one that aims to measure and explore if India's entrepreneurial activities could be related to its growing electronics sector. This comparison was thought upon as the sector is one of the country's fastest growing industries and one that holds great economic importance to the country's financial situation (IBEF 2023).

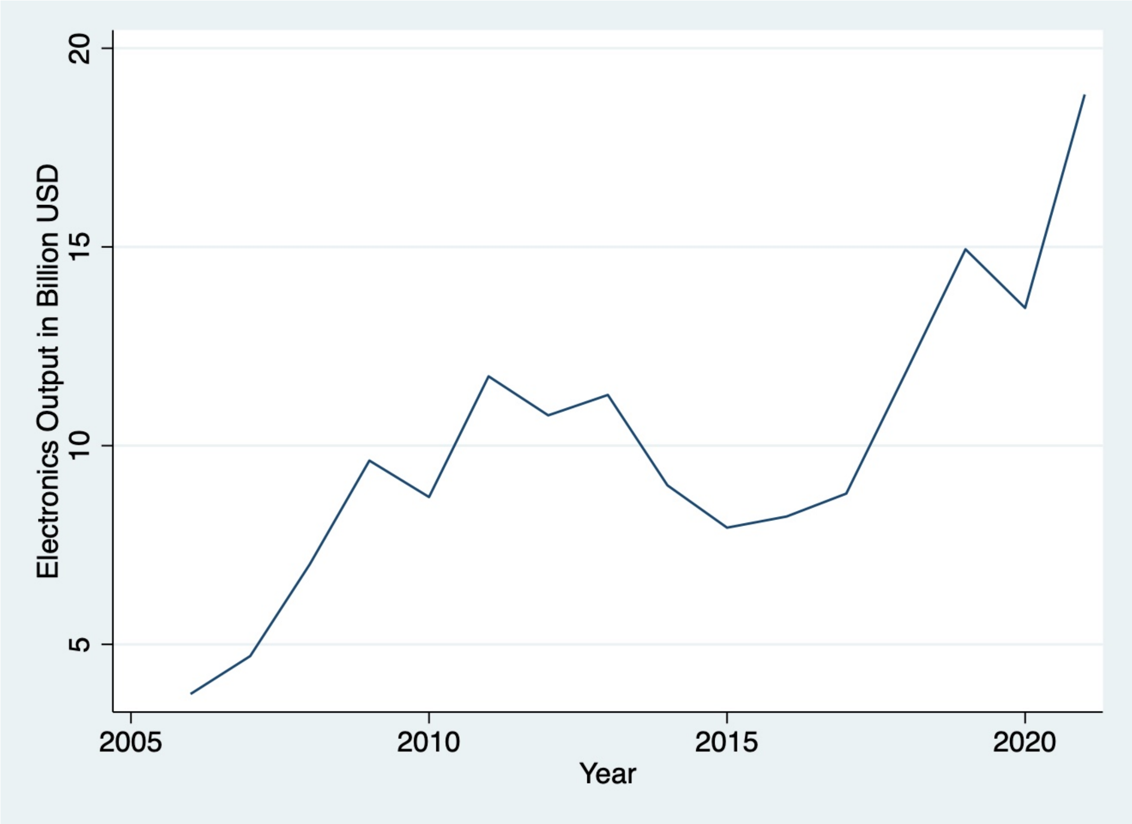

Figure 3.1: Electronic Output in India per Year

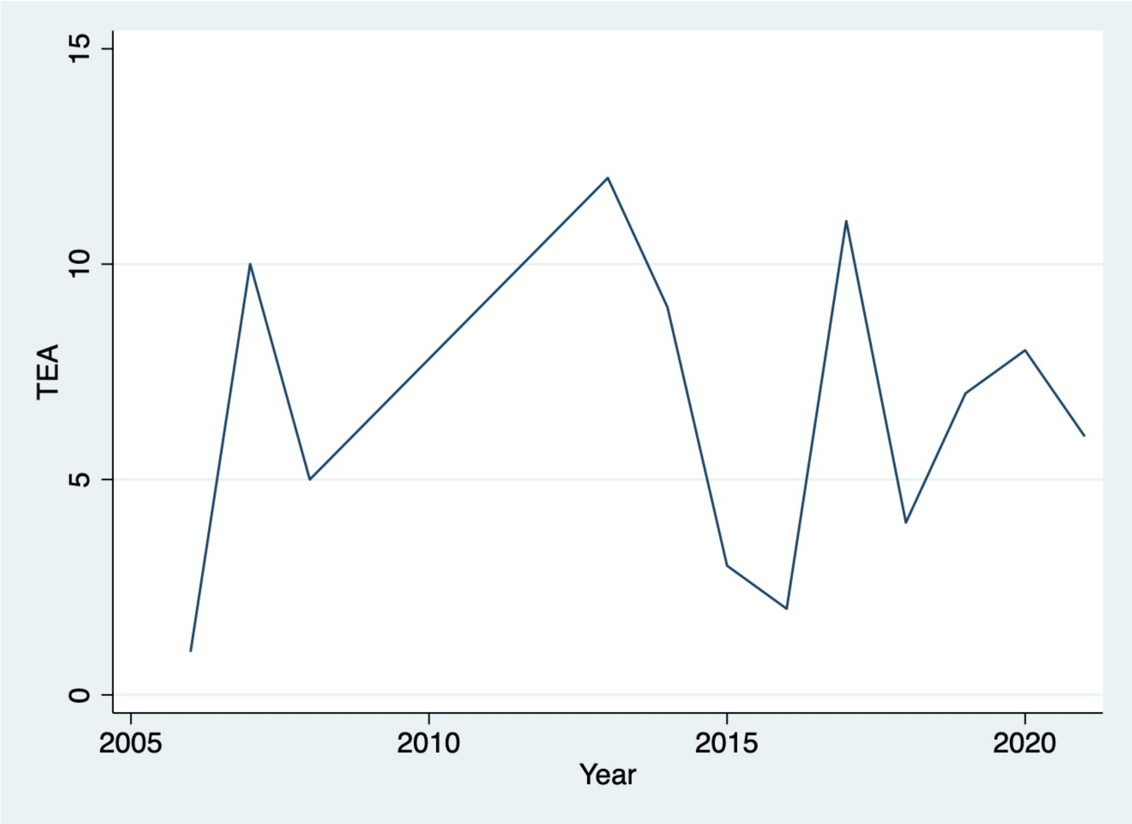

Figure 3.2: Total Entrepreneurial Activity rate per Year

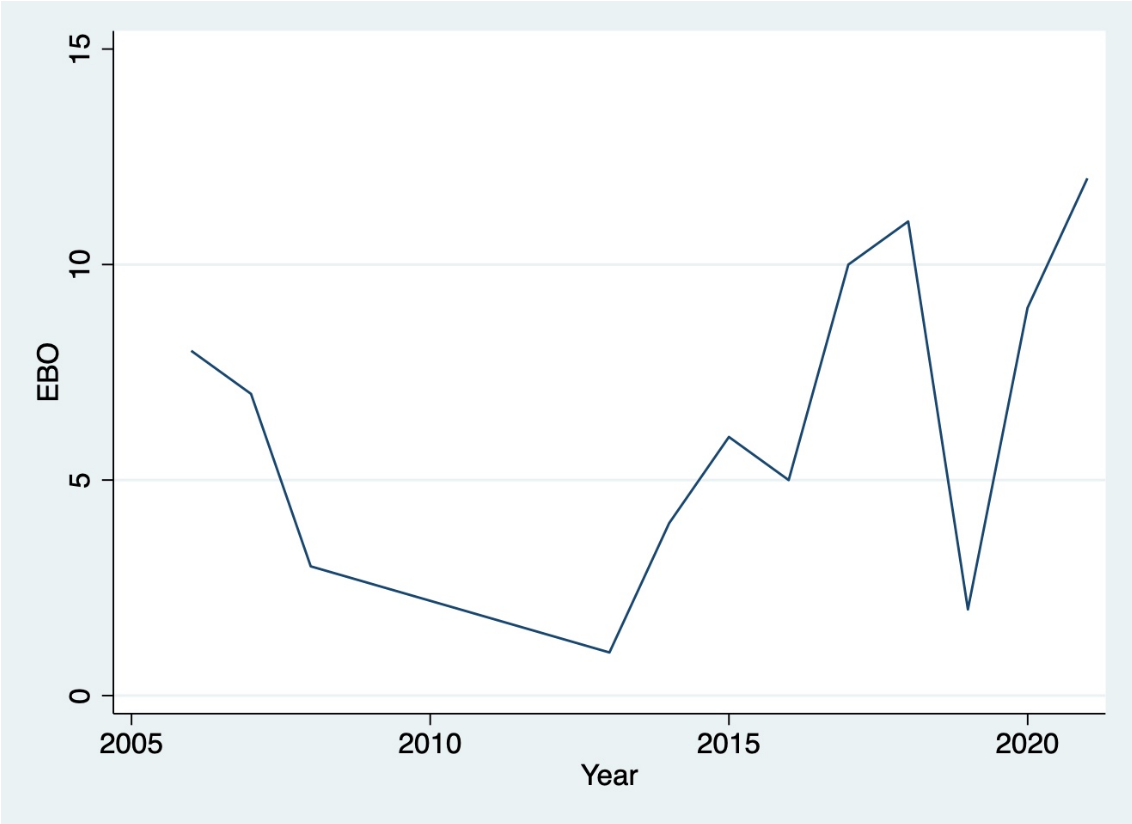

Figure 3.3: Established Business Ownership rate per Year

IV. Empirical Strategy

A. Synthetic Controls

It is usually not a simple thing to measure policy effectiveness for a specific entity, especially if there are no valid individual control groups to compare to. It would take a lot of effort to find one, and it is not even guaranteed to be able to have a valid control group even after a lot of researching. In the case of the research question posed, it is near impossible to find an individual country as a control group to India.

That is why using a Synthetic controls method will be very a useful method to measure the policy intervention's effectiveness on India. In order to choose a control group for the policy, multiple suitable candidates that would compose it and are with similar technological, economic and relative market size were the ASEAN countries, commonly referred to as the tiger cubs. South Korea, China, Pakistan and Laos were also included to ensure more stability towards weight distribution.

This is to ensure that the policy's effectiveness relates to entrepreneurship and helps the growth of entrepreneurial activity for the country. Potential problems for a multiple regression is the Conditional Independence Assumption, or CIA. In order to control for it, it is important to exclude any Mechanisms or Colliders from the OLS.

B. Equations

Looking at the variables at hand, it is logical that there should not be any Mechanisms or Colliders, however if it comes to it we could add an additional variable, and that is the number of higher education graduates per year. This could be used to ensure no Mechanisms are present and a full randomised experiment.

For *H1,* the following equation will be used:

$$Y_{it} = \alpha + \beta D_{it} + \gamma X_{it} + \varepsilon_{it}$$

Where Y is Market Output Growth, I is for Country, T is for time, D is a binary for treatment (=1), and X is a vector of control variables: R&D investments, FDI and electronics manufacturing increase. ε will be the error term.

For *H2,* we will use a more simple OLS model:

$$Y_t = \beta_0 + \beta_1 X_{1,t} + \beta_2 X_{2,t} + \varepsilon_t$$

Where Y is the effectiveness of the NPE, β_0 is the intercept term, β_1 is the effect of the Total Early Stage Entrepreneurial Activity and β_2 is the effect of the Business Ownership in the electronics sector. ε will be the error term.

C. Assumptions

When using a Synthetic controls method in a paper, it helps distribute different weights to the control group members, in order to create a more coherent group that is similar to the treatment in the pre-treatment period, thus eliminating any Parallel Trends Assumption (PTA).

However, it is also important to create a placebo test to measure if the method is effective and ensure no biases to the test.

In a very simple way, the placebo test is a method that measures the intervention if it had happened in a different time period. If the results are significant, then the method should be valid and could be used to measure the effect of the policy. The placebo test is done through Stata commands.

It is also important to mention that synthetic controls method is subject to spill-over effect, and while it is not easy to observe it, it would be helpful to use the placebo test and observe the changes for the different control groups in their synthetic form to remove them from the sample.

For the second hypothesis, a multiple regression method will be used.

One main assumption is that there is a linear relationship between the dependent and independent variables, which is difficult to assume as, regarding what was mentioned above, there were several missing values in the data for India. This could deem the regression invalid and biased from the beginning, however I will move forward with the test in order to know if there could be any results taken away.

V. Results

The discussion of the findings and information gathered by our synthetic methodology will be expanded upon and clarified in this part. For convenience, all the variables used below are expressed below in billions of dollars.

To begin with, a regression model has been created to assess the impact of the variables FDIs, R&D, electronic production rate, and overall output for India in order to assess each of their individual effects on the output of the Indian electronics industry.

The results of the regression model are shown in Table 4.1, where we can see a very strong and positive correlation between Total Output manufacture and the overall rate of electronics manufacture.
The data also showed that Research & Development had a favourable and considerable impact. However, for the FDIs amount there is a negative relation with electronics output, which clearly does not conform to the policy's expectations and goals. However, because this relationship is not significant, no inferences can be made based on this coefficient.

Table 4.1: The model measuring effect of control variables on India's electronics industry

Variables	(1) Multiple Regression Model
Constant	-9.23e+9*** (9.813e+8)
FDIs	-0.329 (.025)
Research & Development	0.020* (.109)
Total Output (in USD)	2.41e+11*** (2.39e10)
Electronic Output Rate	0.032*** (.004)
Observations	16

*Note: *** p<0.01, ** p<0.05, * p<0.1*
Robust Standard Errors in Parentheses

It was no easy task to be able to find the most suitable pool of variables to provide both stability and closer control group pre-treatment. Two additional variables for the electronics output were included as control variable, for the pre-treatment periods of 2008 and 2010.
After implementing the synthetic controls method, table 4.2 provides us with the weight distribution for each control unit. This step is to ensure that the synthetic control group is as close as possible in the most efficient way to India as a treatment unit. It is crucial to note that the test is carried out using this distribution since the predictors are then calculated using this distribution level.
While the rest of the control group received no weight, the weight balances distribution allocated 0.014 for China, 0.382 for Pakistan, and 0.604 for Vietnam. Thus, in our scenario, China, Pakistan, and Vietnam would make up the bulk of the synthetic control group while the remaining nations would not be participants in the control group.

Table 4.2: Weight Balance Distribution

Unit	Weight
China	.014
Indonesia	0
Laos	0
Malaysia	0
Pakistan	.382
South Korea	0
Thailand	0
Vietnam	.604

The weights have a total of 1

Furthermore, the first test conducted was to show the predictor means for both the treated and synthetic groups. This test method is the most common for synthetic controls, as it shows the predictor balances in order to understand more about the differences in variables between both groups and how it could lead to an imbalanced result.

This is namely to show if there are any large differences or gaps between the variable differences for both groups. For simplicity, the Electronic Output in USD variable was divided by a one billion unit, to help clarify figure 4.1 and the subsequent tables.

The two extra control variables of electronics output in USD of the pre-treatment periods 2008 and 2010 helped define more the graph and close the pre-treatment difference between India and the artificial control group, as seen in figure 4.1.

We can also see that, despite general growth from 2006, the manufacturing of electronics in India hasn't increased all that much when compared to the control group. The Indian sector production has grown from around $3 billion to a little less than $20 billion (World Bank, 2022). Nevertheless, we can observe that the synthetic group has had a larger and more exponential increase, which shows in comparison that India has a long way to reach a similar target in its electronics industry. These results are demonstrated numerically in table 4.3, where one can observe the large difference in growth between then two groups from 2012 onwards. The difference gap reaches more than 70 Billion USD between India and the synthetic group.

Regarding the GDP and population variables, large discrepancies in the predictors were also observed. This was mainly due to India overall having a much larger population and GDP than most of the countries in the control group.This led to dropping both variables from our dataset as it provided imbalance to our predictors, thus reducing validity to the test itself.

After running our data in order to further research and measure the policy effectiveness,

And dropping both the Population and GDP variables from our independent variables, we can now observe the data for our first hypothesis.

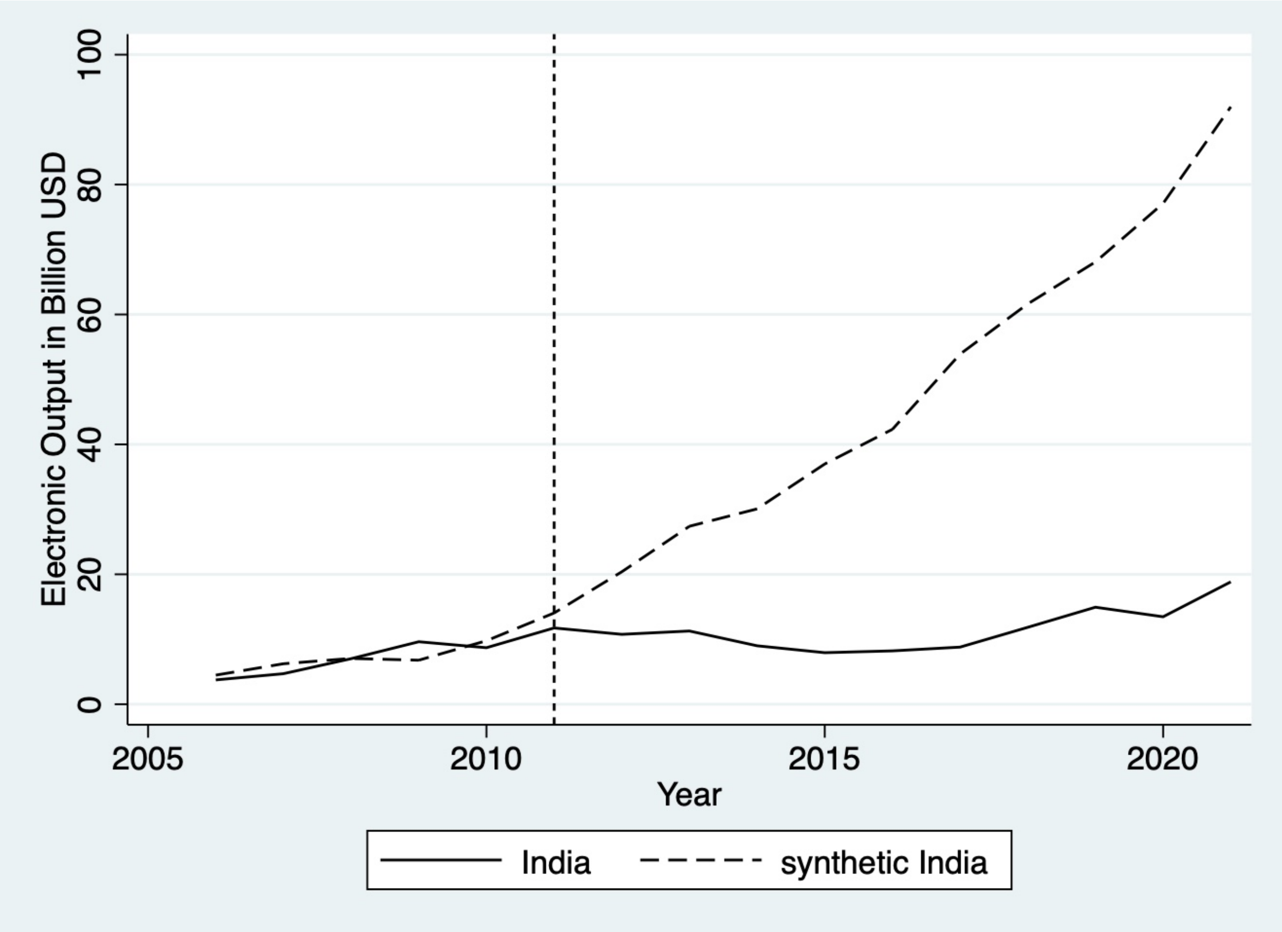

Figure 4.1: plotting of India against the Synthetic Control Group

Table 4.3: Point Estimates of the Synthetic Control Database

	Treated	Synthetic
2006	3.7512887	4.4814729
2007	4.7049364	6.2341997
2008	7.0144837	7.0533167
2009	9.62445	6.7799339
2010	8.7064513	9.7744315
2011	11.744262	14.04331
2012	10.762483	20.390096

2013	11.275864	27.400642
2014	9.0023297	30.072056
2015	7.935913	36.985565
2016	8.2178702	42.322679
2017	8.7938214	53.900316
2018	11.844523	61.637702
2019	14.94071	68.090804
2020	13.464976	77.097399
2021	18.836214	91.967608

Source: UN Comtrade
Point estimates of the variables Electronic Output in billion USD showing the gap between both groups

Table 4.4 demonstrates how closely related the predictors are for the electronic production rate and the electronic output in dollars.

Nevertheless, this is not the case for the rest of the variables. This shows large imbalances for the FDIs, R&D and the total output between both groups.

Such imbalance would show that the validity of the results for the test are very low for the variables provided. It can also lead us to conclude that, when using this synthetic control group, the effect of the policy is minimal, and might even be non-significant, compared to the control group.

This is the same conclusion drawn from figure 4.1 and table 4.3, where we can observe a large difference in production growth between the two groups that consist our database.

The gap between the remaining variables narrows when the variables(Total GDP in USD and Population) with unbalanced predictors are removed, but the gaps between the two groups appear wider on the plotted graph.

To further research the topic and understand more regarding the method, another test was conducted using a different method for the synthetic controls, this time to provide the p-values that will help us draw a conclusion on the hypothesis and whether the policy is significant or not.

Table 4.4: Electronic production predictor means

RMSPE:	1.55	
	Treated	Synthetic
FDIs	30.32828	7.957558
Research and Development Imports	104.0992	21.22282
Total Output (in USD)	169.2266	58.97346
Electronic Output Rate	.0391438	.0480542
Electronic Output in USD (2008)	7.014484	7.053317
Electronic Output in USD (2010)	8.706451	9.774431

Note: Variables FDIs, Research and Development Imports, Total Output(in USD) and Electronic Output in USD are all in billions, and in us dollars.

The second approach estimates p-values based on permutation testing and using point wise inference.

This method also provides placebo tests in order to measure the significance of the results. The purpose of a placebo test is to determine if the effect would have persisted if the period unit had been different by measuring the same variables with the same units but with lagged data of y+1 (year).

According to table 4.5, we can observe the different estimates and p-values provided by our placebo test to understand more regarding the significance of our results and overall the effect of the policy intervention in India.

The table shows the p-values in regards to the placebo test, while the estimates could be considered as the coefficient and the effect of the policy on the market output over the years. The test taken provides insignificant results for all the post-treatment periods after 2011, the year the intervention took place and the policy was implemented. The results in the table provide empirical proof that, at a 5% significance level, the policy was not significant in helping the electronics sector grow as much as it was needed or expected.

This is also in line with the results found in the figure, as the increase in the sector production was not very large when compared to the synthetic control unit. The large p-values for the years 2011-2021 found from the research thus would lead us to conclude that the policy, although has been very well-received by the country's government and the global community, has been insignificant.

This would lead us to the conclusion that although our sample size was big enough with multiple countries forming the synthetic control group, a well-fit graph and weights distribution, the results could not be determined as significant for our hypothesis.
Nevertheless, it is important to note that further research could be drawn to understand more about the sector, and better measure the policy and the sector itself.
For example, the usage of different control variables, extended period of observation or even increase the pool of control candidates to include eastern European or middle eastern economies could all lead to further results and understanding about the policy.

Table 4.5: Adjusted p-values synthetic controls by period

	Estimates	P-value
2012	1.351	.625
2013	2.148	.75
2014	.482	.875
2015	.449	.875
2016	1.093	1
2017	1.359	.75
2018	4.103	.875
2019	7.066	.625
2020	5.385	.875
2021	8.546	.75

*Note: *** p<0.01, ** p<0.05, * p<0.1*
Robust Standard Errors in Parentheses

Moving on to our next hypothesis, a multiple regression test was conducted in order to measure the effect of the policy on entrepreneurial activity and whether there was a significant effect of the policy.
One major shortcoming during our analysis was that the data for India for the period 2009-2012 was not reported by the country's organisation. This could imply that a sample selection bias is established, especially if the missing years' data has unique properties or characteristics.
It further would be more complex to generalise the findings as omitting the years could lead to inaccurate representation of the data.
A regression analysis, nevertheless, was deemed to be valuable in this research to demonstrate if there is any additional effect for the policy that could be relevant to our research question.
Table 4.6 presents the results of the multiple regression formula described in section 3, one that includes both TEA and EBO as control variables and electronics output as the dependent variable.

As observed in the table 4.6, a positive relationship is found in the regression test for the TEA rate, where it increases by 0.289 points when electronic production increases. The same could also be said for the EBO rate, which increases by 0.309 points.
Nevertheless, the results are not significant at a 10% significance level, thus we cannot draw any conclusions about the significance of electronics industry on entrepreneurial levels. Such result could draw from multiple reasons, namely omitted variables as we are using only two control variables in our model.
Furthermore, other reasons would be a small sample size, which in our case extends to only 12 observations for our panel data. Another flaw would be the missing data for the period 2009-2012, however this could not be avoided as the data itself could not be found from other trusted source.

Table 4.6: The relationship between Electronic Production and Entrepreneurship

Variables	(1) Multiple Regression Model
Constant	6.029 (4.062)
Total Entrepreneurial Activity	.289 (.385)
Established Business Ownership	.309 (.385)
Observations	12

*Note: *** p<0.01, ** p<0.05, * p<0.1*
Robust Standard Errors in Parentheses

VI. Conclusion

In conclusion, we have tested two hypotheses in order to help answer the research question. Both were drawn with the intention of measuring the effect of the National Policy on Electronics and its success in India.
The first hypothesis has proven to be non significant, as all the results from the different tests were of similar effect on the data used. In spite of the fact that India's electronics production industry has grown over the same period used for our research, and finding significant and positive results for the majority of the variables used in the regression model drawn using only India, the synthetic controls method has proven that the results are not significant when compared to the synthetic group included.
Regarding the second hypothesis, it was observed from the graphs that both the TEAa and EBO rates in India did not show any significant positive growth. The EBO had its own growth over the period stated yet it was not a large increase when compared to other countries' rates from the database (GEM 2023). After testing the hypothesis, the variables were shown as non significant although a positive relationship could be established with the Electronics production.

This could mainly relate to multiple reasons discussed in the results section, however the approach did provide positive relational results.
For the research, multiple drawbacks were found and could be advised upon. For instance, an increased number of variables could have been proven useful for both hypotheses, especially for the second one. This was not done in this research as the goal was to focus more on the policy and not the sector.
Another drawback for the second hypothesis was the missing values for the years 2009-2012 which has also proven not simple to find. This has led to an unequipped model to test, and possibly one of the reasons why the results were non significant.
To conclude from the results found, the National Policy on Electronics has had no significance effect on making India a global competitor. Such conclusion could also have multiple layers to it, such as corruption, lack of advanced education and lack of infrastructure to name a few.
As India is a very large country through many factors, passing a policy could take more than a few years to have its own effect on the local economy. One could even argue that it is the reason why the government has decided to update and implement a newer policy in 2019, in order to see more significant results in a shorter term. However, this is to be researched further in order to be proven for the research question proposed.

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Appendix

Stata code

```
***Hypothesis 1 testing***

import excel "/Users/philippefaragallah/Desktop/IBEB/Year3/Thesis/Thesis data.xlsx", sheet("Sheet3") firstrow

encode Country, gen(country)

keep if country == 2

reg Electronic_Output_usd FDIs RD_exp Total_output_usd Electronic_Rate

replace Electronic_Output_usd = Electronic_Output_usd/1000000000

line Electronic_Output_usd Year, ytitle("Electronics Output in Billion USD") xtitle(Year)

use "/Users/philippefaragallah/Desktop/IBEB/Year3/Thesis/Thesis data.dta"

tsset country Year

synth Electronic_Output_usd FDIs RD_exp GDP Pop Electronic_Rate Total_output_usd, trunit(2) trperiod(2011) fig nested keep ("/Users/philippefaragallah/Desktop/IBEB/Year3/Thesis/Thesis_Statadata.dta") replace

synth Electronic_Output_usd FDIs RD_exp Pop GDP Total_output_usd, trunit(2) trperiod(2011) fig nested keep ("/Users/philippefaragallah/Desktop/IBEB/Year3/Thesis/Thesis_Statadata.dta") replace

synth_runner Electronic_Output_usd FDIs RD_exp GDP Pop Total_output_usd Electronic_Rate, trunit(2) trperiod(2011) gen_vars

drop pre_rmspe post_rmspe lead effect Electronic_Output_usd_synth

replace Electronic_Output_usd = Electronic_Output_usd/1000000000

replace FDIs= FDIs/1000000000

replace RD_exp= RD_exp/1000000000
```

```
replace GDP=GDP/1000000000

replace Total_output_usd= Total_output_usd/1000000000

summarize

synth Electronic_Output_usd FDIs RD_exp GDP Pop Total_output_usd Electronic_Rate
Electronic_Output_usd(2008) Electronic_Output_usd(2010), trunit(2) trperiod(2011) fig nested

synth Electronic_Output_usd FDIs RD_exp Total_output_usd Electronic_Rate
Electronic_Output_usd(2008) Electronic_Output_usd(2010), trunit(2) trperiod(2011) fig nested

graph export "/Users/philippefaragallah/Desktop/Eelectro output graph.jpg", as(jpg) name("Graph")
quality(90)

synth_runner Electronic_Output_usd FDIs RD_exp GDP Pop Total_output_usd Electronic_Rate
Electronic_Output_usd(2008) Electronic_Output_usd(2010), trunit(2) trperiod(2011) gen_vars

synth_runner Electronic_Output_usd FDIs RD_exp Total_output_usd Electronic_Rate
Electronic_Output_usd(2008) Electronic_Output_usd(2010), trunit(2) trperiod(2011) gen_vars

***Hypothesis 2 testing***

import excel "/Users/philippefaragallah/Desktop/IBEB/Year3/Thesis/Thesis data.xlsx", sheet("Sheet4")
firstrow

summarize

line EBO Year, ytitle("EBO") xtitle(Year)

line TEA Year, ytitle("TEA") xtitle(Year)

reg Electronic_Output_usd TEA EBO
```