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Working capital management in the COVID-19 economic crisis: the case of non-financial enterprises listed in the IPC

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Abstract

The purpose of this study is to analyze the working capital management (WCM) strategies followed by non-financial firms listed in the IPC during the Covid-19 economic crisis, by estimating the target level of working capital requirements. We classify firms by operations in different geographies. Then we employ a regression analysis of random effects to estimate the working capital requirements (WCR) of the different firms, by regions, to understand the strategies of WCM. The study was conducted for the period 2018q1-2020q2, for which we have data available but also comparison for normal times (2018q1-2019q4) vs Covid-19 times (2020q1-2020q2). The contribution is to describe the WCM practices in Mexico, because of the lack of studies of this kind, but also to analyze these practices in periods of economic crisis, where the working capital use to be high. The conclusion is that the WCR are related to the gross margins, but also that firms that have operations in locations different than Mexico have a better WCM.

Keywords: working capital management; economic crisis; Covid-19; short-term strategies; non-financial firms.
JEL classification: G12; C53; D53; F36.

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Gestión del capital de trabajo en la crisis económica del COVID-19: el caso de las empresas no financieras incluidas en el IPC

Resumen

El propósito es analizar las estrategias de gestión del capital de trabajo (ACT) seguidas por las empresas no financieras incluidas en el IPC durante la crisis económica de Covid-19, mediante la estimación del nivel objetivo de requisitos de capital de trabajo. Clasificamos empresas por operaciones en diferentes geografías. Luego, empleamos un análisis de regresión de efectos aleatorios para estimar los requerimientos de capital de trabajo (RCT) de las diferentes empresas, por regiones, para comprender las estrategias de ACT. El estudio se realizó para el período 2018t1-2020t2, para el cual tenemos datos disponibles, pero también comparativos para tiempos normales (2018t1-2019t4) vs tiempos Covid-19 (2020t1-2020t2). El aporte es describir las prácticas de ACT en México, debido a la falta de estudios de este tipo, pero también analizar estas prácticas en períodos de crisis económica, donde el capital de trabajo suele ser alto. La conclusión es que los RCT están relacionados con los márgenes de utilidad, pero también que las empresas que tienen operaciones en ubicaciones diferentes a México tienen un mejor ACT.

Palabras clave: administración de capital de trabajo; crisis economica; Covid-19; Estrategias de corto plazo; empresas no financieras.
Clasificación JEL: G12; C53; D53; F36.

1. Introduction

In the context of a macroeconomic crisis, usually there are two possible strategies at a firm level to face the crisis: on one hand, there is the capital structure management, which is based, on the long-term liabilities and the capital of a firm. On the other hand, there is the working capital management, which means a short-term strategy, this is, the management of current assets and current liabilities.

For the first option, there is a huge literature body that study the relationship between the macroeconomic crisis and the capital structure for the 2008-2009 crisis (Demirguc, Martinez & Tressel, 2015; Morri & Artegiani, 2015; Danso & Adomako, 2014); the 1997 crisis (Lim *et al*., 2009; Deesomsak, Paudyal & Pescetto, 2004; Suto, 2003); the greek crisis (Ballos *et al.*, 2016). The main

hypothesis are related to the channels of financial impact on capital structure, the capital structure and the profitability of the firms, or the effects of the capital structure on the strategy of the firms.

For the second option, there are literature relating the economic crisis and the working capital management (WCM), for the economic crisis of 1997 (Claessens, Djankov & Colin-Xu, 2000) and the 2008-2009 crisis (Tsuruta, 2019; Ranajee & Rajesh Pathak, 2019; Nobanee, 2018; Oseifuah, 2018). This literature relates the profitability of firms and the WCM, and investigates the different profiles of WCM in the context of a macroeconomic crisis.

By another side, there has been different macroeconomic crisis in history, the 2008/2009 "financial crisis", the 2001 crisis "dot.com", the 1997/1998 "Asian crisis", and many other financial crisis. These crises have in common that the impact is almost immediate in the whole world, but the actual "COVID-19 crisis" is different since it was at a first instance an epidemic crisis and then an economic crisis. Then the first effects were the massive virus contagion, which lead to lock down measures in different countries but in different moments.

For the last reasons, we took into account the second literature reference, since the COVID-19 economic crisis started in different times and in different regions. Particularly the health epidemic seems to start in Asia (China) in December 2019, and then it expanded to other regions like Japan, Korea, Singapore, USA, France and other countries in January 2020, Europe in February and particularly in Mexico in March. This asynchronous start gave way to different beginnings of the economic crisis, and as we know, the listed firms in the Mexican IPC have operations in different geographies.

This asynchronous, also gave way to the WCM for the Mexican firms, since some of them have operations in other countries like Asia, Europe, USA and the rest of the world. These firms had the twofold opportunity to prepare for the economic crisis; on one hand, they have information of their operations in Asian, European and North America countries on direct communications. By the other hand, most of them have a supply chain linked to Europe, USA and Asia, which gave them information about the possible impacts of the economic crisis.

The purpose of this research is to examine the WCM strategies followed by the Mexican firms listed in the IPC, which is the most important stock index in Mexico, but also have a strong relation with the Mexican GDP (see Figure 1). By another side, the IPC is one of the most important index in Latin-America, and we took only the non-financial firms listed in the IPC, since the financial firms have a different nature and market scope. We analyze the quarter financial accounts statements published in the Mexican Stock Exchange to contrast the different WCM strategies.

The contribution of this work is to estimate the WCR and the target level of working capital for a developing country, since the major part of these studies

were done for the developed markets and economies like Japan, USA and some European countries. By another side, in Mexico the firms have the opportunity to generate a WCM strategy, since the effects of the crisis arrived one or two months later in Mexico than in the rest of the world, which is different in this study but also for this crisis than in different studies and economic crisis.

We divided the document as follows, apart of the introduction there is a literature review section, in which we analyze the working capital perspectives in times of an economic crisis and the strategies followed by the firms. A third section to describe the data and method to estimate the working capital requirements; the forth section describes the result and highlight the strategies followed by firms with operations in different locations like Asia, Europe, USA and Mexico; finally the conclusion are presented.

2. Literature review

Some of the first studies in WCM field are those from Garcia & Matinez (2007) and Deloof (2003), those studies propose that the WCM style have significant impacts on the profitability of the firm, and by another side, shows some evidences of this relation between profitability and WCM. However, it is after the 2008-2009 economic crisis that the studies on WCM shows a significant growth in the literature (Pratap & Kumar, 2014), most of this literature analyses these relations during the periods of crisis.

In general, in an economic crisis there exist an excessive working capital in firms, which consist of trade receivables, inventories and trade payables (Tsurata, 2019). Some of the main reasons are: *a*) the increase in the inventory levels due to the decline of sales levels; *b*) the increase of unpaid receivables; and c) the increase in trade payables, due to the economic crisis. Therefore, the study of how the firms mitigate this excessive working capital is an important issue for the firms and for the academic researchers.

The recent research literature about WCM is related on two aspects (Yan Loo & Theng Lau, 2019; Pratap & Kumar, 2014; Ramiah, Zhao & Moosa, 2014), the effects of working capital on the profitability measures (ROA, ROE and Gross Margins), and on the other side, the working capital practices or the working capital determinants. However, if firms have credit constraints, carrying excessive working capital can diminish firm performance given by the gross margins, ROA and ROE, because firms are obliged to use relatively expensive sources of finance (Tsurata, 2019).

In this sense, an attempt in the financial literature is to estimate an appropriate target level of working capital for firms (Kieschnick *et al*., 2013; Bañoos Caballero *et al*., 2013; Tsurata, 2019). As those studies stated, the firms

tend to adjust their level of working capital taking into account the target level or the WCR.

Nevertheless, it seems that there is not a literature body on WCM, and the reasons are at least two: most of the research on working capital is empirical, which means that the research on working capital are based on statistical analysis from the financial statements, and only few articles are conceptual or survey based (Pratap & Kumar, 2014). The other reason is, that before an economic crisis "*working capital management may always have been an issue to some extent, but it's never been a priority*" (Ramiah, Zhao & Moosa, 2014: 334).

In this sense, the study of WCM is essential during the economic crisis, as the firms are looking for answers to optimize their assets and increase the efficiency of financing (Nobanee, 2018). The WCM has probed the efficacy to improve the profitability of the firms in crisis periods by adjusting the curret assets and liabilities (Tsuruta, 2019). By another side, not all the curret assets have a significant effect during the crisis period, some current liabilities are important for the financial manager to be aware of like the case of curret debt (Haron & Mansour, 2016).

2.1. Operating cycle and cash cycle

The cash conversion cycle (CCC) and the operating cycle (OC) are popular measures for the WCM (Oseifuah, 2018; Nobanee, 2018; Brandenburg, 2016; Haron & Mansour, 2016; Pratap & Kumar, 2014), particularly the CCC, since their components (inventory conversion period, receivables conversion period and payables deferral period), are very often used as proxy variables in research about WCM. Other proxy variables are corporate cash holding and other financial ratios related to current assets and liabilities (Ranajee & Pathak, 2019; Scholleova, 2012; Görkey & Gokhan, 2011).

Generally, these proxy variables are measuring the time for a firm to make an initial amount of cash to produce goods, sell them and receive cash from clients (OC), and CCC is a measure to express the days needed to convert its inventory and other raw material and resources into cash from sells. In this sense, the both measures are approximating the days needed for a company to operate in the short run, reflecting the operations and working capital needed to make those operations.

The research results in studies using these proxy variables show that some sectors are more efficient than other managing the working capital (Nobanee, 2018); cash levels are higher during the crisis periods (Ranajee & Pathak, 2019); during the crisis there is a negative relation between profitability and CCC (Oseifuah, 2018). Most of the literature is empirical and those focused in working capital practices (Pratap & Kumar, 2014).

Nevertheless, the OCC and CCC are measures of the impacts that some events or changes in the strategy have on the performance of the firms, and then the key variable is the working capital, or the working capital target level. In this sense, we can propose that the WCM strategy settles the OCC and CCC, and those it is important to estimate the working capital target level, rather than the OCC and CCC to comprehend the WCM strategies.

3. WCM and operations in Asia, Europe and USA

As we mentioned in the introduction, the firms listed in the IPC index has operations in Asia, Europe and USA. This condition, has implications for the WCM of the firms, since the firms have the twofold opportunity to prepare their operations before the Covid-19 economic crisis, on one hand, they have direct communications with their pairs in those countries. By the other hand, they have a supply chain with those countries, which have consequences for the Mexican firms that have the information to prepare their operations before the Covid-19 economic crisis.

In this sense, Brandenburg (2016) propose that supply chain has made more scientific the WCM activities, viewed from an inter-organizational perspective. Raźniak & Winiarczyk (2015) explains that some corporations establish operations in other countries to strength their information systems with emerging markets. In this way, the next Table shows the chronology of the pandemic in the first months, which gives an idea of the economic crisis spread that in last instance arrived to Mexico.

Table 1
Covid-19 pandemic chronology

Location	Event
China	Desember 12 - 19 of 2019 (first cases)
China	January 7, 2020 (Announces the new virus)
China	January 11, 2020 (first death by covid-19)
Thailand	January 13, 2020 (first case)
Japan	January 16, 2020 (first case)
USA	January 21, 2020 (first case)
China	January 22, 2020 (Wuhan closes airports and railways)
World	January 24, 2020 (830 cases in Japan, Thailand, South Korea, Singapore, Vietnam, Taiwan, Nepal, and the United States)
France	January 24, 2020 (first case)
USA	January 31, 2020 (Entry to people who traveled to China is closed)
Philippines	February 2, 2020 (first death)
World	February 5, 2020 (Covid-19 deaths exceed 500 people)
WHO	February 11, 2020 (virus is named Covid-19)
World	February 18, 2020 (Covid-19 deaths exceed 2000 people)
Italy	February 23, 2020 (Venice Carnival is suspended)
Europe	February 25, 2020 (positive cases in Norway, Denmark, the Netherlands, Northern Ireland, Estonia, Romania, Greece)
USA	February 29, 2020 (First death from covid-19)
USA	March 3, 2020 (first reaction against FED's covid-19, lowering interest rates)
Spain	March 4, 2020 (Develops massive Covid-19 testing system)
China	March 7, 2020 (Chinese Exports decrease by 17.2% in the January-February period)
Italy	March 9, 2020 (Closing of borders and blocking of the movement of people)
WHO	March 11, 2020 (Covid-19 declared a pandemic)
Spain	March 12, 2020 (the first quarantines begin in Barcelona and other provinces)
USA	March 13, 2020 (Declares national emergency)
Japan	March 24, 2020 (Olympics suspended)
USA	March 27, 2020 (Economic stimulus agreement in the face of the pandemic)
Mexico	March 30, 2020 (Health emergency declared)
Mexico	April 5, 2020 (In its quarterly report AMLO indicates economic packages before Covid-19)

Source: https://cnnespanol.cnn.com/2020/05/14/cronologia-del-coronavirus-asi-empezo-y-se-ha-extendido-por-el-mundo-el-mortal-virus-pandemico/.

From the table 1, it is evident that firms in Mexico that have operations in Asia, Europe and USA, have the opportunity to prepare their operations to face the Covid-19 economic crisis, and most of them have the chance to establish a pessimistic or optimistic outlook. The firms listed in the IPC index, have operations in various geographies, this means that firms have distribution centers or corporate offices, not only sales (see table 2).

Table 2
Non-Financial firms listed in the IPC index with operations in other countries

Firm name	Operations in different locations			Firm name	Operations in different locations		
	ASIA	EUROPE	USA		ASIA	EUROPE	USA
America Movil		X	X	Liverpool			
Walmart de México				Grupo Aeroportuario			X
Femsa			X	Grupo Aeroportuario del Pacifico			
Televisa			X	Alpek		X	X
Grupo México		X	X	Industrias CH			X
CEMEX	X	X	X	TV Azteca			
ALFA	X	X	X	Aleatica		X	
Industria Peñoles			X	Gruma	X	X	X
Coca Cola Femsa				Alsea		X	
Elektra			X	Grupo Carso	X	X	X
Mexichem (ORBIA)	X	X	X	Lala			X
Bimbo	X	X	X	Comercial Mexicana			
Arca continental			X	PINFRA			
Kimberly-Clark	X	X		IEnova			
Genomma Lab			X				

Source: own elaboration from the firm´s website.

Table 2 complements evidence on the communications and supply chains in Asia, Europe and USA that could be used to prepare firms to face the Covid-19 economic crisis, in particular, there are 7 firms with operations in Asia, 12 firms in Europe and 18 firms in USA. The particular hypothesis is that those firms could use this condition to improve their response before the crisis.

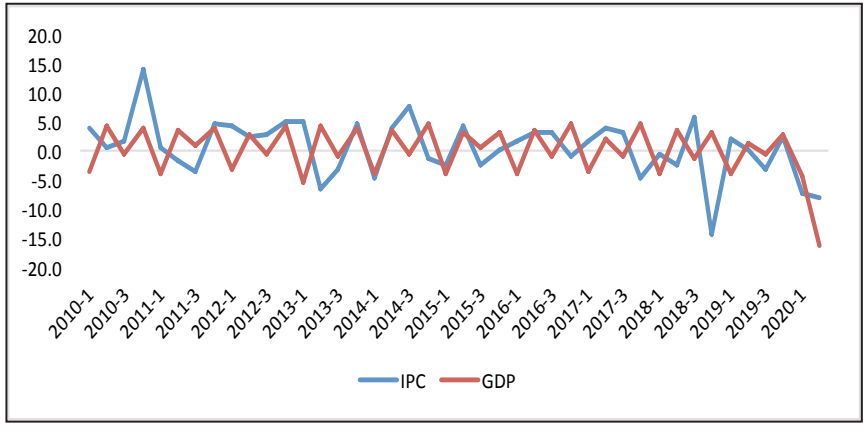
3.1. WCM in Mexico

Studies of working capital and WCM are scarce (Pratap & Kumar, 2014), and the main studies are conducted in the context of Asian or European firms, relating the working capital and the crisis (particularly the Asian crisis of 1997 and the global crisis of 2008-2009).

For the case of Mexico and Latin-America there are few studies about working capital. In particular there is only one relevant work of Morales *et al*. (2011) for the case of Mexico, in which the authors analyses the transformation industry with information from the Mexican Stock Exchange databases and INEGI (National Institute of Statistics and Geography, for their initials in Spanish). They conducted a research on the consequences of the 2008-2009 economic crisis on the Mexican firms; their findings are that these firms adopted an average level of working capital during the crisis.

These diminishing in their operations was due to the connection between the Mexican firms and the USA market, the channel was the exports of goods from Mexican firms to the USA markets. Other consequences was the rising levels of current assets after the crisis, while other sectors diminish these assets in the same period.

In this study, we took into account firms listed in the IPC, because of the relation between this index and the Mexican GDP, as we can see in figure 1. In this sense a better understanding of the WCM strategies of firms listed in the IPC, have an important role on the comprehension of the movements in the Mexican GDP, since there is a correlation of 0.81 at quarter levels (2010q1-2020q2).



Source: own elaboration.

Figure 1
GDP vs IPC index quarter variations 2010q1-2020q2

3.2. Methods and data

The data used in this research came from the Mexican Stock Exchange website, in this site are published the financial statements of each firms, we took information of the income statement and the balance sheet for 29 non-financial firms listed in the IPC index.

We took information of non-financial firms because the nature of banks and other financial firms are different from the rest of firms. The information of these firms correspond to quarter 1 of 2018 to quarter 2 of 2020, Given the provision of information on the portal of the Mexican Stock Exchange and given that we have periods of normal times (2018q1-2019q4) to compare with periods of crisis (2020q1-2020q2). As we explained in the previous section, the 2019q4 and 2020q1 are periods for preparation against the economic crisis for Covid-19, while 2020q2 corresponds to the period of crisis in Mexico.

As we show in table 2, the non-financial firms listed in the IPC have operations in different locations around the world. We defined the operations of a firm, not by the sales or exports to other countries, but with the installation of operation, distribution or corporate centers in other countries, for this for this purpose we look up for the information in the webpages of the firms, looking for this kind of operations in other countries.

The next step was to construct four groups, based in the locations of operations we have: *a*) Asia, Europe & USA; *b*) Europe & USA; *c*) USA and; *d*) México. With these four groups we made some comparisons, it must be it should be clarified that there are firms that have operations in other locations like Central America or South America, but as it is clear from table 1, the first impacts occurred in Asia, Europe and USA.

Then it was calculated the model of working capital requirements (WCR) taken from Tsurata (2019), mainly because this model allow us to estimate the target level of working capital, an those the WCR, as the aim of this study is to estimate the change (or adjust) in the WCR. Where the WCR is defined as the sum of trade receivables and inventories, minus trade payables normalized by sales. Then the WCR are estimated by the next model:

$$WCR_{it} = F(firm\ growth_{it}, Gross\ Margin_{it}, Operating\ Cash\ Flow_{it}, Firm\ Size, GDP_{it})$$

where:

- Firm growth: is the growth measured by growth in sales.
- Gross margin: profit divided by sales.
- Operating Cash Flow (OCF): defined as the net flow of income generated by regular operating activities.

- Firm Size: is the logarithm of total assets.
- GDP: is the gross domestic product growth average for Mexico

By last it is estimated the partial adjustment model to show the effects of the economic crisis for Covid-19 on WCM. Those, following the last equation:

$$WCR_{it} = \alpha X_{it}$$

Where *X* is a function of firm growth, Gross Margin, Operating Cash Flow, Quarter Dummy and GDP. In an equilibrium stage, the WCR is equal to its estimation, nevertheless in a pre-crisis period we need to adjust the WCR by its remaining WCR in previous periods as:

$$WCR_{it} - WCR_{i,t-1} = \emptyset\left(WCR_{it} * -WCR_{i,t-1}\right) + \delta_{it}$$

Where the proportion *Ø* represents the gap between the actual and the desired level of WCR in each period. Which gives the next equation for the partial adjustment:

$$WCR_{it} = \alpha\emptyset X_{it} + (1 - \emptyset)WCR_{i,t-1} + \delta_{it}$$

By a two-stage model, we can estimate *Ø*, which indicates the variations in the WCM practices or the adjustments of working capital in the pre-crisis periods.

With these result it is made a comparison between firms that operate in Asia, Europe and USA with those firms that operate in Mexico or other regions, this comparison is based on the WCR adjusted and the Gross Margin. This comparison make possible to see if the strategies followed by the first group of firms generate more profits than firms that do not operate in those locations.

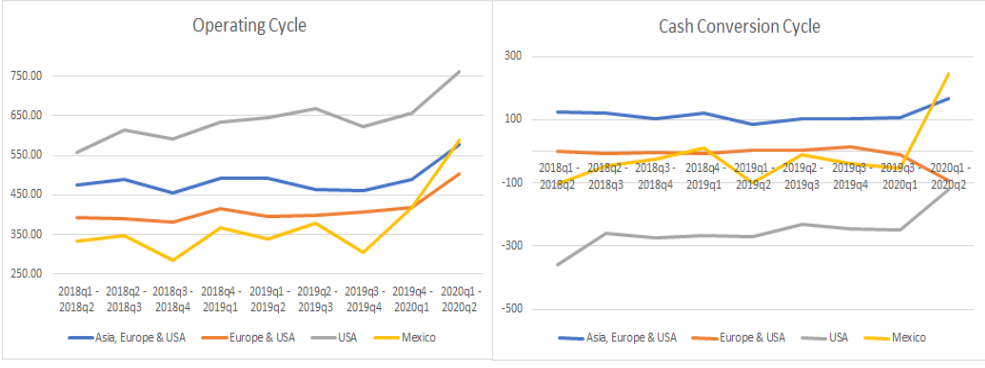
As it is a panel data with 29 firms and 10 quarters (finally we analyze only 9 quarters, since we loss the 2018q1 for the estimation of the firm growth), it is used a panel data fixed and random effects. With the corresponding Haussman test, to verify if it is accurate to use fixed or random effects.

4. Results

4.1. The short-term context of non-financial firms listed in the IPC index

To understand the context in which these firms operate, it is necessary to see the operating cycle (OC) that shows the days that are required for a firm to make an initial amount of cash to produce goods or services and receive cash

from clients. By another side, the cash conversion cycle (CCC) express the average of days required for a firm to convert inventory into cash from sales. In this sense, both metrics are expressed in the figure 2.



Source: own elaboration with information from the Mexican Stock Exchange.

Figure 2
OCC and CCC of non-financial firms listed in the IPC index, with operations in different locations

From the figure 2, it is can be seen that firms that operate in the USA have a longer operating cycle, which means that in the las period (2020q1-2020q2) these firms have an average of 750 days to convert an initial amount of cash for inventory, into cash from sales. By another side, firms that operate in USA have a shorter CCC, which means that it takes in the last period an average of -100 days to convert the inventory into cash from sales, this is that these firms receive advance payments.

In this sense, firms that operate in Asia, Europe and USA have a shorter OC, but a larger CCC, being the firms that operate in Europe and USA the firms with the shortest OC and almost the shortest CCC in the last period.

These cycles where affected by the Covid-19 economic crisis, since all the firms shows a growth in the OC in the last two periods, but the firms that operate only in Mexico exhibit a greater change in the OC in the last two periods, and the largest growth in CCC in the last period. This means that the economic crisis affected the short-term financial administration of non-financial firms listed in the IPC index, but it had different effects depending on the locations in which these firms operate.

4.2. The econometric model of WCR estimation

The econometric model was estimated in different types of panel data models (pooled, fixed and random effects), the main idea is to find the best approximation to the working capital requirements (WCR), and then to estimate the partial adjustment of this variable. The description of the econometric models are in table 3.

Table 3
Panel data models to estimate the WCR

Variables	**Pooled**		**Fixed**		**Random**	
	Coefficient	**Std. error**	**Coefficient**	**Std. error**	**Coefficient**	**Std. error**
Intercept	187.83**	62.64	20.07	14.12	61.26	134.50
Firm size	-7.22*	3.48			-1.36	7.35
Firm growth	-0.05	0.23	-0.32***	0.09	-0.30***	0.09
Gross margin	-0.78**	0.18	0.16	0.15	0.10	0.15
OCF	0.00*	0.00	0.00	0.00	0.00	0.00
GDP growth	-0.15	0.58	-0.30	0.21	-0.41*	0.20
n	29		29		29	
t	9		9		9	
N	261		261		261	
Total sum of squares	959980.00		86611.00		96458.00	
Residual sum of squares	809480.00		76135.00		86472.00	
R-squared	0.16		0.12		0.10	
F-statistic	9.48***		6.25***		Chisq-Statistic	29.45***
Theta					0.89	
Random vs linear test	28.15***					
Fixed vs linear test	78.08***					
Haussman chisq test	4.94					

Source: own elaboration. Significance levels as follows 0 '***' 0.001 '**' 0.01 '*' 0.05.

From the table 3, the random vs linear test shows that the random model is best against the pooled model; the fixed vs linear model test shows that fixed model is also best against the pooled model. Finally, the Haussmann test is not significant, and as a result, the random model effect is the best model to estimate the WCR.

It seems that the individual variables that best explains the WCR are the firm growth and the quarter GDP growth of Mexico, nevertheless the F-statistic and the Chisq-statistic shows that all the independent variables explains the WCR of the firms. Specifically for the random effect model, the theta statistic explains that 89% of the variations in the model came from the individual characteristics of the firms.

The individual effects are the expected, the biggest the firm size the less WCR would be for a firm; as the firm is increasing their sales the firm would need less WCR; a gross margin increase would be followed by a bigger WCR; the growth in the Mexican GDP is going to be accompanied by a smaller amount of WCR. Finally, the only coefficient unexpected is the low contribution of OCF on the changes of WCR, as the coefficient is showing a number near to cero.

Once the optimal model is estimated, we need to estimate the partial adjustment of the WCR, this adjustment represents the changes in the WCR. We also need to remember that we are using the WCR normalized by the total sales, and those the WCR adjusted will show the changes in working capital proportional to sales, that the firm need to face their possible short term obligations, table 4 shows this model.

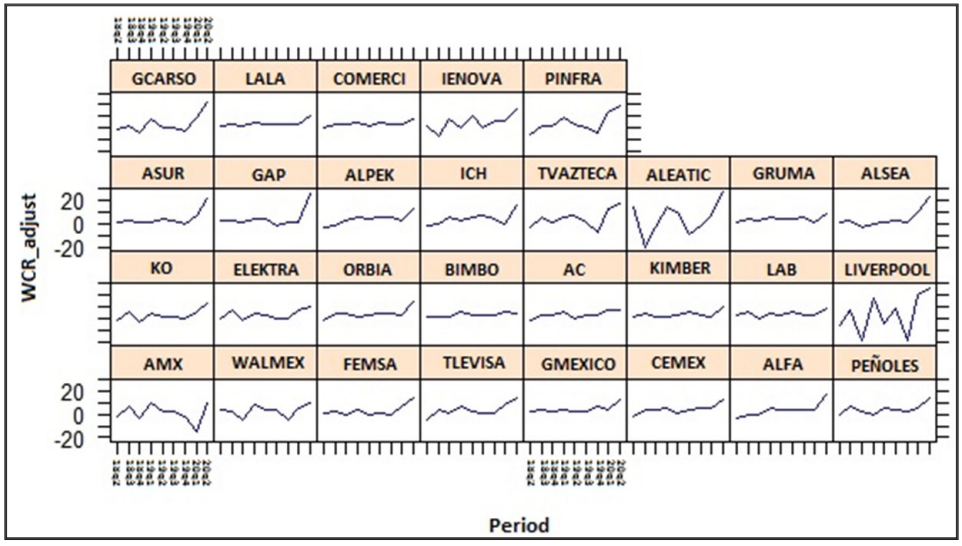
Table 4
Partial adjustment of WCR

Variables	Coefficient	Std. Error
Intercept	-0.59	1.83
lag(WCR_t-1)	-0.01	0.02
Firm size	0.22*	0.10
Firm growth	-0.29***	0.01
Gross margin	0.02***	0.01
OCF	0.00***	0.00
GDP growth	-0.40***	0.02
n	29	
t	8	
N	232	
Total sum of squares	9124.60	
Residual sum of squares	539.31	
R-squared	0.94	
F-statistic	596.95***	

Source: own elaboration. Significance levels as follows 0 '***' 0.001 '**' 0.01 '*' 0.05.

With the results in table 4, it is estimated the partial adjustment on the working capital requirements. From the results in this table, we can say that the WCR depends too much on the WCR in the previous period, but in an opposite way. In addition, the other variables are individually significant, which is an expected result.

The estimation imply an $\emptyset$ equal to -1.01, which indicates a negative variation of the WCM practices or the adjustments respect to the previous periods. This result also imply that the WCM practices is to reverse the WCR in the crisis periods. With this model, we run an estimation of the WCR for each firm for the 2018q2-2020q2 period, which is an exercise to compare the strategies followed by the non-financial firms. The results are in figure 3.



Source: own elaboration. The horizontal axis is showing the periods 18q2, 18q3, 18q4, 19q1, 19q2, 19q3, 19q4, 20q1 and 20q2, and the vertical axis is showing the variations in WCR adjustment from -20 to 20 percent points of the firm total sales.

Figure 3
WCR by firm and period

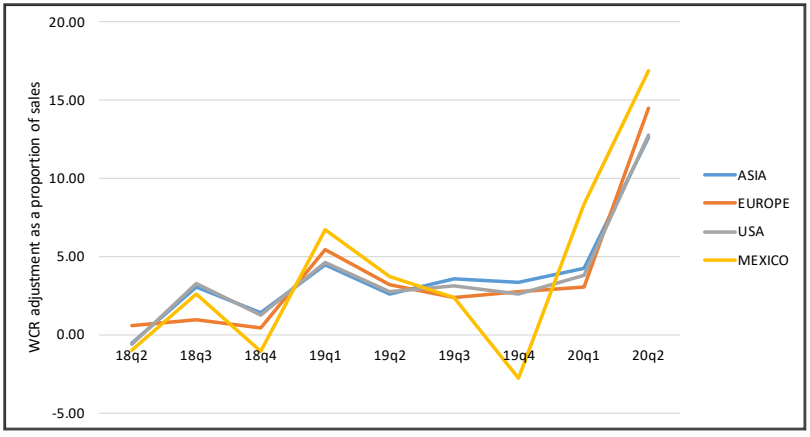
From figure 3, it is clear that the major part of the firms made some adjusts on the WCR in the period 2020q1 and 2020q2, which is reasonable in terms of the economic crisis of Covid-19 and their implied changes due to the uncertainty in the responds of consumers and market conditions.

In this sense, many firms have a stable target level of working capital (which is shown by the smooth WCR in Figure 3). However, the major adjusts were done on 16 firms (PINFRA, GCARSO, ASUR, GAP, IENOVA, ALPEK,

ICH, TVAZTECA, ALEATIC, ALSEA, LIVERPOOL, AMX, FEMSA, TLEVISA, ALFA and PEÑOLES), which means that these firms required to change their strategy in order to face the short-term financial obligations. This result is due to their current liabilities and the excess of current assets, and those, the excess of working capital.

4.3. The WCR adjustments and its relation with gross margins

By another side, it is necessary to establish the difference between firms that operate in Asia, Europe and USA, and those firms that operate in Mexico (or other locations). For this end, it is presented the figure 4, this Figure is presenting the average WCR adjusted for firms that operate in different locations and those firms that only operate in Mexico.



Source: own estimations with data from table 4.

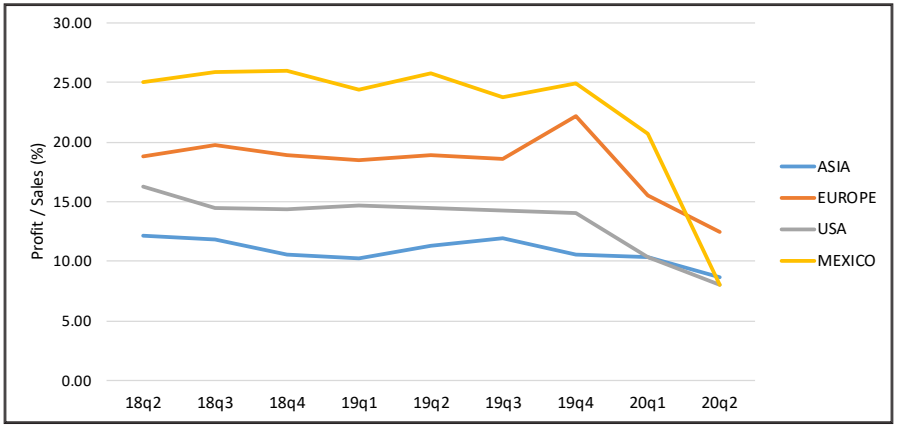
Figure 4
Average WCR (partial adjust) by location

As can be seen in figure 4, the firms that operate only in Mexico responded in quarter 19q4 with a reduction in the partial adjustment of WCR. This is a strange strategy in terms of the possible economic crisis by Covid-19 announced in December, the overproduction of oil in the world by the last quarter of 2019 and the beginnings of 2020, and finally the bond yields bubble seen in the financial markets.

By another side, firms that operate in Asia, Europe and USA responded with a stable level of WCR adjustments of 3.5% of increase (average). This strategy was implemented to face the Covid-19 crisis and other factors mentioned

in the last paragraph, and the radical increase to face the Covid-19 economic crises made on WCR adjustments were done in the second quarter of 2020.

In addition, it is presented the figure 5 which in turn presents the gross margin associated the figure 4 in each period.



Source: own elaborations with data from financial statements of each firm.

Figure 5
Average gross margin of firms by location

The results shown in figure 4 tell us that in the period 2020q1 y 2020q2, the firms that operate only in Mexico showed a larger drop in Gross Margins compared with firms that operate in Asia, Europe and USA. The correlation between average WCR adjustments and gross margins by location are described in table 5.

Table 5
Correlation between average WCR adjustments and gross margins by location

Location	Correlation coefficient
ASIA	-0.83
EUROPE	-0.76
USA	-0.86
MÉXICO	-0.88

Source: own elaboration with data from figure 3 and figure 4.

Table 5, shows that there is a negative lineal correlation between gross margins and WCR adjustments. This results, are particularly interesting since the strategy of adjust WCR affects in major part the profits of firms, which confirms

the evidence in shown in the literature review. In particular, this result is consistent with the Oseifuah (2018) results that tells us that during the crisis, there is a negative relation between profitability and CCC (see table 5 and figure 1).

5. Conclusions

The purpose of this work was to analyze the strategies of WCM followed by firms listed in the IPC during the Covid-19 economic crisis. We analyze these strategies with a classification of firms with operations in different geographies. Taking into account the lack of a specific working capital literature body we propose to analyze the WCM by applying an estimation of working capital requirements, and then the implications of these adjustments on the WCM, which in turn, is shown by the estimation of the target level estimation of the working capital.

In this sense, the main objective of this study was to estimate the target level of working capital, by estimating the WCR with a panel data of 29 non-financial firms in the Mexican Stock Exchange. We found that, those firms made in many cases major adjusts to their WCR, principally due to the longer time in the cash cycle and operation cycle. Firms with operations in USA and Mexico showed a greater impact on these cycles and therefor a greater adjust on their WCR.

We estimated the WCR by a random effects model, in which their individual determinants were the firm growth (sales growth) and the GDP growth in Mexico. With this estimation, then it was applied the partial adjustment model on WCR, which gave way to figure 2 with all the firms and their adjustments on WCR. This model shows that 16 firms made major adjusts in their working capital requirements, but the important fact is that firms with operations in Asia, Europe and USA showed a more stable behavior in their WCR adjustments in the pre-crisis period (2019q4 and 2020q1) than firms that have operations only in Mexico or other regions (see figure 3). The partial adjustment model shows that there is a negative adjustment respect to previous periods of the WCR. In particular, the results imply a $\varnothing$ equal to -1.01, which in turn is a major negative impact on the WCR, especially during the crisis periods.

In addition, the gross margin is closely related to WCR adjustments, and firms with operations only in Mexico have a greater fall on their gross margins associated to a greater adjustment in their WCR (see figure 3, figure 4 and table 5). For these reasons, the WCM practices of firms that operate in Asia, Europe and USA must to be studied in deep.

This work presented a study of the short-term strategies to face the economic crisis. In this sense, some future research lines are related to the long-term strategies, this is, the study of capital structure of the firms and their relation with the strategies to face the economic Covid-19 crisis.

Some limitation are related to the nature of the firms, since in this work we only took into account non-financial firms, but other firms as banks or insurance firms are financial firms that deserve a proper study on the impacts of Covid-19 on their operations. There is also a lack of information about firms that are not listed in the IPC or firms that does not participate in the Mexican Stock Exchange, that are not studied in this work.

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