Dynamics of Employment and Accumulation of Capital in Colombia, 1965-2019: An Econometric Analysis [1]

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Abstract

Following Marx's general law of capitalist accumulation, the present paper seeks to evaluate the impact of fixed capital stock, labor productivity, and the mass of profits on the dynamics of employment in Colombia from 1965 to 2019 using a Vector Error Correction Model (VECM). The results show that the level of employment exhibits a significant long-term relationship (cointegration) with both the fixed capital stock and labor productivity. In line with Marx's theory, the level of employment expands with fixed capital stock and contracts with labor productivity. In turn, the mass of profits has positive effects on both the fixed capital stock and the labor productivity. The empirical findings also support the existence of Marx's biased technical change as well as a negative feedback effect from employment to profits. Finally, Granger causality tests indicate that the Colombian employment level is endogenously determined by the capital accumulation dynamics.

Keywords: employment level, accumulation of capital, productivity of labour, VEC model.
JEL classification: J21, C21, C22, B51

1. Introduction

In the majority of mainstream growth models, labor population and the level of employment are usually considered exogenous variables, accumulation of capital does not imply necessarily technical change nor growing labor productivity (Lorente, 2020), while the profitability of capital does not play any relevant role. For neoclassical, and even Keynesian theorists, capitalist production is for consumption, not profit (Carchedi & Roberts, 2018). Furthermore, when technical change is incorporated, it is usually presented as beneficial for all economic agents, technological unemployment is only frictional and it is compensated in the long run. Finally, from the Keynesian perspective, increases in the level of employment

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are associated with higher levels of aggregate demand, income, and, consequently, profits (Keynes, 2018).

Marxian economic theory, for its part, offers a quite different theoretical picture. First, the dynamics of the labor population and the level of employment are not exogenous but endogenously determined by the evolution of capital accumulation. Second, the process of accumulation of capital necessarily involves competition among many capitals and, therefore, permanent technical change and growing labor productivity. Third, Marx's biased technological change implies both labor-saving and capital-augmenting new techniques that contribute to the reproduction of the labor reserve army. Fourth, increases in the level of employment can lead to growing wages and, thus, to a decline in the profitability of capital.

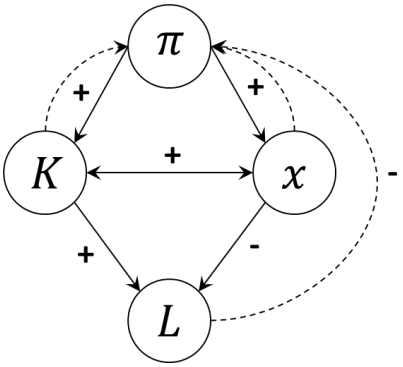
Those elements, presented by Marx (1990) in his General law of capitalist accumulation, are not only present in core capitalist economies but also in peripheral ones, like the Colombian economy. Particularities in the global south are not derived from different economic laws of motion but by the specific application of those general economic laws in the concrete peripheral context (Astarita, 2010). Thus, for instance, Marx's biased technological change is also present in peripheral economies (Marquetti & Porsse, 2017) but is subject to a technological dependency from innovations in core economies. Likewise, the labor reserve army mechanism also operates in peripheral economies, maintaining particularly low wages and high levels of labor exploitation (Fusaro & Sandoval, 2022; Mandel, 1972).

Therefore, following Marx's general law of capitalist accumulation, the objective of this paper is to evaluate the impact of fixed capital stock, labor productivity, and the mass of profits on the dynamics of employment in Colombia from 1965 to 2019 using a Vector Error Correction Model (VECM). The data employed was obtained from Colombian official statistics (DANE, 2021a), the *Extended Penn World Tables* (Marquetti et al., 2021) and other empirical works (Duque, 2022b). The rest of this paper is organized as follows. Section 2 presents the Marxian theoretical framework on the accumulation of capital and employment. Section 3 describes the data employed and the econometric methods employed (VEC model). Section 4 reports and discusses the descriptive statistics as well the econometric results: long-run relationship (cointegration) and short-run dynamics (impulse-response functions and Granger causality test). Finally, section 5 sets out the conclusions.

2. Theoretical framework

Based upon the General law of capitalist accumulation (Marx, 1990) as well as recent Marxian literature (Basu, 2022; Duménil & Lévy, 2003; Foley et al., 2019; Fusaro & Sandoval, 2022; Reuten, 2019), the dynamics of capital accumulation and the level of employment can be summarized in the system of variables depicted in figure 1. Where, π corresponds to the mass of profits, *K* to the fixed capital stock, *x* to the productivity of labor (the ratio between output and number of workers: $x = Y/L$), and *L* to the level of employment (number of workers). Meanwhile, (+) and (-) indicate, respectively, a direct or inverse causal relationship among the variables while the dotted arrows indicate *feedback* effects.

Figure 1 Employment and accumulation of capital: system of variables



Source: Author's own elaboration

Thus, increases in the mass of profits stimulate and allow finance (directly or indirectly through the credit system) investment in fixed capital (new machinery, buildings, facilities, etc.). Nevertheless, insofar as the capital-in-general only exists as many capitals in competition, the expansion of fixed capital implies necessarily the qualitative transformation of production means, use values, and productive techniques, i.e., technological change. This, in turn, is expressed in growing labor productivity. On the other hand, higher profits allow the firms to assume more easily the costs of new techniques/products development and adoption. In a capitalist peripheral economy, like the Colombian one, technical change is also largely a dependent process, i.e., it depends on the importation of new equipment and the adoption of products and production process developed in the core economies.

The level of employment, for its part, expands with increases in fixed capital stock and contracts with technical change and growing labor productivity: that is the contradictory effect of accumulation of capital over the level of employment[2]. Therefore, the rhythm of growth for the level of employment will depend, respectively, on its elasticities to fixed capital and labor productivity as well as the growth of those variables.

In contrast, for the neoclassical approach, technical change activates market mechanisms that allow the efficient reallocation of labor to firms that increase their production, compensating for the reduction of employment in other firms (Minian & Martínez, 2018). Meanwhile, for the Keynesian approach, the employment is a function of the level of effective demand with total independence of the technical change (Keynes, 2018). Hence, from a neoclassical or Keynesian approach, it is not expected a negative aggregate and long-run relationship between labor productivity and the level of employment.

Finally, in Marx's accumulation framework there are several dynamic feedback effects among the variables. First, given an average rate of profit, a growing fixed capital stock will expand the mass of profits. Marx (1991) even claimed the compatibility of a decreasing average rate of profit and an increasing mass of profits. Second, the growing productivity of labor increases the production of surplus value (relative surplus value) and the mass of profits. In Marx´s words (1991, p 326):

> The same development of the productivity of social labour […] and the accelerated accumulation that follows from this –while on the other hand this accumulation also reacts back to become the starting-point for a further development of productivity and a further relative decline in the variable capital– this same development is expressed, leaving aside temporary fluctuations, in the progressive increase in the total labour-power applied and in the progressive growth in the absolute mass of surplus-value and therefore in profit.

Third, expansion of employment could shrink the reserve army labor leading to possible wage increases and, in turn, profit squeeze. This feedback effect, formalized by Goodwin (1967), has given birth to the Goodwin cycles literature and the wider literature on profit squeeze (Boddy & Crotty, 1975; Cámara, 2022; Goldstein, 1985).

[2] Duque (2022a) offers empirical evidence (both cross-sectional and time-series) of this contradictory effect for several countries.

3. Data and methods

The data employed in this paper corresponds to the annual time series, from 1965 to 2019 (55 observations), for the following variables in the Colombian economy: the level of employment (number of workers), L_t, obtained from the *Extended Penn World Tables version 7.0* (Marquetti et al., 2021), the fixed capital stock, K_t, and the mass of profits, π_t, both at constant national prices, obtained from Duque (2022*b*), and the productivity of labor, x_t, estimated as the ratio between the Colombian GDP at constant national prices (DANE, 2021*b*) and the level of employment. In the empirical analysis all variables are expressed in natural logarithms.

Due to the dynamic interaction among the variables (see figure 1), this paper employs a Vector Error Correction (VEC) model, which is a restricted Vector Autoregression (VAR) model intended for use with nonstationary series known to be cointegrated. While simple VAR model focuses on the short-term dynamics among variables, the VEC model focuses on both the long-run relationship (cointegration) between the variables as well for the short-run dynamics. In the context of VAR models, the Granger causality test also allows us to evaluate temporal causality direction among the variables determining whether one variable is useful in forecasting another(s)[3].

The baseline equation is the VAR model:

$$Y_t = A_1 Y_{t-1} + \cdots + A_p Y_{t-p} + e_t \quad (1)$$

Where,

$Y_t = \begin{bmatrix} L_t \\ K_t \\ x_t \\ \pi_t \end{bmatrix}$ is a 4 *x*1 vector of variables of the VAR model.

While $A_i, \{ i = 1, 2, \dots p\}$, are 4x4 coefficient matrices of the VAR model, e_t is a 4x1 vector of shocks and *p* is the number of lags. With cointegration transformation of equation (1), we can get that:

$$\Delta Y_t = \prod Y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta Y_{t-i} + e_t \quad (2)$$

Where,

[3] According to Green (1997), Granger test with non-stationary variables could lead to biased results. Therefore, in the following section, we perform Granger causality test with stationary variables (in first differences).

$$\prod = \sum_{i=1}^{p} A_i - I,$$

$$\Gamma_i = -\sum_{j=i+1}^{p} A_j$$

If Y_t has cointegration relationship, then $\prod Y_{t-1} \sim I(0)$ and equation (2) can be written in the following manner:

$$\Delta Y_t = \alpha\beta' Y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta Y_{t-i} + e_t \qquad (3)$$

Where $\beta' Y_{t-1}$ is the *error correction term* that reflects the long-term equilibrium relationship among the variables (our main interest in this paper). For its part, the second term in equation (3) reflects the short-run adjustment dynamics. Equation (3) corresponds to the VEC model.

As VEC model requires nonstationary variables, I(1), unit root tests are required to determine the order of integration of the variables. Two different standard test were performed: the Augmented Dickey-Fuller (ADF) test (Dickey & Fuller, 1979) and the Phillips-Perron (PP) test (Phillips & Perron, 1988). The specification of the test equation, for each variable, follows the method suggested by Hamilton (1994). The results of those tests are presented in table 1: all variables are integrated variables of order 1 in levels and stationary in terms of first differences.

Table 1 Unit root test, Colombia 1965-2019

Variables	Specification of the test equation	ADF test	PP Test	Order of integration
L_t	Trend and intercept	0.4604	0.0239	I(1)
ΔL_t	Intercept	-2.7841*	-5.9452***	I(0)
K_t	Trend and intercept	-2.8533	-2.3374	I(1)
ΔK_t	Intercept	-3.8454**	-3.8562***	I(0)
x_t	Trend and intercept	-1.4196	-1.5297	I(1)
Δx_t	None	-4.8465***	-4.8465***	I(0)
π_t	Trend and intercept	-2.1574	-2.3392	I(1)
$\Delta\pi_t$	Trend	-6.1975***	-6.1501***	I(0)

Notes: Δ = first differences. *, **, *** denotes rejection of the null hypothesis at the 10%, 5%, and 1% significance levels, respectively. ADF: Augmented Dickey-Fuller test. PP*:* Phillips-Perron test. In the ADF tests, the Schwarz Information Criterion was used to determine the lag length of each test equation. In the PP test we control the bandwidth using the Newey-West bandwidth selection method and the Bartlett kernel. *Source:* Author´s estimations based on the annual data obtained from Duque (2022b), Marquetti (Marquetti et al., 2021) and Colombian official statistics DANE (2021a).

Having established the order of integration of each variable, the question of whether the I(1) variables share a long-run relation (cointegration) then needs to be considered. The Johansen (1995) cointegration tests will be used to check whether the non-stationary variables are co-integrated. Johansen uses two types of likelihood-ratio (LR) test statistics in testing for co-integration: the trace statistic (λ_{trace}) and the largest eigenvalue statistic (λ_{max}). The results of these cointegration tests are reported in table 2. At the 5% significance level, the trace tests suggest that there are two co-integrating equations, whereas the largest eigenvalue tests suggest only one.

Table 2 Johansen co-integration tests based on the trace statistic and the largest eigenvalue statistic, Colombia 1965-2019

Null hypothesis	Alternative hypothesis	Trace statistic		Largest eigenvalue statistic	
		λ_{trace}	5% critical value	λ_{max}	5% critical value
$r = 0$	$r \geq 1$	87.31*	63.87	41.51*	32.11
$r \leq 1$	$r \geq 2$	45.79*	42.91	24.58	25.82
$r \leq 2$	$r \geq 3$	21.20	25.87	14.72	19.38
$r \leq 3$	$r \geq 4$	6.48	12.51	6.48	12.51

Notes: The letter *r* stands for the number of co-integrating equations. An asterisk * denotes rejection of the null hypothesis at the 10% significance level, given the critical values developed by MacKinnon, Haug and Michelis (1999). Trace tests indicate the existence of two co-integrating equations at the 5% significance level. Largest eigenvalue tests indicate the existence of one co-integrating equations at the 5% significance level. The lag length of the VAR is 3. A deterministic linear trend in the data space were included.
Source: Author´s estimations based on the annual data obtained from Duque (2022b), Marquetti (Marquetti et al., 2021) and Colombian official statistics DANE (2021a).

4. Results and discussion

4.1 Descriptive statistics

The time series plots for the four variables are reported in figure 2. There, we also depict the three main economic crises faced by the Colombian economy in that years: the debt crisis of 1982, the end-of-the-century crisis (1999-2000), and the great recession (2008). In general terms, the level of employment, the fixed capital stock, and the mass of profits exhibited a long-term growing tendency for the overall period. However, the long-term growth rate for these three variables slowed down from the 1980 crisis onwards[4].

For its part, labor productivity presents three clear periods: a growing trend from 1965 to 1980, a stagnated trend from 1980 to 2000, again, a growing trend from 2001 to 2019.

[4] Cámara (2005) also finds a similar pattern in the long-term dynamics of capital stock for the Mexican economy.

Those periods are related to the import substitution industrialization (ISI) expansion in the 70s, the ISI crisis during the 80s, the neoliberal transition in the 90s, and the neoliberal consolidation from 2001 onwards (Duque, 2022).

All four variables also exhibit short-run dynamics related to economic cycles and crises. Thus, *grosso modo*, the employment, the fixed capital stock, the mass of profits, and the labor productivity tend to stagnate or decrease during the crisis and recover in the boom periods.

Figure 2 Time series plots of the variables, Colombia 1965-2019

Source: Author´s estimations based on the annual data obtained from Duque (2022b), Marquetti (2021) and Colombian official statistics DANE (2021a)

4.2 Long-run relationship

The coefficients of the long-term relationship among the variables are reported in table 3 (where the level of employment is the dependent variable). Since all variables are expressed in natural logarithms, the estimated parameters correspond to long-term elasticities (the econometric diagnostics for the VEC model are reported in the appendix). As can be

observed, the level of employment has an economically and statistically significant long-term relationship with fixed capital stock and labor productivity. Although the mass of profits is also statistically significant, its elasticity is economically null. This result is congruent with the Classical-Marxian framework presented in section 2: Insofar as the mass of profits affects the level of employment only indirectly, through changes in capital stock and labor productivity (figure 1), the direct *ceteris paribus* effect of profits on employment is expected to be null.

Table 3 Long-term parameter estimation results, Colombia 1965-2019

K_t	x_t	π_t
1.026***	-1.001***	-0.008***

Notes: ***, ** and * indicate statistical significance at 1%, 5% and 10%, respectively. *Source:* Author´s estimations based on the annual data obtained from Duque (2022b), Marquetti (2021) and Colombian official statistics DANE (2021a)

In the long-run, the fixed capital stock expands the level of employment (with an almost unitary elasticity). This is the attraction effect of capital accumulation on the level of employment, already present in Marx´s general law of capitalist accumulation and in the Marxian literature (Foley et al., 2019; Mariña, 2020; Reuten, 2019). In addition, this result is consistent with both cross-sectional and time-series evidence for other countries (Duque, 2022a). Thus, through the last five decades, the expanded reproduction of capital in the Colombian economy has implied a direct, and statistically related, expansion of both living and dead labor where the latter has dominated the former.

Nevertheless, the capital accumulation process in Colombia has not only implied a quantitative expansion of capitalist production but also a *qualitative* one. Technical and structural change has transformed the Colombian economy as well as its average labor productivity (see figure 2). In table 3 it can be observed that, in the long run, increases in labor productivity expels the labor force decreasing, therefore, the level of employment. This finding, also statistically robust, is in line with Marx´s general law of capitalist accumulation and the *Marx-biased technical change* characterized by the prevalence of new labor-saving and capital-intensive techniques (Duménil & Lévy, 2003; Foley et al., 2019).

Here, it is important to highlight that the long-run negative effect of labor productivity over the employment level is not a trivial one. Following Marx (1990), this effect is associated with a strong and direct relationship between labor productivity and the capital-labor ratio (technical composition of capital). This, however, is not tautologically true:

mathematically, both variables are independent. In fact, in the Hicks-neutral technical change, there is growth in labor productivity maintaining the capital-labor ratio unchanged while in the Solow-neutral technical change, there is a reduction in the capital-labor ratio maintaining labor productivity constant (Blecker & Setterfield, 2019).

On the other hand, in capitalist peripheral economies –like the Colombian one– technical change depends on the importation of new equipment and the adoption of products and production processes developed in the core economies. In those economies, there is usually technical change without significant local innovation. However, even under those particular circumstances, the macroeconomic long-run pattern for technical change seems to follow the Marx-biased pattern. This, of course, has contributed to the durability and reproduction of a large labor reserve army in the Colombian economy with the well-known effects on poverty and inequality.

4.3 Short-run dynamics

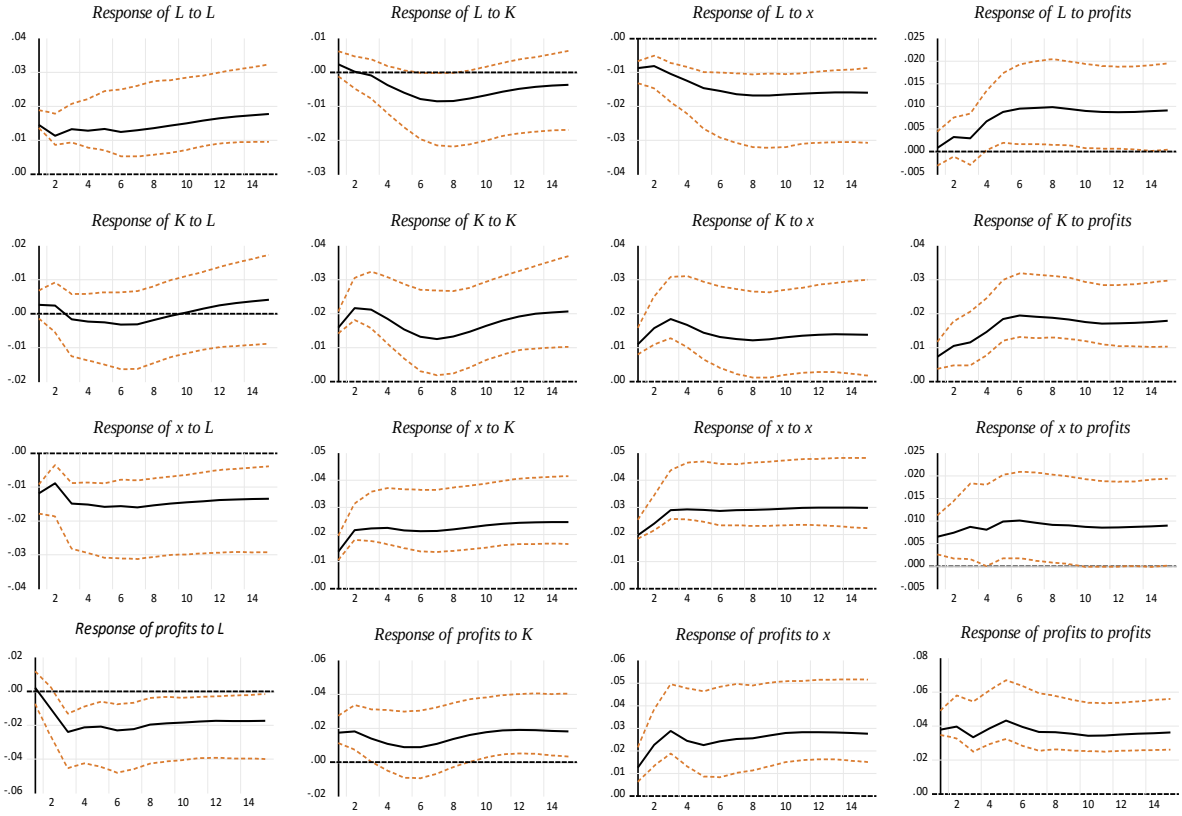
The VEC model also allow us to estimate the short-run dynamic interactions among the variables. The first empirical tool employed corresponds to the generalized impulse-response functions (Pesaran & Shin, 1998) with confidence intervals of 90%. Those confidence intervals where estimated by *bootstrap* method developed by Hall (1992). The results, for a time horizon of 15 years, are reported in figure 3.

As can be observed, and in concordance with our theoretical Marxian framework, the mass of profits has positive, and statistically significant, effects over both the fixed capital stock and the labor productivity (see the last column in figure 3). Moreover, that effect is greater and more persistent over the capital stock than over the labor productivity. That finding seems to reflect the difficulty of technical change compared to simple extensive capital accumulation. Finally, given the higher sensitivity of the capital stock to the mass of profits, the mass of profits has a direct effect on the level of employment, which is only statistically significant after year 4.

There is also evidence of a strong direct correlation between the fixed capital stock and the labor productivity. Increases in one variable has significant and persistent effects over the other, although the effect of capital stock on labor productivity seems to be greater than in the other direction. Again, this empirical result for the Colombian economy is in line with

our theoretical framework: the accumulation of capital does not only imply *quantitative* changes but also *qualitative* ones related with technical change.

Figure 3 Generalized impulse-responses to the variables, Colombia 1965-2019



Source: Author´s estimations based on the annual data obtained from Duque (2022b), Marquetti (2021), and Colombian official statistics DANE (2021a)

In concordance with the previous findings, evidence of labor-saving technical change was also found for the short-run dynamics: increases in labor productivity have negative, persistent, and statistically significant effects on the employment level (figure 3). On the contrary, in the short run, there are no statistically significant effects of capital stock on the level of employment.

Finally, following the system of variables depicted in figure 1, there are several feedback effects of the variables over the mass of profits. First, both the fixed capital stock and the productivity of labor have positive and statistically significant effects on the mass of profits. Although, the effect of labor productivity is greater and more persistent. Those findings are

coherent with the general law of capitalist accumulation (Marx, 1990) as well as the analysis of the mass of profits provided by Marx (1991) in the third volume of capital (section three).

Second, the level of employment has a negative and statistically significant effect on the mass of profits. This lagged effect (significant after the second year), can be explained by the general law of capitalist accumulation (Marx, 1990) where increases in the level of employment can conduce to increases in wages and, in turn, reduction in profits (see figure 1). It is important to point out that this finding is contrary to the Keynesian perspective where increases in the level of employment expand the effective demand, aggregate income, and profits (Keynes, 2018).

Within the VEC framework, Granger causality among the variables can be also assessed. The result of Granger causality test, for the variables in first differences, is reported in table 4. The *p*-values corresponds to the null hypothesis that independent variables are not able to predict the dynamic behavior of the dependent variable. Thus, the rejection of null hypothesis evidences causality in the sense of Granger. As can be observed, there is evidence of bidirectional causality among the level of employment, the fixed capital stock and the mass of profits. Even the labor productivity is also caused by the remaining variables together.

Table 4 Granger causality test: p-values, Colombia 1965-2019

Independent variables	**Dependent variables**			
	$\Delta \boldsymbol{L_t}$	$\Delta \boldsymbol{K_t}$	$\Delta \boldsymbol{x_t}$	$\Delta \boldsymbol{\pi_t}$
ΔL_t	-	0.0002***	0.8200	0.0029***
ΔK_t	0.0001***	-	0.8134	0.0028***
Δx_t	0.0001***	0.0002***	-	0.0027***
$\Delta \pi_t$	0.0725*	0.0931*	0.6962	-
All	0.0012***	0.0038***	0.0621*	0.0176**

Source: Author´s estimations based on the annual data obtained from Duque (2022b), Marquetti (2021), and Colombian official statistics DANE (2021a)

Once more, those results are widely consistent with the Marxian theoretical framework (see figure 1) but not with other economic approaches. Thus, in the neoclassical growth models, the population growth and, hence, the labor-power supply, is traditionally considered exogenous, i.e., determined by non-economic factors. However, our results indicate that the dynamics of the working population are highly dependent on the dynamics of the

accumulation of capital. In Marx's (1990, p. 783) words: “The working population, therefore, produces both the accumulation of capital and the means by which it is itself made relatively superfluous; and it does this to an extent which is always increasing. This is a law of population peculiar to the capitalist mode of production”.

5. Conclusions

This paper offers an empirical analysis of the employment level and capital accumulation in Colombia from 1965 to 2019. Employing an econometric Vector Error Correction model, we found empirical support for Marx’s General law of capitalist accumulation in Colombia.

First, the level of employment holds a long-term relationship with the fixed capital stock (attraction effect) and productivity of labor (eviction effect). Those results are largely consistent with cross-sectional and time-series evidence about the contradictory effect of capital accumulation on the level of employment (Duque, 2022a). Second, the econometric results also evidence positive bidirectional effects of the mass of profit over both the fixed capital stock and the labor productivity of labor. Thus, the profitability of capital plays a central role in the rhythm of both expansions of fixed capital stock and technological change. Third, the inverse relationship between labor productivity and the level of employment, in the long-run and short-run, supports the existence of Marx’s biased technical change for the Colombian economy in the period analyzed. Fourth, in line with profit squeeze models, the level of employment has a negative lagged influence over the mass of profits. Lastly, the Granger causality test reports that employment level is largely an endogenous variable determined by (and determining) the capital accumulation process.

The overall results are consistent with the Marxian economics framework presented in the paper but not with other economic paradigms like the neoclassical or Keynesian where, for instance, there is no Marx’s biased technological change and the effects of employment over profits are positive. On the other hand, our empirical findings illustrate how general laws of capitalism also operate in the concrete conditions of global south capitalism.

Appendix

Table 5 reports the results of the residual serial correlation LM tests for the VEC model. The LM statistics and their corresponding *p*-values suggest the absence of serial correlation up to a lag order of four. On the other hand, to show that the model satisfies the stability condition, the inverse roots of the characteristic autoregressive polynomial were also calculated. As the table 6 shows, the overall model is stable. In addition, table 7 reports the results of the White heteroscedasticity test indicating there is no evidence of heteroscedasticity. Lastly, in table 8 are reported the results of the normality tests for the VEC model. We find that three of four variables in the model follow a normal distribution.

Table 5 Residual serial correlation LM test, Colombia 1965-2019

	VEC model	
Lag order (p)	**LM-Statistics**	**Probability**
1	16.19777	0.4392
2	15.05786	0.5204
3	22.85085	0.1178
4	17.29264	0.3669

Source: Author´s estimations. *Notes:* Null hypothesis: there is no serial correlation at lag order (p).

Table 6 Stability condition test, 1965-2019

VEC model	
Root	**Modulus**
1.000000 - 8.45e-12i	1.000000
1.000000 + 8.45e-12i	1.000000
1.000000	1.000000
0.947427	0.947427
0.675394 - 0.399509i	0.784707
0.675394 + 0.399509i	0.784707
-0.122060 - 0.658145i	0.669368
-0.122060 + 0.658145i	0.669368
-0.568498	0.568498
0.472224	0.472224
-0.285005	0.285005
0.066265	0.066265

Source: Author´s estimations. *Notes:* VEC specification imposes 3 unit root(s).

Table 7 White heteroscedasticity tests for VEC residuals, 1965-2019

Joint test	**VEC model**
Degrees of freedom	180
Chi-Squared statistic (χ2)	159.7281
Probability	0.8590

Notes: Author´s estimations. White test does not include cross terms.

Table 8 Normality tests for VAR residuals, 1967-2019

Component	Jarque-Bera	Prob.
1	0.964851	0.6173
2	3.496237	0.1741
3	0.271468	0.8731
4	14.59955	0.0007
Joint	19.33211	0.0132

Notes: Author´s estimations. Null hypothesis: residuals follow a multivariate normal distribution. Orthogonalization: Cholesky (Lutkepohl)

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