MACROECONOMIC ANALYSIS

On-line purchasing intentions and household spending

Yalina Crispin

Similar to the indicator of Purchasing Intentions of Apartments in Lima <u>See Report here</u>, a similar indicator has been developed to anticipate household spending decisions in the short term using information from Internet searches related to shopping in supermarkets and department stores. We found evidence that this indicator anticipates and improves the ability to predict household spending in the short term.

Internet searches contain relevant information about the buying preferences and intentions of millions of buyers and businesses, and its digitization is enabling its systematic use. Google, one of the main information search engines on the Internet at a global level, has played a key role in this process by channelling and consolidating the diverse data available on to various web pages to facilitate access by all users. A free tool from Google is Google Trends, which provides information in real time about the number of searches for a phrase or word. It is important to note that Google information has been used to make projections in various disciplines such as epidemiology and economics (for more detail see Belapatiño and Crispin (2016)[1]).

Development of an Index of Interest in Purchasing in Peruvian households with information from Google Trends (IICG in its Spanish initials).

To construct the IICG, a list of words related to the interest of householders in purchasing goods was considered[2] (see Annex 1 for more detail). As a result, an indicator that relates to private consumption was found. Dynamic correlation analysis reveals that there is a positive relationship between the IICG and the growth in private consumption, reaching its closest association when the IICG is brought forward two quarters (see Figure 1). Thus, by plotting the growth in private consumption and the IICG with a lag of two quarters, a similar behaviour in both series (see Figure 2) is shown. Also, when performing tests of statistical precedence, it was found that the IICG anticipates (causes) the growth of private consumption (see Appendix 2).

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[1] see Report here Internet searches and sales projections of apartments in Lima.
[2] Durable and non-durable goods, also included a variable of services (travel).
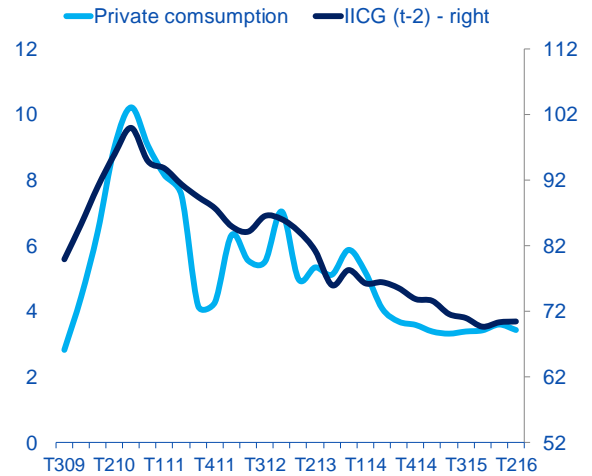
Figure 1

Correlation coefficient between the growth of private consumption and the IICG
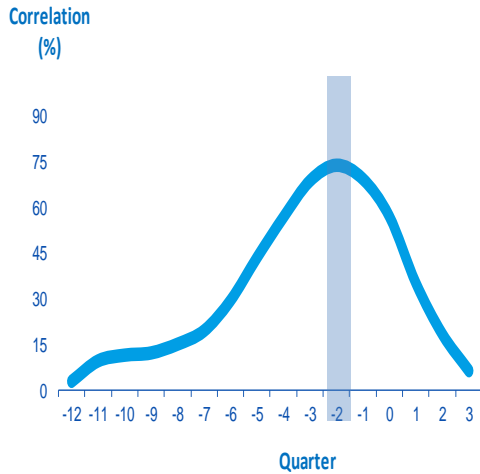
Source: Google, BCRP

Figure 2

Private consumption & the IICG (chg.% YoY & Index)

Source: Google, BCRP

From the above, evidence is found that the purchase interest of households measured by the IICG anticipates private consumption. This result is consistent in practice because many times before making a purchase of any product, we search the internet for information on models, prices, discounts and, in some cases, the purchase is made on-line (see Chart 3).

Figure 3

Relationship between the Interest in purchasing in households (measured by the IICG) and private consumption
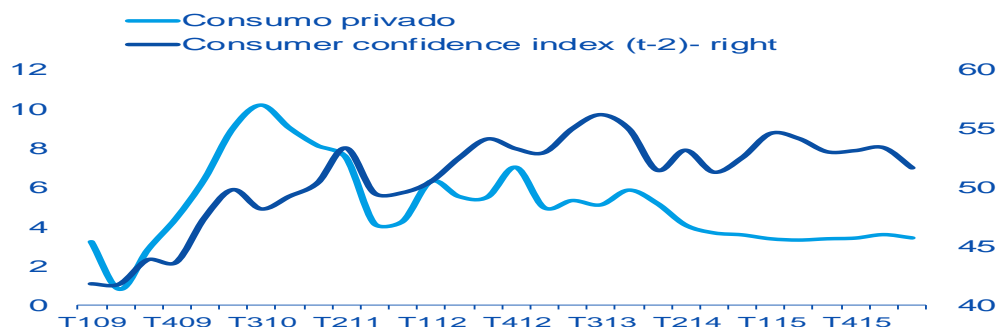

Source: BBVA Research

It is important to note that the IICG shows a better relationship with private consumption than consumer confidence (see Chart 4).

Figure 4

Private consumption and the consumer confidence index* (chg.% YoY & points)

*The Consumer Confidence Index considered was prepared by Apoyo Consultoría. When the index is above 50 points, confidence is within the optimistic tranche. The dynamic correlation analysis (for the period 2Q2003 - 2Q2016) reveals that there is a positive relationship between private consumption and the Consumer Confidence Index, reaching its maximum association (33%) when the confidence index is brought forward two quarters. Source: BBVA Research

The Index of Interest in Purchasing (IICG) improves the ability to predict private consumption

In order to evaluate whether the use of the IICG improves the predictive capacity of private consumption, three econometric models were considered (see Annex 2): one with ARMA specification (Reference Model), a consumption model based on disposable income[3] (Structured Model) and another that includes IICG information (Model with IICG). It was found that the predictive capacity of the model that includes the IICG is an improvement over the two other models proposed. As can be seen in Figure 1, the model that includes the IICG presents a lower mean square error (ECM) and a lower mean absolute error (EMA). Moreover, the R2 is higher in the model that includes the IICG.

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[3] Real GDP growth was considered as a proxy variable.

Table 1

| Indicadores	Modelo de referencia	Modelo Estructurado	Modelo con IICG [1]
Private consumption and the consumer confidence index* (chg.% YoY & points)			
R-squared	75	67	**81**
Errores de proyección [2]			
ECM	1.38	1.46	**1.07**
EMA	1.12	1.12	**0.66**

[1]. The IICG is added to the structured model. [2] Projection errors outside the sample were considered. Source: BBVA Research

Taking into account that the evolution of the IICG, it is consistent with a gradual recovery of private consumption at the beginning of 2017

Interest in purchasing, as measured by the IICG, has begun to slow down since 2013 (in line with the evolution of private consumption) and during the third quarter the indicator showed a slightly better performance. Taking into account that the time lapse between showing interest and purchasing is two quarters (as evidenced in the previous sections), the evolution of the IICG suggests that private consumption will show a moderate recovery at the beginning of 2017.

Figure 5

Private consumption: results of the model that includes the IICG (chg.% YoY)
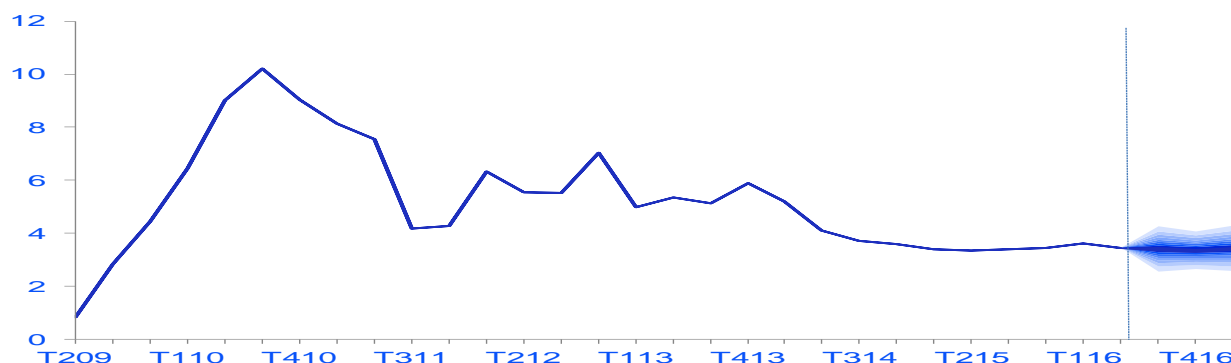
*Projection outside the sample.
Source: BCRP

Conclusions

The results found in the present document show evidence that Internet searches reflect the behaviour of some economic variables in Peru, such as household consumption. The importance lies in the fact that the information on Internet searches is in real time and is available long before the publication of official sources. Therefore, it is a valuable tool as a source of information for monitoring and projecting economic variables.

Information searches on the internet enable the short-term forecasting of private consumption. For this, a purchase interest indicator was constructed (IICG), via Google Trends, which anticipates the behaviour of private consumption by two quarters.

The index of purchasing interest (IICG) improves the ability to forecast private consumption An estimation was made using three econometric models: one with ARMA specification (Reference Model); one consumption model based on disposable income (Structured Model) and another that includes information from the IICG. It was found that the predictive capacity of the model that includes the IICG is better than that of the other two models.

Interest in purchasing, as measured by the IICG, has begun to slow down since 2013 (in line with the evolution of private consumption) and during the third quarter the indicator showed a slightly better performance. Taking into account that the time lapse between showing interest and purchasing is two quarters (as proved in the previous sections), **the evolution of the IICG suggests that private consumption will show a moderate recovery at the beginning of 2017.**

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Appendix 1: Construction of the Google Purchasing Index

To construct the Google index for Apartment Purchasing (IICDG), the five series obtained from the searches in Google Trends were indexed with the following phrases: "household appliances", "new cars", "department stores", "supermarkets", "employment"[4]. The selected series change - through simple averages - on a monthly or quarterly basis.

These changes are carried out to match the IICG's frequency with the series of private consumption (which is only available on a quarterly basis); then an analysis is conducted to determine whether there is a relationship between these two variables. Finally, the series was weighted by the inverse of their standard deviations to reduce the importance of their volatility and uncertainty in the IICG (for more detail see Appendix 1). The weighting process is shown below:

The first step for indexing was to calculate the standard deviation of each of the series that is represented by each one of the selected words. See equation 1 and 2, where σ_n represents the deviation of σ_n representa la desviación de n, being σ_n representa la desviación de n, siendo n one of the 5 series and σ_n representa la desviación de n, siendo n una de las 5 series y t one of the quarters.

$$\sigma_n = \sqrt{\frac{\sum_{t=1}^{T}(x_{tn} - \bar{x}_n)^2}{T - 1}} \qquad \forall \quad t = 1 \, a \, T \, , \qquad n = 1 \, a \, N \qquad (1)$$

$$donde \qquad \bar{x}_n = \frac{\sum_{t=1}^{T} x_{tn}}{T} \qquad (2)$$

Then, each weighting factor is calculated as the division of the inverse of the standard deviation of each series between the sum of the reciprocals of the standard deviations (equation 3).

$$\rho_n = \frac{\frac{1}{\sigma_i}}{\sum_{n=1}^{N}\frac{1}{\sigma_i}} \qquad (3)$$

From this, we get the sum product of the five initial series and their respective weights (equation 4).

$$\text{Índice\_ponderado}_t = \sum_{n=1}^{N} \rho_n x_{tn} \qquad (4)$$

Finally, for the construction of the IGCD, the scale changes to the calculated series in equation 4. To do this, the quarter that shows the greatest interest in purchasing an apartment is valued at 100.

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[4] Each series is seasonally adjusted.

Appendix 2: Projection Models

1. Estimated parameters, endogenous variable: private consumption (y_t)*

Variables exógenas	Modelo de referencia [1]	Modelo Estructurado [2]	Modelo con IICG [3]
Yt (-1)	0.90		
t-Statistic	8.8		
MA(4)	-0.91		
t-Statistic	-24.3		
Ingreso disponible		0.73	0.30
t-Statistic		9.29	4.46
IGCD [4]			0.14
t-Statistic			9.26
Constante	3.54	1.35	7.36
t-Statistic	1.70	2.72	8.42

1/. * The ARMA model specification considered Box-Jenkins methodology (the variables are stationary and the models have no autocorrelation or heteroscedasticity).
2/. Private consumption is modelled as a function of disposable income lagging over a quarter (GDP was considered as a proxy variable).
3/. The IICG is added to the structured model.
4/. The variable is lagging behind in two quarters. It is important to note that the last two models proposed were estimated using GMM (the lag in the variables was considered as an instrument).
Preparation: BBVA Research

2. Causality test like Granger[5]

Causalidad a lo Granger: IICG y el crecimiento del consumo privado*

Hipótesis nula	Probabilidad
a. IICDG no causa al consumo privado	0.00
b. Consumo privado no causa al IICG	0.14

*With a probability of 5% the null hypothesis is rejected. That is to say, the IICG is a variable that allows us to predict the growth of private consumption (the test was carried out with two lags and the null hypothesis "a" was rejected).
Preparation: BBVA Research

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[5] The Granger test analyses the relationship of causality between two variables, a different assessment to calculate only correlations. This test allows us to say whether a variable "y" is caused by another "x", i.e. if "x" helps to estimate and "y" predict. To that end, it evaluates if the coefficients of the lagged variable "x" are statistically significant when estimating "y". However, statement "x" causing "y" does not imply that "y" is the result of "x", because, in addition other factors outside of "x" intervene and affect "y". Sometimes, you can find a double Granger-causality: "x" causes "y" and "y" causes "x".

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