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# Reassessing the Classical Investment Function. A Panel Data Analysis from NAFTA-USMCA

## *Revaluando la función de inversión clásica. Un análisis de panel de datos para el TLCAN-TMEC*

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## Abstract

This study applies the second generation of panel cointegration techniques in conjunction with those estimators that control cross-sectional dependence to test the plausibility of the classical approach to capital accumulation in Canada, Mexico, and the United States from 1960 to 2019 empirically. The findings suggest that private investment is positively related to the profit rate, unit labour costs, and growth in demand both in the short and long-run, while the causality analysis indicates potential feedback loops between the variables.

*Keywords*: Investment, cross-sectional dependence, causality, NAFTA, USMCA.

## Resumen

La presente investigación emplea la segunda generación de las técnicas de cointegración en panel junto con los estimadores que controlan la dependencia de sección cruzada para evaluar empíricamente la validez del enfoque clásico de la acumulación del capital en Canadá, México y los Estados Unidos durante el lapso 1960-2019. Los resultados sugieren que la inversión privada se encuentra positivamente relacionada con la tasa de ganancia, los costes laborales unitarios y el crecimiento de la demanda agregada, tanto en el corto como en el largo plazos. Asimismo, el análisis de causalidad revela la existencia de potenciales bucles de retroalimentación entre las variables del modelo.

*Palabras clave*: inversión, dependencia de secciones cruzadas, causalidad, TLCAN, TMEC.

*JEL Classification / Clasificación JEL*: B12, C33, C52, E10, E22.

## 1. Introduction

The North American Free Trade Agreement (NAFTA), replaced by the United States-Mexico-Canada Agreement (USMCA) in July 2020, established one of the world's biggest free trade deals. However, as evidenced by Gereffi, Spener and Bair (2009) and Ponte, Gereffi and Raj-Reichert (2019), the North American free-trade zone has exacerbated uneven development among member countries over the last three decades, thereby contravening the hypotheses based on convergence economic or the catch-up effects (Barro & Sala-i-Martin, 1992; Baumol, 1986).

In these lines, unlike most modern economic frameworks, the classical political economists conceived capitalist development as a dynamic process leading to global socioeconomics imbalances (Smith, 1776; Ricardo, 1821; Sismondi, 1821; Marx, 1867, 1894). Thus, from a Classical political economy standpoint, those factors contributing to increasing regional disparities in NAFTA-USMCA should be rooted in capital accumulation, namely the future levels and changes in profitability and the competition among firms in an international context where capital moves freely among nations.

In this regard, as shown by Keynes (1936) and Kalecki (1954), aggregate demand also plays an essential role in the firm's investment decisions in the long-term, which is entirely consistent with the importance given by Smith, Ricardo and Marx to effectual demand and the extent of the market to explain economic growth. It is worth mentioning that this apparent connection between Classical political economy and Keynesian economics has given rise to a substantial modern empirical literature that supports the classical theory of investment.

For instance, Alexiou (2010) applies the first generation of panel unit root tests in combination with the fixed and random effects models for the G7 economies in the 1970-2005 period, finding that private investment is positively related to profitability and aggregate demand in the long-run. Stockhammer and Grafl (2010) test the classical investment function under the conditions of financial uncertainty for the United States (US), France, Germany, Netherlands, and the United Kingdom (UK) -spanning from 1960-2007-. Using volatility of the exchange rate, the stock market index, and the real gold price as proxies to measure financial uncertainty, these authors show that private investment reacts positively to an increase in the gross domestic product (GDP) while a rise in the interest rate contracts private investment.

Arestis, González and Dejuán (2012) employ the first generation of panel unit root tests, the system generalised method of moment (sys-GMM), the within-groups estimator for fixed effects, and the LSDV estimator. These authors report that an increase in aggregate demand improves private investment for the most developed countries in the world over the period 1970-2005.

Alexiou, Tsaliki, and Tsoulfidis (2016) use the first generation of panel unit root tests and the group mean fully modified ordinary least square (GM-FMOLS) for the European Union economies during 1980-2013, revealing that an increase in profitability and the GDP expand private investment. In contrast, according to the findings of these authors, capital accumulation may be related negatively to the interest rate.

To test the hypothesis that the GDP leads private investment even under the existence of economic uncertainty, Arestis and González (2016) use four estimators, namely: the within-group estimation to model fixed effects, the GLS to estimate random effects, the Panel Corrected Standard Errors technique by Beck and Katz and the fixed effects (within) estimator with the Driscoll and Kraay standard errors. According to their results, there exists a strong positive correlation between the GDP and private investment in the long-run.

Barrada and Lagoa (2017) conducted a comprehensive assessment of the impact of financialisation on private investment by Portuguese nonfinancial firms over 1979-2013. In their empirical analysis, they estimate an investment function by using profitability, debt, cost of capital and output growth as control variables, and financial receipts and financial payments as measures of the financialisation process in Portugal. Although profitability and output growth may stimulate private investment in both the short and long-run, the findings disclose that those variables associated with the financialisation process have adverse effects on capital accumulation.

Similarly, Barrada (2017) performs a panel data analysis comprising 27 European Union economies spanning from 1995 to 2013 to test the relationship between financialisation and private investment of nonfinancial firms, finding that the process of financialisation constrained the positive effects of profitability and output growth on capital accumulation.

Lastly, Pérez-Montiel and Manera (2020), applying the nonlinear causality test put forth by Diks and Wolski (2016), analyse the multiplier-accelerator nexus in the US from the first quarter of 1947 to the fourth quarter of 2017. Their results appear to strongly support the hypothesis that national private investment is driven by aggregate demand in the long-term.

After this brief literature review, it should be highlighted that the present study aims to reassess the classical investment function in the NAFTA-USMCA region over 1960-2019, employing panel cointegration and causality techniques. Nevertheless, as shown by Urbain and Westerlund (2006) and Banerjee and Carrion-i-Silvestre (2017), under the context of macroeconomic and financial data, it is not reasonable to assume cross-sectional independence, insofar as there exist strong economics linkages among countries, regions, and sectors. The first generation of panel cointegration and causality techniques may lead to deceptive results and size distortions because they do not control cross-sectional dependence. Thereby, the second generation of panel cointegration and causality techniques is more suitable than those standard panel econometrics methods that assume cross-sectional dependence to reach our goal of analysing the nexus between investment, profitability, competition, and the acceleration principle in North America from 1960 to 2019.

To the best of our knowledge, the contribution of our research on the literature of investment theories is twofold. Our study is the first empirical assessment of the classical investment theory in North American economies that uses the second generation of panel cointegration techniques to control cross-sectional dependence. Another contribution is applying the Dumitrescu and Hurlin (2012) Granger non-causality test to analyse the potential feedback loops between the variables suggested by the classical approach of capital accumulation. The outline of this paper is as follows. In section two, we explain the theoretical framework. Section three is devoted to hypotheses definition and the preliminary data analysis. We then move to analyse the empirical evidence in section four. The final section contains a summary and conclusions.

## 2. Theoretical framework

Preceding Keynes`s (1936) General Theory, the classical political economists refused that the interest rate could be the adjustment variable between saving and investment, insofar as the total amount of savings is driven by the rate of capital accumulation (Smith, 1776; Ricardo, 1821; Sismondi, 1821; Marx, 1867, 1894). Given that saving is a residual determined by investment, the classical political economy contends that profit reinvestment depends on both realized and expected profitability. In this vein, Smith (1776) and Ricardo (1821) point out that firms calculate their profitability as the ratio between profits and the capital advanced. In such a framework, hence, private investment ($INV_t$) is a function of current profits ($\pi_t$), expected profits ($\Delta\pi_t$), and the changes in capital stock ($\Delta K_t$):

$$(INV_t) = f(\pi_t, \Delta\pi_t, \Delta K_t) \tag{1}$$

Nevertheless, Sismondi (1821) highlights the circular causation between capital accumulation and profitability since the profit rate induces new fixed-assets investments. Simultaneously, an increased productive capacity implies changes both in profits and in the stock of capital. Thus, as Sismondi sees it, the inquiry is whether the increased production capacity will bring about higher profitability than, lower than, or equal to the previous average profitability. Thereby, the classical political economy posits two-way causality between investment and the profit rate, rooted in capitalism's dynamic nature.

Regarding the latter, Ricardo (1821) and Marx (1867) noted that firms' investment decisions are not voluntary acts, but they are an imposition that stems from the competition between capitals. As McNulty (1968) and Shaikh

(2016) emphasised, classical political economists conceived competition as a dynamic process founded on the struggle to obtain extraordinary profits. Firms compete to obtain extraordinary profits within an industry by cutting their unit labour costs[1] (real wages/real productivity), whereby they should adopt new production methods that increase labour productivity.

In this regard, as Marx (1894) noted, when the profit rate is falling, firms react to increasing their investment in capital goods, looking for reducing their unit labour costs to improve cost-competitiveness to expand their market share[2].

Similarly, an increase in the unit labour costs compels firms to increase their investment to raise the profit rate. Thus, from a classical political economy standpoint, capital accumulation, competition, and profitability are mutually related since firms are not passive price-taker production units, but they try to influence their costs to obtain higher profit rates. Hence, we can include in equation (1) the change in the unit labour costs as a proxy that captures the effects of competition on total private investment:

$$(INV_t) = f(\pi_t, \Delta\pi_t, \Delta K_t, \Delta UCL_t) \tag{2}$$

Although Keynes (1936) and Kalecki (1954) do not concur with the dynamic notion of competition by classical political economy, they are entirely in agreement on the profitability-investment nexus. The novelty is that Keynes and Kalecki include Aftalian and Clark's acceleration principle to emphasise the importance of aggregate demand on private investment. However, it is worth mentioning that Keynes and Kalecki disclose that the simplest form of the accelerator principle is not suitable to explain capital accumulation because it assumes that the installed capacity is fully used, and the investment is undertaken automatically (Baghestani & Mott, 2014).

According to Kalecki (1954, p. 100), increased aggregate demand may not stimulate new net investments in fixed capital in the short-run because there exist huge reserve capacities. Kalecki resolves this *impasse* by pointing out that investment in inventories seems to be associated with changes in the level of aggregate demand. Thereby, Kalecki (1954, pp. 107–108) shows that when investment in inventories is included to obtain the formula for total investment, the acceleration principle stands as a variable that can affect capital accumulation both in the short and the long-run. The above relationship can be reflected by including in equation (2) the changes in the gross domestic product ($\Delta GDP_t$):

[1] The unit labour costs are defined by Ricardo (1821, p. 19) and Marx (1895, p. 26) as the real value of wages and the relative wages, respectively.

[2] However, depending on historical, technological, and social circumstances, other factors may arise to counteract the fall of the profit rate. For instance, the private sector can influence the government to apply contractive wage policies to increase profitability in the short-run, such as has apparently occurred during the 1980s and 1990s in the US and the European Union (Manera et al., 2016, 2019; Boundi-Chraki, 2020a, 2020b).

$$(INV_t) = f(\pi_t, \Delta\pi_t, \Delta K_t, \Delta UCL_t, \Delta GDP_t) \tag{3}$$

Since new investments give rise to a multiplier effect on aggregate demand, Keynes states that the acceleration principle and the investment multiplier interact, making cumulative processes. An enhanced productive capacity contributes to creating consumption and incomes, while an increased aggregate demand improves total private investment[3]. Interestingly, these two-way causal relationships between investment, profitability, competition and the acceleration principle are consistent with the circular and cumulative causation theory by Myrdal (1957) and Kaldor (1970). These authors remark that there is a spatial concentration of economic activity in regions with higher profitability than the average profit rate.

These regions receive more significant private investment inflows than their neighbours, thereby sharping the uneven development. The clustering of economic activity encourages capital accumulation in dynamic regions and reinforces regional competitive advantages. Conversely, rapid accumulation may reduce profitability in the long-run, leading to a technical change to improve the profit rate or compelling a capital migration towards the region with the best profitability conditions (Boundi-Chraki, 2021a, 2021b; Boundi-Chraki & Perrotini-Hernández, 2021).

In sum, we notice that the circular and cumulative causation by Myrdal and Kaldor uncovers that uneven development is rooted in the dynamics of capital accumulation described by the classical theory of investment. Likewise, the circular and cumulative causation suggests potential feedback loops between investment, profitability, competition, and aggregate demand. In the next section, hypotheses are defined, and the preliminary data analysis is implemented.

## 3. Hypotheses and preliminary data analysis

Based on the above theoretical framework, the hypotheses to be tested are the following: 1) in the long-run, private investment is positively related to the profit rate, the unit labour costs, and the growth in demand, and 2) the causal relationships between the variables should be bidirectional.

[3] It should be stressed that those models that combine the income multiplier with the investment accelerator mechanism are called multiplier-accelerator models or supermultiplier models, whose original version was put forth by Hicks (1950). Nevertheless, as noted by McCombie and Thirlwall (1994), and Pérez-Montiel and Manera (2020), both Harrod and Ohlin anticipated Hicks on the viability of the mechanism posited by the so-called supermultiplier. At the same time, Harrod's and Samuelson`s models were used as the basis for the first rigorous assessment to test the multiplier-accelerator mechanism empirically (Pérez-Montiel & Manera, 2020; Perrotini-Hernández & Vázquez-Muñoz, 2019). On the other hand, the modern version of the supermultiplier was developed by Serrano (1995) based on the original Hicks's model, Garegniani's contributions, and the classical surplus approach by Ricardo, receiving significant attention nowadays, such as attests to the abundant theoretical and empirical literature.

We adopt the panel data analysis to assess these hypotheses' plausibility since its numerous advantages over time series and cross-sectional data. Hsiao (2007, pp. 4–6) points out that panel data contains higher degrees of freedom than time-series and cross-sectional data, obtaining more accurate inference of model parameters and improving the efficiency of econometric estimates. Furthermore, Hsiao adds that panel data uncovers dynamic relationships and simplifies computation and statistical inference by including two dimensions: a time-series dimension and a cross-sectional dimension.

Thus, using statistics from Canada, Mexico, and the US over 1960-2019, we obtain strongly balanced panel data where the periods (T) are larger than cross-sections (N). The information was collected from Statistics Canada-Statistique Canada, the National Institute of Statistics and Geography (Instituto Nacional de Estadística y Geografía-INEGI, Mexico), and the Bureau of Economic Analysis (BEA, US) (see Appendix, Table A1).

Total private investment ($INV_{i,t}$) is computed by adding the gross fixed capital formation at constant prices (base year = 2015) plus the change in inventories at constant prices (base year = 2015). The profit rate ($G_{i,t}$) is calculated as the ratio between the net operating surplus at current prices ($g_{i,t}$) and net capital stock at current replacement cost value in the previous year ($K_{i,t-1}$). The unit labour costs ($ULC_{i,t}$) are the ratio between labour compensation ($w_{i,t}$) and gross value added[4] ($Y_{i,t}$) (see Appendix, Table A1). To measure growth in aggregate demand, we use gross domestic product calculated by the expenditure approach at constant prices (base year = 2015) ($GDP_{i,t}$). According to our theoretical framework, the relationship between the dependent variable and the explanatory variables may be expressed as a functional equation:

$$INV_{i,t} = f\left(G_{i,t}, ULC_{i,t}, GDP_{i,t}\right) \tag{4}$$

By taking natural logarithms (*LOG*), our model can be written as follows:

$$LOG(INV_{i,t}) = \beta_0 + \beta_1 LOG\left(G_{i,t}\right) + \beta_2 LOG\left(ULC_{i,t}\right) + \beta_3 LOG\left(GDP_{i,t}\right) + \varepsilon_{i,t} \tag{5}$$

Where the subscripts represent the *i*-th NAFTA-UMSCA member country at the year t = 1960 … 2019. $\beta_0$ is the constant, $\beta_1$, $\beta_2$, and $\beta_3$ are the coefficient of interest, while $\varepsilon_{i,t}$ is an error term.

Our econometric analysis's starting point consists of testing the contemporaneous correlation between Canada, Mexico, and the US, by employing the cross-sectional dependence (CD) test developed by Pesaran (2020). As we can see in Table 1, the CD test strongly rejects the null hypothesis of cross-sectional dependence for most of the variables, whereas the simple

[4] Gross value added is the gross domestic product measured by the income approach.

average of the pairwise correlation coefficients of LOG(INV) and LOG(GDP) is high and moderate for LOG(G) and LOG(ULC). Therefore, the presence of cross-sectional dependence indicates that a change that occurred in a particular North American country could be diffused to its NAFTA-USMCA partners due to the high levels of economic integration between Canada, Mexico, and the US. In sum, the results suggest that cross-sectional dependence should be taken into account to avoid potentially misleading results and size distortion problems.

TABLE 1. CD TEST

| Variable | CD-test | p-value | corr | abs(corr) |
|---|---|---|---|---|
| LOG(INV) | 13.040 | 0.000*** | 0.972 | 0.972 |
| LOG(G) | 1.490 | 0.136 | 0.111 | 0.353 |
| LOG(ULC) | 13.30 | 0.000*** | 0.597 | 0.597 |
| LOG(GDP) | 8.010 | 0.000*** | 0.991 | 0.991 |

Note: *** Denotes rejection at 1%. We employed the *xtcd* command developed by Eberhardt (2011b).
Source: Author`s.

It should be highlighted that in the presence of cross-sectional dependence, heterogeneous slopes may arise in our model. Given that taking no notice of slope heterogeneity may lead to misleading results and inconsistent parameters estimations (Pesaran and Smith, 1995), we test whether there is heterogeneity in the individual slopes by employing the Pesaran and Yamagata (2008) test and Blomquist and Westerlund (2013) test[5].

According to the outcomes reported in Table 2, both the Pesaran-Yamagata test and Blomquist-Westerlund test indicate that the null hypothesis of slope homogeneity cannot be rejected, thereby discarding heterogeneity in the individual slopes across our panel data. Even though our model does not suffer the problem of heterogeneity, the existence of cross-sectional dependence compels us to employ the second generation of panel unit root tests to determine whether our series are integrated I(1).

To control for cross-sectional dependence, we employ the cross-sectional augmented Im, Pesaran, and Shin (CIPS) test by Pesaran (2007). Boundi-Chraki and Perrotini-Hernández (2021) noted that this test represents the unobservable processes that lead to cross-sectional units being correlated through a single common factor, thereby controlling for cross-sectional

[5] Bersvendsen and Ditzen (2020, 2–6) point out that the Pesaran-Yamagata test is a standardized version of Swamy`s method, whereas the Blomquist-Westerlund test is a HAC consistent extension of Pesaran-Yamagata test.

TABLE 2. TESTS FOR SLOPE HETEROGENEITY

| | Pesaran-Yamagata | | Blomquist-Westerlund | |
|---|---|---|---|---|
| | Delta | p-value | Delta | p-value |
| | -0.631 | 0.528 | -0.088 | 0.930 |
| adj. | -0.666 | 0.505 | -0.093 | 0.926 |

Note: We used the *xthst* command by Bersvendsen and Ditzen (2020).
Source: Author`s.

dependence. The CIPS test is computed by using four lags and adding a trend in order to robustness check.

As shown in Table 3, the Pesaran CIPS test fails to reject the null hypothesis of the existence of a unit root both with and without trend, suggesting that the variables are nonstationary and integrated I(1) because they become stationary of order I(0) when transformed into their first difference.

Given that those nonstationary variables at level must be cointegrated to be economically significant in the macroeconomic analysis, we employ the error correction model (ECM) panel cointegration test by Westerlund (2007). The ECM panel cointegration test allows for cross-sectional dependence, which means that its results will be more robust than those obtained by using the first generation of panel cointegration tests. Another advantage of the ECM panel cointegration test over standard panel cointegration tests by Kao, Pedroni and the Fisher-Johansen type by Maddala and Wu consists in the fact that it allows for structural breaks. Note that our data span an extended period, which means that we should consider structural breaks in our assessment.

Based on Persyn and Westerlund (2008) guidelines, we compute the ECM panel cointegration test using the Bartlett kernel window ≈ 3 and calculating robust p-values with 800 bootstrap replications. At the same time, we apply the Akaike information criterion (AIC) to select the optimal lag and lead lengths. As indicated in Table 4, most statistics strongly reject the null hypothesis of no cointegration, suggesting that the variables share a common long-term trend because both p-values and robust p-value associated with coefficients are smaller than 1%. Overall, our results support that the variables are cointegrated, thereby proceeding in the next section to study the long-run equations and the causal relationships.

## 4. EMPIRICAL ANALYSIS

To test the plausibility of the hypotheses, we begin assessing the long-run equations by using the common correlated effects mean group (CCEMG) estimator by Pesaran (2006) and the augmented mean group (AMG) estimator developed by Eberhardt and Teal (2010). These estimators are not only robust in the presence of slope heterogeneity and cross-sectional dependence, but they are also suitable for controlling for unobserved common factors and structural breaks.

TABLE 3. CIPS UNIT ROOT TEST

| | Without trend | | | | | | | | With trend | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| lags | LOG(INV) | | LOG(G) | | LOG(ULC) | | LOG(GDP) | | LOG(INV) | | LOG(G) | | LOG(ULC) | | LOG(GDP) | |
| | Zt-bar | p-value | Zt-bar | p-value | Zt-bar | p-value | Zt-bar | p-value | Zt-bar | p-value | Zt-bar | p-value | Zt-bar | p-value | Zt-bar | p-value |
| 0 | 0.608 | 0.728 | 0.374 | 0.646 | -0.472 | 0.319 | 0.540 | 0.705 | 0.323 | 0.627 | -0.211 | 0.416 | 0.317 | 0.625 | 0.167 | 0.566 |
| 1 | -0.715 | 0.237 | 0.443 | 0.671 | -0.368 | 0.356 | -0.203 | 0.420 | -1.232 | 0.109 | -0.036 | 0.486 | 0.376 | 0.647 | -0.995 | 0.160 |
| 2 | -0.805 | 0.210 | -0.561 | 0.287 | -0.194 | 0.423 | -0.564 | 0.286 | -1.169 | 0.121 | -0.871 | 0.192 | 0.411 | 0.659 | -0.803 | 0.211 |
| 3 | -0.257 | 0.399 | -1.049 | 0.147 | -0.728 | 0.233 | -0.105 | 0.458 | -0.469 | 0.319 | -1.209 | 0.113 | -0.421 | 0.337 | -0.763 | 0.223 |
| 4 | -0.169 | 0.433 | -0.086 | 0.466 | -0.306 | 0.380 | 0.574 | 0.717 | 0.024 | 0.509 | -0.205 | 0.419 | -0.400 | 0.345 | -0.001 | 0.499 |
| First difference | | | | | | | | | | | | | | | | |
| | ΔLOG(INV) | | ΔLOG(G) | | ΔLOG(ULC) | | ΔLOG(GDP) | | ΔLOG(INV) | | ΔLOG(G) | | ΔLOG(ULC) | | ΔLOG(GDP) | |
| | Zt-bar | p-value | Zt-bar | p-value | Zt-bar | p-value | Zt-bar | p-value | Zt-bar | p-value | Zt-bar | p-value | Zt-bar | p-value | Zt-bar | p-value |
| 0 | -6.511 | 0.000*** | -7.661 | 0.000*** | -8.272 | 0.000*** | -6.567 | 0.000*** | -5.740 | 0.000*** | -6.983 | 0.000*** | -7.997 | 0.000*** | -5.536 | 0.000*** |
| 1 | -4.967 | 0.000*** | -4.905 | 0.000*** | -7.381 | 0.000*** | -4.929 | 0.000*** | -4.054 | 0.000*** | -4.032 | 0.000*** | -6.777 | 0.000*** | -3.850 | 0.000*** |
| 2 | -4.323 | 0.000*** | -2.622 | 0.004*** | -4.496 | 0.000*** | -3.957 | 0.000*** | -3.377 | 0.000*** | -1.358 | 0.087* | -3.831 | 0.000*** | -2.844 | 0.002*** |
| 3 | -3.927 | 0.000*** | -3.733 | 0.000*** | -4.252 | 0.000*** | -4.142 | 0.000*** | -2.965 | 0.002*** | -2.847 | 0.002*** | -3.686 | 0.000*** | -3.065 | 0.001*** |
| 4 | -2.910 | 0.002*** | -3.383 | 0.000*** | -3.606 | 0.000*** | -2.743 | 0.003*** | -1.884 | 0.030** | -2.705 | 0.003*** | -3.269 | 0.001*** | -1.700 | 0.045** |

Note: Table 3 presents the results of the CIPS panel unit root tests proposed by Pesaran (2007). *** Denotes rejection at 1%. ** Denotes rejection at 5%. * Denotes rejection at 10%. Δ denotes the first difference. We applied the *multipurt* routine implemented by Eberhardt (2011a) that is based on Lewandowski's (2007) *pescadf* command.
Source: Author`s.

Table 4. ECM panel cointegration test

| Statistic | Value | Z-Value | p-value | Robust p-value |
|---|---|---|---|---|
| $G_t$ | -3.116 | -7.266 | 0.000*** | 0.000*** |
| $G_a$ | -7.420 | 0.331 | 0.630 | 0.108 |
| $P_t$ | -19.733 | -9.739 | 0.000*** | 0.000*** |
| $P_a$ | -11.440 | -6.008 | 0.000*** | 0.000*** |

Note: Table 4 presents the results of the ECM Panel Cointegration Test by Westerlund (2007). *** Denotes rejection at 1%. Test includes constant and trend. the AIC was used to choose optimal lag and lead lengths. Bootstrapped (800). We used the *xtwest* command developed by Persyn and Westerlund (2008).
Source: Author˜s.

As shown in Table 5, both the CCEMG estimator and the AMG estimator suggest that total private investment is positively related to profitability, competition, and the acceleration principle. Concretely, the CCEMG and the AMG point out that a 1% increase in the rate of profit improves total private investment by between 0.405% and 0.203%.

It is interesting to remark that these results align with the findings obtained by those works that have applied standard panel econometrics techniques to test the classical investment theory. For instance, Alexiou (2010) finds that a 1% increase in profit stimulates private investment by approximately 0.36% for the G7 economies[6] over the period 1970-2005, while Alexiou, Tsaliki, and Tsoulfidis (2016) show that a 1% increase in profitability expands private investment by 0.91% for the European Union core economies[7] during 1980-2013.

Concerning the effects of competition on capital accumulation, the CCEMG and the AMG estimators report that a 1% increase in the unit labour costs expands total private investment by between 1.297% and 0.934%. This huge increase seems to be consistent with the classical political economy approach of competition, insofar as Ricardo and Marx described the competition as a dynamic process reflected in the struggle for obtaining extraordinary profits by cutting production costs (Boundi-Chraki, 2021b; Boundi-Chraki & Perrotini-Hernández, 2021). Therefore, we infer that when the unit labour costs are growing, firms react to increasing their investment in fixed assets to improve their cost-competitiveness[8].

On the other hand, the CCEMG and the AMG estimators point out that a 1% increase in aggregate demand boosts total private investment by between 1.345% and 1.929%, which means that the accelerator principle provokes the most significant positive effect on capital accumulation in the North American

[6] The G7 economies comprise Canada, France, Germany, Italy, Japan, the United Kingdom (UK), and the US (Alexiou, 2010, p. 436).
[7] According to the authors, the core economies are Belgium, Denmark, France, the Netherlands, Austria, Finland, Sweden, and the UK.
[8] Although, as aforementioned, the private sector can influence the government to implement contractive wage policies.

Table 5. ccemg and amg

| Dependent variable: LOG(INV) | | |
|---|---|---|
| Variables | CCEMG | AMG |
| LOG(G) | 0.405 | 0.203 |
| | (0.063) | (0.105) |
| | [6.380] *** | [1.940] * |
| LOG(ULC) | 1.297 | 0.934 |
| | 0.244 | 0.187 |
| | [5.310] *** | [4.98] *** |
| LOG(GDP) | 1.354 | 1.929 |
| | 0.498 | 0.421 |
| | [2.720] *** | [4.580] *** |
| CDP | | 0.771 |
| | | 0.349 |
| | | [2.210] ** |
| Intercept | 0.879 | -6.756 |
| | (0.915) | (2.811) |
| | [0.960] | [-2.400] ** |
| Observations | 180 | 180 |
| Countries | 3 | 3 |
| Wald chi2 (3) (p-value) | 45.790 (0.000***) | 36.590 (0.000***) |
| CD-test (p-value) | -4.670 (0.000***) | -4.480 (0.000***) |
| Root Mean Squared Error (sigma) | 0.031 | 0.048 |

Note: Table 5 presents the results of CCEMG and AMG by Pesaran (2006) and Eberhardt and Teal (2010). *** Denotes rejection at 1%. ** Denotes rejection at 5%. * Denotes rejection at 10%. For the AMG estimator, the coefficient averages were computed as unweighted means, and we include a common dynamic process (CDP). Cross-sectional averaged regressors are excluded because they are no relevant for the analysis. We apply the *xtmg* command by Eberhardt (2012).
Source: Author`s.

countries. Thus, Prima facie, our results appear to be supportive of the findings obtained by Arestis, González and Dejuán (2012) and by Arestis and González (2016), who contend that the accelerator principle has the strongest positive impact on private investment in the developed countries.

Concretely, Arestis, González and Dejuán show that a 1% increase in aggregate demand improves private investment by between 0.15886% and 0.04827% for the most developed countries in the world[9] over the period 1970-2005. Similarly, Arestis and González report that a 1% increase in GDP expands private investment by between 0.3631% and 0.3209% for the leading economies from Europe[10], Australia, Canada, and the US over 1970-2012.

[9] Their sample comprises Australia, Belgium, Canada, Denmark, France, Germany, Italy, Norway, Austria, Spain, the UK and the US.
[10] These European countries are Belgium, France, Germany, Italy, Norway, Austria, Spain and the UK.

To check the robustness of the above results, we employ the cross-sectionally augmented autoregressive distributed lag (CS-ARDL) approach developed by Chudik and Pesaran (2015), and the cross-sectionally augmented distributed lag (CS-DL) approach proposed by Chudik et al. (2016). Like the CCMEG and the AMG estimators, the CS-ARDL and the CS-DL are appropriate in the presence of both slope heterogeneity and cross-sectional dependence, and they can control for unobserved common factors and structural breaks. Likewise, Westerlund (2007) highlights that those techniques based on an ARDL approach are adequate when time series (T) is larger than cross-sections (N), while Sharma and Pal (2020) note that both estimators are complementary, thereby justifying their implementation for checking robustness. For our study, the CS-ARDL model specification is (1,1,1,1), and we impose one lag on the CS-DL model.

Table 6. cs-ardl (1,1,1,1)

| Dependent: ΔLOG(INV) | Coef. | Std. Err | z | P>\|z\| |
|---|---|---|---|---|
| Short-Run Estimates | | | | |
| ECT | -0.898 | 0.056 | -15.920 | 0.000*** |
| ΔLOG(G) | 0.127 | 0.050 | 2.540 | 0.011** |
| ΔLOG(ULC) | 0.502 | 0.158 | 3.180 | 0.001*** |
| ΔLOG(GDP) | 1.783 | 0.314 | 5.680 | 0.000*** |
| Long-Run Estimates | | | | |
| LOG(G) | 0.139 | 0.051 | 2.720 | 0.007*** |
| LOG(ULC) | 0.570 | 0.187 | 3.050 | 0.002*** |
| LOG(GDP) | 2.000 | 0.372 | 5.380 | 0.000*** |
| CD p-value | 0.000*** | | | |
| *R*-squared | 0.460 | | | |
| *N X T* | 495 | | | |

Note: Table 6 presents the results of CS-ARDL by Chudik and Pesaran (2015). *** Denotes rejection at 1%. ** Denotes rejection at 5%. * Denotes rejection at 10%. The symbol Δ represents the first difference. The number of lags of the cross-sectional averages is three. We employed the *xtdcce2* command by Ditzen (2018).
Source: Author`s.

As we can see in Table 6, the CS-ARDL estimator shows that both competition -expressed in decrease/increase of ULCs- and the acceleration principle induce a noteworthier influence on firms´ investment decisions than the profit rate in the short and long-run. More precisely, in the short-run, while a 1% increase in the profit rate induces an increase in total private investment by 0.127% (short-run), a 1% increase in the unit labour costs and GDP expand total private investment by approximately 0.502% and 1.783%, respectively. In the long-run, a 1% growth in the rate of profit improves private investment by 0.137%, whereas a 1% upsurge in the unit labour costs and aggregate demand increase private investment by 0.570% and 2.000%, respectively.

Likewise, the error correction term (ETC) is statistically significant, negative, and its value is between 0 and 1, revealing that the adjustment to equilibrium is fast. The CS-DL results are quite similar, showing that the long-run relationship between the dependent and explanatory variables is positive and strongly significant. That is, both competition and the acceleration principle provoke greater effects than profitability on private investment.

TABLE 7. CS-DL ($\rho = 1$)

| Dependent: ΔLOG(INV) | Coef. | Std. Err | z | P>\|z\| |
|---|---|---|---|---|
| ΔLOG(G) | 0.171 | 0.069 | 2.480 | 0.013** |
| ΔLOG(ULC) | 0.807 | 0.239 | 3.380 | 0.001*** |
| ΔLOG(GDP) | 1.764 | 0.425 | 4.150 | 0.000*** |
| CD p-value | 0.000*** | | | |
| *R*-squared | 0.410 | | | |
| *N X T* | 504 | | | |

Note: Table 7 presents the results of CS-DL by Chudik et al. (2016). *** Denotes rejection at 1%. ** Denotes rejection at 5%. The symbol Δ represents the first difference. (0,2,2,2) is the number of lags of the cross-sectional averages. We employed the *xtdcce2* command by Ditzen (2018).
Source: Author˜s.

According to Table 7, a 1% increase in the profit rate expands private investment by 0.171%, while a 1% increase in the unit labour costs and GDP improves private investment by 0.807% and 1.764%, respectively. Therefore, both CS-ARDL and the CS-DL are supportive of the hypothesis that the accelerator principle may be the chief driver of private investment in North American countries. However, it should be highlighted that our theoretical framework establishes that investment, profitability, competition, and the accelerator principle are mutual linked, revealing that the direction of the cycle could be any which way.

Although firms invest in obtaining higher net profits, new net investments in fixed assets can spur competition, expanding aggregate demand in both the short and the long-run. In turn, increased aggregate demand may both upraise profitability and encourage competition among firms. Moreover, when profitability is low and the unit labour costs are increasing, firms are compelled to improve their technical production conditions by expanding their investment in capital goods. These new investments will generate income and consumption, thereby interacting with the investment multiplier and the accelerator principle.

Therefore, this circular and cumulative causation discloses potential feedback loops between variables that should be tested using panel causality techniques. Since our preliminary data analysis revealed the existence of cross-sectional dependence, we evaluate the causal relationship between the variables by employing the Dumitrescu and Hurlin (2012) Granger non-causality test. This test applies a block bootstrap procedure for controlling cross-sectional dependence (Dumitrescu & Hurlin, 2012, p. 1450), thereby achieving results much more robust than those obtained through the standard Granger (1969) non-causality test. However, it must be underlined that the Granger non-causality test proposed by Dumitrescu and Hurlin (2012, p. 1451) requires stationary variables. For satisfying this condition, our variables have been transformed into their first difference, given that the Pesaran CIPS test reported that they are non-stationary at level. On the other hand, although the Dumitrescu and Hurlin test is robust in the presence of cross-sectional dependence, some limitations of this approach should be briefly pointed out. First, the Dumitrescu and Hurlin test is based on the Wiener-Granger method and therefore is confined to analysing the short-run causal relationship between two variables (Bressler & Seth, 2011).

Second, the Dumitrescu and Hurlin test may not be suitable in the presence of a structural break in the parameters of regression models, thereby can leading to bias in our forecasting. According to the literature, these limitations may be resolved by using the Granger non-causality test by Breitung and Candelon (2006) and the asymmetric panel Granger non-causality test by Hatemi-J *et al.* (2016) and Eyuboglu and Eyuboglu (2020). Nonetheless, given that our interest rests in reassessing the empirical plausibility of classical investment function in the presence of cross-sectional dependence, the Dumitrescu and Hurlin Granger non-causality test may be appropriate to reach this aim.

The results from Table 8 suggest two-way causality between total private investment and the explanatory variables, insofar as we can reject the null hypothesis for all pairwise comparisons. Regarding the causality among the explanatory variables, the Dumitrescu-Hurlin test indicates significant bidirectional causality between profitability and GDP growth, while the causality between profitability and competition and between the accelerator principle and competition may be unidirectional. Thus, we obtain some evidence that supports the circular and cumulative causation by Myrdal and Kaldor. On the other hand, it is worth mentioning that our result appears to be consistent with those reached by Pérez-Montiel and Manera (2020), namely, private investment may be governed by permanent demand because at 1% and 5% of significance, we cannot reject the null hypothesis that investment does not Granger cause changes in the GDP.

However, as we remarked above, capital accumulation is not a voluntary act but is bound by competition - as an external coercive law-, which means that it is not reasonable to sustain that the only driving force of investment is household final consumption expenditure spurred by government spending. In this regard, as Smith (1776, Chapter III, Book I) and Marx (1867, Chapter III) pointed out, the immediate object of capitalist production is to valorise value, not to satisfy consumer needs, hence imposing the exchange-value on the use-value.

As long as the production of use-values is motivated by the expectation of profits, aside from effective demand -or effectual demand in Smith`s sense (1776, Chapter VII, Book I)- firms should also consider profitability to invest in fixed assets. In these lines, Marx (1973, p. 26) states that production not only creates an object for the subject, but also a subject for the object. That is to say; production is capable of creating new needs of consumption for society through innovations and technical change (Hirschman, 1958; Schumpeter, 1942). Although this does not contradict the importance of aggregate demand in capital accumulation, as the statistical evidence suggests, the strong independence between production and consumption does not allow the conclusion that aggregate demand is a pure independent variable. Confirmation or denial of this possibility would require a more thorough analysis beyond the scope of the present study.

Table 8. dumitrescu-hurlin granger non-causality test

| Null Hypothesis | W-Stat. | Zbar-Stat. | Prob. |
|---|---|---|---|
| ΔLOG(G) does not Granger cause ΔLOG(INV) | 8.051 | 4.786 | 0.000*** |
| ΔLOG(INV) does not Granger cause ΔLOG(G) | 11.819 | 7.805 | 0.000*** |
| ΔLOG(ULC) does not Granger cause ΔLOG(INV) | 7.118 | 4.038 | 0.000*** |
| ΔLOG(INV) does not Granger cause ΔLOG(ULC) | 11.725 | 7.730 | 0.000*** |
| ΔLOG(GDP) does not Granger cause ΔLOG(INV) | 6.931 | 3.888 | 0.000*** |
| ΔLOG(INV) does not Granger cause ΔLOG(GDP) | 4.600 | 2.418 | 0.076* |
| ΔLOG(ULC) does not Granger cause ΔLOG(G) | 2.892 | 0.652 | 0.514 |
| ΔLOG(G) does not Granger cause ΔLOG(ULC) | 6.996 | 3.940 | 0.000*** |
| ΔLOG(GDP) does not Granger cause ΔLOG(G) | 12.134 | 8.058 | 0.000*** |
| ΔLOG(G) does not Granger cause ΔLOG(GDP) | 4.834 | 2.208 | 0.027** |
| ΔLOG(GDP) does not Granger cause LOG(ULC) | 11.937 | 7.899 | 0.000*** |
| LOG(ULC) does not Granger cause LOG(GDP) | 3.381 | 1.043 | 0.297 |

Note: Table 8 presents the results of the Granger non-causality test by Dumitrescu and Hurlin (2012). *** Denotes rejection at 1%. ** Denotes rejection at 5%. * Denotes rejection at 10%. We impose two lags on the test. This test was computed by using Eviews11.
Source: Author`s.

## 5. Summary and concluding remarks

This research showed that investment in the three NAFTA-USMCA countries is governed by profitability, competition, and the acceleration principle. Using estimators that control for cross-sectional dependence, the findings suggest that private investment is positively related to the profit rate, unit labour costs, and aggregate demand growth in the short and long-run.

Likewise, the Dumitrescu-Hurlin (2012) test points out that there are bidirectional causal relationships between most variables, suggesting potential feedback loops in line with the circular and cumulative causation. Given the consistency between the tests and estimators applied in each of the empirical analysis sections, we have obtained robust empirical evidence that supports the classical approach to capital accumulation in the context of one of the most important commercial areas in the world economy. Thus, uneven development in North America stems from the dynamic that motivates the profit reinvestment (or surplus reinvestment in the Classical political economy's sense).

In this vein, some policy initiatives can be derived from our findings. Since the change in aggregate demand appears to be the strongest positive effect on investment, the North American policymakers could stimulate capital accumulation by increasing government spending focused on improving infrastructure. It should be highlighted that the increased government expenditure on economic and social infrastructures may expand the market's extent and improve the general technical conditions of production, in the long-run, thereby activating the feedback loops analysed in the above section.

Concretely, economics and social infrastructure can reduce circulation costs and costs of the social reproduction of labour-power, increasing profitability and stimulating capital accumulation in the long-term. In turn, economics and social infrastructures may reinforce backwards and forwards linkages among sectors, improving labour productivity and firm's competitive advantages in the world economy. In this regard, Ros (2013) points out that Mexican slow economic growth is rooted in low rates of public investment, pro-cyclical fiscal policy, and contractionary monetary policy, while Vázquez Muñoz and Avendaño Vargas (2012) reveal that the maquila export sector is not linked to the other industries from the Mexican economy because of the inadequate economic and social infrastructure.

Furthermore, Ros (2013) underlines adverse effects on capital accumulation derived from scarce and expensive bank credit. Therefore, a common North American regulatory framework for the banking sector that encourages credit granting to firms would also be a helpful tool for stimulating capital accumulation in NAFTA-USMCA countries. Finally, further research should expand the model considering the effects of credit, government spending, interest rates, and real exchange rates on private investment, extending the sample by including more countries.

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## 7. Data availability statement

The data that support the findings of this study are openly available in Mendeley Data at https://doi.org/10.17632/7xmmtyry55.1

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# Appendix

## Table A1. Variables

| Variable | Description | Measurement | Database |
|---|---|---|---|
| Dependent | | | |
| $INV_{i,t}$ | Total private investment. Include only non-residential investment from non-financial private sector. | $INV_{i,t} = gross\ fixed\ capital\ formation + change\ in\ inventories$ <br><br> Note: Both variables are measured at constant prices (2015 as year base). Gross fixed capital formation excludes investment in residential assets. | - Statistics Canada-Statistique Canada (Canada).<br>- INEGI (Mexico).<br>- BEA (US). |
| Independent | | | |
| $G_{i,t}$ | Profit rate in non-financial private sector. | $G_{i,t} = \frac{g_{i,t}}{K_{i,t\text{-}1}} = \frac{net\ operating\ surplus\ (current\ year)}{net\ capital\ stock\ (previous\ year\ )}$ <br><br> Note: Both variables are measured at current prices. Net capital stock is measured at current replacement cost, excluding residential assets. | - Statistics Canada-Statistique Canada (Canada).<br>- INEGI (Mexico).<br>- BEA (US). |
| $ULC_{i,t}$ | Unit labour costs. | $ULC_{i,t} = \frac{w_{i,t}}{Y_{i,t}} = \frac{Labour\ compensation}{Gross\ value\ added}$ <br><br> Note: Both variables are measured at current prices. Gross value added is the gross domestic product measured by the income approach. | - Statistics Canada-Statistique Canada (Canada).<br>- INEGI (Mexico).<br>- BEA (US). |
| $GDP_{i,t}$ | Gross domestic product. | Gross domestic product was calculated by using the expenditure approach at constant prices (2015 as year base). | - Statistics Canada-Statistique Canada (Canada).<br>- INEGI (Mexico).<br>- BEA (US). |

Source: Author`s.