*Did They Hurt Growth? A Synthetic Control Estimate of the Impact of "Bachelet's Reforms"**

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Abstract

This paper uses the synthetic control method to estimate the short-term impact on GDP of the reforms implemented between 2014 and 2017 in Chile by the government of President Michelle Bachelet.

I find a cumulative fall by the end of 2017 of 13% relative to the synthetic counterfactual. This result is robust to the use of a donor pool that includes economies for which primary commodities are relevant, as well as one that only includes OECD countries.

JEL-Codes: H0, E6.
Keywords: *Structural reforms, Tax reform, Control, Chile, GDP.*

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I Introduction

In small open economies it is usually hard to disentangle the role of foreign shocks versus the effect of domestic policy in explaining economic performance. For this reason, these foreign shocks can sometimes be blamed in times of low economic growth. For instance, during the 2017 Chilean presidential campaign there was a debate about the impact of the reforms implemented by the leaving government on the economic performance between 2014 and 2017. The next two quotes exemplifies the type of assertions expressed during the campaign:

"Because it is extremely complex, cumbersome, arbitrary, and slows growth, employment, investment ... That tax reform has cost Chile 2 points of lower growth".[1] *Sebastian Piñera, former president and candidate. Debate ARCHI, Dec. 7, 2017.*

"Experts have said, on both sides, that 2/3 are due to bad policies in Chile and 1/3 of the slowdown that the Chilean economy has it is due to the international economy".[2] *Sebastian Piñera, former president and candidate. Debate ARCHI, Dec. 7, 2017.*

In this paper, I use the synthetic control method to estimate the short term impact on real gross domestic product of the reforms implemented by the government of President Michelle Bachelet during her term between 2014 and 2017[3]. I construct the synthetic conterfactual as a weighted average of a pool of economies for which primary commodity production and exports are relevant (labeled as "commodity republics" in Céspedes and Velasco (2014)).

I find a cumulative real GDP fall by the end of 2017 of 13% relative to the synthetic counterfactual. This result is robust to the use of an alternative donor pool that only includes OECD countries although the point estimate is smaller (approximately 9%).

This result is important because represents a cautionary tale about the design and implementation of structural reforms, and their potential short term economic cost. Moreover, this exercise illustrates how this recently proposed technique for comparative case studies can be used to evaluate economic claims often made during

[1]The original quote in Spanish is *"Porque es extremadamente compleja, engorrosa, arbitraria, y frena el crecimiento, frena el empleo, frena la inversión... Esa misma reforma tributaria le costó a Chile 2 puntos de menor crecimiento."*

[2]The original quote in Spanish is *"Los expertos han dicho, de ambos lados, que 2/3 se deben a malas políticas en Chile y 1/3 del frenazo que tiene la economía chilena se debe a la economía internacional."*

[3]Appendix 2 summarizes the main measures included in these reforms.

political campaigns.

The rest of the paper is organized as follows. Section II briefly describes the methodology and data. Section III presents the results, and Section IV states the main conclusions.

II Methodology and Data

The synthetic control method consists of the construction of a relevant counterfactual for comparison as a weighted average of a set of untreated units[4]. The method has been proposed in Abadie and Gardeazabal (2003) and Abadie et al. (2010), and has been recently used to study the impact of the German reunification (Abadie et al. (2015)), the impact of the economic liberalization episodes (Billmeier and Nannicini (2013)), the impact of Hugo Chavez on the Venezuelan economy (Grier and Maynard (2016)), and the impact of the U.S. sanctions on Iran (Gharehgozli (2017)), among others.

The basic idea consists of the comparison between the post-treatment outcome variable of a treated unit Y_{1t} and a weighted average $\sum_{j=2}^{J+1} w_j^* Y_{jt}$ constructed from a pool of J untreated units during a post-intervention period T_1. This synthetic control is created by choosing the $J \times 1$ vector of weights W that minimizes a weighted distance between the M pre-intervention characteristics of the treated unit X_{1m} and the characteristics of the untreated units X_{0m} (K-vector), with $m = 1, .., M$. In other words, W solves the following:

$$W = argmin \sum_{m=1}^{M} \nu_m (X_{1m} - X_{0m} W)^2 \tag{1}$$

where ν_m corresponds to the weight assigned to the m^{th} characteristic reflecting its relative importance[5].

I use an annual panel data set for the period 1980-2017, where the period between 1980 to 2013 is considered the pre-intervention period. The donor pool considers the following countries: Argentina, Australia, Belgium, Bolivia, Brazil, Cameroon, Canada, Colombia, Costa Rica, Cuba, Denmark, Dominican Republic, Ecuador, Ghana, Guatemala, Hungary, India, Indonesia, Iran, Jamaica, Kuwait, Malawi, Malaysia, Mexico, Netherlands, New Zealand, Norway, Paraguay, Peru, Poland, Romania, Saudi Arabia, South Africa, Uruguay, and Venezuela. All these economies

[4] I implement the estimator using the user-written command synth in Stata.

[5] For a more complete explanation, see Abadie et al. (2015)

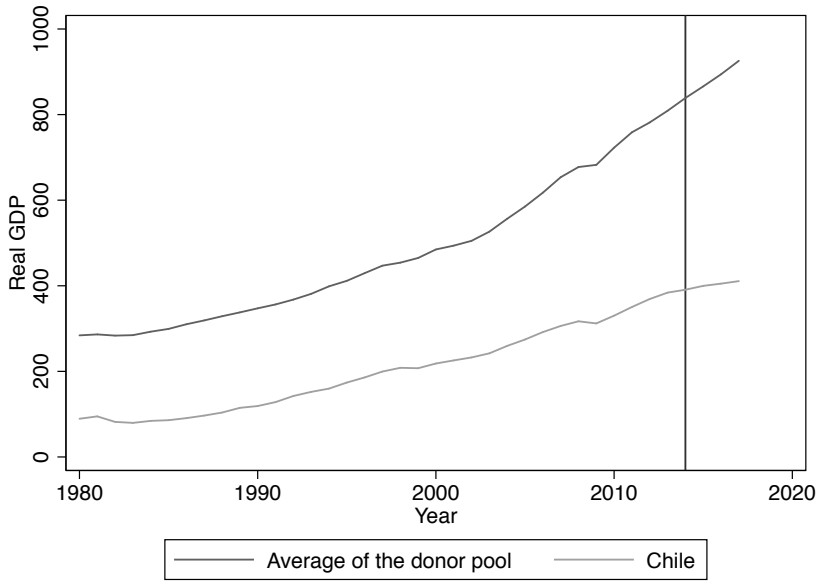
have been labeled "commodity republics" by Céspedes and Velasco (2014) because the relevance of primary commodities production and commodity exports for them. The outcome of interest is GDP Purchasing Power Parity (PPP)-adjusted and measured in 2011 international U.S. dollars (expressed in billions). The pre-intervention characteristics include a standard set of economic growth predictors: GDP, inflation rate, industry share of value added, agriculture share of value added, service share of value added, investment rate, human capital index, and a measure of trade openness. The details are listed in the Appendix 1 alongside their data sources.

III Results

I Construction of Synthetic Chile

Figure 1 compares the evolution of the Chilean GDP over time compared to a simple average of the donor pool. They have very different levels and also show different trends without a clear distinction before and after 2014.

Figure 1: Real GDP: Chile vs Average of the donor pool



In order to achieve a better fit, a weighted average that I call "synthetic Chile" is constructed using only India, Kuwait, Malaysia, Norway, New Zealand, and Uruguay

(in other words, the solution to Equation 1 gives positive weights only to these countries from the donor pool). Table 1 shows their respective weights. Table 2

Table 1: W Weights

Country	W Weight	Country	W Weight	Country	W Weight
Argentina	0.000	Australia	0.000	Belgica	0.000
Bolivia	0.000	Brazil	0.000	Canada	0.000
Cameroon	0.000	Colombia	0.000	Costa Rica	0.000
Denmark	0.000	Dom. Rep.	0.000	Ecuador	0.000
Ghana	0.000	Guatemala	0.000	Hungary	0.000
Indonesia	0.000	India	0.004	Iran	0.000
Jamaica	0.000	Kuwait	0.083	Mexico	0.000
Malawi	0.000	Malaysia	0.417	Netherlands	0.000
Norway	0.019	New Zealand	0.200	Peru	0.000
Poland	0.000	Paraguay	0.000	Romania	0.000
Saudi Arabia	0.000	Uruguay	0.277	Venezuela	0.000
South Africa	0.000				

reports the balance between the average values of the predictors for Chile versus Synthetic Chile.

Table 2: Balance

	Treated	Synthetic
GDP(1980)	89.237	80.384
GDP(1990)	119.009	120.494
GDP(2000)	218.386	218.359
GDP(2010)	330.158	337.363
Population growth	1.392	1.666
Total investment	23.304	24.266
Inflation rate	11.054	12.329
Natural rents	10.501	10.490
Trade	59.471	100.806
Human capital index	2.731	2.573
Industry, value added	39.069	37.319
Agriculture, value added	6.527	10.327
Service, value added	54.404	51.595

II Main Results

Figure 2 shows the paths of real GDP for Chile versus synthetic Chile. It can be seen that synthetic Chile tracks actual Chile relatively well in the pre-intervention period (between years 1980 and 2013).

Figure 2: Real GDP: Chile vs synthetic Chile

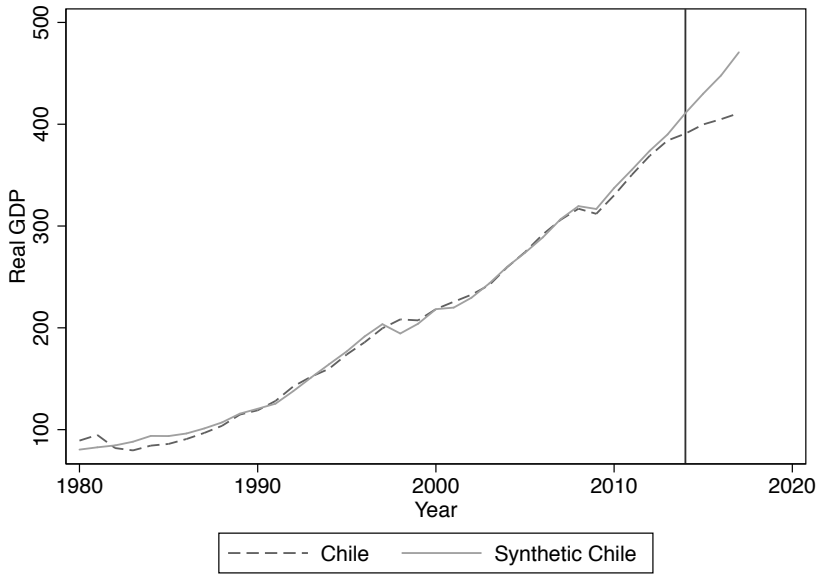


Figure 3 plots the gap between the real GDP of Chile and synthetic Chile. In the pre-treatment period the gap moves around 0, however since 2014 a noticeable divergence can be observed. By the end of 2017, there is a cumulative fall of approximately 13% in real GDP. This gap corresponds to approximately 60 billions in 2011 international dollars using purchasing power parity rates.

III Placebo Studies

To assess the robustness of this result, I perform two placebo exercises. First, I assume the reforms were implemented in the year 2001 and a apply the method[6]. This exercise is called "in-time" placebo by Abadie et al. (2015). Figure 4 shows that

[6]Due to data limitations, this placebo exercise does not use the covariates agriculture, industry and service value added.

Figure 3: Annual GDP gap between Chile and synthetic Chile

there is not a clear divergence between the actual path and the synthetic control after the year 2000.

Second, I assume the treatment is done for each other country to construct a distribution of placebo effects. Figure 5 presents the distribution of what is called "in-space" placebo by Abadie et al. (2015). The annual GDP gap does not seem to be large relative to the distribution, however many of the countries in the donor pool do not have a synthetic control that achieve a good fit relative to Chile. For this reason I restrict the distribution and consider only countries with a root mean square prediction error (rmspe) equal or less than Chile. Figure 6 reports the results under this constraint. In this case, the gap for Chile is the largest relative to the distribution. Given this result, I can compute a p-value of 1/13 which states that there is a probability equal to approximately 7.7% of finding an impact of the size found for Chile by chance[7].

[7]With the restriction of two times the rmspe of Chile (see Figure 9 in Appendix 3) the p-value increases to 11% (2/18).

Figure 4: In-time placebo effect

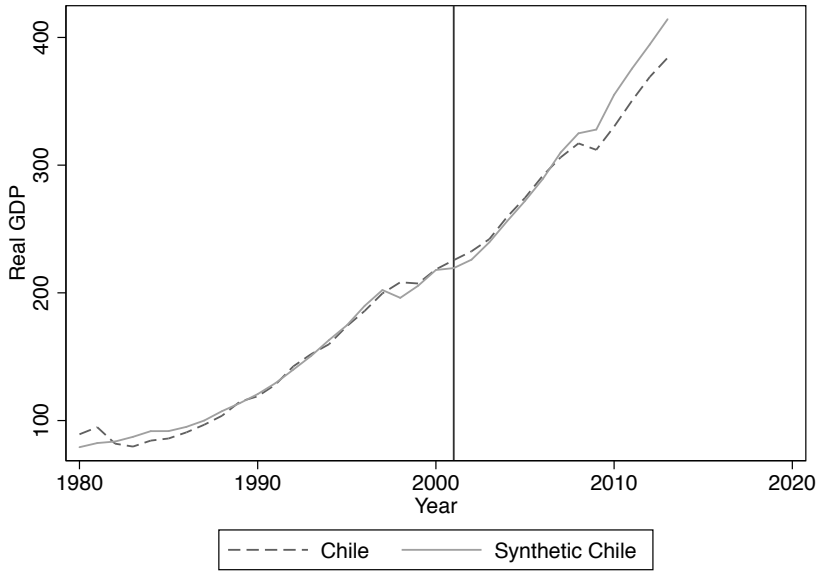


Figure 5: In-space placebo effect distribution

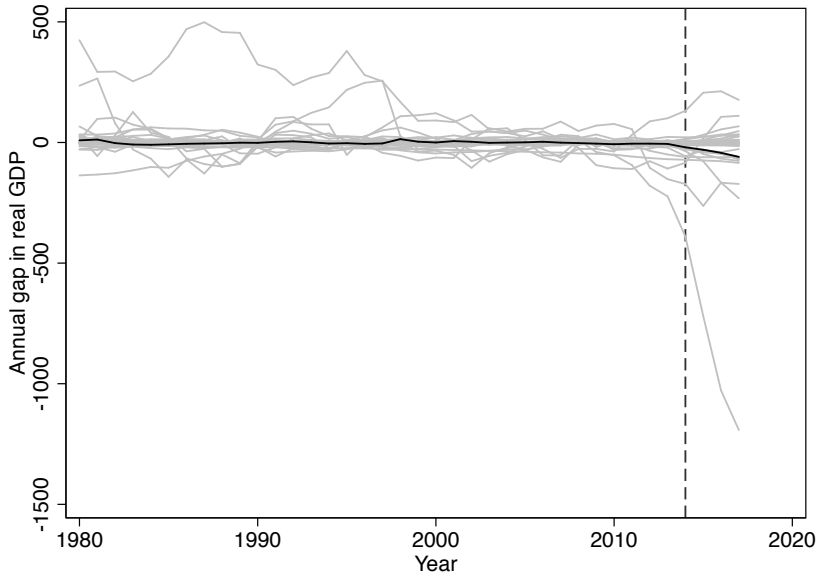
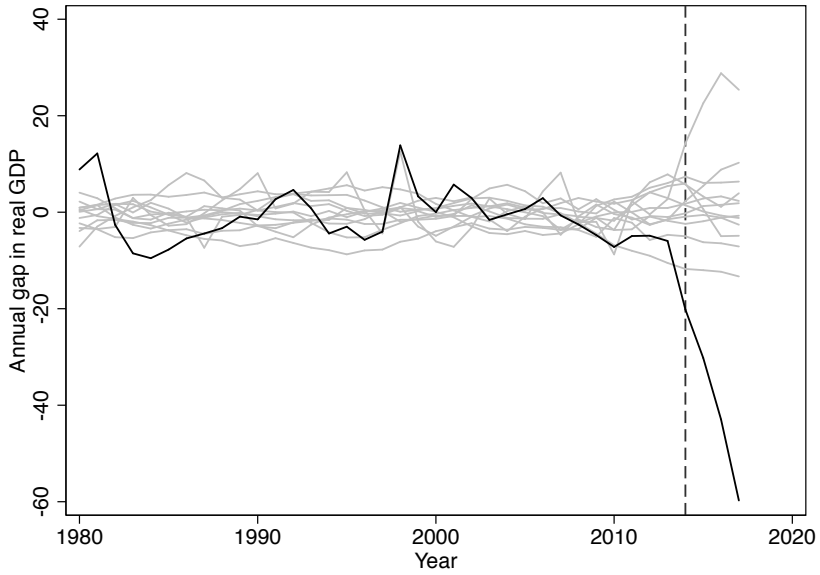


Figure 6: In-space placebo effect distribution



Note: Leaving out controls with MSPE>1*MSPE of Chile

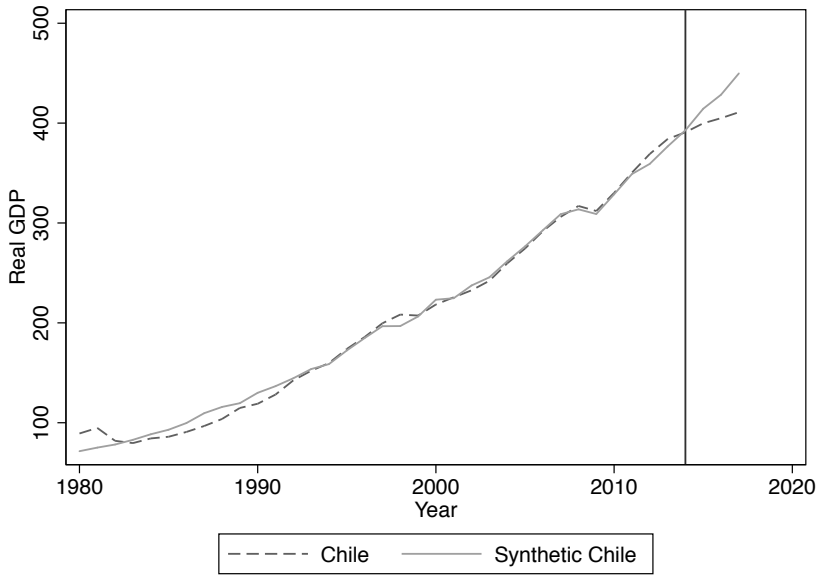
IV Alternative Donor Pools

In this section I analyze Chile using two different donor pools: OECD countries and Latin American countries. The first set include: Austria, Australia, Belgium, Canada, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea, Latvia, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom, and United States. The second set include: Argentina, Bolivia, Brazil, Colombia, Costa Rica, Dominican Republic, Ecuador, Guatemala, Honduras, Haiti, Mexico, Nicaragua, Panama, Peru, Puerto Rico, Paraguay, El Salvador, Uruguay, and Venezuela.

Figure 7 shows the paths of Chile and the synthetic control using OECD countries. The results are qualitatively similar to the case of commodity republics. However, the point estimate of the cumulative impact until 2017 is smaller than before (Figure 10 in Appendix 3).

Figure 8 shows the paths of Chile and the synthetic control using Latin American countries. The results differ to the previous one, however it can be seen that the fit obtained with these countries is relatively worse. This result suggests that Latin

Figure 7: Real GDP: Chile vs synthetic Chile using OECD donor pool



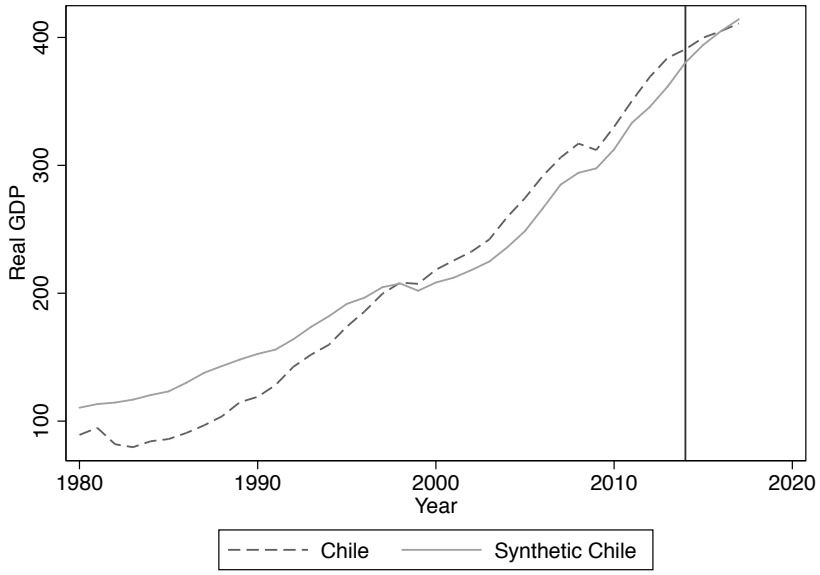
American countries are not an optimal donor pool for the Chilean economy and for that reason I base my conclusions on the first donor pool analyzed.

IV Concluding Remarks

This paper applies the synthetic control method to assess the impact on GDP of a set of structural reforms implemented during the government of Michelle Bachelet in Chile (between 2014 and 2017). By the end of 2017, I find a negative cumulative impact of 13% with respect to what real GDP would have been without the reforms.

Finally, it is important to point out two things that are beyond the scope of this paper. First, these reforms may have a long term positive impact that is not captured here (see for example, Eyraud and Santoro (2015)). Second, the drivers of this impact on GDP could have been the actual changes but also the uncertainty during the discussion of the reforms. For example, Cerda et al. (2018) create an economic uncertainty index and show that it has a non-negligible negative impact on GDP, investment and employment. In this paper I do not try to identify which one of these two potential mechanisms is the actual driver.

Figure 8: Real GDP: Chile vs synthetic Chile using Latin American donor pool



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Appendix 1: Data

The data sources employed in the analysis are as follows:

- Gross Domestic Product (PPP, Constant 2011 international dollars). Source: World Economic Outlook, October 2018.
- Total Investment (percentage of GDP). Source: World Economic Outlook, October 2018.
- Inflation rate. Source: World Economic Outlook, October 2018.
- Total Population. Source: World Economic Outlook, October 2018.
- Trade (Exports plus Imports as percentage of GDP). Source: World Development Indicators Data Bank, The World Bank.
- Total Natural Resources Rents (Percentage of GDP). Source: World Development Indicators Data Bank, The World Bank.
- Agriculture, Value Added (Percentage of GDP). Source: World Development Indicators Data Bank, The World Bank.
- Services, Value Added (Percentage of GDP). World Development Indicators Data Bank, The World Bank.
- Industry, Value Added (Percentage of GDP). Source: World Development Indicators Data Bank, The World Bank.
- Human Capital Index. Source: Penn World Table, version 9.0

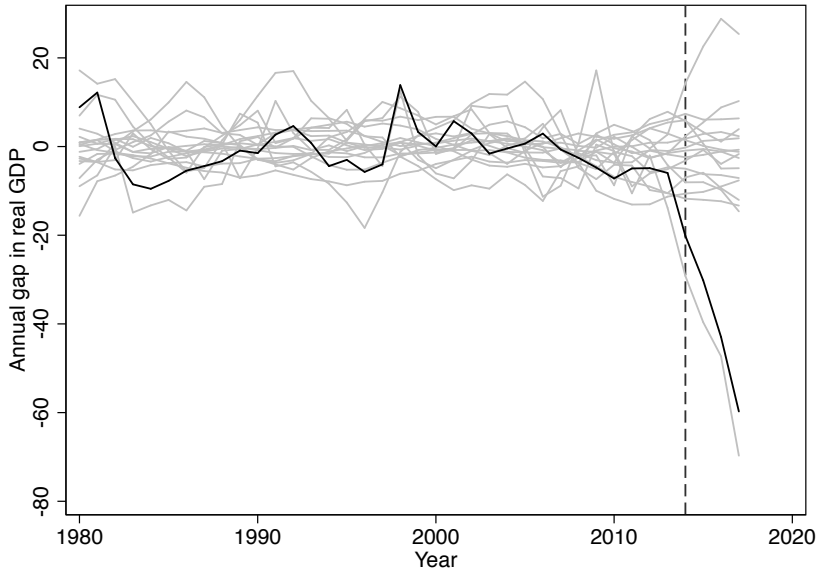
Appendix 2

Reform Areas	Main Measures	Passed in
Tax Reform	Capital Income Tax	2014
	Excise and Broadening of VAT Base	
Education	Repeal Private Co-payments and Student Selection	2015
	Eliminate For-Profit Institutions	
	Free Tertiary Education	
Labor Market	Last collective agreement as the minimum to negotiate	2016
	Broadening of practices qualified as anti-unions	
	Strengthen rules that mandate firms to provide information for the negotiation	
Energy	Promote competition to reduce prices	2014-15
	Incentivize renewable energy	

Table 3: Structural Reforms

Appendix 3

Figure 9: In-space placebo effect distribution



Note: Leaving out controls with MSPE>2*MSPE of Chile

Figure 10: Annual GDP gap between Chile and synthetic Chile using OECD donor pool