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Fiscal Reform and Economic Growth: A Synthetic Control Method (SCM) approach to Korean Economy

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Fiscal Reform and Economic Growth

- A Synthetic Control Method (SCM) approach to Korean Economy

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-Extended Abstract-

The policy environment faced by the Korean economy, including aging, is very difficult and severe. The current policy constraints in Korea are summarized as population aging, weakening of growth potential, rapid increase in welfare financing requirement, expansion of income inequality, and preparation for future unification.

Firstly, population aging is a big constraint. The population aging of Korea is proceeding at the fastest rate in the world and it is ahead of Japan at the aging rate. Aging is a constraint on economic growth that has been common in developed countries, such as a decline in the economically active population, a decline in social vitality, and a fall in investment due to a decline in savings rates. The next constraint is the depletion of growth potential. The potential growth rate is expected to show 1.0% in 2030 ~ 60, which is highly pessimistic. The third constraint is that the public need for welfare is large and the financial need to solve the disparities between generations / classes will be enormous. In 2014, Korea's public social welfare expenditure is 10.4% of GDP, which is less than half of the OECD average of 21.6%. However, considering the population aging and welfare demand, public spending for welfare is expected to increase rapidly in the mid- to long-term perspective. The fourth constraint is that economic inequality is expanded and fixed in the

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situation of stagnation of growth, so that the economic difficulties of the lower stratum are increased and income inequality is expanded. Recently, there has been an increasing trend of productivity, value added and wages between large enterprises and SMEs in Korea, and the per capita added value of SMEs is decreasing over the long term compared to the value added per capita of companies with 500 or more employees. Income inequality has also been widening since the late 1990s, with the proportion of lower and upper classes rising and the proportion of middle class declining. Recently, the portion of the middle class has risen again, but the income improvement in the lower class is continuously sluggish, and the conflicts about the redistribution of income are increasing. The final constraint is that it will take enormous resources to prepare for unification. According to the Ministry of Unification (2011), it is estimated that 1.3% to 6.0% of South Korea's GDP will cost for the period of 10 years after unification. Among these various constraints, one of the biggest problems is the decline of growth potential. Korea's real GDP growth was 8% in the 1980s, 6% in the 1990s, 4% in the 2000s, and 3% after the 2008 global financial crisis. According to the Korean government's long-term prospects of public finance (2015), it is expected to grow by 1% since the 2030s. Behind the declining growth rate, there are factors such as the limitation of growth strategy, the decrease of the physical production input factor, and the decrease of the total factor productivity, and the aging of the population structure is expected to become more negative factor for the potential growth decline. Therefore, it is time to raise a question about the role of fiscal reform in setting up a new growth strategy.

This study examines the effects of structural fiscal reform policies (tax and fiscal spending reform) on economic growth through empirical analysis. Economic growth usually results from the input of production functions and technological advances. If so, economic growth may or may not be stimulated by tax-fiscal policies that affect production inputs and

skill levels. For example, there are maternity policy, immigration policy, retirement system, active labor market policy, income tax relief, unemployment welfare system which affect labor input. These systems and policies are closely related to the fiscal reform. In other words, the fiscal reform proposed in this study refers to the growth-friendly policy change of the tax-fiscal policy related to the input of production factors and technological progress in the economic growth theory.

For this, the Synthetic Control Method (SCM) is used. This methodology was first introduced in Abadie and Gardeazabal (2003) and has been actively applied in recent years and has been extensively used by Abadie et al. (2010, 2014), Billmeier & Nannicini (2013) and Cavallo et al. (2013).

SCM is a data-driven methodology that quantifies the effect of a particular event, such as fiscal reform, on the outcome variable of interest, for example, a 10-year mid- to long-term growth rate. In microeconomic economics, we use difference-in-difference (DID) methodology to deal with differences in performance after the events of the treatment group and the control group for the causal relationship of specific events. SCM is a methodology that applies to macroeconomic aggregate variables in the unit of countries and regions. This methodology, for example, analyzes the effect of the event of fiscal reform, using the data before the fiscal reform to estimate the counterfactual, ie, the growth rate in the absence of fiscal reform. By doing this, we can estimate the specific effect of fiscal reform.

In this methodology, a hypothetical synthetic unit for estimating performance is composed of weighted averages of countries that have similar characteristics to the treatment group but are not affected by specific events. Country weight in selecting synthetic groups is chosen to minimize the differences between the treatment group countries that we are interested in analyzing and the reflexive synthetic group countries.²⁾

2) A detailed description of the methodology is provided in Section III of this paper.

Thus, the effect on an event is obtained as the difference between the dependent variable for the treatment group and the dependent variable for the combined control group that we are currently analyzing.

The robustness to this analysis is performed by placebo effects tests. For example, the time of occurrence of a particular event moves forward or backward, or the outcome of the control group is compared to other countries that have not been affected by the particular event. Since there are two potential biases in the SCM analysis, it should be cautious to interpretate the results. One is that the effects of fiscal reform can be overestimated because it is very difficult to separate the effects of fiscal reform from the various other factors that influence economic growth. It is also possible that the differences in the growth effects of fiscal reform may be due to other factors besides fiscal reform measures, despite the fact that they are tested for various placebo effects for robustness of the estimation results.

The composition of this study is as follows. First, Section II explains the path of fiscal reform to growth. It briefly explains the path of tax-fiscal policy that affects traditional production factors such as labor, physical capital, human capital and total factor productivity, and then describes the growth-friendly tax-fiscal reform policies that the IMF (2015) surveyed and analyzed. Section III explains SCM used in this study. Section IV analyzes the effects of Korean fiscal reform on economic growth using SCM. Here, we first define fiscal reform and determine the timing of Korea's fiscal reform through various indicators. The results of fiscal reform are estimated through SCM and the robustness analysis is also conducted. Finally, Section V closes the paper and suggests some policy implications.

JEL Classification: E6, H2, H5, O4

Keywords: Fiscal reform, Economic Growth, Synthetic Control Method (SCM)

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1. Motivation

- Fiscal Challenges the Korean government in ageing era
 - The major one is declining growth potential. The real GDP growth rate was about 8% in 1980s, 6% in 1990s, 4% in 2000s, and 3% on since 2008 crisis
 - The long-term fiscal projection from Korean government (2018) predicts 1% in 2030s
 - The limitation of previous growth strategy, the decline of physical inputs, the declining of total factor productivity have played on these.
 - In addition, the ageing is supposed to cause more negative effect on this
 - It is needed to take a serious step to tackle down this from the view points of fiscal reform and fiscal policy on economic growth.

- Menu of Options: Fiscal Policies for Medium- to Long-Term Growth IMF (2015)
 - Macroeconomic Stability
 - Reduce large fiscal deficit
 - Adjust pace and composition of fiscal consolidation to protect growth
 - Contain increase in age-related expenditure
 - Structural Fiscal Policies
 - Policies to encourage labor supply
 - Policies to enhance investment in physical capital
 - Policies to support human capital development
 - Policies to increase total factor productivity and promote technological progress
 - Fiscal space
 - Revenue measure
 - Expenditure measure
 - Equity and Growth

<Table 1> Menu of Options: Fiscal Policies for Medium- to Long-Term Growth (IMF 2015)

	Advanced Economies	Emerging Economies	Low-Income Countries	Examples from Country Studies
Macroeconomic Stability (Section II.A)				
Reduce large fiscal deficits	xxx	xxx	xxx	Chile, Ireland, Malaysia, Netherlands
Adjust pace and composition of fiscal consolidation to protect growth	xxx	xxx	xxx	Ireland, Netherlands
Contain increase in age-related expenditure	xxx	xx	x	Germany, Poland, Australia
Structural Fiscal Policies (Section II.B)				
<i>Policies to encourage labor supply</i>				
Reduce labor taxes, especially at low income levels	xxx	xx	x	Ireland, Netherlands
Redesign unemployment benefits, including by tightening eligibility and shortening duration	xxx	xx	x	Netherlands, Germany
Provide in-work benefits and tax credits	xxx	xx	x	Germany, Netherlands
Increase use of active labor market programs (ALMPs)	xxx	xx	x	Germany
Stimulate labor force participation of:				
-women, including through individual taxation	xxx	xx	x	Ireland
-older workers, by restricting early retirement and providing tax incentives	xxx	xx	x	Australia, Germany, Netherlands
-low-skilled workers, through targeted ALMPs and use of in-work benefits	xxx	xx	x	Germany, Netherlands
<i>Policies to enhance investment in physical capital</i>				
Design a system that taxes excess returns on capital	xxx	xx	x	
Provide well-designed tax incentives that reduce the cost of capital	xxx	xx	xx	
Protect or increase the public capital stock	xxx	xxx	xxx	Poland, Tanzania, Malaysia
Enhance the productivity of public investment by strengthening the investment process	xx	xx	xxx	Tanzania
<i>Policies to support human capital development</i>				
Provide access to education for disadvantaged groups by:				
-spending more at lower levels	xxx	xxx	xxx	Ireland, Tanzania, Uganda
-increasing cost-recovery for tertiary education	xxx	xx	xxx	
-conditioning cash transfers on school enrollment	xx	xxx	xxx	
Expand access to basic healthcare by:				
-reducing user charges for low-income households	xxx	xxx	xxx	Tanzania, Uganda, Chile
-addressing supply-side barriers in less developed areas	x	xxx	xxx	Tanzania, Uganda
-conditioning cash transfers on preventive health visits	x	xxx	xxx	
<i>Policies to increase total factor productivity and promote technological progress</i>				
Grant tax credits or deductions for R&D	xxx	xx	x	Ireland, Poland, Malaysia
Increase public R&D spending	xxx	xx	x	Netherlands
Provide more efficient public infrastructure	xxx	xxx	xxx	Poland, Tanzania, Malaysia

Fiscal Space (Section II.C)				
<i>Revenue measures</i>				
Use indirect, property/wealth and environmental taxes to raise revenue	xxx	xxx	xxx	Chile, Poland
Broaden tax base, including by reducing exemptions and preferential regimes	xxx	xxx	xxx	Australia, Malaysia, Uganda
Improve revenue administration and simplify forms and procedures	x	xx	xxx	Chile, Malaysia, Tanzania, Uganda
<i>Expenditure measures</i>				
Rationalize the public wage bill	xxx	xxx	xxx	Chile, Germany, Ireland, Netherlands, Malaysia
Improve the design of social spending programs by better targeting	xx	xxx	xxx	Chile, Germany, Ireland, Netherlands, Poland
Improve the efficiency of spending through targeted sectoral reforms, e.g. in health or education	xxx	xxx	xxx	Netherlands
Eliminate generalized subsidies, especially for energy products	x	xxx	xxx	
Reform inefficient SOEs	x	xxx	xxx	Chile, Malaysia, Tanzania
Equity and Growth (Section II.D)				
Include mitigating measures when implementing potentially regressive reforms (e.g. increasing indirect taxes)	xxx	xxx	xxx	Ireland, Malaysia
Growth-enhancing reforms that also help equity include closing tax loopholes used by the wealthy and targeted CCTs	xxx	xxx	xxx	
Policy Design and Complementarity (Section III)				
Build social consensus through effective communication and/or compensating losers	xxx	xxx	xxx	Ireland, Netherlands
Complement fiscal reforms with other structural reforms and consistent macroeconomic policies	xxx	xxx	xxx	Chile, Germany, Ireland, Malaysia, Netherlands

Note: 'xxx' denotes highly relevant policy, 'xx' denotes moderately relevant policy and 'x' denotes less relevant policy.

2. Synthetic Control Method

Synthetic Control Method (SCM) 1

- The Synthetic Control Method (SCM) is a formal data-driven procedure to quantify the effect of an event (fiscal reform in this study) on an outcome variable of interest (i.e., medium- to long-term growth, defined as 10-year average growth rates).
- The method is based on the creation of an artificial counterfactual (i.e., growth performance in the absence of fiscal reform) using data prior to the event and then comparing the outcomes for the counterfactual and the unit being analyzed (the country that implemented fiscal reforms in this case) after the event has occurred

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□ Synthetic Control Method (SCM) 2

- the method first uses data prior to an event to create a counterfactual unit as a weighted average of comparison units, using an iterative optimization algorithm that minimizes the distance between the unit of interest and its counterfactual in terms of both the outcome variable of interest and its predictors
- The comparison units are chosen so that they are similar to the unit of interest but are unaffected by the event in question.
- Once the counterfactual is created, the post-event outcome in the unit of interest is compared to developments in the counterfactual.

○ Example

- $j=0, 1, 2, \dots, J$ countries $j=0$ is treatment country, the others are control group countries.

- $t=1, 2, \dots, T_1$. pre-reform period $t=1, 2, \dots, T_0$,

post-reform period $t=T_0+1, T_0+2, \dots, T_1$

- How to calculate target variable performance? The basic idea is as follows;

- Y_{0t}^I refers to the outcome that would be observed if unit $j=0$ is exposed to the intervention
- Y_{0t}^N refers to the outcome that would be observed for unit $j=0$ at time t if unit $j=0$ is not exposed to the intervention
- The effects of the intervention $A_{0t} = Y_{0t}^I - Y_{0t}^N$ (for $t > T_0$)
- Since Y_{0t}^N is not observable, we have to estimate it.

□ Synthetic Control Method (SCM) 3 : robustness checks

- Rather than using standard statistical inference methods which rely on large sample properties, for the SCM method it is more appropriate to confirm the robustness of the point estimates with placebo analysis In-time placebo and in-space placebo analysis.
- In-time placebo: the SCM is applied to alternative points in time when the event of interest did not take place
- In-space placebo: the SCM is applied to each of the comparator units that did not experience the event by construction.
- Intuitively, placebo analyses attempt to demonstrate that the SCM does not generate large differences in outcomes unless applied to units and times in which the event actually took place.
- Sensitivity analysis can also be used for robustness check-up.

□ Synthetic Control Method (SCM) 4: Implementation steps

- step1: Choose potential comparator countries and explanatory variables.
 - Comparator countries are those that are as similar as possible to the country of interest, but did not experience the same event within the sample period.
 - Predictor variables are those that are considered as good predictors of the outcome variable of interest (economic growth in our case).

- step2: Given the group of comparator countries and outcome and predictor variables, calculate a synthetic series.
 - Given country and variable selection, the procedure calculates weights of the predictor variables and comparator countries to reproduce as closely as possible the values of the outcome variable pre-event
 - Not all comparator countries have to receive a positive weight to create the synthetic

comparator. The procedure is based on an iterative optimization algorithm as follows:

- X_0, X_1 are matrices of predictor variables for the unit of interest and its comparator units, respectively. V some initial vector of weights of the predictor variables, W country weights to minimize a distance.
- In particular, W^* minimizes the following

$$\|X_1 - X_0 W\|_V = \sqrt{(X_1 - X_0 W)' V (X_1 - X_0 W)} \quad (1)$$

- Once the country weights W^* are chosen, variable weight V^* is chosen among all positive definite and diagonal matrices such that the mean square prediction error (MSPE) of the outcome variable is minimized over pre-event periods. In particular:

$$V^* = \operatorname{argmin}_{V \in \mathcal{V}} (Z_1 - Z_0 W^*(V))' (Z_1 - Z_0 W^*(V)) \quad (2)$$

Where Z_1, Z_0 are matrices of the outcome variable for the unit of interest and its comparator units, respectively.

- The resulting V^* is used as input to (1) for the next round of optimization. This iterative

process continues until both V^* and W^* converge.

- In summary, the synthetic series is constructed by solving a nested optimization problem that minimizes (2) for given $W^*(V)$ (Abadie and others, 2011)
- Using the weights W^* , V^* thus obtained, we then use the synthetic comparator to create a counterfactual path of the outcome variable post-event.

○ step3: Compare actual post-event outcome variable series with the synthetic comparator.

- The difference between the two series $A_{0t} = Y_{0t}^I - Y_{0t}^N$ is the estimated impact of the event (assuming that all other factors potentially affecting the variable of interest have been controlled for successfully).

○ step4: robustness check-up

- in-time placebo analysis, in-space placebo analysis

3. Empirical Analysis

Fiscal reform in Korea

how to identify the year or period of fiscal reform?

- From 1980 calculate change in fiscal reform indicators over at least two consecutive five-year periods (IMF(2015)). The reason why we use five year average is to control the business cycle effects.
- In case of S.Korea, there are lots of fiscal reforms, we introduce stricter criterion for evaluating fiscal reform. I.e., we consider reform if the change in fiscal reform indicators over two consecutive five-year periods be larger overall average change.
- 8 quantitative fiscal reform indicators.

○ Tax policy area:

- Change in tax mix (direct-to-indirect tax ratio): negative change over at least two consecutive five-year periods.
- Change in VAT standard rate (percent): positive change over at least two consecutive five-year periods.
- Change in top corporate income tax rate (percent): negative change over at least two consecutive five-year periods.
- Change in top individual income tax rate (percent): negative change over at least two consecutive five-year periods.

○ Expenditure policy area:

- Public capital spending (percent of GDP): positive change over at least two consecutive five-year periods
- Health spending (percent of GDP): positive change over at least two consecutive five-year periods

- Education spending (percent of GDP): positive change over at least two consecutive five-year periods

- Macroeconomic stability area

- Change in overall fiscal balance (percent of GDP): positive change over at least two consecutive five-year periods.

<Table 2> Fiscal reform in Korea

	Tax policy				Expenditure			Macroeconomic stability
	tax mix	VAT	top individual income tax rate	top corporate income tax rate	public capital	health	education	fiscal balance
(A) 5 year average of each indicators (%)								
1980-85	1.80	10.00	55.00	30.00	5.68	0.55	2.37	-2.43
1986-90	1.26	10.00	53.00	30.80	5.17	0.69	2.31	0.10
1991-95	0.83	10.00	48.00	31.60	6.00	0.99	2.98	-0.28
1996-00	0.79	10.00	40.00	28.00	6.47	1.69	3.73	-1.18
2001-05	0.70	10.00	36.60	26.80	6.15	2.81	4.64	1.23
2006-10	0.56	10.00	35.00	23.80	5.06	3.94	4.72	1.08
(B) change over 5 year average (%p)								
1980-85	-	-	-	-	-	-	-	-
1986-90	-0.54	0.00	-2.00	0.80	-0.51	0.13	-0.06	2.53
1991-95	-0.43	0.00	-5.00	0.80	0.82	0.30	0.67	-0.37
1996-00	-0.04	0.00	-8.00	-3.60	0.47	0.70	0.75	-0.90
2001-05	-0.10	0.00	-3.40	-1.20	-0.32	1.12	0.91	2.41
2006-10	-0.13	0.00	-1.60	-3.00	-1.09	1.13	0.08	-0.15
average	-0.25	0.00	-4.00	-1.24	-0.12	0.68	0.47	0.70

(C) fiscal reform identification								
1980-85	-	-	-	-	-	-	-	-
1986-90	-	-	-	-	-	-	-	-
1991-95	○	-	○	-	-	-	-	-
1996-00	-	-	○	-	○	○	○	-
2001-05	-	-	-	-	-	○	○	-
2006-10	-	-	-	○	-	○	-	-

○ Fiscal reform identification

- Above table ○ is indicated if the following both of two conditions met,
(criterion 1) whether change in fiscal reform indicators over at least two consecutive five-year periods (IMF(2015)) is shown as predicted or not?
(criterion 2) whether the change in (criterion 1) be larger overall average change or not?

○ According to these, we can identify as 1996-2000 as fiscal reform has happened in S. Korea.

Figur 1. TAX mix (=direct/indirect tax ration) (%)

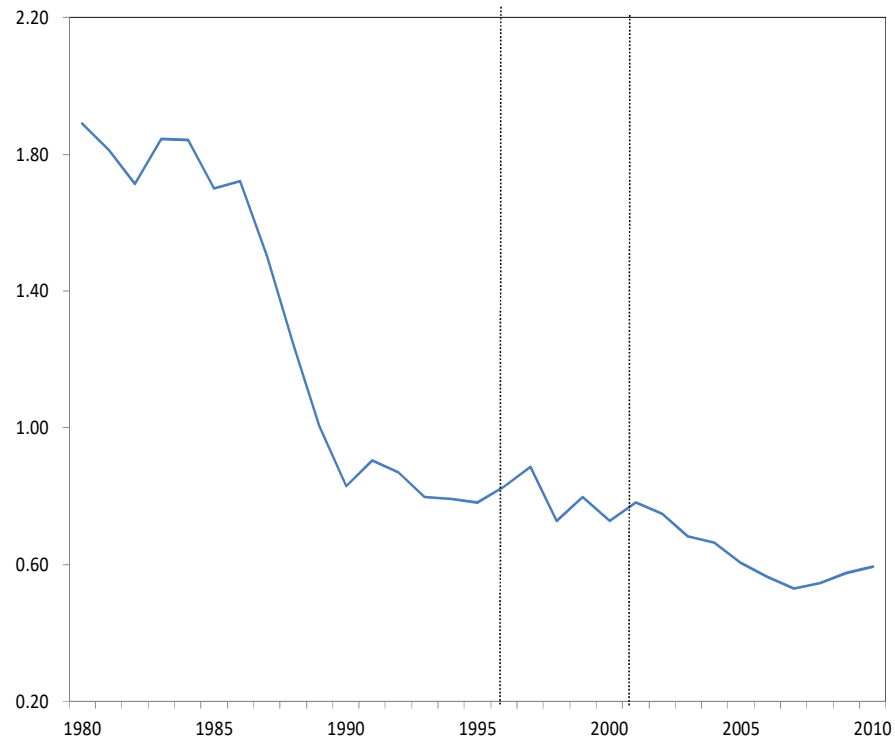


Figure 2. Top individual income tax rate(%)

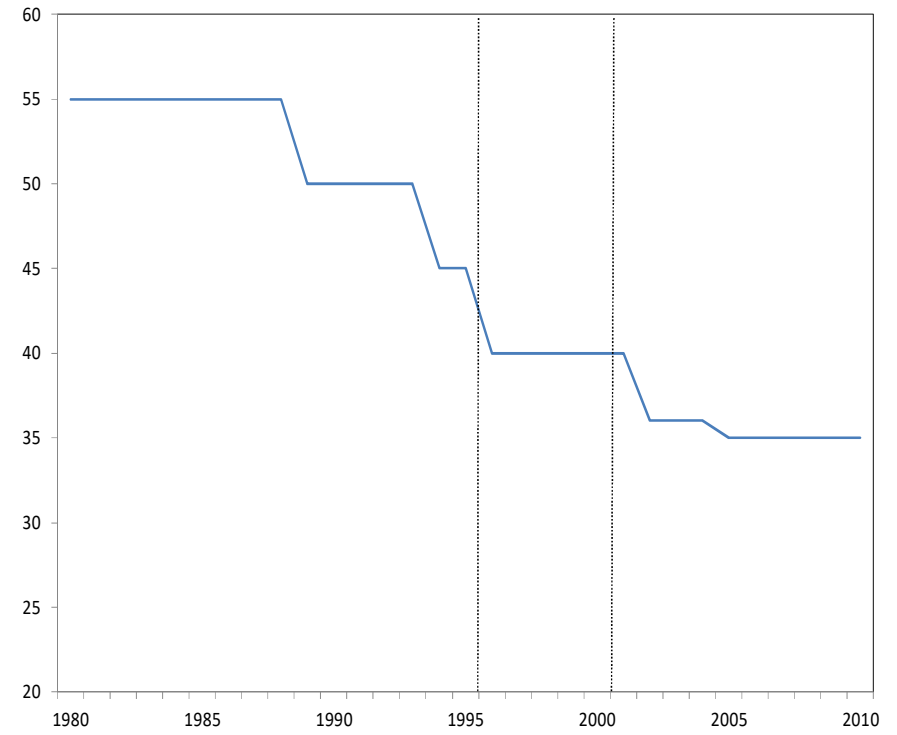


Figure 3. Top corporate income tax rate (%)

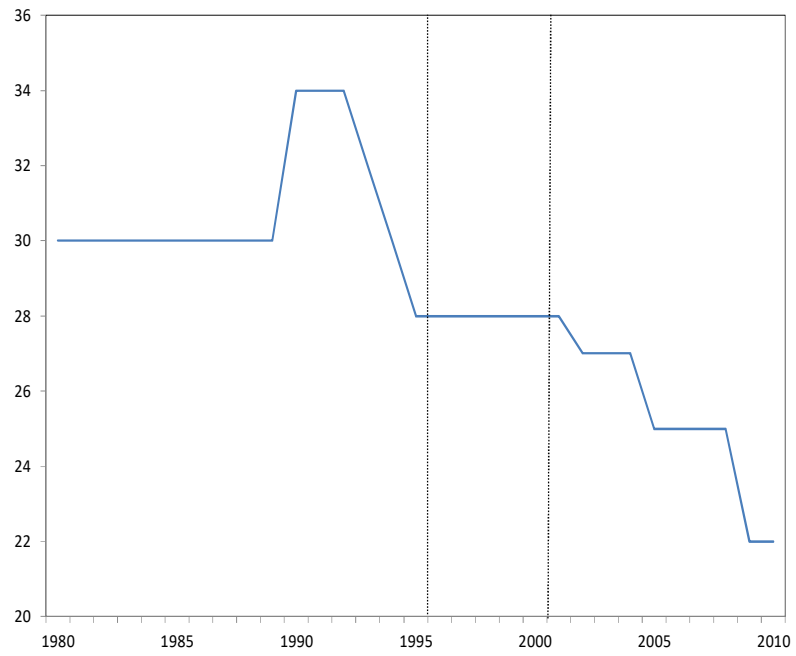


Figure 4. Public capital (GDP %)

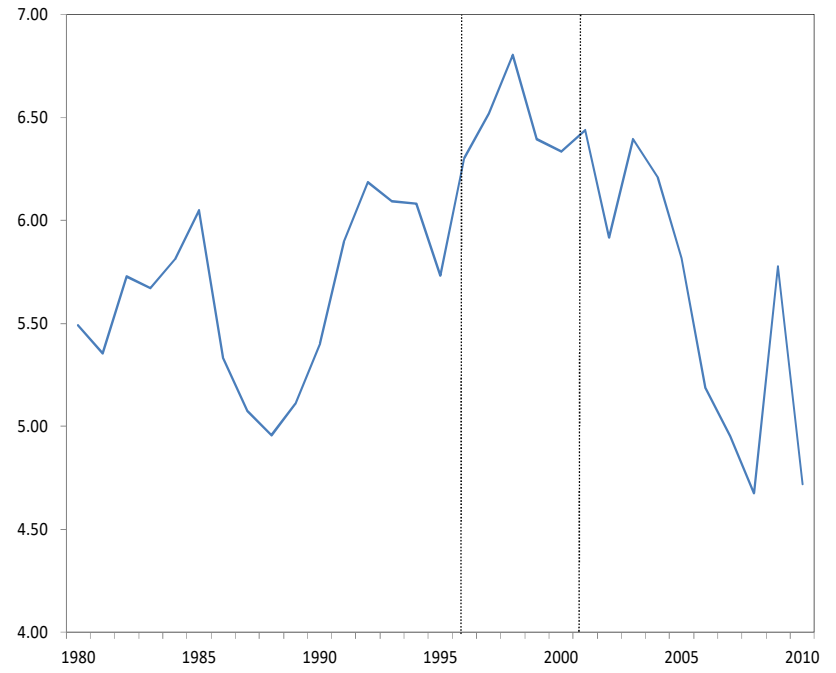


Figure 5. Health expenditure (GDP %)

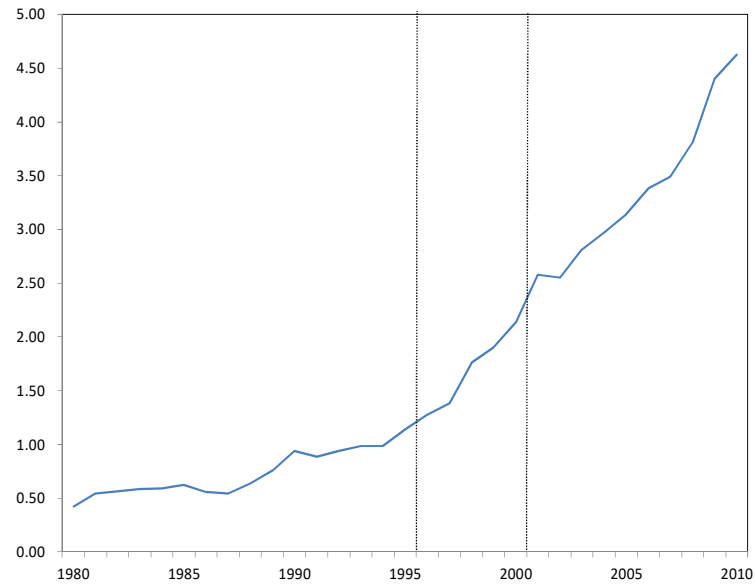


Figure 6. Education expenditure (GDP %)

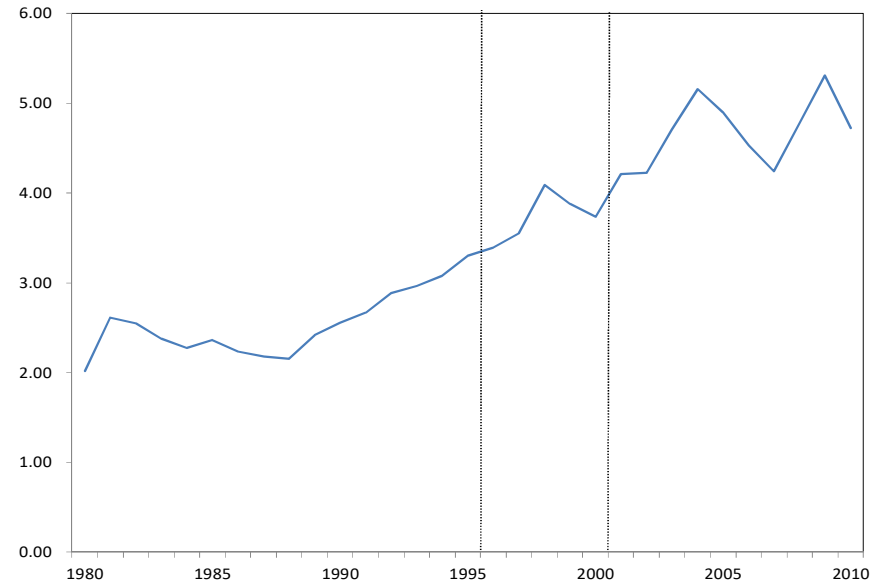
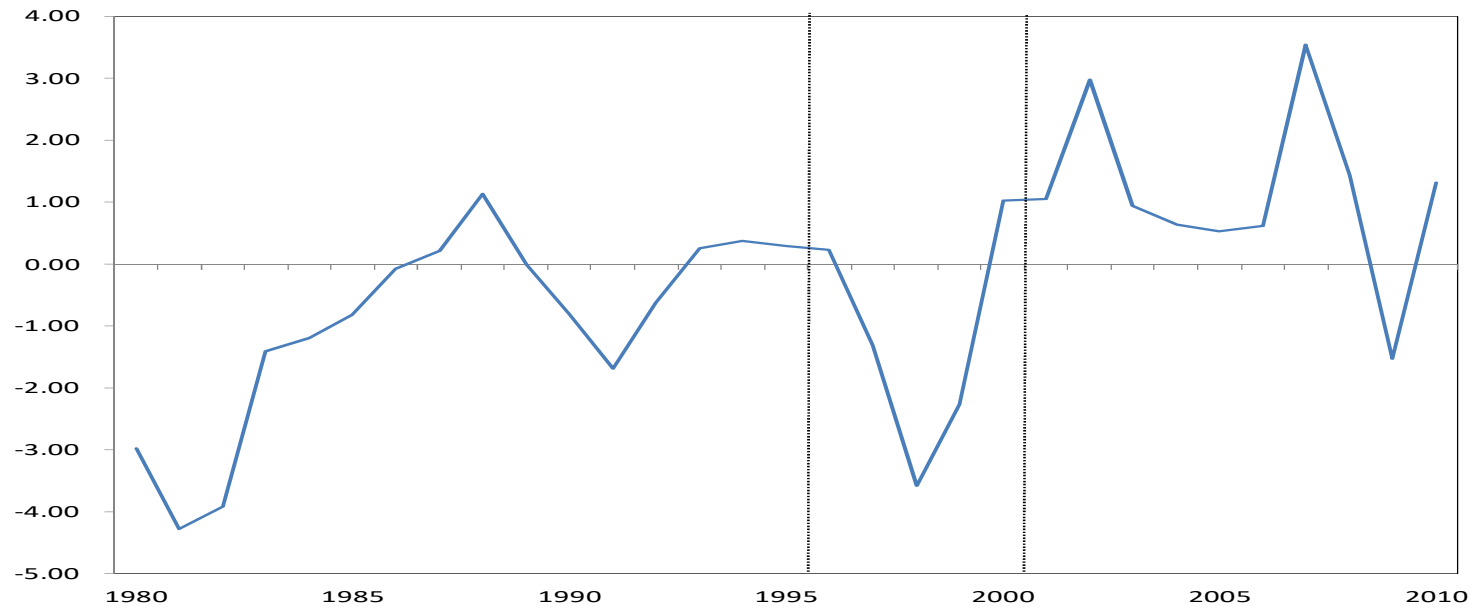


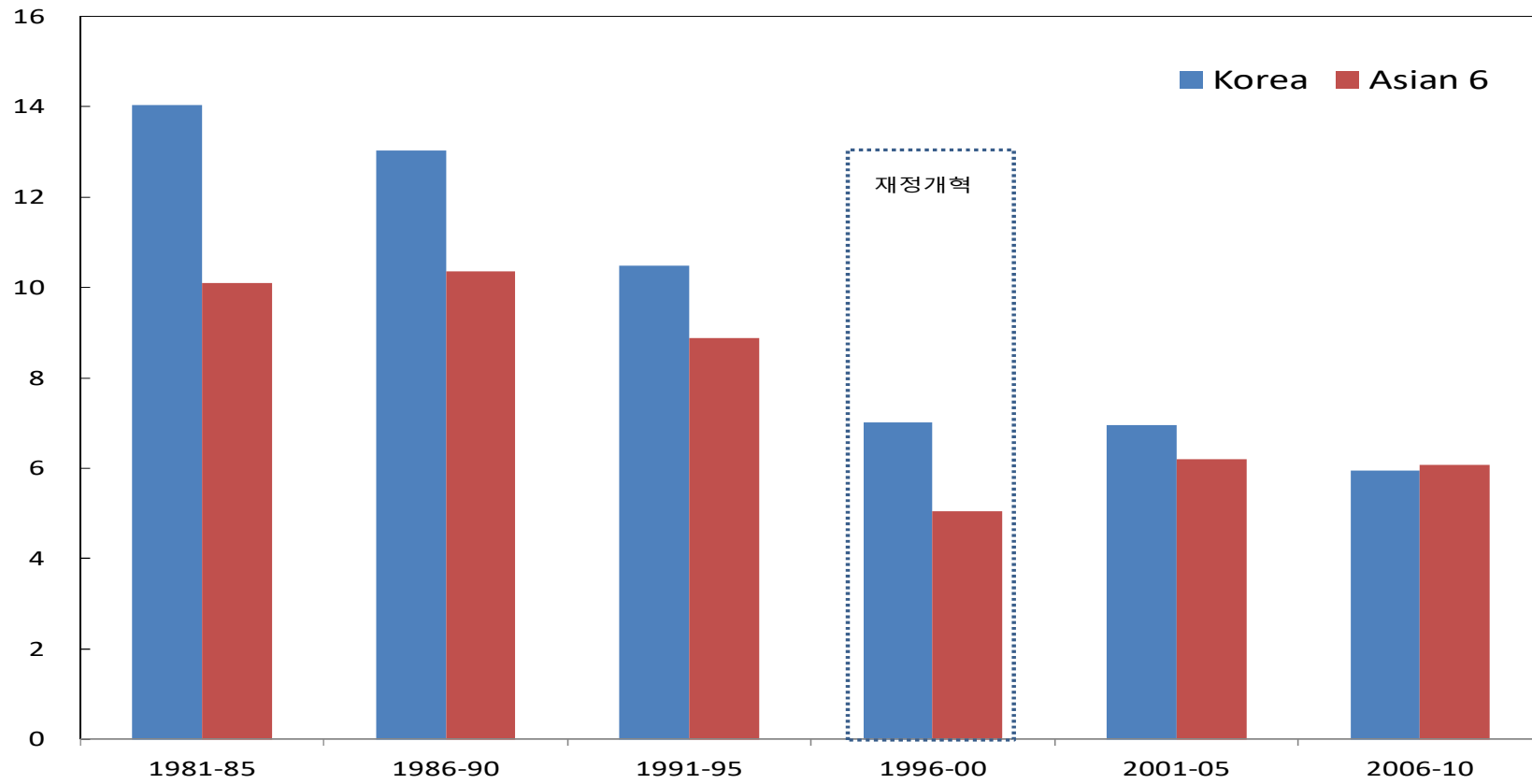
Figure 7 Fiscal balance (GDP %)



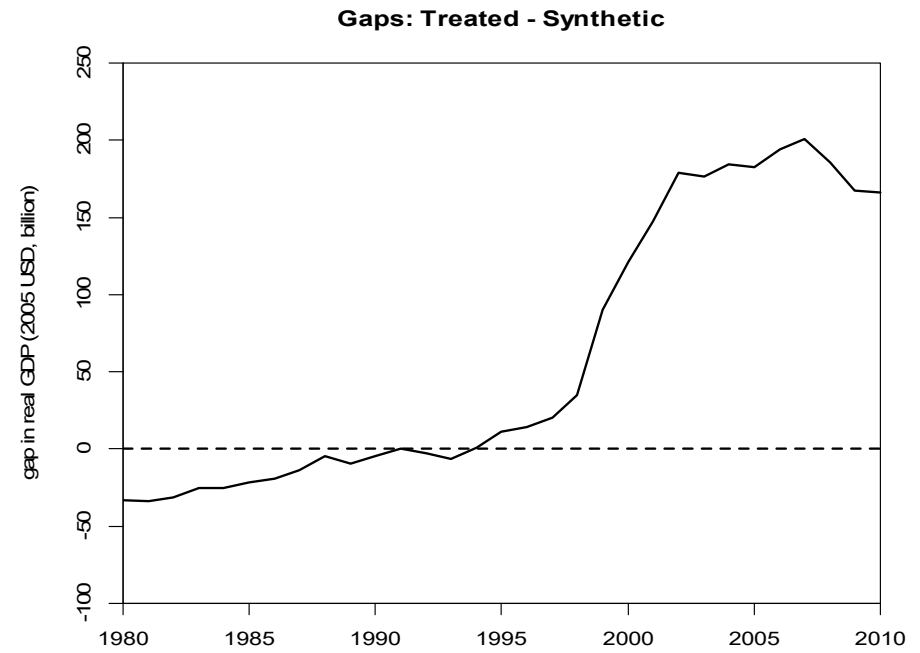
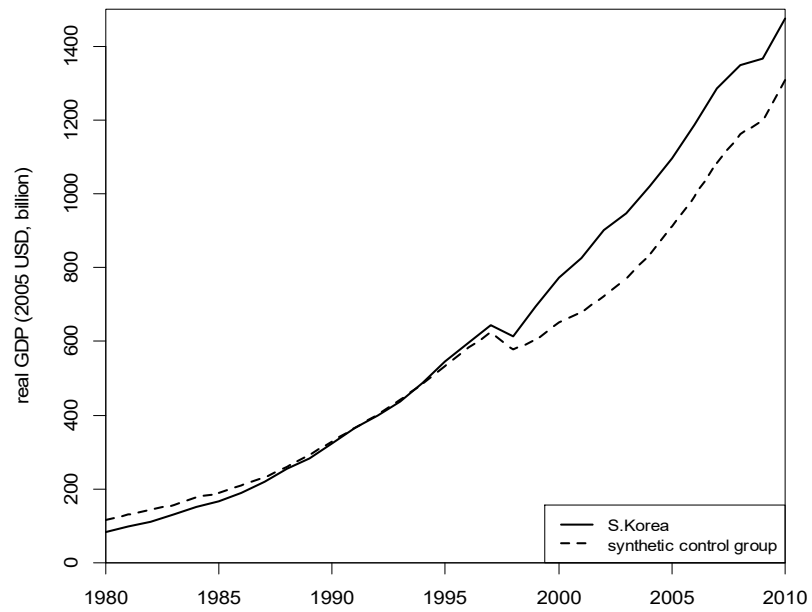
□ Empirical result

- Fiscal reform in Korea: 1996-2000
- Synthetic cohort comparator countries;
 - Japan, Singapore, Hongkong, Taiwan, Indonesia, Malaysia (6 countries)
 - Australia, Ireland can be considered.
- Sample period: 1980-2010
- predictor variables
 - per capita GDP (PGDP): 2005 US constant real dollars, IMF
 - inflation rate (rcpi): change in CPI, IMF
 - outbound openness (openness): $(\text{Exports} + \text{Imports}) / \text{GDP}$
 - human capital stock (schooling): Schooling year of 25-year old over
 - dependent variable: GDP, 2005 US constant real dollars, IMF

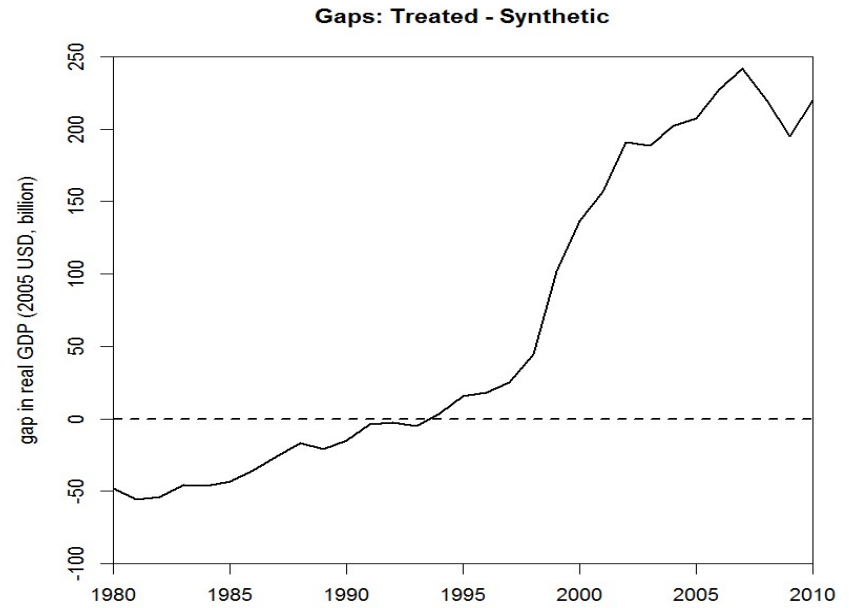
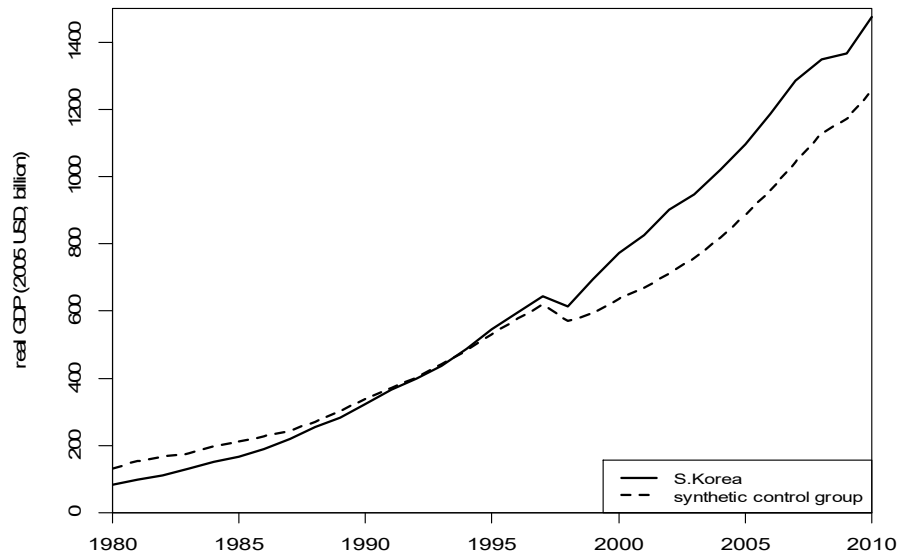
Figure 8. Simple comparison of growth rate between S. Korea and control group



□ SCM result 1: S. Korea and Asian 6 countries

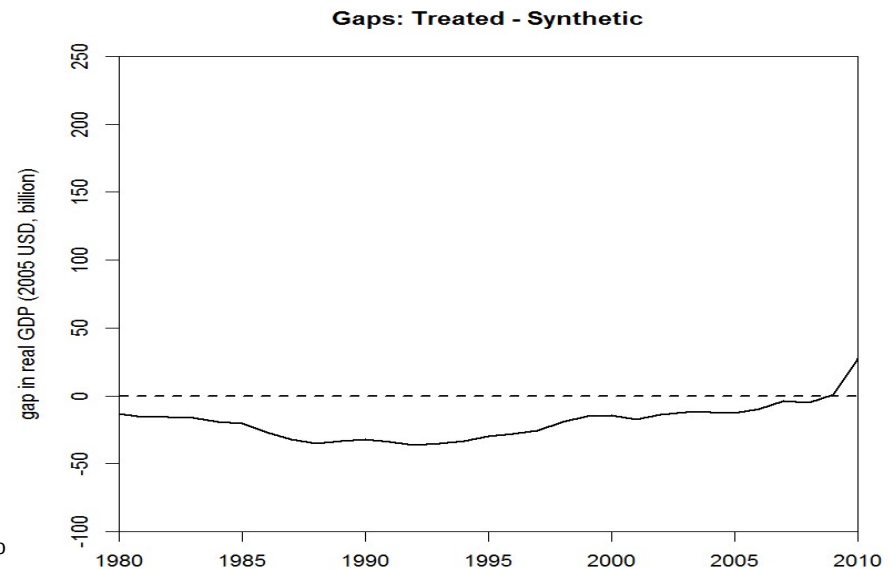
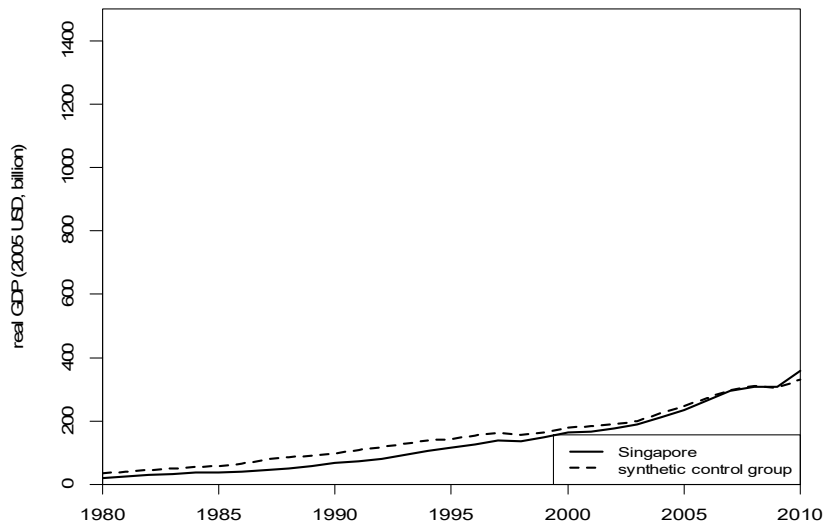


□ SCM result 1: S. Korea and 6 countries + 2 more countries(Australia and Ireland)



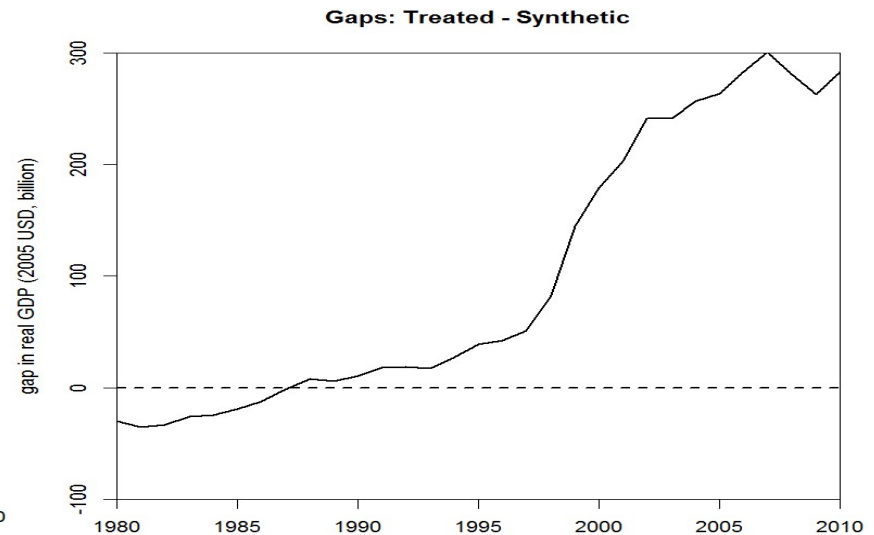
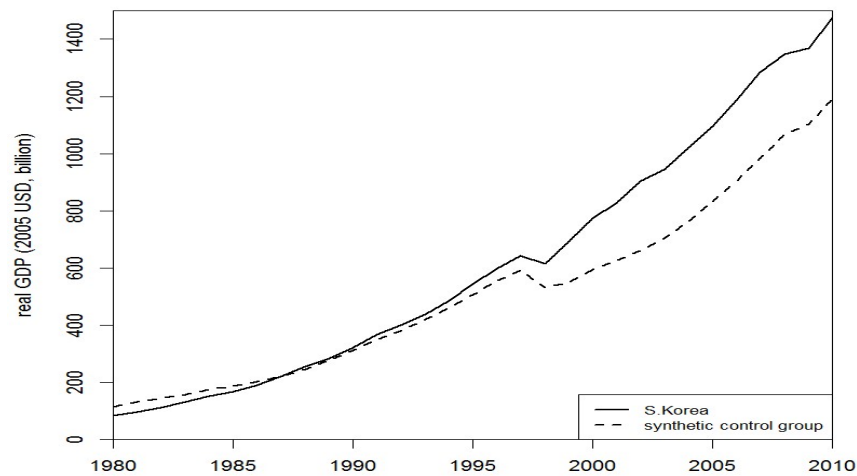
□ Placebo analysis: in-space placebo analysis

- treatment country: Singapore, Control group: the other 5 asian countries (excluding S. Korea)
- Since we did NOT find any significant difference between Singapore and its synthetic control series, we can conclude that there is no identifiable treatment effect in Singapore after 1996-2000. But it is obvious since there was NO fiscal reform in Singapore!



□ Placebo analysis: in-time placebo analysis

- What if fiscal reform took place in 1990-1995 not in 1995-2000? And apply SCM approach to this.
- We expect that the path of actual GDP series and its synthetic series will be similar to the baseline scenario since the reform happened in 1996-2000.
- The figure shows our expectation is right.



4. Concluding remarks

Fiscal reform in S.Korea

- IMF (2015)
- Tax policy, Expenditure policy, and Macroeconomic Stability
- The fiscal reform was active in 1996-2000 periods.
- OECD membership
- Post IMF crisis reform.

SCM method

- Event study tool
- DID(Difference in difference) in microeconometrics scheme in aggregate macroeconomic variables

- Basically data-driven method
- Used widely!

□ Policy implications

- These results can be used for policy direction.
- What is to be done in terms of fiscal policy to promote economic growth?
- Some limitations:
 - did not discuss the qualitative aspect in fiscal reform. Say, labor market reform, pension reform, fiscal expenditure management reform etc.
 - did not fully consider other long-term influencing factors of economic growth, for example, ageing, technological advance etc.

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