Provincial Investment Effect of Special Economic Zone Policy in China: A Case Study of Hainan Province

Jasen Lo

Final Project - SS154

1 Introduction

In the late 1970s and early 1980s, the Chinese government initiated The Open Door Policy - a series of economic policies to reform the state controlled Chinese economy. One of these policies was to begin allowing foreign investment into the previously closed and protectionist economy. On 26 August 1980, at its 15th plenary session, the Standing Committee of the Fifth People's Congress approved the opening of four coastal cities of Shenzhen, Zhuhai, Shantou, Xiamen as Special Economic Zones (SEZ) which would enjoy more preferential laws and economic policies as free ports to attract foreign direct investment[1]. No official definition of a SEZ existed, since each SEZ had the autonomy to institute their own regime of local regulations. Generally, however, SEZs had the following characteristics that set it apart from other areas of the country [2]:

- Large portions of enterprise ownership was non-state-owned, being instead Chinese-foreign equity or contractual joint ventures and exclusively foreign-owned enterprises
- Foreign capital enterprises in the SEZs are given operation and management autonomy, without interference from local or central government
- The economic system within the SEZs was more market-oriented
- Preferential tax regimes are available to foreign capital enterprises

In 1984, 14 coastal cities were opened to overseas investment: Dalian, Qinhuangdao, Tianjin, Yantai, Qingdao, Lianyungang, Nantong, Shanghai, Ningbo, Wenzhou, Fuzhou, Guangzhou, Zhanjiang and Beihai. These cities were governed by a different body of regulations compared to the SEZs, but still offered simplified governmental approval procedures for incorporation and management of enterprises and preferential tax benefits, though not as attractive as those of the SEZs [2].

In 1988, when the island province of Hainan was made a separate province from Guangdong, it was also designated as China's fifth and largest SEZ [1]. The sparsely populated and largely agricultural Hainan was not similar to the first established SEZ cities of Shenzhen, Zhuhai, Shantou, Xiamen, which have had experienced immense economic development since their SEZ designation in 1979 [3] [2].

Much literature has already been written about non-generalisability of SEZ policy [4] [5]. Chinese leaders chose the first SEZ cities carefully - these cities were near and shared linguistic ties to the developed financial hub of Hong Kong. On the other hand, Hainan's access to investment capital had been scarce given its remote location close to protectionist Vietnam in the South China Sea [6]. Due to the heterogeneity of economic development throughout the geographical immensity of China, it was unclear whether or not a backwater province like Hainan with inadequate infrastructure would be attractive to investors and benefit from economic liberation. By designating Hainan as a SEZ despite it's small existing administration, Chinese officials signalled that Hainan would be the experimental grounds to prove a developmental model through economic liberation even in a non-capital intensive or investment unattractive environment unlike the already established SEZs and semi-liberalised coastal cities would be viable.

According to a 2016 United Nations Trade and Development Report, "acceleration of investment helps developing countries reach a critical mass of activities in certain industrial sectors which then contributes to steady technological advances and diversification"[7]. Investment is thus an important indicator for economic growth. This paper will examine if Hainan Province experienced accelerated economic growth through receiving increased per-capita fixed investment, both domestic and foreign, because of Hainan's designation as a SEZ in 1988. Using pre-treatment time series of covariates that control for provincial differences from 1980 - 1988, the author creates an artificial synthetic unit representing the counter-factual of a Hainan Province that was made into a separate province in 1988, but not designated as a SEZ. Looking at the post-treatment difference between the investment series of Hainan Province and that of the synthetic unit would demonstrate the effect on per-capita fixed investment of the SEZ policy designation on Hainan. A positive and statisically significant difference would infer that SEZ designation causes provincial level economic growth through increased investment from domestic and foreign sources even in relatively remote and unattractive investment destinations such as Hainan.

[1] #casestudy - Using Hainan as a case study, this paper tries to see what is the effect of economic liberalisation on economic growth in the context of China in the late 20th Century, but perhaps also generalise to different contexts or time periods.

[2] #interventionalstudy - This synthetic control method is only possible because of an intervention that was made to one province of China.

2 Data

The author used annual, provincial-level data from the Chinese National Bureau of Statistics of China between 1980 - 1995. Although Hainan was made a province only in 1988, due to its statuses as the Hainan Administrative Region within Guangdong Province, independent data exists for Hainan before it was made into a separate province in 1988. The dataset includes the 31 first-level administrative regions of China during this period, consisting of 22 provinces, five autonomous regions and three municipalities. The dataset does not include data from the regions of Taiwan, Hong Kong and Macau because China did not have de facto control over these regions during the period under examination. The modern-day municipality of Chongqing is also excluded since it was not established until 1997.

2.1 Units

Of these 31 regions, the regions of Guangdong, Fujian, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Shandong and Guangxi were further excluded from this study. The four established SEZs, and the 14 semi-economically liberalised coastal cities are contained within these regions. The municipality of Beijing was excluded as well since Beijing's status as the political capital would likely attract investment regardless of the degree of liberalisation of economic policies of the municipality. The pruning procedure of investment attractive regions removes interpolation bias during the construction of the synthetic Hainan unit since these control units experienced some degree of the treatment. This allows for a synthetic unit that better reflects the less capital-intensive economic context of Hainan to be produced.

2.2 Variables

The dependent variable used in this study is Per-Capita Fixed Investment **(I_pc)**, defined as the volume of activities in construction and purchases of fixed assets of the region and related fees, expressed in per-capita monetary terms during the reference period. Per-capita investment measurement controls for provincial population differences and exhibits a region's degree of economic growth as justified by the 2016 UNCTAD report in the previous section.

The independent covariates that were chosen to construct the synthetic control unit are as follows:

- **stateexp_pc** - Local Governments General Budgetary Per-Capita Expenditure in Yuan

- **staterev_pc** - Local Governments General Budgetary Per-Capita Revenue in Yuan
- **wages** - Average Wage of Staff and Workers in Urban Units in Yuan
- **agriculture_pc** - Per-Capita Output Value of Agriculture, Forestry, Animal Husbandry and Fishery in Yuan
- **industrial_pc** - Per-Capita Number of Industrial Enterprises above Designated Size

  The five covariates above were chosen since they were important economic indicators that are correlated with investment in economic theory [8] [9]. Since many enterprises, industries and buisnesses in the Chinese economy was still heavily state-managed, state revenue and expenditure are viable predictors of Chinese economic growth during this time period.

- **coastal** - Coastal Dummy

  This variable serves as a control variable to control for the differences between the more economically prosperous coastal regions and the less economically developed inland regions

- **pop_density** - Population Density

  As the Chinese National Bureau of Statistics of China only carried out two population censuses in 1982 and 1990 between 1980 - 1995, the population data for those years were linearly extrapolated and interpolated to fill in all of the missing years. Robustness tests were carried out to see if varying results were found between a model which only consisted of 1982 population data and a model with all of the interextrapolated years. *Figure 1* shows that the inter/extrapolated model and the model with only 1982 data are similar, which validifies the approximation of the interextrapolated population data.

Table 1: Summary Statistics of Variables in Hainan Synthetic Control Model

	(1)	(2)	(3)	(4)	(5)
Variable	Obs	Mean	Std. Dev.	Min	Max
I_pc	304.0	3,937.9	4,156.8	321.8	31,457.5
stateexp_pc	304.0	2,038.1	1,741.2	302.4	14,614.4
staterev_pc	304.0	1,078.2	763.8	-558.9	5,305.3
wages	304.0	1,891.1	1,201.8	673.0	7,382.0
industrial_pc	304	0.0003	0.0001	0.0001	0.0005
agriculture_pc	304.0	5,539.7	4,115.5	1,320.7	28,473.3
pop_density	304.0	157.9	131.4	1.5	553.8
coastal	304.0	0.2	0.4	0.0	1.0

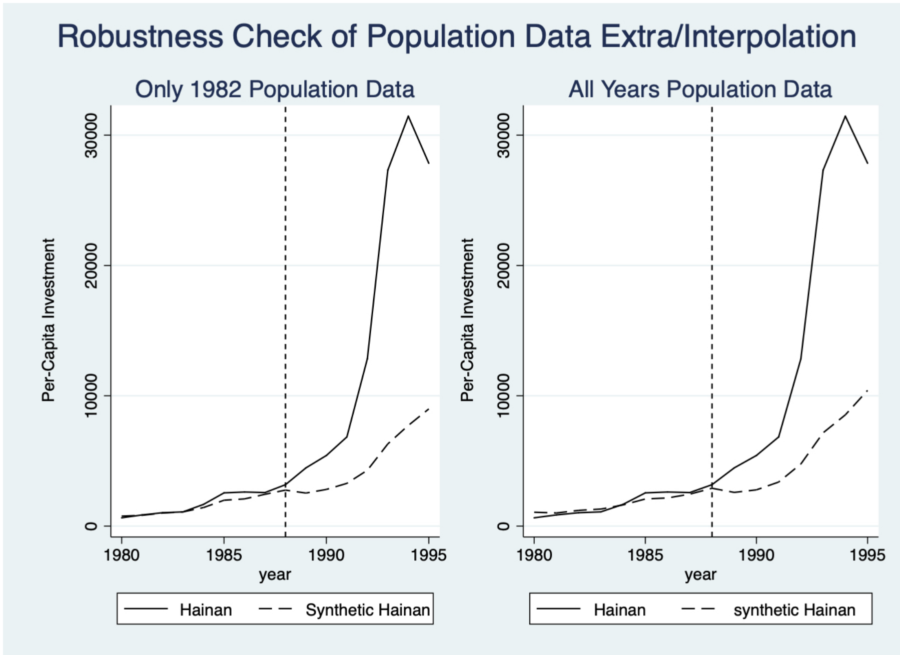

Figure 1: Robustness check of Synthetic Control Results of the Population Inter/Extrapolation. The synthetic control model on the left only uses population data from 1982, while the model on the right uses extra/interpolated population data from all years and uses per-capita variables. Both models have approximate post and pre-treatment trends.

2.3 Time Series

This study contains 16 years of time series data: eight pre-treatment years (1980 - 1987) and seven post-treatment years (1989 - 1995).

The reason for the time series to start in 1980 was to provide enough pre-treatment data for the synthetic control to be constructed. Another reason for this year was that the Chinese National Bureau of Statistics of China did not make available or did not collect the relevant data before 1980.

The time series end year of 1995 was chosen because Hainan Province underwent a speculative property collapse in 1993, which would bias the per-capita investment figures to the point that Hainan would not be comparable to the synthetic unit created after 1995, assuming a 1-2 year investment response lag [10]. The author was unable to locate propety price data during this time to control for this likely shock on investment.

Figure 2 provides support to the hypothesis of biased effects due to property, as a dip in per-capita fixed investment is observable following 1994. Another reason for limiting the time series to this period was that China began to experiment with different types of economic zones which attracted foreign capital in many regions from 1992. These included free trade zones, technological developmental zones and high-tech industrial developmental zones in every province. In the same year, all provincial capitals were opened to foreign investment. Although it is impossible to control for the effects of these policies on regional investment, it is likely that this study is underestimating the post-treatment per-capita investment of the control units and therefore the Hainan synthetic unit after 1992.

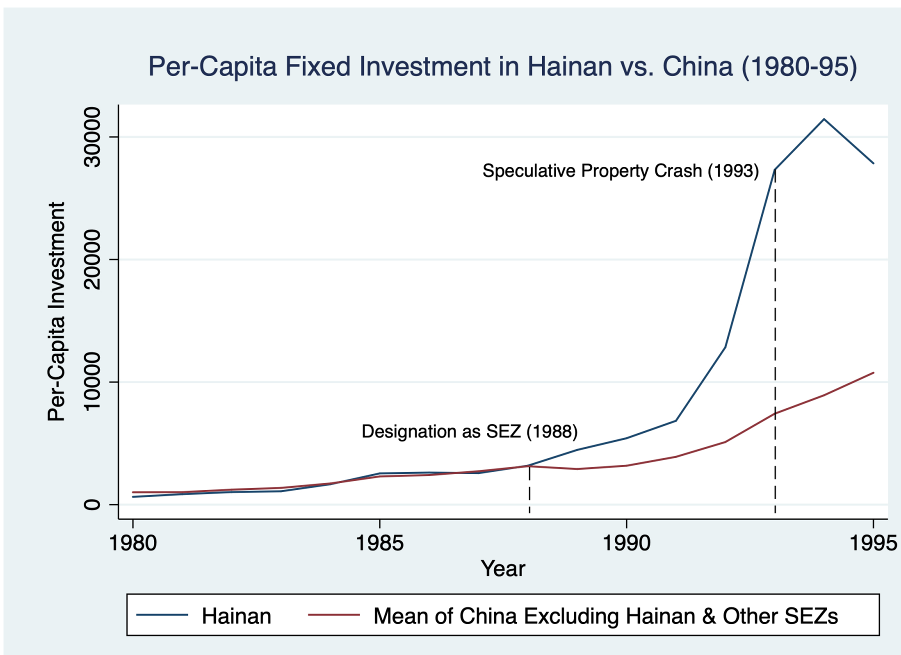

Figure 2: Time series of Per-Capita Fixed Investment in Hainan from 1980 to 1995. Note the dramatic increase following the designation of Hainan as a SEZ. The figure also shows the timing of the speculative property crash in Hainan in 1993.

3 Methodology (1 - 2 pages)

This paper uses a Synthetic Control methodology as proposed in Abadie & Gardeazabal [2003] to model an artificial counterfactual of the treatment unit that did not receive the treatment, which in this case, is Hainan Province's designation as an SEZ in 1988 [11]. The synthetic unit is constructed from a weighted average of the control units, in which the control units' pre-treatment covariates would be estimated as close as possible to the treatment unit's pre-treatment characteristics, including both dependent and independent variables. Abadie et al. 2010 notes the importance of including pre-treatment outcome to control for heterogeneity, thus the pre-treatment per-capita investment data is included as a control variable [12]. In this paper, the donor pool would consist of all the other regions of China (excluding those that were dropped due to recieving partial treatment effects).

Tables 2 & 3 shows the weights of the donor regions that contributed to the synthetic Hainan and the pre-treatment covariate balance between treated versus synthetic Hainan respectively [3]:

Table 2: Donor Regions Synthetic Control Weights

Region	Unit Weight
Inner Mongolia	.135
Jilin	.219
Heilongjiang	.045
Anhui	.399
Sichuan	.141
Tibet	.061

Table 3: Treated vs. Synthetic Hainan Pre-Treatment Covariate Balance

	Treated	Synthetic
I_pc(1980-87)	1.63e-06	1.61e-06
stateexp_pc	.0000718	.0001024
staterev_pc	.0000359	.0000537
wages	921.5	963.006
industrial_pc	.0002415	.0003571
agriculture_pc	.0004292	.0003104
pop_density	165.0361	207.4291
coastal	1	.264

[3] #controlgroup - The synthetic control unit is the closest control unit or counterfactual, of the treated unit that is untreated that can be created based on the covariates and data that I have.

In *Table 2*, there is a broad diversity of different regions that are represented in terms of geographical location; however, the weights are not unexpected. Four of the regions, Jilin, Heilongjiang, Anhui and Sichuan, were like Hainan in their strong agricultural bases, while aside from Sichuan, the other five regions were also relatively unattractive investment destinations in the 1980s given their respectively remote locations [13] [14].

One can observe that the treated Hainan and the synthetic Hainan have good covariate balance from *Table 3*, aside from the coastal dummy, which is unsurprising given many of the coastal regions aside from those in the far north (Heilongjiang, Jilin), had SEZs or foreign-investment opened coastal cities by the time of the treatment in 1988. *Table 3* and it‘s short list of eight covariates highlights an assumption of the Synthetic Control method. The synthetic unit's post-treatment series is conditional on the limited number of pre-treatment observable covariates and fails to account for the effects of post-treatment unobservable or omitted variable bias, thereby rendering the synthetic control's post-treatment series as an inaccurate model should these biases exist. Given the limited number of covariates used in this paper‘s model, there is a risk of that the synthetic Hainan does not model the counterfactual non-treated Hainan well due to the fact that there are not enough predictors for per-capita investment that are included in the model.[4] [5]

[4]There is an acute shortage of pre-1990 economic data from Chinese National Bureau of Statistics data, these figures were not collected until after the Chinese economy was further liberalised in the 1990s

[5]#constraints - Despite the difficulties of finding population data, I was able to use extra/interpolation to find missing data and showed that these extra/interpolations were robust.

4 Results

Figures 3 visually demonstrate the effect on Hainan's Per-Capita Investment after 1988 while *Table 4* reports the estimated treatment effect per post-treatment year. These findings are supported by placebo tests results in *Figures 4 & 5*, which support a statistically significant effect on per-capita investment of Hainan following its SEZ designation.

Table 4: Estimated Treatment Effect of Hainan's SEZ Designation

Year	Estimated Treatment Effect Per-Capita Investment in Yuan (1988-1995) in Hainan
1988	273.57
1989	1880.66
1990	2639.06
1991	3460.14
1992	8070.00
1993	20158.80
1994	22917.70
1995	17429.05
Mean(1988 - 95)	**9603.62**

Table 4 reports the estimated treatment effect of per-capita investment to Hainan for each post-treatment year, and the Hainan synthetic control model estimated a rapidly increasing per-capita investment growth after 1988, starting from 1,880 Yuan in 1989 to a peak of 22,918 Yuan in 1994. The average estimated treatment effect during the post-treatment time period is 9,604 Yuan, which means that **Hainan experienced a 9,604 Yuan increase in per-capita fixed investment from 1989 - 1995 because of its designation as a SEZ in 1988.**

Figure 3 compares the per-capita investment series of the treated Hainan versus the Synthetic Hainan constructed from a weighted combination of the donor regions in *Table 2*. The pre-treatment series are closely fitted, while both series diverge following the treatment in 1988. Although the synthetic Hainan exhibits a small degree of per-capita investment growth, reaching 10000 Yuan in 1995, the acutal Hainan already had a per-capita investment of approximately 30000 Yuan in the same year, almost three times the magnitude of the synthetic Hainan. The post-treatment series of *Figure 3* and that of the acutal per-capita investment outcome for the rest of China (exluding other SEZs) in *Figure 2* resemble each other closely, supporting synthetic Hainan as a valid counterfactual control unit.

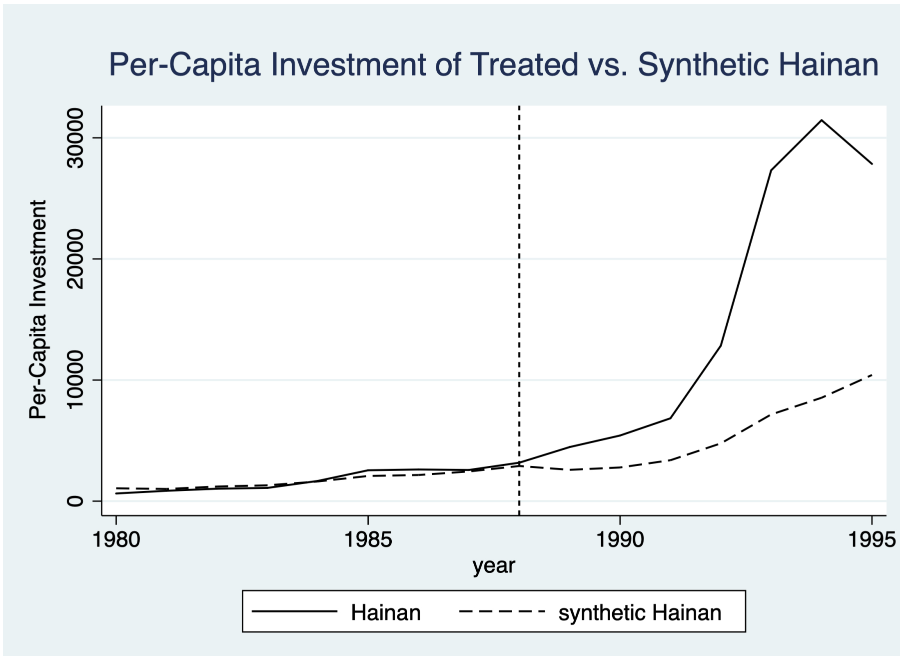

Figure 3: Synthetic Control Model: Per-Capita Investment of Treated vs. Synthetic Hainan (1980-1995)

Figure 4 reports the results of the placebo tests of the donor regions. A placebo test is carried out to show if the treatment effect was extreme for the treated unit by iteratively applying the synthetic control method for every unit in the dataset. Hainan would be treated as a donor unit for the construction of the donor regions' synthetic control unit. Hainan should have the largest magnitude of treatment effect amongst all units.

A synthetic unit was created for each donor region, and the prediction error gap between the control regions' actual per-capita investment series and their' synthetic per-capita investment series were plotted in *Figure 4*. One can understand this difference as the estimated treatment effect, while the pre-treatment fit show how well each sythetic control constructed reflect ed the characteristics of the actual donor region. The graph on the right of *Figure 4* removes those units which have a poor pre-treatment fit, defined as as units that have a pre-treatment Root Mean Square Prediction Error (RMSPE) twice of the pre-treatment RMSPE of Hainan. Even before pruning these units, however, it is clear that *Figure 4* show that Hainan experiences the strongest treatment effect relative to the other donor regions'.

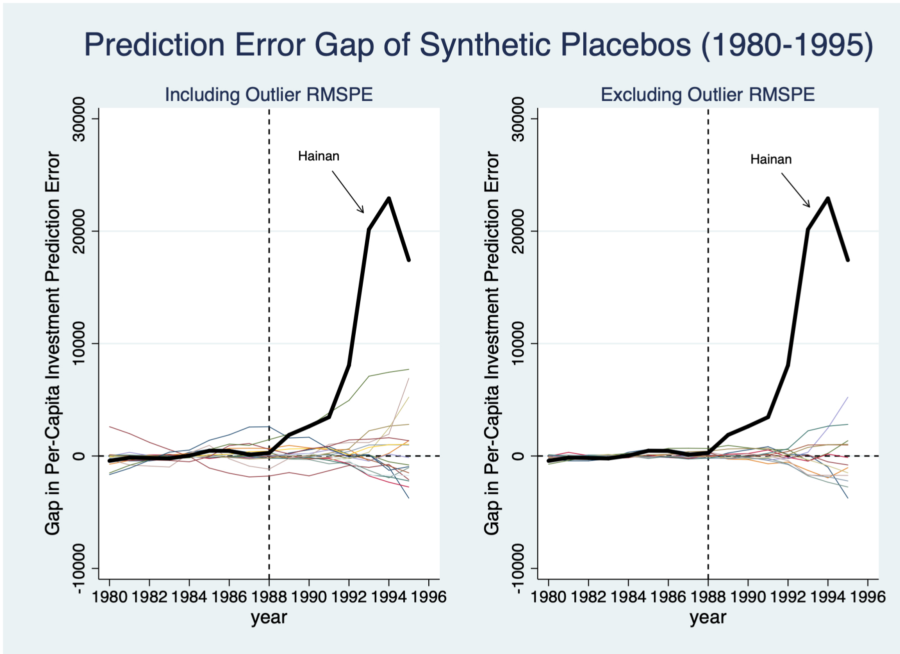

Figure 4: Prediction Error Per-Capita Investment Gap of Synthetic Placebos of Donor Regions (1980-1995). The figure on the right excludes donor regions‘ synthetic units if they have poor pre-treatment fits. These units are: Inner Mongolia, Tibet, Qinghai, Ningxia and Xinjiang.

Figure 5 shows the distribution of Pre/Post Treatment RMSPE Ratios of all the units in the dataset. These ratios can be used to test for statistical significance using by calculating their exact p-values by rank per the Fisher's Exact Test, as suggested in Abadie et al. [2010] [12] [15]

The higher the RMSPE ratio, the larger difference between the unit's actual per-capita investment series and the unit‘s synthetic unit‘s per-capita investment series. The larger this outcome difference, the more extreme the treatment effect according to the lower exact p-value of the Fisher Exact Test. Hainan has the highest RMSPE ratio, which reflects how Hainan is ranked 1st out of 19 provinces.[6] The Fisher Exact Test gives Hainan has an exact p-value of .0526, which is statistically significant at an α level of 0.1, and shows that the treatment effect of Hainan was extreme relative to those of the donor regions‘ placebo tests.

[6]Recall that many units were dropped for receiving partial SEZ or SEZ-like effects.

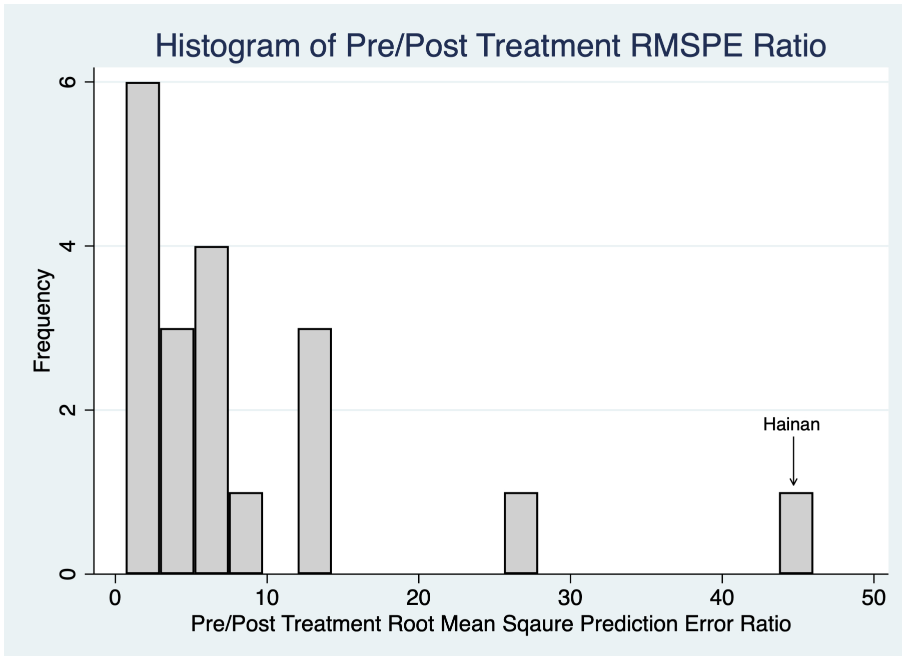

Figure 5: Histogram of the Pre/Post Hainan SEZ Designation Prediction Error Per-Capita Investment of all units. Notice that Hainan is on the extreme right of the RMSPE distribution, showing that Hainan has the highest pre/post-treatment RMSPE ratio of all units.

5 Conclusion

This paper establishes that the SEZ designation of Hainan in 1988 did have a positive and statistically significant impact on the province's per-capita fixed-investment, which is a reliable indicator of economic growth. The synthetic control model that was used in this paper found an average of 9603 Yuan increase in per-capita investment over seven post-treatment years, from 1989 - 1995.

This finding is supported by existing literature on the role of SEZ in liberalising the Chinese economy and their impact on economic growth. Leong [2012] found that the presence of SEZs in China and India increased regional growth, although increasing the number of SEZ has a negligible effect on growth [16].

Two crucial limitations of this paper, however, was the risk of omitted variable bias due to the small numbers of covariates used in the synthetic control model, and the small degree of treatment that all of the control regions received due to the 1992 provincial capital liberalisation and the general spillover effects of economic growth and investment into non-SEZ regions from SEZ provinces.

Although these findings show that economic liberalisation was an effective tool in bringing about economic growth in China during the late 20th Century and seem ungeneralizable to other developing countries, an important takeaway was that this paper confirms that it is possible for regions in developing countries that are not necessarily attractive investment locations to experience economic growth via economic liberalisation. The findings of this paper may be relevant to countries that are experimenting with economic liberalisation policies as a response to regional differences in wealth and infrastructure. Even though Hainan began as an inconsequencial backwater region, it was still able to benefit from the massive influx of foreign and domestic capital after 1988 because of its designation as a SEZ that year.

6 Appendix

```
*http://data.stats.gov.cn/english/easyquery.htm?cn=E0103
cd "/Users/jasenlo/Documents/Minerva/Hyderabad 19/SS154/Final"
*import data
clear
import delimited "/Users/jasenlo/Documents/Minerva/Hyderabad 19/SS154/Final/Hain

*cleaning data
rename ??id id
drop v14-v38
*dropped Chongqing
drop if region == "Chongqing" /* id22 */
*dropped controls as these experience treatment
drop if region == "Fujian" /* id13 */
drop if region == "Guangdong" /* id19 */
drop if region == "Beijing" /* id1 */
drop if region == "Tianjin" /* id2 */
drop if region == "Hebei" /* id3 */
drop if region == "Liaoning" /* id6 */
drop if region == "Shanghai" /* id9 */
drop if region == "Jiangsu" /* id10 */
drop if region == "Zhejiang" /* id11 */
drop if region == "Shandong" /* id15 */
drop if region == "Guangxi" /* id20 */

*time-series
tsset id year

*adjusting pop from thousands to full population
replace pop = pop*1000
*adjusting units from 100 Million Yuan to Yuan
replace stateexp = stateexp*1000000000
replace staterev = staterev*1000000000
replace agriculture = agriculture*1000000000
replace investment = investment*1000000000

*interpolate
ipolate population year, gen(pop) epolate by (id)
ipolate investment year, gen(I) epolate by (id)

*per-capita
gen staterev_pc = staterev / pop
gen stateexp_pc = stateexp / pop
gen industrial_pc = industrial/pop
```

```
gen agriculture_pc = agriculture/pop
gen I_pc = I/pop

*gen pop_density
gen pop_density = pop/area

*saves dataset
save final.dta, replace

*----------------------------------------------------------------------------

* Justifying Inter/Extrapolation of Population
*Only 1982 Population Model
#delimit;

synth   I_pc I_pc(1982) stateexp_pc(1982)
                staterev_pc(1982) wages
                industrial_pc(1982) agriculture_pc(1982)
                pop_density(1982) coastal
                ,
                trunit(21) trperiod(1988) unitnames(region)
                mspeperiod(1980(1)1988) resultsperiod(1980(1)1995)
            keep(synth_bmprate.dta) replace fig;

                mat list e(V_matrix);
#delimit cr
*Inter/Extrapolation Population Model
#delimit;

synth   I_pc I_pc stateexp_pc
                staterev_pc wages
                industrial_pc agriculture_pc
                pop_density coastal
                ,
                trunit(21) trperiod(1988) unitnames(region)
                mspeperiod(1980(1)1988) resultsperiod(1980(1)1995)
            keep(synth_bmprate.dta) replace fig;

                mat list e(V_matrix);
#delimit cr

*Figure 1 - Justifying Inter/Extrapolation of Population
graph combine only1982.gph allyears.gph

*----------------------------------------------------------------------------
*summary statistics
```

```
drop id-investment
drop prices-population
drop pop-I

order I_pc stateexp_pc staterev_pc wages
industrial_pc agriculture_pc pop_density coastal

outreg2 using sum,sum(log) replace tex dec(1)

*----------------------------------------------------------------------------
**Figure 2 - Time series data of Hainan Investment
clear
use final.dta, replace
egen mean_I_pc = mean(I_pc) if id != 21, by(year)
twoway tsline I_pc if id == 21 || tsline mean_I_pc if id == 4
tsline meanI_pc if id == 5
*----------------------------------------------------------------------------
clear
use final.dta, replace
* Figure 3 - Hainan model of investment
#delimit;

synth   I_pc I_pc stateexp_pc
                staterev_pc wages
                industrial_pc agriculture_pc
                pop_density coastal
                ,
                trunit(21) trperiod(1988) unitnames(region)
                mspeperiod(1980(1)1988) resultsperiod(1980(1)1995)
            keep(synth_bmprate.dta) replace fig;

                mat list e(V_matrix);
#delimit cr

* Plot the gap in predicted error
use synth_bmprate.dta, clear
keep _Y_treated _Y_synthetic _time
drop if _time==.
rename _time year
rename _Y_treated  treat
rename _Y_synthetic counterfact
gen gap21=treat-counterfact
sort year
twoway (line gap21 year,lp(solid)lw(vthin)lcolor(black)),
yline(0, lpattern(shortdash) lcolor(black)) xline(1988,
lpattern(shortdash) lcolor(black)) xtitle("",si(medsmall))
```

```
xlabel(#10) ytitle("Gap in Per-Capita Investment prediction error",
size(medsmall)) legend(off)
save synth_bmprate_21.dta, replace
*------------------------------------------------------------------------------
* Placebo test
clear
use final.dta, replace

#delimit;
set more off;

local regionlist  4 5 7 8 12 14 16 17 18 21 23 24 25 26 27 28 29 30 31 32;

foreach i of local regionlist {;

synth   I_pc I_pc stateexp_pc
                staterev_pc wages
                industrial_pc agriculture_pc
                pop_density coastal
                ,
                trunit(`i') trperiod(1988) unitnames(region)
                mspeperiod(1980(1)1988) resultsperiod(1980(1)1995)
                        keep(synth_bmprate_`i'.dta) replace;
                        matrix region`i' = e(RMSPE); /* check the V matrix*/
                        };


 foreach i of local regionlist {;
 matrix rownames region`i'=`i';
 matlist region`i', names(rows);
 };

#delimit cr


local regionlist  4 5 7 8 12 14 16 17 18 21 23 24 25 26 27 28 29 30 31 32;

 foreach i of local regionlist {
        use synth_bmprate_`i' ,clear
        keep _Y_treated _Y_synthetic _time
        drop if _time==.
        rename _time year
        rename _Y_treated  treat`i'
        rename _Y_synthetic counterfact`i'
        gen gap`i'=treat`i'-counterfact`i'
        sort year
```

```
        save synth_gap_bmprate`i'.dta, replace
}

use synth_gap_bmprate21.dta, clear
sort year
save placebo_bmprate21.dta, replace

local regionlist  4 5 7 8 12 14 16 17 18 21 23 24 25 26 27 28 29 30 31 32;

foreach i of local regionlist {
                merge year using synth_gap_bmprate`i'
                drop _merge
                sort year
        save placebo_bmprate.dta, replace
}

* All the placeboes on the same picture
use placebo_bmprate.dta, replace


* Picture of the full sample, including outlier RSMPE
#delimit;

twoway
(line gap4 year ,lp(solid)lw(vthin))||
(line gap5 year ,lp(solid)lw(vthin)) ||
(line gap7 year ,lp(solid)lw(vthin)) ||
(line gap8 year ,lp(solid)lw(vthin)) ||
(line gap12 year ,lp(solid)lw(vthin)) ||
(line gap14 year ,lp(solid)lw(vthin))||
(line gap16 year ,lp(solid)lw(vthin)) ||
(line gap17 year ,lp(solid)lw(vthin)) ||
(line gap18 year ,lp(solid)lw(vthin)) ||
(line gap23 year ,lp(solid)lw(vthin))||
(line gap24 year ,lp(solid)lw(vthin))||
(line gap25 year ,lp(solid)lw(vthin)) ||
(line gap26 year ,lp(solid)lw(vthin)) ||
(line gap27 year ,lp(solid)lw(vthin)) ||
(line gap28 year ,lp(solid)lw(vthin)) ||
(line gap29 year ,lp(solid)lw(vthin)) ||
(line gap30 year ,lp(solid)lw(vthin)) ||
(line gap31 year ,lp(solid)lw(vthin)) ||
(line gap21 year ,lp(solid)lw(thick)lcolor(black)), /*treatment unit, Hainan*/
yline(0, lpattern(shortdash) lcolor(black)) xline(1988,
lpattern(shortdash) lcolor(black))
xtitle("",si(small)) xlabel(#10)
```

```
ytitle("Gap in investment prediction error", size(small))
        legend(off);

#delimit cr

*------------------------------------------------------------------------

* Estimate the pre- and post-RMSPE and calculate the ratio of the
* post-pre RMSPE
set more off

local regionlist  4 5 7 8 12 14 16 17 18 21 23 24 25 26 27 28 29 30 31 32;

foreach i of local regionlist {
use synth_gap_bmprate`i', clear
gen gap3=gap`i'*gap`i'
egen postmean=mean(gap3) if year>1988
egen premean=mean(gap3) if year<=1988
gen rmspe=sqrt(premean) if year<=1988
replace rmspe=sqrt(postmean) if year>1988
gen ratio=rmspe/rmspe[_n-1] if year==1989
gen rmspe_post=sqrt(postmean) if year>1988
gen rmspe_pre=rmspe[_n-1] if year==1989
mkmat rmspe_pre rmspe_post ratio if year==1989, matrix (region`i')
}

* show post/pre-expansion RMSPE ratio for all states, generate histogram
local regionlist  4 5 7 8 12 14 16 17 18 21 23 24 25 26 27 28 29 30 31 32;

foreach i of local regionlist {
matrix rownames region`i'=`i'
matlist region`i', names(rows)
}

#delimit ;
mat region=region4\region5\region7\region8\
region12\region14\region16\region17\region18\
region21\region23\region24\region25\region26\
region27\region28\region29\region30\region31;
#delimit cr

mat2txt, matrix(region) saving(rmspe_bmprate.txt) replace
insheet using rmspe_bmprate.txt, clear
ren v1 region
drop v5
gsort -ratio
```

```
gen rank=_n
gen p=rank/19
export excel using rmspe_bmprate, firstrow(variables) replace
import excel rmspe_bmprate.xls, sheet("Sheet1") firstrow clear
*Figure 6 - Histogram of RMSPE ratios
histogram ratio, bin(20) frequency fcolor(gs13) lcolor(black) ylabel(0(2)6)
xtitle(Post/pre RMSPE ratio)
list rank p if region==21

*list regions with more than 2 times rmspe_pre of treatment
list region rmspe_pre if rmspe_pre > 2*298.8237

*---------------------------------------------------------------------------
* Picture of the full sample, exluding outlier RSMPE
clear
use placebo_bmprate.dta, replace

#delimit;

twoway
(line gap4 year ,lp(solid)lw(vthin))||
(line gap7 year ,lp(solid)lw(vthin)) ||
(line gap8 year ,lp(solid)lw(vthin)) ||
(line gap12 year ,lp(solid)lw(vthin)) ||
(line gap14 year ,lp(solid)lw(vthin))||
(line gap16 year ,lp(solid)lw(vthin)) ||
(line gap17 year ,lp(solid)lw(vthin)) ||
(line gap18 year ,lp(solid)lw(vthin)) ||
(line gap23 year ,lp(solid)lw(vthin))||
(line gap24 year ,lp(solid)lw(vthin))||
(line gap25 year ,lp(solid)lw(vthin)) ||
(line gap27 year ,lp(solid)lw(vthin)) ||
(line gap28 year ,lp(solid)lw(vthin)) ||
(line gap21 year ,lp(solid)lw(thick)lcolor(black)), /*treatment unit, Hainan*/
yline(0, lpattern(shortdash) lcolor(black))
xline(1988, lpattern(shortdash) lcolor(black))
xtitle("",si(small)) xlabel(#10)
ytitle("Gap in investment prediction error", size(small))
        legend(off);

#delimit cr

*---------------------------------------------------------------------------
*Figure 5, combined placebos
graph combine placebo1.gph placebo2.gph
```

References

[1] Jiaxiang Hu. “Shanghai Free Trade Pilot Zone”. In: *Regional cooperation and free trade agreements in Asia* (2014), p. 246.

[2] Bin Xue Sang. “Pudong: Another Special Economic Zone in China–An Analysis of the Special Regulations and Policy for Shanghai’s Pudong New Area”. In: *Nw. J. Int’l L. & Bus.* 14 (1993), p. 130.

[3] Ilaria Maria Sala. *Story of cities 39: Shenzhen from rural village to the world‘s largest megalopolis*. 2016, May. URL: https://www.theguardian.com/cities/2016/may/10/story-of-cities-39-shenzhen-from-rural-village-to-the-worlds-largest-megalopolis.

[4] Tianlun Jian, Jeffrey D Sachs, and Andrew M Warner. “Trends in regional inequality in China”. In: *China economic review* 7.1 (1996), pp. 1–21.

[5] Dali L Yang. *Beyond Beijing: Liberalization and the regions in China*. Routledge, 2012.

[6] Paul M Cadario, Kazuko Ogawa, and Yin-Kann Wen. *A Chinese province as a reform experiment: the case of Hainan*. The World Bank, 1992.

[7] G UNCTAD. “World Investment Report–Investor Nationality: Policy Challenges”. In: *Geneva: UNCTAD* (2016).

[8] Robert C Feenstra and Gordon H Hanson. “Foreign direct investment and relative wages: Evidence from Mexico’s maquiladoras”. In: *Journal of international economics* 42.3-4 (1997), pp. 371–393.

[9] Sourafel Girma, Yundan Gong, and Holger Görg. “What determines innovation activity in Chinese state-owned enterprises? The role of foreign direct investment”. In: *World Development* 37.4 (2009), pp. 866–873.

[10] Langi Chiang. *China’s Hainan hopes to avoid property crash*. 2010, May. URL: https://www.reuters.com/article/china-property-hainan/chinas-hainan-hopes-to-avoid-property-crash-idUKLNE64303D20100504.

[11] Alberto Abadie and Javier Gardeazabal. “The economic costs of conflict: A case study of the Basque Country”. In: *American economic review* 93.1 (2003), pp. 113–132.

[12] Alberto Abadie, Alexis Diamond, and Jens Hainmueller. “Synthetic control methods for comparative case studies: Estimating the effect of California‘s tobacco control program”. In: *Journal of the American statistical Association* 105.490 (2010), pp. 493–505.

[13] Harry G Broadman and Xiaolun Sun. “The distribution of foreign direct investment in China”. In: *World Economy* 20.3 (1997), pp. 339–361.

[14] Cletus C Coughlin and Eran Segev. “Foreign direct investment in China: a spatial econometric study”. In: *World Economy* 23.1 (2000), pp. 1–23.

[15] Ronald Aylmer Fisher. *The design of experiments*. Oliver And Boyd; Edinburgh; London, 1937.

[16] Chee Kian Leong. "Special economic zones and growth in China and India: an empirical investigation". In: *International Economics and Economic Policy* 10.4 (2013), pp. 549–567.