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What Has New Zealand Gained From The FTA With China?: Two Counterfactual Analyses*

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Abstract

New Zealand (NZ) was the first developed country to have signed a free trade agreement (FTA) with China. We investigate the effects of the 2008 NZ-China FTA on (i) exports from NZ to China, and (ii) real GDP per capita in NZ using the synthetic control method that focuses on estimating the counterfactual outcomes. We find that NZ exports to China were more than 200% higher in 2013 and 2014 than what they would have been if NZ had never signed the FTA with China. Even though the NZ export sector experienced gains from the 2008 FTA, this agreement did not have any observable impact on real GDP per capita of NZ.

JEL classification: F13, F14, F43, O56.

Keywords: Trade agreements, New Zealand, China, synthetic control method.

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1 Introduction

New Zealand (NZ) was the first developed country to have signed a free trade agreement (FTA) with China. The NZ-China FTA took effect in October 2008, resulting in a large increase in trade between the two countries. We study this event from the perspective of a policy evaluation problem and investigate the effects of the 2008 NZ-China FTA on trade flows (exports from NZ to China) and income (real GDP per capita in NZ) using the synthetic control method (SCM) that focuses on estimating the counterfactuals. We use a combination of other OECD countries to construct a “synthetic” control NZ, which resembles relevant economic characteristics of the NZ economy before signing the FTA with China. The subsequent economic evolution of this “counterfactual” NZ without the FTA with China is compared to the actual experience of the NZ economy.

We ask two questions in this paper. Question one asks: *Have NZ’s exports to China increased significantly because of the 2008 FTA?* We find that NZ exports to China were more than 200% higher in 2013 and 2014 than what they would have been if NZ had never signed the FTA with China. We also explore trade creation and trade diversion effects of the 2008 FTA for NZ exports. That is, as NZ experienced larger commodity exports going to China, it also experienced declines in exports to other major trading partners, such as Australia and the United States (US). We extend our analysis to examine trade creation and trade diversion effects. We find that total commodity exports from NZ to the world would have been 22% less than what they are today had the FTA never occurred. This trade creation effect can be mainly seen through NZ’s most important export category ‘food and live animal’, which includes dairy products. We find that this sector’s exports to China would have been 185.5% less in the counterfactual outcome. The second question we ask is: *How has the FTA with China affected the welfare of the NZ economy?* We find that even though the NZ export sector experienced gains from the 2008 FTA, this FTA did not have any observable impact on real GDP per capita, where GDP per person is an informative indicator of welfare across a broad range of countries.

Our paper, to the best of our knowledge, is one of the first (if not the first) study that provides a systematic quantitative analysis of the 2008 NZ-China FTA on the economic performance of NZ with several counterfactual comparisons.¹ Our paper is related to a small but growing literature that tries to understand the impact of past trade agreements using the SCM. The two papers most closely related to ours are Hannan (2016) and Hannan (2017). Hannan (2016) explores the impact of past trade agreements using 104 country pairs

¹There are some descriptive studies on China’s impact on the NZ economy. See, for example, Bowman and Conway, 2013a,b; Kendall, 2014. Osborn and Vehbi (2013) provide a quantitative analysis of the impact on NZ of economic growth in China employing a vector autoregressive model.

that had engaged in trade agreements between 1983 and 1995, and finds that substantial gains are generated, with average increases in exports of 80%, and annual growth of 3.8%. Hannan (2017) employs the SCM to determine the impact of trade agreements for 64 Latin American country pairs in the 1989-1996 period. Her results suggest that trade agreements have markedly boosted exports in Latin America, on average by 76.4 percentage points over ten years. Hosny (2012) and Aytuğ et al. (2017) provide more specific examples of trade agreements between countries. Hosny (2012) studies Algeria’s trade agreement with the Greater Arab Free Trade Area (GAFTA) and investigates what would have happened if Algeria had signed this FTA in 1998 instead of 2005. Hosny’s results suggest that Algeria’s trade would have improved in comparison with the counterfactual. Aytuğ et al. (2017) study the effects of EU-Turkey Customs Union (CU) on the Turkish economy. By implementing the SCM the authors find that had Turkey not joined the CU, GDP per capita would have fallen by 13% and exports would have fallen by 38%. By exploring the ‘what if’ counterfactuals, we aim to dissect the magnitude of bilateral trade agreements on NZ exports and explore the gains from trade, both at the aggregate and sector levels. A further novel contribution to the trade literature is the direct examination of the welfare effect from trade and its impact on NZ. We do this by studying the evolution of real GDP per capita and estimating the counterfactual real GDP per capita of having never signed the FTA with China. This counterfactual analysis quantifies the effect of the 2008 FTA on NZ’s economic well-being, proxied by real GDP per capita that captures the effects of terms of trade changes.

The remainder of the paper is organized as follows. Section 2 presents information regarding China, a major trade partner of NZ. Section 3 discusses the SCM as a tool for counterfactual analysis and reviews the related literature. Section 4 presents our quantitative analysis for NZ’s exports to China. Section 5 provides the SCM results for the evolution of real GDP per capita in NZ. Section 6 concludes.

2 The 2008 NZ-China FTA

For many years, China’s development was largely indigenous, mainly because of the country’s isolation from the rest of the world. However, over the last three decades China has become an increasingly important part of the global trading system. China has become the leading exporter for merchandise trade and China’s accession to the World Trade Organization (WTO) has been marked as an important milestone. China officially started its WTO membership application in 1986 and was formally accepted on 11 December 2001.² In accor-

²In 1997 NZ became the first country to agree to China’s accession to the WTO by concluding the bilateral negotiations component of that process (<https://www.mfat.govt.nz/en/countries-and-regions/>)

dance with WTO rules, China committed to liberalize further and to better integrate into the global economy. China has signed several FTAs to strengthen international economic cooperation since 2002.³ NZ was the first developed country to commence FTA negotiations with China. In November 2004, NZ and China launched FTA negotiations and in April 2008, NZ became the first OECD country to successfully conclude FTA negotiations with China.⁴ On 7 April 2008, Chinese Premier Wen Jiabao and NZ Prime Minister Helen Clark witnessed the signing of the NZ-China FTA in Beijing, which came into force on 1 October 2008. Since then, NZ has seen dramatic increases in bilateral trade with China.

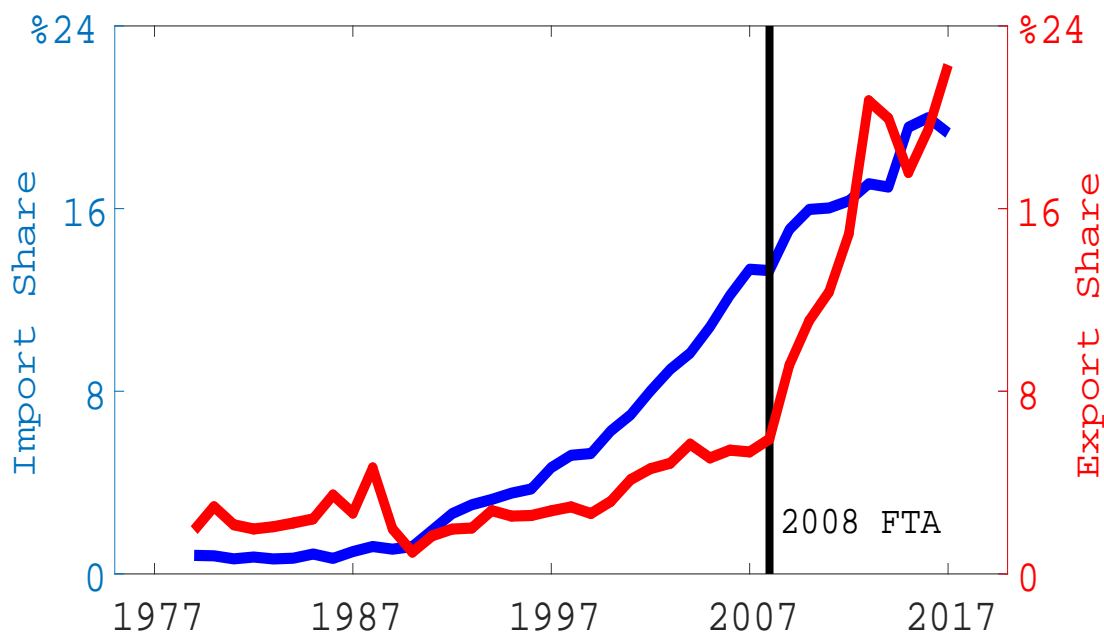


Figure 1: NZ's exports to and imports from China, 1979-2017

Figure 1 shows that China gradually became NZ's main source of (commodity) imports.⁵ NZ's imports from China in 1979 were little higher than US\$ 37 million, which increased to more than US\$ 7.7 billion in 2017. NZ's share of imports from China, which was only 0.8% of China, was around 20% in 2017. In addition, China has become NZ's top commodity export destination in recent years; for example, 22.3% of NZ's exports went to China in 2017. Exports to China were close to US\$ 90 million in 1979; however, they now sit at almost US\$ 8.5 billion. NZ's export share to China was only 1.9% in 1979, and this share tripled by

north-asia/china/).

³See China FTA Network for details of these FTAs as well as the agreements being negotiated (<http://fta.mofcom.gov.cn/english/index.shtml>).

⁴Chile-China FTA was signed in November 2005 and entered into force in October 2006. However, Chile was not an OECD country at that time. Chile became an OECD member on 7 May 2010.

⁵Data are from the United Nations' Comtrade Database (<https://comtrade.un.org>).

2008 at 5.9%. Only five years after that NZ’s share of exports to China had tripled again to 20.7% in 2013.

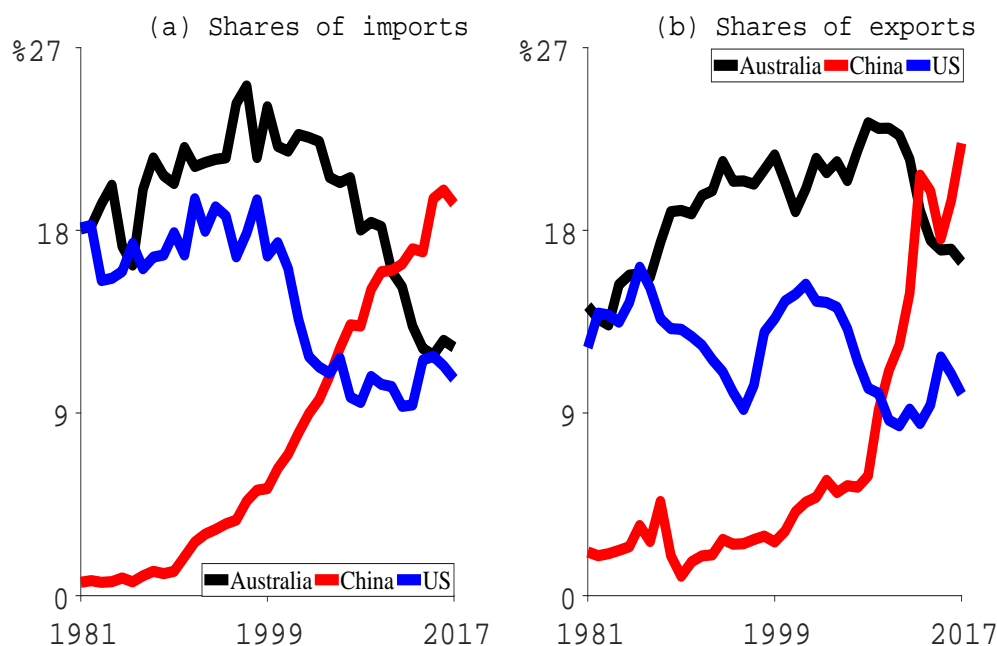


Figure 2: Shares of NZ total commodity imports and exports (%), 1981-2017

Figure 2 shows how China has become a major trading partner for NZ in terms of total trade of merchandise goods.^{6,7} Panel (a) in Figure 2 shows NZ’s three most important partners in terms of total commodity imports. In 1981, Australia and the US together supplied 36.2% of NZ’s commodity imports. That share declined to 22.9% in 2017 as China increased its share of NZ’s imports from 0.7% in 1981 to almost 20% in 2017. China gradually became NZ’s main source of imports. Panel (b) in Figure 2 plots NZ’s three most important trade partners in terms of total commodity exports. In 1981, NZ’s share of exports to Australia and the US totalled 26.5%, whereas the corresponding share of exports to China was only 2.2%. The share of exports going to China had gradually increased to 5.3% in 2007. After the FTA was signed in 2008, there was a marked increase in NZ’s export share going to China. However, the share of exports going to the US declined from 11.5% in 2007 to 9.9% in 2017. The corresponding figures for Australia were 21.9% in 2007 and 16.4% in 2017.⁸

⁶Data are from the United Nations’ Comtrade Database (<https://comtrade.un.org>).

⁷In terms of goods and services (not just commodities), Australia remains NZ’s top trading partner, with China NZ’s second biggest trading partner (<https://www.mfat.govt.nz/>).

⁸However, NZ remains a relatively unimportant trading partner for China. This is not surprising considering the relative sizes of each economy. NZ’s population is less than 5 million people, whereas China’s population is more than 1.3 billion people. China was a US\$ 12.2 trillion economy in 2017 making it the

In 2005 China’s average applied tariff was around 10% across all products, with a higher average of 14.6% applied to agriculture product (MFAT, 2007). The FTA resulted in the removal of these tariffs and reduction of other impediments to bilateral trade over time. Tariffs are now eliminated for over 97% of NZ goods exports to China. In 2018, all exports other than dairy (some products remain subject to tariffs and safeguards that will be phased out by 2024), and a small number of products that were excluded from the FTA are eligible for tariff-free access into China. In 2018, all imports from China are eligible for tariff-free access.⁹ Currently, China and NZ are negotiating to upgrade the existing 2008 FTA. Negotiations commenced in April 2017 and the sixth round was held in Beijing in November 2018. The upgraded FTA will add new provisions to the existing Agreement.¹⁰

3 Empirical Strategy

3.1 The Potential Outcome Model of Causal Inference

Program evaluation methodologies have long been used to measure the effect of different economic or political interventions (treatments). The central problem in causal inference is evaluating how exposure of a treatment on a set of units (or individuals) has affected their outcomes.¹¹ Let us illustrate this using the potential outcome set up (Rubin, 1974; Holland, 1986; Imbens and Rubin, 2015). Consider $J + 1$ units over $t = 1, \dots, T_0, T_0 + 1, \dots, T$ periods. The first unit is affected uninterruptedly by an intervention in period $T_0 + 1$ until period T , after an initial pre-intervention period $t = 1, \dots, T_0$. The leftover J units are the controls that form the so-called ‘donor pool’, and they are not affected by the intervention (Gardeazabal and Vega-Bayo, 2017). Let $Y_{j,t}$ denote the outcome variable of unit j at period t . $Y_{j,t}^1$ and $Y_{j,t}^0$ denote the potential outcome of unit j at time t under treatment and in the absence of treatment, respectively. We can write $Y_{j,t} = D_{j,t}Y_{j,t}^1 + (1 - D_{j,t})Y_{j,t}^0$, where $D_{j,t}$ is dummy variable that takes value 1 if unit j is under treatment at time t and value 0 otherwise. The identification problem is that the treatment effect depends on the potential outcome in both states ($D_{j,t} = 0$ and $D_{j,t} = 1$), while we can only observe realizations under one of the potential treatment statuses.

second largest in the world in terms of nominal GDP. On the other hand, NZ’s GDP was little higher than US\$ 0.2 trillion in 2017 (World Bank, 2018).

⁹<https://www.mfat.govt.nz/en/trade/free-trade-agreements/free-trade-agreements-in-force/china-fta/nz-china-fta-overview/>

¹⁰<https://www.mfat.govt.nz/en/trade/free-trade-agreements/agreements-under-negotiation/nz-china-fta-upgrade/timeline/>

¹¹See Imbens and Wooldridge (2009) and Athey and Imbens (2017) for comprehensive reviews of the recent developments in program evaluation literature.

3.2 The Synthetic Control Approach

Building on an idea in Abadie and Gardeazabal (2003), Abadie et al. (2010) develop the synthetic control method (SCM) that exploits variation over time in the outcomes of units that are either exposed to treatment only after some period or that are never exposed (see also Abadie et al., 2015). A primary reason to use this method is to control for the effect of unobservable factors that have an impact on the common time trend in the treatment and control groups (Abadie et al., 2010; Acemoglu et al., 2016). Since its introduction, the SCM has seen a range of applications in economics, political science, and international relations.¹² In the words of Athey and Imbens (2017, p. 9), the synthetic control approach is “arguably the most important innovation in the policy evaluation literature in the last 15 years.”

Suppose that we observe data for $(J + 1) \in \mathbb{N}$ countries. We also assume that there is a treatment that affects only country 1 from period $T_0 + 1$ to period T uninterruptedly, where $T_0 \in (1, T) \cap \mathbb{N}$. In other words, without loss of generality, we assume that first country signed a FTA with China, so that we have J remaining countries that serve as potential controls. Let the scalar $Y_{j,t}^0$ be the potential outcome that would be observed for country j in period t if there were no treatment for $j \in 1, \dots, J + 1$ and $t \in 1, \dots, T$. Let the scalar $Y_{j,t}^1$ be the potential outcome that would be observed for country j in period t if country j received the treatment (i.e., signed the FTA with China) from period $T_0 + 1$ to period T . We define $\alpha_{j,t} = Y_{j,t}^1 - Y_{j,t}^0$ as the treatment effect for country j in period t and $D_{j,t}$ as the treatment indicator that assumes value 1 if country j is treated in period t and value 0 otherwise. The observed outcome for country j in period t is given by

$$Y_{j,t} = Y_{j,t}^0(1 - D_{j,t}) + Y_{j,t}^1 D_{j,t}. \quad (1)$$

Because only the first country is exposed to the intervention and only from period $T_0 + 1$ to T , we have that

$$D_{j,t} = \begin{cases} 1, & \text{if } j = 1 \text{ and } t > T_0 \\ 0, & \text{otherwise.} \end{cases} \quad (2)$$

¹²Examples of such applications include openness and trade liberalization policies (Nannicini and Billmeier, 2011; Billmeier and Nannicini, 2013; Ritzel and Kohler, 2017), impact of trade agreements (Hosny, 2012; Hannan, 2016, 2017; Aytuğ et al., 2017), impact of joining a currency union (Saia, 2017; Puzzello and Gomis-Porqueras, 2018), economic regimes/political stability (Grier and Maynard, 2016; Meyersson, 2017; Jales et al., 2018; Matta et al., forthcoming), natural disasters (Coffman and Noy, 2012; Cavallo et al., 2013; Mideksa, 2013; Barone and Mocetti, 2014; Mohan, 2017), terrorism, civil wars, crime, and political risks (Montalvo, 2011; Pinotti, 2015; Singhal and Nilakatan, 2016; Bilgel and Karahasan, 2017; Bove et al., 2017; Costalli et al., 2017; Bove and Elia, 2018), health economics (Bilgel and Galle, 2015; Krief et al., 2016), economic sanctions (Gharehgozli, 2017), migration (Powell et al., 2017), and natural resource discoveries (Smith, 2015).

The goal is to estimate the treatment effect on the treated, i.e., $\alpha_{1,t} = Y_{1,t}^1 - Y_{1,t}^0$. Recall that we have defined $\alpha_{j,t} = Y_{j,t}^1 - Y_{j,t}^0$. This guarantees that we only need to estimate the counterfactual $Y_{1,t}^0$ to identify $(\alpha_{1,T_0+1}, \dots, \alpha_{1,T})$ because $Y_{1,t}^1$ is observable for $t > T_0$ (Ferman et al., 2018). Since $Y_{1,t}^0$ for $t > T_0$ is not observed, the main idea of the SCM is to consider a weighted average of the control countries to construct a proxy for this counterfactual.

Let $\mathbf{W} = (w_2, \dots, w_{J+1})'$ be a collection of weights, with $w_j \geq 0$ and for $j = 2, \dots, J + 1$ and $w_2 + w_3 + \dots + w_{J+1} = 1$. Each value of \mathbf{W} represents a potential synthetic control. Let \mathbf{X}_1 be a $(K \times 1)$ vector of pre-intervention (pre-FTA) values of K predictors for the treated country (NZ). Let \mathbf{X}_0 be a $(K \times J)$ matrix which contains the values of the same variables for the J possible control countries. Let \mathbf{V} be a diagonal matrix with nonnegative components. The values of the diagonal elements of \mathbf{V} reflect the relative importance of the different predictors (Abadie and Gardeazabal, 2003). The vector of weights $\mathbf{W}^* = (w_2^*, \dots, w_{J+1}^*)'$ is chosen to minimize $(\mathbf{X}_1 - \mathbf{X}_0 \mathbf{W})' \mathbf{V} (\mathbf{X}_1 - \mathbf{X}_0 \mathbf{W})$ subject to $w_j^* \geq 0$ for $j = 2, \dots, J + 1$ and $\sum_{j=2}^{J+1} w_j^* = 1$. The synthetic control estimator of the effect of the treatment for the treated country in post-intervention period t ($t > T_0$) is $\hat{\alpha}_{1,t} = Y_{1,t} - \sum_{j=2}^{J+1} w_j^* Y_{j,t}$ (Abadie and Cattaneo, 2018). Arguably, the choice of \mathbf{V} could be subjective and Abadie and Gardeazabal (2003) and Abadie et al. (2010, 2015) propose data-driven selectors of \mathbf{V} .

Abadie et al. (2010, 2015) use a minimum distance approach, combined with the restriction that the resulting weights are nonnegative and sum to one.¹³ The synthetic control is calculated as convex combination of the countries in the donor pool and best replicates the outcome variable of the treated country in the pre-intervention period. As long as the weights reflect structural parameters that would not vary in the absence of the 2008 China-NZ FTA, the synthetic control provides a counterfactual scenario for the evolution of the NZ economy in the absence of this FTA (Pinotti, 2015).¹⁴

¹³Abadie and Cattaneo (2018) note that in general (that is, ruling out certain degenerate cases) if \mathbf{X}_1 does not belong to the convex hull of the columns of \mathbf{X}_0 , then \mathbf{W}^* is unique and sparse, meaning that \mathbf{W}^* has only a few nonzero elements. Doudchenko and Imbens (2016) propose a more general class of synthetic control estimators, which allow the weights to be negative and do not necessarily restrict the sum of the weights. Abadie and L'Hour (2018) address the problem of multiplicity of solutions, which is finding a synthetic control that best reproduces the characteristics of a treated unit may not have a unique solution. A recent research agenda focuses on (robust) generalization of the SCM (see, for example, Xu, 2017; Amjad et al., 2018; Becker and Klößner, 2018).

¹⁴The SCM builds on difference-in-differences (DID) estimation, but when constructing the counterfactual, SCM puts more weight on donor countries that closely resemble the treated country, whereas the DID approach assigns equal weight to each donor country. Therefore, the SCM uses systematically more attractive comparisons than those of the traditional DID estimation (Athey and Imbens, 2017).

3.2.1 Placebo Tests

In order to ensure that a particular synthetic control estimate reflects the impact of the 2008 FTA, we perform a series of falsification tests known as in-space placebo tests. We apply in-space placebo tests by applying the SCM on countries in the donor pool that did not sign a FTA with China. These tests compare the magnitude of the estimated effect on the treated country with the size of those obtained by assigning the treatment randomly to any (untreated) country of the donor pool (Olper et al., 2018). This allows us to assess whether the effect estimated by the synthetic control for the country affected by the FTA is large relative to the effect estimated for a country chosen at random (which was not exposed to the 2008 FTA). Large sample asymptotic inference tests are not appropriate in our case because our data are of small sample size and identification of the treatment effect arises from the change in policy by a small group of countries. However, placebo tests à la Abadie and Gardeazabal (2003), Bertrand et al. (2004), Abadie et al. (2010, 2015) can be used to evaluate the significance of treatment effects (Adhikari and Alm, 2016). The essence of placebo tests is to test whether the estimated impact of the 2008 FTA could be driven entirely by chance.

Abadie et al. (2015) propose an inference procedure where they permute which unit is assumed to be treated and estimate, for each $j \in \{2, \dots, J + 1\}$ and $t \in \{1, \dots, T\}$, $\hat{\alpha}_{j,t}$ as described above. Then, they compute the test statistic for the ratio of the mean squared prediction errors (i.e., the ratio of post/pre treatment mean squared prediction errors). They name this ratio as RMSPE. In addition, they propose to calculate a p -value:

$$p = \frac{\sum_{j=1}^{J+1} \mathbb{1}[RMSPE_j \geq RMSPE_1]}{J + 1}, \quad (3)$$

where $\mathbb{1}[\oplus]$ is the indicator function of event $[\oplus]$, and reject the null hypothesis of no effect if p is less than some pre-specified significance level (Ferman et al., 2018).¹⁵

3.2.2 Pretreatment Fit Index

We also use the pretreatment fit index to assess whether the comparison country created by the synthetic control method is a ‘good’ counterfactual following the work of Adhikari and Alm (2016) and Adhikari et al. (2018). We use this index to assess the overall quality of the pretreatment fit. The advantage of the pretreatment fit index is that it normalizes the RMSPE. This makes it possible to compare the fit between different SCM models. This is

¹⁵Although the p -value from this placebo test lacks a clear statistical interpretation, this test is commonly used in the SCM applications. Ferman and Pinto (2017), Hahn and Shi (2017), Ferman et al. (2018), Firpo and Possebom (2018) provide comprehensive discussions using both theoretical and Monte Carlo methods.

done by defining the benchmark RMSPE, which is obtained from the zero-fit model.¹⁶ The fit index is defined as the ratio of the RMSPE to the benchmark RMSPE:

$$Fit\ Index = \frac{RMSPE}{Benchmark\ RMSPE}. \quad (4)$$

The range for this index is $[0,U]$, where U is the finite upper bound, meaning that the RMSPE is equivalent to the RMSPE obtained when the difference between the treated and the synthetic unit is U percent for each pre-treatment year (Adhikari et al., 2018). If the index is 0, then the fit is perfect. An index greater than 1 indicates a poor fit and synthetic units should be discarded. We report the pretreatment fit index and the RMSPE values. If the preintervention ‘fit’ is good, the post intervention counterfactual is likely to be more accurate.

4 A Counterfactual Design for NZ Exports

The goal of this section is to assess the impact that the 2008 NZ-China FTA has had on NZ’s exports to China. A method for generating a hypothetical counterfactual is to look at the outcomes where there has been no treatment, that is a control group. We need a control that tells us what the outcome variable for NZ would have been without the 2008 China-NZ FTA. Since an exact control does not exist (we have no post-2008 observations on NZ where the FTA with China was not signed), we create a control group by synthesizing the performance of countries similar to NZ; and the experiences of the control group would form the basis of a hypothetical counterfactual for the treatment country.

4.1 Construction of the Synthetic NZ

We use annual country-level data for the 1991-2015 period. This gives us a pre-intervention period of 17 years (1991-2007) and a post-intervention period of 8 years (2008-2015). Recall that the synthetic NZ is constructed as a weighted average of potential control countries in the donor pool. The countries we use to construct our synthetic NZ is a donor pool of 24 OECD member countries: Australia, Austria, Canada, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea, Netherlands, Norway, Poland, Portugal, Spain, Sweden, Switzerland, the United Kingdom (UK), and the US.¹⁷ The out-

¹⁶ $RMSPE = \sqrt{\frac{1}{T_0} \sum_1^{T_0} \left(Y_{1,t} - \sum_{j=2}^{J+1} w_j^* Y_{j,t} \right)^2}$. $Benchmark\ RMSPE = \sqrt{\frac{1}{T_0} \sum_1^{T_0} (Y_{1,t})^2}$.

¹⁷We start with the 35 OECD countries; however, we automatically exclude Chile since Chile had an FTA with China before 2008. We exclude Turkey and Mexico because of their middle-income status and

come variable is (nominal) exports to China, measured in current US dollars. Motivated by the gravity model¹⁸ as predictors of trade flow, we use nominal GDP, GDP per capita, population and bilateral exchange rates, and population weighted distance between country i and China (see Appendix A.1).

Data for trade flows are from the World Integrated Trade Solution (WITS) database, which uses the United Nations' Comtrade database. WITS reports several nomenclatures and we use the Standard International Trade Classification (SITC2-Division) data to extend the sample period. We also source all of our SITC2 commodity level export values from the WITS, along with total exports to the world. All are measured in current US dollars. From the World Bank's World Development Indicators (WDI), we retain the variables for GDP (in current US dollars) and population (World Bank, 2018). Exchange rates are from the OECD.¹⁹ Exchange rates are measured in national currency per US dollar. This is used to construct the variable national currency per Chinese yuan, which is the national currency reflected in Chinese yuan on an annual level. Finally, we use the population weighted distance from the GeoDist dataset of the CEPII.²⁰

We construct a synthetic NZ, where weights are chosen so that each donor country's root mean square prediction error (RMSPE) is minimized and the resulting synthetic NZ best reproduces the actual NZ in the preintervention period. The transparency of the synthetic control estimation allows us to see what donor countries are being used to construct the synthetic NZ and the particular weights applied to each country. We calculate the weights assigned to each country in the control group in the construction of the counterfactual outcomes. Five countries receive positive weights. In this case the synthetic NZ is a weighted combination of Canada (4.8%), Iceland (13.9%), Japan (0.7%), Portugal (78.5%) and Sweden (2.2%). All other countries obtain zero weights within the donor pool.²¹

these two countries cannot be named as peer countries to the NZ economy. We also exclude the post-communist countries such as Estonia, Latvia, Slovak Republic, Slovenia, and the Czech Republic. Belgium and Luxembourg are excluded because of their small sizes and limited trade flow observations. Thus, a sample of 24 OECD countries are used to construct our synthetic NZ.

¹⁸The gravity equation has been used as a workhorse for analysing the determinants of bilateral trade flows since Tinbergen (1962). Head and Mayer (2014) provide a historical review of the fundamental equation and discuss theory-consistent estimation, covering number of alternative techniques. Estimating the gravity equation is beyond the scope of this current paper.

¹⁹http://stats.oecd.org/Index.aspx?DataSetCode=SNA_TABLE4

²⁰The CEPII (The Centre d'Études Prospectives et d'Informations Internationales) gathers and harmonizes data from different sources, produces indicators and statistical measures (http://www.cepii.fr/cepii/en/bdd_modele/bdd.asp). We take the related CEPII variables from their dataset GeoDist (http://www.cepii.fr/cepii/en/bdd_modele/presentation.asp?id=6). GeoDist provides several geographical variables, bilateral distances measured using city-level data to account for the geographic distribution of population inside each nation. We use the population weighted distance.

²¹Like for nearest neighbor matching estimators, most of the synthetic control weights are equal to zero and a small number of untreated countries contribute positive weights.

Table 1 displays the pre-treatment characteristics of the NZ economy and compares them with the characteristics of the sample average and the characteristics of the weighted average of the 24 OECD countries using the synthetic control weights. We include three lagged values of exports in 1995, 1996, and 2006 as additional predictors. We include lagged values to minimize the possible problem of time-constant restriction on predictors (Chung et al., 2016). These lagged values can also explain the time trend of exports to China. Overall, the synthetic NZ provides a much better comparison than using a sample average of the OECD countries in the donor pool.

Table 1: Trade predictor means before the NZ-China FTA

	NZ	Synthetic NZ	OECD Sample
GDP	7.24E+10	1.88E+11	1.10E+12
GDP per capita	18517	17865	32233
Population	3847029	10600000	35119669
Bilateral exchange rate	0.23	1.52	8.38
Weighted distance	10241	9707	7876
Lagged exports 1995	0.35	0.33	2.76
Lagged exports 1999	0.33	0.31	3.08
Lagged exports 2006	1.21	1.24	13.2
RMSPE		0.193	

Note: All variables are averaged over 1991-2007.

4.2 Counterfactual and Inference Tests

Figure 3 displays the exports trajectory of NZ and its synthetic counterpart. During the preintervention period the synthetic NZ almost exactly reproduces the exports of NZ to China. This close fit in the exports to China and the values from Table 1 demonstrate that there is some combination of other countries that reproduce the economic attributes of NZ trade before the FTA was signed. Therefore, one does not need to extrapolate outside the data to generate a counterfactual. The divergence between the treated and synthetic NZ post agreement is an indication of the gains from trade in the NZ export sector. The large divergence in the export sector between NZ and its synthetic counterpart occurs within the same year as the FTA. The calculated pretreatment fit index is 0.037. This means on average, there is a 3.7% difference between the treated unit and the synthetic unit in the pretreatment period. The estimated effect of the FTA on NZ's exports is given by the difference between actual NZ exports and that of its synthetic counterpart, shown in Figure 3. Exports at

its peak in 2013, were 260% higher than the synthetic counterpart. Both the immediate divergence and magnitude of the estimated effect, relative to the counterfactual indicates how important and impactful the FTA was on the NZ export sector.

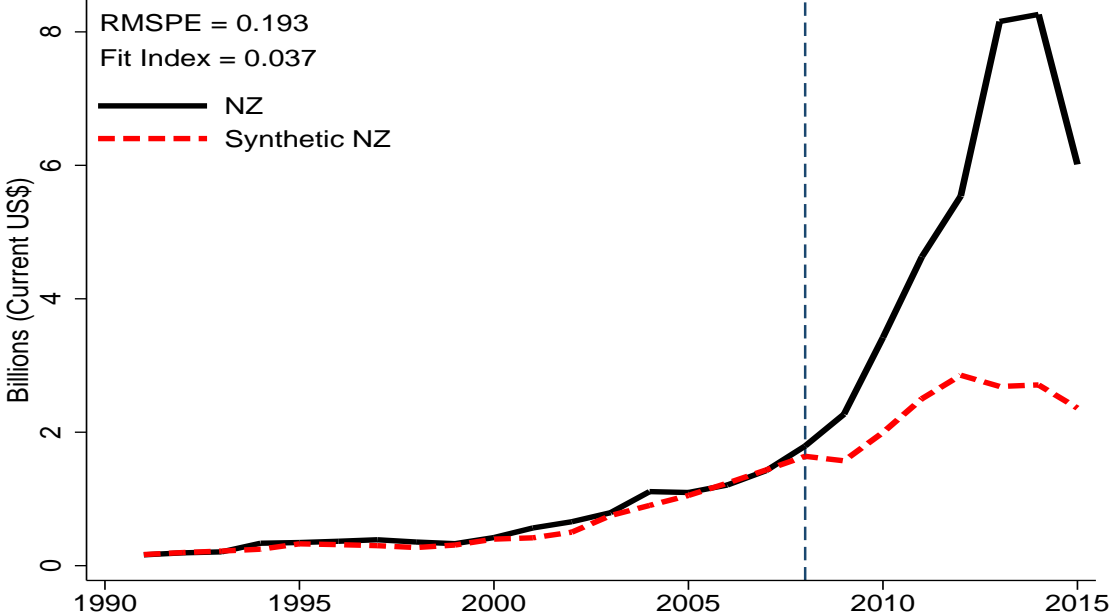


Figure 3: Exports to China: NZ versus synthetic NZ

Next, we perform the placebo tests. The placebo test works by iteratively applying the treatment of interest on all other control units within donor pool. This procedure can then provide a distribution of estimated placebo treatment effects for all countries within the sample pool. They are placebo effects because the countries in the donor pool by construction have never experienced the intervention. We can then compare the main synthetic result against all other estimated placebos. If the estimated effect for the NZ case is unusually large compared to the distribution of our control units, we can infer that the treatment of interest had a significant effect. The bold line in Figure 4 shows the synthetic NZ’s estimated treatment effect against all other estimated treatment effects from the donor pool. The synthetic NZ stands outside the distribution of the placebo studies, providing some confidence that the estimated effect isn’t purely by chance but instead driven by the effect of the FTA.

We make statistical inferences by looking at the ratios between the pre-2008 RMSPE and the post-2008 RMSPE for NZ and for all other countries within the donor pool. The importance of the ratio comes from controlling for a large RMSPE in the post intervention period, when that same country also has a large RMSPE in the pre intervention period, thus giving a small post-to-pre ratio. Therefore, a large RMPSE in the post treatment period

does not mean that it is a statistically large effect, if the fit is ‘bad’ in the pretreatment period. This post/pre-FTA RMSPE value is shown in Figure 4 and NZ stands out as the country with has highest post/pre-FTA RMSPE. Therefore, if one were to pick a country at random from the sample, the chances of obtaining a ratio as high as observed for NZ is $1/25 = 0.04$, which is the p-value of statistical significance.

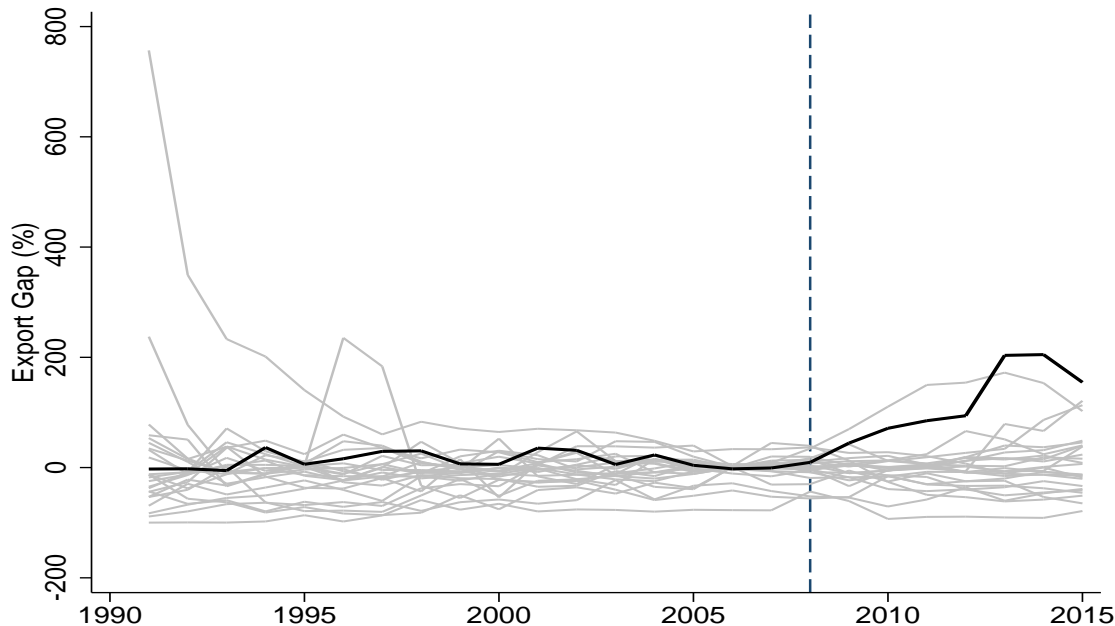


Figure 4: Placebo tests for exports

4.3 Trade Creation and Trade Diversion

Whether or not bilateral trade agreements, such as the NZ-China FTA, promote or divert trade remains unclear within the literature. Figure 3 and 4 both demonstrate the large increases in the import and export sectors for NZ. However, one can see declines in exports to and imports from NZ’s other two major trading partners, Australia and the US. In what follows, we employ the SCM to examine the overall effects the 2008 FTA had on NZ’s exports to the world and exports to the world excluding trade with China. Keeping the same donor pool and retaining the same covariates that explain trade, we adjust the outcome variable to total exports in current US\$.

Figure 5 shows NZ’s exports to (i) the world, (ii) the world excluding China, and (iii) China. NZ’s exports to the world follow the same outcome path as the exports to the world, had NZ never traded with China. Although primitive, the large gap in exports to world and exports to the world excluding China suggests two things. Firstly, the NZ-China FTA

increased total exports to the world for NZ. In the pretreatment period, NZ was exporting very little to China as the difference between the two exports series suggests. However, the large increase in NZ's total exports seems to be driven by an increase in trade with China, which coincides with the signing of the FTA. This suggests trade creation.

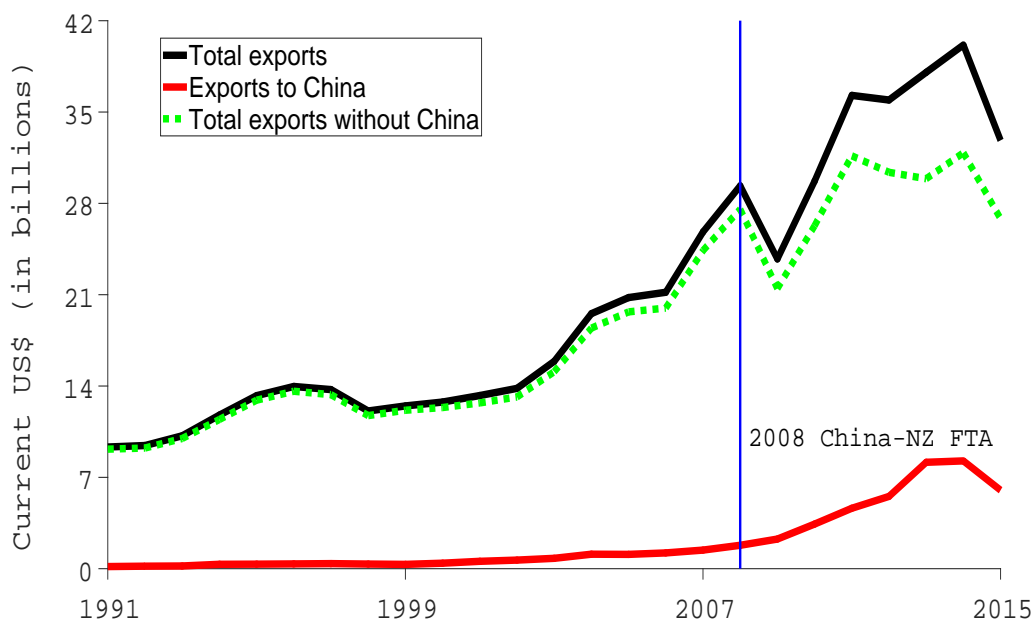


Figure 5: Export destinations of NZ: China versus rest of the world, 1991-2015

Panel (a) in Figure 6 shows the counterfactual analysis of what NZ's total exports would have been had the FTA never occurred. In the counterfactual outcome, given by the dashed red line, total exports to the world would have been 22% less in 2014 if NZ had never signed this FTA. In panel (c), the counterfactual analysis of the outcome variable is exports to the rest of the world if NZ never traded with China (total exports without China). Thus, if NZ had never signed an FTA with China, the counterfactual outcome tells us that total exports to the world would not have changed. In other words, if the synthetic outcome was higher than the treated unit, this would suggest that NZ might have traded more with the world had the FTA never been signed. However, we see no difference between the actual outcome of exports and the synthetic outcome. Therefore, the FTA actually increased total export trade for NZ and did not experience a trade diversion effect, or at least a trade diversion effect that outweighed trade creation.

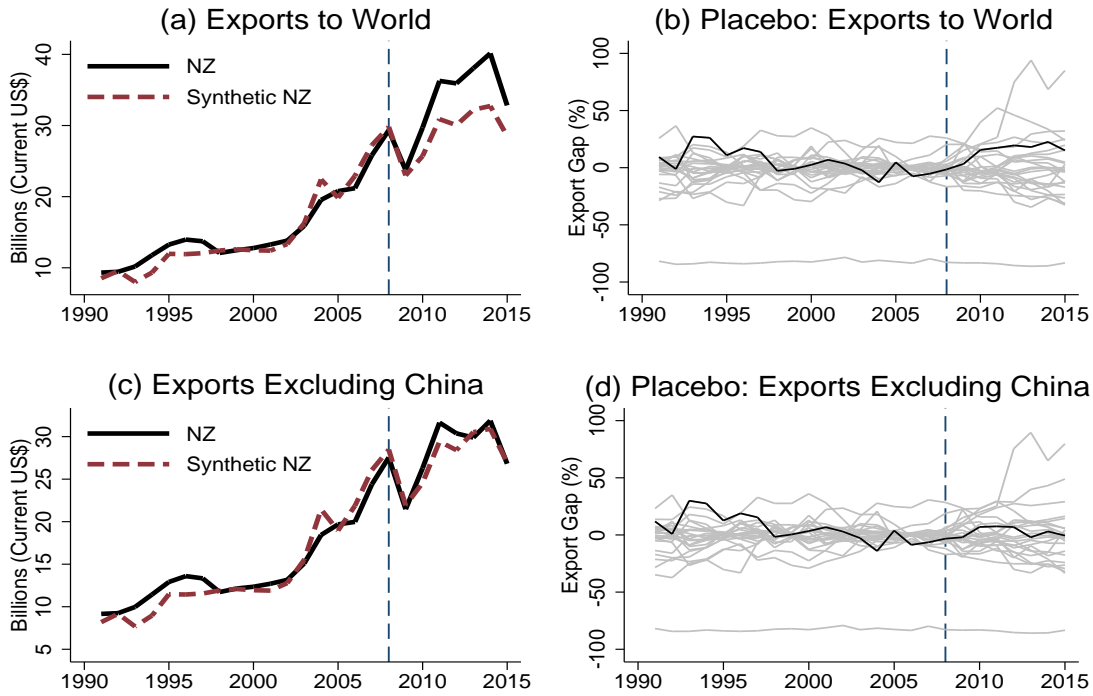


Figure 6: Trade creation and trade diversion

4.4 The Two Most Important Export Sectors

Table 2 shows the NZ industry share of imports and exports to China.²² In 2007, NZ’s export share of food and animals (SITC 0) was 36%. By 2017, this share increased to 61.4%, making up more than half of NZ’s trade with China. The share of crude oil (SITC 2) being exported to China was 44% in 2007, this decreased to 27.4% in 2017. The other remaining products in the SITC code make up only a small share of exports to China. We explore the SITC 0 and SITC 2 industries and how they were affected by the NZ-China FTA.²³

We employ the SCM at the sector level to examine the effects of the NZ-China FTA on NZ’s two main exporting industries: (i) food and live animals (SITC 0), and (ii) crude materials (SITC 2). Panel (a) in Figure 7 shows the evolution of NZ’s food and live animals exports, which includes NZ’s dairy exports. Had NZ never signed the FTA with China, its food and live animal’s exports would have been 185% less in 2014. This finding suggests that the FTA was an important factor for expanding export growth of NZ’s food and live animals sector. The bold line in panel (b) represents the percentage export gap for the food and live

²²The share of exports to China is calculated by dividing any industry exports to China by total trade to China of goods in that year.

²³In construction of the sector level exports it is important to note that SITC 0 (food and live animals) main component of trade with China is dairy products and birds’ eggs (SITC 02). Appendix A.2 provides a discussion of this.

animals, the gap between actual exports and its synthetic control, in NZ between 1991 and 2015. The real gap in NZ very closely tracks in the zero-gap line, which indicates a good fit. Gray lines represent placebo tests and they are the deviations from synthetic control for the other control countries in the dataset. The next main sector for NZ’s exports to China is crude materials (Table 2). Panel (c) suggests that crude materials would have been exporting more than what NZ currently exports if the FTA never been in place. However, the placebo distribution in panel (d) shows that this is not a significant effect due to the large RMSPE in the pretreatment period, followed by a small post-treatment RMSPE.

Table 2: What does NZ export to and import from China?

SITC	Industry	<i>Export share (%)</i>		<i>Import share (%)</i>	
		2007	2017	2007	2017
0	Food and live animals chiefly for food	36.0	61.4	2.3	2.3
1	Beverages and tobacco	0.1	0.5	0.1	0.1
2	Crude materials, inedible, except fuels	44.0	27.4	0.6	0.6
3	Mineral fuels, lubricants and related materials	0.001	0.001	0.1	0.1
4	Animal and vegetable oils, fats and waxes	4.5	0.3	0.1	0.1
5	Chemicals and related products, nes	4.2	2.3	4.9	6.7
6	Manufactured goods classified chiefly by materials	6.0	1.9	16.6	17.1
7	Machinery and transport equipment	4.0	0.8	37.6	42.6
8	Miscellaneous manufactured articles	0.8	0.3	37.7	29.5
9	Commodities and transactions not classified	0.4	5.0	0.2	0.9

Source: United Nations Statistics Division, Commodity Trade Statistics Database.

Overall, the trade analysis shows how the FTA helped promote trade creation through NZ’s main export sectors. Had the FTA never been signed, NZ’s total exports to the world would have remained the same. We have shown total exports to China in 2013 was 260% higher than the counterfactual counterpart. Most of the drive in increased exports seems to be coming from the dairy industry, which in 2016 made up 56% of NZ’s exports to China. The estimated export gains from the FTA are in line with trade creation rather than trade diversion from other main trading partners. The estimated export growth at the sector level was mainly in the sector of food and live animals. The second largest export sector, crude materials, was shown have been negatively impacted by the FTA as both the counterfactual and reduction in share of exports to China demonstrate. Although not all industries are examined here, our analysis shows that the dairy sector, which is NZ’s primary exporting sector, clearly incurred a substantial gain from the NZ-China FTA.

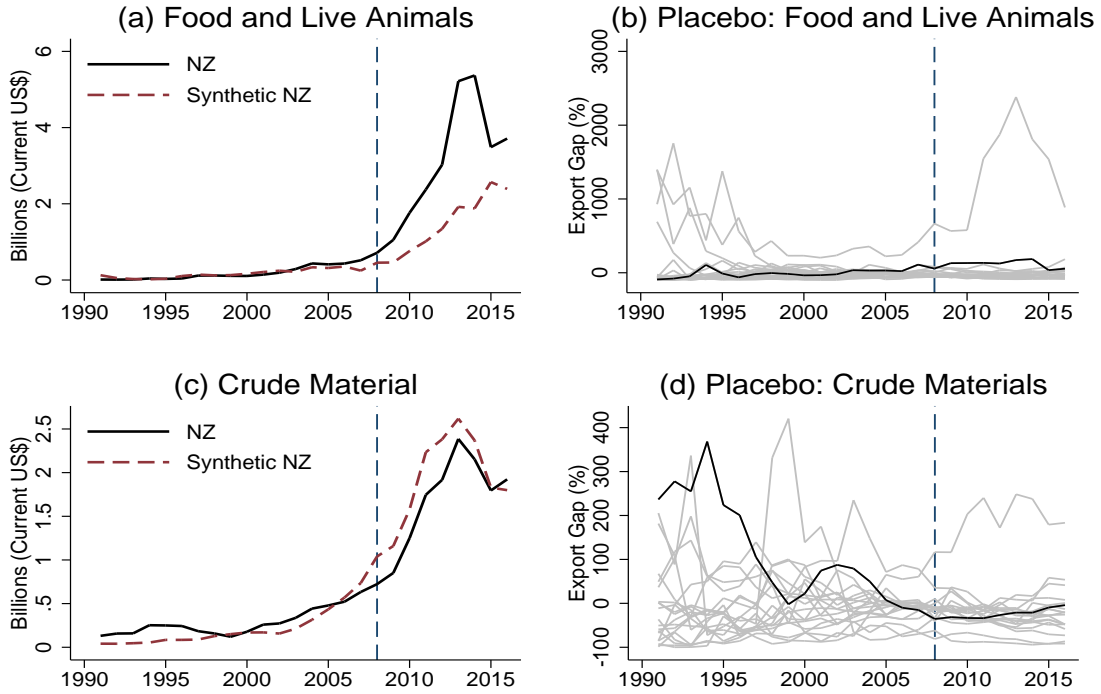


Figure 7: Sector level counterfactuals

5 A Counterfactual Design for Real GDP Per Capita

NZ, as a small open economy, relies heavily on the international market which is reflected through the terms of trade. Understanding the economic costs that a large developing country can have, via international trade, on NZ and quantifying this effect is a considerable task. That is, what would NZ's GDP per capita have looked like if NZ had never signed the 2008 FTA with China. From the causal estimation results of exports, signing the FTA with China improved NZ's export sector. We explore whether this has been reflected in GDP per capita in NZ. By invoking the SCM, we study the path of real GDP per capita had NZ never signed the FTA with China.

5.1 Data

We use annual country-level data for the 1990-2014 period. We end our sample period in 2014 because we would like to use the latest version of the Penn World Tables, which ends in 2014 (see below for a discussion). We use a standard set of economic growth predictors for real per capita GDP, our main dependent outcome variable in this section. This set of covariates are based on a set of growth models within the literature and in a broad sense are meant to capture the impact of institutions, demography and macroeconomic conditions as

well as standard growth accounting variables (such as stock of physical and human capital) (Barro, 1991; Mankiw et al., 1992). We also base our set of predictor variables on other SCM models used in the literature, which explore growth effects of structural reforms measured by real GDP per capita (Abadie et al., 2015; Adhikari and Alm, 2016; Meyersson, 2017; Adhikari et al., 2018). The variables we use and data sources are described below.

Variables from the Penn World Table: The Penn World Tables (PWT hereafter) provide data on many indicators for a substantial amount of countries on aspects such as relative levels of income, output, production factors, productivity, etc. The latest version, PWT 9.0, includes 182 countries between 1950 and 2014²⁴ and features several upgrades in concepts, methods and data sources (Feenstra et al., 2015). PWT 9.0 is prepared on the basis of major upgrades in the concepts and methods of the underlying national accounts of the different participating countries to the 2011 round of the International Comparison Program.

From the PWT 9.0, we retain the variables for (i) GDP, (ii) population, (iii) employment, (iv) physical capital, (v) human capital, and (vi) openness. Specifically, we use the variable *rgdpe* (expenditure-side real GDP at current PPPs (in millions of 2011 US\$))²⁵ for GDP, and *pop* (population (in millions)) for population, with which we calculate GDP per capita for each country. The human capital index (variable *hc*) is constructed following the procedure implemented by Hall and Jones (1999) and Caselli (2005), combining years of schooling with the appropriate rates of return. We use the variable *ck* (capital stock at current PPPs (in millions of 2011 US\$)) for physical capital stock,²⁶ and *pop* (population (in millions)) for population, with which we calculate physical capital per capita for each country. We use the variable *csh_x* (share of merchandise exports at current PPPs) for export share, and *csh_m* (share of merchandise imports at current PPPs) for import share. These are summed (i.e., export share plus import share) to calculate a measure of openness. Finally, we generate a variable, which is the share of population employed. This variable is generated by taking *emp*, which the number of people engaged in working (millions) divided by the total level of people *pop* (in millions).

Variables from the WDI: From the WDI (World Bank, 2018), we retain the variables for (i) age dependency ratio, (ii) share of female labor force, (iii) fertility, (iv) land area, and (v) inflation.²⁷

²⁴All versions of the PWT are available at <https://www.rug.nl/ggdc/productivity/pwt/>.

²⁵Expenditure-side real GDP, using prices for final goods that are constant across countries and over time.

²⁶The physical capital variable (capital stock *ck*) is measured in terms of current PPPs (in millions of 2011 US\$) and includes a wide range of assets such as residential and non-residential structures, transport equipment, computers, communication equipment, software, etc.

²⁷Age dependency ratio is the ratio of dependents – people younger than 15 or older than 64– to the working-age population – those ages 15-64. Total fertility rate represents the number of children that would

Variables from the Varieties of Democracy (V-Dem): Varieties of Democracy (V-Dem) provides a multidimensional and disaggregated dataset that reflects the complexity of the concept of democracy as a system of rule that goes beyond the simple presence of elections. From V-Dem (<https://www.v-dem.net/en/>), we retain the variable for democratic participation. There are many measures and varieties for capturing democratic participation of countries. Democracy is more than free and fair elections, as theorists often suggest different models in capturing democratic measurements. We use the participatory democracy index $v2x_{partipdem}$ put forward by Coppedge et al. (2017). They focus on five key principles that offer a distinctive approach to defining democracy electoral, liberal, participatory, deliberative and egalitarian. In this case the participatory principle of democracy emphasizes active participation by citizens in all political processes. As our donor pool is made up of OECD countries, all countries score high on this index (and on alternative indices).

5.2 Results

Table 3 shows the predictor means for NZ and its synthetic counterpart alongside the OECD average over the preintervention period. This demonstrates how well the SCM is performing relative to the OECD average in terms of matching the covariates of the treated unit. We calculate the weights of each individual donor country used in the construction of the synthetic counterfactual. From the available number of donor countries, the synthetic control is a weighted combination of Canada (6.4%), Germany (18.7%), Hungary (24.9%), Israel (32.3%) and Japan (8.9%), with lower weights on Poland (4.5%) and Portugal (4.4%). All other countries obtain zero weights within the donor pool.

Figure 8 plots the time paths of real GDP per capita for NZ and its synthetic counterpart between 1990 and 2014. The synthetic real GDP per capita trajectory is constructed by using the combination of countries within the donor pool that closely resemble NZ's real GDP per capita before signing the FTA with China. During the preintervention period, the synthetic NZ closely follows actual real GDP per capita. The RMSPE is 0.024 and the fit index is 0.005, which suggest that, on average, there is only a 0.5% difference between NZ and its synthetic counterpart in the preintervention period. After signing the FTA with China, indicated by the vertical blue dashed line in 2008, NZ's real GDP per capita suffers a small dip, which is brought on by the 2007-2009 global financial crisis (GFC), but this effect is also

be born to a woman if she were to live to the end of her childbearing years and bear children in accordance with age-specific fertility rates of the specified year. The land area of a country's total area, excluding area under inland water bodies, national claims to continental shelf, and exclusive economic zones. In most cases the definition of inland water bodies includes major rivers and lakes. Inflation is measured by the consumer price index which reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services.

captured in the synthetic counterpart. The treated country of interest (NZ) should not have undergone any structural shocks during the intervention period, as this would cause doubt on how isolated the treatment effect was. Bilgel and Karahasan (2017) point out structural breaks such as the 2007-2009 global financial crisis (GFC), that had affected the entire donor pool, does not invalidate the synthetic control estimates. The effects of the GFC on NZ's GDP per capita are summarized as: The average annual growth rate of GDP per capita was -1.1% between 2007 and 2009. In the post GFC recovery period, the 2010-2014 period, NZ's GDP per capita grew at a rate of 2.7% on average. Figure 8 clearly supports the growth estimates as NZ and its synthetic counterpart trend upward together in the post-GFC era.

Table 3: GDP per capita predictor means preintervention period

	NZ	Synthetic NZ	OECD average
Human capital	3.27	3.20	3.20
Openness	0.57	0.67	0.72
Share of population employed	0.46	0.45	0.46
Capital per capita	68628	77232	97080
Age dependency ratio	52.13	52.35	49.68
Share of female labor force	44.90	43.92	43.52
Fertility	2.01	1.90	1.67
Land area	263310	726829	1267279
Inflation	2.32	8.95	5.46
Democratic participation	0.61	0.58	0.61
Lagged GDP per capita (1994)	23323	23199	25735
Lagged GDP per capita (1998)	25867	26067	30527
Lagged GDP per capita (2002)	28483	28718	33804
Lagged GDP per capita (2006)	29329	29273	36808
RMSPE		0.0239	

The estimated impact of the NZ-China FTA on per capita income is given by the difference between the actual and the synthetic real GDP per capita. In 2009, NZ's real GDP per capita was 0.84% higher than that of the synthetic NZ due to the FTA. In 2014 the estimated effect of the FTA on NZ's real GDP per capita was only 1.15% higher than the counterfactual GDP per capita. This suggests the FTA-induced impact, albeit positive, was very small (especially compared to the export gains); therefore, may not have led to a large impact on NZ's welfare, income per person and general living standards.

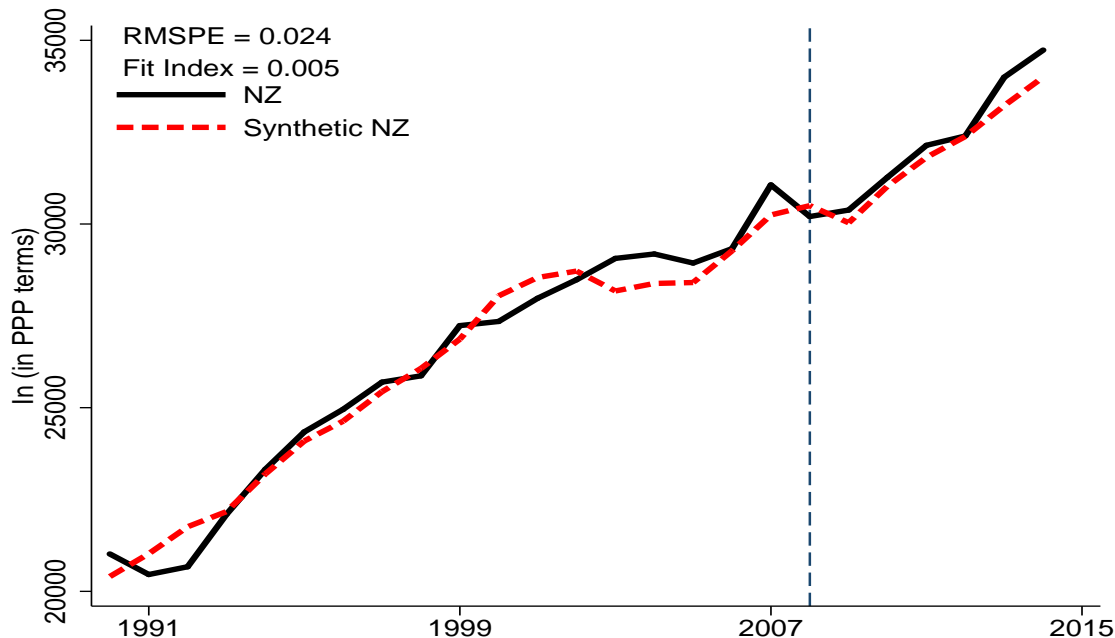


Figure 8: Real GDP per capita counterfactual

5.3 Inference and Robustness Tests

To ensure that the synthetic control estimates reflect the impact of the intervention, we perform the placebo test. Panel (a) in Figure 9 shows the placebo distribution of all other donor countries against our synthetic NZ. After artificially assigning the FTA treatment period on them, we compare where our synthetic NZ sits relative to the distribution and calculate the post/pre value. This post/pre value allows us to identify the exact significance of the estimated effect from the FTA (see panel (b) in Figure 9 for the post/pre values). This ratio is the p-value and can be interpreted as the probability of obtaining a post/pre value that is at least as large as the ones obtained through artificially assigning treatment to the unexposed countries. In other words, if a country had been selected at random from the sample, the probability of obtaining a post/pre RMSPE at least as high as that of NZ is 0.88 (=22/25). This test suggests that the NZ-China FTA had no direct causal effect on NZ's real GDP per capita.

We conduct a sensitivity test to assess the potential pitfalls that can occur when using the SCM. It has become a popular choice within the application of the SCM to include the entire pretreatment outcome path of the outcome variable as part of the set of economic predictors (i.e., include all past lagged observations of the dependent variable). Kaul et al. (2017) argue that researchers should never use all pre-intervention outcome periods of the dependent variable as economic predictors. Firstly, they use the Billmeier and Nannicini (2013) data

to illustrate the shortcomings of the SCM. More specifically they changed the pretreatment outcome lags of the dependent variable, in addition to the set of other covariates. This drastically changed the outcome of the synthetic control and the estimated impact of the treatment effect. Secondly, a further shortcoming of this method is the choice to include the entire pretreatment outcome path as economic predictors leads to the irrelevancy of other outcome predictors (covariates), which is proven mathematically.

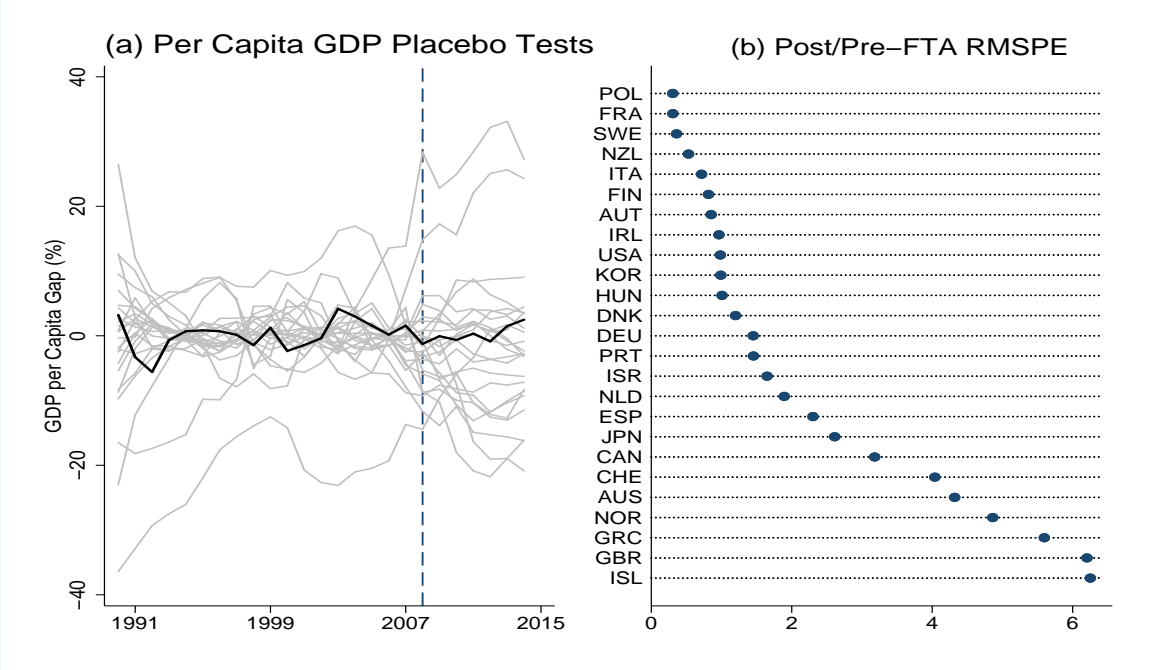


Figure 9: Inference tests

We examine the concern of Kaul et al. (2017) that including all outcome lags for pretreatment years will render the other predictor variables useless and change the outcome trajectory of the synthetic unit. By plotting our original choice of pretreatment outcome lags against several other combinations of outcome lags, we examine the synthetic unit’s sensitivity under different specifications. Figure 10 shows the variations in the synthetic outcome due to changes in alternative lagged outcomes. The solid black is our actual GDP per capita (in PPP terms) and the solid red line is the benchmark result that we have provided for our counterfactual analysis. Experiment 1, denoted by ‘E1’ is GDP per capita with all the past outcome lags. ‘E2’ includes only even years of the lagged outcome covariate. ‘E3’ includes outcome lags at 5-year intervals (i.e. 1995, 2000, and 2005). ‘E4’, following Meyersson (2017), considers only the last 5 years of the pre-intervention period. Following the recommendation of Kaul et al. (2017), ‘E5’ is just the last outcome lag of the intervention period (in this case it is 2007). We argue that due to the low variation within each specification, our synthetic alternatives follow a similar outcome path to the benchmark

specification. Therefore, it appears our main results under the alternative specifications will not significantly change the estimated results.

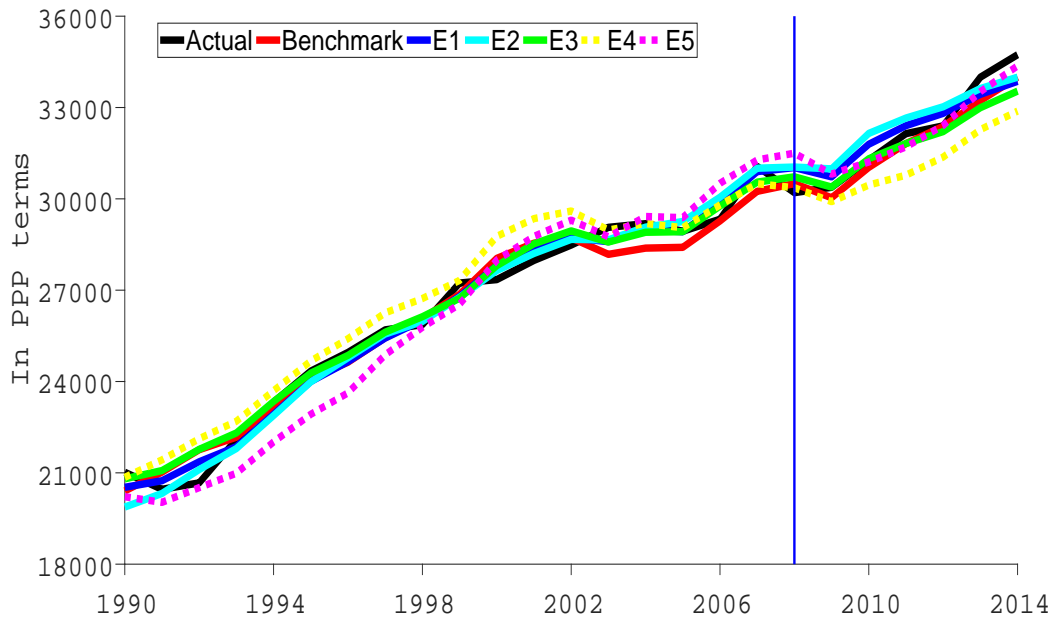


Figure 10: Synthetic NZ GDP per capita with various outcome lags

5.4 Terms of Trade

The choice to use real GDP on the expenditure-side as our measure for economic well-being is influenced by its inclusion of a country's terms of trade.²⁸ Terms of trade, the ratio of export prices to import prices, measure a country's purchasing power abroad and is closely related to gains from trade (see Kohli, 2003, 2004; Kehoe and Ruhl, 2008; Reinsdorf, 2010). NZ is a small open economy and relies on its external sectors as a source of economic growth and development. Accordingly, we use the newly developed GDP on the expenditure-side from PWT 9.0 as this accounts for changes in terms of trade.

PWT 9.0 provides two different real GDP measures (at chained PPPs): (i) expenditure-side real GDP to compare relative living standards across countries and over time (variable *rgdpe*); (ii) output-side real GDP to compare relative productive capacity across countries and over time (variable *rgdpo*). To demonstrate the difference between these two GDP measures, we plot the two variables for real GDP and per capita real GDP. Figure 11 shows that GDP series close match each other over time. However, during 1950-2014, *rgdpe* was higher than *rgdpo*. For example, real GDP on the expenditure-side was 2.9% higher than real

²⁸See Feenstra et al. (2009, p. 201) for a simple example to illustrate this.

GDP on the output-side, on average, between 1991 and 2014. A country will have favourable ToT if it receives a relatively high price for its exports and pays a relatively low price for its imports. This tends to make $rgdpe$ higher than $rgdpo$ (Feenstra et al., 2015).²⁹ This is exactly the case for NZ. We are interested in examining if the FTA with China improved economic welfare for NZ. Accordingly, our benchmark results are based on the real GDP on the expenditure-side (variable $rgdpe$). Having said that, we replicate our exercises using the real GDP on the output-side (variable $rgdpo$) and find the results reassuringly robust.

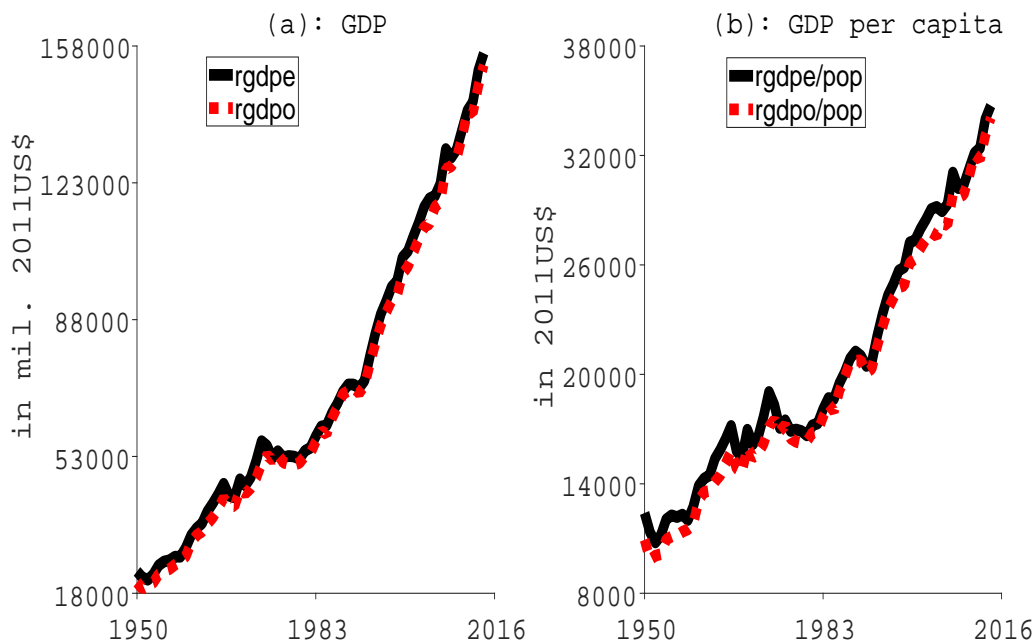


Figure 11: Real GDP^e vs. Real GDP^o at chained PPPs

Figure 12 shows the evolution of terms of trade in NZ between 1980 and 2016. NZ's terms of trade since the mid-1980s have grown steadily and increased markedly between 2000 and 2007. NZ is a primary commodity exporter, and the increase in the country's terms of trade during the 2000s reflected rising export prices. In addition, as argued by Steenkamp (2014), NZ has benefited from reductions in non-oil import prices due to increased levels of low-cost manufacturing production in emerging Asian economies. Nevertheless, declines in the terms of trade occurred over the GFC and the huge reduction in dairy prices of 2014 is reflected in Figure A4. Grimes (2006) finds that a rise in NZ's commodity's terms of trade is driven largely by real price rises in the agricultural sections. In addition, an increase of terms of trade for NZ can explain the strong GDP growth that NZ has experienced since 2001. At the same time volatility in NZ's terms of trade has increased. Higher variability in terms of

²⁹It is important to note that the gap between these two measures of real GDP is not a measure of the gains from trade for countries, or at least, not the gains from trade as compared to autarky.

trade has been shown to cause reallocation of both inputs and outputs (Grimes, 2006). This discussion adds to the idea that by utilizing the real GDP per capita from the PWT 9.0, we are able to capture an important driving factor for NZ’s economic growth performance.

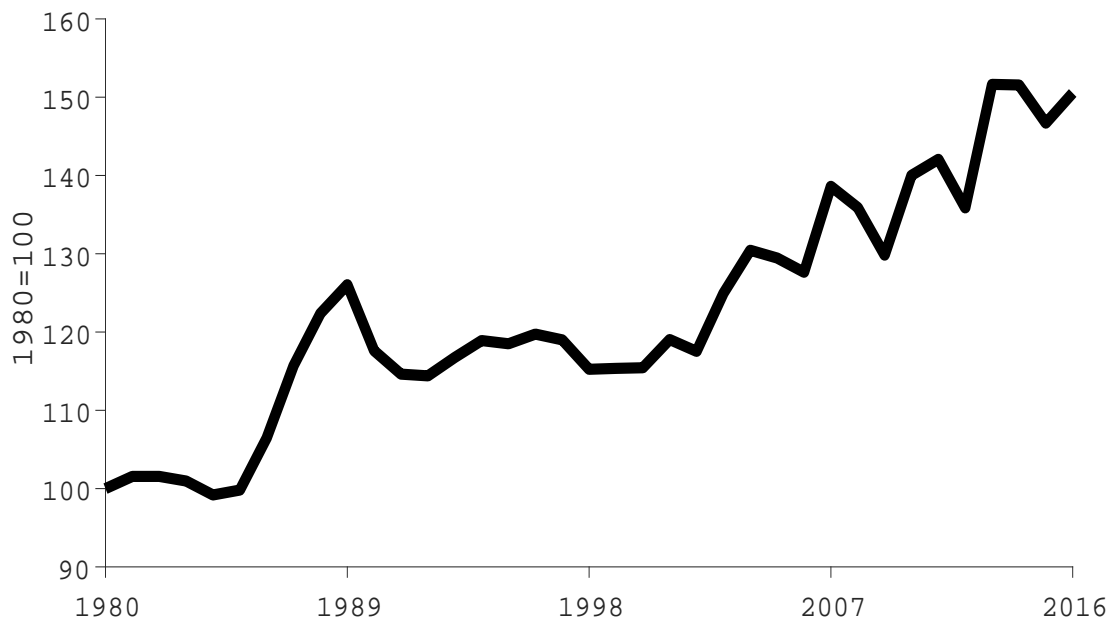


Figure 12: NZ’s terms of trade, 1980-2016

6 Conclusions

Our paper is timely as recently FTAs all over the world have been negotiated or renegotiated.³⁰ We highlight that there is evidence to suggest that bilateral trade agreements are an important factor for export growth and overall increase levels of exports at the sector level. This is suggestive of increased productivity in its primary industry and perhaps a more permanent reallocation into the country’s competitive advantage. Overall, NZ has seen large increases in exports to China, which are supportive of trade creation. The agricultural sector has benefited from such an agreement. The caveat to these findings is the concentration shift at the sector level of NZ’s exports to China. This is especially important within the dairy sector, whose exports have increased from 36% in 2007 to 56.4% in 2016. China is NZ’s biggest export partner in terms of merchandise goods, and any predicted down turn in the Chinese economy would have serious implications for NZ’s trading and flow on effects for

³⁰Canada, Mexico, and the US signed a trade deal to replace NAFTA at the G20 summit in Argentina on 30 November 2018. It is known as the US-Mexico-Canada Agreement, or USMCA.

the economy. China's recent urbanization is a driver for the huge increase in demand for NZ milk powder, which dominates the NZ dairy exports to China (Kendall, 2014). However, the future developments in the Comprehensive and Progressive Trans-Pacific Partnership may provide NZ with an opportunity to further diversify its export partners and insulated itself from any unexpected exogenous shocks in prices and overseas demand.³¹

Our findings regarding the counterfactuals for GDP per capita do not suggest any specific welfare impact that trade might have on NZ. As noted by some scholars, GDP can be a flawed measure of economic welfare (Sen, 1999; Coyle, 2014; Jones and Klenow, 2016), and it is possible that GDP per capita may not capture all welfare effects that globalization has generated (e.g. dispersion of technology, increased productivity, rates of innovation, etc.). Nevertheless, GDP per capita remains an important measure for economic growth despite the measurement pitfalls. While our paper is not an examination on possible welfare metrics, evaluating economic growth and well-being is a considerable task. Finally, carefully constructed dynamic multi-country, multi-sectoral general equilibrium models that take into account sectoral linkages between tradable and non-tradable sectors will likely provide many valuable insights for policymakers (see Caliendo and Parro, 2015; Caliendo et al., 2018). For the NZ case, it would be interesting to examine how a small open economy is affected by trade with such a large open economy in terms of productivity and reallocation of resources.

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³¹The Trans-Pacific Partnership (TPP) was a FTA designed to liberalize trade and investment between 12 Pacific-rim countries: New Zealand, Australia, Brunei Darussalam, Canada, Chile, Japan, Malaysia, Mexico, Peru, Singapore, the US and Vietnam. The concluded TPP Agreement was signed on 4 February 2016, and New Zealand ratified the Agreement in May 2017. When the US dropped out of the TPP, remaining 11 countries signed an amended agreement on 8 March 2018 in Chile. The TPP is now known as the Comprehensive and Progressive Trans-Pacific Partnership (CPTPP). New Zealand ratified the CPTPP on 25 October 2018, after the legislation required to implement the Agreement received Royal Assent. Australia ratified the CPTPP on 30 December 2018. With Australia's ratification, the CPTPP has met the threshold requirements to enter into force.

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Appendix A

Appendix A.1 Gravity Features of Trade Data

The graphical representations of trade data show the key gravity features of bilateral trade flows and motivate our use of the gravity model (see also Head and Mayer, 2014, Section 1.1). The first important feature of trade data is how exports and imports rise proportionately with the economic size of a country. Using GDP as a proxy for the economy size, Figure A1 shows NZ's exports (imports) to (from) OECD countries in 2006.³² On the vertical axis is NZ's exports to OECD countries and on the horizontal axis is GDP in current US dollars for 2006. The line shows the predicted values for a simple regression of log trade flows on log GDP. Both panels in Figure A1 suggest a near unit elasticity which demonstrate that trade flows rise in proportion to the size of the economic destination.

Figure A2 illustrates the second key empirical relationship embodied in the gravity equation, the strong negative relationship that exists between physical distance and trade. Figure A2 shows NZ's exports/imports after accounting for GDP or size of respective trading partners, and both panels demonstrate the "spirit" of the gravity gravity model, as it displays how trade is inversely proportional to the distance between two countries.

³²For Figure A1-A2 we combine the countries Belgium and Luxembourg, which is labelled BLX.

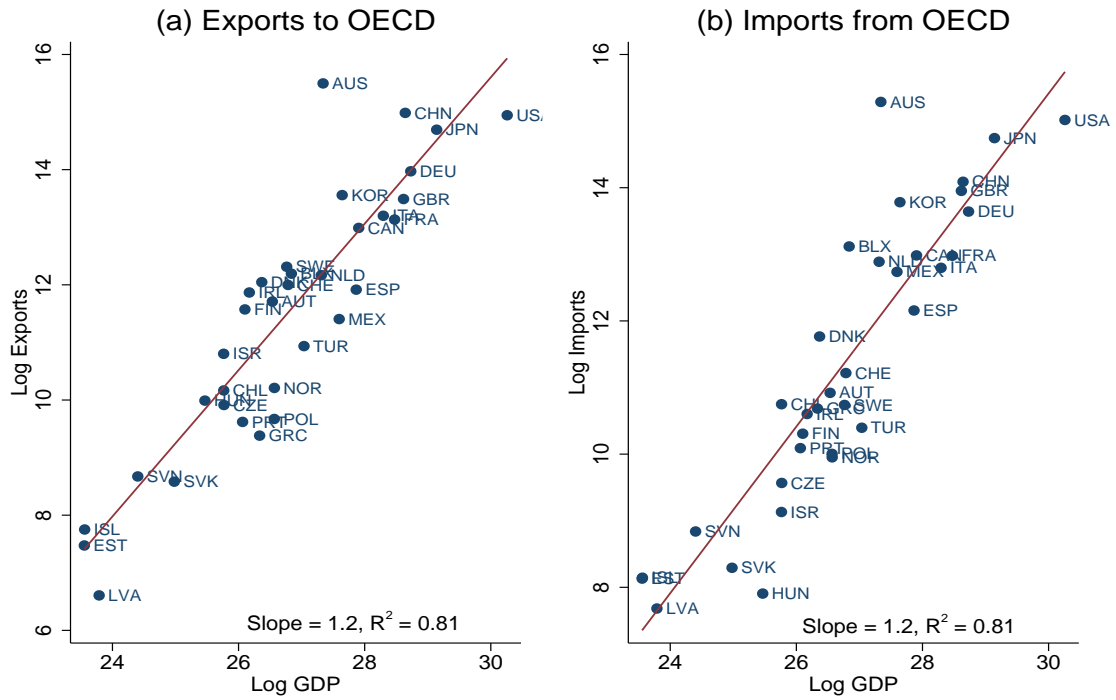


Figure A1: NZ's exports to and imports from OECD, 2006

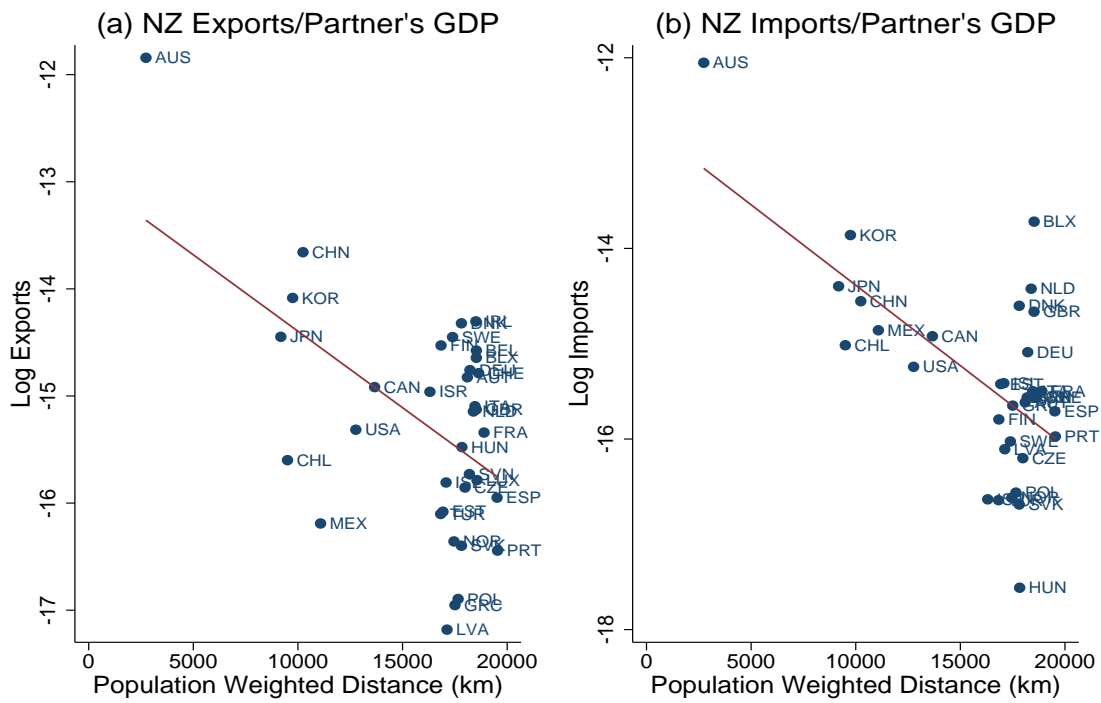


Figure A2: Trade inversely proportional to distance, 2006

Appendix A.2 A Look at the Dairy Sector

Figure A3 clearly shows that dairy products and birds' eggs (SITC 02) is the largest component of food and live animals (SITC 0) exports to China (SITC 02/SITC 0). Figure A3 also plots the share of SITC 02 in total exports going to China (SITC 02/SITC Total) between 2000 and 2017, and suggest that dairy and birds' eggs is a major component of exports to China (SITC 02/SITC Total). There is a noticeably sharp increase in NZ's dairy exports to China in the post-2008 NZ-China FTA era. It is possible that these sharp increases in dairy exports may be driven by reduced tariffs and change in food/dairy prices. Figure A4 shows the evolution of the FAO food price index (FFPI) and the FAO dairy price index (FDPI) between 1990 and 2017 (where the base period is 2002-2004) to explore this point further.³³ Food prices (and dairy prices) experienced a strong upswing in 2007 and 2008, reaching historically high levels. For the whole of 2008, the FFPI averaged 201.4 points, up 24.8% from 2007 and representing the highest annual average. Food prices declined 18.7% from 2014 to 2015. The decline was more severe for dairy price index. For the whole of 2005, the FDPI averaged 160.3 points, down 28.5% from 2014. Overall, the FDPI averaged 202.2 points in 2017, up 31.5% from 2016. This also provides an explanation behind the large drop in NZ exports to China during 2014-2015, which coincides with a drop in the FFPI and the FDPI. Table 2 displays that more than half of the NZ exports to China is the category of food and live animals (SITC 0). Therefore, a drop in the dairy price index is significant contributing factor to the decline in NZ total exports to China over 2014-2015.

Lastly, we mention the so-called Fonterra contamination incident. On 3 August 2013, Fonterra, one of the world's largest dairy companies, informed the NZ's Ministry for Primary Industries (MPI) of a possible food safety issue relating to a suspected contamination of whey protein concentrate with *Clostridium botulinum*. China ordered the recall of potentially contaminated milk imported from New Zealand after this incident. This temporary ban didn't impact whole milk powder and skim milk powder or imports of infant milk formula that had already been processed.³⁴ Stojkov et al. (2018) note that the affected products made up only a small proportion of NZ's dairy exports, with the vast majority of dairy exports being unaffected. On 28 August 2013, MPI announced that further testing confirmed no products had been contaminated. The incident was a false alarm. However, the Chinese ban remained in place until October 2014. Stojkov et al. (2018) examine the impact of a food contamination scare in the dairy sector on dairy exports using SCM and find that there was an initial negative shock to the exports of products that were thought to have been contaminated, but that there were no significant sustained impacts on other dairy products. They argue that total dairy exports were 0.6-1.9% lower than they would have been had the scare not occurred.

³³Data are available at <http://www.fao.org/worldfoodsituation/foodpricesindex/en/>. The Food and Agriculture Organization (FAO) FFPI was introduced in 1996. The only major modification made to it was in 2009, when its base period was updated to 2002-2004. FFPI consists of the average of five commodity group price indices (meat, dairy, cereals, vegetable oil, and sugar), weighted with the average export shares of each of the groups for 2002-2004. FDPI consists of butter, skim milk powder, whole milk powder, and cheese price quotations and world average export trade shares weight the average for 2002-2004.

³⁴<https://www.nbr.co.nz/article/china-lifts-temporary-ban-fonterra-whey-products-one-russia-remains-bd-164795>

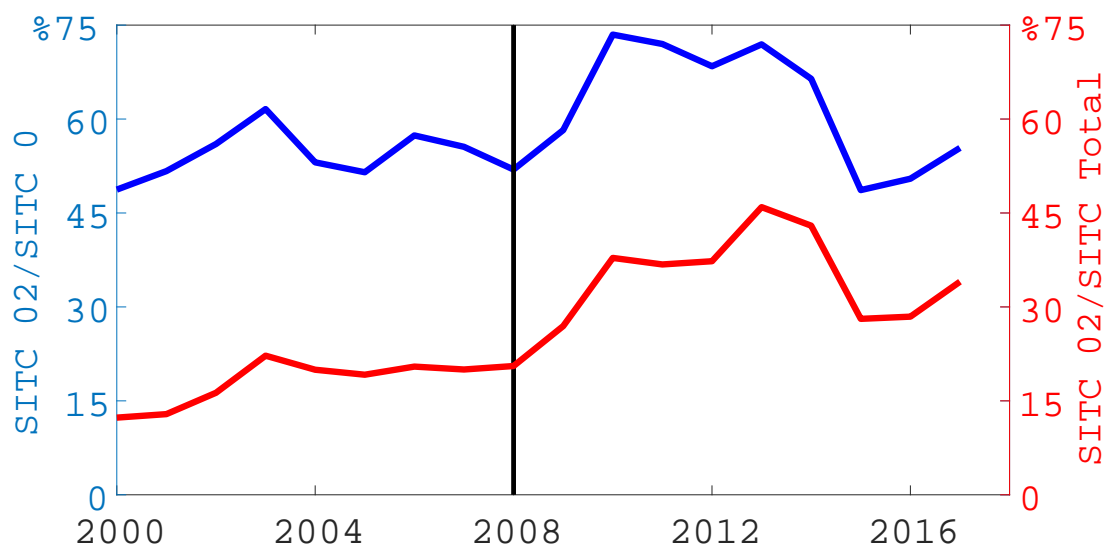


Figure A3: NZ's dairy products and birds' eggs exports to China (%), 2000-2017

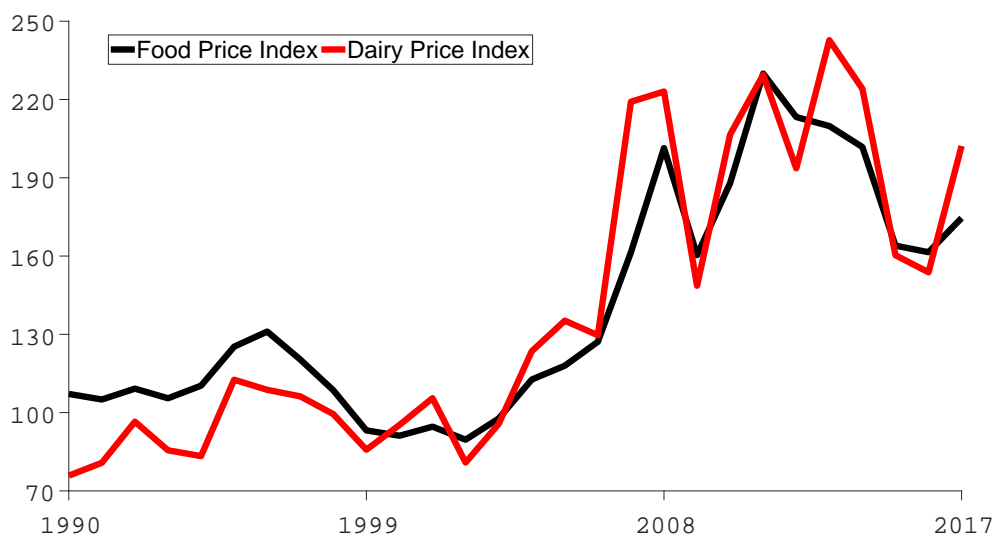


Figure A4: Annual food price indices (2002-2004=100), 1990-2017