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## Trade Liberalisation and Migration Hump

NAFTA as a Quasi-Natural Experiment

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- analyse migration as part of broader global change
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## Abstract

This paper investigates the effect of trade liberalisation on migration, using the North American Free Trade Agreement (NAFTA) as a ‘quasi-natural experiment’. I employ a data-driven and transparent event analysis methodology – synthetic control method – suitable for policy evaluation at the macro level, to assess the counterfactual scenario. This paper combines data from DEMIG-C2C and MOxLAD for the 1974–2010 period. Using regular migration from Mexico to the US as a ‘treated unit’ and the other sixteen Latin American countries to construct a ‘synthetic Mexico’, I find evidence of ‘migration hump’ following the implementation of NAFTA. The duration of the hump is estimated to be around fifteen years. This lengthy adjustment period was likely prolonged by Mexico’s subsequent financial crisis in the mid-1990s occurring in the early years of NAFTA’s implementation. The findings of this paper suggest that trade and migration are short-run complements and long-run substitutes, with a significant period of adjustment. Instead of supporting the neoclassical theory of trade and migration, our empirical evidence is more in line with the theoretical prediction of migration hump phenomenon proposed by Martin & Taylor (1996).

**Keywords:** trade, migration, migration hump, NAFTA, synthetic control method

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--“We want to export goods, not people”--

*(Carlos Salinas de Gortari, President of Mexico 1988-1994)*

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# 1 Introduction

Theory on trade and migration dates back to Stolper and Samuelson (1941) and Mundell (1957) who propose that trade in goods and factors (labour) mobility are substitutes for each other. The model predicts that higher barriers to trade such as import tariffs will increase the price of scarce factors of production relative to the prices of other factors and goods. If migration is a response to international wage differentials, trade protectionism shall trigger more migration as predicted in price-equalisation theorem. Consequently, lower barriers to trade such as trade liberalisation policies, which promote international trade, shall reduce trade in factors of production i.e. labour, resulting in lower migration.

Trade and migration can also be complements. If we relax some assumptions – for instance if the country-pairs have different technologies or one country has the production with increasing return to scale instead of constant return to scale and the presence of highly imperfect markets, in which these are the basis for trade instead of differences in factor endowments – then as shown by Markusen (1983) and Wong (1983) among others, the Stolper-Samuelson's factor price equalisation theorem that was utilised by Mundell (1957) no longer holds. In other words, wages between the pair-countries will diverge, and thus trade and migration are complements. This prediction is also stated in world systems theory of migration in which economic linkages created by the penetration of capitalism supports migration flows (Massey et.al., 1993).

Later theoretical models, on the other hand, contend that the interplay between trade and migration is ambiguous. These models usually classify the factor of production (labour) into two categories: skilled and unskilled. Panagariya (1992) contends that the ambiguity of trade-migration relationship is dependent on labour migrants' skill level in which skilled labours and trade are complements while unskilled labours and trade are substitutes. Finally, Martin and Taylor (1996) propose that trade and migration are complements in the short-run but substitutes in the long-run, coining the term 'migration hump'. In this case, sluggish adjustment in the wake of trade reforms may initiate the hump (de Haas, 2010).

The lack of consensus in existing theoretical models indicates that the effect of NAFTA on Mexico-US migration is ambiguous a priori (Taylor et al., 2012). This gives the opportunity for empirical research that tries to test these opposing theoretical conjectures. The case of Mexico-US bilateral migration and trade provides us with the environment for some type of 'natural experiment'. There are four reasons why NAFTA is well-suited for natural experiment for the analysis of trade liberalisation impact on migration. First, due to small membership of NAFTA, it is easier to isolate the migration between NAFTA's member countries as treated units. Second, although NAFTA entered into force in 1994, its phase-in stages last for fifteen years (Burfisher et al., 2001), which is a good case for long-term policy impact analysis. Third, because twenty years have passed since the establishment of NAFTA, such significant time period allows us to assess both short-term and long-term impact ex-post. Fourth, and perhaps most importantly, NAFTA is an excellent case to investigate the effect of free trade regime between countries with different level of economic development. This is conceptually important because in such condition, the assumptions of neoclassical theory are not likely to holding, making it possible to hypothesize that its predictions may not find empirical support.

This paper asks whether trade liberalisation leads to lower migration? This paper contributes to the literature by applying a systematic ex-post counter-factual analysis on the impact of trade liberalisation on migration flows based on counterfactual analysis at the macro-level. That said, Mexico-US migration is an excellent example of 'natural experiment' with the NAFTA agreement. Moreover, it is well known that one of the rationale of NAFTA agreement is to reduce Mexico-US

migration (Taylor, 1996). Thus, such a policy goal is based on the premise that trade and migration are substitutes in line with the traditional Heckscher-Ohlin-Samuelson model's prediction. By combining the longitudinal bilateral US data on migration compiled by DEMIG project and MOxLAD database on Latin American economies, I construct synthetic Mexico-US bilateral migration flows and estimate the outcome of Mexico-US migration such that if NAFTA had not been implemented.

In other words, this paper takes Mexico-US as the 'treated unit' and other Latin America-US bilateral pairs as 'control units'. I use the potential control units of sixteen Latin American countries following the MOxLAD data availability. This counter-factual simulation approach i.e. synthetic control method allows us to directly and empirically test the effect of NAFTA (trade liberalisation policy) on Mexico-US migration flow. This approach shares the same spirit with the common practice in micro-level policy impact evaluation (treatment vs control groups) while at the same time testing the competing theories about the interplay between trade and migration based on quantitative comparative case studies.

One challenge in evaluating NAFTA's impact on Mexico-US migration is the fact that the peso (tequila) crisis, which started in December 1994, coincided with the year NAFTA entered into force. I take this into account in the analysis and show that the results still hold even after considering these dual events. It is evidently probable that the tequila crisis prolonged the length and magnified the size of the migration hump.

Another challenge in evaluating Mexico-US migration is the burgeoning presence of irregular migration. Since official migration statistics do not record irregular migration, the real magnitude of Mexico-US migration is largely understated. There are several options to deal with issue. First, by accounting for irregular migration and adding it to regular migration. The problem with this strategy is that the data quality on irregular migration statistics is unconvincing at best. Some studies have attempted to use apprehension, as a proxy for irregular migration, however, raw apprehension data is a seriously problematic indicator as it is essentially 'a joint function of the number of migrants attempting unauthorised entry and the effort made to apprehend them' (Massey and Pren, 2012).

Second, to exclude irregular migration in the empirical analysis and focus on regular migration. This is the approach taken by this paper. The rationale is the following. Using regular migration statistics means that we will have comparable statistics over different migration corridors. Therefore, we have valid ground to construct our treatment and control units because they are comparable. One may argue that regular migration statistics will largely underwhelm unskilled migrants. As explained by Ambrosini and Peri (2012), this is simply not the case as they find that highly educated Mexicans are significantly under-represented in Mexican migrants. They further argue that family unification channel and migration network may explain this phenomenon. Since Mexican migrants have largely been composed of unskilled migrants historically, relatives in Mexico who are also relatively low-educated may join them via family unification channel. It is also possible that the impact of migration networks lowering migration costs is mostly targets unskilled migrants.

Given these reasons, I contend that the use of regular migration flow statistics capture both skilled and unskilled migration without having to suffer from the risk of falling into 'estimates-within-estimates trap' if we also include proxies for irregular migration. This approach is a safer path and reduces the risk of reaching erroneous conclusions due to measurement errors in data.

I find that NAFTA triggers hump-shaped effect on Mexico-US migration, that is, in the short-run NAFTA resulted in more migration. Our estimate shows that the time-period of the migration hump for NAFTA is about fifteen years, surprisingly consistent with the migration hump hypothesis

(Martin and Taylor, 1996; Martin, 2005). I find that that had NAFTA not been implemented, Mexico-US migration rate would have been in average 0.07% lower (measured as percentage of regular migration to Mexico population). Given the average value of Mexico-US migration rate over our sample period is only 0.08%, the policy impact of NAFTA on migration is thus considerably large. Incorporating dual events of tequila crisis does not change the results. Our pre-intervention estimates of synthetic Mexico is close to perfectly match the treated Mexico. In addition, our placebo estimates indicate that our synthetic control results are unlikely to be driven by chance.

I start this paper by first providing some background on the development of NAFTA. I then discuss the theoretical debates and empirical findings on the relationship between trade and migration. The data and method applied in this paper is then described, followed by a discussion on the findings follow afterwards. Then finished with some conclusions.

## 2 Background

The history of NAFTA for Mexico can be traced back to the failure of import substitutions industrialisation (ISI) implemented by the Mexican government in 1980s. This development strategy relies heavily on public spending. Partly due to the oil crisis of 1982, in order to support the ISI strategy, Mexico had to rely on external debt (Galan and Oladipo, 2009). Unsurprisingly, Mexico then fell into debt crisis. In response to the debt crisis Mexico changed the direction of their economic policies in the following decade. In addition to curbing inflation, Mexico implemented economic restructuring by privatising many state-owned enterprises, deregulating domestic market and reducing barriers to foreign trade and investment (Kehoe, 1995). In 1986, Mexico gave its assent to the General Agreement on Tariffs and Trade (GATT). In 1994, Mexico's economic liberalisation culminated when NAFTA, the largest free trade bloc worldwide, came into force.

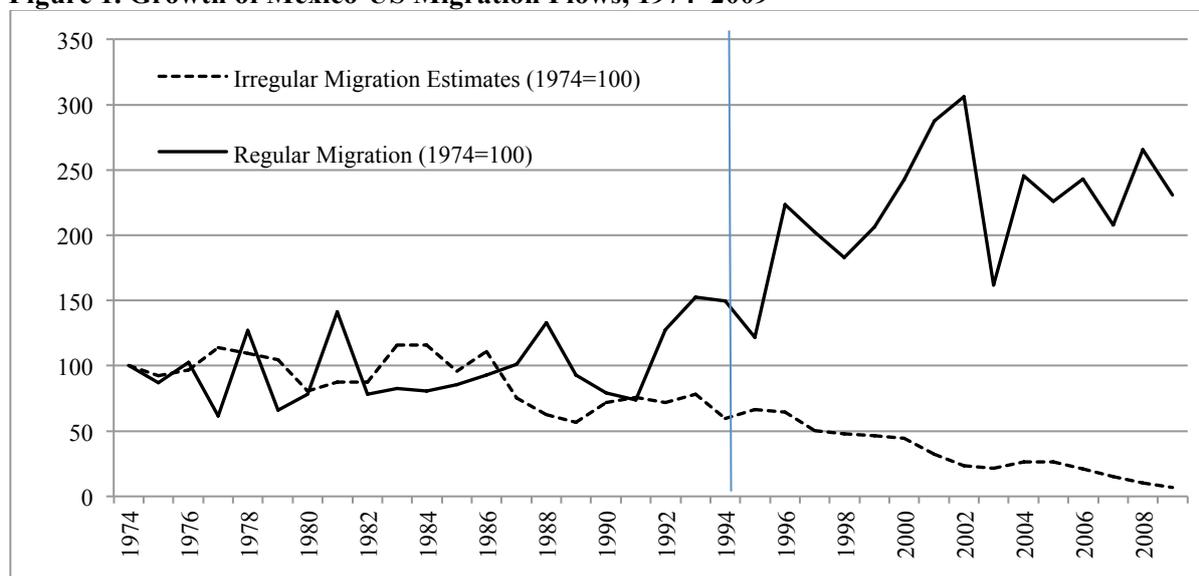
Migration has never been an explicit agenda of NAFTA. Little attention was paid to the issue of labour mobility, in contrast to the European Union including labour mobility as part of its agenda (Fernandez-Kelly and Massey, 2007). Interestingly, from the US perspective, NAFTA was actually seen as a panacea for chronic migration pressures from Mexico (Hufbauer and Schott, 2005). Ex-ante analysis based on neoclassical theory also supported this expectation. Unfortunately, this prediction turned out to be quite incorrect as migration keep on growing following NAFTA's inception (Hufbauer and Schott, 2005; Fernandez-Kelly and Massey, 2007; Martin, 2005; Zamora, 2009). The US reaction to the undeterred migration flow was to increase border controls, which have been growing more repressive since 1986 (Fernandez-Kelly and Massey, 2007).

Has overall migration really increased since the introduction of NAFTA? Massey and Pren (2012) use an indicator to proxy for irregular migration. They divide the apprehension number by the number of border patrol agents. Although it is not the real value of irregular migration, as they correctly state, it can be useful to compare trend and is conceptually better than raw apprehension statistics. In figure 1, I plot irregular and regular migration for 1974-2009. To get the true flow value of regular migrants for each year, the IRCA naturalisation numbers are excluded in regular migration statistics. I transform the absolute value into an index (1974=100) so that we can get clearer depiction on how Mexico-US immigration has evolved over time.

Figure 1 shows that following the start of NAFTA in 1994, there has been a considerable surge in regular migration from Mexico to US. As explained previously, this surge is likely to be caused by increase in migration from a range of skill and education levels. On the other hand, the estimates of irregular migration shows steady decline. One may point out that Massey and Pren's (2012) estimates of irregular migration actually depict stricter border controls. Even if this is the case,

the trend in irregular migration is stagnant at best. As a result, we see the widening gap between regular and irregular migration. This casual observation suggest that NAFTA is associated with more regular migration.

**Figure 1. Growth of Mexico-US Migration Flows, 1974–2009**



Source: DEMIG database, Massey and Pren (2012), Own calculation. Regular migration excludes IRCA naturalisation.

Several factors related to NAFTA, could be attributed to the continuing rise of Mexico-US migration. First, NAFTA had a 15 year phase-in period (Burfisher et al., 2001). This may have prolonged the adjustment period, which is likely to be the case, especially in ‘South-North’ bilateral free trade agreement faced by Mexico and US. Second, the tequila crisis could contribute to the continuing surge of migration. The crisis severed the adjustment period of displaced Mexican workers due to NAFTA. The combination of strong economic performance of US (pull) and worsening economic condition of Mexico (push) enhanced the steady increase of migration from Mexico to US, in line with theory (Hatton, 2005; Hatton and Williamson, 2009; Tilly, 2011). Third, the positive growth impact of NAFTA may enhance migration from people with higher education and skill. As argued by Burfisher et al. (2001) and Kose et al. (2004), NAFTA has a large positive impact on Mexico’s economy. Although no consensus has been reached yet, several studies have found that Mexico-US migration is more positively selected (Chiquiar and Hanson, 2005; Orrenius and Zavodny, 2005; McKenzie and Rapoport, 2010). Increasing aspiration and capability may explain the increase in migration (de Haas, 2009). The case for this argument is even stronger for those in the middle- and upper-part of skill and education level who may reap the benefit of NAFTA-induced additional economic growth.

Meanwhile, a longer-term look into simple descriptive statistics of Mexico-US migration indicates that the migration-reducing impact of NAFTA has started to materialise in recent period. This gives the hint that the adjustment period due to NAFTA (the migration hump), exacerbated by financial crisis, may be close to end amidst increasing absolute number of migrants. Table 1 shows that between 1995 and 2000, migration from Mexico to US far exceeded the reverse. However, in 2005-2010, the data show that actually more people are moving from US to Mexico instead of the other way around. Mexico-US migration in 2005-2010 was less than half of it was in 1995-2000. Although Table 1 is purely descriptive, it gives the impression that the migration hump hypothesis which predicts 5 to 15 years of adjustment (hump) period may indeed explain what has happened to Mexico-US migration following NAFTA. Figure 1 and table 1 provide early indication that following

NAFTA, Mexico-US migration has been growing in earlier time and now has started to come down. The inclusion of Mexico as part of the next exciting emerging economies, MINT, could mean that going forward Mexico is heading toward migration transition, and becoming a rising destination country.<sup>1</sup>

**Table 1. Mexico in Transition: Migration Flow (in million)**

	1995-2000	2005-2010
Mexico -> US	2.94	1.37
US -> Mexico	0.67	1.39
Net Migration	2.27	-0.02

Source: [http://www.nytimes.com/interactive/2013/09/22/world/americas/migration-to-mexico.html?\\_r=0](http://www.nytimes.com/interactive/2013/09/22/world/americas/migration-to-mexico.html?_r=0)

### 3 Related literature

The traditional view of trade theorists is that trade liberalisation, in the context of South-North mobility, shall lead to less migration. This prediction is the implication of the neoclassical models proposed by Heckscher (1949), Ohlin (1933), Mundell (1957) and Stolper and Samuelson (1941). This model considers countries with different factor endowments – thus, fits well with the South-North dichotomy. Assuming that the country-pair possesses similar production functions (technology) and factors of production, under a free trade regime, the country will export the goods that uses intensively the abundant factor, vice versa. Under this scenario, capital-rich country (North) shall export capital-intensive goods more intensively whereas labour-rich country (South) exports more of labour-intensive goods.

Under the neoclassical trade model, if a tariff is imposed by capital-rich country against labour-intensive imports from labour-rich country, this will result in the rise of factor prices (wages) relative to other factor and goods prices in capital-rich country. To put it in a migration context, such event shall increase the wage differentials between capital-rich and labour-rich countries. Assuming that wage differentials serve as a trigger for migration, unfree trade regime shall increase migration. Conversely, a free trade regime shall reduce the push-pull factor to migrate from the ‘South’ to the ‘North’.

This neoclassical model is likely to be the intellectual motivation for trade liberalisation policy such as NAFTA. As confirmed by the quotation above from former Mexican President Salinas, Mexican government’s stated policy goal is to export more of its goods instead of its people. In fact, as mentioned by Martin and Taylor (1996), the Commission for the Study of International Migration and Co-operative Economic Development established through 1986 IRCA concluded in their report that expansion of trade between US and migrant-sending countries is the ‘single most important remedy’ to reduce migration.

The policy logic is that by establishing freer or less-restrictive trade regime between US and migrant-sending countries, this shall promote ‘specialisation’, hence shifting in production of labour-intensive goods to migrant-sending countries while capital-intensive goods production will be shifted to the US. Eventually, the wage level at migrant-sending countries shall experience an upward pressure, thus possibly reducing inter-country wage differentials and discouraging migration.

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<sup>1</sup> MINT countries are Mexico, Indonesia, Nigeria, and Turkey. This acronym is popularised by a former Goldman Sachs’ economist Jim O’Neill, as the next cohort of uprising emerging economies after BRIC (Brazil, Russia, India, and China). BBC in January 2014 wrote a piece on MINT (<http://www.bbc.co.uk/news/magazine-25548060>).

Neoclassical trade model has gone through some criticism due to its assumptions that are unlikely to be satisfied in the real world. Several later trade theorists thus attempt to further develop the neoclassical model by relaxing some of its assumptions. For instance, Markusen (1983) argues that trade and migration could be complements if the motivation for trade is other than difference in factor endowments. For instance, if trade happens because of technological differences, then trade and migration may no longer be substitutes. Such assumption may fit better in reality. It is not that easy to imagine that Mexico and US share the same technological level.

Martin and Taylor (1996) support the argument laid by Markusen (1983) by providing an illustration of a freer trade regime for grain between US and Mexico. Since US has more advanced technology in grain production compared to Mexico, this will lead to US grain producers to have a comparative advantage in grain production. As such, the removal of trade barriers for grain market might eventually lead to more migration since given US grain producers' comparative advantage due to their high-technology, labour displacement shall occur in Mexico, hence lowering the wage level in Mexico which will eventually lead to more migration from Mexico to US.

Schiff (1996) goes further to model the case where trade and migration become complements. He proposes three mechanisms to support his argument. The first model incorporates migration costs and financial constraints faced by potential migrants. Since trade liberalisation leads to higher general welfare, through an increase in employment and wages, this will relax the financial constraints faced by the financially constrained migrants –those who could have not migrate without higher income level.

The second mechanism is more relevant to high-skilled migration case. Schiff (1996) argues that assuming the existence of factor specificity in the form of significant adjustment costs –the cost to relocate factors from one economic sector to another-, trade liberalisation may lead to a temporary increase in unemployment or decrease in wages level in the sector being liberalised in the 'South' country. If one considers high-skilled migrants as more mobile internationally, these type of individuals may migrate more abroad if they are displaced because their sector is temporary 'distressed' caused by trade liberalisation.

The third mechanism proposed is more relevant to the Mexico-US case. Consider that in most 'South' countries, labour-intensive sectors are the ones that are heavily protected. Schiff (1996) points out that in the mid-90s, agricultural import substitutes sectors in Mexico are notable cases where specific sectors still enjoyed the highest-degree of protection level. Since these sectors are more likely to be more labour-intensive than other tradable sectors, trade liberalisation may indeed lower wages, triggering more migration.

The relationship between trade and migration is not only substitutes or complements. Some scholars have argued that it could be both. We have seen that earlier scholars argue for the substitution relationship between trade and migration e.g. Mundell (1957), and further reconfirmed by Faini and Venturini (1993). On the other hand, some later scholars propose the possibility in which trade and migration are complements e.g. Markusen (1983) and Schiff (1996).

There is a third possible relationship in which both substitutes and complements effect take place if one decomposes the effect into short- and long-run. This phenomenon is called 'migration hump', in which temporary dislocations occur, and its persistence depends on the length of adjustment due to trade liberalisation. 'Migration hump' hypothesis was proposed by Martin and Taylor (1996), who argue that trade liberalisation may have two contrasting effect to migration. In the short- or medium-run, trade liberalisation may trigger more migration whereas in the long-run their relationship shifts to substitutes (migration hump). This somewhat 'hybrid' explanation borrows the theoretical

rationale of both theoretical camps. However they put a time-dimension by allowing the short- and long-run effect to differ. However, there is always a reason for prolonged ‘hump’, which is called ‘migration plateau’ (Martin and Taylor, 1996; de Haas, 2010).

Thus, the ‘migration hump’ model does not explain much about the timing of shift i.e. when the substitute effects of trade liberalisation will kick in. In general, Martin and Taylor (1996) and Martin (2005) believe the duration of the hump to be approximately 5–15 years. Furthermore, Martin and Taylor (1996) argue that the amplitude of migration hump is likely to be relatively small. This implies that in the long-run free trade does indeed reduce migration. The short-run migration pressure, the size of the hump, depends on several factors in both ‘North’ and ‘South’ countries are important.

The size of the hump is affected by the comparative advantage of the ‘North’ after trade liberalisation takes place. The greater the advantage, for instance due to huge technological gaps or economies of scale, the more prolonged the hump will be. The amount of migration also depends on how big the adjustment cost is for the ‘South’. If the ‘temporary wounds’ due to trade liberalisation are deep and quite long, this means the adjustment costs are higher. Such event will end up in prolongation of the migration hump (‘migration plateau’). Martin (2005) provides three conditions that lead to migration hump: (i) continued demand-pull for migrants in the destination country; (ii) an increased supply-push in the country of origin; and (iii) migration networks that can move workers across borders.

Theoretical models of trade and migration are inconclusive in their empirical prediction or policy implication regarding the impact of trade liberalisation on migration. Therefore, this conundrum of trade and migration relationship is more likely to be an empirical task. Nonetheless, such thing is not that easy to be executed. The main reason has been more on the migration data. Well-documented and well-harmonised data on international migration were scarce, let alone quality data on migration. Hence, empirical exercise to assess the impact of trade liberalisation policy on migration is quite a daunting task both methodologically and data-wise; thus some studies assessing the migration impact of NAFTA have relied more on ex-ante approach.

One example of ex-ante studies is Robinson et.al. (1993) that construct a computable general equilibrium (CGE) model to estimate the impact of NAFTA on Mexico-US migration flows in a comparative-static framework. They find a dilemma in bilateral trade growth and labour migration relationship. Trade liberalisation leads to more migration, both Mexican internal migration and Mexico-US migration. The case for reduction in Mexico-US migration only happens if Mexican growth is more robust relative to US growth and if Mexico do not revoke their farm support programs. There is a dilemma however, since more support to Mexican farmers leads to less bilateral trade growth. Accordingly, policy maker has to deal with this policy trade-off.

Another study that also performs simulation approach is, for instance, Faini and de Melo (1996) that employ a macroeconomic simulation and applies it to the case of Morocco. They show that trade liberalisation could yield a positive effect on employment in the migrant-sending country, hence reducing migration. In the case of Morocco, their estimates show that trade liberalisation reduces migration through two channels, these are higher domestic income and stronger employment growth.

Meanwhile, empirical ex-post studies on this matter are plagued both by the lack of data availability on international migration and methodological challenge to successfully isolate trade liberalisation policy. The implication is that the orientation of econometric exercises tend to lean more towards micro-level studies by exploiting survey data. Nevertheless, such an approach is also limited by the fact that migration phenomenon is inherently self-selected. Consequently, this makes micro-

level exercises e.g. survey-based studies are likely to suffer from self-selection problem, resulting in biased estimates. These challenges, both for macro-level and micro-level studies, lead to not-so-many statistical-approach studies that evaluate trade liberalisation such as NAFTA.

Most macro-level studies that discuss migration and trade mostly focus on the impact of migration on trade. That is, whether more migration leads to more trade or in other words, the trade-creation effect of migration. As explained before, estimating trade liberalisation policy effect is a tricky task, and thus most empirical studies only incorporate and analyse the relationship between trade and migration –thus no where close to really investigate any policy effect.

One example that attempts to estimate the impact of NAFTA on Mexico-US migration at the macro level is Melchor Del Rio and Thorwarth (2009). Using irregular migration as dependent variable and employing a distributed lag model, they do not find any significant impact of NAFTA on reducing irregular migration. They capture the effect of NAFTA by coding it as dummy variable. They do find the positive relationship between trade flows and irregular migration, however, the direction of causality is unclear and NAFTA impact is not significant.

Other NAFTA-related studies have been more micro-inclined. For example, Boucher et al. (2007) investigate the impact of various migration-related policy, including NAFTA on the supply of Mexican labour to US farms. Coding the NAFTA effect as dummy variable, and incorporating it to a village-level survey data, and by employing the Arellano-Bond generalised method of moments (GMM) procedure, they find that NAFTA increases the supply to US farms. Another village-level study is Richter et al. (2007), by conducting a least square dummy variable (LSDV) method, that find a significant effect of NAFTA in reducing Mexico-US migration. They inclusion of NAFTA is also by dummy variable. Both Boucher et al. (2007) and Richter et al. (2007) use the same data source: a randomised survey of Mexican village – Mexico National Rural Household Survey (ENHRUM), which means self-selection problem should be less an issue in their estimates.

As we can see, inconclusive findings are also found in empirical studies related to impact of NAFTA on Mexico-US migration. Moreover, the main challenge of policy evaluation still prevails. NAFTA is basically a policy intervention at the macro level with over-arching micro-effect. As such, macro-level policy assessment is a tricky task due to the non-experimental nature of macro-data. Evaluating NAFTA's impact on migration at the micro-level is also not an easy task due to the fact that the effect of NAFTA is not randomly distributed over sample –even if the survey is randomly assigned-, it is still impossible to separate the control and treatment based on NAFTA.

Thus, most empirical studies have relied on the traditional approach of dummy variable inclusion to the empirical model or alternatively rely on ex-ante simulations. This paper attempts to contribute to the current literature of trade and migration by conducting a macro-level policy impact assessment of NAFTA on migration, moving away from dummy variable approach, and instead go for data-driven event analysis suitable for comparative case studies i.e. synthetic control method.

## 4 Method and data

This paper applies synthetic control method as its main method. In the presence of exogenous policy intervention and clear-cut control group(s), researchers can easily deploy comparative case studies. In the topic related to migration, one example is Card (1990) that analyses the effect of 1980 Mariel Boatlift on the labour market in Miami by using other Southern US cities as control group. However, some specific policy such as NAFTA is inherently specified at the macro-level. Therefore, it is not so easy to determine the appropriate comparison group.

Abadie et.al. (2010) propose a novel empirical methodology that may suit as an alternative tool for policy evaluation at the macro level: synthetic control method. Basically, the synthetic control method constructs a weighted combination of control units from potential pool of ‘donors’. In our case, Mexico-US migration is our treatment unit. Any other migration flows from other countries could be considered as potential donors for our ‘synthetic Mexico’. As such, Canada-US migration flows, as example, are hence excluded for consideration as donor because Canada is also affected by NAFTA policy (part of treatment).

In principle, synthetic control method aims to remedy several main drawbacks of the usual comparative case studies approach. First, synthetic control method provides more transparent and less ambiguous procedure in the selection of comparison. Traditional comparative case studies give space for a considerable case of ambiguity in its selection of control groups. Abadie et.al. (2010) state that in traditional comparative case studies method, ‘researchers often select comparison groups on the basis of subjective measures of affinity between affected and unaffected units’. Therefore, synthetic control method offers a more objective procedure in the construction or selection of comparison group. Thus, it lets the data speak more and put subjectivity aside.

Second, synthetic control method is transparent and prevents extrapolation. It provides explicitly the relative contribution of each control unit in the construction of the ‘synthetic unit’ to assess the counterfactual. Furthermore, no extrapolation will happen because the sum of the weights of each control unit in the ‘synthetic unit’ will always equal to one.

One example in the use of synthetic control method went back to Abadie and Gardeazabal (2003) – at that time the name ‘synthetic control method’ was not yet introduced instead it was still classified a specific type of event studies. They analyse the economic costs of conflict in the Basque region. Instead of subjectively choose one Spain region as comparative group – such as in Card and Krueger (1994) in their choice of Pennsylvania as comparison group and go for micro-analysis – Abadie and Gardeazabal (2003) stay at the macro-level and thus develop a novel methodology which gives the way for the introduction of synthetic control method.

Another example in the use of synthetic control method is Abadie et.al. (2010), who give the seminal theoretical and empirical example in the use of synthetic control method for comparative case studies in social sciences. That said, they contend that synthetic control method is a promising alternative option for social science researchers interested in a more data-driven comparative case studies method that is transparent and more objective as well as more suitable for ex-post policy intervention evaluation at the macro level.

We follow Abadie et.al. (2010) to describe analytically how synthetic control method works. It is natural to consider that we have a panel data set up in which we have  $i=1$  to  $J$  cross-sectional unit observation, thus we have  $J+1$  units in  $T$  periods. Suppose our first unit  $1$  i.e. Mexico is exposed to policy intervention in  $T_0$ . Consider  $Y_{it}$  as the outcome that is observed for  $i$  at time  $t$ , so that we have the general model for all potential outcomes for all units as the following:

$$Y_{it} = \tau_{it} + \delta_t + v_{it} \quad [1]$$

in which  $v_{i,t}$  could be expressed by the following factor model:

$$v_{it} = z_i\theta_t + \lambda_t\mu_i + \varepsilon_{it} \quad [2]$$

where  $\tau_{it}$  is the dynamic treatment effects in which  $\tau_{it} = 1$  if  $i=1$  and  $t>T_0$ , and  $\tau_{it} = 0$  if otherwise.  $\delta_t$  is common time period effect and  $v_{i,t}$  is error.  $z_i$  is a vector of relevant observed covariates not affected by the intervention,  $\theta_t$  is a vector of time-specific parameters,  $\lambda_t$  is a vector of unobserved

common factor,  $\mu_i$  is unit-specific unobservables, and  $\varepsilon_{it}$  is zero-mean transitory shocks at the unit level.

In the context of this paper,  $z_i$  is thus the predictors of migration flows as well as migration flows of any potential unit pre-NAFTA. The goal is to obtain estimates when  $t > T_0$ , thus post-intervention counterfactuals, which can be written as:

$$\alpha_{1t} = Y_{1t} - y_{1t}^C \quad [3]$$

where  $Y_{1t}$  is already known thus we estimate its counterfactuals  $y_{1t}^C$ .  $\alpha_{1t}$  is thus the gap in outcome variable between our treatment unit  $Y_{1t}$  and its synthetic control  $y_{1t}^C$ . In other words,  $\alpha_{1t}$  is the estimated effect of intervention.

To do so, we define a  $(J \times 1)$  vector of weights for  $W = (w_2, \dots, w_i)$  such that  $w_i \geq 0$  and  $\sum w_i = 1$ . The first term ensures that all weight will be positive and the second term implies that the sum of the weight of all control units is equal to one.  $W$  thus incorporates the contribution of weights from potential pool of ‘donor’ units which is used to construct the synthetic unit or in short, a particular weighted average of control units.

Thus, incorporating the weights to estimate  $y_{1t}^C$  in [3] into [1] and [2], we can write the following equation to determine the estimates of the outcome variable for each synthetic control weighted by  $W$ :

$$\sum_{i=2}^{J+1} w_i Y_{it} = \delta_t + \theta_t \sum_{i=2}^{J+1} w_i z_i + \lambda_t \sum_{i=2}^{J+1} w_i \mu_i + \sum_{i=2}^{J+1} w_i \varepsilon_{it} \quad [4]$$

Suppose there are  $(w_2^*, \dots, w_i^*)$  such that the following conditions hold:

$$\begin{aligned} \sum_{i=2}^{J+1} w_i^* Y_{i1} &= Y_{11}, \sum_{i=2}^{J+1} w_i^* Y_{i2} = Y_{12}, \dots, \\ \sum_{i=2}^{J+1} w_i^* Y_{iT_0} &= Y_{1T_0}, \quad \text{and} \quad \sum_{i=2}^{J+1} w_i^* z_i = z_1 \end{aligned}$$

Then, we can rewrite [3] as the following:

$$\alpha_{1t} = Y_{1t} - \sum_{i=2}^{J+1} w_i^* Y_{it} \quad \text{for } t \in \{T_0 + 1, \dots, T\} \quad [5]$$

The computation of  $w^*$  is then used to minimise the distance  $\|X_1 - X_c W\|$  where  $X_1$  is the vector of pre-treatment characteristics and  $X_c$  is its synthetic counterpart.

The main drawback of synthetic control method is that it does not provide statistical inferences normally used in large data set panel estimation. This comes unsurprisingly since most often we likely to end up with relatively small number of control units to construct the synthetic unit. Abadie et.al. (2010) suggest to conduct a battery of placebo studies to evaluate the significance of synthetic control method estimates.

The idea of placebo test is to perform the synthetic control algorithm sequentially to every country in the donor pool of our potential control units, and compare the placebo results with our baseline treatment unit estimates. That means we treat other control units as if they had been exposed to the intervention.

If the placebo studies result in gap pattern relatively identical to the synthetic control estimates, then our estimated intervention effect does not provide significant evidence. In other words, the results of our synthetic control estimation are likely to be driven by chance. On the other hand, if our synthetic control result yields distinct pattern compared to the placebo results, then we can confidently argue that our results are valid. In the case of this paper, if the result of our synthetic Mexico is not significantly different from placebo results, then the policy effect is not likely to be valid.

Another important thing is the precision of pre-intervention synthetic control. This aim is to construct a synthetic control which as precisely as possible fits the treated unit in pre-intervention period. Poor fit between the synthetic control and the treated unit for pre-intervention period brings the implication that any post-intervention gap is likely to be driven artificially by the lack of fit rather than policy intervention (Abadie et al., 2010). In this case, inferences from synthetic control approach may be erroneous.

The data for this paper are taken from various sources: MOxLAD, World Bank, Penn World Table, CEPII, and DEMIG database. I initially limit the selection of countries to 20 Latin American countries, including Mexico, based on MOxLAD database. In synthetic control approach, it is not advisable to simply pool all available units as potential donors. In our case, pooling all countries in the world is actually a sub-optimal decision. Large degree of heterogeneity in the potential pool of donors may induce interpolation bias, even if the synthetic control has a good fit with the treated unit. Abadie et al. (2010) suggest to limit the potential donor pool to units that share similar characteristics to the unit exposed to policy intervention. This argument supports our decision to limit our sample for Latin American countries only.

After merging the dataset, I had to drop Paraguay, Cuba, and Haiti from the potential control unit pool of countries due to missing data for some predictor variables. Thus, we ended up with 17 Latin American countries in total. For the 1974–2010 period. Therefore, we have a sufficient post-intervention period to assess short- and long-run effect of NAFTA on Mexico-US migration. The outcome variable of interest is annual migration flows to the US as share of sending country's population compiled by the DEMIG project of the International Migration Institute. Definition of variables and sources are provided in the appendix.

## 5 Results

Before I conduct the synthetic control, it is useful to start with simple regression model. The regression shall complement the descriptive statistics presented before in which we are interested whether we can get some hints of migration hump. I only use Mexico data for this analysis. To capture the possibility of migration hump hypothesis, I introduce the squared-term of NAFTA trend.<sup>2</sup> I also control for the potential effect of the 1990s Tequila Crisis.<sup>3</sup> Given that we have time-series regression, I run ordinary least squares (OLS) regressions with Newey-West standard errors so that the standard errors are consistent in the presence of heteroscedasticity and autocorrelation. The regression is basically an AR(1) model. The results are presented below in Table 2.

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<sup>2</sup> NAFTA trend is defined as time trend following NAFTA's implementation. Thus, 1994=1, 1995=2, 1996=3, and so on.

<sup>3</sup> Tequila Crisis dummy is defined as 1 for 1994-2000, and 0 otherwise. This categorisation follows Reinhart and Rogoff (2009).

**Table 2. AR(1) Regression for Mexico-US Migration**

Independent Variable	Dependent Variable			
	Log of Migration		Migration Rate	
	Coefficient	Newey-West S.E.	Coefficient	Newey-West S.E.
Log of Migration (lagged)	-0.093	0.197		
Migration Rate (lagged)			-0.106	0.153
Population Mexico	1.980	1.956		
NAFTA trend	0.149***	0.048	0.018***	0.004
NAFTA trend squared	-0.006***	0.002	-0.001***	0.000
1990s Financial Crisis	0.110	0.109	0.002	0.013
F-Stat	68.94***		21.57***	
Observations	44		44	
Time Trend	YES		YES	
Constant	YES		YES	

From Table 2, we again find some hint of the potentially hump-shaped effect of NAFTA. These findings do not change if we use different measure of migration flows. However, the magnitude of squared term of NAFTA trend is pretty small. This indicates a somewhat prolonged positive impact of NAFTA on Mexico-US migration flow. According our simple AR(1) model, the inflection point of NAFTA's impact occurs after 12–14 years. Hence, our regression exercise further supports the descriptive statistics discussed previously. We will compare this regression finding with our counterfactual analysis using synthetic control method.

Now we shall deepen our analysis by conducting the synthetic control method. The first step is to construct synthetic Mexico. To do so, I use the 16 Latin American countries. The intervention date for our baseline estimate is 1994. This is based on the fact that as early as January 1994, trade liberalisation measures have started to put into effect. Boucher et.al. (2007) point out that some agricultural commodity trade was already liberalised in that month. Hence, putting 1994 as our policy intervention date seems to be the most reasonable choice.

However, one may rise the question to the choosing of 1994 as policy intervention date. Is it really the case that NAFTA is the only migration-related policies taking place in 1994? Is there any other non-migration or migration policies started effectively in 1994? Certainly, for the concern to qualify, such policy has to be considered as having nation-wide impact on Mexico-US migration flows.

Massey and Pren (2012) show that there were two restrictive enforcement operations launched by the US Department of Homeland Security in 1993 (Operation Blockade) and 1994 (Operation Gatekeeper). Furthermore, they state that these measures were heavily publicized, 'including official releases, press conferences, and saturated media coverage' in addition to being broader in its scope. Certainly, we would expect that such restrictive migration measures would affect more on irregular immigration flows. Nevertheless, such measures might deter any potential migrants from migrating at all.

Another issue, and perhaps is more interesting, is the fact that in December 1994, Mexico started to experience the peso (tequila) crisis. The value of peso depreciated by around 50% in just around six months. As we have discussed, theory shows that economic slump in origin country may trigger more migration. Thus, the tequila crisis could be a nuisance in our estimates.

To reduce the risk of having multiple opposing interventions in our exercise (broder control vs free trade and tequila crisis) and if we add this up with the expectation that broader implementation or impact of NAFTA took some time to kick in, I also use 1995 as the intervention point. This also

serves as further check of intervention date selection, to see if our results are robust to slightly different intervention period.

To construct the synthetic Mexico-US migration flows, I rely on traditional variables used in gravity models of international migration: GDP percapita and distance. I also include measure to proxy migration networks i.e. migration stock for the 1980 and 1990. These basic gravity variables are then supplemented by various economic variables of the origin country that may characterise and determine migration flows to the US. I include measure of income inequality i.e. share of income owned by the top 20% of population. The inclusion of this variable is relevant because within-inequality is an important determinant of international migration as well as migration selection.

Next, I also include the measure of foreign direct investment. This variable is highly relevant as it serves the trade and migration literature, both neoclassical and world systems theory. Another variable is public education spending. The inclusion of this variable is important because education, important ingredient to support human development, may affect migration decision. Especially, if the nation is lacking accessible private education provision, as is the case in many developing countries. The final variable to be included is domestic credit to GDP as a proxy for financial development. The inclusion of this variable allows us to also apply the rationale from new economic of labour migration, in which missing credit markets is considered as the central cause of migration.

As depicted in Table 4, for 1994 as intervention date, our synthetic control is constructed from Costa Rica and Dominican Republic (model 1). Using 1995 as intervention point gives us additional set of country donors: Argentina and Venezuela (model 2). The weights of countries in synthetic Mexico and the value of pre-intervention variables for synthetic Mexico are given in table 4. Only Costa Rica and Dominican Republic appear in both models as donors. Costa Rica consistently shows up as large contributor in both models with nearly 90% and 32% share of the synthetic control weight ( $W^*$ ) in model 1 and model 2, respectively. Dominican Republic also consistently contributes between 13-19% in both models. In model 2, Argentina is the top donor with 44% weight.

The results of our synthetic control estimates are given in Figures 2 and 3. The fit of synthetic Mexico pre-NAFTA appears to be quite excellent. In Figure 3, I employ 1995 as intervention date. Overall, both model 1 and 2 have very small root mean squared prediction error which indicates that our synthetic control is reliable.

In general, the results indicate that post-NAFTA period, migration flows to the US from Mexico increased with around one-year policy lag with a ‘hump’ like shape. In both models, the result hints that the complementary effect of NAFTA on migration took place around one-year after the initial implementation of such trade liberalisation. The hump duration is estimated to be approximately 15 years. Thus, our hump estimates confirm Martin and Taylor (1996) theoretical conjectures of ‘migration hump’ duration. This hump-alike shape is clear to see in Figure 4 when I plot the estimated effect for each year. As can also be inferred from Figure 4, model 2 displays a slightly faster move towards the substitution impact of trade liberalisation after 15 years of the implementation of NAFTA. The qualitative interpretation though remains the same. If the pattern we see in our synthetic control estimates continues, *ceteris paribus*, we should expect that after 2010, legal labour migration flows to US should follow a decreasing trend (trough episode).

The size of the hump (average hump amplitude) is around 0.07% (measured as migration flows share to total population). Given the average value of migration share for our sample is 0.08%, this means that the estimated NAFTA effect is large. However, we need to take into account that our intervention date coincides with the tequila crisis. Therefore, the rapid surge of migration following NAFTA is likely to be further strengthened by the crisis.

Unfortunately, it is impossible to separate NAFTA and the financial crisis effect. However, we can be sure about our estimates because given that NAFTA had a 15 year phase-in period, this means the effect of NAFTA is staggering and quite possibly is depicted in the long-run pattern of our estimates. Meanwhile, the effect of the tequila crisis is not likely to have longer persistence.

This conjecture is supported by the financial crisis episodes collected by Reinhart and Rogoff (2009). As we can see in Table 3, Mexico was basically in a combination of financial crises in 1994–2000. What initially started as peso crisis (currency crisis) evolved into multitude of financial crises such as inflation crisis and banking crisis. This series of financial crises further strengthen our argument that the prolonged migration hump as well as the relatively large size of the hump are corroborated by the crises. In other words, the financial crises experienced by Mexico made the post-NAFTA adjustment period longer and more severe. It triggers more push-factors to migrate to the US and creates the migration hump.

**Table 3. Mexico: Post-NAFTA Episodes of Financial Crises**

Year	Currency crises	Inflation crises	Stock market crash	Banking crises	Crisis total
1994	1	0	1	1	3
1995	1	1	1	1	4
1996	0	1	1	1	3
1997	0	1	0	1	2
1998	1	0	1	1	3
1999	0	0	0	1	1
2000	0	0	1	1	2
2008	1	0	1	0	2

Source: Reinhart and Rogoff (2009). 1=crisis, 0=no crisis

Following the economic crisis, in 1995 total unemployment in Mexico rose to 6.9% compared to only 4.2% in 1994 based on ILO data. Interestingly, this spike in unemployment rate is attributed to youth unemployment (15-24 years of age). In 1995, youth unemployment in Mexico was 11.2% in contrast to merely 7.0% in previous year. As younger population in productive age has more propensity to migrate and the presence of strong Mexican migrant network in the US, it is no surprise that migration went up. The adjustment lags and costs related to trade liberalisation i.e. NAFTA hence amplifies the incentives to migrate. Another issue is factor specificity. The structure of labour supply may not respond swiftly to the adjustment and displacement due to NAFTA. Agricultural workers cannot be transformed immediately into manufacturing workers. Given the lack of protection and missing credit markets typical in developing countries, these segment of population hence have more incentives to migrate (Martin and Taylor, 1996).

How confident are we with our findings? We employ placebo studies to assess the validity of our results. As can be seen in Figure 5, we can detect that our estimates have quite distinctive pattern compared to other placebos. The shape resembles a hump with considerable amplitude. After a one year lag for the impact to kick-in, trade and migration are complements following trade liberalisation. In the long-run, trade and migration relations becomes more of a substitute. To further check the validity of our synthetic control method, I follow Abadie et.al. (2010) by conducting more restrictive placebo estimates. Countries with pre-NAFTA mean squared prediction error (MSPE) two times higher than Mexico's are dropped.<sup>4</sup> Therefore, our placebo exercise will only be based on countries that have similar pre-NAFTA MSPE values as our synthetic Mexico. In other words, I drop estimates for countries with poor fit in the pre-intervention period. Thus, we now compare Mexico with other placebo estimates that have similar good fit. Figure 6 clearly shows the distinct pattern of our

<sup>4</sup> These countries are Dominican Republic, Nicaragua, Panama, and El Salvador.

Mexico's estimated gap. This corroborates our conviction on the validity of our estimates using synthetic control method.

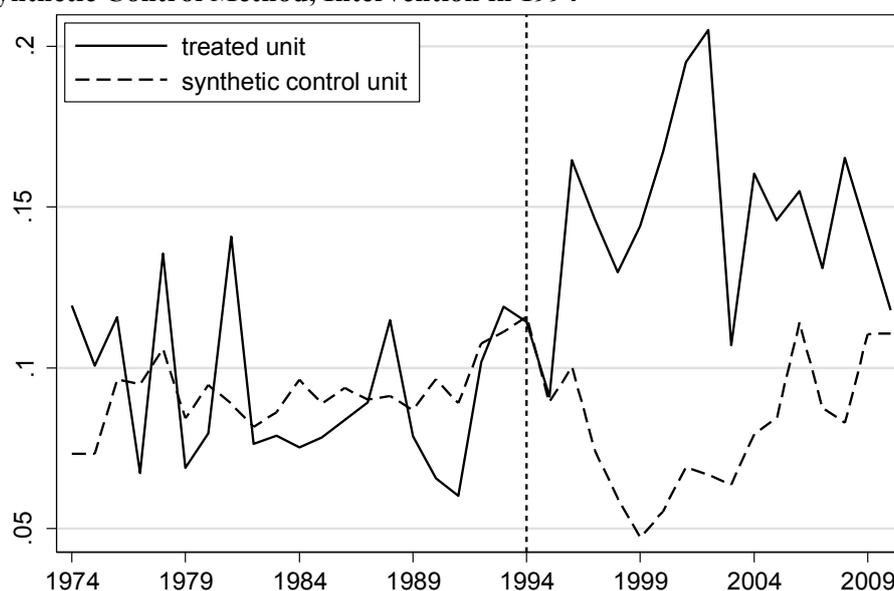
To sum up, synthetic control method confirms the findings based on simple regression analysis conducted earlier (Table 4). I find non-linear impact of NAFTA. The inflection point, nevertheless, differs slightly. Our estimates using synthetic control method shows 15 years of hump period compared to 12-14 years using AR(1) regression model. However, since synthetic control method is basically a counterfactual scenario analysis, we can be confident about the effect of NAFTA. The magnitude of NAFTA impact is amplified by the Tequila Crisis happening almost at the same period. The prolonged hump is explained by the lengthy crisis period suffered by Mexico as well as the 15 years phase-in period of NAFTA.

**Table 4: Synthetic Control Method Results: Weights and Control Units**

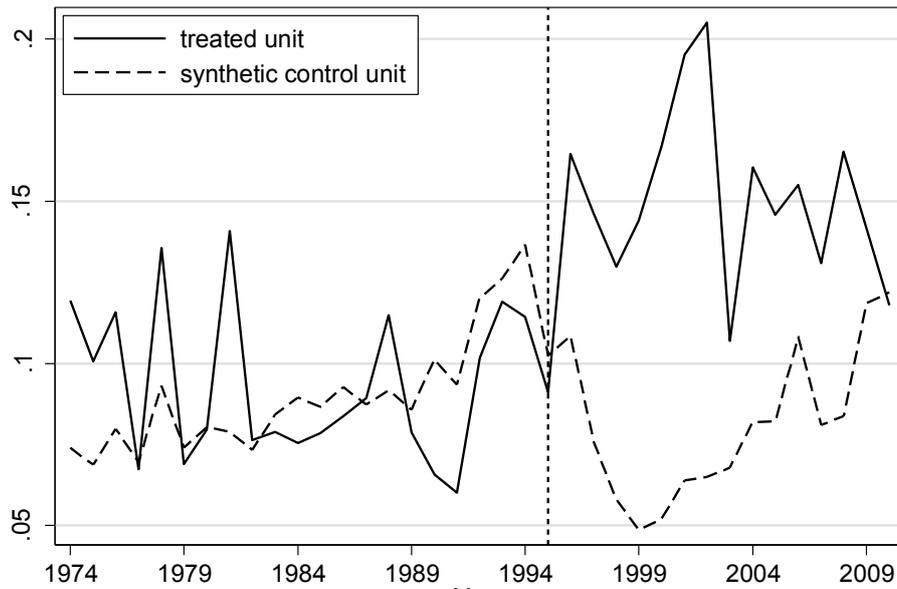
Predictors	Model 1: 1994			Model 2: 1995		
	Mexico	Synthetic Mexico	All controls <sup>a</sup>	Mexico	Synthetic Mexico	All controls <sup>a</sup>
Public Spending on Education	2.755	4.714	3.148	2.829	2.890	3.139
Income share owned by top 20%	46.593	49.713	56.300	49.168	51.029	56.188
Foreign Direct Investment, Net	1.022	1.668	0.847	1.098	1.149	0.914
Domestic Credit to GDP	19.586	20.865	30.874	20.494	23.160	30.837
Log GDP per capita	9.134	8.847	8.508	9.139	8.855	8.510
Log Distance	7.392	8.123	8.439	7.392	8.531	8.439
Migrant Stock in US, 1980	3.157	1.552	1.042	3.157	1.123	1.042
Migrant Stock in US, 1990	5.164	1.982	2.079	5.164	1.541	2.079
<b>Relative Weight (W*)</b>						
	Costa Rica		0.869	Argentina		0.442
	Dominican Republic		0.131	Costa Rica		0.321
				Dominican Republic		0.187
				Venezuela		0.050
Root Mean Squared Prediction Error			0.024			0.026

<sup>a</sup> Average of all control countries in specified pre-intervention period

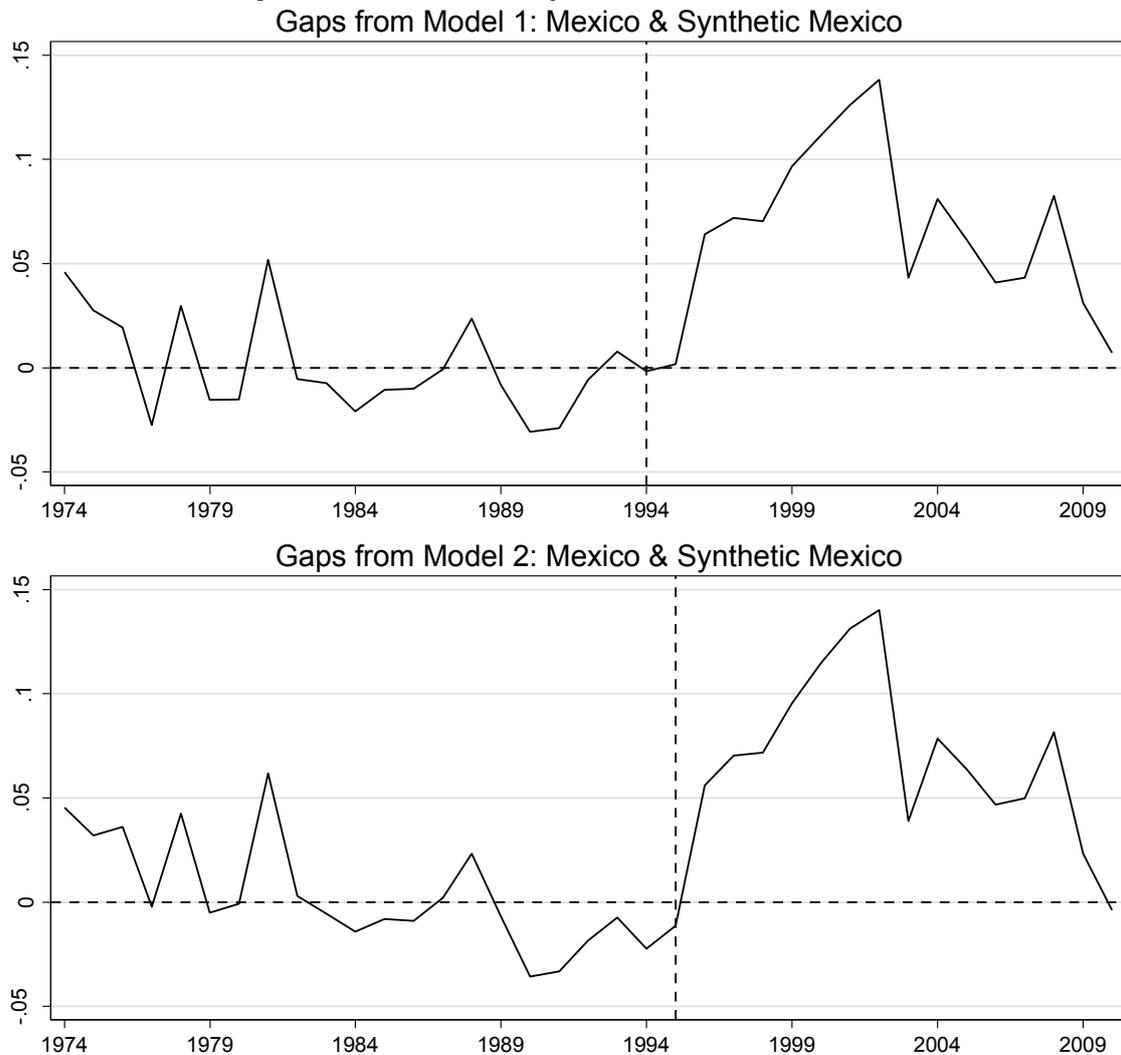
**Figure 2: Synthetic Control Method, Intervention in 1994**



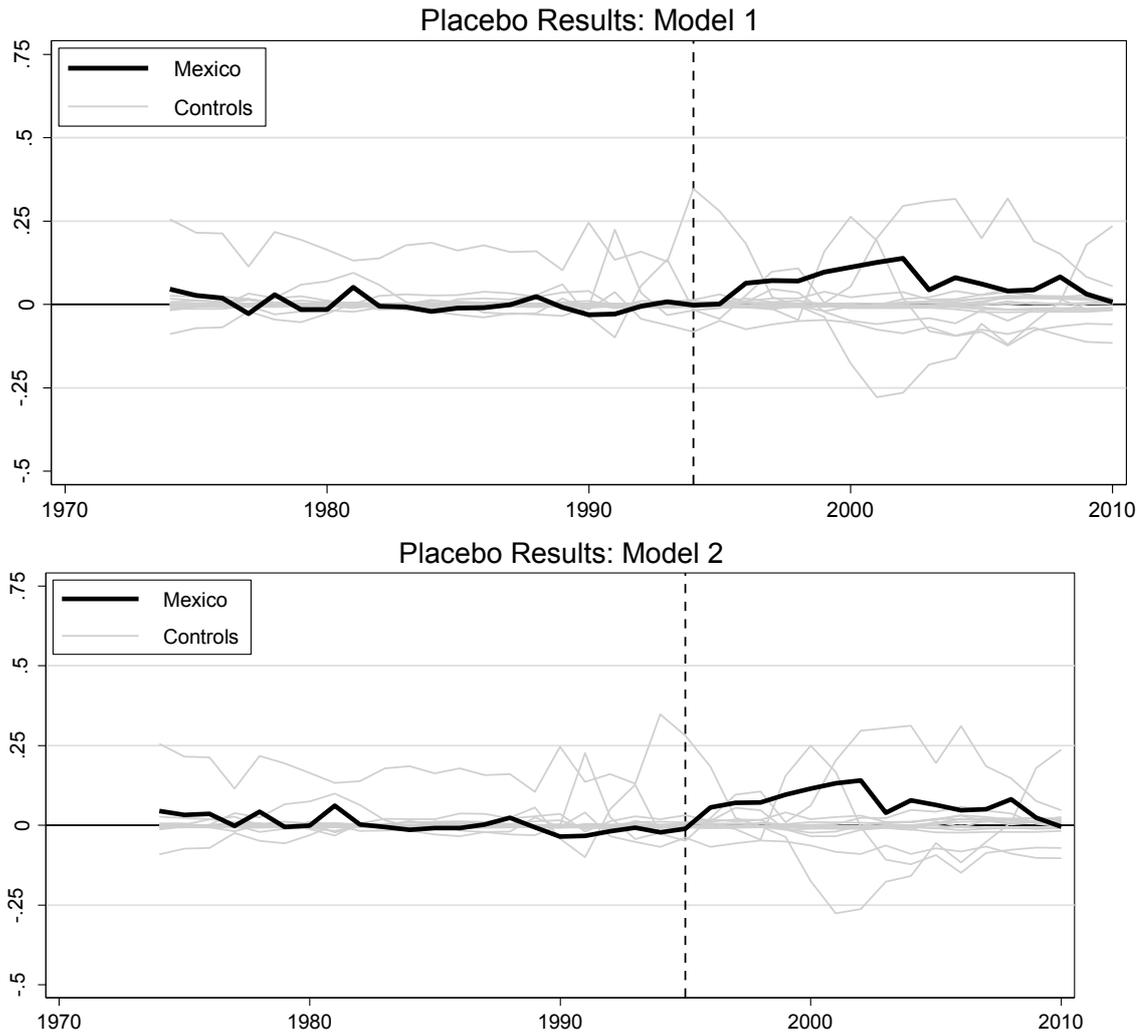
**Figure 3: Synthetic Control Method, Intervention in 1995**



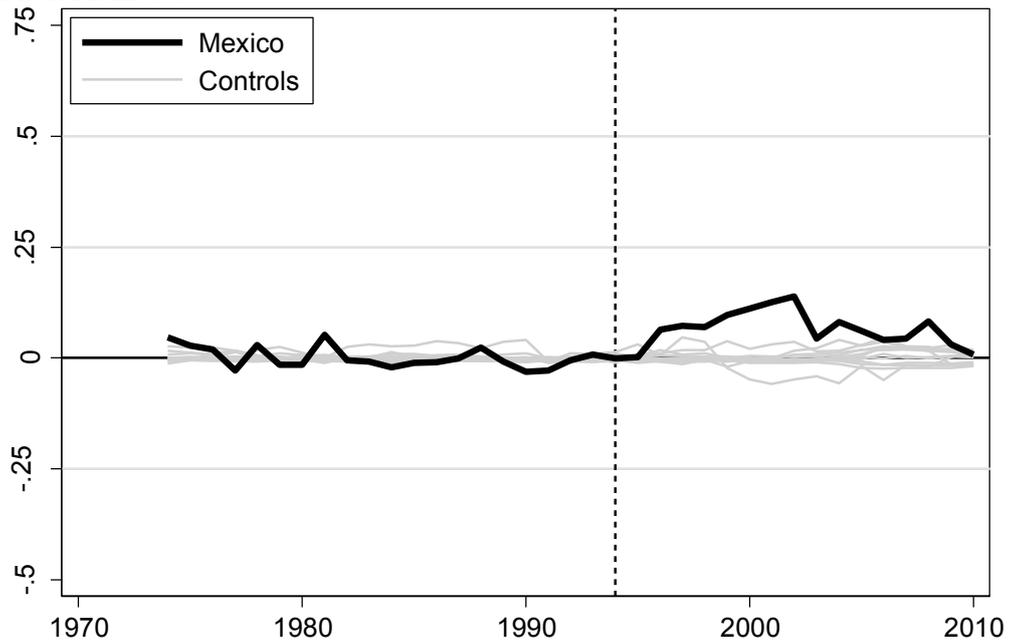
**Figure 4: Estimated Gaps between Mexico & Synthetic Mexico**



**Figure 5: Placebo Simulation results**



**Figure 6. Placebo Simulation Results: Discard Countries with Pre-NAFTA MSPE Two Times Higher Than Mexico's**



## 6 Conclusions

To sum up, in this paper I present the evidence of ‘migration hump’ phenomenon in Mexico-US migration flows pattern following NAFTA. The placebo estimates also show that the hump shape is a considerably distinct property of synthetic Mexico which shows the robustness of our results. This paper provides the empirical support for the ‘migration hump’ model following trade liberalisation as proposed by Martin and Taylor (1996).

There is caveat regarding the choice of intervention date. The official kick off of NAFTA, 1994, would be a natural choice, nevertheless, given restrictive migration policy measures conducted by US in 1993–1994 to control Mexico-US border which may deter all kind of potential migrants, thus this policy event could be a nuisance. In other words, if these restrictive measures are regarded as having important impact on migration flows, then 1994 might not be the appropriate intervention date. I use 1995 to check for the robustness of our results, and this action does not change our findings. Both 1994 and 1995 intervention dates accommodate the dual events happening in the same year: NAFTA and tequila crisis. However, unlike the restrictive migration policy measures, these two events are likely to point to the same direction. That is, trade liberalisation initiates economic adjustment that creates a migration hump. Then, the presence of financial crisis magnifies the size of the hump and prolongs the duration of the hump. However, as the effect of NAFTA lingers in the long-run due to the 15-years phase-in period, once the effect of tequila crisis subsides in post-2000 period, the remaining effect on migration is largely dominated by NAFTA.

In this paper, I show that NAFTA is an excellent case of exogenous policy intervention as it provides us with a ‘quasi-natural experiment’ to evaluate policy impact. This paper has presented robust evidence on the presence of ‘migration hump’ regarding trade and migration relationship following trade liberalisation policy such as NAFTA. This paper shows that the relationship between trade and migration is not as simple as complements vs substitutes. In the presence of ‘migration hump’, we may see a short-run complements and long-run substitutes relationships between trade and migration. Thus, the policy implication of this paper is that it will be quite wishful thinking to believe that the opening of trade barriers between developing and developed countries will immediately result in migration reduction. The case is stronger if the countries have strong migration history and network such as US and Mexico. As we have shown in this paper, the migration-reduction impact will need time to materialise.

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# Annex

## Variables description and sources

Predictors	Sources
Foreign Direct Investment, Net Inflows (% of GDP)	World Bank
Domestic Credit to GDP (% of GDP)	
Income share owned by highest 20%	
Migrant Stock in US (% of total population)	
Log GDP per capita	Penn World Table
Log Distance	CEPII
Migrant Flows to US, annual (% of total population)	DEMIG
Public Spending on Education (% of GDP)	MOxLAD

## List of Latin American Countries included in the analysis

Argentina  
Bolivia  
Brazil  
Chile  
Colombia  
Costa Rica  
Dominican Rep.  
Ecuador  
El Salvador  
Guatemala  
Honduras  
**Mexico**  
Nicaragua  
Panama  
Peru  
Uruguay  
Venezuela