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Economic expectations and private investment decision for the Peruvian consumer sector 2010Q4-2020Q1: Preliminary analysis under COVID-19 scenario

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A B S T R A C T

This work estimates the relationship between the economic expectations given by Tobin's q variables, terms of exchange and 3-month economic expectations with private gross investment for the period from the first quarter of 2010 to the first quarter of 2020, under the stress scenario of the COVID-19 pandemic. Through an econometric model, results were obtained such as that the variation in private gross investment VIBP has an inertial behavior with a coefficient of 0.258791, shadow cost of capital or q of Tobin QTC with a coefficient of -0.03213, as well as terms of TI exchange with a coefficient of 0.805618. This indicates that the private investment decision by the companies analyzed depends on factors such as economic expectations, the inertial effect of investment and the shadow cost of capital expressed in Tobin's q.

1. Introduction

Bernanke (2004) mentions that an important reason for studying investment conduct is that it plays a key role in the economy's long-term productive capacity, because this investment generates new capital goods, so a high investment rate means a rapidly growing capital stock, and Sachs (2013) notes that investment depends on the perception of future marginal capital productivity , therefore this decision to increase the capital stock depends on the investor's expectations determined by multiple factors. Investment in Peru is a very important variable since it represents approximately 20.85% of total Gross Domestic Product GDP as of 2019 according to World Bank data, a figure that has varied due to multiple internal and external scenarios, such as the situation of trade war or political adversities in the country, therefore, investment in the consumption sector can be analyzed as volatility of the same and subsequently the investment made in response to this. The pandemic scenario generated by COVID-19 has very important implications within the investment analysis because, in its nature, it is essentially much more volatile than consumption, this leads to the question of how the private investment decision in the consumer sector reacts to the systemic changes generated by the situation. For a detailed and detailed approach to investors' expectations of return, a variable considered to be the shadow cost of capital was investigated, called q of Tobin proposed by Tobin (1969) with alternatives to their methodology by Chung and Pruitt (1994) and Lindenberg and Ross (1981), in this way with companies in the consumer sector listed in the S&P/BVL Peru Select Index proceeded to generate the variable of cost shadow of capital or q of Tobin for the consumer sector.

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The research is related to several important lines of research, he also has extensive literature on the determinants of investment such as Eisner (1978), Hayashi (1982), Barro (1990), Lamont (2000) and closer both temporarily and conjunctally those of Montoro & Navarro (2010) where they study the behavior of investment in a period of financial crisis (1999-2009), Rousseau & Kim (2006) who study the behavior of investment in Korea during the post-crisis period (1997-2001) or research Gennaioli, Ma, & Shleifer (2016) based on the relationship of real expectations and investment decision for corporate companies in the United States of America.

This research aims to establish and measure the relationship between the private investment decision and economic expectations with variables such as private gross investment (IBP) in previous periods, the shadow cost of capital or Tobin´s q (QTC), terms of exchange (TI) and 3-month economic expectations (EE3) through a generalized time model (GMM) applied to a PRE-COVID and COVID period.

2. Literature Review

2.1 Investment

According to Larraín and Sachs (2013) the production of goods requires inputs work, capital and technology, this understood as private or business capital; therefore, investment is defined as flows that change the economy's capital stock. The increase in this (capital stock), investment expenditure increases the future production levels of the economy. As well as consumption theory, investment theory has an intertemporal component, since the investment decision is to increase the chances of production or future profits. Capital and investment rates refer to: fixed investment of the company (production plant and equipment); investment in stocks (raw material inventories, semi-finished products and finished goods that are not yet sold) and investment in residential structures or domestic investment (construction and maintenance of homes, which has a unique component since within the market if a family buys a home did not generate investment, because from an economic point of view, a new capital stock was not generated but changed hands). The difference between these is capital depreciation, which occurs when capital stock wears out for a certain amount of time; therefore, you have:

$$Net\ investment = K_{t+1} - K = I - \delta k = gross\ investment - depreciation$$

2.2 Investment with expectations

According to Larraín and Sachs (2013) the investment depends on the perception of future marginal capital productivity since in practice investment decisions are full of uncertainties because the marginal productivity of capital depends on the future demand that the goods produced may have. This also depends on multiple variables that are not known as technologies that affect production. In addition Blanchard (2000) mentions that investment depends on the uncertain and fluctuating nature of the events, that is, that entrepreneurs, having no certainty of future events, are protected with cautious behavior and this gives the appearance of being rational behavior. This is inferred from assuming that existing opinions are based on a certain vision of the future, which as a whole gives stability to markets, but at the same time Keynes called these criteria "conventional judgments". Contrary to the denying of such judgments, instability is created, because as Keynes asserts, individual behavior is rational and that these decisions are made in an irrational world. Following Larraín and Sachs (2013) an important variable has to be analyzed with respect to the investment that is depreciation.

$$(1 - \delta)^t$$

where δ is the depreciation rate and t is the depreciation period, according to the author's logic the investment decision has the following form, where the company is supposed to buy machinery ΔK with its own cash flow:

$$K_{t+1} = (1 - \delta)K_t + I_t$$

In the next period you get a utility equal to PMK ΔK. The new machine is valid (1-δ)ΔK in the second period, then the total effect on the company value is:

$$Investment.decision = -\Delta K + \frac{[PMK\Delta K + (1-\delta)\Delta K]}{1+r}$$

In the second term of the equation it is seen that the profit flows are discounted at the rate of interest r to obtain the present value of these. It is seen that the value of the company increased if and only if the marginal capital product is greater than the sum of the interest rate and the depreciation rate.

In small volume investments this condition is almost assured since the PMK is very probable that it is greater than r+δ since the PMK is high when K is low, the optimal investment decision is to match the equation to a level at which the PMK is exactly equal to r+δ.

2.3 The shadow cost of capital or Tobin's q

Defining Tobin's q, as a term coined in reference to its author Tobin (1969) winner of the Nobel Prize in Economics in 1982, which presents a model for investment behavior based on the idea of adjustment or replenishment costs, where a company's market value is an indicator for measuring the gap between K and K+1. Tobin's q is defined as the division of the company's market value (VM) and its cost of capital replenishment (VR). This cost of capital replenishment refers to the cost to be paid for machinery, equipment and inventories in the market.

$$q_{tobin} = \frac{VM}{VR}$$

While the value of Tobin's q is greater than 1 and it shows that the investment decision must be high, on the contrary, if it is less than 1, the investment decision must be low. Another way to see Tobin's q-value is to deduct the future dividends that the company will distribute per unit of capital, assuming a stock of capital, PMK and constant depreciation, the dividend per unit of capital is equal to PMK-δ and Tobin's q would be:

$$q = \frac{PMK - \delta}{1 + r} + \frac{PMK - \delta}{(1 + r)^2} + \frac{PMK - \delta}{(1 + r)^3} + \cdots +$$

$q = (PMK - \delta)/r$Where equality would become:

It is seen that Tobin's q will tend to be greater than 1 if the PMK is greater than r+δ in future periods, and Tobin's q will be less than 1 otherwise, reaching the same optimal investment decision conclusion. Another way to calculate Tobin's q comes one of an accounting form proposed by Chung & Pruit (1994) that applies a simple method of calculating the Tobin q that approximates the ratio as:

$$Qcp = \frac{VM(AC) + VL(PS) + Debt}{VL(TA)}$$

where VM(AC) is the result of the price of common shares by the number of shares issued, VL(PS) is the settlement of preferred shares and TA is the book value of the company's total assets, the debt has the following calculation:

$$Debt = VL(DLP + INV + DCP - ACP)$$

In short, the sum of the book value of short-term debt (DCP), the book value of long-term debt (DLP) and inventories, minus short-term assets (ACP). Undoubtedly this approach is much simpler than those consulted for the elaboration of this work, despite this, the methodology of Chung & Pruitt (1994) find that for the case of the United States this calculation shares more than 95% of the variability than the Methodology of the Tobin Q proposed by Lindenberg & Ross (1981).

2.3 Optimal investment decision

The model developed below understands that the owners of the firm are interested in magnifying or maximizing the value of the firm, so they make investment decisions in each period. Consider a representative firm which has to choose the optimal capital decision such that it maximizes the current value of your dividends.

$$E_t\{\sum_{i=0}^{\infty} \frac{D_{t+i}}{R^i}\}$$

Where R is the interest rate and $D_t = \Pi(K_t, \theta_t) - I - C(I_t, K_t)$ is the value of dividends, it depends on the profits, your investment and the cost of installing new capital. This benefit will depend on the accumulation of capital and technology. To withdraw the possibility of increasing yields at scale the profits are concave in Kt, in addition the capital stock evolves according to the equation of accumulation of neo-Keynesian capital.

$$K_{t+1} = (1 - \delta)K_t + I_t$$

where δ is the depreciation rate as already discussed in previous points.

Taking K as a dice, the signature value is given by:

$$V(K_t, \theta_t) = \max_{I_t K_{t+1}} \{\Pi(K_t, \theta_t) - I_t - C(I_t, K_t) + R^{-1}E\{V(K_{t+1}, \theta_{t+1})\}\} \quad (1)$$

Replacing the capital accumulation equation at Eq. (1) to get

$$V(K_t, \theta_t) = \max_{I_t K_{t+1}} \{\Pi(K_t, \theta_t) - I_t - C(I_t, K_t) + R^{-1} E\{V(I_t + (1-\delta)K_t, \theta_{t+1})\}\} \quad (2)$$

where the first order condition is derived from

$$1 + C_I(I_t, K_t) = Q_t \quad (3)$$

$C_I(I_t, K_t) = \frac{\partial C(.)}{\partial I_t}$This condition equals the cost of buying capital on the market, which is equal to 1 plus the marginal cost of adjustment with Tobin's q, called the shadow price of capital. This is equivalent to:

$Q_t = R^{-1} E_t\{V_k(K_{t+1}, \theta_{t+1}\}$.

The expected marginal value of the signature of an additional unit of capital discounted by the interest rate. Since the optimality condition relates Tobin's q to the investment, so if q increases the investment will also, in addition if qt has a value greater than 1, it is optimal for companies to continue increasing capital, until the value of the q is equal to 1.

3. Method

3.1 Sample and Population

Research has a quantitative approach because it is based on numerical and statistical analysis. The level of research is correlated since the purpose is to determine the relationship between economic expectations with the variables it encompasses and the private investment decision for the Peruvian consumer sector during the period 2010Q1-2020Q1 with PRE-COVID and COVID applications. The series of private fixed gross investment was obtained from the quarterly statistical series of the Central Reserve Bank of Peru BCRP, in the same way the terms of exchange, economic expectations at 3 months and additionally the gross domestic product that will be used as an instrumental variable following the reference of Montoro & Navarro (2010)

In addition to the construction of Tobin's capital shadow price or q variable for the Peruvian consumer sector, consumer companies listed in the S&P/BVL Peru Select Index were used with Chung & Pruitt methodologies (1994), using Bloomberg as the main source for the consultation of the financial statements required for each quarter and subsequent calculation of the variable, are listed below:

Table 1

Companies in the consumer sector S&P/BVL Peru Select Index

Companies	Pneumonic
Alicorp	ALICORC1
InRetail	INRETC1
Casa Grande	CASAGRC
Backus	BACKUSI1
Austral	AUSTRAC1

3.2 Data collection instruments

The data were obtained from primary sources, such as the Central Reserve Bank of Peru BCRP for obtaining statistical series for variables such as private fixed gross investment (IBP), terms of exchange (TI), economic expectations at 3 months (EE3) and Bloomberg's additional gross domestic product (GDP), for the construction of Tobin's q (QTC) or shadow cost of capital by querying quarterly financial statements in the period 2010Q1-2020Q1.

3.2.1. Study variables

The variables generating this work are private fixed gross investment (IBP) as a dependent variable, private gross investment with lags (IBP), terms of exchange (TI) and economic expectations at 3 months (EE3) as independent variables, taking as references the studies of Montoro and Navarro (2010), Tovar Rodriguez and Chuy Kon (2000), Dominitz and Manski (1996).

3.2.2. Econometric Model

The econometric model initially used was that of Minimum Ordinary Squares (MCO) but having suspicions of endogeneity because of the nature of the variables and their temporal behavior, the Haussman test was carried out to determine endogeneity. Finally, he decided on the econometric method of Generalized Moments Method (GMM).

This methodology presented by Hansen (1982) posits that the Generalized Moment Method includes many of the standard econometric estimators such as MCO, MC2E or MV in some cases, these models have to meet orthogonality conditions, to identify an equation is requested at least as many orthogonality conditions as variables to estimate, these can be supplanted by equivalent expressions including the original parameter vector that is estimated. This type of estimate has many facilities when estimating, since for samples with natures such as the one presented it has characteristics such as: identification, consistency, efficiency and optimal combination of moments. To justify the use of this methodology, tests are performed, such as the Hausman test to test endogeneity, as well as rejecting standard estimates such as MCO, MC2E and Maximum Plausibility since these methodologies do not achieve the optimal combination of dynamic moments.

Taking reference to the study of Montoro and Navarro (2010) as a support for the use of the econometric model as well as the versatility and efficiency found in the model theoretically, it is represented by the following formula:

$$\Delta IBP = B_o + B_1 \Delta IBP_{t-1} + B_2 \Delta QTM_{t-1} + B_3 \Delta TI_{t-1} + B_4 \Delta EE3_{t-1} + \varepsilon_t$$

where:

ΔIBP: Change in private fixed gross investment lagging a period

ΔQTM: Tobin Q variation for the lagging consumption sector a period

ΔTI: Changing the terms of trade to lagging indices a period

ΔEE3: Changing economic expectations to 3 months lagging a period

ε: Term of error

3.2.2. Hypothesis

H1: There is a direct relationship between the shadow cost of capital and the private fixed gross investment decision for the consumer sector in Peru 2010Q1-2020Q1

H2: There is a direct relationship between the terms of trade and the private fixed gross investment decision for the consumer sector in Peru 2010Q1-2020Q1

H3: There is a direct relationship between 3-month economic expectation and the private fixed gross investment decision for the consumer sector in Peru 2010Q1-2020Q1

4. Results

4.1. Descriptive results

Table 2
Summary of descriptive statistics

Variable	Observations	Mean	Standard deviation	Min.	Max.
IBP	61	20121.99	5570.98	8446.02	26707.27
TI	61	92.396	10.30	69.70	114.2735
QTC	61	1.043	0.38	0.455	2.0
EE3	61	58.14453	9.1837	35.33	73.33

4.2. Correlation coefficient test

The following table shows the coefficient correlation test, to measure the strength of associativity between study variables

Table 3
Correlation results

Variable	IBP	TI	QTC	EE3
IBP	1			
TI	.4490	1		
QTC	-0.1624	.5681	1	
EE3	-0.4258	.2875	.5398	1

It can be observed that variables have a certain degree of correlation with respect to IBP. A positive correlation coefficient means that variables have a direct relationship, a negative correlation coefficient indicates that variables have an inverse reaction.

4.3. Outcome of the Generalized Moment Method (GMM)

Table 4
Result of regressions

	PRE-COVID 2010Q1-2019Q4			COVID 2010Q1-2020Q1		
	Coefficient	value p		Coefficient	value p	
Constant	0.005890	0.0084	***	0.007170	0.0038	***
VIBP	0.381732	0.0000	***	0.258791	0.0001	***
VQTC	-0.032134	0.0488	**	-0.063103	0.0000	***
VTI	0.496078	0.0000	***	0.805618	0.0000	***
VEE3	0.045356	0.1194		0.036891	0.2839	
R2	0.330343			0.167777		

Note: (*) (**) and (***) represent statistical significance at levels of 10%, 5% and 1%, respectively.

Estimates were made to find statistically significant results.

5. Discussion

5.1 Reverse relationship between the shadow cost of capital and the private investment decision for the consumer sector

The results show that there is a negative correlation between the shadow price of capital (QTC) and the private gross investment decision (VIBP) for the Peruvian consumer sector, with a coefficient of -0.032134 in a PRE-COVID period and a coefficient of -0.063103 in the COVID period with results according to what was found by Montoro & Navarro (2010), which can be observed in Table 4. This means that it has an inverse relationship with respect to private gross investment, something that sounds contradictory at first glance, but by performing an empirical analysis of the variables you can sense why this behavior:

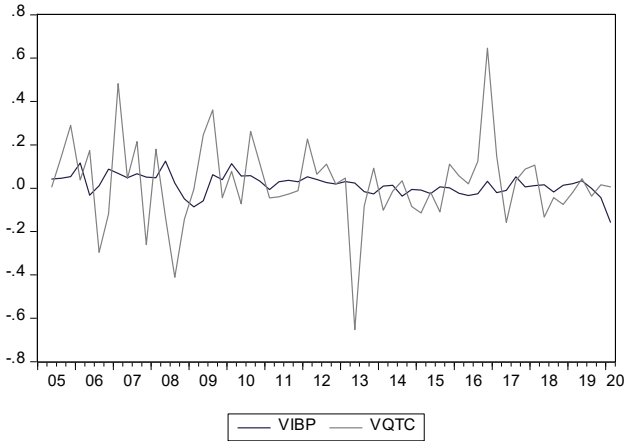

Fig. 1. Var % Fixed gross investment - Var % Tobin´s q Consumption

As you can see the investment suffered a considerable collapse during the last quarter of 2019 and for the effects of the situation an even more noticeable collapse in the first quarter of 2020, while the shadow cost of capital for the consumer sector maintained minimum levels of variation, this is because, despite the current situation of pandemic, consumption levels were not greatly affected like other economic sectors. It is also assumed that the efficiency of the capital shadow price variable as a predictor variable of investment behavior, as can be seen in the periods of contraction of the variable and subsequent contraction of private investment in the consequent period.

5.2 Direct relationship between the terms of exchange and the private investment decision for the consumer sector

The results show that there is a direct correlation between the terms of exchange (TI) and the private investment decision (IBP) for the Peruvian consumer sector, with a coefficient of 0.496078 in a PRE-COVID period and a coefficient of 0.805618 over a COVID period, which can be observed in Table 4.

This direct relationship between the terms of exchange and the investment decision has a rather intuitive nature in a context

Illustration 1. Var % terms of exchange - Var % private gross investment

such as the Peruvian, for its explanation a graphical analysis was carried out

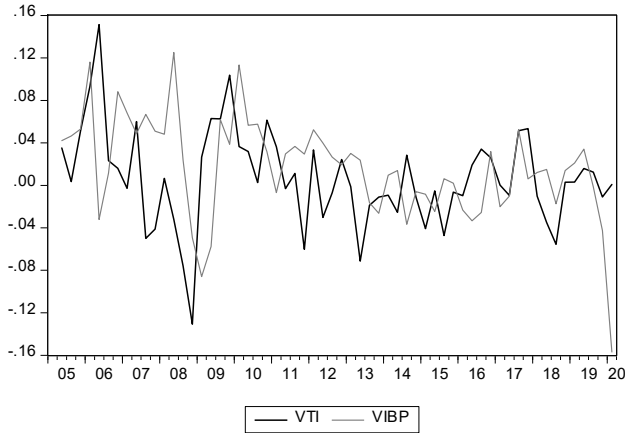

Fig. 2. Var % terms of exchange - Var % private gross investment

Fig. 2 shows that the behavior of the terms of exchange had a recovery in the last periods of 2018 through the third quarter of 2019, where it had a small contraction and subsequently a recovery during the first period of 2020 already considering the COVID scenario, while private gross investment had a considerable collapse , explained by the nature and volume of mining investment in Peru, which is strongly influenced by the terms of exchange and which was also not stopped during the first moment of the COVID scenario.

5.3 Direct relationship between 3-month economic expectations and private investment decision for the consumer sector

The results show that there is a direct but not significant correlation between 3-month economic expectations (EE3) and the private investment decision (IBP) for the Peruvian consumer sector, with a coefficient of 0.045356 over a Pre-covid period and a coefficient of 0.036891 over a COVID period, which can be observed in Table 4

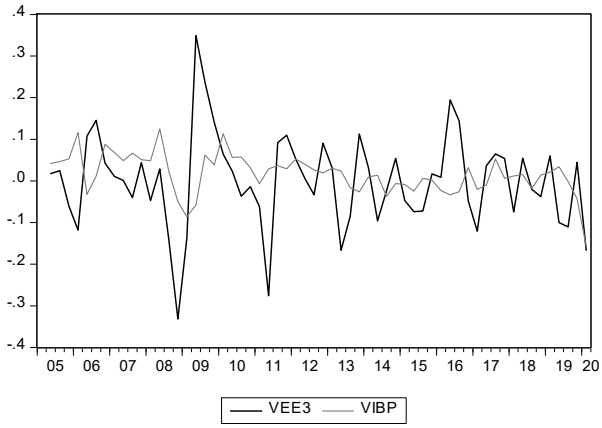

Fig. 3. Var% 3 month economic expectations - Var% private gross investment

Despite the contraction in fixed gross investment since the fourth quarter of 2019 and the first quarter of 2020, it is seen that this variable of 3-month economic expectations had a very significant collapse as a forward looking variable of investment return in addition to this a change in the sign is seen having a behavior commensurate with that of the investment. Finding that the variable is meaningless in both contexts analyzed, it is concluded that the 3-month economic expectations collected by the BCRP still lack representativeness in the investment behavior for the Peruvian consumer sector.

6. Conclusions

Private investment in the consumer sector is a key component in the formation of capital stock in the country, which is the dynamic engine of growth and development, even more so in a sector where natural investment volatility is contained by consumption behavior even in the face of the current pandemic context by COVID-19.

In this way, it is also understood by the results that private investment has an inertial component within itself with its previous periods, this because corporate investments do not run in a single period, if not, in consecutive periods, where improvements

are made to installed capacity or inventory renewal.

On the other hand, the shadow cost of capital, despite being a significant variable directly related to investment, is observed as not consistent with the definition of the optimal investment decision that says that a growth in the shadow cost of Capital or q of Tobin would generate investment growth, which would be a more non-reverse direct relationship as shown by the results , but the context from which the values called for research are obtained show that they have a severe degeneration due to factors such as global financial crisis 2008, adverse effects of national policy, economic wars and greatly the phenomenon of pandemic generated by COVID-19.

The 3-month economic expectations collected by the Central Reserve Bank of Peru BCRP directly show the confidence and security that agents feel regarding the economic outcome in later periods, but being a shallow and volume consultation has a small effect that loses relevance in scenarios such as current ones.

Finally, careful review of the results means that it is still a developing model due to limited information from institutions, in addition to the variables considered, by the nature of the country could have a greater impact on an analysis in other larger sectors such as in the mining sector that requires a more thorough and deeper study , in the same way by observing the impact of the terms of exchange on investment, include a variable measuring market exposure to external factors and in the same way include variables such as the sector's preference for bank credit before the stock market which would better explain the behavior of the variable called the shadow price of capital.

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