Economic Costs and Benefits of EMU membership from the Perspective of a Non-Member

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Abstract: The result of the decision whether to join the European Monetary Union, an irreversible policy choice for several European Union members, presents potentially significant costs and benefits. With a focus on the second largest EU economy outside of the euro, Sweden, this paper applies the novel synthetic control method of estimation to evaluate whether there are costs or benefits associated with EMU membership in terms of various aspects of economic performance and how these have developed from 1999 until 2013. Findings indicate that Sweden would have borne non-trivial costs from currency union membership, exemplified by 10-12% lower productivity, 10% lower exports, and 7% greater government expenditure for the year 2013, following from greater peaks in the crisis years. The robust results suggest the costs may be persisting and in some cases growing in magnitude.

Keywords: European Monetary Union, Sweden, synthetic control method

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1. Introduction

The result of the decision whether to join the European Monetary Union, an irreversible policy choice for several European Union members, presents potentially significant costs and benefits. Benefits include reduced exchange rate volatility, trade uncertainty, and relative price variability; harmonisation of interest rates; and increased welfare from augmented international competition (Eichengreen, 1990). Costs include loss of independent monetary and budgetary policies and thereby the ability to combat idiosyncratic shocks and smooth business cycles, as well as inhibiting currency devaluation to bolster competitiveness (Feldstein, 1997 and De Grauwe, 2016).

Although legally committed to adopt the common currency, several countries postpone or opt out of this obligation. Advanced economies like the United Kingdom and Denmark negotiated explicit exemption agreements, while others such as Sweden and Poland do not fulfil certain convergence criteria and therefore remain noncompliant with their Treaties of Accession.[1] In all four cases, there has been strong popular opposition to replacing the respective national currencies. This paper aims to assess whether there are economic costs or benefits associated with EMU membership and how these have developed from 1999 to 2013. We focus on Sweden, the second largest EU economy outside the euro area. Using the novel synthetic counterfactual method of estimation, it is found that Sweden would have borne non-trivial costs from currency union membership, exemplified by 10-12% lower labour productivity in terms of GDP per hour per worker.

[1] For a detailed description of convergence assessments for euro adoption see the convergence reports of the European Commission: http://ec.europa.eu/economy_finance/euro/adoption/convergence_reports/index_en.htm.

Having regard to the growing literature highlighting shortcomings of the EMU, it may be that the estimated costs associated with membership are due to these shortcomings, or "design flaws". However, given significant recent reforms and implementation of policies and institutions such as the Banking Union, the European Stability Mechanism, as well as the Single Supervisory Mechanism and Single Resolution Mechanism, some of these shortcomings have been corrected such that the net balance of economic costs and benefits of EMU membership may have shifted. Assessment of whether these recent measures have been successful in resolving the shortcomings and yield net economic benefits of currency union membership remains for future research.

The paper is organised as follows. The next section describes the primary flaws of the EMU that may have contributed to the costs observed for Sweden, some empirically found benefits of EMU membership, and a review of relevant counterfactual analyses. The third section introduces and motivates the methodology. The fourth section presents the main results, and the fifth section inference and robustness tests. The sixth section concludes.

2. Motivation and Previous Literature

One may generally define three strands of flaws of the European Monetary Union: first, the absence of a common fiscal policy; second, the application of a single monetary policy without a mechanism to promote business cycle convergence among member states; and third, the failure to oversee financial stability.

Firstly, although there was awareness of the necessity for fiscal policy coordination and discipline, which led to the provisions contained in preventive measures such as the Maastricht criteria and the Stability and Growth Pact, the euro project lacked an effective mechanism for their enforcement (Durré, Maddaloni, and Mongelli, 2014). As a result, EMU membership

became associated with perceived protection from risk for sovereigns, which lead to risk mispricing by market participants, allowing countries to access cheaper borrowing terms.

Various explanations for this mispricing are given. Hannoun (2011) argues that the underestimated risks observed during 1999-2011 fit into a general long-term trend of financial market sovereign risk pricing: periods of complacency, characterised by unusually low risk perceptions and compressed spreads, occur while risks accumulate and are followed by a stark market correction as interest rate spreads diverge widely. Among academic contributions, Bianchi (2016) indicates that risk pricing failed to consider the state of the external indebtedness of the economy in periods of low global uncertainty, similarly to Giordano, Pericoli, and Tommasino (2013) who suggest that mispricing occurred as market participants remained (at least partially) ignorant to macroeconomic fundamentals when pricing sovereign risks. Arghyrou and Kontonikas (2012) pose that sovereign risk mispricing was supported by the perception of currency union membership irreversibility as well as mutualisation of fiscal debts, and that only after the events of the Greek crisis did market expectations shift away from these two convictions. Frankel (2013) argues that the compression of risk premia occurred due to markets maintaining an expectation of ECB bailouts to troubled countries, despite the "no bail-out" clause embedded in the euro foundation.

However the perception of reduced sovereign risk emerged, it allowed repeated violation of the Maastricht criteria without substantial punitive action or remedy, and indeed, lax fiscal policies were present in several countries. For example, Greece never posted a budget deficit below the envisaged 3% threshold nor did the debt-to-GDP ratio ever decline from 100% (reported in 1993) toward the 60% limit (Frankel, 2013). The situation precipitated when the crisis called for public intervention and, thus, public debts exploded. Although beyond the scope of this paper to discuss the implications of EMU membership on public debt burden,

results of this study indicate that Sweden would have reported 11% greater government expenditure in 2008 as a currency union member, which would have needed either to be financed by politically painful fiscal measures or increased accumulation of public debt. Without credible fiscal controls, the politically favourable choice is likely the latter option.

With regard to the second strand of flaws, according to the theory on Optimum Currency Areas, the overall net benefits of a common currency are increasing in the degree of business cycle synchronisation among member economies (Mundell, 1961). A shared monetary policy will not be optimal for all countries involved if their business cycles are considerably divergent. Indeed, common monetary policy can in this case exacerbate the business cycle fluctuations of union participants by on one hand being insufficiently accommodative for a member state approaching a trough while on the other hand not being tight enough for a booming economy, leading to even stronger boom and bust dynamics. De Grauwe and Ji (2015) expand this argument further by stating that EMU membership does little to promote the convergence of business cycles within the union.

The literature appears divided on whether European business cycles are converging, and it seems that Europe has undergone periods of both convergence and divergence (Massmann and Mitchell, 2004). Earlier studies suggest convergence occurred especially since the 1980s, and there is support for the argument that currency union membership, by promoting trade, endogenously contributes to business cycle convergence within the monetary union.[2] Although confirming the finding of increased synchronisation also in the early 1990s, De Haan, Inklaar, and Jong-A-Pin (2008) find that significant desynchronisation remains, without convergence toward a 'European' business cycle. Aguiar-Conraria and Soares (2011) add support to this conclusion in finding that Portugal, Greece, Ireland, and Finland do not show statistically

[2] See for example Artis, Krolzig, and Toro, 2004; Boewer and Guillemineau, 2006; and for the endogeneity argument see Frankel and Rose, 1998.

relevant degrees of synchronisation with Europe, nor do recent Euro members Slovakia and Cyprus. Furthermore, Pentecôte, Poutineau, and Rondeau (2014) conduct a study on the impact of trade integration on business cycle convergence among the original eleven euro area countries and find that new trade flows have a negative impact on cycle synchronisation.

A second potential consequence of implementing a shared monetary policy is related to the unique exchange rate, or in other words, the linkage to competitiveness. In the absence of nominal exchange rate flexibility, cross-border imbalances require an economy that suffers from slacking competitiveness to undergo painful internal revaluation through its price level, which can spark a debt-deflation spiral with serious consequences. The economic divide between the southern and northern European countries has become most apparent in the aftermath of the great recession, when the latter group experienced higher economic growth and price level gains compared the former group, in which recessionary and deflationary pressures have been more persistent (for example Sinn and Valentinyi, 2013).

The third strand of flaws, regarding oversight of financial stability and bank supervision, received only limited attention, as noted by Begg et al (1991), and was not operationally addressed until well into the establishment of the monetary union. Indeed, to centralise bank supervision at the European level was not expected to become a necessity at first, with close cooperation of the ECB and national competent authorities responsible for bank supervision forecasted as sufficient (Padoa-Schioppa, 1999). However, as noted during the recent financial crisis, when the lack of sufficient bank supervision and regulation lead to excessive accumulation of credit alongside diminishing loan quality, the effects on financial stability can be disastrous. Giavazzi and Wyplosz (2015) point out that delaying the appointment of responsibility for bank supervision had serious consequences: drawing a parallel to how the financial crisis was mitigated in the United States, they argue that by first addressing the

problems in the banking sector through TARP (Troubled Asset Relief Program) and then proceeding to deploy macroeconomic tools, the US was able to significantly shorten the crisis compared to Europe where the initially applied monetary policy measures were rendered less effective by an impeded credit channel.

We now turn to the potential benefits of joining the EMU, starting with Micco, Ordonez, and Stein (2003) who estimate the effects of membership on trade among members and non-members. EMU membership has a *ceteris paribus* augmenting effect on trade among members of around 10-15%, in addition to a positive spillover effect of increasing trade among members and non-members by 8%. This suggests the EMU functions as an overall catalyst to trade, which is not limited to bilateral trade within the union. In the case of Sweden, the authors postulate trade with EMU member states would have been 11% higher by 2001 if Sweden had joined the monetary union.

A decade following the initial Calmfors Commission investigation (Calmfors et al., 1997) into the advantages and disadvantages of Swedish EMU membership, Söderström (2008) revisits the evaluation with updated data until 2005. Using a DSGE model in a VAR analysis, different counterfactual exercises are conducted to analyse the development of economic indicators in a setting mimicking the prevailing conditions of currency union membership. When incorporating monetary policy shocks, an unambiguous interpretation in favour of EMU membership is found.

Pesaran, Smith, and Smith (2007) apply an alternative counterfactual approach to the question of how EMU membership would have affected output and the price level in the United Kingdom and Sweden. Unlike the typical counterfactual analysis contrasting a counterfactual to the actual trend, this method compares two counterfactuals; one with the restriction of fixing short-term interest rates and exchange rates, simulating EMU membership, and one without,

avoiding the problem of disentangling treatment effects from forecasting errors. The authors find that both the UK and Sweden would have had lower interest rates and higher output as currency union members.

The synthetic control method (SCM), first introduced by Abadie and Gardeazabal (2003) does not rely on forecasts of the counterfactual, rather it constructs the counterfactual using real time data based on statistical matching. Recently, there has been interesting applications of the SCM to cost and benefit analyses of policy programmes, including the EMU. Manasse, Nannicini, and Saia (2014) examine the impact on various aspects of the Italian economy, finding considerable costs in terms of subdued labour productivity. As a likely explanation the authors cite the necessity of price level adjustment in the absence of currency devaluation within the monetary union, which may have transferred resources from more to less productive and competitive sectors. Gomis-Porqueras and Puzzello (2015) apply the SCM to identify the countries that benefited from EMU membership. In support of the Mundell (1961) argument, they find that nations that joined which had closer synchronised business cycles to the monetary union fared better by gaining more or losing less from membership compared to joiners with more desynchronised business cycles.

This paper aims to shed further light on the economic costs and benefits of EMU membership from the perspective a non-member, Sweden. The study contributes to the literature by examining the components of expenditure GDP separately, in addition to looking at the effects on productivity within the SCM framework. The focus is on labour productivity, measured as GDP per hour per worker, rather than the level of GDP, as productivity represents a more meaningful metric of economic development for an advanced economy such as Sweden and many other non-members. The differentiation after GDP components allows for a more nuanced picture of EMU membership effects beyond productivity, which has not been studied

in previous literature. In contrast with the relatively shorter post-intervention time span in Micco et al. (2003) and De Nardis and Vicarelli (2003), the present analysis, with over a decade of post-treatment data, incorporates also business cycle fluctuations over time.

3. Data and Methodology

To answer the question of whether Sweden would have experienced net costs or benefits associated with EMU membership, an appropriate counterfactual analysis is required. A recent innovative methodology, the synthetic control method (SCM), further adapted in Abadie, Diamond, and Hainmueller (2010, 2015), allows for the comparison of an outcome of a unit that undergoes some treatment to a synthetic control unit that does not undergo treatment. The method requires specification of three components: a treatment and a treatment period; a donor pool of units from which the synthetic control is created; and matching covariates to link the treated unit to the control units. One observes how the unit of interest is affected by the treatment and aims to compare this to its unobserved, hypothetical development without treatment.

Typically the method is applied to the hypothetical outcome in the absence of a particular treatment: the Basque Country in the absence of ETA terrorism (Abadie and Gardeazabal, 2003) or West German GDP growth without reunification (Abadie et al., 2015). In the current analysis, the opposite version of the method is applied: the treatment is not joining EMU, captured by the actual observed data for Sweden, which is compared to the data of the untreated control unit, a weighted average of the original eleven EMU members.[3]

The synthetic control is formed such that the weighted combination of donor pool units mimics the pre-treatment values of the treated unit Sweden. Generally, the longer the pre-treatment

[3] The original eleven members of EMU from 1999 are Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Spain, and Portugal. Germany was excluded from the donor pool for the labour productivity analysis due to limited comprehensive data.

period, the better fit may be found in terms of minimising the deviation of the synthetic control from the actual series. It follows intuitively that only control units that are similar in both observed and unobserved characteristics can match the treated unit over longer periods of time. Consequently, if it can be established that the synthetic control follows the actual values closely over a longer pre-treatment period, then a deviation in the post-treatment period can be interpreted as being caused by the treatment itself (Abadie et al., 2010). Data for Sweden and the eleven initial EMU members are available yearly over the time period 1971 – 2013.[4] With the start of treatment in 1999, there are ample years of pre-treatment data and over a decade of post-treatment in which to observe any deviation of synthetic Sweden in the EMU to actual Sweden not in the EMU.

Covariates should predict the various components of GDP and labour productivity without being affected by the treatment. The literature on the growth drivers and predictors of GDP components is immense. Therefore, in line with the synthetic counterfactual analyses of Abadie and Gardeazabal (2003), Billmeier and Nannicini (2013), as well as Campos, Coricelli, and Moretti (2013), the primary covariates adopted in this study are those presented by Barro and Sala-i-Martin (1995). In addition, a few other variables suggested by the literature for the various components are included, such as demographic measures of population shares above 65 and below 14 years of age influencing government expenditure and consumption; real exchange rates and relative price levels of imports and exports; as well as years of schooling and returns to education influencing investment decisions.[5] Data has been collected primarily from the World Bank World Development Indicators and Penn World Tables 7.1 and 8.0.

[4] For labour productivity data was available in the period 1980-2010 and for investment data was available 1971-2011.

[5] See for example Aydun, Ciplak, and Yucel (2004) for a discussion of drivers of exports and imports, Shelton (2007) for government expenditure, Gidehag, Öhman, and Larsson (2001) for investment, Berg and Bergstrom (1995) for consumption.

Synthetic Sweden is identified as the weighted average of control units, i.e. the EMU member countries, such that the root mean squared prediction error (RMSPE) of synthetic to actual Sweden is minimised. However, the RMSPE is a function of the predefined covariates used in the construction of synthetic Sweden. An issue that emerges is the identification of the set of covariates that minimises the RMSPE. This can in principle deviate from the set including all covariates. Therefore, to obtain the best possible fit an iterative algorithm was applied to compute the RMSPE for each possible set of covariates. The optimal set of covariates is defined to be the set which is associated with the lowest RMSPE and includes at least three covariates. This iterative process is to the best of the author's knowledge a novelty in the literature applying the SCM. It lowered the RMSPE for all but one case (see table 1). The prediction error fell by 60% in the case of government expenditure, presenting the most significant gain from the iterative analysis. Table 2 demonstrates the different covariate specifications for labour productivity and each component of GDP. All subsequent analyses were conducted using both the full set of covariates, denoted baseline specification and available upon request, as well as the lowest RMSPE set of covariates, denoted best fit specification, presented here.

Now follows a more technical description of the methodology. Suppose there are J control units constituting the donor pool, indexed by j, and one unit undergoing treatment, for a total of J + 1 units.[6] In this paper, Sweden is unit 1, the country of interest, and there are 11 control units represented by the initial EMU members. Assume a balanced panel can be formed of these J + 1 units over some T time periods, indexed by t. Further assume there is some positive number of pre-treatment periods and some positive number of post-treatment periods, where the start of the treatment period is denoted by T_0 such that $1 < T_0 < T$. Assume the treatment has no effect prior to T_0 and has uninterrupted effect when $t \in [T_0, T]$. Let this full post-treatment

[6] For studies where there are more than one unit undergoing treatment the method may be applied to each unit separately or to all units affected by treatment aggregately (Abadie et al., 2012).

period be denoted by T_1. The objective is to compare the treated unit to the synthetic untreated unit when $t \in [T_0, T]$, based on a fit of the synthetic control to the actual treated unit in the pre-treatment period, $t \in [1, T_0]$. In the present paper, pre-treatment starts from 1971 and treatment is set to start in 1999, when the EMU was officially instated. The post-treatment period is comprised of data 1999 – 2013.

Let $X_1 = \begin{bmatrix} X_{11} \\ \vdots \\ X_{1k} \end{bmatrix}$ be a vector of pre-treatment values of the K covariates, growth predictors, for unit 1 being exposed to treatment, that is, the pre-treatment values for Sweden.

Let $X_0 = \begin{bmatrix} X_{11} & \dots & X_{1j} \\ \vdots & \ddots & \vdots \\ X_{k1} & \dots & X_{kj} \end{bmatrix}$ be a K x J matrix of the pre-treatment values for the K covariates for the J control units, i.e. the pre-treatment values for the eleven Eurozone countries, forming a K x 11 matrix.

Let $W = \begin{bmatrix} w_2 \\ \vdots \\ w_{J+1} \end{bmatrix}$ be a vector of weights for the control units forming the synthetic control such that the following conditions hold;

$$w_i \geq 0 \; \forall \; i \text{ and } \sum_{i=2}^{J+1} w_i = 1$$

Thus, selecting a particular W is equivalent to selecting a particular synthetic control. As suggested previously, the synthetic control is formed by creating a weighted average of the donor pool such that it mimics the pre-treatment values of the unit of interest. That is, the synthetic control for Sweden is comprised of a weighted average of the eleven EMU countries in the donor pool such that the combination provides the closest pre-treatment match to Sweden. The closeness of this fit is represented by the vector $X_1 - X_0 W$ and the aim is to minimise this distance.

Consider covariate a, one of the K covariates, such that X_{1a} is the pre-treatment value of a for unit 1 and $X_{0a} = [X_{01} \quad \dots \quad X_{0j}]$ is a vector of the pre-treatment values for the J control units. Then, the weighting matrix W is chosen to minimise the following expression

$$\sum_{a=1}^{k} v_a (X_{1a} - X_{0a} W)^2$$

Where v_a is a measure of the relative importance for covariate a in predicting the outcome of interest. For example, in the current paper, GDP per capita and inflation are predictors of consumption. Now, say GDP per capita is a better predictor of consumption in Sweden than inflation, then it is important that the synthetic control matches the GDP per capita of Sweden closer than its inflation history. Let V be a square matrix of these relative weights chosen among positive semidefinite and diagonal matrices such that the mean squared error of the synthetic control estimator is minimised over the pre-treatment period.

The synthetic control estimator compares the post-treatment outcome of the treated unit to that of the untreated synthetic control. Let $Y_1 = \begin{bmatrix} Y_{1T_0} \\ \vdots \\ Y_{1T} \end{bmatrix}$ be a vector of post-treatment values of the outcome for the unit of interest, that is, post-treatment values for each of the GDP components of Sweden. Let $Y_0 = \begin{bmatrix} Y_{0T_0} & \dots & Y_{jT_0} \\ \vdots & \ddots & \vdots \\ Y_{0T} & \dots & Y_{jT} \end{bmatrix}$ be a $T_1 \, x \, J$ matrix of post-treatment values of the outcome for the J control units, thus, six matrices of post-treatment values for GDP and each of the components of GDP for the 11 units in the donor pool. In general, let Y_{jt} represent the outcome of unit j at time t. The synthetic control estimator, reflecting the difference between the treated and the synthetic untreated unit, is given by;

$$Y_{1t} - \sum_{j=2}^{J+1} w_j^* Y_{jt}, \; t \geq T_0.$$

The method can be readily executed using the software scripts developed and made available by Abade, Diamond, and Hainmueller.[7]

4. Results

Results from the synthetic control method analysis using the combination of variables that yield the lowest RMSPE are reported in figures 1.1 – 1.6. The solid line represents actual Sweden, the dashed line synthetic Sweden, and a dashed vertical line at 1999, represents treatment – the commencement of EMU. Using these figures, the aim is to discern whether there is a deviation of synthetic to actual Sweden from 1999 onward. Accompanying figures 2.1 – 2.6 display the difference between the two series for each year in the post-treatment period, illustrating the magnitude of each gap and its persistence over time.

4.1 Labour Productivity

Figure 1.1 displays the counterfactual analysis for labour productivity. Actual Sweden and its synthetic control are moving closely congruently together in the pre-treatment period, reflecting a close match of the synthetic control to the actual values, with a clear and widening gap from 1999 onward. The graph suggests labour productivity would have had a substantially flatter trend if Sweden had joined the EMU. This is apparent in accompanying figure 2.1 which shows a largely increasing deviation with actual Sweden reaching a peak of 13.1% in excess of the synthetic control in 2006. Subsequently, the gap remains steady around 11%, reflecting a sustained loss in labour productivity had Sweden entered the monetary union.

The composition of the synthetic control unit changes slightly from the baseline to the best fit specification, but in an interesting way. In the former case, the synthetic control unit is composed of 0.4% Austria, 21% Italy, 56% Netherlands, and 23% Portugal, while in the latter case it is formed of 35% Italy, 46% Netherlands, and 19% Portugal. The importance of

[7] See http://www.stanford.edu/~jhain for more information and download support.

Netherlands as a constituent of the control unit in mimicking Sweden is noticeable, and not surprising given similarities in economic size and population of the two nations. The inclusion of Portugal in the synthetic control stems from its similarity to Sweden in terms of population size and to a certain extent inflation history, industry share of value added, and openness. Italy has had similar developments to Sweden in secondary- and tertiary school enrolment as well as agriculture share of value added.

4.2 Exports

In figure 1.2 actual and synthetic Sweden move harmoniously together as one line throughout the full pre-treatment period as well as past the 1999 treatment start. This prolonged co-movement during the first years of the euro suggests Sweden would have recorded roughly the same export amounts as a member of EMU than as a non-member. Around 2003 however, a gap between actual and synthetic Sweden emerges and the series remain separated for the remainder of the post-treatment period, indicating actual Swedish exports steadily exceeded the amounts that would have been recorded as a currency union member. Greater exports have a *ceteris paribus* positive effect on the trade balance. These results suggest that Sweden did not suffer trade discrimination and decreased exporting opportunities due to currency union non-membership as postulated by for example Micco et al. (2003).

Using the best fit specification, the RMSPE fell considerably and one may remark on how the control unit composition changes between the two specifications. The baseline specification features 29% Austria, 18% Belgium, 29% Finland, 5% Italy, and 19% Luxembourg, while the best fit composition includes 27.5% Belgium, 41.5% Finland, 18% Luxembourg, and 13% Spain. Due to geographical similarities it is not unexpected that the better fit specification includes a larger share of Finland with regards to exports. What is perhaps surprising is that Austria falls out and Spain enters. However, considering which variables constitute the best fit specification one sees that for example population, which Austria can better mimic, is

excluded, while inflation, which has been historically more similar to Spanish developments in the pre-treatment period, remains included.

4.3 Imports

Similar to exports, figure 1.3 displaying results for imports shows that the synthetic control follows the actual series closely throughout the pre-treatment period as well as into the post-treatment years, which is further evident in figure 2.3 illustrating the close difference between the actual and the synthetic series during the post-treatment period. This suggests Swedish imports would have been roughly the same whether or not Sweden was a member of EMU until the 2008 crisis. The gap that opens in the latter years of the 2000s suggests Swedish imports exceed the imports Sweden would have had as a currency union member, reaching a maximum of 5.2% in excess of the synthetic control in 2011, which coincides with a historical high as reported by Statistics Sweden. Greater import amounts have a *ceteris paribus* negative influence on the trade balance; however, following 2011 the gap shrinks again. During the substantial nominal appreciation of the euro against the SEK in 2009, actual Swedish imports did not decrease to a lower amount than what Sweden would have been recorded as an EMU member. The relative fall in imports is slightly greater for actual Sweden following the all-time peak observed in 2011, but despite this appreciation Sweden would have imported roughly the same amount whether it was in the currency union or not. Indeed, the import origins of Sweden include many non-euro countries, including Denmark, Norway, and United Kingdom, as well as non-European countries like China and the United States. This left Swedish imports less exposed to euro exchange rate fluctuations. The synthetic control unit is formed from 31% Belgium, 66% Finland, and 3% France, again a reflection of the economic similarities between Sweden and Finland, especially in terms of trade patterns.

4.4 Government Expenditure

The results of the synthetic counterfactual analysis of government expenditure may be viewed in figure 1.4. The dashed line, representing synthetic Sweden, moves near uniformly synchronous with actual Sweden in the pre-treatment period. As might be expected *a priori*, actual government spending exceeds that of the synthetic control in the 1991 recession as this idiosyncratic shock cannot be fully mimicked by the components of the control unit. From 1999 at the start of EMU, a clear and relatively wide gap between the synthetic and the actual series emerges, suggesting Swedish government expenditure would have been greater as a member of EMU than as a non-member. The additional public outlay is estimated to have been 11% greater in 2008, indicating a substantially increased need for expanded government expenditure at the onset of the crisis within the currency union than without it. Such expanded government expenditure would have needed to be financed through either (politically painful) fiscal measures or increased accumulation of public debt. In the absence of effective fiscal disciplinary tools and overall mechanisms promoting the convergence of economic developments, external imbalances emerge (De Grauwe and Ji, 2015).

The application of the iterative algorithm to analyse all covariate combinations yielded the greatest impact, to the magnitude of a 60% reduction in prediction error, for government expenditure. Regarding the composition of the synthetic control, the best fit specification included 12% Austria, 56% Belgium, 3% Germany, 9% Italy, and 19% Luxembourg, while in comparison, the baseline specification synthetic control was composed of 38% Belgium, 35% Finland, 7% France, 7% Italy, and 13% Luxembourg. As the number of elements in the covariate set falls to achieve the best fit specification, one may note that Austria and Germany enter, and countries like Italy and Luxembourg gain greater proportions of the control unit. This is due to similarities with the data recorded for Sweden, where for example Austria, with similar population numbers joins the synthetic control, while Italy that shares historical

similarities in terms of tertiary school enrolment and agriculture share in value added increases its share in the control as these variables remain in the best fit specification.

4.5 Investment

Figure 1.5 clearly demonstrates the difficulty in mimicking the response of one country's investment to its idiosyncratic business cycle fluctuations. To smooth these fluctuations, an unreported analysis was conducted using 5 year rolling averages of the covariates and investment data, not yielding significantly different interpretations. Finland, which experienced most similar variations, constitutes 43% of the synthetic control, while Netherlands corresponds to 17% and Portugal 40% of the comparison unit. The synthetic control is able to imitate the general trend, but not as closely as for the previously presented components of GDP. Investment in Sweden remains stunted following the recession of the early 1990s, subsequently reaching a higher peak in the crisis compared to the synthetic unit and faces a similar, albeit slightly deeper fall in 2009. Due to the high RMSPE it is difficult to make definite counterfactual statements regarding the effect of currency union membership on investment in Sweden. Nevertheless, one might suggest that Sweden undergoes a deeper fall in the 2008 crisis but recovers better than it would have as an EMU member. This claim is supported in figure 2.5, which shows actual Sweden falls 2.2% below its synthetic counterfactual in 2009, but then exceeds it substantially to the magnitude of 12% by 2010.

4.6 Consumption

Consumption is the only component of GDP for which the iterative process of examining covariate combinations fails to find a closer fit of the synthetic control to the actual series in the pre-treatment period. Therefore, the synthetic control composition remains unchanged as 20% France, 7% Luxembourg, and 73% Netherlands. Similar to investment, household consumption responds to idiosyncratic business cycle fluctuation, which complicates the

formation of a better fitting synthetic control. The 1991 recession and the sluggish recovery are apparent in the line, which cannot be well imitated by the synthetic control. This is reflected in figure 2.6, where it is evident that consumer confidence remained low for an extended period, hovering around 6% below the synthetic counterpart well into the 2000s. Nevertheless, figure 1.6 displays a continuously increasing gap between the actual and the synthetic series starting circa 2005, from which point it continues to grow and culminates at almost 13% in excess of the synthetic control, suggesting consumption would have been substantially lower as an EMU member by 2013.

5. Inference and Robustness

The SCM literature speaks primarily of two types of "placebo" testing for inference; in-space and in-time (see for example Abadie et al., 2010; 2015). These tests aim at verifying the method's ability to accurately reflect the effect of the treatment in isolation by assigning treatment to each of the donor pool countries and to an arbitrary point in time prior to actual treatment, respectively. This inference testing is followed by a robustness analysis of using different geographical regions of the euro area as alternative donor pools.

5.1 Placebo In-Space

Placebo in-space testing consists of applying the SCM to all donor countries to assess whether sizable differences may be found between the actual donor country and its corresponding synthetic control. The result of the test is illustrated in a figure plotting the distribution of actual to synthetic differences for all the donor pool countries in addition to Sweden. If the graph for Sweden lies well within the spectrum of donor pool country graphs, there may be reason to believe the original synthetic counterfactual analysis fails to capture a significant treatment effect as it suggests donor pool countries, which did not undergo treatment display greater treatment effects than Sweden which did undergo treatment. Each of the donor pool countries

can only be composed of a combination of the other remaining donor pool countries, which, due to the restricted donor pool, renders it statistically challenging to form an appropriate synthetic control for some donor pool countries, e.g. France and Germany. This results in poorly fitting synthetic controls with very high RMSPEs that distort the figures by wrongfully suggesting large treatment effects, while rather being reflections of statistical inadequacy in forming a better control. Indeed, a large RMSPE, and large deviations of the synthetic to the actual control, are not indicative of a large treatment effect if also the RMSPE prior to treatment is large, which holds for many countries in the subsequent analysis. To avoid this erroneous distortive interpretation, such countries are excluded from the graph as suggested by Abadie et al. (2015).

Indeed, in most analyses, Germany, France, and Portugal display such poor fits, to the magnitude of ten or even up to fifty times the RMSPE of Sweden, that they were subsequently removed from the figures.[8] Furthermore, due to the unique economic profile of Luxembourg the statistical analysis failed to find a stable solution in four out of six cases, while in the remaining two cases unreasonably high RMSPEs were found, leading to the exclusion of Luxembourg from all analyses. Overall, the limited donor pool often is not successful in producing synthetic controls of comparable fits to that of Sweden. Nonetheless, the plot of the difference between the synthetic and actual Sweden lies, by and large, on the external boundary of the donor country plots. This adds validity to the original results in suggesting that Sweden, which did undergo treatment, displays greater treatment effects than the donor pool countries which did not undergo treatment.

[8] See figures 3.1 – 3.6 and corresponding RMSPEs in tables 3.1 – 3.6, where Sweden appears in black in the figures and in bold in the tables for emphasis.

5.2 Placebo In-Time

The intuition for the placebo in-time test is as follows. If the synthetic control has been appropriately constructed, then assigning a hypothetical earlier treatment starting point should still yield a close co-movement of the two series, the actual and the synthetic, until 1999 when the euro was actually introduced. Observing a sizable deviation of the synthetic from the actual series following this artificial treatment start would undermine the results obtained in the original analysis with treatment starting in 1999 as it would suggest the counterfactual is capturing some treatment effect other than that of EMU membership.[9]

Specifically, the placebo in-time tests consist of executing the synthetic counterfactual analysis over the period 1971 – 1998, with an artificial treatment date set at 1985 in all cases except labour productivity where 1990 was used due to pre-treatment starting in 1980. Unreported findings with the treatment set at 1980 display similar results. There is no evidence of a significant divergence occurring at 1985 in any of the figures presented (see figures 4.1 – 4.6), which adds validity to the original analysis and suggests that the effect recorded by the synthetic control from 1999 onward is caused by EMU. A degree of deviation may be observed in the early 1990s, which follows naturally from the inability of the donor pool countries in mimicking the idiosyncratic shocks experienced by Sweden in this period and should not be interpreted as significant weakening of original results.

5.3 Alternative Donor Pools

As a robustness check one may apply alternative donor pool specifications of different geographical areas, which allows for the assessment of how results are driven by certain regions

[9] See Heckman and Holz, 1989 for a related discussion.

and how this affects control unit composition as well as the fit in terms of RMSPE. This study will consider the following alternative donor pools; North, South, and Central.

The North donor pool, consisting of Finland, Germany, Ireland, and Netherlands clearly demonstrates the similarity of Finland and Netherlands to Sweden and their respective importance in contributing to the synthetic control (see table 4.1). Finland experienced a similar recession in 1991 and has been subject to comparable economic fluctuations as Sweden, therefore functioning as an appropriate control unit for mimicking Sweden. This is evident in the analysis of imports and government expenditure where Finland represents 78% and 87% respectively of the synthetic control. Likewise, the Netherlands assumes a remarkable 99% of the synthetic control for investment and 82% for consumption. Ireland generally does not feature as a donor country of importance in these analyses, nor does it feature in any of the original studies, which may have been expected given the dissimilar historical and economic developments in Sweden and Ireland.

The South donor pool, consisting of France, Italy, Portugal, and Spain, displays the overall worst results in terms of fit (see table 4.2). The southern countries differ substantially from Sweden in many regards, economically and politically, thus one may have also *a priori* expectations of a poorer synthetic control fit based on these countries. Spain, with one exception, does not feature in any analysis and does not generally constitute a prominent part in the synthetic control of the original analyses. Nevertheless, France shares some similarities, in particular with respect to investment and consumption data. For example, the synthetic control for investment in the baseline original analysis is composed solely of France. Furthermore, Portugal functions as a prominent synthetic control contributor given its similarity in terms of population size as well as, to a lesser degree inflation history, industry share in value added, and openness.

As a summary, given their similarities in terms of economic profile and developments over time, Austria, Belgium, Finland, and Netherlands feature prominently in the synthetic control unit for Sweden.

6. Conclusion

This paper has aimed to shed light on the economic costs and benefits of the important irreversible policy decision to join the European Monetary Union faced by European Union members outside the euro. Exchange rate stability, enhanced trading opportunities, lower interest rates, and greater output are some of the potential benefits associated with accession. Potential costs include repercussions due to loss of independent monetary and budgetary policies, as well as the inability to enhance competitiveness through currency devaluation. We apply the innovative synthetic counterfactual method of estimation that allows for the comparison of actual Sweden, which did not join the monetary union, to a hypothetic Sweden, composed of a statistically derived weighted average of the original euro area countries, which did join. A novelty in the utilisation of this estimation method is the application of an iterative algorithm to assess each possible combination of predictor variables of productivity and the GDP components to obtain the closest fit of the synthetic series to the actual series. In the case of government expenditure the iterative method resulted in a 60% improvement in fit in terms of reduced prediction error.

Sweden would have borne non-trivial costs from EMU membership, exemplified by 10-12% lower labour productivity, 10% lower exports, and 7% greater government expenditure for the year 2013, following from greater peaks in the crisis years. This result conforms to previous literature where Mazumder and Pahl (2012) find that the United Kingdom would have had higher unemployment and lower output had it joined the EMU in 1999 and Manasse et al.

(2014) who suggest that Italy would have fared better outside of the EMU in terms of augmented labour productivity.

The estimated costs associated with EMU membership may be due to shortcomings, or "design flaws" of this union. However, in light of significant recent reforms and the implementation of policies and institutions such as the Banking Union, the European Stability Mechanism, as well as the Single Supervisory Mechanism and Single Resolution Mechanism, some of these shortcomings have been corrected such that the net balance of economic costs and benefits of EMU membership may have shifted. Thus, although the analysis uncovers costs until 2013, it is not certain it would not be economically beneficial to join the EMU presently. Assessment of whether the recent measures have been successful in resolving the shortcomings and yield economic benefits of currency union membership is left for future research.

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8. Tables and Figures

Table 1: Fit Improvement from Iterative Covariate Combination Analysis

	Labour Productivity		Exports		Imports		Government		Investment		Consumption	
	Baseline	Best Fit	Baseline	Best Fit	Baseline	Best Fit	Baseline	Best Fit	Baseline	Best Fit	Baseline	Best Fit
RMSPE	0.61	0.60	3.81	2.90	4.45	3.82	3.16	1.26	58857.5	41638.4	899.67	899.67
Fit Gain		1.64%		23.88%		14.16%		60.12%		29.26%		0%

Notes: By applying the synthetic control method iteratively using an algorithm to analyse every possible combination of variables, from the full set specification to a minimum of three variables, table 1 reports the lowest root mean squared prediction errors (RMSPEs) found. The RMSPEs for labour productivity are reported in constant 2005 USD GDP per worker per hour worked. The RMSPE for investment and consumption are reported in constant 2005 USD per capita. The RMSPE for exports, imports, and government expenditure are reported in billions constant 2005 USD.

Table 2: Covariates

	Labour Productivity		Exports		Imports		Government		Investment		Consumption	
	Baseline	Best Fit	Baseline	Best Fit	Baseline	Best Fit	Baseline	Best Fit	Baseline	Best Fit	Baseline	Best Fit
GDP per capita	✓		✓	✓	✓	✓	✓		✓		✓	
Investment share GDP	✓	✓	✓		✓	✓	✓	✓	✓		✓	✓
Population	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓
Population Growth	✓	✓	✓		✓	✓	✓		✓	✓	✓	
Secondary School Enrolment	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	
Tertiary School Enrolment	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	
Inflation	✓		✓	✓	✓		✓	✓	✓		✓	
Industry share VA	✓		✓	✓	✓	✓	✓		✓	✓	✓	
Agriculture share VA	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓
Openness	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	
Terms of Trade	✓	✓	✓		✓	✓	✓		✓	✓	✓	
Export Price Level			✓									
Import Price Level					✓	✓						
Real Exchange Rate					✓	✓						
Population < 14 yrs							✓	✓				
Population > 65 yrs							✓	✓			✓	
Years of Schooling									✓			
FDI in									✓			
Real interest rate											✓	✓

Table 3.1: Labour Productivity Placebo In-Space RMSPE

Donor Pool Country	RMSPE[a]
Austria	*0.397*
Belgium	1.650
Finland	*0.349*
France	2.686
Ireland	1.113
Italy	*0.483*
Luxembourg	-
Netherlands	*0.487*
Portugal	5.141
Spain	*0.454*
Sweden	**0.600**

[a] Constant 2005 USD per hour worked per worker.

Table 3.2: Exports Placebo In-Space RMSPE

Donor Pool Country	RMSPE[b]
Austria	131
Belgium	38.0
Finland	91.4
France	101
Germany	263
Ireland	10.2
Italy	17
Luxembourg	45.8
Netherlands	*6.09*
Portugal	76.8
Spain	56.0
Sweden	**2.90**

[b] Billions, constant 2005 USD.

Table 3.3: Imports Placebo In-Space RMSPE

Donor Pool Country	RMSPE[b]
Austria	19.7
Belgium	*5.0*
Finland	9.3
France	7.3
Germany	-
Ireland	5.3
Italy	10.5
Luxembourg	-
Netherlands	6.7
Portugal	29.4
Spain	15.7
Sweden	**3.82**

[b] Billions, constant 2005 USD.

Table 3.4: Government Expenditure Placebo In-Space RMSPE

Donor Pool Country	RMSPE[b]
Austria	2.0
Belgium	1.7
Finland	*1.5*
France	62.3
Germany	57.2
Ireland	4.8
Italy	16.0
Luxembourg	-
Netherlands	1.7
Portugal	8.1
Spain	8.9
Sweden	**1.26**

[b] Billions, constant 2005 USD.

Table 3.5: Investment Placebo In-Space RMSPE

Donor Pool Country	RMSPE[c]
Austria	42 644.9
Belgium	*32 293.6*
Finland	119 346.9
France	*34 882.9*
Germany	*32 216.3*
Ireland	91 592.4
Italy	*27 215.4*
Luxembourg	-
Netherlands	45 731.7
Portugal	151 991.8
Spain	49 325.9
Sweden	**41 638.4**

[c] Per capita constant 2005 USD.

Table 3.6: Consumption Placebo In-Space RMSPE

Donor Pool Country	RMSPE[c]
Austria	1548.2
Belgium	3572.4
Finland	1845.5
France	3417.6
Germany	*773.3*
Ireland	3111.2
Italy	1166.1
Luxembourg	6723.2
Netherlands	*892.9*
Portugal	5367.6
Spain	3384.7
Sweden	**899.7**

[c] Per capita constant 2005 USD.

Table 4.1: Best Fit North Donor Pool

	Labour Productivity	Exports	Imports	Government	Investment	Consumption
RMSPE	1.24[a]	4.13[b]	4.51[b]	2.70[b]	96381.01[c]	1033.14[c]
Finland	0	59.2	77.6	87.2	1.3	0
Germany	-	1.5	4.4	12.8	0	18.4
Ireland	38.7	16.7	0	0	0	0
Netherlands	61.3	22.6	18	0	98.7	81.6

Notes: Table 4.1 displays the percentage composition of the synthetic control for labour productivity and the components of GDP as described in the text, using a regional donor pool specification of Finland, Germany, Ireland, and Netherlands, for the best fit specification of variables. [a] Constant 2005 USD per hour worked per worker. [b] Billion, constant 2005 USD. [c] Per capita, constant 2005 USD.

Table 4.2: Best Fit South Donor Pool

	Labour Productivity	Exports	Imports	Government	Investment	Consumption
RMSPE	0.94[a]	4.84[b]	8.46[b]	5.40[b]	45740.6[c]	1058.15[c]
France	56.7	15.3	18.8	0	64.4	100
Italy	17.6	4.3	0	23.1	4.3	0
Portugal	25.7	80.4	81.2	76.9	0	0
Spain	0	0	0	0	31.3	0

Notes: Table 4.2 displays the percentage composition of the synthetic control for labour productivity and the components of GDP as described in the text, using a regional donor pool specification of France, Italy, Portugal, and Spain, for the best fit specification of variables. [a] Constant 2005 USD per hour worked per worker. [b] Billion, constant 2005 USD. [c] Per capita, constant 2005 USD.

Table 4.3: Best Fit Central Donor Pool

	Labour Productivity	Exports	Imports	Government	Investment[d]	Consumption
RMSPE	0.89[a]	4.86[b]	5.82[b]	1.70[b]	101804.7[c]	909.95[c]
Austria	62.9	89.9	80	0	7.8	0
Belgium	0	0	0	80.4	0	0
Germany	0	0	0	2.7	0	0
Luxembourg	0	3.5	10.4	0	0	8.4
Netherlands	37.1	6.6	9.6	16.9	92.2	91.6

Notes: Table 4.3 displays percentage composition of the synthetic control for labour productivity and the components of GDP as described in the text, using a regional donor pool specification of Austria, Belgium, Germany, Luxembourg, and Netherlands, for the best fit specification of variables. [a] Constant 2005 USD per hour worked per worker. [b] Billion, constant 2005 USD. [c] Per capita, constant 2005 USD. [d] Using baseline specification as best fit results were unstable.

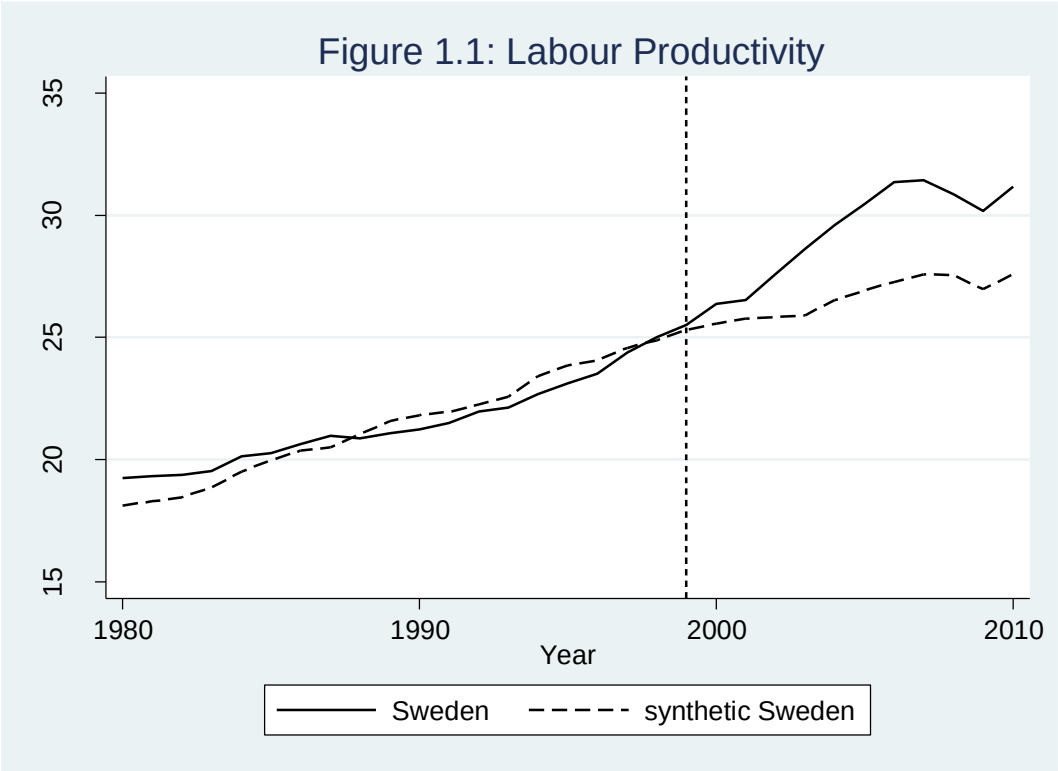
Figure 1.1: Labour Productivity
35
30
25
20
15
1980
1990
2000
2010
Year
Sweden
synthetic Sweden

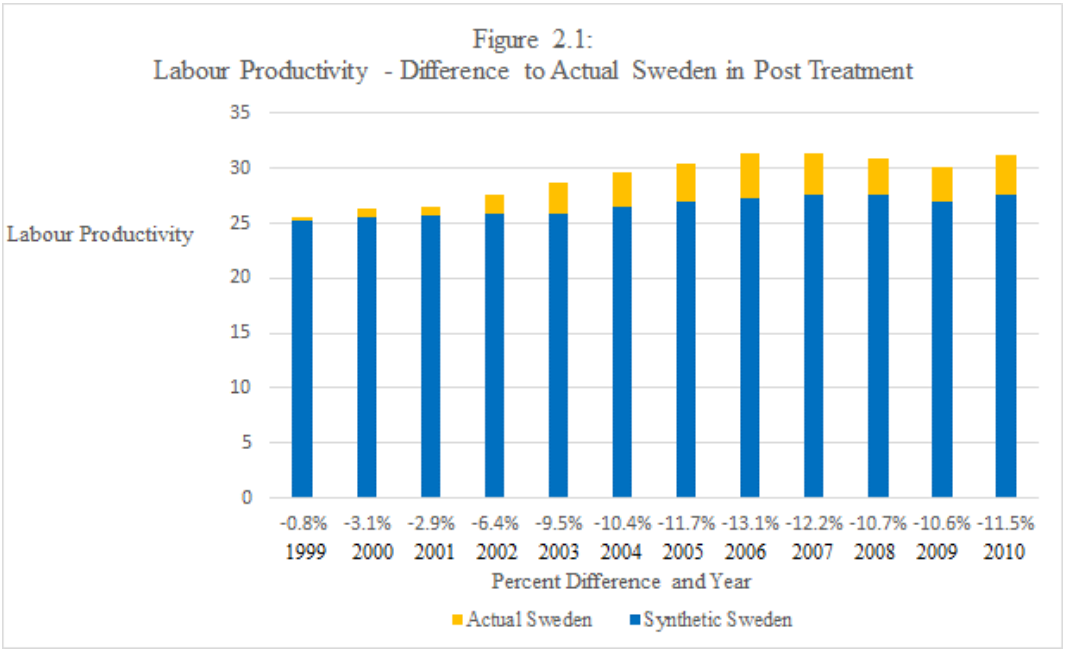
Figure 2.1:
Labour Productivity - Difference to Actual Sweden in Post Treatment
Labour Productivity
35
30
25
20
15
10
5
0
-0.8% -3.1% -2.9% -6.4% -9.5% -10.4% -11.7% -13.1% -12.2% -10.7% -10.6% -11.5%
1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010
Percent Difference and Year
Actual Sweden
Synthetic Sweden

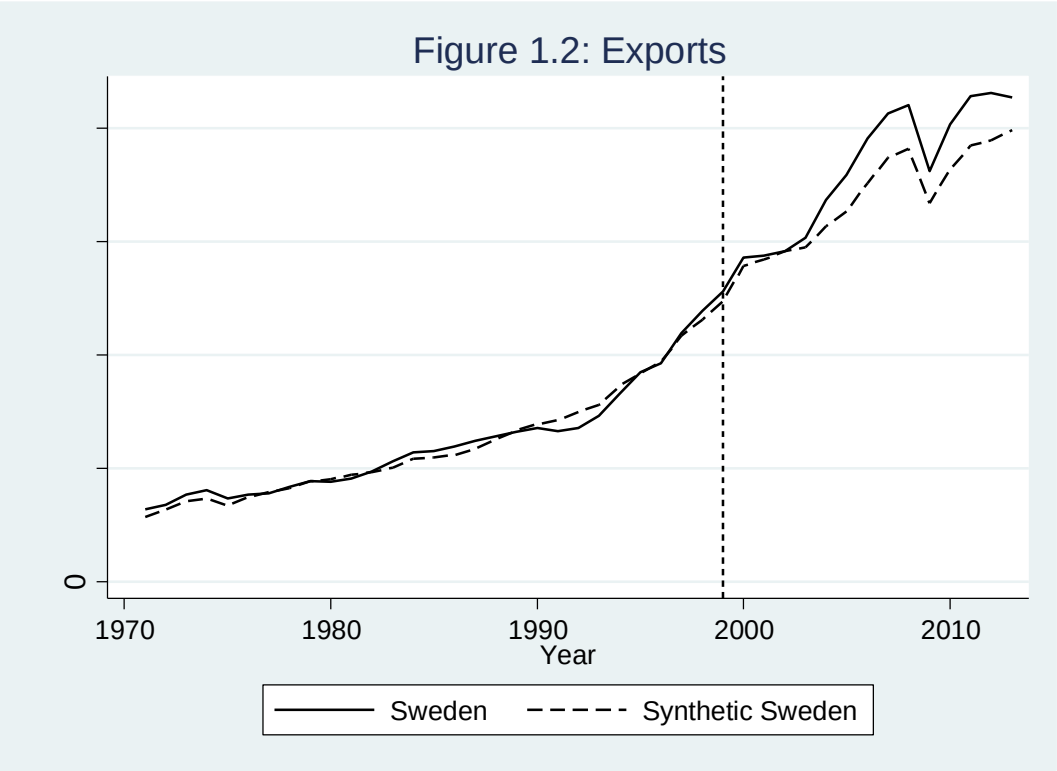
Figure 1.2: Exports
0
1970
1980
1990
2000
2010
Year
Sweden
Synthetic Sweden

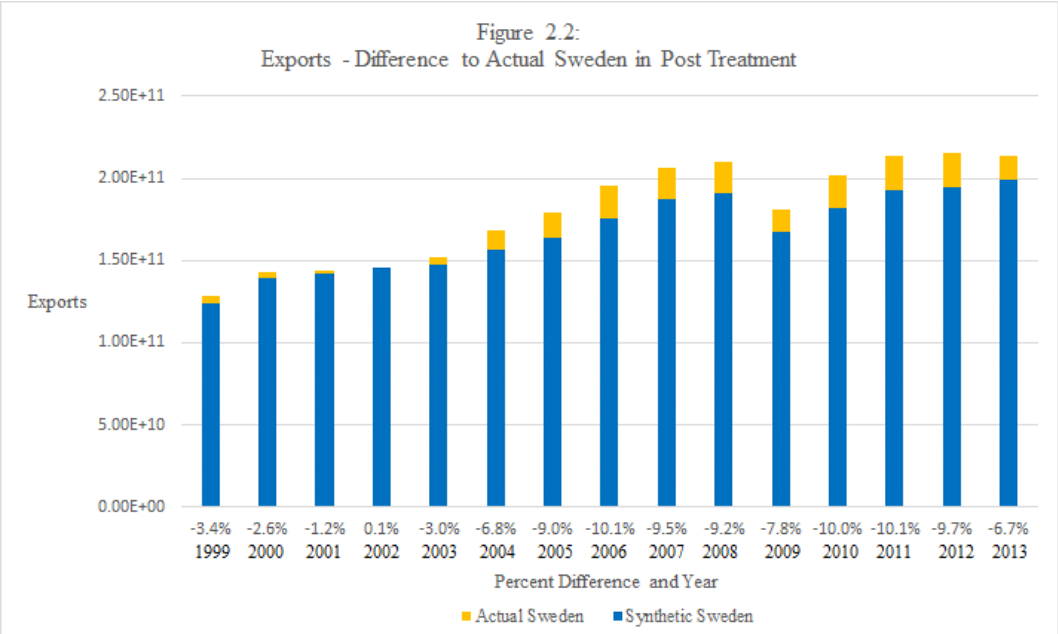
Figure 2.2:
Exports - Difference to Actual Sweden in Post Treatment
2.50E+11
2.00E+11
1.50E+11
1.00E+11
5.00E+10
0.00E+00
Exports
-3.4% -2.6% -1.2% 0.1% -3.0% -6.8% -9.0% -10.1% -9.5% -9.2% -7.8% -10.0% -10.1% -9.7% -6.7%
1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013
Percent Difference and Year
Actual Sweden
Synthetic Sweden

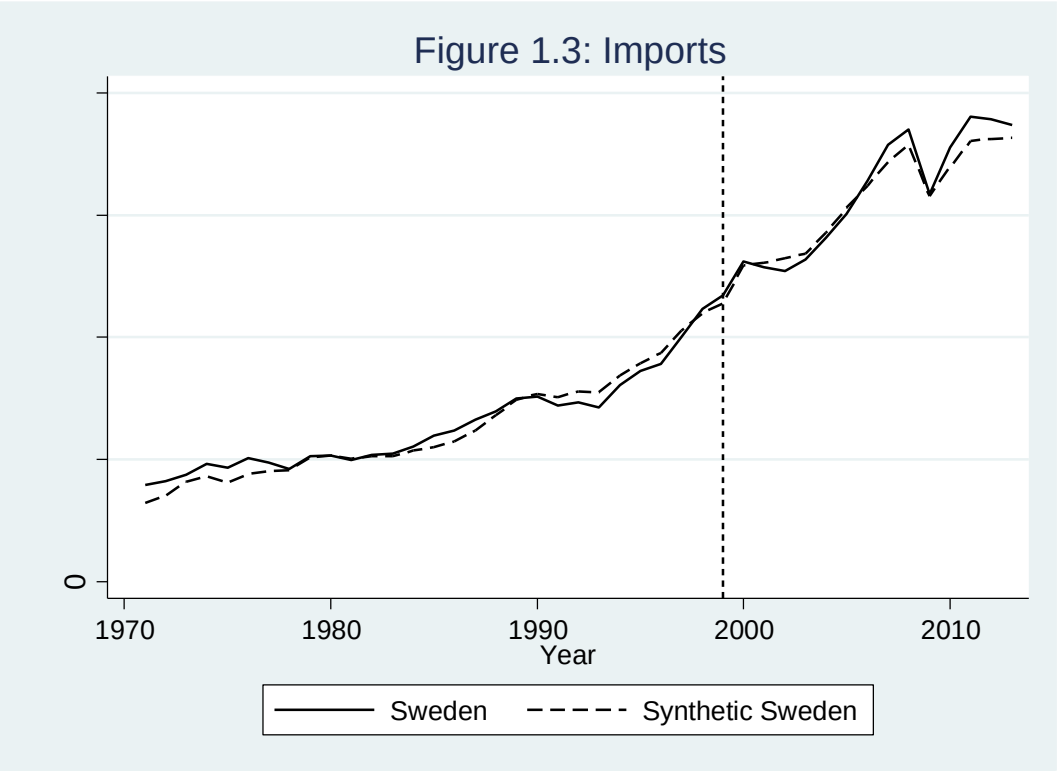
Figure 1.3: Imports
0
1970
1980
1990
2000
2010
Year
Sweden
Synthetic Sweden

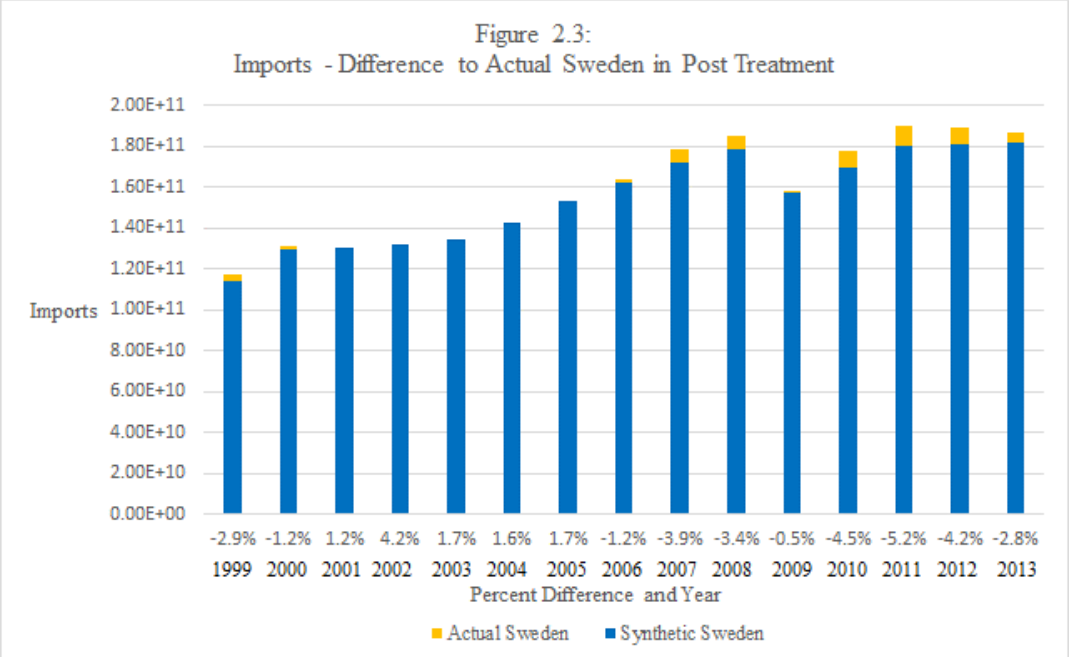
Figure 2.3:
Imports - Difference to Actual Sweden in Post Treatment
Imports
2.00E+11
1.80E+11
1.60E+11
1.40E+11
1.20E+11
1.00E+11
8.00E+10
6.00E+10
4.00E+10
2.00E+10
0.00E+00
-2.9% -1.2% 1.2% 4.2% 1.7% 1.6% 1.7% -1.2% -3.9% -3.4% -0.5% -4.5% -5.2% -4.2% -2.8%
1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013
Percent Difference and Year
Actual Sweden
Synthetic Sweden

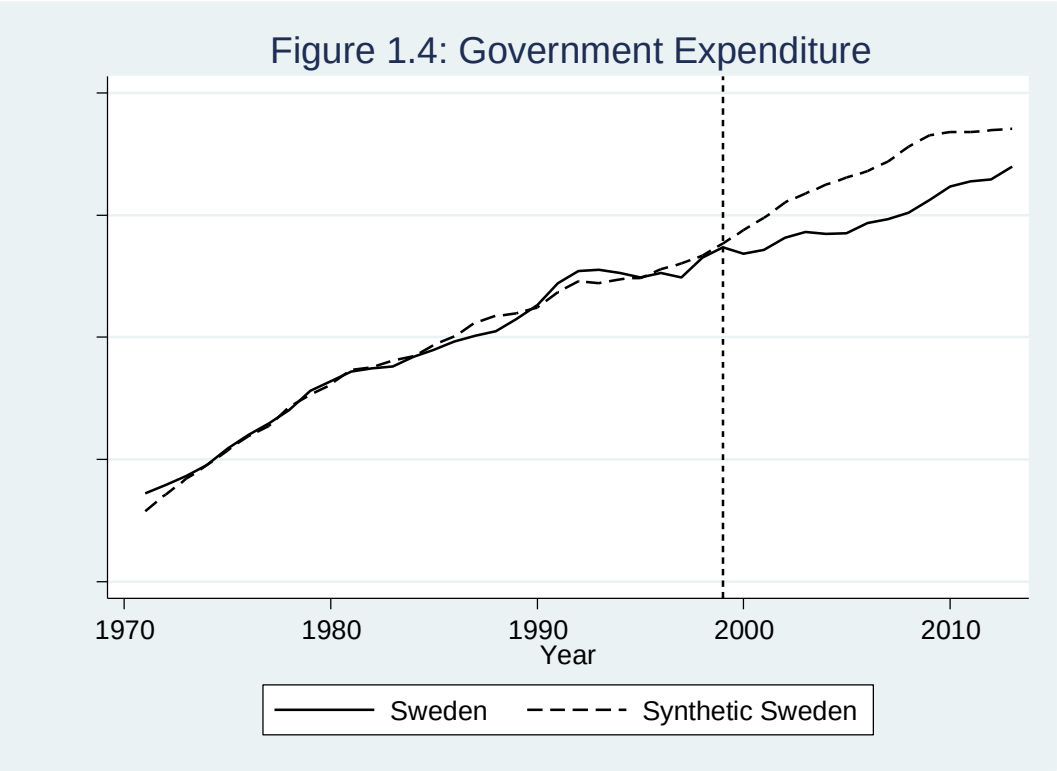
Figure 1.4: Government Expenditure
1970
1980
1990
2000
2010
Year
Sweden
Synthetic Sweden

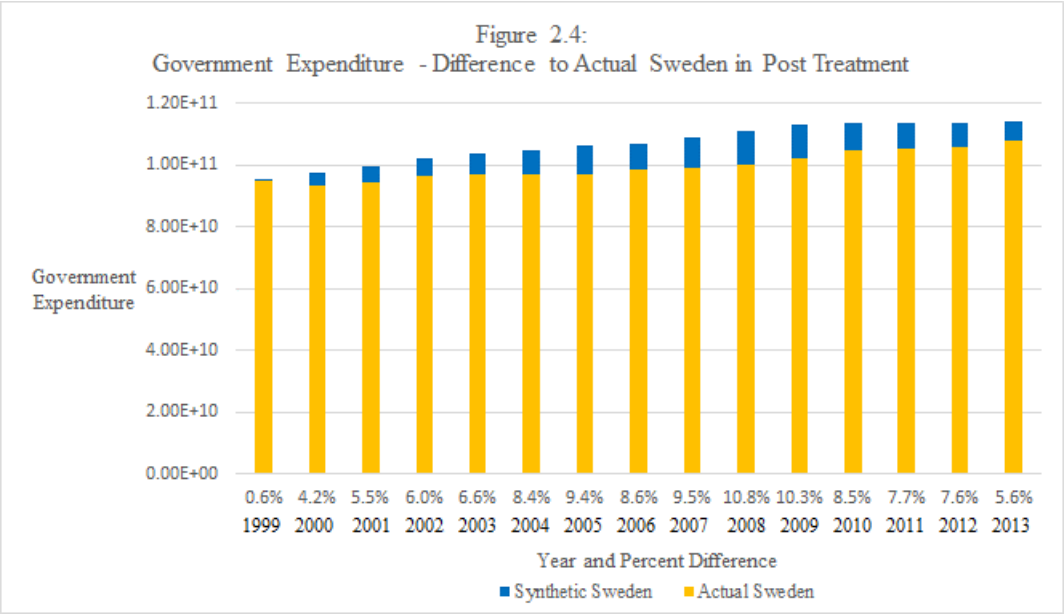
Figure 2.4:
Government Expenditure - Difference to Actual Sweden in Post Treatment
1.20E+11
1.00E+11
8.00E+10
6.00E+10
4.00E+10
2.00E+10
0.00E+00
Government Expenditure
0.6% 4.2% 5.5% 6.0% 6.6% 8.4% 9.4% 8.6% 9.5% 10.8% 10.3% 8.5% 7.7% 7.6% 5.6%
1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013
Year and Percent Difference
Synthetic Sweden
Actual Sweden

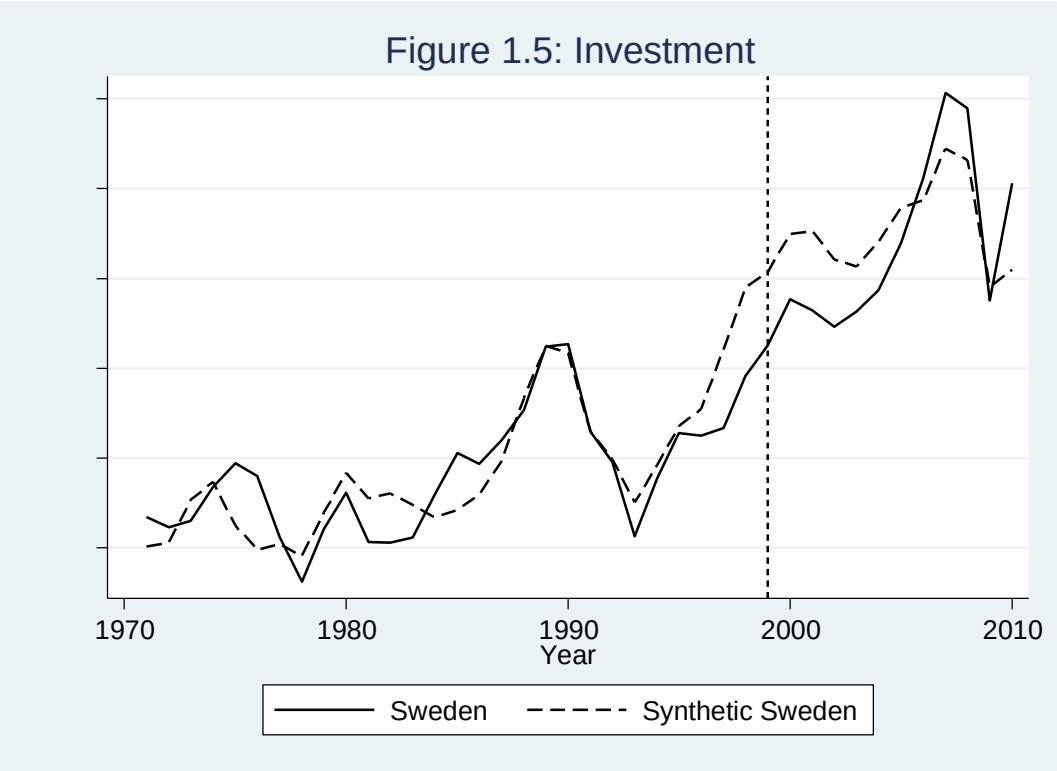
Figure 1.5: Investment
1970
1980
1990
2000
2010
Year
Sweden
Synthetic Sweden

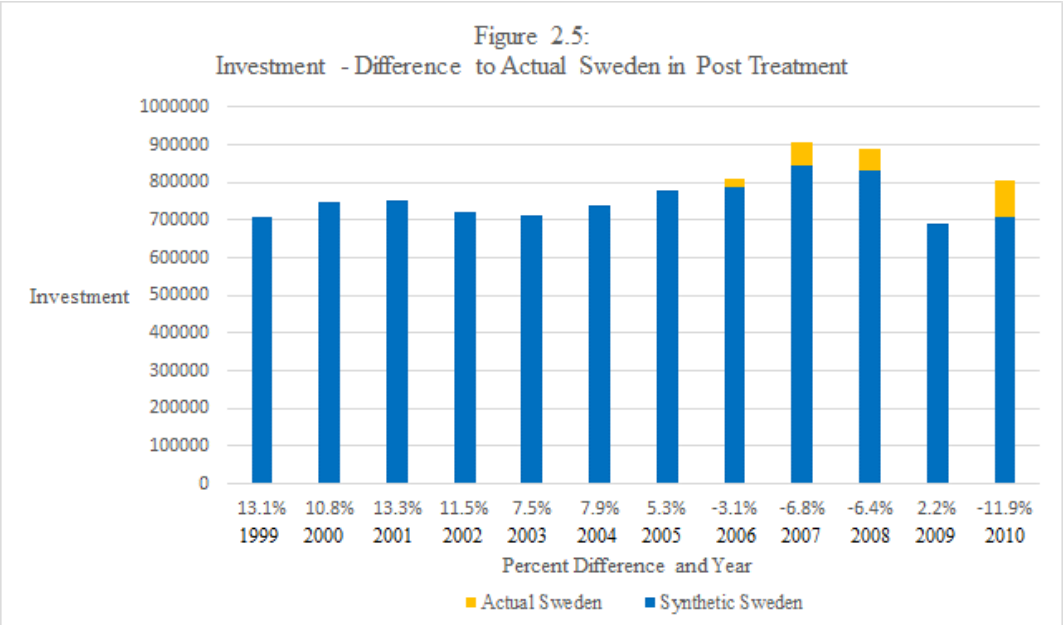
Figure 2.5:
Investment - Difference to Actual Sweden in Post Treatment
Investment
1000000
900000
800000
700000
600000
500000
400000
300000
200000
100000
0
13.1%
10.8%
13.3%
11.5%
7.5%
7.9%
5.3%
-3.1%
-6.8%
-6.4%
2.2%
-11.9%
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
Percent Difference and Year
Actual Sweden
Synthetic Sweden

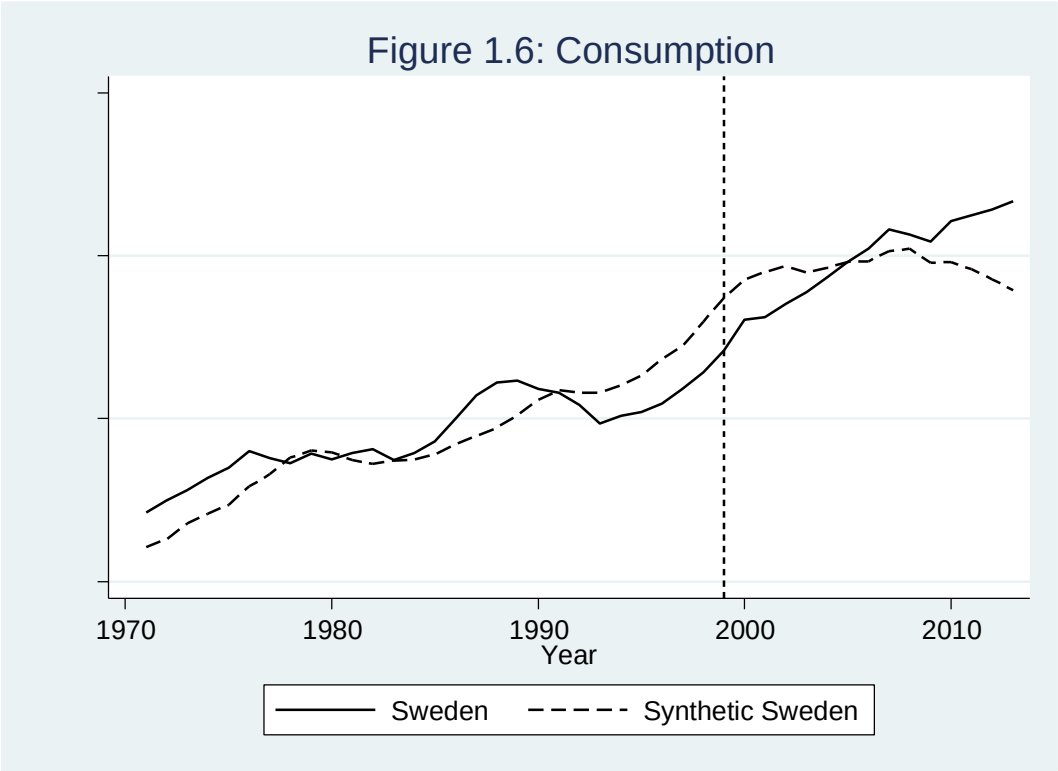
Figure 1.6: Consumption
1970
1980
1990
2000
2010
Year
Sweden
Synthetic Sweden

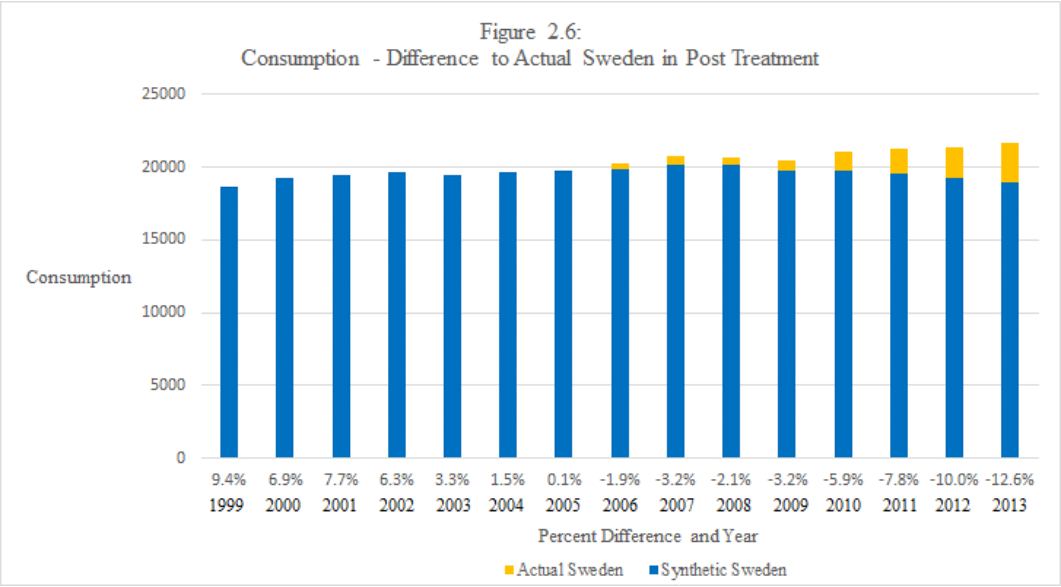
Figure 2.6:
Consumption - Difference to Actual Sweden in Post Treatment
Consumption
25000
20000
15000
10000
5000
0
9.4% 6.9% 7.7% 6.3% 3.3% 1.5% 0.1% -1.9% -3.2% -2.1% -3.2% -5.9% -7.8% -10.0% -12.6%
1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013
Percent Difference and Year
Actual Sweden
Synthetic Sweden

Figure 3.1:
Labour Productivity Placebo In-Space

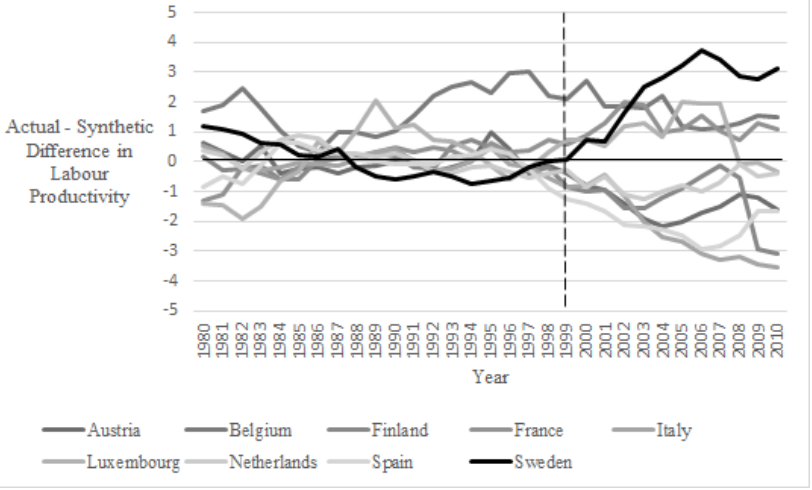

Figure 3.2:
Exports Placebo In-Space

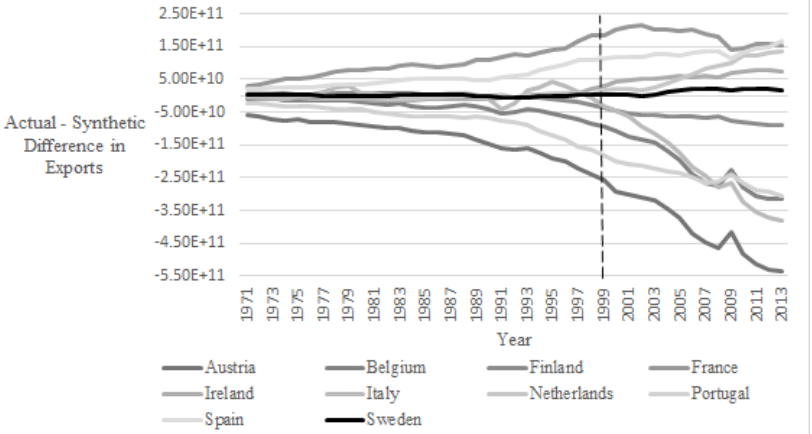

Figure 3.3:
Imports Placebo In-Space

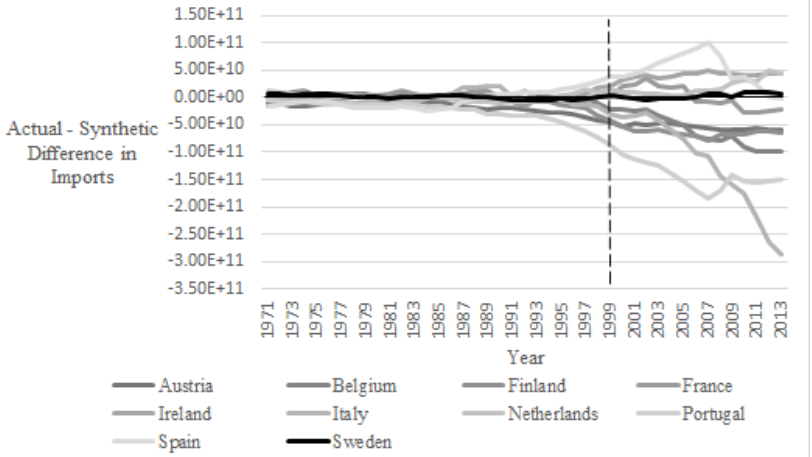

Figure 3.4:
Government Placebo In-Space

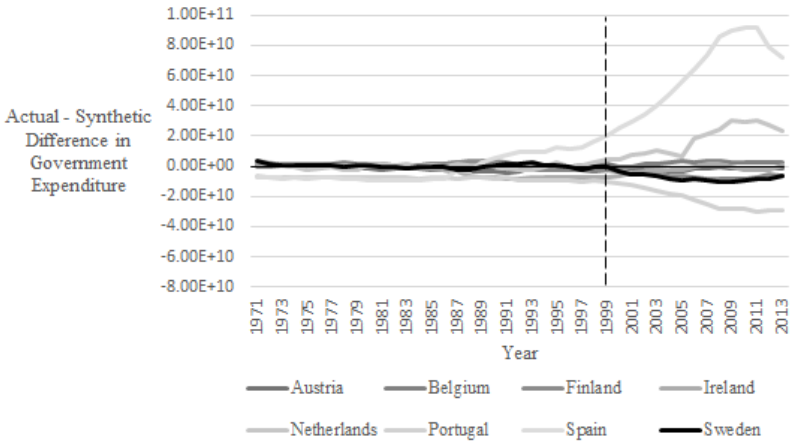

Figure 3.5:
Investment Placebo In-Space

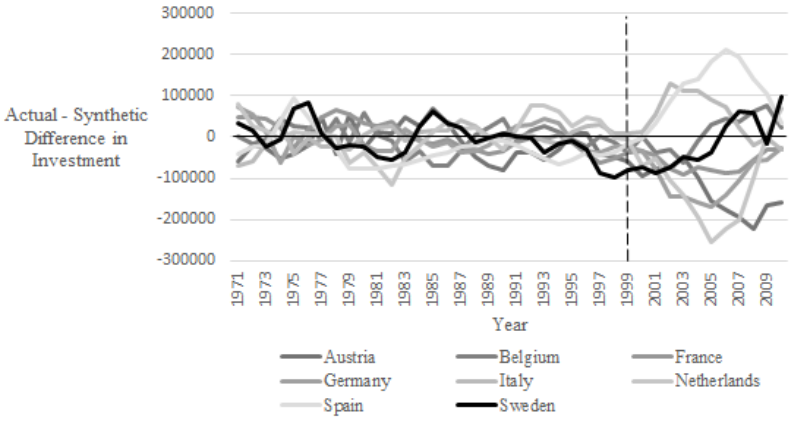

Figure 3.6:
Consumption Placebo In-Space

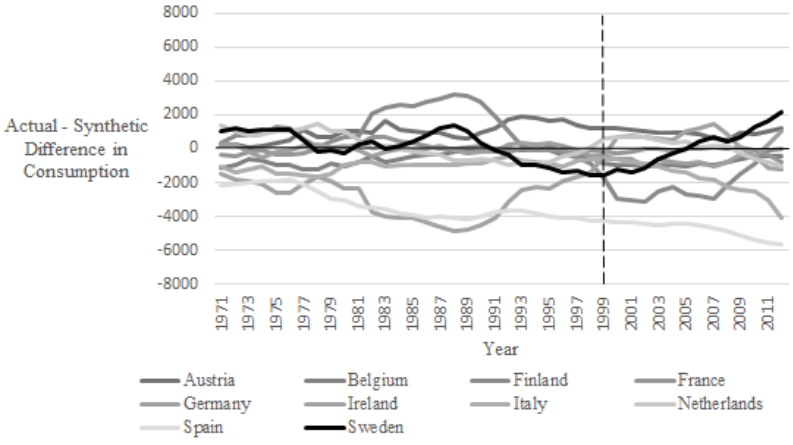

Figure 4.1: Labour Productivity Placebo In-Time

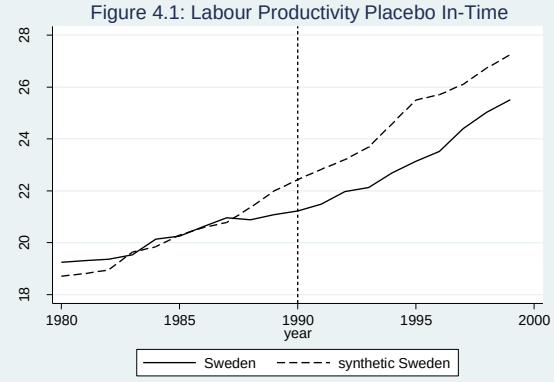

Figure 4.2: Exports Placebo In-Time

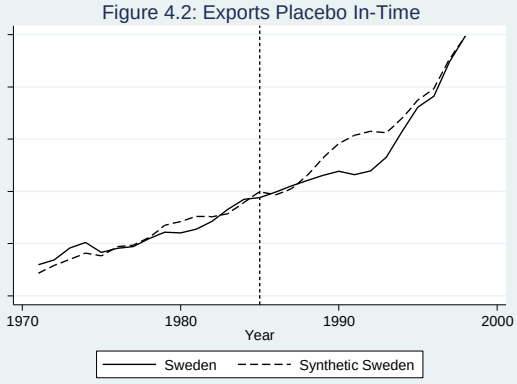

Figure 4.3: Imports Placebo In-Time

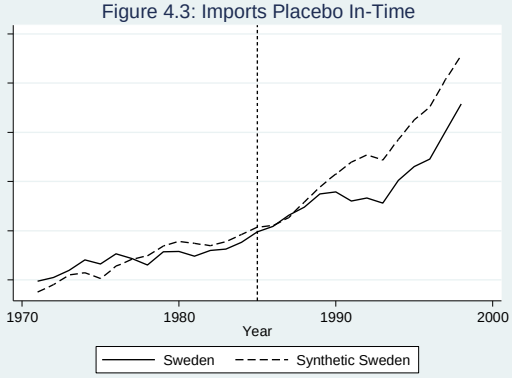

Figure 4.4: Government Expenditure Placebo In-Time

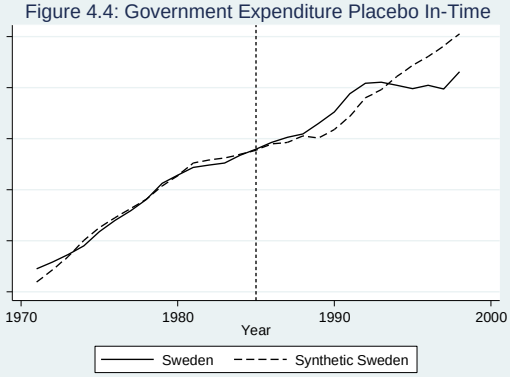

Figure 4.5: Investment Placebo In-Time

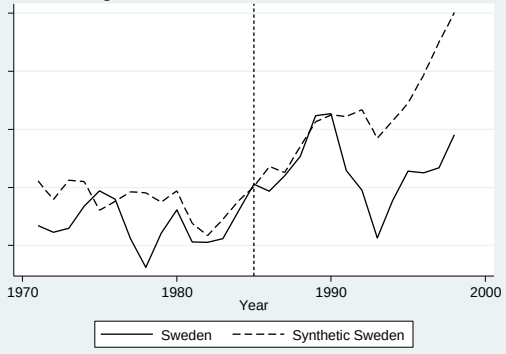

Figure 4.6: Consumption Placebo In-Time