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# The Effect of a Free Trade Agreement with the United States on Member Countries' per capita GDP: A Synthetic Control Analysis

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**Abstract**

This study employs the synthetic control method (SCM) to estimate the economic effects of signing free trade agreements (FTAs) with the United States. This method allows for a counterfactual –the country's per capita GDP had it not signed a FTA–, which can be compared with the observed per capita GDP. This difference speaks to the causal impact of the FTA. We principally find that FTAs seem to have a heterogeneous impact. In particular, there is evidence that signing a FTA with the U.S. had a positive impact on Chile and Jordan's per capita GDP and that NAFTA harmed Mexico's per capita GDP. In several other cases, no significant economic impact is discernible. Besides, the more a country depends on the U.S. for its trade, the less beneficial signing a FTA with the U.S. is. This article contributes to the debate on the effectiveness of trade as a development strategy. In particular, the SCM opens up the possibility of a "case-by-case" analysis, ultimately revealing that a FTA with the U.S.–a country situated at the world's technology frontier–has heterogeneous outcomes and, by itself, does not guarantee economic development (obtained through a higher per capita GDP).

**Keywords:** International Linkages to Development, Comparative Studies, Free Trade Agreement, Impact Evaluation, Synthetic control method.

**JEL codes:** O19, O57, F43, F14, F15

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# 1 Introduction

This article aims to evaluate the impact of signing a free trade agreement (FTA) on per capita gross domestic product (GDPPC). Although the immediate objective of an FTA is to increase trade between the signatory countries (Dür et al. 2014), from the perspective of evaluating public policy, it is crucial to evaluate its impact on citizens' well-being, and the GDPPC is a better measure of a said impact than measures that pertain to trade alone.

In particular, we focus on the GDPPC of the 20 countries that have signed an FTA with the United States. This focus is motivated by the fact that the U.S. is the biggest, most developed economy in the world and has signed the most extensive trade agreements of any country. North-South agreements tend to be the most extensive, whereas South-South agreements tend to be the least far-reaching (Dür et al. 2014). Hence, this study helps shed light on the development effects of North-South agreements for Southern (developing) countries.

## 1.1 North-South Agreements

Since Ethier's (1998) seminal work, the literature on North-South agreements has focused on evaluating "new regionalization" and how trade has contributed to it. However, Ethier (1998) explains that the results of studying whether regionalism helps or hinders multilateral trade are mixed: Some results demonstrate trade creation, while others show trade diversion. Ethier (1998, 2001) explains the many stages of "old regionalism" under which, during the 1950s and 1960s, many countries tried to integrate without success. Yet, in the late 1980s, everything changed, and an emerging world economy based on trade ignited interest in integration. Ethier (2001) focuses on regional treaties in the geographical sense, but, as we will see below, not all treaties are regional.

On the contrary, most of the treaties that the U.S. has signed are with countries that do not share a border with the U.S.; yet, this has not made them more or less successful. The only exceptions are Canada and Mexico, which signed NAFTA (the North American Free Trade Agreement) in 1993. Ethier (1998) purported that this trade liberalization would mainly benefit Mexico, but the results of later analysis do not pan out that way since Mexico's GDPPC did not improve post-NAFTA.

On the other hand, Chafuffor and Maur (2011) mention that the dynamics of preferential trade agreements (PTAs) –North-South, South-South and North-North–, differ considerably. Nevertheless, North-South PTAs are on the rise since many developing countries have started to make agreements with developed countries, especially cross-regional ones. Thus, given that the U.S. has predominately signed onto North-South agreements over the last four decades, the FTAs that this study will analyze are mainly of this kind. Some scholars speculate that the U.S. has taken this course of action based on the idea that this type of agreement benefits the North's welfare at the expense of the South (Escobar-Andrae 2011). The only North-North agreement that the U.S. signed in this time frame corresponds to a 1986 agreement with its northern neighbour, Canada.

Finally, it is reasonable to assume that countries that sign a FTA with the U.S. are lagging in all or almost all sectors that generate growth; according to the Schumpeterian theory, sectors intensive in human capital, which depend on innovation and technology, must innovate to survive.[1] The U.S. is on the world's technology frontier, and almost all agreements with the U.S. are North-South; thus, if a developing country signs a FTA with the U.S., consideration of previous reforms to incentivize innovation are particularly relevant. Therefore, this study concentrates on the U.S. not on a whim or to test a particular method (the SCM in this case), but because the U.S. is an innovation leader. It does not seek to measure the impact of FTAs on a country's growth per se but instead intends to measure said impact when a FTA is signed with an innovation leader like the U.S.

## 1.2 Trade and economic growth

For trade to promote economic development, through a higher per capita GDP, it should facilitate technological progress absorption from the rest of the world (Edwards 1993). In particular, modern growth theories purport that improving aggregate factor productivity in a signatory country is a precondition for a FTA to engender increased growth therein. Endogenous growth models emphasize the role of innovation and technological improvement as crucial sources of long-term

[1]We discuss the effect of trade on innovation and technological improvements, in-depth, in the following section.

productivity improvements. Aghion & Howitt (2009, ch.15) distinguish three channels: (i) a market size effect, that is, an increase in the size of production favours learning-by-doing spillovers (Grossman & Helpman 1989, 1993); (ii) a knowledge spillover effect, whereby knowledge flows from more to less advanced countries; under this effect, trade can induce knowledge transfers from more developed to less developed countries (Keller 2004, Sachs & Warner 1995); and (iii) a product market competition effect, as trade liberalization creates incentives for enhancement of domestic productivity and innovation through the creation of new products or varieties thereof (Trefler 2004). Aghion & Howitt (2009) develop a Schumpeterian growth model that embeds these effects, showing that trade has the potential to raise both the level and growth of the GDPPC.

There is, however, an exception: if one of the signatory countries lags in all economic sectors, then, after the trade reform, all of the innovators will choose to reside in the advanced country (Lapham & Devereux 1994). Note that this may be the case for FTAs negotiated with the U.S., a country considered to be at the world's technological frontier. In contrast, many Latin American countries that signed a FTA with the U.S. carry the weight of protectionist policies (implemented during the 1960s and 1970s) that discourage innovation. In this regard, one policy implication refers to the relevance of properly timing reforms, including implementing institutional reforms to promote innovation in the first place and then, only when domestic sectors have become leaders, removing barriers to trade (Aghion & Howitt 2009).

Besides, several economic development scholars emphasize institutions' primacy over geography and trade (Rodrik et al. 2004). A FTA only engenders further development because it motivates reforms to resolve institutional weaknesses and uncertainty, implicit in total factor productivity. Rodrik (2018) argues that modern FTAs include clauses aimed at protecting intellectual property and conflict resolution mechanisms to shield foreign direct investment from possible expropriation. These additional clauses may hinder further technology transfer, threatening the perception of economic benefits from signing a FTA. Thus, advanced countries' gains happen at the expense of emerging countries' losses (Grossman & Helpman 1995, Dür 2007). Indeed, Dür et al. (2014) find that these additional provisions have a significant impact on trade.

## 1.3 FTAs with the U.S.

The United States has been an ardent supporter of trade liberalization. Since President Roosevelt's administration, the U.S. has assumed that trade openness guarantees stable economic growth. In that line, during the last century, the U.S. has traded with various countries, becoming a leader and a role model on trade openness in this era of global economic integration.

The main trade agreement explosion occurred during the early 2000s, after agreements with Israel (1985), Canada (1988) and Canada and Mexico (1994). At the time of this study, the United States had signed FTAs with 20 countries. Two of these FTAs were multilateral (NAFTA and CAFTA); NAFTA includes Canada and Mexico, while CAFTA includes countries in Central America and the Caribbean (2004). The rest of the agreements were bilateral, including with Israel (1985), Jordan (2001), Chile, Singapore (2003), Australia, Morocco (2004), Bahrain (2005), Oman, Peru (2006), Colombia, Panama (2007), and the Republic of Korea (2010).

Table 1 lists the type of FTA, the relevant dates and the related negotiation period.[2] In particular, it includes three important dates: the date when negotiations initiated, the date of signature and the date of the treaty's commencement. It distinguishes between signature and entry into force because the signatory countries' governments must ratify the agreement's signing. From the beginning of negotiation until the signing of the treaty, an average of 1.63 years passed. Between signing the agreement and its entry into force, an average of 2.03 years elapsed, during which time each country deliberated on implementation of the treaty (internal negotiations).

The total average time elapsed between the start of negotiations and entry into force corresponds to 3.66 years. The treaty with Israel took the least amount of time to negotiate and implement (1.31 years in total; both countries ratified the treaty on the day of signature). In contrast, the treaties between the U.S. and Colombia, Panama and South Korea faced the most prolonged internal and external negotiations (8.04, 7.84 and 6.12 years, respectively). The total negotiation time for more recent treaties is significantly longer, reflecting greater complexity and thematic extension. The most recent FTAs also reflect this complexity with a notable increase in word count, expanded

[2]Dates were obtained from the website of the Office of the United States Trade Representative.

articles and chapters (Rodrik 2018), and the number of substantive provisions included. Relatedly, the extent of the agreements, which remained stable after the end of World War II, has steadily and significantly increased since 1990 (Dür et al. 2014).[3]

There is, however, substantial variation in the depth of agreements across countries, as Dür et al. (2014) note. Using different depth measures (number of substantive provisions and latent trait analysis), they show that the U.S. and Japan signed the most far-reaching agreements.

The results of this study suggest that a FTA with the U.S. delivers heterogeneous outcomes; in some countries, like Chile and Jordan, it had a positive effect on the GDPPC, while in others, like Mexico, it had an adverse impact. Other cases present neither a significant positive nor negative effects from signing an FTA with the U.S. These results point to institutions' primacy over geography and trade. Secondly, signing a FTA with the U.S. is expected to have a more negative economic impact in countries that depend on the U.S. for trade at higher rates. This negative relationship may reflect the exercise of stronger bargaining power on behalf of the U.S., at the expense of its trade partner. Finally, we find a substantial need for a case-by-case analysis to provide relevant information about an FTA's success with the U.S. as part of development policy.

The remainder of this paper proceeds as follows: In the next section, we look at empirical studies that use the SCM to study similar questions. Section 3 focuses on the SCM's methodological aspects, while Section 4 describes the dataset. Section 5 presents the results of said estimations. Section 6 addresses the relationship between the average impact and the relative importance of the U.S. in its partners' trade; finally, Section 7 concludes this study.

## 2 Empirical strategy

To assess this impact, we employed the synthetic control method (Abadie & Gardeazabal 2003, Abadie et al. 2010, 2015), which entails the construction of a counterfactual, that is, the GDPPC that would have been observed had the country not signed the FTA. The impact of the FTA is

[3]See Moser & Rose (2012) for the determinants of the duration of trade negotiations.

thus defined as the difference between the observed GDPPC and the counterfactual. This method is handy for our study since it allows us to construct a counterfactual - the synthetic control - for each country separately. In this way, the SCM makes it possible to handle treatments that may have unique characteristics, by estimating a separate effect for each country, instead of estimating an average effect, as would be if we used methods based on regressions (such as differences in differences ).

This method appropriately complements comparative case studies with a quantitative analysis of the impact of a given intervention, and indeed it has been used for many different ends. As one of the most significant advances in causal studies and policy evaluation in the last decade, it is among the most used approaches to public policy evaluation (Athey & Imbens 2017).

The SCM is an application of Rosenbaum and Rubin's counterfactual analysis framework (1983). Doudchenko & Imbens (2016) show that the SCM can be considered an extension of the difference–in–difference method, another procedure commonly used in program evaluation (Wooldridge 2010, chap. 6). The SCM, however, solves the omitted variable bias problem, caused by confounding factors that are not observable over time.

Hence, the SCM is a suitable tool for evaluating interventions confined to a single region or a small number of regions. It compares the post-intervention time series of specific variables of interest (like the GDPPC) in the economies under consideration with similar regions not under study.

Abadie & Gardeazabal (2003) and Abadie et al. (2015) were pioneers in applying this approach to the political and social sciences. In particular, Abadie & Gardeazabal (2003) studied the economic impact (using the GDPPC measure) of terrorism in the Basque Country, and Abadie et al. (2015) analyzed the same impact in terms of German reunification. Since then, this method has been widely used, in part due to the ease of interpretation and transparency (Abadie 2020).

In particular, this method is considered a handy tool for evaluating regional policies such as institutional reforms, regional trade agreements, and liberalization periods (Breinlich et al. 2014, Percoco 2014). The SCM allows for constructing a counterfactual path and analyzing how an economy evolves when a variable of interest is absent. Graphically comparing its trajectory with the economy under consideration provides for assessing policy impact over a possibly large number of post-intervention periods. Furthermore, it is possible to use placebo studies, taken from the literature related to treatment effects, thus supplementing qualitative comparisons with statistical interpretation.

Notably, several studies that focus on interventions implemented by groups of countries find mixed effects. Billmeier & Nannicini (2013) find that liberalizing the economy had a positive impact in most regions; however, recent instances (mainly in Africa) presented no significant effect. Gabriel & Pessoa (2020) investigate whether joining the European Monetary Union (and losing the power to set monetary policy) affected the economic growth of Eurozone countries. They identify losers (France, Germany, Italy, and Portugal) and a winner (Ireland). Furthermore, through GDP decomposition, they also find that the drivers thereof are heterogeneous.[4] Adhikari et al. (2018) also find positive, but varied, effects of market reforms on GDPPC. In political science, studies have also found mixed impacts on GDPPC (Gardeazabal & Vega Bayo 2016, Bove et al. 2017).

There are two broad reasons for this heterogeneity. Although generally similar, a treaty (like a FTA) may include particular clauses that are state-specific. Indeed, Dür et al. (2014) find evidence of considerable differences in the design of modern FTAs. Secondly, the success of a policy may be highly dependent on a country's specific economic structure. For instance, developing countries may face higher fixed trade costs due to higher border-crossing costs or weaker trade infrastructure (Baier et al. 2018).

Thus, from a methodological point of view, a case-by-case evaluation is justified. For this part, by constructing a suitable metric that allows one to compare effects among different regions, the synthetic control method is an appropriate procedure for estimating the distribution of a heterogeneous treatment effect (see, for example, Gardeazabal & Vega Bayo 2016). The next step involves finding critical determinants in interventions, which may include country- or treatment-specific characteristics. A GDP decomposition analysis may also be used (Gabriel & Pessoa 2020).

[4]See also Puzzello & Gomis-Porqueras (2018).

While we focus on the first step ( case-by-case evaluation), we argue that our results can shed light on the ongoing debate surrounding the preconditions under which FTAs promote economic growth in developing countries (Chauffour & Maur 2011, Helpman 2018).

While some researchers used the gravity model to explain the average effects of trade policies and trade costs on bilateral trade flows, several papers adopt non-parametric methods, such as matching methods for causal inference and the synthetic control method, as alternatives to gravity equations. For example, Persson (2001) and Chintrakarn (2008) use matching methods for causal inference to assess the causal effect of monetary unions on trade flows, and Baier & Bergstrand (2009) do the same for free trade agreements. Also, Gabrielczak & Serwach (2017), Ritzel & Kohler (2017), and Stoj?i? et al. (2018) also use this method to identify the causal effects of trade policies on exports.

Another strand of the literature applies the SCM to an ex-post evaluation of the formation of the Eurozone. Puzzello & Gomis-Porqueras (2018) and Gabriel & Pessoa (2020) apply said method to several countries with mixed results, while Saia (2017) finds that the U.K. bore a cost for staying out of the Eurozone, in terms of lower aggregate trade flows, both with Eurozone members and non-members.

The SCM is also suitable for studying the indirect effects of trade liberalization, such as health improvements. For instance, Barlow (2018) and Olper et al. (2018) find that trade liberalization events between 1960 and 2010 reduced child mortality rates on average but still identified a significantly heterogeneous impact thereof depending on the institutional context. For example, positive results were mainly found in democracies vis-a-vis autocracies.

# 3 Methodology

The SCM consists of comparing the time evolution of a variable $Y$ after implementing a particular intervention or treatment in a unit with the evolution of the same variable $Y$ if there was no such intervention. In general, the unit treated is a country or a sub-national political entity.

Typically the intervention is maintained over time. For example, Abadie & Gardeazabal (2003) study the effects of the Basque separatist conflict on the GDPPC in the Basque country during the period in which the conflict transpired. Similarly, Abadie et al. (2010) study the impact of imposing restrictions on tobacco consumption in California, while Abadie et al. (2015) study the impact of Germany's reunification process on its GDPPC.

However, the method is also applicable if the intervention occurs during a fixed period, but its effects continued over time. For instance, Cavallo et al. (2013) study the impact of natural disasters on GDPPC. Although these disasters only develop over one or at most two periods, their effects (damage to and loss of infrastructure and people) persist over time.

The method involves observing the variable of interest $Y$ for which measuring impact is of interest for $N$ units, during the years $t = 0, ..., T$. By convention $n = N$ denotes the unit treated and $n = 1, ..., N - 1$ denotes the units used to construct the synthetic control. These $N - 1$ units are often called controls or donors, and the set of these units is called the donor pool. The year $\tau$ between 0 and $T$ is the year in which the treatment started. We assume $0 < \tau < T$. That is, the variable is observed at least one year before in one after treatment. Let $Y_{nt}$ be the observation of $Y$ for unit $n$ in year $t$. For this study, $Y_{nt}$ represents the GDPPC of country $n$ in year $t$. We also observe $J$ characteristics $Z^j$, $j = 1, \ldots, J$, related to the variable of interest. Thus, $Z^j_{nt}$ is the observation of characteristic $j$ for country $n$ in year $t$.

Each characteristic $j$ is used to construct linear combinations of the original characteristics observed in the years before the treatment. The number of linear combinations may vary between features. Commonly used linear combinations include the simple average of the pre-intervention period and observations of the characteristic in question during particular periods. Let $\tilde{\mathbf{Z}}^j_0$ denote the matrix of all linear combinations of characteristic $j$ for the donor pool. The matrix $\tilde{\mathbf{Z}}_0$ results from stacking the $J$ matrices $\tilde{\mathbf{Z}}^j_0$.

Similarly, $L$ linear combinations related to the variable of interest can also be constructed. Let $\tilde{\mathbf{Y}}_0$ denote the $(L \times N - 1)$ matrix of all linear combinations related to the variable of interest for the donor pool.

The matrix $\mathbf{X}_0$ results from stacking the previous matrices $\tilde{\mathbf{Z}}_0$ and $\tilde{\mathbf{Y}}_0$. The matrix $\mathbf{X}_1$ for the unit treated is constructed in the same way.

A synthetic control of the unit treated is a (column) vector of weights $(w_1, w_2, \ldots, w_{N-1})$, with the restrictions $0 \leq w_n \leq 1$ for every weight $n$, and $\sum_{n=1}^{N-1} w_n = 1$. The impact of an intervention for any year $t$ thereafter is defined as follows:

$$\Delta_t = Y_{Nt} - Y_{Nt}^C, \qquad t = \tau + 1, \tau + 2, \ldots, T$$

where $Y_{Nt}$ is the variable of interest observed, and $Y_{Nt}^C$ is the value observed if unit $N$ is not treated. This value is usually called "counterfactual." Abadie et al. (2010) propose estimating it by the synthetic control of the unit under study:

$$\hat{Y}_{Nt}^C = \sum_{n=1}^{N-1} w_n Y_{nt}, \qquad t = \tau + 1, \tau + 2, \ldots, T.$$

Thus, the estimated impact of the treatment on the unit studied, for each $t > \tau$, is

$$\hat{\Delta}_t = Y_{Nt} - \hat{Y}_{Nt}^C.$$

Abadie et al. (2010) determine the asymptotic properties of this estimation assuming that $Y_{Nt}^C$ is given by a factor model. In particular, they show that if there is $W^* = \left(w_1^*, w_2^*, \ldots, w_{N-1}^*\right)$ such that:

**(i)** $Y_{Nt} = \sum_{n=1}^{N-1} w_n^* Y_{nt}$, for all $t = 1, \ldots, \tau$,

**(ii)** $\mathbf{X}_1 = \sum_{n=1}^{N-1} w_n^* \mathbf{X}_0$,

**(iii)** the number of periods prior to the intervention is large enough,

**(iv)** the treatment does not affect $Y_{nt}$, $n = 1, \ldots, N$, $t = 1, \ldots, \tau$,

then $\hat{Y}_{Nt}^C \to Y_{Nt}^C$. In other words, under conditions **(i) - (iv)**, $\hat{\Delta}_t$ is an unbiased estimator of the impact of the treatment on the variable of interest $Y_N$.

We implement the method by finding the vector of weights $W^*$ that minimizes

$$\sqrt{(\mathbf{X}_1 - \mathbf{X}_0 W)' (\mathbf{X}_1 - \mathbf{X}_0 W)}$$

where $\mathbf{X}_1$ and $\mathbf{X}_0$ are the matrices with pre-intervention averages of the predictors and lags related to the GDPPC for the treated and the controls, respectively. [5]

# 4 Data

## 4.1 GDPPC determinants and data sources

Researchers that use the synthetic control method to measure certain policies or interventions' impacts on GDPPC agree on including a proxy for human and physical capital, as well as variables related to the economic structure and institutional context. They also include GDPPC lags, which control for initial conditions and allow researchers to capture trends. For instance, Billmeier & Nannicini (2013) use variables like population, human capital (secondary school enrollment), investment share, inflation, and polity2, as a proxy for democracy (Marshall & Jaggers 2015).

In the present article, we rely on Feenstra et al. (2015) 's dataset (the Penn World Table or PWT) as our baseline for the GDPPC and related variables. This dataset contains real output per worker, human capital per worker, and real physical capital per worker, and it covers 182 countries between 1950 and 2017. The GDPPC is calculated as the ratio between the real gross domestic product measured according to the product approach (in USDs) corrected by purchasing power parity (PPP), and the population. The capital stock per-capita is the capital stock (in USDs) adjusted by PPP, divided by the population.

The human capital index combines education quantity (years of schooling) with quality in terms of returns to education (Psacharopoulos 1985). Thus, it is a better proxy for human capital than just primary or secondary school enrollment. It is calculated using the average years of schooling, from Barro & Lee (2013), and an assumed rate of return for primary, secondary, and tertiary education, based on Mincer's estimations (see Caselli, 2005 for details on the construction of this index.).

[5] Abadie et al. (2010) propose finding $W^*$ to minimize $\sqrt{(\mathbf{X}_1 - \mathbf{X}_0 W)' \, \mathbf{V} \, (\mathbf{X}_1 - \mathbf{X}_0 W)}$ where $\mathbf{V}$ is a diagonal matrix of dimension $M \times M$ whose positive components measure the relative importance assigned to each variable of $\mathbf{X}$. They suggest choosing $\mathbf{V}^*$ which minimizes the mean square error $||Y_N - \mathbf{Y}_0 W^* (\mathbf{V})||^2$. The search for $W^*$ and $\mathbf{V}^*$ can be implemented using a nested algorithm which is computationally intensive. We did not get significant improvement in the fit when using the nested algorithm.

Feenstra et al. (2015) also calculate a measure of total factor productivity relative to the U.S., which is closely related to the GDPPC. Hence, it is also considered a predictor.[6]

Overall, these variables allow for the construction of suitable synthetic controls, as shown below. Additional variables, such as public expenditure share, school enrollment, inflation and polity2, were also added but did not improve the synthetic control's fit. They did, however, significantly increased computation time.

Besides the good fit of the synthetic controls for each country, another advantage of using the same dataset and predictors for all cases (except El Salvador and Oman) is found in the fact that the chosen model can be cross-validated. The root-mean-squared prediction error (RMSPE) can be used as a criterion for assessing the goodness of fit of the synthetic control estimations. Besides, they are theoretically grounded, since they correspond to the variables in the neoclassical aggregate production function, which is by far the main specification considered in applied research on economic growth.

## 4.2 Series and intervention date

It is advisable to include a large number of years before the intervention as a condition for the estimator's asymptotic unbiasedness (Abadie et al. 2010). For this reason, all available pre-intervention data in the PWT were considered for each country.

The series begins in 1960 in all cases except Bahrain, the Dominican Republic and Oman, which start in 1970. Pre-intervention time averaged 40.9 years, with a minimum of 25 (Israel) and a maximum of 50 (Republic of Korea). Magee (2008) provides evidence that (trade) anticipation effects may be relevant in the four years before a FTA enters into force. This period is broadly consistent with the average elapsed time between the official start of negotiations and the negotiated FTA's entry into force and signing by the U.S., which is 3.66 years (see Table 1). However,

[6]We used these predictors in all cases, except in El Salvador and Oman. For El Salvador, information on capital stock per capita and total factor productivity is lacking and, in Oman, there is no data on human capital and total factor productivity. Instead, investment as a percentage of the GDP (also from Feenstra et al. 2015) was included for both countries.

uncertainty regarding the final result of the negotiation process is considerable. At the same time, it may diminish substantially when the FTA is signed (even if it enters into force after approval by each country's legislative body). For this reason, estimations are performed, taking into account the date of signature as the criterion for distinguishing between pre and post-intervention periods (see Table 1).

### 4.3 Descriptive statistics

Table 2 displays average growth rates related to the GDPPC, capital stock per capita, the human capital index, total factor productivity (TFP), the average level of investment, and the average trade with the U.S. relative to aggregate trade. These averages are calculated for both the pre and post-intervention periods.

## 5 Results

### 5.1 FTAs' impact on countries' GDPPC

In all cases, GDPPC lags were included with the idea of obtaining a better fit. One-third of the pre-treaty years were included in an interleaved manner. In this way, the long-term GDPPC trend was captured without the other predictors losing relevance in determining the synthetic control (Kaul et al. 2017). In all cases, interaction effects were added. The same specification was used for 18 of the 20 countries. Although the procedure in its most general form allows one to incorporate any linear combination of the predictors, only the simple average was used. This practise is standard in this type of research.

Figure 1 shows the path of the observed GDPPC (black) and the synthetic control (blue) for each country. All outcomes are scaled so that each country's GDPPC is 1 in the last pre-treatment period. Thus, the effects can be interpreted as percentages of the GDPCC in the year before the intervention.

The fit is very good in general: The highest RMSPE (pre-intervention period) corresponds to Nicaragua (0.224), while the rest of the RMSPE are lower than 0.1, ranging from 0.013 (Australia) to 0.094 (Jordan). Even in the cases with a poor fit, the synthetic control captures the observed trend. See Table 3 for the RMSPE obtained in each case. Figure 2 displays the placebo study, with control units signing fictional FTAs with the U.S. Because control units are countries that did not sign a FTA, the effect of this fictitious treatment–a placebo–should be a function of chance. Assessment of the significance thereof comes through comparing the effect on the unit studied and on the control units.

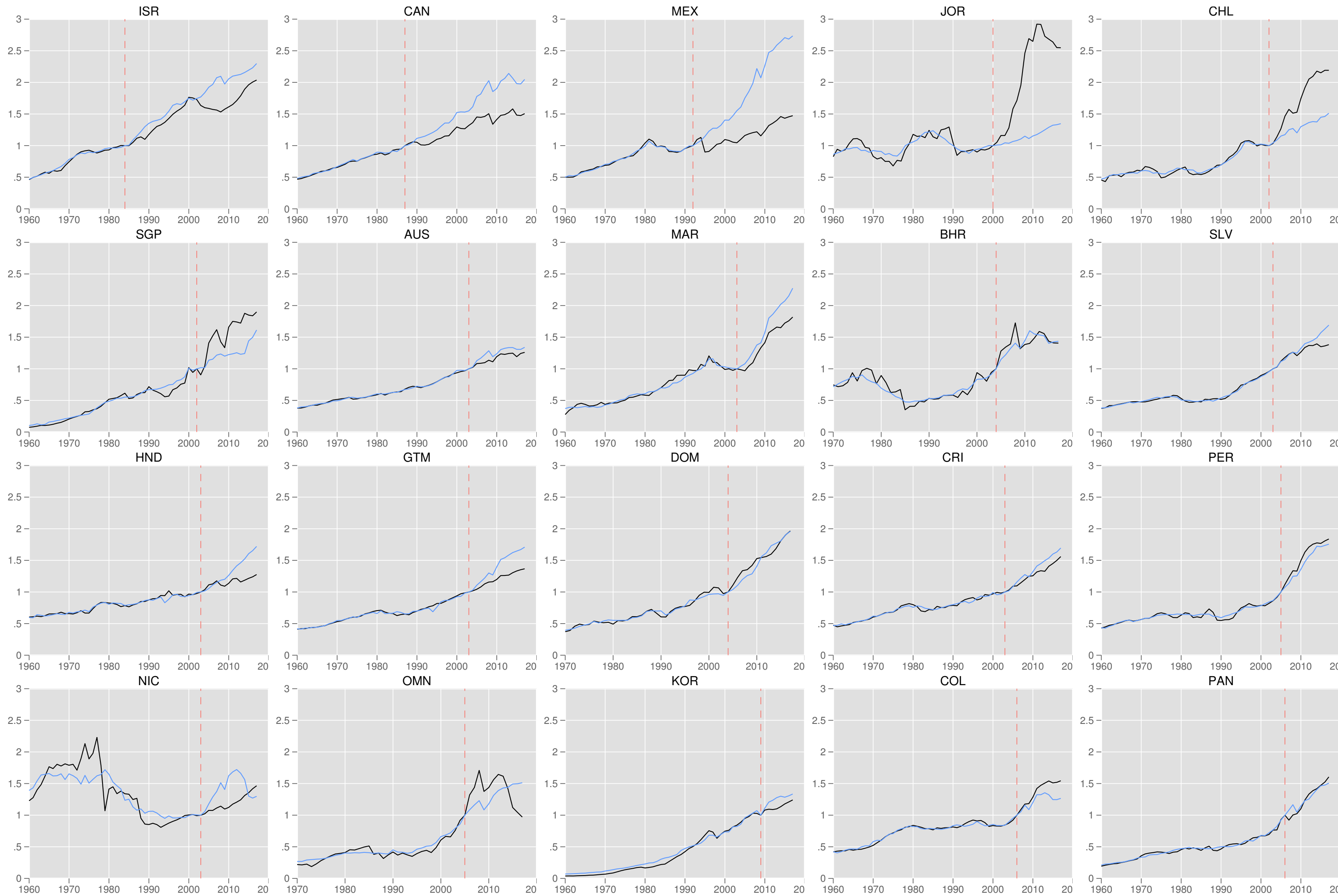
From Figure 1, it is clear that an FTA with the U.S. was beneficial for Chile, Jordania, and Singapore, while it harmed Mexico. The significance of these impacts can be seen in Table 3, which reveals that GDPPC's trajectory in Jordan, Chile and Singapore is above that of most of the control units, while the opposite holds in the case of Mexico. Adverse effects can also be seen for Canada, Honduras and Guatemala, and a positive effect is also spotted for Colombia. However, the corresponding placebo studies are less conclusive.

For the following countries, the impact is not significant: Australia, Morocco, Bahrain, El Salvador, Dominican Republic, Costa Rica, Peru, Republic of Korea and Panama. Figure 2 shows no significant difference between the number of placebos above or below the trend of the treated unit. The same holds for Israel during the decade after the treaty. Since 2000, there seems to be a negative effect. However, the placebo study (Figure 2) gives no conclusive evidence.

Oman's FTA with the U.S. had a positive impact in the short run, but there is no evidence that this impact persisted in the long run. The opposite holds for Nicaragua: there is a negative effect in the short run, but there is no significant effect in the long run.

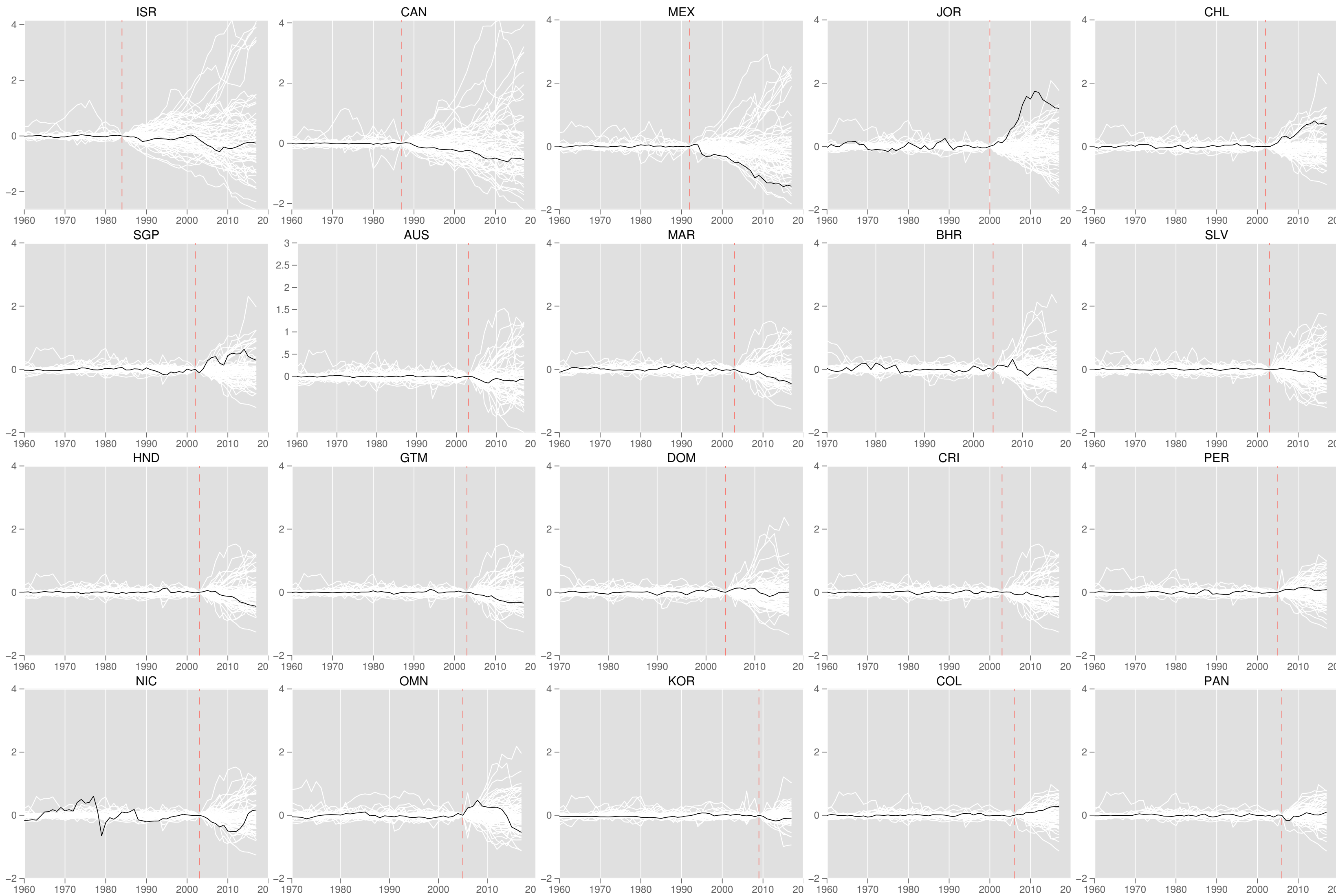
Overall, impacts are heterogeneous. Figure 3, exhibits a histogram of the average effect for the first ten years after the intervention. For eight countries, the impact is negative but small. Mexico and Nicaragua have larger negative impacts, and effects for Bahrain, Dominican Republic and Panama are close to zero. For the rest of the countries, the average effect is positive. Recall that the outcome (GDPPC) is normalized to 1 for the last pre-treatment period. The average ten-year effect ranges from -33.8% (Nicaragua) to 65% (Jordania) with mean and standard deviation being 1% and 21% respectively, and a mode around -1%.

Figure 1: Economic effects of FTAs with the U.S. - Real vs Synthetic GDP




*Real GDP in black; Synthetic GDP in blue.*

Figure 2: Economic effects of FTAs with the U.S.- Placebo study



## 5.2 FTAs' impact versus the U.S.'s share in total trade

As a check of robustness, the relationship between the expected economic impact and the U.S.'s participation in its partner's total trade is assessed. Whether positive or negative, the impact should be more significant the more the country depends on trade with the U.S.

Let $e_{i,t}$ be the economic impact of the FTA for country $i$ during post-intervention period $t$. Also, let $p_{i,t}$ be the ratio of the number of countries with a bigger impact (in absolute value) than country $i$, relative to the total number of countries in the placebo study. This ratio can be interpreted as the probability that the effect $e_{i,t}$ is dependent on chance, instead of being causally related to the FTA. Thus, $1 - p_{i,t}$ is the probability that the FTA has a significant economic impact on country $i$ during period $t$.

The expected economic impact of the FTA on country $i$'s GDPPC during period $t$ is

$$E_{i,t} = p_{i,t} \times 0 + (1 - p_{i,t}) \times e_{i,t} = (1 - p_{i,t}) \times e_{i,t}.$$

The average expected economic impact for country $i$ is the average of the expected economic impact over the following ten post-intervention years:

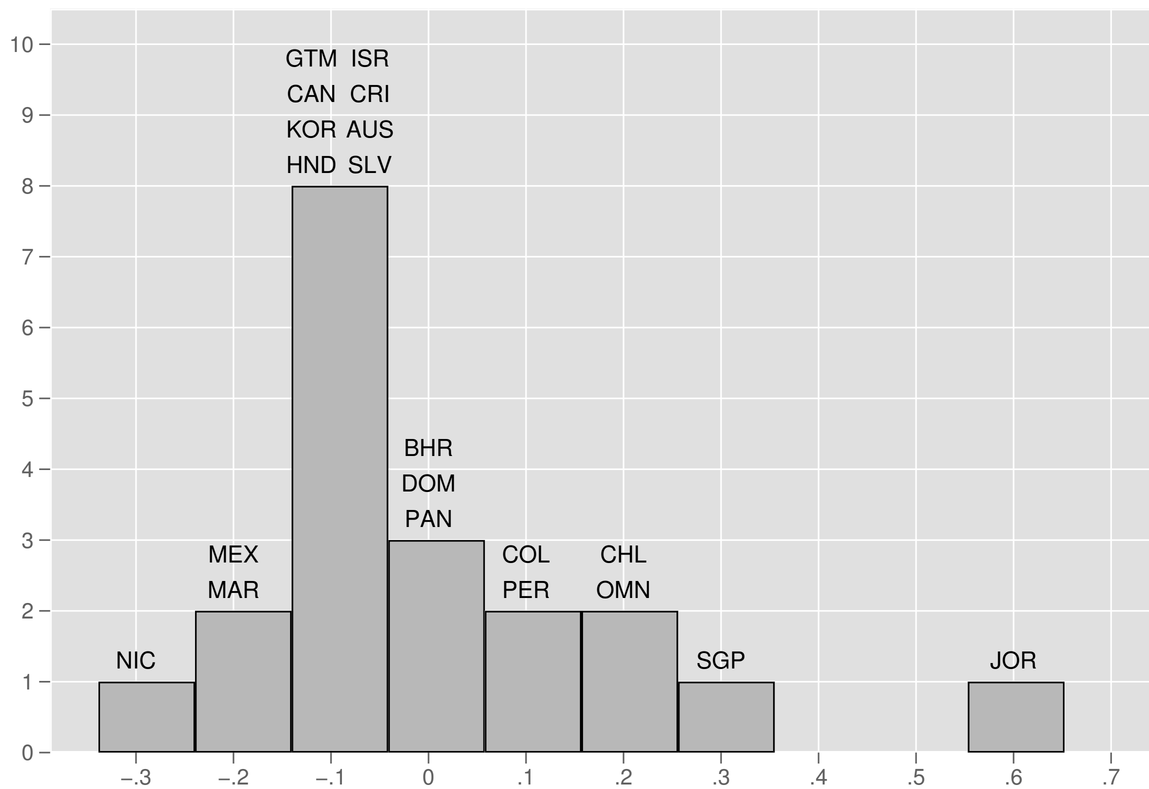
$$E_i = \frac{1}{10} \sum_{t=1}^{10} E_{i,t},$$

where $t$ is a post-intervention year.

Figure 4 depicts the relationship between the FTA's expected economic impact and the U.S.'s share in country $i$'s total trade, measured as the average share during the ten years before the intervention. The relationship between expected economic impact and the U.S.'s participation in each country's total trade is negative and significant at standard confidence levels. In particular, the slope coefficient is $m = -0.0040214$ with standard error $S = 0.0018014$, t-statistic $t = -2.23$, p-value $p = 0.039$ and 95% confidence interval $[-0.007806, -0.0002368]$.

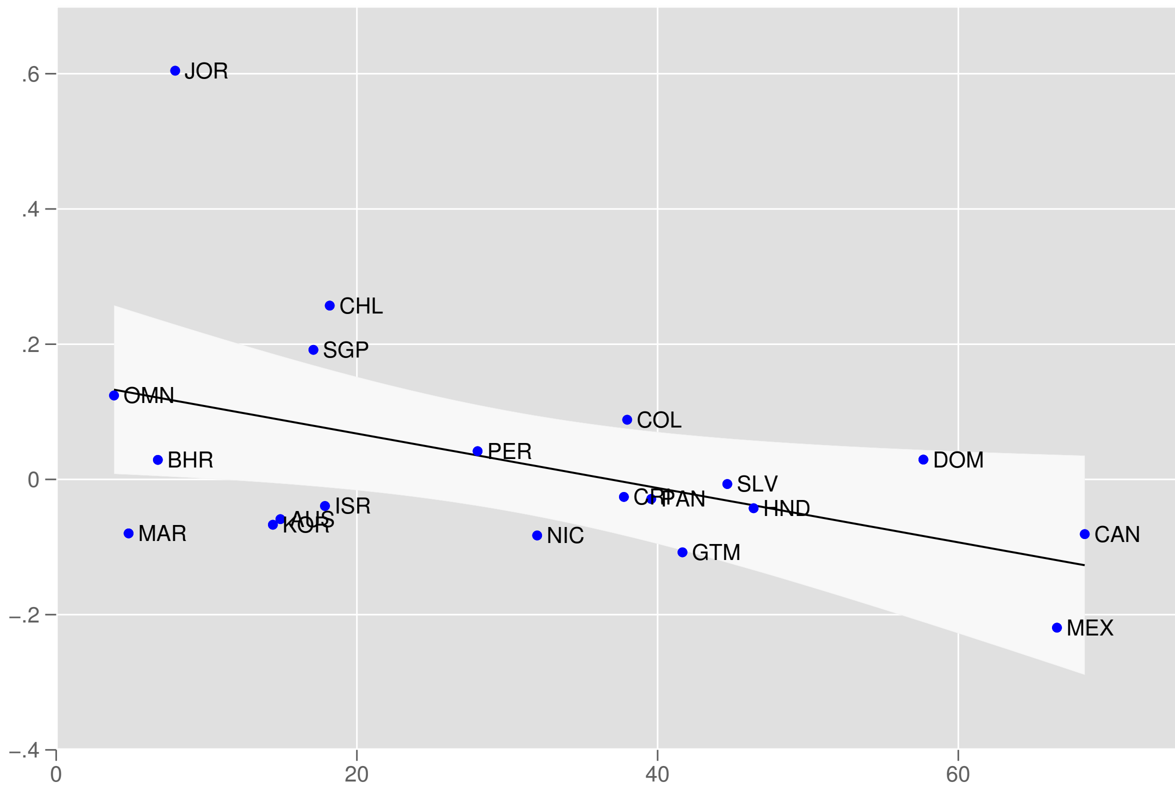
From Figure 4, it is clear that countries with low U.S.'s share on their total trade (like Jordan,

Figure 3: Histogram: Distribution of 10 year average effects




*Mean: 0.01 (1% of the last pre-intervention GDPPC; mode is around -1%.*

Figure 4: Average 10-year impact (vertical axis) vs participation of the U.S. in total trade (%)




*Slope coefficient:* −.00402*; p-value:* 0.039

Chile or Singapore with less than 20% of their total trade with the U.S.) have a positive economic impact from the FTA with the U.S., after ten years. In contrast, countries with a large U.S. participation on their total trade (like Canada and Mexico, with over 60%) have an overall negative impact on their economy. One possible explanation follows Rodrik's (2018) argument: Countries that rely heavily on trade with the U.S. have lower bargaining power in FTA negotiations. As a result, one would expect to observe more clauses favouring the U.S. at its partner's expense.

# 6 Concluding remarks

In general, FTAs seem to have a heterogeneous impact. In particular, there is evidence that signing a FTA with the U.S. had a positive impact on the GDPPC in Chile and Jordan and that NAFTA harmed Mexico's GDPPC. There seems to be no significant economic impact in several other cases, such as Israel, Canada, Australia, Costa Rica, Peru, the Republic of Korea and Panama. These results suggest that the success of FTAs depend more heavily on the primacy of institutions than on geography and trade. Also, by motivating reforms to resolve institutional weakness and insecurity, the countries that sign FTAs with the U.S. can develop further.

A case-by-case analysis can provide additional insights into the effectiveness of a FTA as a development policy. It is certainly the case that each FTA has its particular characteristics (Dür et al. 2014). Besides, it is worth considering Rodrik's (2018) hypothesis that particular interests dominate negotiation and that the impact of a FTA is at least partially determined by the type of sectors represented by interest groups.

In Mexico's case, despite signing NAFTA in 1994, and increasing its trade with the U.S. and Canada five times over, productivity has stagnated in most Mexican industries, including manufacturing. This industry has been underperforming compared to the service industry, with a negative average TFP growth during 1991-2018. Even reforms during the Calderon and Peña-Nieto administrations did not properly address the problem.

Therefore, a case-by-case analysis may explain the factors that make some countries benefit from a FTA with the U.S. Such an analysis can help determine if a lack of strong institutions or other factors (i.e., geography, R&D investment, lack of competition in some sectors, lack of innovation) make the difference.

The main policy implication is that supplementary institutional reforms are needed, for an FTA to lead to increases in the GDPPC. These reforms should redirect productive activity towards sectors intensive in innovation and technological change, which are the critical determinants of long-term economic growth. For this reason, it may also be convenient to put in place political mechanisms that limit the influence of private interest groups on the negotiation process, especially if they try to avoid competition via technological or quality improvements. These concerns are particularly valid for countries with strong trade ties with the U.S., because they have less bargaining power, as they have a lot to lose if the treaty does not go through.

Besides the relevance of institutional reforms, potential policy implications hereof include the suggestion that FTAs can be used as a means to increase trade among the countries involved and, as a result, boost economic growth. However, FTAs do not always benefit the population as a whole, sometimes negatively impacting the GDPPC instead of increasing it and generating regional inequality within a country. Therefore, specific policies should be established to help regions/sectors/households that do not benefit from a given FTA and ensure equitable distribution. In this way, countries can avoid increasing inequality among households and regions, and promote shared prosperity instead.

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Table 1: FTA's with the U.S.

| U.S. partner | Treaty | Start of negotiations (1) | Date of Signature (2) | In force since (3) | First year after the intervention | Years of Negotiation (2)-(1) | Years before Approval (3)-(2) | Total time (3)-(1) |
|---|---|---|---|---|---|---|---|---|
| Israel | Bilateral | 01/01/1984 | 04/22/1985 | 04/22/1985 | 1985 | 1.31 | 0.00 | 1.31 |
| Canada | Bilat. / NAFTA | 05/01/1986 | 01/02/1988 | 01/01/1989 | 1989 | 1.67 | 1.00 | 2.67 |
| Mexico | NAFTA | 06/10/1990 | 12/17/1992 | 01/01/1994 | 1994 | 2.52 | 1.04 | 3.56 |
| Jordan | Bilateral | 06/06/2000 | 10/24/2000 | 12/17/2001 | 2002 | 0.38 | 1.15 | 1.53 |
| Chile | Bilateral | 08/01/2002 | 06/06/2003 | 01/01/2004 | 2004 | 0.85 | 0.57 | 1.42 |
| Singapore | Bilateral | 12/04/2000 | 05/06/2003 | 01/01/2004 | 2004 | 2.42 | 0.66 | 3.08 |
| Australia | Bilateral | 04/01/2003 | 05/18/2004 | 01/01/2005 | 2005 | 1.13 | 0.62 | 1.76 |
| Morocco | Bilateral | 01/21/2003 | 06/15/2004 | 01/01/2006 | 2006 | 1.40 | 1.55 | 2.95 |
| Bahrain | Bilateral | 01/01/2004 | 09/14/2004 | 01/11/2006 | 2006 | 0.70 | 1.33 | 2.03 |
| El Salvador | CAFTA DR | 01/08/2003 | 05/28/2004 | 03/01/2006 | 2006 | 1.39 | 1.76 | 3.15 |
| Honduras | CAFTA DR | 01/08/2003 | 05/28/2004 | 04/01/2006 | 2006 | 1.39 | 1.84 | 3.23 |
| Nicaragua | CAFTA DR | 01/08/2003 | 05/28/2004 | 04/01/2006 | 2006 | 1.39 | 1.84 | 3.23 |
| Guatemala | CAFTA DR | 01/08/2003 | 05/28/2004 | 07/01/2006 | 2006 | 1.39 | 2.09 | 3.48 |
| Dominican R. | CAFTA DR | 01/12/2004 | 08/05/2004 | 03/01/2007 | 2007 | 0.56 | 2.57 | 3.13 |
| Costa Rica | CAFTA DR | 01/08/2003 | 05/28/2004 | 01/01/2009 | 2009 | 1.39 | 4.60 | 5.99 |
| Oman | Bilateral | 03/01/2005 | 01/19/2006 | 01/01/2009 | 2009 | 0.89 | 2.95 | 3.84 |
| Peru | Bilateral | 05/01/2004 | 04/12/2006 | 02/01/2009 | 2009 | 1.95 | 2.81 | 4.76 |
| Korea | Bilateral | 02/02/2006 | 12/01/2010 | 03/15/2012 | 2012 | 4.83 | 1.29 | 6.12 |
| Colombia | Bilateral | 05/01/2004 | 11/22/2006 | 05/15/2012 | 2012 | 2.56 | 5.48 | 8.04 |
| Panama | Bilateral | 01/01/2005 | 06/28/2007 | 10/31/2012 | 2012 | 2.49 | 5.35 | 7.84 |
| | | | | | Averages: | 1.63 | 2.03 | 3.66 |

Table 2: Descriptive statistics: averages for pre and post intervention periods

| Country | Date of FTA | Number of pre FTA years | GDP per capita growth | | Capital stock per capita growth | | TFP growth | | HC growth | | Investment rate | | % Trade with the U.S. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | pre | post | pre | post | pre | post | pre | post | pre | post | pre | post |
| Canada | 1988 | 28 | 2.9 | 1.4 | -0.4 | -0.7 | 0.1 | -0.4 | 0.8 | 0.5 | 25.5 | 25.3 | 68.4 | 72.4 |
| Mexico | 1993 | 33 | 2.3 | 1.7 | -0.7 | 0.4 | -0.7 | -0.7 | 1.1 | 0.8 | 21.0 | 19.7 | 66.6 | 78.7 |
| Dominican R. | 2005 | 35 | 2.4 | 5.4 | 0.3 | 3.5 | -0.9 | 1.3 | 1.1 | 1.4 | 20.2 | 21.3 | 57.7 | 46.7 |
| Honduras | 2004 | 44 | 1.2 | 1.8 | -1.0 | 1.2 | -0.9 | -1.5 | 1.0 | 1.4 | 15.9 | 23.7 | 46.4 | 40.4 |
| El Salvador | 2004 | 44 | 2.4 | 2.4 | | | | | 1.0 | 1.1 | 11.0 | 14.1 | 44.6 | 42.0 |
| Guatemala | 2004 | 44 | 2.1 | 2.3 | -0.1 | 1.3 | -0.3 | -0.4 | 0.8 | 1.1 | 11.6 | 14.0 | 41.7 | 39.6 |
| Panama | 2007 | 47 | 3.8 | 4.5 | 0.5 | 8.0 | 0.3 | -2.1 | 0.9 | 0.6 | 20.0 | 32.3 | 39.6 | 31.2 |
| Colombia | 2007 | 47 | 2.0 | 4.1 | -1.9 | 2.3 | 0.0 | 0.8 | 0.8 | 1.0 | 21.4 | 20.9 | 38.0 | 31.1 |
| Costa Rica | 2004 | 44 | 1.8 | 3.2 | -0.7 | 2.2 | -0.8 | 1.1 | 1.0 | 0.4 | 13.5 | 19.0 | 37.8 | 42.4 |
| Nicaragua | 2004 | 44 | 0.2 | 2.8 | -2.2 | 1.8 | -3.2 | -0.5 | 1.0 | 1.0 | 21.1 | 20.8 | 32.0 | 23.4 |
| Peru | 2006 | 46 | 2.1 | 5.3 | -0.2 | 2.5 | -0.6 | 2.5 | 1.4 | 0.1 | 15.9 | 21.0 | 28.0 | 18.4 |
| Chile | 2003 | 43 | 2.1 | 5.5 | -0.7 | 3.6 | -0.3 | 1.6 | 0.9 | 0.6 | 16.3 | 23.6 | 18.2 | 15.3 |
| Israel | 1985 | 25 | 3.3 | 2.2 | -1.3 | -0.2 | 1.8 | -0.1 | 0.9 | 0.7 | 29.7 | 26.8 | 17.9 | 22.3 |
| Singapore | 2003 | 43 | 6.7 | 5.0 | 4.5 | 3.2 | 1.6 | -0.1 | 1.5 | 2.6 | 51.3 | 34.7 | 17.1 | 10.1 |
| Australia | 2004 | 44 | 2.3 | 1.7 | -1.4 | 1.5 | 0.2 | -0.3 | 0.6 | 0.0 | 30.1 | 27.2 | 14.9 | 8.9 |
| R. of Korea | 2010 | 50 | 7.1 | 2.8 | 3.3 | 2.0 | 2.0 | -0.3 | 1.6 | 0.9 | 32.9 | 32.3 | 14.4 | 10.6 |
| Jordan | 2001 | 41 | 0.9 | 6.0 | -0.1 | 3.4 | -2.2 | 2.7 | 1.8 | 0.9 | 21.1 | 24.0 | 7.9 | 10.3 |
| Bahrain | 2005 | 35 | 2.2 | 3.4 | 0.9 | 0.5 | -2.1 | 1.1 | 1.7 | -0.2 | 38.3 | 34.0 | 6.8 | 4.9 |
| Morocco | 2004 | 44 | 3.2 | 4.4 | 1.6 | 7.3 | -0.1 | -1.7 | 1.0 | 1.1 | 15.3 | 32.9 | 4.8 | 5.2 |
| Oman | 2006 | 36 | 5.2 | 0.8 | 4.3 | 2.2 | | | | | 25.5 | 33.5 | 3.8 | 3.4 |

Table 3: Pre-intervention RMSPE

| Country | RMSPE |
|---|---|
| Australia | 0.013 |
| Canada | 0.015 |
| El Salvador | 0.018 |
| Mexico | 0.019 |
| Guatemala | 0.024 |
| Israel | 0.025 |
| Panama | 0.026 |
| Colombia | 0.026 |
| Costa Rica | 0.028 |
| Honduras | 0.033 |
| Peru | 0.033 |
| Chile | 0.037 |
| Dominican Republic | 0.041 |
| Republic of Korea | 0.045 |
| Morocco | 0.047 |
| Singapore | 0.055 |
| Oman | 0.056 |
| Bahrain | 0.082 |
| Jordan | 0.094 |
| Nicaragua | 0.224 |