TRACKING THE FUTURE ON THE WEB: CONSTRUCTION OF LEADING INDICATORS USING INTERNET SEARCHES

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Abstract

This paper reviews some of the applications that use the vast swathes of information provided by Internet user searches for economic analysis and forecasting. This enormous volume of information, available in real time, can be handled by analysts thanks to statistical tools such as “Google Insights for Search”, which allow trends in different areas of interest to be classified and evaluated. Previous work focused predominantly on the labour market, on the housing market, on retail sales and on consumer confidence. This paper presents a very specific application for the Spanish economy: British tourist inflows to Spain (the Spanish tourist industry's main customers). The improvement in the forecasting provided by the short-term models that include the G-indicator depends on the benchmark model. This does, however, allow an adjusted indicator of the inflow of British tourists to be obtained with a lead of almost one month.

This is but an initial step in the use of on-line searches for constructing leading indicators of economic activity. Other applications to be explored are car sales, consumer confidence and house purchases. The chief characteristic of these procedures is that, with time and the continuous growth of Internet use, results can only improve in the future. It should nonetheless be recalled that the construction of these G-indicators requires caution so as to avoid mistakes arising, inter alia, from the different use of language in different countries. Not taking due caution and blindly confiding in these indicators may lead to erroneous results being obtained.

Keywords: Google, forecasting, nowcasting, tourism.

JEL classification: C22, C53, C82, E17, E37, L83.

Resumen

En este trabajo se revisan algunas de las aplicaciones que utilizan la vasta información proporcionada por las búsquedas realizadas por los usuarios de Internet para el análisis y la previsión económica. Este enorme volumen de información, disponible en tiempo real, es manejable para los analistas gracias a herramientas estadísticas como "Google Insights for Search" que permiten clasificar y evaluar las tendencias en distintas áreas de interés. Los trabajos precedentes se han centrado predominantemente en el mercado de trabajo, en los mercados de la vivienda, en las ventas minoristas y en la confianza de los consumidores. En este trabajo se ha presentado una aplicación muy específica para la economía española: los flujos de turistas británicos entrados en España —los principales clientes de la industria turística española—. Los modelos de corto plazo que incluyen el G-indicador mejoran la predicción en algunos casos, dependiendo del modelo que se tome como referencia. Permite, no obstante, obtener un indicador ajustado del flujo de turistas británicos con casi un mes de adelanto.

Este es solo un primer paso en la utilización de las búsquedas online para construir indicadores adelantados de actividad económica. Otros temas que podrían explorarse con esta herramienta serían las ventas de automóviles, la confianza de los consumidores y la compra de viviendas. La principal característica de estos procedimientos es que, con el tiempo y los continuos avances en el uso de Internet, los resultados no pueden más que mejorar en el futuro. No obstante es necesario recordar que la construcción de estos G-indicadores ha de ser cuidadosa con el objeto de evitar equívocos derivados, entre otros aspectos, del distinto uso del lenguaje en diferentes países. Ignorar estas cautelas y confiar de forma ciega en estos indicadores que no siempre mejoran la capacidad predictiva de los modelos de previsión a corto plazo más tradicionales puede llevar a la obtención de resultados erróneos.

Palabras clave: Google, predicción, turismo.

Códigos JEL: C22, C53, C82, E17, E37, L83.

1 Introduction

The popularity of the Internet has given rise to a whole range of new activities and has changed the way we go about traditional activities. We increasingly read the press online (a trend which has radically changed the traditional business model of newspapers), we look for medical information on the Web before –and after– seeing the doctor, we buy many products and services online (books, music, air tickets, etc.), we increasingly participate in social networks (Facebook has nearly 700 million users worldwide and Twitter has 175 million registered users), we write e-mails and we use the Internet in operations with banks and government, to speak on the phone or to watch TV. This multitude of activities leaves tracks on the Web, generating an enormous volume of information on products, people, institutions, purchase intentions, voting intentions, and so on. This is what has come to be known as **big data**, a body of information so extensive and varied that it cannot be processed by the software used in traditional databases.

This over-abundance of information in terms of both volume and areas of interest is giving rise to a number of developments. In the words of Gary King, the director of Harvard's Institute for Qualitative Social Science: "It´s a revolution, we are really just getting under way. But the march of quantification, made possible by enormous new sources of data, will sweep through academia, business and government. There is no area that is going to be untouched".[1]

The exploitation of the huge amount of information –often unstructured– in a systematic manner requires the massive use of text recognition technologies, in what is commonly known as "sentiment analysis". Its applications include, to mention just a few examples, the design of new strategies to create value for companies,[2] the New York Federal Reserve's initiative to promote an application for tracking opinions expressed in social networks,[3] or the harnessing of its potential as a prediction tool in the analysis of public health, development economics[4] or economic activity.

The present study falls into this area. It follows the line of research initiated by Choi & Varian, based on "Google Insights for Search", a statistical tool designed by Google which allows the searches made by Internet users to be analysed from different standpoints. It marks a first step in the analysis of the huge mass of information on the Web concerning the Spanish economy. This article reports a specific application –UK tourist inflows– illustrating the possible use for predicting demand and activity variables in Spain. The ongoing expansion of Web-related activities means that the predictive power of present-day results can only improve in the future.

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1. The New York Times, 11 February 2012.

2. See "Big Data: The Next Frontier for Innovation, Competition and Productivity", McKinsey Global Institute, May 2011.

3. Sentiment Analysis and Social Media Monitoring Solution RFP. Federal Reserve of New York. The declaration of intent states that: "*Social media platforms are changing the way organizations are communicating to the public. Conversations are happening all the time and everywhere. There is need for the Communications Group to be timely and proactively aware of the reactions and opinions expressed by the general public as it relates to the Federal Reserve and its actions on a variety of subjects*".

4. Global Pulse is a new United Nations initiative which monitors social networks to detect risk situations of different types in developing countries.

Box 1. Other uses of information available on the Web

The last few years have brought developments in different areas which share the common characteristic of exploiting the vast amount of information available on the Web. This box describes the main new developments known to us.

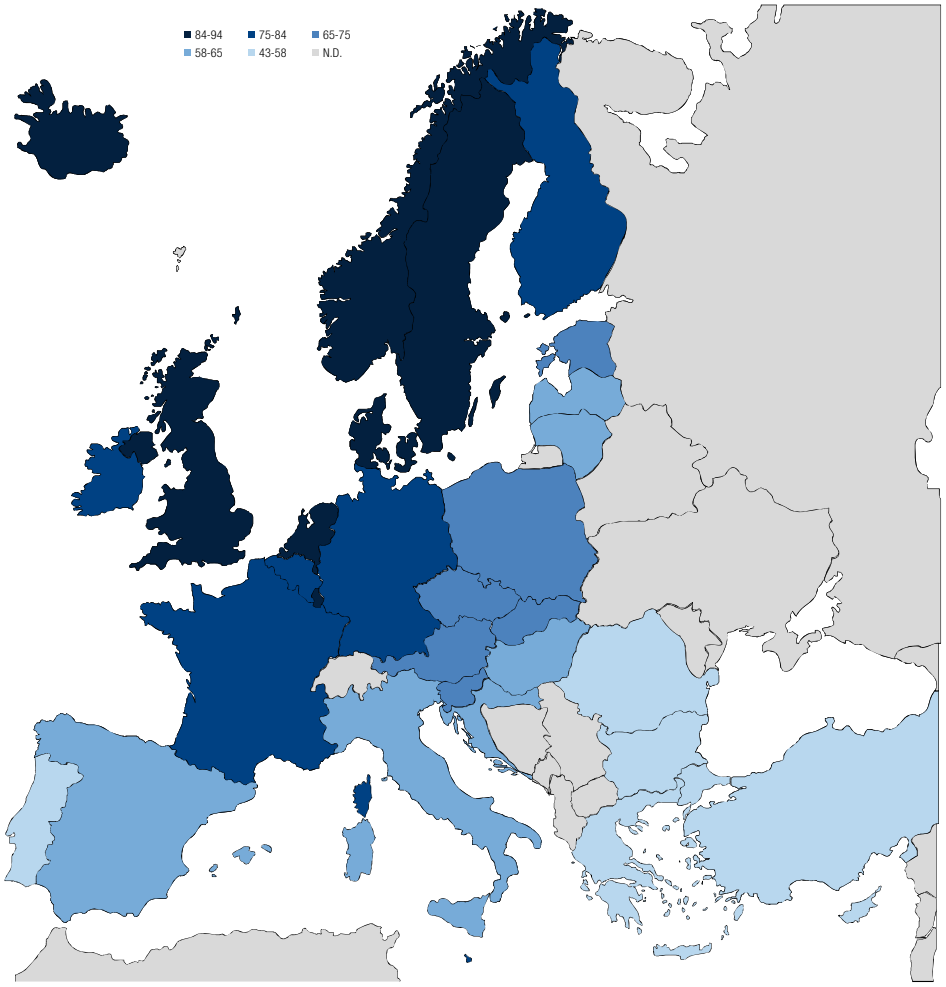
1. Confidence indicators based on people's sentiment as reflected in **Twitter** messages. This line of research includes work on the prediction of stock market performance in "Twitter mood predicts the stock market", Bollen, J. et al. (2010) and the construction of confidence indicators —based on semantic analysis of tweets— which lead the message contained in survey-based conventional confidence indicators, reported in ¨From Tweets to Polls: Linking Text Sentiment to Public Opinion Time Series¨ O´Connor, B. et al. (2010). A more recent reference to this research can be found in the Economist (June 2011) in the article "Can Twitter predict the future?".
2. Another line of research which exploits the information available on the Web is the "**Billion Prices Project**", which generates daily inflation indicators based on prices gathered from corporate websites. This project, commenced in Argentina in 2008 by Cavallo, A. and Rigobon, R., was greatly expanded to give rise to the company PriceStats, founded in 2011, which sells reports on the prices of more than five million products in 70 countries.
3. A third group of projects, based on the software company **Recorded Future**, combs the Web for information from various sources, including traditional news media, new forms of communication such as blogs and social networks, and government reports. The large-scale processing of these records allows probabilities to be assigned to future events with different time horizons. The company's products are on sale on its website.

The article is organised as follows. Section 2 describes the main activities of Internet users, focusing on the search for information about goods and services and on how these searches lead to purchases either online or in traditional establishments. Section 3 reviews the studies in which **big data** is used to construct leading indicators in many areas ranging from the early detection of non-seasonal influenza to forecasting house prices or unemployment and the prediction of mortgage foreclosures. Section 4 describes an application to the Spanish economy: forecasting UK tourist inflows. Finally, Section 5 draws some conclusions and proposes follow-up projects.

2 Penetration and use of the Internet in Europe

The importance of the Internet in people's daily activities has increased exponentially in recent years. Since 2002, Eurostat has conducted an annual survey on Internet access and use by European households.5 The most recent of these surveys, that for 2011, shows that the fraction of the adult population (aged 16 to 74) without any contact at all with the Internet (so-called *digital exclusion*) decreased drastically from 42% in 2006 to 24% in 2011. The European digital agenda for 2015 sets a level of *digital exclusion* not exceeding 15% of the adult population. Some member countries of the EU27 already comfortably meet this objective (the percentage of the population excluded from the digital world is only 5% in Sweden, 7% in the Netherlands and 11% in the UK). Focusing on the four large continental countries in the EU27, Germany with 16% of its population excluded and France with 18% excluded are close to the objective set for 2015. However, in 2011 Italian and Spanish households excluded from the digital world still accounted for a sizeable fraction of the population: 39% and 29%, respectively.

HOUSEHOLDS WITH INTERNET ACCESS (%) 2011 CHART 1



SOURCE: Eurostat.

5. "ICT usage in households and by individuals". Eurostat.

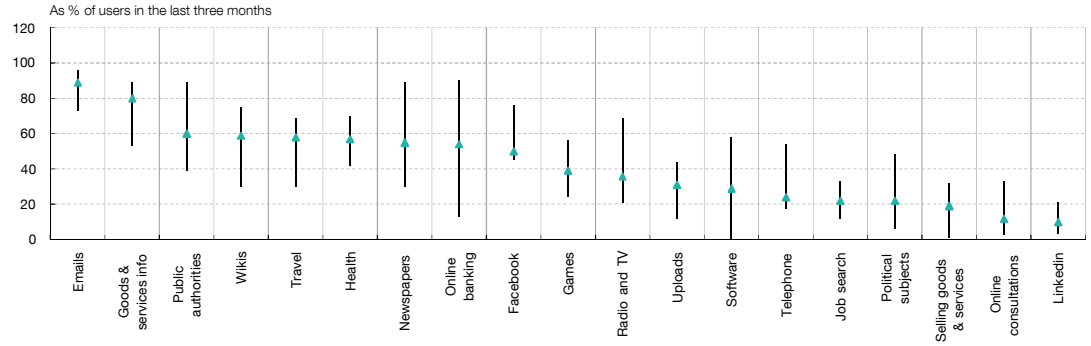
In 2011, 73% of European (EU27) households had access to the Internet, compared with 41% in 2004. The number of households with broad-band connection more than doubled between 2006 and 2011, by which time the proportion of households with access had risen to 68%.

Although these advances took place in all countries, Internet penetration in European households continues to be very uneven (see Chart 1). The most advanced countries, with more than 90% of households connected to the Internet, are the Netherlands (94%), Denmark (90%) and Sweden (91%). At the opposite extreme, with a coverage below 50%, are Bulgaria, Romania and Greece.

2.1 What activities are carried out by users?

The Eurostat survey on Internet usage allows us to analyse which are the most popular activities among users (see Chart 2). The top activity in all countries involves communication: 89% of users in euro area countries account on the Internet to send or receive messages. The differences in e-mail usage between countries are small. Notably, the second most common activity is searching for information on goods and services, selected by 80% of respondents. A second group of activities, carried out by nearly 60% of users, involves interacting with public authorities (60%), consultation of "wikis" to obtain information on different subjects (59%), accommodation and travel (58%) and seeking health information (57%).

INTERNET ACTIVITIES (a) CHART 2

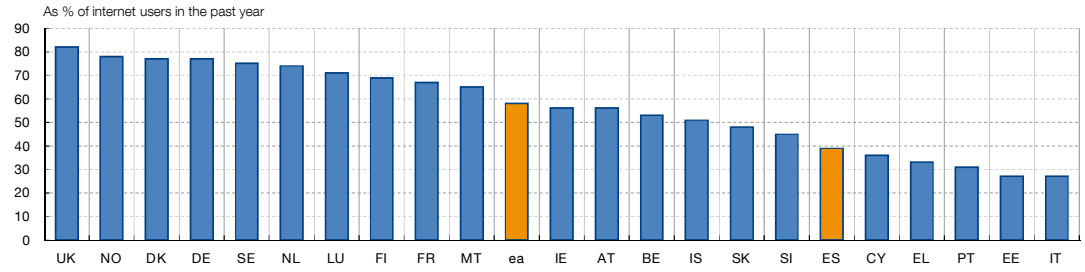


SOURCE: Eurostat.

(a) The countires included are the seventeen euro area countries + Denmark (DK), Sweden (SE), Norway (NO), Iceland (IS) and the United Kingdom (UK).
The vertical bars show the dispersion of the values in the 22 countries examined.

Around 55% of euro area users read the press online and do their banking through the Internet. In both cases the dispersion among countries is very large. For example, online banking is performed by more than 80% of users in Scandinavia (Norway, Denmark, Estonia, Finland and Sweden) and by only 13% of Greek users. Regarding the press, the inhabitants of Scandinavia are again notable as the most avid readers of the online press (more than 85% of users), whereas only 30% of the French and 39% of the Irish use this information channel. Half of European users participate in social fora (facebook, twitter, etc.), the use of which is fairly even across all countries and somewhat higher in Scandinavia. The popularity of other activities is much lower at 40%, and the variability between countries rises notably.

ONLINE CONSUMERS CHART 3



SOURCE: Eurostat.

The Eurostat survey includes a separate section to assess the impact and characteristics of electronic commerce. In 2011, 58% of Internet users declared they had shopped online in the previous twelve months. The differences between countries are considerable (see Chart 3). Most notable is the United Kingdom, where the popularity of online purchases exceeds 80% of users, followed by Denmark and Germany (77%) and Sweden (75%). At the opposite extreme are Italy and Greece, where electronic commerce extends to only 30% of users. Spain stands below the average, with 40% of users.

2.2 What do Europeans buy on the Web?

Table 1[6] shows the distribution of Internet sales in the euro area, along with the highest and lowest values and the figures for Spain. The most common Internet purchases are books, music, films and software. Overall, one-third of Internet users purchased one or more of these products in 2010. 30% purchased trips or made hotel reservations, 27% bought clothes or sport goods and 20% purchased tickets for concerts, theatre, cinema, etc.

ONLINE SHOPPING (as % of internet users in the past year) (a) TABLE 1

	Euro area	Max.	Min.	Spain
Films/music or books, magazines, e-learning material, software	33	56	9	13
Holiday travel and accommodation	30	53	9	23
Clothes, sporting goods	27	68	7	10
Tickets for events	20	51	2	15
Household goods	19	34	2	7
Films/music or books, magazines, software, either delivered or updated online	16	33	3	7
Electronic equipment	14	27	4	7
Computer hardware	12	19	2	6
Pharmaceutical products	7	20	0	0
Food	6	19	1	4
Other	6	26	1	6
Shares, financial services or insurance	4	16	1	2

SOURCES: Eurostat and Banco de España.

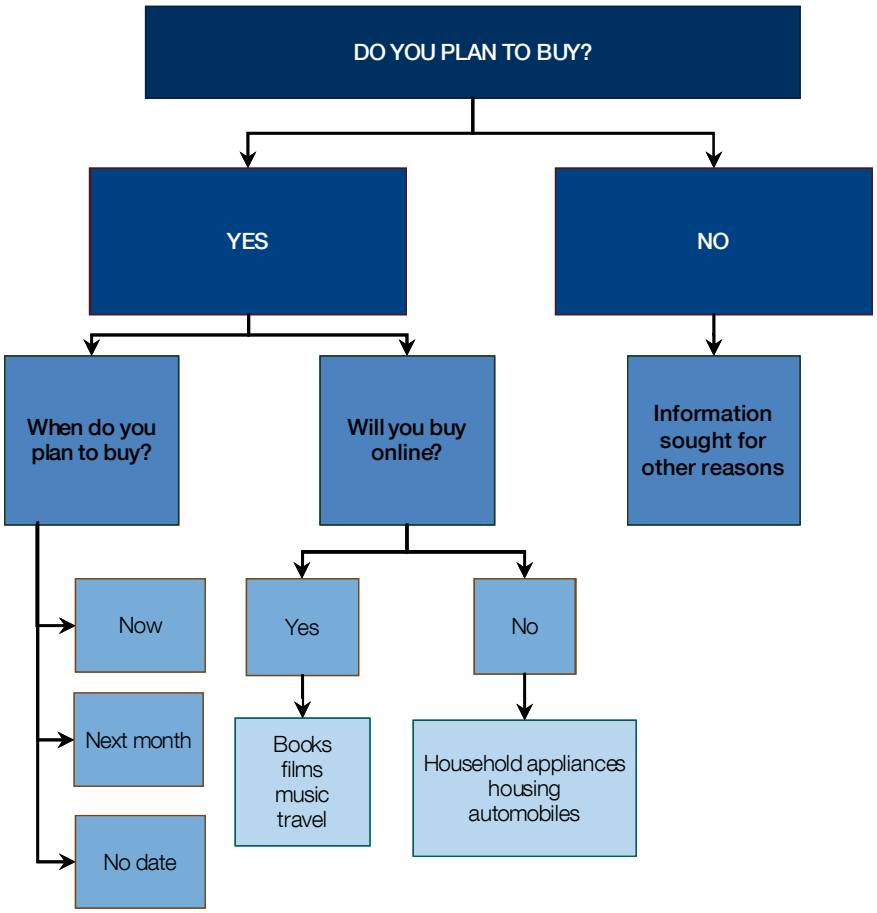
a. The countries included are those listed in Chart 2.

6. The Eurostat survey naturally allows multiple answers, i.e. interviewees have to select all the categories corresponding to the purchases made by them.

2.3 Online searches and purchases

Given that one of the most popular activities of users is searching for information on goods and services, the next question is what fraction of these information searches results in actual purchases. It can be expected that some of the searches on a given product seek to gather information with a view to buying it. Sometimes that purchase is made simultaneously with the search for information (e.g. buying music or books). It may even be the case that online purchases are not preceded by a Web search (e.g. ticket purchases). In other cases, particularly when shopping for consumer durables of some importance (e.g. house, car or domestic appliance purchases), the most usual behaviour is an online search to compare products, prices and suppliers and subsequently make the purchase in a traditional establishment. For example, it does not seem very common to purchase a car online, because of the need to try it out first. It is, however, very common to search for information on the Web weeks or months before buying a car. The time lag between gathering online information about cars and the actual purchase offline provides the opportunity to build a leading indicator of car sales, which should be further researched. Chart 4 summarises the various possible cases discussed here.

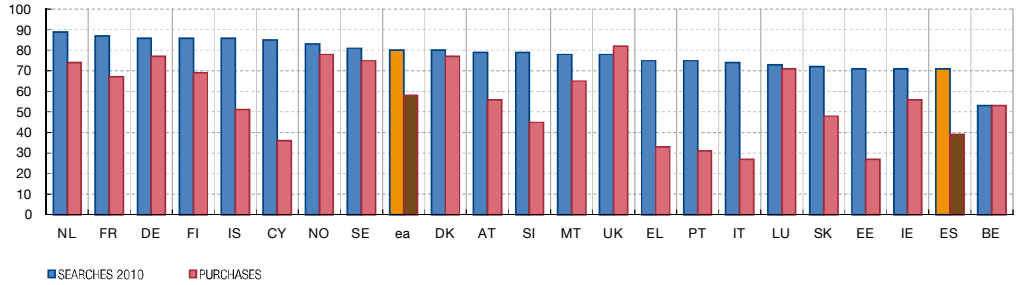
SEARCH FOR INFORMATION ON GOODS AND SERVICES ON THE WEB CHART 4



SOURCE: In-house preparation.

At an aggregate level, the relationship between the search for goods and services and their purchase is not very high (see Chart 5): whereas, as mentioned in the previous section, the preference for searching for information on products is fairly prevalent in all countries, there are large differences between countries in the propensity to make online purchases.

ONLINE SEARCHES AND PURCHASES (a) CHART 5



SOURCE: Eurostat (2010 Survey).

(a) Searches measured as % of internet users in the previous three months; purchases as % of users in the past year.

3 Construction of leading indicators from users' searches

The launch of the tool known as Google Insights for Search (GIS)[7] allows us to use the enormous amount of information on Internet users' searches to construct leading indicators in different areas of knowledge. Box 2 summarises the basic ideas of this tool. A more detailed description is available at http://www.google.com/insights/search/#

Box2. Basic ideas of Google Insights for Search (GIS)

This box sets out the basic ideas behind the Google Insights for Search (GIS) tool.

- GIS analyses a random **sample** of searches by users, rather than the total population of searches.
- The indices generated by GIS represent the popularity of the searches for a term with respect to the total searches in a certain geographical area and time period measured in relative terms. The time series generated by GIS do not therefore provide absolute numbers of searches, but rather a relative frequency of them. For example, if the search term **tea** is entered, with the location parameter set as **Scotland** and the time parameter as **March 2007**, the GIS indicator gives the popularity of this term among users in Scotland in March 2007 –for a sample of searches– in comparison with the searches for all terms in Scotland in March 2007.
- The indices are **normalised on a scale from 0 to 100** by dividing the relative popularity at any time t by the maximum in the reference period. The frequency is weekly.
- To preserve the quality of the indicators, GIS establishes a **minimum traffic threshold** below which the index is set at 0. Also, to prevent artificial manipulation by users, GIS **deletes repeat searches** by the same user in a short space of time.
- The scope of the search can be defined in terms of various parameters: geographical area, time period (from 2004) and search category, in certain languages only (English, German, Italian, Japanese, Russian, Swedish and Polish). In December 2011, categories became available also in Spanish, Arabic, Slovenian and Turkish, among other languages.
- The searches are classified in categories which assign the searches to certain industries or markets. There are 27 categories at the top level and **241 sub-categories**. This classification is done automatically by a natural language processor (semantic orientation device). For example, the category Autos & Vehicles comprises 21 sub-categories, including: Automotive Industry, Bicycles & Accessories, Boats & Watercraft, Motorcycles, and Vehicle Shows.
- GIS is freely available for the general public.
- **Caution should be exercised in some respects**.
  Each time GIS is used to analyse the relative popularity of a term, GIS selects a new random sample. The new sample is stored in Google's servers for one day; this

7. Some sources also refer to this tool as Google Trends, which was its original name. Google Insights for Search is a more complete version of the original one.

means that the index may vary from one day to the next, although the variations do not seem to be particularly significant.

It is important to check that the search index is providing the information actually desired. The tool should not be used in a purely mechanical manner at the risk of obtaining meaningless results. For example, suppose we are interested in knowing the countries where there is relatively high interest in travelling to Spain. A search would be done for the word "Spain" in the Travel category. Where is there greatest relative interest in travelling to Spain? GIS tells us that Ireland is the country with the highest proportion of Internet searches about travelling to Spain (normalised to a value of 100 for the average 2004-present), followed by the United Kingdom with a value of 84. The third country is Trinidad and Tobago, with a value of 64, which seems surprising at first, until we realise that the capital of Trinidad and Tobago (one of the few Caribbean countries where English is spoken) is Port of Spain.

3.1 Pioneering work: flu and unemployment

One of the ground-breaking studies was in the field of epidemiology. Ginsberg, J. et al. (2008) analysed the millions of searches on non-seasonal flu outbreaks and their relationship with visits to the doctor. The study estimates fairly accurately the level of weekly influenza activity in each region of the United States and generates indicators which, with reporting lag of only one day, are available earlier than more conventional statistical information, allowing earlier and more effective treatment of the illness.

Among the early applications in the field of economics are the studies of Choi and Varian "Predicting the Present with Google Trends" and "Predicting Initial Claims for Unemployment Benefits", both published in 2009 in the Google research blog. Google user searches allow information to be gathered in real time on the behaviour of consumers in different markets. Specifically, the work analyses how Google Trends allows improved short-term predictions of **retail sales, automotive sales, real estate market activity and travel**. In many cases the prediction obtained using conventional models can be improved by the inclusion of time series of the Google Trends index. The strategy in each of these applications is as follows:

- Adjust the best possible forecasting model using the usual statistics, including the lagged endogenous variable (Model 0 in the aforementioned studies).

- Add the Google Trends index as an additional explanatory variable (Model 1 in these studies).

- Assess the improvement in the predictions. This is typically done through the mean absolute error (MAE) of the out-of-sample predictions using a rolling window forecast.

To what extent does this procedure enable the predictions of conventional short-term models to be improved?

The results vary from case to case. In some the improvement is small, while in others it is substantial. For example, in automotive sales the gain obtained by including a Google search indicator is 18% over a conventional model. By contrast, in the same work Choi & Varian report the results of including Internet searches to obtain more accurate predictions of Ford automobile sales. The results are, in this case, poor, yielding an improvement of only 3% over the alternative model. With a similar methodology, Choi & Varian estimate an improvement of 15% in predictions of claims for unemployment benefits when they include an indicator based on Google searches for terms relating to unemployment.

3.2 Other fields of application: housing markets, unemployment rate, consumer confidence

Subsequently, numerous studies have used this tool in different activities and geographical areas. Chamberlin (2010) explored the construction of indicators of retail sales, property transactions, car registrations and foreign trips based on online searches in the United Kingdom. Bughin (2011) carried out a similar exercise for the Belgian economy and found that an increase of 10% in the intensity of searches for terms relating to purchases gave rise to an increase of 2% in the sales figures for the quarter in question. In the case of unemployment, an increase of 10% in searches was associated with an increase of 1% in the number of unemployment claims.

One of the most common lines of research seeks to use this technique to improve the prediction of unemployment. D´Amuri & Marcucci (2009) found that unemployment rate predictions in the United States improved enormously when an indicator based on Internet searches was included. Askitas & Zimmermann (2009) report that unemployment rate predictions in Germany improve when the model includes the online job searches made in the last two weeks of the preceding month. Fondeur & Karamé (2011) found that the inclusion of online searches produced gains in unemployment predictions that depended on the age group: the accuracy of predictions increased by around 20% for young people aged between 15 and 24 years old and by 18% in the group aged between 25 and 49, while for those aged over 50 the statistical evidence did not yield a conclusive result.

Wu & Brynjolfsson (2009) and Webb (2009) apply the indicators generated by Google to the US housing market. The first of these studies focuses on forecasting prices and sales volumes in the housing market, the second on the mortgage market where it analyses the strong correlation between the key word “foreclosure” and eviction statistics. A line of research which is beginning to become common is the construction of confidence indicators. Della Penna and Huang (2009) construct a consumer confidence indicator based on the relative popularity of certain searches (such as bankruptcy, office furniture or luxury goods) which is available earlier than conventional confidence indicators based on surveys and improves on them in private consumption forecasts in the US economy.

In short, insofar as the reality of a country is reflected in online searches by its citizens, the aggregate information from these searches allows a whole series of real-time indicators of present and future economic situations to be constructed, which may be useful for central banks when they make economic predictions. This is the idea behind the recent study published by the Bank of England[8] where, after exploring the potential of search-based indicators for the UK labour and housing markets (with better results for

8. “Using Internet search data as economic indicators” QB 2011Q2.

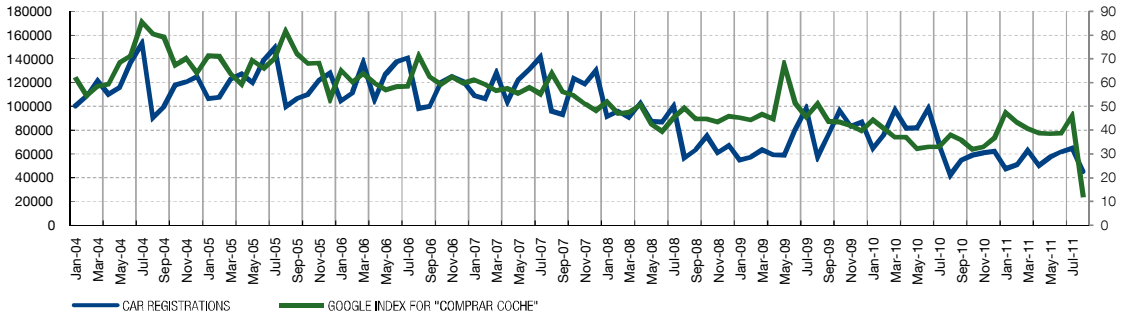
the latter), the conclusions state that the bank "*will continue to monitor these data as part of the range of different indicators it considers in forming its view about the outlook for the economy of the UK*".

More recently, the New York Federal Reserve has published in its blog an article entitled "Forecasting with Internet Search Data" which explores the possibility of applying Internet searches to present and future financial market developments, specifically in the mortgage market, and to expectations of appreciation/depreciation of the renminbi.

4 An application to the Spanish economy: tourist inflows

On considering the use of this tool for the Spanish economy, several options arose; specifically, the labour market appeared to be a promising field of research work where, moreover, we could follow the lead of papers written in other countries. Further, following the schema of Chart 4, *Google Insights for Search (GIS)* allows the construction of leading indicators of the purchase of consumer durables and of certain services, insofar as these purchases are preceded on many occasions by Internet searches.[9] For instance, the relationship between searches for the term "comprar coche" (buy car) and new car registrations by individuals can be analysed (see Chart 6). However, there were three reasons that led us to explore the potential of this tool in forecasting foreign tourist inflows. The first is purely technical; when this project began (in July 2011) the categorisation of searches was not available in Spanish (see Box 3)[10], which led us to look for an application in which the non-existence of categories in Spanish was not an obstacle. This gave rise to the idea of analysing foreign tourist flows. The key search languages chosen were English, German and French, languages for which GIS did categorise searches. The application of online searches to tourism was a practically unexplored field, with the exception of the above-mentioned paper by Choi & Varian.[11]

ONLINE SEARCHES FOR "COMPRAR COCHE" (buying car) CHART 6



SOURCES: ANFAC and Google Insights for Search.

Secondly, tourism is one of the most Internet search-intensive activities, both for obtaining advance information on destinations and packages, and for the online purchase of such trips. Accordingly, search statistics might provide most valuable –and possibly leading– data on the future trajectory of tourist flows.

9. It is also a useful instrument for detecting real-time developments in respect of other consumer products where there is no time lag between search and purchase, e.g. books, music, etc.

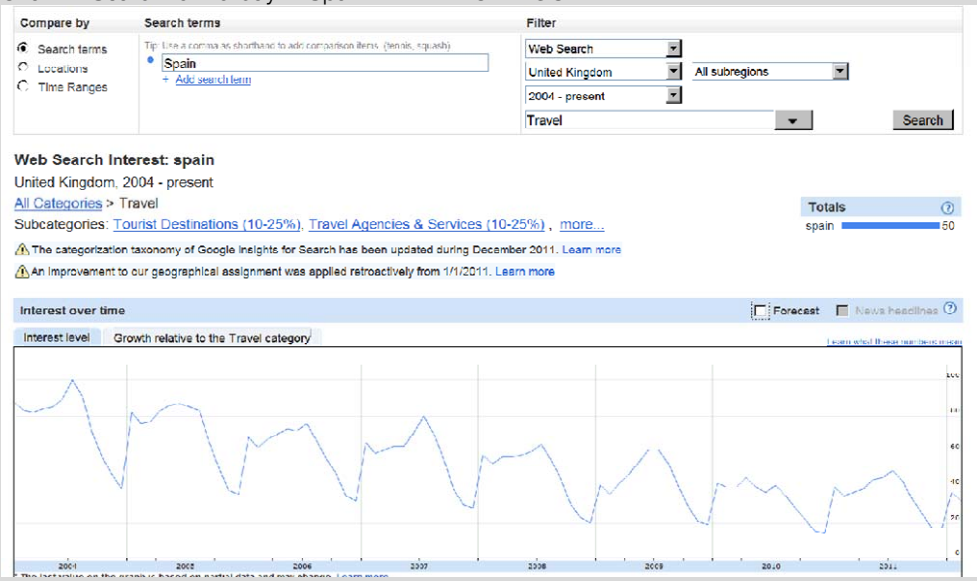
10. The categories are not vital, although they do enormously simplify the initial phases of the analysis.

11. In January 2012, BBVA presented a tourism indicator also based on Google. So far, information relating to the models used is not available.

Box 3. Category-based searches

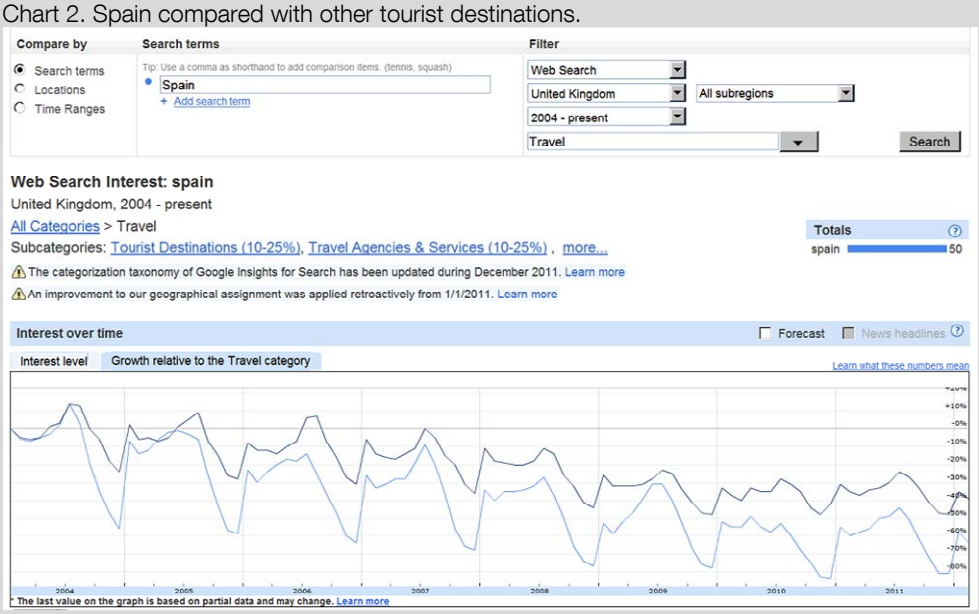
Alternatively, the automatic categorisation provided by GIS can be used, searching for the term "Spain" within the travel category (see Chart 1). The diminishing trend of the searches is confirmed, a trend more marked than when the searches are made on the basis of a manual search for terms relating to "holiday Spain". GIS generates additional information when the searches are made within a specific category: it shows the interest in the search term relative to its category. In this case it compares the relative interest in travelling to Spain with that of travelling to any other place (see Chart 2). The popularity of travel searches has fallen by 26% since 2004, and the relative popularity of trips to Spain has declined by around 50%.

Chart 1. Search for holiday in Spain. TRAVEL CATEGORY.



Source: Google Insights for Search.

Chart 2. Spain compared with other tourist destinations.



Source: Google Insights for Search.

Finally, the interest in analysing tourist flows is fully warranted given the major contribution by the tourist industry to the national economy. Spain is not only one of the world's main tourist destinations (fourth in terms of the number of tourists and second in terms of tourism receipts) but is also the developed country with the greatest dependence on tourism in the world (see Table 2).

TOURISM IN SPAIN, IN PERSPECTIVE TABLE 2

	International arrivals (million) 2010	Tourism receipts ($bn) 2010	Tourism as % of GDP 2009	Tourism as % of employment 2009
France	76.8	46.3	3.7	na
United States	59.7	103.5	2.6	na
China	55.7	45.8		
Spain	52.7	52.5	10.7	12.7
Italy	43.6	38.8	4.8	9.7
United Kingdom	28.1	30.4	2.7	na
Turkey	27.0	20.8		
Germany	26.9	34.7	3.2	na
Malaysia	24.6			
Mexico	22.4			

SOURCES: World Tourism Organisation (2011) and OECD (2010).

The main clients of the Spanish tourist industry are the United Kingdom, Germany and France (see Table 3). Since peaking in 2007, tourist inflows have fallen by 3%. The fall in British tourists since 2007 has been the biggest (16%). The reduction in tourists from Germany and France has been much smaller, 10% and 6%, respectively. The number of tourists from other European countries has also contracted to a greater or lesser extent, with the exception of the Scandinavian countries (Denmark, Finland, Norway and Sweden), whose Spain-bound tourists have increased by 13% over the period, and Russia, whose numbers more than doubled between 2007 and 2010, although their actual scale is still small (850,000 people in 2011). Tourism from the rest of the world brought 4.8 million people to Spain in 2011, partly offsetting the fall-off in tourist flows from most of the European countries.

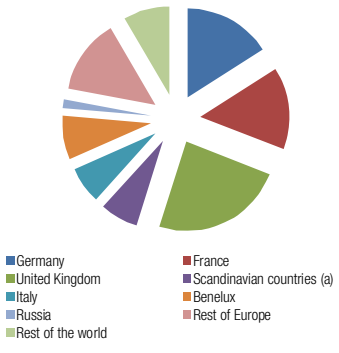
TOURIST INFLOWS BY COUNTRY OF RESIDENCE TABLE 3

	2007	2011	2011	2011/2007
Germany	10.1	9.0	17%	-10%
France	9.0	8.5	16%	-6%
United Kingdom	16.3	13.6	26%	-16%
Scandinavian countries (a)	3.4	3.9	7%	13%
Italy	3.6	3.8	7%	4%
Benelux	4.2	4.6	9%	8%
Russia	0.4	0.9	2%	101%
Rest of Europe	7.8	7.7	15%	1%
Rest of world	3.7	4.8	9%	28%
DE+UK+FR	35.4	31.1	59%	-12%
Total	58.7	56.7	100%	-3%

SOURCE: IET.

a. Scandinavian countries: Denmark, Finland, Norway and Sweden.

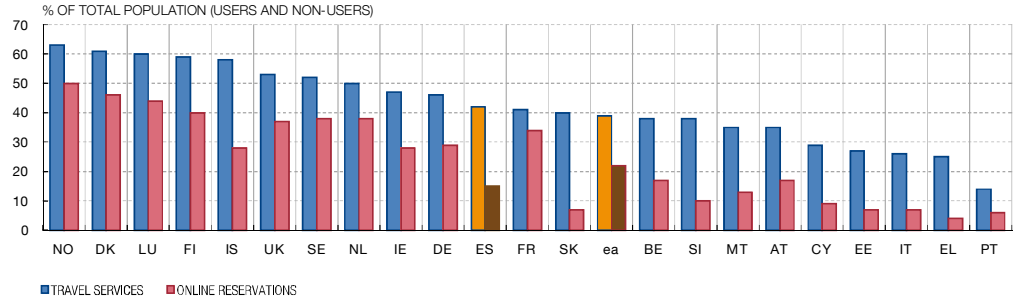
Tourists 2011



4.1 Applying Google Insights for Search (GIS) to tourist flows

According to the EU Survey on Information and Communication Technologies (ICT) usage in households and by individuals[12], 39% of residents in the euro area engage in online activities related to travel, while 22% make online purchases of this type of service. The gap therefore stands at 17 pp.[13] The size of this discrepancy varies greatly from one country to another (see Chart 7), although the two statistics offer a similar message: the correlation between them is 0.903. The biggest deviations are found in Iceland (one of the countries where Internet access and use is most entrenched), more than 58% of whose citizens inform themselves online, but where scarcely 28% of them purchase trips online. Other countries where the gap is relatively wide are Slovenia, Slovakia and Spain. The reasons behind the greater discrepancy in these countries might be due to users' scant trust in online security when making purchases or to the lesser development of online sales by companies operating in the European Union, or perhaps to both, since these two obstacles feed off each other.

TRAVEL SERVICES AND ONLINE RESERVATIONS (a) CHART 7



SOURCE: Eurostat (2010 Survey).

(a) Travel services include the use of the Internet to gather information and to buy goods and services relating to holiday travel/accommodation. Online reservations comprise those made in the past 12 months.

Since 2009, the European Commission has been making a specific survey on tourism ("Survey on the attitudes of Europeans towards tourism"). It covers detailed information on Europeans' travel uses and practices, including: the method of transport used on holidays, the associated financial aspects, their favourite destinations, their plans for forthcoming holidays or the reasons why they did not take holidays the previous year.[14] According to the survey, the percentage of the population who browse Internet as the principal source of tourist information has increased by 6 pp, from 38% in 2009 to 45% in 2011,[15] standing only second behind recommendations from friends and colleagues (the favourite source for 58% of Europeans) and well ahead of personal experience (21%) and

12. The survey is targeted at households where at least one person is aged between 16 and 74 and at individuals in the same age bracket. Households are asked about Internet access by any family member living in the family home. The questions to individuals include frequency and place of access, activities performed and their skill in performing them. The sample for EU 27 in the 2011 edition of this survey covers close to 150,000 households and more than 200,000 individuals.

13. It is not suggested that the second variable is a sub-set of the first one; the sizes of the two groups are simply being compared.

14. Interviews are by telephone in most cases. The sample comprises 30,000 people aged over 15 and who reside in the EU 27 countries, Croatia, Turkey, Macedonia, Norway and Iceland.

15. Note that these figures are consistent with the EU Survey on Information and Communication Technologies (ICT) usage in households and by individuals.

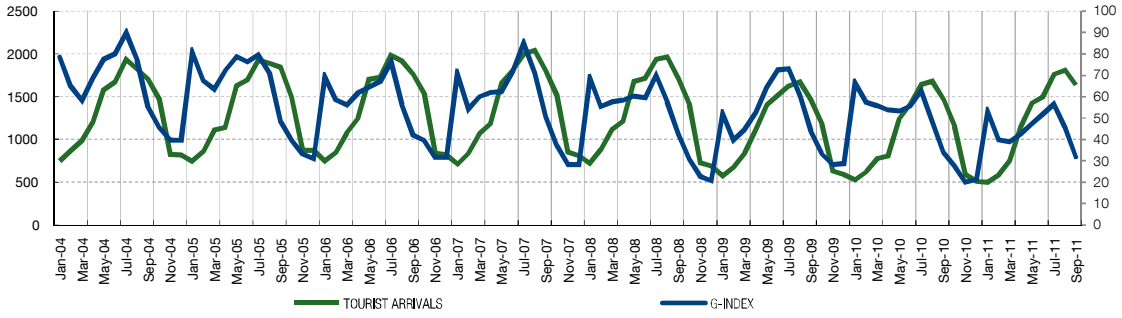
traditional travel agencies (21%).[16] In sum, almost half of European citizens seek information on travel and holidays primarily on the Internet. This vast swathe of information on potential trips is the substrate on which it is intended to compile an indicator on the interest in travelling to a specific location, with a specific application for trips to Spain.

To illustrate the potential of this tool, but also the caution with which it should be used, the discussion below focuses on the sub-group of British travellers seeking holidays in Spain. The British are the main customers of the Spanish tourist industry, and they also lead the way in Internet use in Europe; accordingly, they are ideal to use as an example in the construction of a leading indicator of tourist inflows.

The starting point is searches made from the United Kingdom for the term "Spain holiday".[17] The relative interest of British citizens has fallen almost continuously since 2004. In July 2011, the search indicator showed a value of 63, in relation to the peak of 100 in July 2004, down 37%. To correctly interpret these figures it should be recalled that what is involved is a ratio of the searches for the term "Spain holiday" to the total searches of all types made by Britons. In short, the decline seen simply reflects the fact that all other searches have grown more than searches for holidays in Spain.

As earlier indicated, inflows of British tourists into Spain have declined by 9% between 2004 and 2011. The path of the two series is not very different (see Chart 8) and the G-index appears to lead tourist arrivals by a couple of months.

BRITISH TOURISTS AND GOOGLE SEARCHES CHART 8



SOURCES: IET and Google Insights for Search.

The high correlation between the two series largely reflects their strong seasonal component, although a reasonable correlation persists when these are calculated on the basis of the seasonally adjusted series. The biggest inflows of British tourists are in July and August, the flow diminishes slightly in September, somewhat more in October, and reaches its minimum point between October and January. This strongly seasonal nature appears to have become more acute in recent years as a result of a greater decline in tourism outside the

16. Other sources of information are much less popular: non-commercial brochures, e.g. of official tourist offices (13%), travel guides (13%) or conventional media.

17. Alternatively, the exercise can be conducted using the term "Spain" and browsing solely under the travel category. The results, which are very similar, are presented in Box 4.

July-August season.[18] This greater concentration of tourist arrivals in mid-summer appears to be caused by the persistence of the economic crisis that has led Britons to reduce their holiday trips abroad. Internet searches for trips to Spain reflected in the Google indicator also show highly marked seasonality, with July and January proving to be the most dynamic months in terms of holiday searches. November and December evidence the least activity. The seasonal patterns are fairly similar with the exception of January, when tourist inflows are at a low although Web searches are significant. The correlations (see Table 4) are calculated for the series of British tourists and the coincident G-indicator, and with up to six lags.[19] With the raw series, the highest correlation occurs with lag 2, i.e. between the searches in a given month and incoming visitors two months later; however, for the seasonally adjusted series the highest correlation is the coincident one.

CORRELATION BETWEEN BRITISH TOURISTS AND THE SEARCH G-INDEX (a) TABLE 4

	G-Index lags						
	0	1	2	3	4	5	6
Original data	0.42	0.67	0.72	0.56	0.31	0.00	-0.25
m-o-m rates	0.00	0.32	0.40	0.22	0.31	-0.12	-0.06
Y-o-y rates	0.41	0.32	0.22	0.33	0.10	0.19	0.17
Seasonally-adjusted	0.61	0.59	0.57	0.58	0.59	0.61	0.63

SOURCES: IET and Google Insights for Search.

a. Seasonally adjusted series using Tramo-Seats.

Table 5 summarises the results of the estimates made. Panel 1 compares a very simple ARIMA model that normally shows good forecasting properties with the same model augmented with the coincident G-indicator[20] for the series of British tourists. The mean of forecasting errors improves by a far-from-negligible 18%. Nonetheless, this gain is cancelled out if the comparison is made with a second, more synthetic ARIMA model in which the regular component, which is non-significant in the first estimate, is set at zero. In this case the average error is not significantly different from that obtained in the synthetic ARIMA model selected by TRAMO.

18. The Max/min ratio, measured by the ratio of travellers arriving in July or August to those arriving in January, rises from 2.5 in the initial years to 3.5 in the last two years.

19. The search series provided by Google are weekly. They have been inter-periodically allocated in monthly terms bearing in mind the number of weeks in each month so as to be able to compare them with the monthly tourist series.

20. Initially, the G-indicator with up to six lags was also included; however, none of these proved significant.

SIGNIFICANCE OF THE BENCHMARK MODEL (a)
ARIMA models for British tourists (b)

TABLE 5

Panel 1: MA(1)*MA(12) model and MA(1)*MA(12) model augmented using Google Index

Models estimated by maximum likelihood.	θ	Θ		Standard error of residuals	AIC	BIC	Out-of-sample MSE
Est	-0.12	-0.40		51.8	509.4	8.1	0.5131 E+04
SE	0.15	0.19					

	θ	Θ	G	Standard error of residuals	AIC	BIC	Out-of-sample MSE
Est	-0.17	-0.28	10.20	49.4	504.8	8.1	0.3961 E+04
SE	0.16	0.18	3.83				

Panel 2: MA(12) model and MA(12) model augmented using Google Index

	θ	Θ		Standard error of residuals	AIC	BIC	Out-of-sample MSE
Est	0.00	-0.38		51.7	508.1	8.0	0.3588 E+0.4
SE		0.13					

	θ	Θ	G	Standard error of residuals	AIC	BIC	Out-of-sample MSE
Est	0.00	-0.17	13.08	45.0	495.3	7.9	0.3738 E+04
SE		0.14	3.53				

SOURCES: Banco de España.

a. Models estimated using TRAMO, which adjusts for an additive outlier in April 2009.

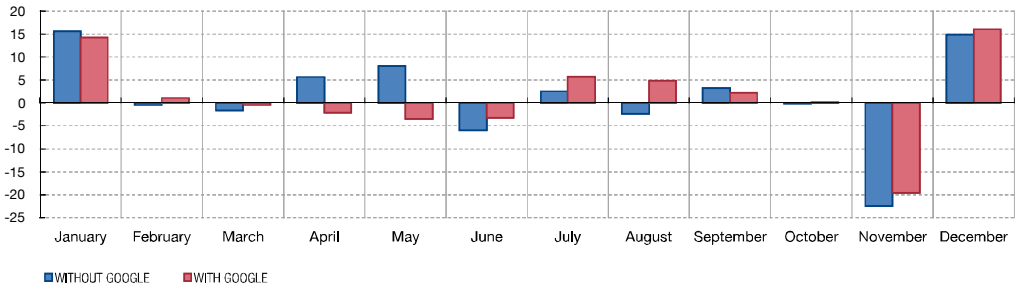
b. Models estimated using TRAMO for the period 2006-2010 (60 observations). The parameters obtained in those estimates are used to make one-period-ahead forecasts for 2011.

In short, the improvement in forecasting compared with conventional models depends crucially on which ARIMA model is taken as a benchmark. This is a consideration to be taken into account when presenting the forecasting benefits arising from the use of G-indicators. However, this does not mean that the information contained in Google searches is not of value for making forecasts (see Chart 9), merely that the power of these indicators has to be judged in the appropriate context.

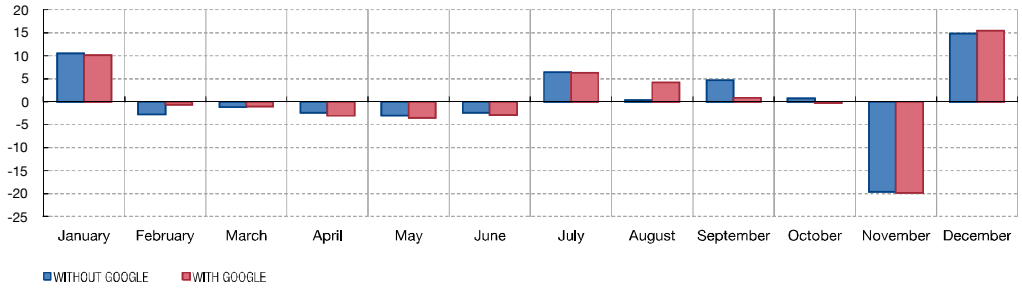
In any event, it should be recalled that these exercises have been conducted over what is still a short estimation period.[21] In principle, by increasing the number of observations, the estimates of the Google-augmented model should improve in relation to those of the ARIMA forecasting model. Further, the G-indicators provide information in real-time. For example, the data on tourists for May is not published until late June, while the Google indicator is available on the last day of May, meaning that the timely indicator constructed on the basis of searches allows for an improvement in the information available for conducting conjunctural analysis.

ONE-PERIOD-AHEAD FORECASTING ERRORS CHART 9

Panel 1



Panel 2



SOURCES: IET, Google Insights for Search and in-house calculations.

21. All the models have been estimated for the period 2006-2010 (60 observations). The one period-ahead estimates have been made with the parameters set in these estimates.

5 Conclusions and future developments

In this paper we have reviewed some of the applications developed in the economic forecasting and analysis field that use the vast amount of information provided by Internet user searches. This swathe of information, rich in volume and obtained in real time, proves manageable to analysts thanks to statistical tools such as "Google Insights for Search", which allows trends in different areas of interest to be classified and assessed. Earlier papers have focused predominantly on the labour market, the housing market, retail sales and consumer confidence. This paper has presented a very specific application for the Spanish economy, namely British tourists (the Spanish tourist industry's main clients) visiting Spain. The improvement in forecasting provided by the short-term models which include the G-indicator depends on the model taken as a benchmark. Nonetheless, it allows an adjusted indicator of the flow of British tourists to be obtained with a lead of almost one month.

Given the significance of tourism for the Spanish economy, future steps to be taken include the making of similar estimates for tourists from other countries, so that the predictive quality of this type of model may be enhanced. A further aim is to obtain a leading indicator of incoming tourists and, ultimately, of tourist expenditure. Other applications to explore are car sales, consumer confidence and house purchases. The main characteristic of these procedures is that, with time and the ongoing growth of Internet use, the results can only improve in the future. Nonetheless, it should not be forgotten that the construction of these G- indicators requires care so as to avoid mistakes arising, among other things, from the different use of language in different countries. Not taking due caution and blindly relying on these indicators, which do not always enhance the predictive power of the more traditional short-term forecasting models, may lead to erroneous results.

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