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DISSERTATION SUMMARY

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Determining the impact of the 2004 Australian Baby Bonus on fertility rates using a synthetic control analysis

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Abstract

The longstanding issue of declining fertility in developed nations motivates a revaluation of the effectiveness of fertility-targeted policies. This thesis focuses on the 2004 Australian Baby Bonus, a past pronatalist incentive offering a lump sum financial transfer for every child born after 1 July 2004. We employ the synthetic control method to construct a counterfactual scenario for Australia in the absence of the policy's introduction. Using aggregate country-level data from the World Bank World Indicator's Database from 1998 to 2012, we carefully select suitable Organisation for Economic Co-operation and Development countries as control units and economic indicators to include as covariates. Our primary specification reveals a 6.82% increase in total fertility between 2005 and 2012, induced by the ABB. Robustness tests, including various model specifications, consistently confirm a positive fertility effect. This comparative case study provides a comprehensive analysis of the ABB's impact,

This article is a summary of an Economics Honours dissertation. The full dissertation can be accessed at https://drive.google.com/file/d/1fYgh_GRXHWcaJzC159cJU9BxNBIqvmST/view?usp=sharing.

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emphasising the significance of methodological choices in assessing fertility-related policies.

KEYWORDS

Baby Bonus, fertility, synthetic control method

1 | INTRODUCTION

The ongoing decline in fertility, indicating the average number of children born to a woman in her lifetime, is a persistent issue in many Organisation for Economic Co-operation and Development (OECD) countries, including Australia. Australia's total fertility rate (TFR) dropped from 3.55 to 1.77 by 2002 in just four decades (ABS, 2021). This decline in Australia and globally presents servicing ageing populations, necessitating a reassessment of past fertility policies and their effectiveness. The 2004 Australian Baby Bonus (ABB) was a prominent universal AUD 3000 payment available to parents for any child born after 1 July 2004. The ABB sits within a global policy effort to boost fertility rates along with similar policies from OECD countries (Chuard & Chuard-Keller, 2021; González & Trommlerová, 2023; Luci-Greulich & Theveon, 2013). This paper re-evaluates the impact of the introduction of the ABB in boosting fertility rates, contributing to the international literature on fertility-related incentives.

The ABB has been widely assessed in the empirical literature, with most studies indicating a positive fertility effect, showing an increase in births ranging from 2% to 8% overall within certain states and specific population sub-groups (Drago et al., 2011; Gray et al., 2022; Lain et al., 2009; Langridge et al., 2012; Parr & Guest, 2011; Sinclair et al., 2012). These studies have often relied on time-series variation and utilised extensions of simple linear regression tools to estimate the effectiveness of the bonus. However, such approaches may fail to account for systematic shocks, leading to potential bias in estimating fertility impact. Figure 1 illustrates fertility trends in Australia and several OECD countries, indicating a blip in fertility in other countries around the same time the ABB was introduced, questioning the bonus's impact and prompting a re-evaluation using an alternate approach.

This thesis builds on existing literature by employing the synthetic control method (SCM) to construct a counterfactual Australia, using variation across countries and time. It is the first to ascertain the impact of the ABB on TFRs using this identification strategy in a comparative case study with international-level data. Unlike regression-based counterfactuals, the SCM avoids extrapolation, providing transparency in fit between treated units and the convex combination of untreated units. It explicitly outlines each control unit's contribution to the synthesised counterfactual (Abadie, 2021). Under its assumptions, the SCM offers a more rigorous approach to constructing a counterfactual for Australia, allowing for arguably stronger causal evidence regarding the policy's effectiveness.

Utilising international-level data from the World Bank WDI databank, focusing on OECD countries, we employ a strict selection criteria and screening process to identify suitable control units. We identify suitable OECD countries to use as control units, considering their history of pronatalist policies and similarities to Australia over our period of interest, that is, 1998–2012. Our chosen predictors encompass economic and socio-demographic indicators, recognising the subjective nature of covariate selection in SCM (McClelland & Mucciolo, 2022). The synthetic control (SC) estimator, constructed through a precisely weighted sum of control units, aligns pre-policy data to create a close fit of the SC to Australia. We explore various SC model specifications

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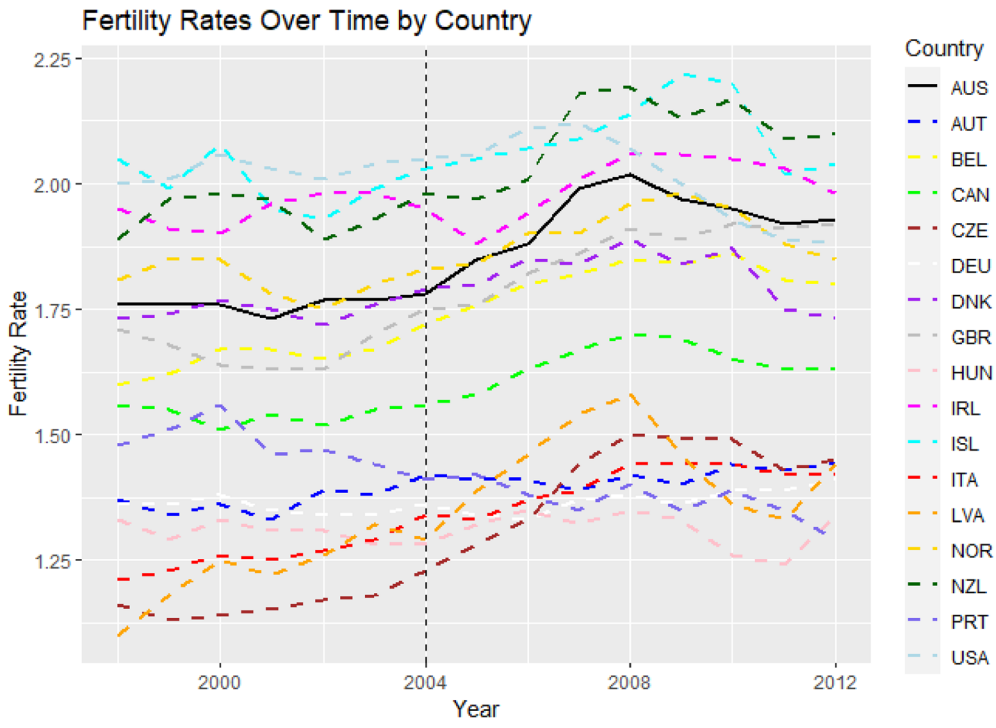


FIGURE 1 TFR trends for Australia and on average across selected OECD countries. [Color figure can be viewed at wileyonlinelibrary.com]

to simulate Australia's projected alternate TFR path from 2005 to 2012. Our primary SCM analysis estimates a 6.84% increase in TFR due to the ABB over the post-policy period.

Several robustness tests and sensitivity analyses confirm the consistent positive impact of the ABB on TFR despite model sensitivity to alternate predictor specifications. We attribute this to the subjective nature of predictor choice and data unavailability of important determinants of fertility, such as educational attainment and contraceptive prevalence. Despite some concerns about methodologies used in past literature, our findings using the SCM are similar in direction and magnitude, validating that the 2004 ABB boosted fertility.

2 | INSTITUTIONAL BACKGROUND

The ABB was Australia's first prominent pronatalist policy introduced in response to declining fertility trends. It was a federally funded unconditional, and non-taxable lump sum cash incentive of AU$ 3000 for every child born (or adopted child under 2 years of age) on or after 1 July 2004. The ABB aimed to absorb part of the direct costs associated with childbearing, enticing couples to have children.

Over time, the Bonus underwent several modifications, increasing to $4000 in July 2006 and $5000 in July 2008. In 2009, means-testing was introduced, restricting eligibility for families based on a combined taxable income limit of $75,000 (Rawlings et al., 2016). The introduction of a Paid Parental Leave scheme in 2011 provided an alternative option alongside the ABB, offering the primary caregiver 18 weeks of leave paid at the full-time minimum wage (Bassford & Fisher, 2020).

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By 2013, the Bonus remained at $5000 but was reduced to $3000 for second and subsequent births. Finally, in 2014, the ABB was abolished. Supporting Information Table A1 summarises the timeline of changes to the ABB.

3 | DATA AND VARIABLES

We chose the World Bank's WDI database over the OECD database because it offers more extensive data and a broader range of indicators for potential use as covariates. Our selected outcome variable is the TFR, representing the total number of children born per woman within the childbearing ages of 15–49. We focus on the period from 1998 to 2012 to ensure adequate pre- and post-policy periods, to achieve a suitable goodness of fit for our SC unit and to detect any noticeable deviation in the TFR path between the SC and Australia.

3.1 | Donor pool

We limit our choice of donor pool countries (control units) to OECD countries as they share resemblances to Australia and are predominantly developed nations.

To enhance credibility and minimise biases, we independently screen OECD countries, examining their history of pronatalist policies and their impact on fertility and whether a country exhibits markedly different trends in vital economic indicators, particularly during the pre-policy period (Abadie et al., 2012; Adema et al., 2020; McClelland & Mucciolo, 2022).

We impose the following criteria in selecting donor pool units, with priority given in their listed order:

1. Member of the OECD
2. No significant policy changes, similar policies to the ABB, or known idiosyncratic shocks that could significantly impact TFR within our period of interest
3. Similarity to the treated country (Australia) in terms of economic indicators such as economic performance and demographic factors based on Cowgill (2019)

This screening process analyses all 37 OECD countries (excluding Australia) as shown in suitability Supporting Information Table B1, which summarises their history of pronatalist policies over out period of interest. It also summarises the impact that these countries' previous pronatalist policies had on fertility and how these countries rank in similarity to Australia.

Each country is classified as 'yes', 'maybe' or 'no' based on its suitability for inclusion in the donor pool. In our primary specification, both 'yes' and 'maybe' countries are included. The criteria for classification are as follows:

> 'Yes' = Had no major pronatalist or fertility-related policy and ranked above the median in similarity to Australia

> 'Maybe' = To consider excluding due some form of fertility-related reform, program, or legislative change or underwent no such policies but ranked below the median in terms of similarity to Australia.

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'No' = Experienced significant history of impactful pronatalist policies

Supporting Information Figure C1 provides a visual representation of our screening process and allocation of suitability classifications. Supporting Information Figure D1 presents a World Map visualisation of donor countries, and Figure 2 conveys the TFR trends of our donor countries distinguished by suitability classification. The 16 countries include 'yes' countries: Canada, Italy, Iceland, Latvia and Portugal, and 'maybe' countries: the United States, Austria, Ireland, Belgium, Denmark, Czechia, Germany, the United Kingdom, Hungary, Norway and New Zealand.

3.2 | Covariates

Using World Bank WDI's database, we choose the following yearly indicators as our set of covariates because they are expected to predict fertility and are available for all donor countries for every year in our period of interest.

- GDP per capita growth (annual %).
- Urban population growth (annual %).
- Unemployment, total (% of total labour force) (national estimate).
- Labour force, female (% of total labour force).
- Age dependency ratio (% of working-age population).
- Ratio of female to male labour force participation rate (%).
- Net migration rate.

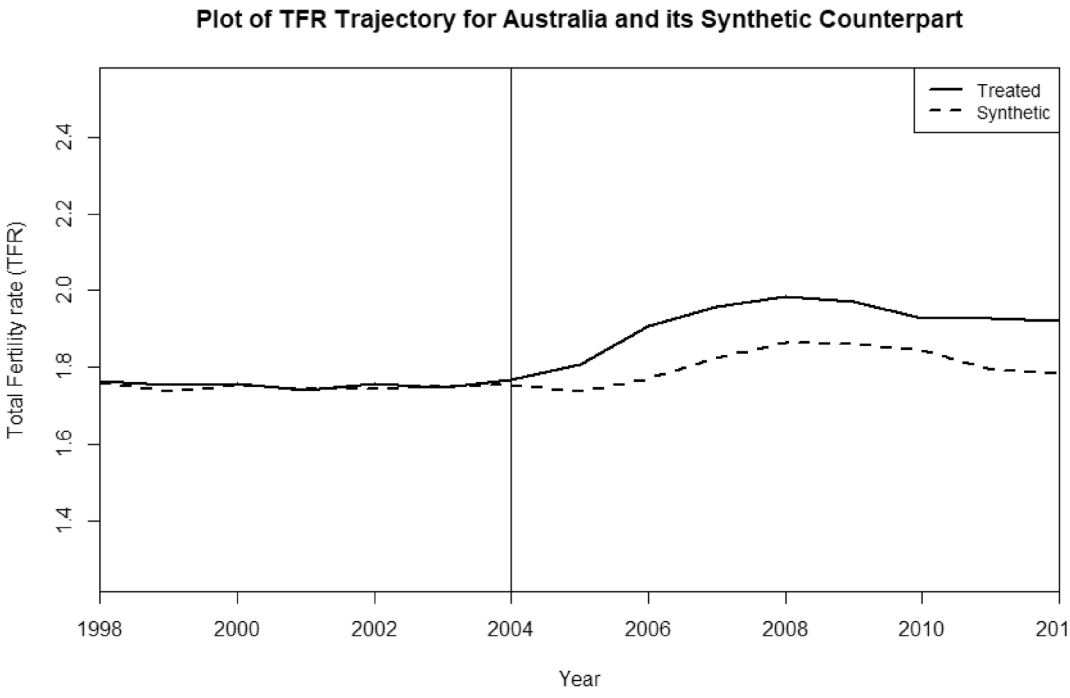


FIGURE 2 Path plot under primary specification.

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4 | METHODOLOGICAL FRAMEWORK

4.1 | The synthetic control method

The SCM is a data-driven research design that leverages a set of predictors and donor pool units to construct a counterfactual of the treated unit, consolidating it into a single control. In our SCM application, the SC unit serves as a counterfactual to Australia, simulating its projected TFR trend during the post-policy period (2005–2012) in the absence of the 2004 ABB intervention. The algorithm achieves this by using a weighted sum of untreated units from the donor pool (selected OECD countries) to replicate Australia's pre-policy characteristics. Specific weights (ranging from 0 to 1) are assigned based on the explanatory value and relevance of each donor pool country and predictor in mimicking Australia's pre-policy characteristics (Abadie, 2021). By comparing the post-policy TFR paths between Australia and its synthetic counterpart, we can infer the impact of the ABB in stimulating fertility levels.

A difference-in-difference requires the parallel trends assumption to hold, which is unlikely in a cross-country comparison. However, the SCM meets the parallel trend criterion after conditioning on a set of predictors, such as outcome lags and covariates (Kreif et al., 2016). Lagged outcomes capture historical data for each pre-policy year and enhance goodness of fit, particularly with data limitations. However, including the entire pre-treatment path of TFR can significantly diminish the predictive power of covariates (Kaul et al., 2022) and may result in overfitting (McClelland & Gault, 2017).

4.2 | The synthetic control estimator

For each country j and year t, Y_{jt} is the observed TFR. Hence, Y_{jt}^{N} is the weighted average for the donor countries $j = 2...,J+1$, which forms the synthetic version of Australia in the absence of the ABB.

Synthetic Australia is given by:

$$\widehat{Y}_{1t}^{N} = \sum_{j=2}^{J+1} W_j \times Y_{jt}$$

where W_j are weights algorithmically selected to optimise the correspondence between the synthetic and actual Australia in the pre-policy period (Abadie & Gardeazabal, 2003; Hainmueller & Diamond, 2023). The SC estimator is given by the difference between TFR for Australia and TFR for the SC in the post-policy period, that is, $t > T_0 + 1$.

$$\widehat{\tau_t} = Y_{1t}^{I} - \widehat{Y_{1t}^{N}}$$

5 | RESULTS

We employ the Synth and SCtools packages in R for model computations. Due to limited data for specific indicators and a small donor pool, we take a flexible approach, testing various model specifications, leading to multiple SC estimators. Our main analysis presents the primary SC model

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specification and tests its robustness. In Supporting Information Appendix F, we perform a sensitivity analysis by testing three alternative specifications as distinct SC runs. These variations shed light on changes in goodness of fit resulting from alterations in the donor pool size and predictor selection, offering insights into common strategies employed in selecting predictors.

5.1 | Estimation results

Due to relatively few 'yes' countries, our primary specification includes both 'yes' and 'maybe' countries in the donor pool. We enhance model fit by including a subset of lagged outcomes (TFR in 2000 and 2003) alongside covariates.

Table 1 summarises the estimated percentage increase in TFR due to the ABB. The estimates are derived from our primary and alternate specifications, which are discussed in the sensitivity analysis later. Additionally, the table includes Australia's ranking based on its post/pre-mean-squared-prediction-error (MSPE) ratio under each specification relative to all countries in the donor pool.

According to our primary specification, the introduction of the ABB leads to an average 6.84% increase in TFR during the post-policy period (2005–2012). Australia also exhibits the largest post-/pre-MSPE relative to the 'yes' and 'maybe' donor countries. The remaining columns present the results under our alternate model specifications. Column 2 shows results from a specification using all lagged outcomes as predictors (as is commonly done); column 3 includes covariates only (which may alleviate concerns of overfitting); and column 3 further restricts the donor pool to 'yes' countries. Across specifications, Ireland is consistently assigned a high weight, suggesting it is the most relevant comparison unit (see Supporting Information Table E1). Outcome lags dominate predictive power over covariates in constructing the SC, despite net migration having the highest predictive power among covariates (Supporting Information Table E2). Although the weights are somewhat sensitive to specification, the estimates all point to an increase in TFR between 2005 and 2012, ranging from 5.2% to 8.8%. Supporting Information Table E3 summarises the closeness of fit between Australia and the SC unit by comparing mean indicator values.

Figure 2 illustrates the paths plot for our primary specification, allowing for a visual assessment of the goodness of fit and the estimated treatment effect.

We can observe a close pre-policy fit followed by a noticeable divergence in the TFR paths between the SC and Australia immediately after the policy's introduction. Using the gaps plot (Supporting Information Figure E4), we estimate a 6.84% increase in TFR. For comparison with previous literature, we ran the primary specification replacing TFR with crude birth rate (which has a 93% correlation with TFR) and obtained an estimate of 6.24%.

TABLE 1 Summary of estimates and Australia's ranking across specifications.

	Primary specification	Lagged outcomes specification	Covariates specifications	Covariates specification with 'yes' only donor countries
Estimated effect	6.84%	8.82%	5.20%	7.25%
Ranking of Australia	1/17	1/17	3/17	1/7

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Supporting Information Appendix F contains the gaps plots and post-/pre-MSPE ratio distribution plots generated from our sensitivity analysis. In Supporting Information Appendix G, we make minor adjustments to our primary specification where we exclude covariate, 'Labour force, female (%)' due to its high correlation with 'Ratio of male to female labour force participation'. We also modified our primary specification to use the average of all lagged outcomes, as Kaul et al. (2022) recommended. We obtain similar point estimates to our main specification.

5.2 | Inference

We obtain randomisation inference *p*-values by conducting a series of placebo tests, where we reassign the implementation of the ABB to each control country as if it were the treated unit, shifting Australia into the donor pool. Each estimated treatment effect is then ranked according to the MSPE, indicating the average squared discrepancies between the TFR for the treated unit and its synthetic counterpart, with the exact *p*-value corresponding to the rank order. For our primary specification, $p = .059$, which while marginally insignificant is the smallest *p*-value obtainable with only 17 countries in the sample. Further analysis of the placebo plot (Supporting Information Figure E5) and the post/pre-MSPE ratio distribution under our primary specification (E6) is in Supporting Information Appendix E.

6 | DISCUSSION

In contrast to prior empirical tools assessing the ABB's impact, the SCM meticulously controls for confounding factors and mitigates biases by leveraging data to adjust for shocks affecting covariate indicators and TFR that are common across countries.

Despite being concerned that previous studies may have overstated the effect of the ABB due to bias from systematic shocks, we confirm the positive impact of the ABB on fertility and obtain larger estimates than previous studies. This implies that a relatively modest cash bonus of $3000 can boost fertility rates, even in a wealthy developed country. For 2005–2006, before the first increase to the cash amount, we estimate it cost the government $45,918.46 per additional birth induced by the policy.[1]

7 | CONCLUSION

This thesis explores the impact of the introduction of the ABB in 2004 on fertility rates. Our comparative case study using the SCM estimates an average 6.84% increase in the TFR between 2005 and 2012.

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[1]In 2005–2006, there were 544,588 births in Australia (AIHW, 2007, 2008) of which 36,233.01 can be attributed to the baby bonus given our estimate of a 6.99% increase in TFR in those years. The marginal cost per additional birth is calculated as $\$3000 \times 544{,}588/36{,}233$.

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