Foreign exchange earnings probabilities, long-term investment and foreign currency debt, before and during the Covid-19 outbreak: An analysis of Mexican companies

Probabilidad de ganancias cambiarias, inversión de largo plazo y deuda en moneda extranjera, antes y durante el brote de Covid-19: un análisis de empresas mexicanas

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Abstract

This paper shows the analysis of the impacts of long-run assets' investments, debt in foreign currency and the peso-dollar parity on the probability of obtaining exchange gains during the Covid-19 period, in comparison with the previous period (1990-2019). By means of logit specifications, it is found that before the pandemic, intangible assets, investment in fixed assets during the recent twelve months, the peso-dollar parity and dollar debt reduce the probability of obtaining exchange gains; only investments in property, plant and equipment have an positive effect in the probability of obtaining exchange gains in the case of a currency depreciation. During the period associated with the contingency, only recent investments in fixed assets were significant, keeping the inverse relationship observed into the previous period.

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Resumen

Este artículo muestra el análisis de los impactos de las inversiones en activos de largo plazo, deuda en moneda extranjera y de la paridad peso-dólar en la probabilidad de obtener ganancias cambiarias durante el periodo de Covid-19, en comparación con el periodo previo (1990-2019). Mediante especificaciones logit, se encuentra que antes de la pandemia los activos intangibles, la inversión en activos fijos durante los doce meses recientes, la paridad peso-dólar y la deuda en dólares reducen la probabilidad de obtener ganancias cambiarias; únicamente las inversiones en inmuebles, planta y equipo tiene un efecto positivo en la probabilidad de obtener ganancias cambiarias en el caso de una depreciación monetaria. Durante el periodo asociado con la contingencia, únicamente fueron significativas las inversiones recientes en activos fijos, manteniendo la relación inversa observada en el periodo previo.

Introduction

Salomao and Varela (2018) note that foreign currency financing has made it easier for companies to acquire fixed assets, which have helped them achieve higher levels of growth. However, domestic currency depreciation could negatively affect corporate earnings if there is a currency mismatch between assets and liabilities. Several studies have demonstrated that exchange rate fluctuations have a differentiated impact on the financial situation of companies. Most of them agree that the levels of permanent investments, foreign currency financing, and exchange gains are affected. If the level of foreign exchange losses is high, it can induce companies to illiquidity that will be reflected as an overdue portfolio for credit institutions and a decrease in net profits that will translate into a reduction in tax payments, so foreign exchange gains and the determinants in terms of business decisions should be studied.

The Mexican peso exchange rate against the dollar remained below 22 pesos per dollar from 1990 to 2019. The unanticipated outbreak of Covid-19 and the uncertainty caused by pressures in the international oil market precipitated a sudden and abrupt depreciation of the Mexican currency by approximately 30% in the first quarter of 2020. It also caused a strong contraction of the economy due to the fall in domestic consumption and the closing of the manufacturing sector due to the confinement of the population. According to López-Herrera and Rodríguez (2020), the increases in the peso-dollar rate negatively affected the prices of the companies listed in the Mexican stock market.

As is known, the Covid-19 pandemic also negatively impacted world consumption, particularly in the United States. This negatively affected Mexican exports, which contracted by 56.7% in May (INEGI, 2020a), negatively impacting the dollar revenues and profits of Mexican companies. This context changed companies' investment and financing environment, as it posed different conditions to the premises on which their original investment and financing plans for 2020 may have been based. The levels of investment in real estate, manufacturing plants, and equipment remained at low levels, as shown by the figures for gross fixed capital formation: -11% in April, -37.9% in May, -39.9% in June, and -24.1% in July according to INEGI data. In the period before Covid-19, economic variables maintained different behavioral parameters, suggesting the need to study the variables that influence the probability of exchange rate gains in the two periods: the one prior to the health crisis and the one during the pandemic.

This work presents how the influence of permanent investments and foreign currency debt on the probability of foreign exchange gains during the first two quarters of 2020, the period associated with the Covid-19 pandemic, changed relative to the previous period from the first quarter of 1990 to the fourth quarter of 2019. Although the period of the unexpected health crisis is still short and is not yet over, the results presented on its immediate effects on the relationships between the variables under study could be useful for understanding these relationships in the presence of other large economic shocks, probably not associated with public health problems. Naturally, over time, more data will make possible more complete analyses, both in breadth and in depth.

In order to carry out this work, two hypotheses were put forward. (1) The higher the levels of investments in long-term assets, foreign currency debts, and the higher the dollar value, the lower the probability of obtaining foreign exchange gains. (2) Given the change in the economy's behavior during the crisis period caused by Covid-19, the relationship between foreign exchange gains with permanent investments and foreign currency debts suffered alterations.

The relative scarcity of studies on the foreign exchange earnings of companies in Mexico make this work, in general, a contribution to broadening and deepening the knowledge of the influence of investment levels and the use of foreign currency debt on the probability of foreign exchange earnings. Moreover, it contributes to understanding the effects of the pandemic on those earnings. This study builds on the results of Morales and Lopez-Herrera (2021a) and Morales and Lopez-Herrera (2021b), focusing on the internal company variables related to long-term investment and financing.

The structure of this article is organized as follows. The subsequent section provides a review of the relevant literature. Then, a section is dedicated to the presentation of the variables under study and the logit model, which is the methodological instrument selected for this analysis. This is followed by an analysis of the estimation results for the periods prior to Covid-19 and the period corresponding to the health emergency, with the final section devoted to the conclusions.

Literature review

According to Chow (2015), Caballero, Panizza, and Powel (2014), Chui, Kuruc, and Turner (2016), Nuñez, Perrotini, and López-Herrera (2018), and Bruno and Song (2018), many companies in emerging economies increased their foreign currency liabilities due to easy access to global capital markets, low interest rates, and good investment opportunities. However, devaluations and depreciations make it difficult for companies to service debt. Byström (2017) found that companies in Chile, Colombia, Mexico, and Peru showed significantly different currency mismatches leading to foreign exchange losses in the case of local currency depreciation. Local currency revaluation can produce negative effects by reducing exports of domestic companies (see Mishkin (2014), Madura (2015), & Mankiw (2006)). Although there are also benefits: in the case of imports, local currency prices are reduced, as are interest and principal payments on foreign currency loans.

Venkatesh and Gourishankar (2019) studied—in companies from 22 emerging economies—the financial fragility arising from the exchange rate risk derived from corporate financing in a foreign currency different from that of their revenues, finding that in Latin America and Central Europe this situation is common. Kesriyeli, Özmen, and Yigit (2011) found that a group of Turkish companies holding higher dollar debt than the international average from 1992 to 2003 were more vulnerable to exchange rate depreciation, as depreciations contract companies' earnings, the more leveraged they are in that foreign currency. However, they show that exports reduce this vulnerability by earning revenues in foreign currency, which, by providing a natural hedge, could make possible a greater margin of leverage in that currency to the extent that such revenues are greater than the present level of the debt.

Analyzing the corporate balance sheets of Brazil, Colombia, Hungary, Indonesia, Israel, Malaysia, Mexico, Peru, Poland, Russia, South Africa, South Korea, Thailand, and Turkey, Du and Schreger (2016) found that between 2004 and 2012 the higher the foreign currency financing the higher the risk of sovereign default. They claim that a government is more inclined to default than to control inflation when the currency mismatch of the corporate sector has adverse effects as a result of depreciation. Forbes (2002) studied the impact of 12 depreciations that occurred between 1997 and 2000 in 13,500 companies in 42 countries. The results show that after one year, companies show higher growth in their market value, suggesting that they increase the present value of expected future earnings. Exporters show a higher return, demonstrating the advantages of the commercial channel.

Kadirgan (2019) mentions that the excessive increase of foreign currency credit in companies in emerging countries is worrisome because it can deteriorate solvency in the face of depreciation. He found that Turkish companies with direct access to international financial markets export more and have a higher proportion of foreign currency assets than companies that only use credit from domestic banks,

thus decreasing their insolvency risk in the face of a depreciation. Harasztosi and Kátay (2020) investigated the efforts of Hungarian companies to match the currency composition of their assets and liabilities. They demonstrated that currency matching is important in the exporters' choice of debt currency. Consequently, the probability of borrowing in a foreign currency is higher when export revenues fully cover the foreign currency debt service costs. However, natural hedging is not the main reason for choosing a foreign currency, as it explains only 3.8% of all new foreign currency loans taken out. In addition to natural hedging, they suggest that both carry trade and diversification strategies are relevant factors in foreign currency financing decisions. These authors clarify that there are additional factors. Allayannis et al. (2003) suggest the agency theory of costly monitoring and profitability-based signaling as a possible explanation for the use of foreign currency debt. Shapiro (1984) indicates that in some countries, such as Sweden, tax law encourages the use of foreign debt by allowing foreign exchange losses to be immediately tax deductible.

Salomao and Varela (2018) found that companies in Hungary that used foreign currency borrowing during 1996-2010 can achieve a higher level of growth. They confirmed that highly productive companies with low capital prefer to borrow in foreign currency and expose themselves to foreign exchange risk to reach their optimal production scale faster. Studies show that the correlation between revenues and foreign currency debt is insufficient to ameliorate exchange rate risk. The above is demonstrated by Ribeiro et al. (2017), who proved that currency depreciation negatively impacted the balance sheet of Brazilian companies with foreign currency debt during the 2009-2015 period. Currency depreciation affects the economy's performance, which, according to Mishkin (2014), sets the pattern of investment in real estate, manufacturing plants, and equipment. Romer (2006), Bonono and Terra (2001), and Madura (2015) argue that a depreciation expands the production of export goods, boosting investment in fixed assets.

Bleakley and Cowan (2005) found that from 1990 to 1999, emerging market companies with mismatches in their foreign currency liabilities and assets reduced their investment in the face of depreciation. Banerjee, Hofmann, and Mehrotra (2020) study companies in Canada, France, Germany, Italy, Japan, the United Kingdom, the United States, Brazil, Chile, China, India, Indonesia, Korea, Mexico, Russia, and South Africa, finding that depreciations during 2000-2015 impacted the investment of companies leveraged in foreign currencies. According to their results, companies decreased their investment before the crisis and subsequently increased it, falling again in 2015. In emerging economies, the decline was greater, suggesting that the large depreciation of their currencies contributed significantly to the recent slowdown in investment in those economies.

According to Benavente, Johnson, and Morandé (2003), the depreciations in Chile from 1994 to 2001 after the Asian crisis could expand investment in companies leveraged in foreign currency. Conversely, Cowan, Hansen, and Herrera (2005) found that during the 1995-2003 period, after a depreciation, Chilean companies with more debt in dollars did not present a statistically different level of investment from those indebted only in local currency. Alvarez and Hansen (2017) examined a panel of Chilean companies during 1994-2004 and did not identify any effects of foreign currency indebtedness on profitability or asset investment after a devaluation.

Restrepo, Niño, and Montes (2014) demonstrated that Colombian companies did not match the currency composition of their liabilities with their assets and revenues during 2005-2012. Because of this, they proved that a currency depreciation of 10% leads to a 3% reduction in the rate of investment in fixed assets of companies with the highest amount of debt in dollars. Barajas, Restrepo, and Steiner (2017) found that Colombian companies increased their foreign currency debts during 2005-2013, increasing their vulnerability if external conditions changed. They found an impact on investments during exchange rate fluctuations, which is much stronger in depreciations than in appreciations, with the possibility that vulnerable companies may have to cut their investments to respond to an adverse shock to their balance sheets. Carranza, Cayo, and Galdón (2003) analyzed 163 companies in Peru and found that those with dollar-denominated debt were negatively affected by the depreciation of their currency. Furthermore, they faced a contraction in domestic demand that severely affected their sales, where the export sector was characterized by being relatively small and concentrated in a few industries. This situation is a cause for concern since a sharp depreciation could lead to the bankruptcy of companies with large currency mismatches and have serious consequences for the real economy, creditors, and even public finances.

As Fernandes (2020) points out, measures to address the health crisis unleashed by the SarsCov-2 outbreak disrupted the functioning of global supply chains, affecting businesses in all countries. Consumers were forced to change their consumption patterns, which resulted in shortages of many goods in supermarkets. Global financial markets have recorded sharp declines, with volatility reaching higher levels than in the 2008 financial crisis.

Hassan, Hollander, Lent, and Tahoun (2020) found that as Covid-19 spreads, the main concerns of US companies relate to collapsing demand, increased uncertainty and disruption of supply chains, reductions in production capacity, shutdowns, and employee welfare. They identified that some companies foresee opportunities in new markets due to the spread of the disease. Fairlie (2020), in an analysis of the impacts of the pandemic on small businesses in the United States, found that during the crucial period from February to April 2020, 3.3 million businesses stopped operations, equivalent to 22% of the total 15 million businesses. Losses were perceived in almost all branches of economic activity. Baker, Bloom, Davis, and Terry (2020) assess the macroeconomic impact of the pandemic using the

Baker, Bloom, and Terry (2020) model that estimates the effects of disasters, finding that the year-to-year contraction in US real GDP may be nearly 11% as of the fourth quarter of 2020, with a 90% confidence interval extending to a contraction of nearly 20%. Continued losses in May and June, and partial rebounds beginning in April, were felt across all demographic groups and most economic branches in that country.

Using a simulation method, Inoue and Todo (2020) found that if Tokyo stops its economic activity for one month, the indirect effect on other regions could be twice as large as the direct effect on Tokyo, leading to a total loss of production in 5.3% of its annual GDP. According to ECLAC (2020), Latin American companies have registered significant income drops due to the health crisis. They are having difficulties in maintaining their activities, with serious problems in meeting their salary and financial obligations, and difficulties accessing financing for their working capital. In the case of Mexico, according to INEGI (2020b), slightly more than half of Mexican companies implemented technical stoppages or temporary closures as a preventive measure. A total of 93.2% registered at least one impact, the main one being revenue decrease. In April, 45% made home deliveries of orders, 33.8% had special promotions, 32.6% worked from home, and 29.6% sold online.

Morales and López-Herrera (2021b) used panel data models to study 16 variables constructed using information from the financial statements of non-financial companies listed on the Mexican Stock Exchange. Moreover, they included five macroeconomic variables. Their study covered from 1990 to 2018, finding through a sequential reduction process of the original model that among the eight relevant variables to explain exchange gains are the different categories of investments in real estate, manufacturing plants and equipment, debt in dollars, and the exchange rate. Morales and Lopez-Herrera (2021a) found that long-term investments and foreign currency financing affect the probability distribution of foreign exchange gains of non-financial companies listed on the Mexican Stock Exchange.

Data and methodological aspects

The financial ratios were selected based on the analysis of Morales and López-Herrera (2021a and 2021b) of the 84 non-financial companies listed on the Mexican Stock Exchange (see Annex).[1] The dollar price was obtained from Banco de México and the accounting data from Economatica; all observations are quarterly. Two periods were studied: the first one from the first quarter of 1990 to the fourth quarter of 2019, considered the pre-Covid-19 period, and the epidemic period comprising the first two quarters of 2020.

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[1]Financial sector companies are excluded due to their atypical behavior.

The accounting data of the operations coming from the commercial activities of the company and those originating from its interaction with the financial markets, as is the case of exchange gains, are presented in the balance sheet, the income statement, and the cash flow statement, which together are called financial statements. According to AC-CINIF A-3 (2018), these statements indicate economic-financial behavior, stability, vulnerability, effectiveness, and efficiency. For this purpose, financial ratios are used. With the information from the financial statements of the 84 companies in the sample corresponding to all the quarters included in the analysis presented in the following section and following the guidelines established in the International Financial Reporting Standards (CINIF and IMCP, 2019), financial ratios were constructed, considering also that, as stated by Ross, Westerfield, and Jordan (2019:57):

"...another way to avoid the problems in comparing companies of different sizes is to calculate and compare financial ratios. These ratios are ways of comparing and investigating the relationships between different parts of financial information. Using such ratios eliminates the problem of [company] size because size is standardized...What is left are percentages, multiples, or periods."

Table 1
Model variables

Variable	Formula	Description
SCUN[*] Gain (loss) derived from exchange balance	Exchange Balance ÷ Net Income	A negative sign means exchange losses; a positive sign means exchange gains. It reflects the effect of the exchange mismatch on total earnings.
AIAT	Intangible Assets ÷ Total Assets	Quantifies the amount of investment in patents and trademarks out of total investments
AIPERG Long-term investment	Property, Manufacturing Plants, and Equipment ÷ Investment Activities	Measures the percentage of investment made during the last year in property, manufacturing plants, and equipment It was obtained from the Cash Flows Statement
DMEAT Debts in Foreign Currency	Foreign Currency Debt ÷ Total Assets	The proportion of assets that have been financed in foreign currency
DOLLAR	Dólar Fix, published by Banco de México	US dollars
IPEAT Long-term assets	Property, Manufacturing Plants, and Equipment ÷ Total Assets	The number of investments in fixed assets of total investments expressed in times. It is obtained from the Balance Sheet.

[*] SCUN is the dependent variable; the other variables are independent
Source: created with the calculations of the author based on the definitions of the Financial Reporting Standards, A.C. CINIF. (2018)

The financial ratios for this study measure exchange gains (losses), investment in intangible assets, the recent acquisition of fixed assets, investment in property, manufacturing plants and equipment, foreign currency debts, and the peso-dollar exchange rate; see Table 1. All variables are expressed in dollars.

The exchange rate is included as a control variable to separate the effects of exchange rate and economic dynamics on exchange gains (losses) from the effects on exchange gains (losses) that are presumably attributable to long-term investments (prior and in-period) and foreign currency financing.

The gain from the exchange balance (SCUN) of the companies under study varies from a minimum (negative) to a maximum (positive) value, even passing through a value of zero or an overall balance with no profit or loss.

To study how the independent variables affect the probability that a company obtains foreign exchange gains vs. losses, using $\text{SCUN}^* = y_i^*$, the following model can be defined

$$y_i^* = \beta_0 + \sum_{j=1}^k \beta_j x_{ij} + u_i$$

(1)

Creating a dichotomous variable that separates the quarters in which each of the companies had foreign exchange gains from the quarters in which there were no such gains:

$$y_i = \begin{cases} 1 \text{ si } y_i^* > 0 \\ 0 \text{ si } y_i^* \leq 0 \end{cases}$$

(2)

Then the probability of foreign exchange gains is a function of the independent variables

$$\mathbb{P}(y_i = 1 | x) = F\left(\beta_0 + \sum_{j=1}^k \beta_j x_{ij}\right) = F(x'\boldsymbol{\beta})$$
$$0 < F(x'\boldsymbol{\beta}) < 1, \beta_0 + x'\boldsymbol{\beta} \in \mathbb{R}$$

(3)

$x = (\boldsymbol{AIAT}, \boldsymbol{AIPERG}, \boldsymbol{DEMEAT}, \boldsymbol{DOLAR}, \boldsymbol{IPEAT})$

If F (•) is a cumulative logistic distribution function, then we have

$$\mathbb{P}(y_i = 1|x) = \frac{e^{x'\beta}}{1+e^{x'\beta}}$$
$$\mathbb{P}(y_i = 0|x) = \frac{1}{1+e^{x'\beta}}$$

(4)

Based on (4), the odds ratio can be constructed as follows

$$\frac{\mathbb{P}(y_i=1|x)}{\mathbb{P}(y_i=0|x)} = e^{x'\beta}$$

(5)

Taking logarithms, we have the logit

$$ln\left(e^{x'\beta}\right) = x'\beta = \beta_0 + \sum_{j=1}^{k}\beta_j x_{ij}$$

(6)

The parameter vector can be estimated by maximizing the log-likelihood function $ln\mathcal{L}(\boldsymbol{\beta})$:

$$\widehat{\boldsymbol{\beta}} = \arg\max_{\beta}[ln\mathcal{L}(\boldsymbol{\beta})] = \arg\max_{\beta}\left[\sum_{i=1}^{n}\left(y_i ln\left(\frac{e^{x'\beta}}{1+e^{x'\beta}}\right) + (1-y_i)ln\left(\frac{1}{1+e^{x'\beta}}\right)\right)\right].$$

(7)

According to (5) and (6), the relationship between logits and explanatory variables is nonlinear, so it is not always easy to express the effect on the probability of an increase in the explanatory variables. The marginal effect of an explanatory variable measures the change in the probability as a consequence of a marginal change in that explanatory variable, keeping the other variables constant, and is calculated as:

$$\frac{\partial\left(\mathbb{P}(y_i=1|x)\right)}{\partial x_{ij}} = \mathbb{P}(y_i = 1|x)\left(1 - \mathbb{P}(y_i = 1|x)\right)\beta_j = \frac{e^{x'\beta}}{\left(1+e^{x'\beta}\right)^2}\beta_j.$$

(8)

The marginal effect of a variable depends on the value of the estimated coefficient, the other parameters of the model, and the probability density function (logit in this case). Therefore, each combination of values of the explanatory variables has a different marginal effect. In practical terms, each observation of the dependent variable has a different marginal effect. A common practice is calculating the partial effects based on the average values of the explanatory variables.

Analysis of foreign exchange gains

Table 2 shows that during the health crisis there have been notable changes in the probabilistic distribution of exchange gains for the sample of companies analyzed. The minimum and maximum differ ostensibly from the previous ones. They have a notable shift of the average, which has become negative, as well as a strong shift of the median to a higher level and a more than twofold growth in the dispersion of exchange gains observed before the pandemic.

Table 2
Basic statistics and quartiles of exchange gains

	Minimum	Maximum	μ	σ	25%	50%	75%
Pre (1990q1-2019q4)	-20.825	77.308	0.064	1.898	-0.042	0.001	0.062
Covid-19 (2020q1-2020q2)	-44.501	27.005	-0.229	4.720	-0.050	0.034	0.211

Source: created by the author

Table 3 presents the five companies with the lowest SCUNs and the five with the highest SCUNs, both for the pre-Covid-19 period and the period corresponding to the health crisis. In the first period, there were three from the materials sector that presented minimum values, ICH 4th quarter 1990, Q.B. Industrias 4th quarter 2001, SIMEC 2nd quarter 2002; one from the frequent consumer products sector, GRUMA in the 2nd quarter 2000 and one from telecommunications, AXTEL 4th quarter 2019.

Table 3
The five companies with the highest foreign exchange losses (negative sign) and the five companies with the highest foreign exchange gains (SCUN)

Company	Quarter	SCUN	Sector
Pre Covid-19 period 1990q1-2019q4			
AXTEL SAB de CV	2019q4	-20.82	Telecommunications
Industrias CH SAB de CV	1990q4	-20.82	Materials
Grupo SIMEC SAB de CV	2002q2	-18.19	Materials
Q.B. Industrias SA de CV	2001q4	-14.70	Materials
GRUMA SAB de CV	2000q2	-12.75	Frequently Consumed Products
HIMEXSA SAB de CV	2004q1	32.5	Non-basic Consumer Products
GRUMA SAB de CV	2003q1	58.29	Frequently Consumed Products
HIMEXSA SAB de CV	2003q4	58.54	Non-basic Consumer Products
GRUMA SAB de CV	1999q1	76.91	Frequently Consumed Products
Altos Hornos de México SA de CV	1998q1	77.31	Materials
Covid-19 2020q1-2020q2			
Convertidora Industrial SAB de CV	2020q2	-44.5	Materials
Convertidora Industrial SAB de CV	2020q1	-7.96	Materials
Grupo SIMEC SAB de CV	2020q1	-7.77	Materials
Grupo LAMOSA SAB de CV	2020q1	-6.23	Industrial
América Móvil SAB de CV	2020q2	-5.02	Telecommunications
Industrias CH SAB de CV	2020q2	3.92	Materials
Internacional Cerámica SAB de CV	2020q1	4.37	Industrial
Compañía Minera AUTLAN SAB de CV	2020q2	5.12	Materials
Grupo FAMSA SAB de CV	2020q1	5.99	Non-basic Consumer Products
Grupo SIMEC SAB de CV	2020q2	27.00	Materials

Source: created by the author

Maximum values were found in one from the frequent consumption sector, GRUMA, in the 1st quarter of 1999 and the 1st quarter of 2003, one from the non-basic consumption sector, HIMEX, in the

4th quarter of 2003 and the 1st quarter of 2004, and finally, one from the materials sector, Altos Hornos de México during the 1st quarter of 1998.

For the first two quarters of 2020, companies in the materials sector prevail in the minimum (negative) and maximum exchange gains (losses). Companies in these sectors require large proportions of fixed assets to develop their operations, including mining companies that are generally large exporters. The above could indicate the importance of investments in real estate, machinery, and equipment to obtain exchange gains.

As can be seen in the reference table, the sector does not seem to be a relevant factor in explaining exchange gains (losses). The reason is that companies in the same sector can behave in a notably differentiated manner. As an example of the behavior, there is the case of Convertidora Industrial, classified by the Mexican Stock Exchange as a member of the materials sector, which in the two quarters of 2020 analyzed, together with other companies in the same sector, is among the five companies with the highest exchange losses, while Grupo SIMEC, also in the same sector, obtained, like other companies also in the materials sector, exchange gains during the second quarter of 2020, while it had suffered losses in the previous quarter. Something similar could also be said even for the period before the outbreak of the Covid-19 epidemic.

Table 4 presents the results of the logit model estimations and shows that considering the period before Covid-19, from the first quarter of 1990 to the fourth quarter of 2019, the variables are highly significant, even at 1%, except for AIPERG, which is only significant at 5%.

The estimated model for the first two quarters of the health emergency period showed that the variable of recent investment in real estate, plant, and equipment (AIPERG) is the only significant one. However, it is only weakly so, which is why the Wald test was performed (lower panel of Table 4) to test the restriction that the value of the coefficients of the other variables of the original model is equal to zero.

Since this work did not find sufficient evidence to reject the null hypothesis, the model was estimated again by removing all the non-significant variables, thus obtaining the results in the upper right panel of the same table.

The AIPERGs reflect the fact that recent investments, i.e., those made within a year or less, were probably made partly considering a scenario in which the economy was expected to maintain the pace it had sustained during 2019. Social confinement resulting from the Covid-19 pandemic caused economic activity to decline, turning recent fixed asset investments into idle investments for many companies during the pandemic.

In the pre-Covid-19 period, it is shown that only a marginal increase in IPEAT has a positive effect, increasing by 9.9% the probability that the company has foreign exchange profits when the explanatory variables are at their mean values. It is also noteworthy that under the same circumstances, a

marginal change in AIAT reduces almost 41% of that probability in that period and that a marginal change in AIPERG practically does not affect the probability of profits. Changes in the dollar and DMEAT reduce, respectively, the probability of exchange gains by almost 25% and 16%.

The results of the model estimation for the pre-Covid-19 period are consistent with Caballero, Panizza, and Powel (2014), Chow (2015), and Chui, Kuruc, and Turner (2016), who found that foreign currency debts deteriorate the liquidity of companies, erode their ability to pay and as a consequence produce foreign exchange losses. This work's evidence is also consistent with Bleakley and Cowan (2005) and Banerjee, Hofmann, and Mehrotra (2020), who found that exchange rate fluctuations affect investment in fixed assets, impairing profits.

Table 4
Estimated logit models

Variable	Pre-Covid-19 period (1990q1 to 2019q4)				Pre-Covid-19 period (1990q1 to 2019q4)			
	β_i	p	$\dfrac{dp}{dx}$	$\bar{x}$	β_i	p	$\dfrac{dp}{dx}$	$\bar{x}$
Constant	0.3389	< 0.01			0.5384	< 0.01		
AIAT	-1.6548	< 0.01	-0.40802	0.06364				
AIPERG	-0.0002	0.0406	-0.00005	0.00002	-0.3146	0.0982	-0.07353	0.05052
IPEAT	0.4023	< 0.01	0.09918	0.43185				
DOLLAR	-1.0336	< 0.01	-0.25485	0.10795				
DMEAT	-0.6349	< 0.01	-0.15655	0.16340				
Wald Test (model estimated for the Covid-19 period)					F	p	χ^2	p
H_0: $\beta AIAT = \beta IPEAT = \beta DOLAR = \beta DMEAT = 0$					0.2364	0.9174	0.9455	0.9179

p denotes the value of the marginal significance level and $\dfrac{dp}{dx}$ the marginal effect of x

For the Covid-19 period, the notable change in the magnitude of the coefficient associated with investment in AIRPEG real estate, plant, and equipment, as well as the marginal effect, in both cases maintaining the negative sign, can be considered as possibly a direct consequence of the fact that this type of investment grew in all items. The above was reported by INEGI in the results of gross fixed capital formation from January to June 2020[2] after falling continuously from January to May, except for the construction sector, which began its recovery this last month.

A slowdown in economic activity was also observed, measured by a 20.7% drop in GDP in the first quarter of 2020 and 16.9% in the second quarter. This reflected the magnitude of the decline in productive activity, mainly in April and May, due to the social distancing measures derived from the health crisis and a 56.3% drop in non-oil exports (INEGI, 2020a).

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[2]https://www.inegi.org.mx/temas/ifb/, accessed September 7, 2020

On the other hand, the price of the dollar hold sustained increases during the first half of 2020, reaching the price of almost 25 Mexican pesos. Although it fell back again during June, it did not return to the levels it had at the end of 2019, which was below 19 pesos per dollar. All these elements together explain why the recent investment in AIRPEG real estate, plant, and equipment decreases the probability of foreign exchange gains in companies during the first half of 2020.

It is observed that during the first two quarters of 2020, economic activity decreased, as shown by the indicators of the fall in GDP, and therefore the recent investment in real estate, plant, and equipment is partially used. This may be a reason that explains its negative relationship with the exchange gains in this period. This coincides with Mishkin (2014), who points out that the economy's performance establishes the pattern of investment in long-term productive assets.

Conclusions

This work analyzed the relationship between the probability of the foreign exchange earnings of Mexican companies and their fixed investments, their foreign currency debts, and the value of the dollar. It also analyzed the alterations that occurred in this relationship due to the change in the economy's behavior during the Covid-19 pandemic, comparing the behavior of these variables with that observed during the period from the first quarter of 1990 to the last quarter of 2019.

Naturally, having only two quarters of information for the period of the pandemic can be considered a natural limitation of this study. Nevertheless, it is convenient to consider that in those quarters, there was a sharp drop in private investment compared to the pre-crisis period, i.e., a key variable to explain the behavior of exchange rate gains was generally affected, as shown in this work and other studies. In addition, during that period there was a sharp fall in the exchange rate, the control variable of the model used in the estimates of this work, which is why, for comparison purposes, it is possible to take the model estimated for the pre-Covid-19 period as a counterfactual.

For the pre-Covid-19 period, it was found that recent investments in fixed assets, intangible assets, and real estate, plant, and equipment, as well as foreign currency debts and the dollar, are significant variables in the estimated logit model for the probability of obtaining foreign exchange gains. Intangible assets (AIAT) have the largest negative impact on exchange rate gains. This impact is most likely a result of the foreign currency payments made by the companies studied during the scenarios of depreciation of the national currency for servicing foreign currency debt, the intensive use of software, and franchise contracts in other intangible asset items essential for their operations during the lockdown.

In contrast, recent fixed asset investments (AIRPEG) have little impact on the probability of foreign exchange gains. Generally, these acquisitions are determined by investment plans, so the amount

disbursed could have been offset by the income produced with the estimated new scale of operation that gave rise to the recent investments, establishing a natural hedge against exchange rate fluctuations. Only investment in real estate, plant, and equipment (IPEAT) increases the probability of exchange rate gains. This increase can be explained because a currency depreciation originates an international competitive advantage of national products that increases local aggregate demand and the need to produce more. The above is pointed out by Mishkin (2014), Bonono and Terra (2001), and Romer (2006), and it establishes a positive relationship with these investments that provide the production capacity required to meet the increase in demand.

According to the estimates presented in previous pages, from 1990 to 2019, the movement of the peso-dollar exchange rate reduced the probability of foreign exchange gains by just two-thirds of the impact of intangible assets. That result is in line with Byström (2017), who showed evidence that, due to different currency mismatches, companies' balance sheets record foreign exchange losses when a local currency depreciation occurs.

Dollar debts (DMEAT) decrease the probability of foreign exchange earnings by one-third of the effect of investments in intangible assets. The result of this work is different from that of Salomeo and Varela (2018). They argue that companies use foreign currency debt to achieve faster growth in their productive capacity and achieve higher exports and foreign currency revenues, which translate into foreign exchange gains during local currency depreciation events. This discrepancy could be because foreign currency debt, although it may have raised the level of sales, may have been preponderantly in domestic currency, not reflecting these increased revenues in exchange gains or, as shown by Ribeiro et al. (2017), exchange rate depreciation may negatively impact the balance sheets of companies due to the decline in the prices of their export products.

Only the recent investment in AIRPEG real estate, plant, and equipment during the health crisis was significant, although this significance was lower than that of the period from 1990 to 2019. The magnitude of the coefficient increased significantly.

With the evidence presented in this research, the first hypothesis was validated for the 1990-2019 period because a negative relationship was found between exchange gains and the levels of investments in intangible assets, fixed assets, and the levels of liabilities in foreign currency. For the 2020 period, this hypothesis is partially accepted because only investments in intangible assets were statistically significant for foreign exchange gains.

Regarding the second hypothesis, it is partially accepted because the relationship between permanent investments and foreign debts changed its relationship with foreign exchange earnings originating from the effects of Covid-19 in the Mexican economy, at least in the immediate period of the health pandemic.

Decisions made by companies regarding their investments in fixed assets can contribute to the recovery of the economy deteriorated by the Covid-19 pandemic since, as argued by Krugman (1999) and Hong (2018), investments and capital flows reflected in the balance sheets of companies are necessary conditions for reviving economic activity.

When economic activity recovers after the pandemic, there could be a similar behavior in the variables studied to that before the crisis, i.e., the observed relationships could return to their previous general level. Differences will probably be observed in the recovery processes of the different branches of economic activity, with the response of the probability of exchange rate gains to their determinants also varying in a differentiated manner. It could even be that the pandemic has meant a change in the structure of the relationships between exchange gains and the variables that affect their realization. The above could generate different relationships from those that existed before the economic crisis derived from the health crisis, with different conditions being observed in these relationships not only for each sector of the economy but even for the same company.

According to the evidence found in this research, the sector to which the companies belong does not seem to condition exchange gains in any way since there were companies with exchange gains and others with exchange losses during the same period. Companies can behave differently even if they belong to the same sector. It is even worth noting that the same company could show differences in the generation of exchange gains (losses) despite being in similar conditions.

Naturally, it is important to consider future analyses on the different effects that dollar investments and financing could have on exchange rate gains. Despite the results reported in this article, it might be useful to study the possibility of differentiated effects for each of the sectors of economic activity because there could be structural changes in economic relations as new supply chains are reconstructed or built, as well as modifications in the markets due to permanent changes in the way of doing business and in consumer preferences.

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Annex

Table A1
Sample companies

ACCELSA	CORPORACIÓN MOCTEZUMA	INDUSTRIAS BACHOCO
GRUPO ROTOPLAS	G COLLADO	GRUPO BAFAR
ALFA	CONVERTIDORA INDUSTRIA	GRUPO BIMBO
CONSORCIO ARA	CYDSA	CONTROLADORA COMERCIAL MEXICANA
CONSORCIO ARISTOS	GRUPO CEMENTOS DE CHIHUAHUA	FOMENTO ECONÓMICO MEXICANO
GRUPO AEROPUERTARIO DEL SURESTE	GRUPO MÉXICO	GRUPO GIGANTE
INTERNACIONAL DE CERÁMICA	INDUSTRIAS ICH,	GRUPO MODELO
DINE	MEXICHEM	GRUMA
GRUPO CARSO	MINERA FRISCO	GRUPO HERDEZ

CORPORACION GEO	INDUSTRIAS PEÑOLES	KIMBERLY-CLARK DE MÉXICO
GRUPO INDUSTRIAL SALTILLO	GRUPO POCHTECA	COCA-COLA FEMSA
GRUPO MEXICANO DE DESARROLLO	Q.B. INDUSTRIAS	GRUPO INDUSTRIAL MASECA
CONSORCIO HOGAR	GRUPO SIMEC	GRUPO MINSA
DESARROLLADORA HOMEX	ALSEA	ORGANIZACIÓN SORIANA
EMPRESAS ICA	GRUPE	WAL-MART DE MÉXICO
IMPULSORA DEL DESARROLLO Y EL EMPLEO EN AMÉRICA LATINA	CORPORACIÓN INTERAMERICANA DE ENTRETENIMIENTO	AMÉRICA MÓVIL
GRUPO KUO	CMR	AXTEL
GRUPO LAMOSA	EDOARDOS MARTIN	TV AZTECA
GRUPO AEROPUERTARIO DEL CENTRO NORTE	GRUPO ELEKTRA	EMPRESAS CABLEVISIÓN
PROMOTORA AMBIENTA	GRUPO FAMSA	MAXCOM TELECOMUNICACIONES
PROMOTORA Y OPERADORA DE INFRAESTRUCTURA	GRUPO PALACIO DE HIERRO	MEGACABLE HOLDING
SARE HOLDING	HOTELES CITY EXPRESS	GRUPO QUMMA
URBI DESARROLLOS URBANOS	HIMEXSA	GRUPO RADIO CENTRO
CONTROLADORA VUELA COMPAÑÍA DE AVIACIÓN	EL PUERTO DE LIVERPOOL	GRUPO TELEVISA
ALTOS HORNOS DE MÉXICO	GRUPO POSADAS	FARMACIAS BENAVIDES
ALPEK	REAL TURISMO	CORPORATIVO FRAGUA
COMPAÑÍA MINERA AUTLAN	GRUPO VASCONIA	GENOMMA LAB INTERNACIONAL
CEMEX	ARCA CONTINENTAL	GRUPO CASA SABA

Source: created by the author with data from the Mexican Stock Exchange