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Contribution of Foreign Direct Investment to Mexico's Economic Growth during NAFTA Years (1994 -2019)

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Abstract:

This paper analyses the impact of foreign direct investment on labor productivity for the period 1994-2019 in Mexico. It proposes a production process with labor and three types of capital: private national, public national and foreign, and uses a human capital index, which we estimate through a vector error correction model. The estimation finds a long-run joint positive causality for the three types of capital on labor productivity. The contribution of private capital to economic growth is 2.6 times greater than that of foreign capital. If we add private and government capital, the contribution of national capital to economic growth is 3.2 times greater than that of foreign capital. The different contributions to growth of the three types of capital suggest the need for a change of strategy to one that relies less on FDI, and focuses more on domestic producers, making them more competitive and stimulating local private investment.

Key Words: *Capital accumulation, FDI, NAFTA, Mexico, Growth*

JEL Codes: *O54, O11, E22, F43.*

NAFTA Yıllarında (1994-2019) Doğrudan Yabancı Yatırımların Meksika'nın Ekonomik Büyümesi Üzerindeki Katkıları

Özet:

Bu makale, 1994-2019 yılları arasında Meksika'daki doğrudan yabancı yatırımların emek üretkenliği üzerindeki etkisini analiz etmektedir. Çalışma, emek ve sermayenin üç çeşidi olan özel-ulusal, kamu-ulusal ve yabancı sermayenin olduğu bir üretim süreci önermektedir. Özel sermayenin ekonomik büyümeye katkısı, yabancı sermayenin katkısından 2.6 kat daha yüksektir. Eğer, özel ve kamu sermayesini de eklersek, ulusal sermayenin ekonomik büyümeye katkısı, yabancı sermayenin katkısından 3.2 kat daha fazla olmaktadır. 3 çeşit sermayenin büyümeye olan farklı katkıları göz önüne alındığında, daha az DYY'ye (doğrudan yabancı yatırım) dayanan bir stratejiye geçilmesi gerekmektedir. Yerli üreticilere daha fazla odaklanılmalı, daha rekabetçi yapılmaları ve yerel özel yatırımlar teşvik edilmelidir.

Anahtar Kelimeler: *Sermaye birikimi, Doğrudan yabancı yatırımlar, NAFTA, Meksika, Büyüme*

JEL Kodları: *O54, O11, E22, F43.*

1. Introduction

Since the 1980s, foreign direct investment (FDI) flows have increased more than world production or world trade (Waldkirch 2008). Accordingly, for many developing countries, FDI has become an important, if not the most important source of external financing (see UNCTAD 2019). However, the effects of FDI on economic growth remain unclear and may well depend on the national policies of the recipient countries. These may vary from liberal policies that seek to attract as much FDI investment as possible in a non-discriminatory way, to the most interventionist that restrict it to a few sectors, conditioning it in several dimensions: technology transfers; associating it with national capital and / or job creation; etc. We analyze the Mexican case, which, we argue, constitutes an illustrating example of a liberal approach to economic policy regarding FDI.

The vast expansion of FDI and its characteristics have led to a large number of studies that focus on this type of investment, examining its effects on economic growth and related variables, such as labor productivity, technology acquisition, etc.

We estimate a VEC (Vector Error Correction model) for the 1994-2019 period using quarterly data. This estimate finds a positive and significant joint effect of domestic, foreign, and government capital on labor productivity. However, the contribution of foreign capital on Mexican growth is 40% that of private national capital and only 1.6 times greater than public capital. This result makes us wonder about the desirability of the Mexican government strategy that trusts in the inflow of FDI to be the main strategy to push the development of the country.

In the next section, we discuss the literature regarding these effects. Nevertheless, it is essential to state from the very beginning that such results may very well be dependent on the regulations and policies carried out by the recipient countries. Therefore, we feel justified to focus our analysis on one case, the Mexican one, which in Section III, we argue has been following policies to attract, and not to discrimination against, FDI.

In this paper, we analyze the impact of foreign direct investment on labor productivity for the period 1994-2019 in Mexico. Section II presents a brief overview of the literature;

Section III presents a quick review of the policies carried out by the Mexican Government for more than 36 years regarding FDI. Section IV reviews the relation between economic growth measured in terms of GDP per capita and labor productivity. Section V presents our theoretical equation of the determinants of labor productivity. Section VI estimates this relationship using a VEC model (Vector Autoregressive Model). Section VII concludes.

1.1. Literature on the Effects of FDI

Firms locating in a foreign country may do so to export, benefiting from lower costs or particular production factors in that country, or to enter the market of the recipient country.

Although tariffs may influence these two objectives differentially, they may be complementary, as Lipsey and Weiss (1984) found. These two objectives are relevant for Mexico due to its proximity to the US and the importance of its domestic market.

However, these two objectives may have different consequences concerning the displacement of domestic production. For example, some Asian countries, such as China, first accepted foreign investments in their Special Economic Zones with corresponding regulation, but without access to the domestic market, boosting growth through exports while protecting the local market for national firms.

As a response to the potential existence of coordination failures between producers of intermediate goods in emerging economies, which would be an argument in favour of industrial policy, Markusen and Venables (1999) consider that FDI can create backward linkages, increasing the demand for intermediate goods in the host country. The literature has highlighted the beneficial role of FDI in potentially helping a developing country to overcome its developmental difficulties. By their nature, large foreign multinational companies would not be affected by the coordination problems of small national producers in emerging countries. In theory, the arriving multinationals would help solve any domestic coordination problems and organize local producers.

Contradictory as it seems in terms of a dichotomy of attracting FDI while protecting the local market, or attracting FDI with cheap labor and geoFigureical advantages, in practice, the deregulation of FDI has been accompanied by trade liberalization, as happened with NAFTA and other free trade agreements. The rationale was that trade openness would make a country more attractive to foreign firms as they would have access to cheaper, or better quality imported intermediate goods. However, this could have been achieved through Special Economic Zones, or through expanding the maquila regime present in Mexico since 1965.[1]

Due to there being multiple reasons for receiving FDI, there is no clear relationship

1 In 1965 the Mexican government established the in-bond or maquiladora program, a program that allows duty-free importation of raw materials, components and equipment needed for the assembly, or manufacture of finished goods for subsequent export. The program originated from the need to industrialize northern Mexico and slowdown migration to the U.S. by creating jobs along the border. Source: https://teamnafta.com/manufacturing-resources-pages/2016/4/18/nafta-and-the-maquiladora-program

between a country's trade openness and the arrival of FDI, which may be the reason for the lack of clear causality of FDI on growth through a particular open regime.

Although it has been argued that lower tariffs attract FDI, it has also been found that, in some cases, FDI is higher in countries with higher tariffs (Tadesse and Ryan 2011). This is because FDI may respond to a variety of causal conditions, one of which is attending to the needs of the local market. In that case, FDI would be an alternative to trading and would be more beneficial when tariffs were higher.

Multilateral institutions like the Organization for Economic Co-operation and Development (OECD) have promoted favorable deregulation of FDI taking into account their potential benefits in the recipient countries, such as technology spillovers, assistance for human capital formation, creation of competitive environments, the introduction of cleaner technologies and socially responsible practices. The unclear impact of FDI on developing countries' economic growth has been argued to be related to the recipients not reaching some threshold of their internal conditions, such as the quality of their institutions or the qualification of their labor force (OECD 2002).

However, it is hard to believe that such benefits are expected to occur in the recipient countries when FDI is motivated to leave their home country to avoid the related costs of policies in their own countries; for instance, if FDI has indeed favored the international convergence of wages (Gopinath and Chen 2010), lowering salaries in their home country and achieving more flexible labor conditions. Similarly, sometimes FDI is established in a developing country to avoid stricter environmental regulations in the multinationals' country of origin (Hanna, 2010).

One of the most cited mechanisms through which FDI would have additional effects is the transfer of technology (see Saggi 2002 for a review of the literature), which can happen as a result of "demonstration effects", local firms' workers imitating and learning, named "labor turnover"; and vertical linkages. Nevertheless, firms' technology, as a part of their knowledge, is such a valuable asset that FDI has no incentives to share if it is not forced to do so. Other forms of internationalization, such as licensing, have suffered from risks regarding the loss of firms' knowledge-based assets (see, for instance, Ethier and Markusen 1991). There is a possibility of the transfer of technology through supply chains, forcing the suppliers to adopt certain strict norms of production. Still, this possibility only enters into consideration in the case that the multinational corporation's supply chain is local, while if the inputs are supplied by imports, this possibility disappears.

Although there have been studies that empirically find a positive relationship between inward FDI and economic growth in developing countries (see Borensztein et al. 1998), suggesting that technology transfers may take place, one should be careful with cross-country analysis, since the legislation on both FDI and intellectual property protection varies between countries. In some cases, FDI may be forced to associate with local investors, national content requirements, and/or share its technology, while in other cases that is not the case.

Nevertheless, evidence for the presence of positive externalities in the host countries caused by the mere presence of FDI is very scarce. As Rodríguez and Rodrik (2000) point out: "Literature on economic policy is full of extravagant findings of the existence of positive spillovers derived from FDI, but the evidence is very austere." Alfaro et al. (2005), with data from several countries for the period 1975-1995, find that FDI plays an ambiguous role in economic growth, with more significant benefits occurring in countries with mature financial markets. Herzer et al. (2008) find that almost no country shows a long-term positive Granger-causality between FDI and per capita GDP. In countries for which they observe a positive relationship, they show two-way causality. Similar results can be found in Liu et al. (2002) and Chakraborty and Nunnenkamp et al. (2007). Carkovic and Levine (2005), using a generalized method of moments to deal with endogeneity, do not find that FDI has any effects on economic growth.

The considerable variation of FDI effects on growth has led to the construction of explanations for the lack of technology transfers in those cases. Assuming that foreign multinationals were eager to share their knowledge with local firms, recipients' ability to absorb the new technologies has been questioned.

Ironically, it has been through free trade agreements that the countries of origin of FDI have pressed recipient countries to adopt stronger regulations regarding intellectual property protection. Again, paradoxically, technological transfers are the proposed mechanism through which FDI is supposed to have a differential effect on growth compared to domestic capital, but stricter intellectual protective regulations have been approved to attract multinational firms, when such regulations also serve to limit those types of potential benefits.

There is a growing consensus that accepting the complete package offered by TNCs, which includes financing, technology, and manageability, is not the best way to achieve long-term industrial development in a country. For instance, Fransman and King (1984), Fransman (1986), and Haque et al. (1996), among others, have raised concerns about growth strategies that rely on attracting FDI to promote industrialization. These authors consider that it is much better to encourage national companies to build their own "packages," using their management skills, with some outsourcing if necessary. That is why it is interesting to compare the effect of FDI on productivity as opposed to other types of capital. It would help us determine if the policy of attracting FDI, which, as we will show in the next section, has been the primary tool used by the Mexican government to accelerate economic growth, has been justified.

1.2. FDI Deregulation and Expected Effects in Mexico

Since 1982, Mexico's different governments have actively sought to attract FDI. During Miguel de la Madrid's presidency, existing restrictions on FDI were relaxed, first, by allowing the National Commission on Foreign Investments (NCFI) to relax the 49% maximum participation of FDI in particular cases, then, by reducing the number of products that were classified in the most restrictive sectors. In 1993, under the presidency of Carlos Salinas de Gortari, the Foreign Investment Act was formally amended to include a more liberal interpretation of the 1989 regulation. Also, provisions that were contained in the

North American Free Trade Agreement were added, and NCFI procedures were simplified.[2]

One milestone in the regulation of FDI coming into Mexico is related to the NAFTA, which came into effect as of January 1, 1994. Regarding Mexico, the attraction of FDI was one of the main objectives for the reduction of tariffs, which had already taken place to a great extent since Mexico's entry into GATT in 1986. NAFTA's primary purpose was to give confidence to investors about Mexico's government's commitment to maintain and deepen the economic reforms undertaken as of December 1, 1983, which had led to significant FDI inflow. NAFTA facilitated the development of a vertically integrated production network in North America, with imports of intermediate goods from third countries, resulting in the fragmentation of production processes from a national perspective (see Deardoff 2001 and Puyana and Romero 2005).

Although, as we have seen in the previous section, some of the theoretical benefits of FDI would be dispersed with trade, the economic reforms that started at the end of 1982 were not only looking to attract FDI; they also eliminated trade barriers and reduced the state's participation in the economy. Openness, it was thought, would bring economies of scale and access to a variety of inputs and competition. These factors would increase Mexican firms' competitiveness and they would export more, its current account would be improved and the Mexican economy would grow. There was no need to create local production capabilities since Mexican comparative advantage was on non-qualified labor. The pro-market regulation also favoured private over public investment. Accordingly, many of the public companies were sold to private capital below their market prices. Public investment was assumed to be less efficient than private, without any empirical evidence that this is actually the case. Therefore, the belief was that efficiency gains would increase.

Previous studies on FDI in Mexico, such as Ramírez (2002), among others (see also Kokko 1994), found a significant relationship between FDI and labor productivity using data for the period 1960-2001. However, one needs to be careful in evaluating these results due to a significant structural change that took place during those years. Romo (2005: 25) notes that the studies which found evidence that FDI increased productivity used data from the 1970s, when FDI was highly regulated and conditioned; for more recent data, however, there is some evidence of spillovers on market access, but not on productivity. Mendoza (2008) finds a statistically significant, but economically unsubstantial effect of FDI on GDP growth. Geijer (2008) analyses the relationship between FDI and GDP growth using a dynamic adjusted model for the period 1993-2007 and fails to find a statistically significant relationship between these two variables. Mendoza (2011) empirically analyses the impact of foreign FDI on the growth of the Mexican manufacturing sector for the period 1999-2008 and finds a positive effect on trade openness, but not on its growth.

We believe it is relevant to study the Mexican case since the policies previously mentioned have, indeed, transformed Mexico's productive composition, with transnational corporations having gained importance in manufacturing and exports. Mexico's imports'

2 (Dussel 2007: 80).

share of intermediate goods has increased, at the expense of capital goods. In the early 1980s, imports of intermediate goods accounted for 40% of its total imports. By 2018, they had doubled their relative weight to 80% of the total. Imports of capital goods accounted for about 60% of total imports in the early 1980s, but by 2018, their relative share had fallen to 10%.[3] The low weight of imports of capital goods and the heavy burden of imports of intermediate products within Mexico's total imports reveal Mexico's actual type of industrialization. It is characterized by a manufacturing sector that produces for both the domestic market and foreign markets with a high content of imported intermediate goods, and with little technological sophistication.

It is worth examining Mexico's main exported products and the nationality of the predominant firms in those sectors. The composition of its manufacturing exports includes automotive products (36.27%), electrical and electronic equipment (18.36%), special machinery and equipment (15.93%), professional and scientific equipment (4.75%), food, beverages, and tobacco (4.62%) and other manufactures (16.2%).[4] With data of the 500 largest companies in Mexico[5] according to their sales, the three main exporting sectors, a) automotive products, b) electrical and electronic equipment and appliances and (c) machinery and equipment accounted for 70.6% of Mexican manufacturing exports in 2018. Within the 15 top automotive firms, none were Mexican companies, and within the 30 top auto parts companies, only six are registered as Mexican. In the second group, electrical and electronic equipment, there are 12 companies, all but one of which are foreign. Finally, in the third group, machinery and equipment, there are nine companies of which only two are Mexican.

For these reasons, we find it interesting to focus on Mexican as a unique and distinctively different case than that of the East Asia region, and also to compare how various forms of capital are related to productivity.

2. Materials and Methods

2.1. Labor Productivity and GDP per capita

We focus on labor productivity to approximate per capita income,[6] which, according to both economists and historians, is the best indicator of a country's standard of living.[7] GDP per capita (GDP / P) can be decomposed into average labor productivity (GDP / E), the rate of participation of the workforce within its population (L / P), and its employment rate (E / L), where P refers to population, L, to its labor force; and E to employment. That is

3 INEGI (2020).

4 INEGI (2020).

5 Expansión Intelligence (2019).

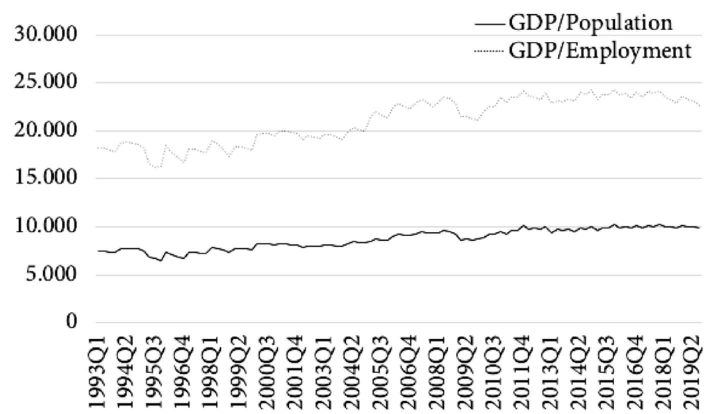
6 See Romero (2018) for a discussion about labor productivity being a more reliable measure of growth than the so called "total factor productivity."

7 "It is the product per capita, and not the total one, which provides the economist and historian with the best (if imperfect) indication of production and thus of the state of an economy" (Coatsworth 1990: 25).

$$\frac{GDP}{P} \equiv \left(\frac{GDP}{E}\right)\left(\frac{L}{P}\right)\left(\frac{E}{L}\right). \qquad (1)$$

This identity shows that the observed GDP per capita responds to factors related to productivity, socioeconomic trends and the level of economic activity. Figure 1 presents the behavior of the GDP per capita and labor productivity during the period 1994-2019.

Figure .1. *GDP per capita and labor productivity: 1994-2019 (constant 2015 US$)*



Source: *Authors' own calculations from the data described below.*

Then, the growth rate of the GDP per capita can be expressed as the sum of the growth rate of average labor productivity, the growth rate of a population's participation in employment and the growth rate of the employment rate[8], that is:

$$\left(\frac{GDP}{P}\right)^0 = \left(\frac{GDP}{E}\right)^0 + \left(\frac{L}{P}\right)^0 + \left(\frac{E}{L}\right)^0, \qquad (2)$$

where superscript ° indicates growth rates, Table 1 shows the average growth rates of *GDP, P, E, (GDP / P), (GDP / E)* and *(L / P)* for the period 1994-2019.

During the period 1994-2019, GDP per capita grew at an annual average rate of 1.1%, labor productivity growth was 0.89%, and the difference was provided by a yearly increase in the rate of participation of the population in the labor force of 0.21%. From these results, we can conclude that the growth in average labor productivity during these 36 years was minimal. Notice that the absence of labor productivity growth during the period does not impede the study of its causations.

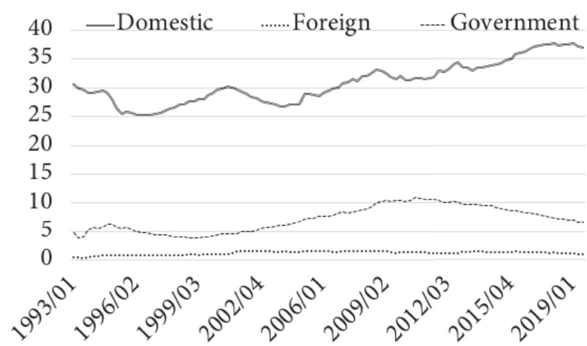
Table 1. *Average annual growth rates*

	1994-2019
GDP	2.51%
P: Population	1.41%
E: Employment	1.62%
GDP/P	1.10%
GDP/E	0.89%
L/P	0.21%

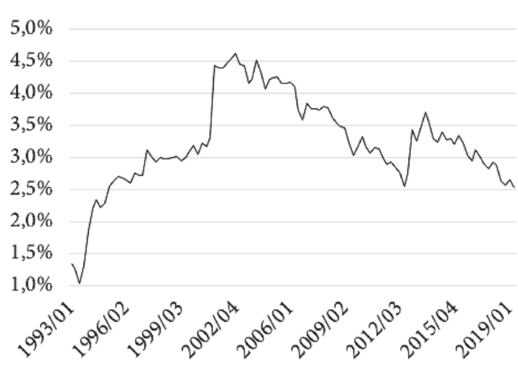
Source: *Authors' own calculations with the data described below.*

Figure 2. *Capital stocks by type: 1994-2019*

Panel A: *(constant 2015 billion US$)*



Panel B: *Foreign Capital as a % of Total Physical Capital*



Source: *Authors' own calculations with the data described below.*

Figure 2, Panel A presents the evolution of real capital: private national (excluding foreign capital), foreign and government for the period 1994-2019 in Mexico. Overall, we observe a decline in both the governments' investments and private capital investments for the entire period. Foreign capital shows a continuous increase throughout the period 1994 to 2001; since then, its participation has declined. This might be related to China's becoming a full member of the World Trade Organization (WTO) and its turning into an attractive alternative to Mexico for FDI. Panel B: shows foreign capital as a percentage of total capital.

2.2. Labor Productivity and FDI

Following Rand (2016: 43-65), GDP per capita can be derived from a production relationship. We begin with a simple Cobb–Douglas production function for the whole country, defined as

$$Y = AK_p^{\alpha} K_f^{\beta} K_g^{\rho} (Eh)^{1-\alpha-\beta-\rho}, \qquad (3)$$

where *Y* is output; K_p is the stock of private physical capital; K_f is the stock of foreign physical capital; K_g is the stock of the governments' physical capital; *E* is the amount of labor employed; and *h* is an index of human capital per person. Notice that the parameters $\alpha, \beta, \rho > 0$ and $\beta + \rho < 1$. We divide both sides of Eq. (3) by *E* and obtain:

$$y = Ak_p^{\alpha}\, k_f^{\beta}\, k_g^{\rho} h^{\ 1-\alpha-\beta-\rho}, \qquad (4)$$

where lower case letters mean variable per worker. Applying logarithms to (4), we obtain:

$$\ln(y) = \ln(A) + \alpha\ln(k_p) + \beta\ln(k_f) + \rho\ln(k_g) + \theta\ln(h), \qquad (5)$$

where $\theta = 1 - \alpha - \beta - \rho > 0$.

2.3. The Empirical Model

In this section, we estimate the model of economic growth. Notice that Equation (5) can be rewritten as

$$\ln y_t = \beta_0 + \beta_1 \ln k_{p,t} + \beta_2 \ln k_{f,t} + \beta_3 \ln k_{g,t} + \beta_4 \ln h_t + \beta_5 \ln RER_t + \varepsilon_t. \qquad (6)$$

The signs of β_1, β_2, β_3 and β_4 are expected to be positive. In the expression (6), we also include the real exchange rate $ln(RER_t)$ as an explanatory variable, where an increase in RER_t means a real depreciation of the peso. Although the latter was not included in the production function, it may reflect another source of exterior dependence. If the Marshall Lerner condition is fulfilled, the value of β_5 should be positive, so that depreciation increases the net external demand and, consequently, growth. However, the opposite might occur: an abrupt nominal devaluation (similar to the ones that took place in Mexico in 1954, 1976, 1981, 1994, etc.), as a product of a balance-of-payments crisis, could generate inflationary pressures that usually call for austerity programs, thus constraining domestic production. Therefore, the sign of β_5 could be either positive or negative.

2.4. Description of the Data

To estimate the Equation (6) for the period 1994q1-2019q3, we use quarterly data of the nominal GDP, the total gross investment, the gross government investment, and foreign direct investment. The data for the nominal GDP, the nominal total investment, and the nominal gross government investment were obtained from INEGI (2020). To transform nominal values into real 2015 US dollars, we deflate the nominal values in millions of pesos, with the 2015 producer Price Index base (obtained from INEGI 2020), and convert to US dollars using the 2015 quarterly average nominal exchange rate (obtained from the Bank of Mexico 2020). Data for FDI was obtained in nominal US dollars from the Balance of Payments, published by the Bank of Mexico (2020). To transform the amounts of FDI to 2015 US dollars, we use the U.S. Producer Price Index from the Federal Reserve Economic Data Bank of St. Louis, Missouri (2020). To obtain private domestic real investment in millions of 2015 US dollars, we subtract the real government investment and the total real FDI from the total real investment (all expressed in 2015 US dollars).

Total employment data was obtained from INEGI and is expressed in millions of people. The Annual Human Capital Index for México[9] was retrieved from FRED[10] and transformed into a new base, where1993q1=1. To convert annual data into quarterly data, we use the linear version of the "low to the high-frequency method." Data for the real exchange rate for 49 countries was obtained directly from the Bank of Mexico (2020).

With this information, we proceed to calculate capital stock using the perpetual inventories method, which is described in the Loría (2007). For physical capital, we used a depreciation rate of 0.11 (Martin 2002). With this information, we construct the GDP per worker (y), National Private Capital per worker (k_p), foreign capital per worker (k_f), government capital per worker (k_g), Human Capital Index (h), and real exchange rate (RER)[11].

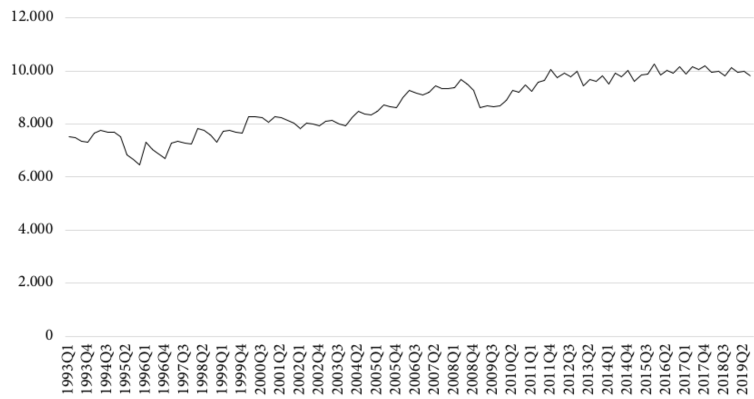
9 Official data for the Human Capital Index stops in 2017, so to obtain data for 2018 and 2019 we use the constant annual growth rate observed from 2014 to 2017: 0.73553%.

10 HCIYISMXA066NRUG: Index of Human Capital per Person for Mexico, Index, Annual.

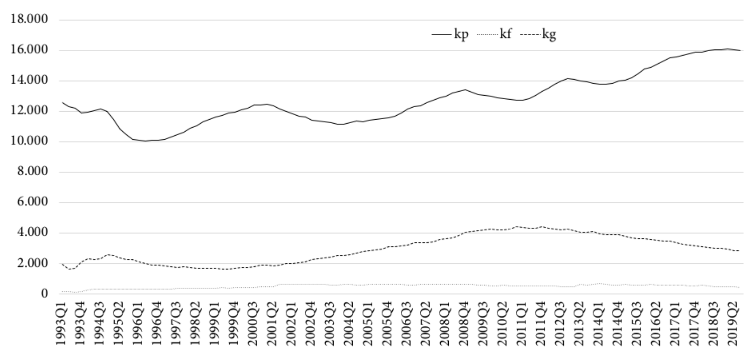
11 The data is publicly available at doi:10.4121/uuid:97942235-0a1c-4dc0-b650-a81a040e9d1d

Figure 3. *Data Sets in Levels*

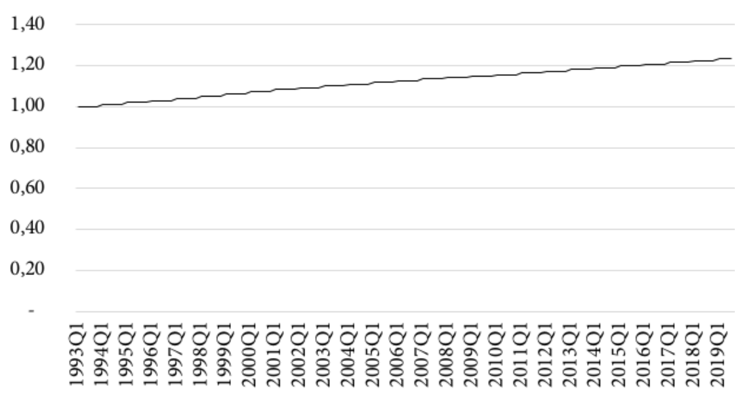
Panel A: *GDP per capita*



Panel B: *Capital per capita*



Panel C: *Human Capital Index*



Panel D: *Real Exchange Rate*

3. Results

3.1. Unit root tests and VAR model

Unit root tests using the Phillips-Perron Test[12] for the six series expressed in logarithms are shown in Table 2. These tests indicate that all the series have the same level of integration; all are I (1).

Table 2. *Phillips-Perron test (trend and intercept)*

Serie	Levels	First differences
$ln\,(y)$	-3.032371	-11.84258
$ln(k_p)$	-3.356160	-7.368060
$ln(k_f)$	-1.731958	-8.321047
$ln(k_g)$	-0.577186	-8.941685
$Ln(IHK)$	-3.478332	-22.99665
$ln(RER)$	-2.582923	-9.775399

Note: *the critical values of the Phillips-Perron test for trends and intercept at significance levels of 1%, 5%, and 10% are, respectively, -4.046925, -3.452764, and -3.151911.*

Since the variables are found to be I(1), we proceed to estimate a VAR (Auto-Regressive Vector) and analyze if there are dynamic effects between the variables: $ln(y)$, $ln(k_p)$, $ln(k_f)$, $ln(k_g)$, $ln(h)$ and $ln(RER)$. Table 3 shows different criteria for lag selection.

Table 3. *Lag order selection criteria*

Lag	LogL	LR	FPE	AIC	SC	HQ
0	1633.031	NA	3.92e-22	-32.26326	-31.31958	-31.88145
1	1753.929	212.4867	7.11e-23	-33.97836	-32.09100	-33.21474

2	1811.784	94.67250	4.65e-23	-34.41989	-31.58885	-33.27444
3	2004.736	292.3502	2.02e-24	-37.59062	-33.81590	-36.06336
4	2107.913	143.8235	5.52e-25*	-38.94774	-34.22934*	-37.03867*
5	2141.090	42.22546	6.40e-25	-38.89072	-33.22864	-36.59983
6	2189.645	55.91105*	5.68e-25	-39.14434*	-32.53858	-36.47164
7	2217.747	28.95401	8.05e-25	-38.98479	-31.43535	-35.93028
8	1633.031	NA	3.92e-22	-32.26326	-31.31958	-31.88145

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

The FPE, SC and HQ criteria suggest five lags, while LR and AIC suggest seven lags. Following Asghar and Irum (2007), we should have selected five lags, but this led to a lack of stability of the estimated VAR. Staying the closest, but assuring stability, we estimated a four lag VAR, which, as we show in Table 4, satisfies stability, since no root lies outside the unit circle.

Table 4. *Roots of characteristic polynomial (lag specification: 14)*

Root	Modulus
0.997059	0.997059
0.003926 - 0.993302i	0.993310
0.003926 + 0.993302i	0.993310
-0.987321	0.987321
0.969655 + 0.072693i	0.972376
0.969655 - 0.072693i	0.972376
0.875055 - 0.252424i	0.910735
0.875055 + 0.252424i	0.910735
0.837156	0.837156
-0.816158	0.816158
0.741773 + 0.245413i	0.781316
0.741773 - 0.245413i	0.781316
0.105430 + 0.769847i	0.777033
0.105430 - 0.769847i	0.777033
-0.341879 - 0.642356i	0.727669
-0.341879 + 0.642356i	0.727669
0.193803 - 0.678876i	0.705997
0.193803 + 0.678876i	0.705997
0.052278 - 0.577540i	0.579901
0.052278 + 0.577540i	0.579901
0.436013	0.436013

-0.132102 - 0.348770i	0.372950
-0.132102 + 0.348770i	0.372950
-0.328418	0.328418

3.2. Estimation of the VEC model

The next step in the construction of the VEC model is to verify that the variables are cointegrated. For that purpose, we perform the Juselius Johansen test with four lags to the sixth series. We assume intercept and no trend (model iii), since the variables show a positive trend in levels.[13] Tables 5 and 6 show the results of the Johansen Juselius tests according to the trace statistic and the maximum eigenvalue.

Table 5. *Unrestricted cointegration rank test (Trace)*

Hypothesized No. of CE(s)	Trace Statistic	0.05 Critical Value	Prob**
None *	127.4554	95.75366	0.0001
At most 1*	84.76231	69.81889	0.0020
At most 2	46.89547	47.85613	0.0614
At most 3	25.15543	29.79707	0.1560
At most 4	10.97190	15.49471	0.2132
At most 5	0.610747	3.841466	0.4345

The Trace test indicates two cointegrating equations at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table 6. *Unrestricted Cointegration Rank Test (Maximum Eigenvalue)*

Hypothesized No. of CE(s)	Max-Eigen Statistic	0.05 Critical Value	Prob**
None *	42.69311	40.07757	0.0248
At most 1*	37.86684	33.87687	0.0158
At most 2	21.74004	27.58434	0.2340
At most 3	14.18353	21.13162	0.3502
At most 4	10.36116	14.26460	0.1893
At most 5	0.610747	3.841466	0.4345

The Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Johansen's cointegration tests suggest that the hypothesis of vectoral non-cointegration can be rejected at least at the level of five percent, thus indicating the presence of a cointegration equation. This justifies estimating a VEC model; that is, a model that combines the

13 This gives us 102 observations after adjustments. Lag intervals are (in first differences) from one to six.

short-term properties of economic relationships with long-term data information in the form of a level provided by the Johansen test.

We proceed to estimate a VEC and focus on the first equation

$$\Delta y_t = \beta_0 + \sum_{i=1}^{N} \beta_i \Delta y_{t-i} + \sum_{i=1}^{N} \delta_{1,i} \Delta x_{1,t-i} + \cdots + \sum_{i=1}^{N} \delta_{j,i} \Delta x_{j,t-i} + \sum_{i=1}^{M} \theta_i D_i + \varphi Z_{t-1} + \mu_t, \quad (7)$$

where is the dependent variable in the first equation of the VEC; x_i , $i = 1, ..., 4$ are the variables that appear as dependent on the other equations of the VEC, but as independent in the first equation; D_i are exogenous variables for all the VEC and Z_{t-1} is the residual of the cointegration equation. The error-correction term, φ, is related to the fact that the deviation of the last period from the long-run equilibrium (the error) influences the short-term dynamics of the dependent variable. Thus, the coefficient, φ measures the speed of adjustment to which the variable *ln*(*GDP / E*) returns to equilibrium after a change in the independent variables.

The results of the estimation of the Equation (7) are given in Tables 7 and 8[14]. The long-run relationship is:

Table 7. *Cointegration equation*

y_{T-1}=	-0.887	+0.432 $ln(kp)_{t-1}$	+0.169 $ln(kf)_{t-1}$	+0.108 $ln(kg)_{t-1}$	+0.329 $ln(h)_{t-1}$	+0.193 $ln(RER)_{t-1}$
	Standard errors	(0.11288)	(0.03619)	(0.01825)	(0.32091)	(0.20133)
	t-Statistics	[-3.82348]	[-4.68220]	[-5.91522]	[-1.02639]	[-0.95728]

The adjusted R^2 is 0.74, so we have a good fit. We also find that the first term of error correction, , has the expected sign and is significant. This implies that the model returns to its equilibrium level at a rate of 15.7% per quarter. These results confirm that there exists a long-term joint *causality* of all independent variables on labor productivity.

Table 8 *Estimation by Least Squares (Gauss-Newton / Marquardt steps)*

$$\Delta y_t = C(1)Z_{t-1} + C(2)\Delta\ln(y)_{t-1} + C(3)\Delta\ln(y)_{t-2} + C(4)\Delta\ln(y)_{t-3} + C(5)\Delta\ln(y)_{t-4} + C(6)\Delta\ln(k_p)_{t-1} + C(7)\Delta\ln(k_p)$$
$$C(8)\Delta\ln(k_p)_{t-3} + C(9)\Delta\ln(k_p)_{t-4} + C(10)\Delta\ln(k_f)_{t-1} + C(11)\Delta\ln(k_f)_{t-2} + C(12)\Delta\ln(k_f)_{t-3} + C(13)\Delta\ln(k_f)_{t-4} +$$
$$C(14)\Delta\ln(k_g)_{t-1} + C(15)\Delta\ln(k_g)_{t-2} + C(16)\Delta\ln(k_g)_{t-3} + C(17)\Delta\ln(k_g)_{t-4} + C(18)\Delta\ln(IHK)_{t-1} + C(19)\Delta\ln(IHK)_{t-2} +$$
$$C(20)\Delta\ln(IHK)_{t-3} + C(21)\Delta\ln(IHK)_{t-4} + C(22)\Delta\ln(RER)_{t-1} + C(23)\Delta\ln(RER)_{t-2} + C(24)\Delta\ln(RER)_{t-3} + C(25)\Delta\ln(RER)$$
$$C(26)\ Constant + C(27)D1 + C(28)D2 + C(29)D3 + C(30)D4 + C(31)D5 + C(32)D6$$

	Variable	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	$\varnothing$	-0.157096	0.091345	-1.719817	0.0899
C(2)	$\Delta\ln(y)_{t-1}$	-0.012384	0.103424	-0.119737	0.9050
C(3)	$\Delta\ln(y)_{t-2}$	-0.211817	0.092078	-2.300401	0.0244
C(4)	$\Delta\ln(y)_{t-3}$	-0.299873	0.077383	-3.875153	0.0002
C(5)	$\Delta\ln(y)_{t-4}$	0.472031	0.083925	5.624437	0.0000
C(6)	$\Delta\ln(k_p)_{t-1}$	0.132235	0.219632	0.602075	0.5491
C(7)	$\Delta\ln(k_p)_{t-2}$	0.088506	0.201193	0.439905	0.6614
C(8)	$\Delta\ln(k_p)_{t-3}$	0.168992	0.183888	0.918998	0.3613
C(9)	$\Delta\ln(k_p)_{t-4}$	-0.800672	0.166018	-4.822798	0.0000
C(10)	$\Delta\ln(k_f)_{t-1}$	0.045017	0.030194	1.490918	0.1405
C(11)	$\Delta\ln(k_f)_{t-2}$	0.006789	0.034423	0.197224	0.8442
C (12)	$\Delta\ln(k_f)_{t-3}$	0.020778	0.027610	0.752545	0.4542
C (13)	$\Delta\ln(k_f)_{t-4}$	-0.079900	0.027678	-2.886727	0.0052
C(14)	$\Delta\ln(k_g)_{t-1}$	0.211207	0.146553	1.441159	0.1540
C(15)	$\Delta\ln(k_g)_{t-2}$	-0.222968	0.163856	-1.360755	0.1780
C(16)	$\Delta\ln(k_g)_{t-3}$	0.084745	0.129268	0.655575	0.5142
C(17)	$\Delta\ln(k_g)_{t-4}$	-0.051846	0.102195	-0.507327	0.6135
C(18)	$\Delta\ln(h)_{t-1}$	1.496470	1.697654	0.881493	0.3811
C(19)	$\Delta\ln(h)_{t-2}$	1.647326	1.748569	0.942099	0.3494
C(20)	$\Delta\ln(h)_{t-3}$	1.010871	1.652799	0.611611	0.5428
C(21)	$\Delta\ln(h)_{t-4}$	2.362484	1.703274	1.387025	0.1698
C(22)	$\Delta\ln(RER)_{t-1}$	-0.457062	0.135647	-3.369504	0.0012
C(23)	$\Delta\ln(RER)_{t-2}$	-0.251372	0.135900	-1.849685	0.0686
C(24)	$\Delta\ln(RER)_{t-3}$	-0.484604	0.145247	-3.336426	0.0014
C(25)	$\Delta\ln(RER)_{t-4}$	0.164447	0.158889	1.034978	0.3042
C(26)	*Constant*	-0.009179	0.012860	-0.713722	0.4778
C(27)	*D1*	-0.046694	0.018972	-2.461157	0.0163
C(28)	*D2*	-0.080221	0.020550	-3.903747	0.0002
C(29)	*D3*	0.043221	0.016046	2.693536	0.0088
C(30)	*D4*	0.050450	0.018560	2.718249	0.0083
C(31)	*D5*	-0.059272	0.016504	-3.591393	0.0006
C(32)	*D6*	0.047573	0.017329	2.745292	0.0077

R-squared	0.816612	Mean dependent var	0.002001
Adjusted R-squared	0.735398	S.D. dependent var	0.029237
S.E. of regression	0.015040	Akaike info criterion	-5.305296
Sum squared resid	0.015833	Schwarz criterion	-4.481775
Log-likelihood	302.5701	Hannan-Quinn criteria.	-4.971824
F-statistic	10.05499	Durbin-Watson stat	2.030215
Prob(F-statistic)	0.000000		

The residual is given by:

$$Z_{t-1} \equiv \ln (y)_{t-1} + 0.887 - 0.432 \ln (kp)_{t-1} - 0.169 \ln (kf)_{t-1} - 0.108 \ln (kg)_{t-1} - 0.329 \ln (h)_{t-1} - 0.193 \ln (RER)_{t-1}. \quad (8)$$

We continue with the diagnosis of the residuals, which consists of three parts: a) autocorrelation test, b) heteroscedasticity test and c) normality test. The results for the Breusch-Godfrey autocorrelation test are given in Table 9.

Since the probability value 58.3% is higher than 5%, we do not reject the null hypothesis; that is, we assume that the model does not have a serial correlation in the residuals. We continue with the heteroscedasticity test for which we use the Breusch-Pagan-Godfrey test. The results are shown in Table 9. Since the probability of the statistic Obs*R-squared is 37.4%, higher than the 5% required, we cannot reject the null hypothesis and conclude that our model does not have heteroscedasticity in the residuals.

Table 9. *Breusch-Godfrey Serial Correlation LM Test*

F- statistic	0.4748	Prob. F(4,66)	0.7541
Obs*R-squared	2.8528	Prob. Chi-Square(4)	0.5828

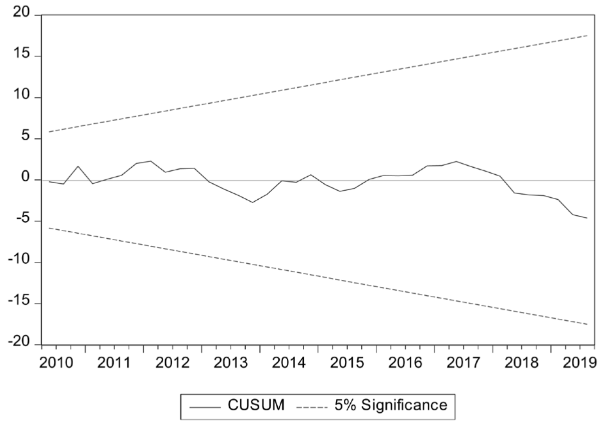
Finally, we perform the normality test of residuals and we find a value of 0.1382 for the Jarque-Bera coefficient with a probability of 0.9332. This value of 93.32% is higher than the 50% required, so we cannot reject the null hypothesis and, therefore, conclude that our model presents normality in the residuals.

Table 10. *Heteroskedasticity Test: Breusch-Pagan-Godfrey*

F-statistic	1.04722	Prob. F(38,99)	0.4267
Obs*R-squared	37.4429	Prob. Chi-Square(38)	0.4027
Scaled explained SS	19.0631	Prob. Chi-Square(38)	0.9908

We also check if the model is stable according to the CUSUM test. In Figure 4, we show the 5% limits are not exceeded and conclude that the model is stable.

Figure 4. *Stability Test*



3.3. Short-run causality test

Once we have verified that the model meets the desired properties, we make inferences. From Table 9, we can obtain the aggregated effects of the lags of the leading independent variables.

Table 11. *The cumulative effect on the growth of (GDP/L)*

	Sum of lag coefficients	Standard Error of the Sum*	t-Statistic
D*ln(kp)*	-0.4109	0.3874	-1.0607
D*ln(kf)*	-0.0073	0.0602	-0.1215
D*ln(kg)*	0.0211	0.2747	0.0769
D*ln(IHK)*	6.5172	3.4018	1.9158
D*ln(TCR)*	-1.0286	0.2885	-3.5658

* *The standard error of the sum was calculated by adding the square of the respective standard errors of every lagged variable that are given in Table IX.4 and extracting the squared root of the sum* $S.E. = \sqrt{s_1^2 + s_2^2 + s_3^2}$.

As shown in Table 11, we did not find any significant cumulative effect of the growth of national private capital, foreign capital, or government capital on the growth of labor productivity. Growth in the Human Capital Index has a positive accumulative effect, and real exchange rate growth has a significant negative impact. This is not surprising; the cumulative growth effects all types of capital in the long run, but not in the short run.

Then, we can focus on the long-run relationship of the different types of capital, the Human Capital Index, and the real exchange rate on labor productivity. The value of the coefficients, their standard errors and significance appear in Table 7. The coefficients for the Human Capital Index and the real exchange rate are not significant in the long run.

Regarding the effects of the different types of physical capital, we find all of them to be significant, but with differences in magnitudes. The elasticity of labor productivity with respect to a one percent change in private capital per worker, foreign capital per worker and government capital per worker are, respectively, 0.432, 0.169, and 0.108.

4. Conclusions

The discussion about the lack of relevance of human capital is essential and may be related to the lack of adequacy of the educational policy and its coordination, or it could be associated with a lack of relevance for the type of production in which Mexico has chosen to specialize. A specialization of labor-intensive fragments of the global production process with low technology content needs little skilled labor, nor specialized research and development infrastructure. Under such conditions of subcontracting low skilled segments in the integrated process, human capital becomes irrelevant to increase productivity. However, this discussion goes beyond the limits of this paper.

As we have previously mentioned, FDI attraction policies have had a prominent role during almost the entire last four decades. The Mexican industrial policy followed from 1983 to 2020 has been an integration with the United States and Canada, but mainly, with the USA. Foreign companies have been attracted to Mexico to take advantage of low wages and its proximity to the USA, without any regulation or strategy on how Mexico should use FDI to complement national private investment.

Our estimation allows us to verify that the effects of foreign capital on the Mexican economy are not particularly spectacular. Furthermore, the contribution of FDI to Mexican growth is 40 percent of the contribution of private national capital, and only 1.6 times greater than public capital.

This result makes one wonder about the desirability of the Mexican government's policy of putting all their hope for advancing economic development on the inflow of FDI. It would be more effective if this strategy was changed to concentrate on Mexican private and public investment. The contribution of Mexican private capital to economic growth is 2.6 times greater than that of foreign capital. And if we add private and government capital, the contribution of national capital to economic growth is 3.2 times greater than that of foreign capital.

It might be desirable for Mexico to impose regulations on FDI as is the case in several East Asian countries, where FDI is required to comply with specific criteria, such as technology transfers and integration into the local productive chains. On the other hand, it also would be desirable to change the local environments in which domestic firms operate. Mexico should use all necessary tools to make it more attractive for local investors to develop their capabilities through "learning by doing," and should help them to build their own "know-how" and "know why" abilities.

To break the curse of more than 36 years of sluggish growth (a 1.4% average of GDP per capita), we need to try something different rather than concentrating on attracting more FDI. Attracting more FDI is impossible; we cannot offer more guarantees because we have already given them all, nor do they make economic sense because the contribution of foreign capital is only 40% of the contribution of local private capital. We need to change strategies and focus on domestic producers, helping them become more competitive using similar (although not the same) strategies as those followed by countries in the East Asia region.

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