A study of the competitiveness of the Spanish construction industry

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Abstract: This study has a two-fold objective. First, it sets out to describe the present situation of the Spanish construction industry and its importance for the competitiveness of the national economy. It then goes on to consider the issue of forecasting for this strategically important sector, by considering three time series – total amount of tendering, the consumption of cement and the total number of homes built – and then forecasting by applying the Box-Jenkins methodology. The comparison of ex-post forecasts with the real data for the three variables, provides a way to evaluate the goodness of the models selected for forecasting.

Keywords: competitiveness; Spain; construction industry; forecasting.


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1 Introduction

According to the Annual Sector Report published by the Chambers of Commerce, Spain’s construction industry will continue to be one of the driving forces of the Spanish economy, and will become its third biggest industrial sector as far as growth is concerned, with an estimated growth rate of around 4.3%. It is important to study the situation of the industry and to be able to make the best possible forecasts regarding the development of certain variables that are key factors for competitiveness.

The aim of this study is two-fold. It will first analyse the general situation of the construction industry in Spain and consider its contribution to the competitiveness of the Spanish economy, since it is clear not only that the sector is one of the most dynamic sectors of the economy, but also that it will continue to be so in the coming years, if government forecasts are correct (SEOPAN, 2002a; 2002b; 2002c; 2002d; 2003a; 2003b). Having established this strategic importance, the study then goes on to consider the key issue of developing models in order to forecast future industry trends. Three time series - total tendering, cement consumption, and the total number of houses built – were selected from the National Institute of Statistics’ Tempus database and ex-post forecasts were made based on these series. Forecasts were then compared to the real January to December 2002 results. Comparison of both figures will indicate the quality, and by extension, the utility of the results generated from the time series analysis. Conclusions and potential lines for future research round off this study.

2 Spanish construction industry

2.1 Introduction

This section of the study describes the present situation of Spain’s construction industry by analysing its importance to the Spanish economy in terms of Gross National Product (GNP), gross added values, gross fixed capital formation, number of people employed in the industry and productivity. Furthermore, we have also carried out general and regional analyses of the industry, and a study of its main overseas markets.

2.2 A general overview of the industry

The construction industry has been one of the most dynamic sectors of the Spanish economy in terms of both job creation and production during 2002. The SEOPAN Report on the construction industries results sets total production for the sector at 116,000 million euros, that is 16.7% of the GNP (set at 695,000 million euros), an increase of 4.6% on the equivalent figures for 2001. The construction industry’s role in the Spanish economy can be summarised in the following data: the industry represented 8.6% of GNP via VAT (59,509 million euros), 9.5% of gross added value (59,509 million out of a total of 626,349 million euros), 59.1% of gross fixed capital formation (104,272 million out of a total of 176,358 million euros), and provides work for approximately 1,913,175 workers, that is 11.8% of the country’s work force. The industry’s growth rate is 2.6 percentage points ahead of the growth of the Spanish industry as a whole.


Table 1 shows a comparison of real variation rates for the main magnitudes of the construction industry and the economy in general (percentage variation compared to the same period of the previous year).

**Table 1**  A comparison of real variation rates

<table>
<thead>
<tr>
<th></th>
<th>Construction</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>GFCF (1)</td>
<td>GAV</td>
</tr>
<tr>
<td>I 01</td>
<td>6.1</td>
<td>5.3</td>
</tr>
<tr>
<td>II 01</td>
<td>6.4</td>
<td>5.5</td>
</tr>
<tr>
<td>III 01</td>
<td>5.2</td>
<td>4.3</td>
</tr>
<tr>
<td>IV 01</td>
<td>5.6</td>
<td>5.3</td>
</tr>
<tr>
<td>A.A. 01/00 (%)</td>
<td>5.8</td>
<td>5.1</td>
</tr>
<tr>
<td>I 02</td>
<td>4.6</td>
<td>5.0</td>
</tr>
<tr>
<td>II 02</td>
<td>3.9</td>
<td>4.5</td>
</tr>
<tr>
<td>III 02</td>
<td>4.8</td>
<td>5.5</td>
</tr>
<tr>
<td>IV 02</td>
<td>3.7</td>
<td>4.2</td>
</tr>
<tr>
<td>A.A. 02/01 (%)</td>
<td>4.2</td>
<td>4.8</td>
</tr>
</tbody>
</table>

*Source:* SEOPAN (2003a)

- gross fixed capital formation and gross added value. Millions of constant euros
- persons employed
- relative labour productivity. GAV in millions of euros per person working in the industry, per year and per term.

Moreover, public sector demand generated a production of 22,520 million euros, 22% of total production in the industry, also up 9% on 2001. The remaining 78% of total production, 90,80 million euros, was generated by the private sector. This was a variation of over 3% on figures for the previous year.

### 2.3 Sector analysis of the Spanish construction industry

A breakdown of the total activity for the construction industry yields the following description. House construction rose by 2% to represent 31% of the industry’s total production. This increase was mainly sparked off by the increasing demand of non-residents investment buyers, coupled with low interest rates. Non-residential construction rose by 3%, tallying 18% of total activity. A lower rate than in 2001 can be put down to two fundamental factors, the uncertainty surrounding the international situation and the global slowdown. Civil engineering managed a 9% increase, reaching 26% of total activity, due mainly to increasing demand from the public sector, which was particularly boosted by the Ministry of Public Work’s Infrastructure Plans and the Environment Ministry’s Hydrological Plan. Finally, renovation and restoration work
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grew by 5%, representing 25% of total production in the Spanish construction industry. This positive trend has been slowed to some extent by a slowdown in the demand for home maintenance.

One final point of interest is that the development of all the sub-sectors of Spain’s construction industry has been positive for the last five years.

Aggregate figures for the different sectors of the construction industry for the European Union (EU) are as follows (SEOPAN, 2003a): house and home construction (23%), non-residential constructions (19%), civil engineering (21%) and renovation and maintenance (37%).

2.4 A regional analysis of the Spanish construction industry

An analysis of growth in the construction industry in the different regional government areas of Spain also yields some interesting data (SEOPAN, 2003a). Andalucía, Valencia, Rioja, Murcia and Navarra figure prominently as areas that have grown at a faster rate than the average for 2001, whilst Aragon, Asturias, the Balearic Islands, the Canary Islands, Cantabria, Castilla-La Mancha and Madrid fell below the national average growth rate.

2.5 The Spanish construction industry in the European Union

The importance of the construction industry in the different countries comprising the EU is also an interesting consideration, and a comparison of the results of each country’s construction industry production with total production within the European Community yields the following rankings (SEOPAN, 2003a): Germany (22%), France (16%), Italy (14%), the UK (14%) Spain (12%), the Netherlands (5%) and remaining countries (17%). This makes Spain the fifth largest European market in the construction industry.

2.6 The Spanish construction industry and its foreign market

The Spanish construction industry’s turnover from foreign markets in 2002 topped 3,100 million euros. Analysis shows that the main foreign markets are the European Community and South America by a long chalk, with 34% and 32% of the quota, respectively. According to (SEOPAN, 2003a; 2003b), these two main markets therefore make up 66% of turnover, the remaining 34% being divided amongst non-EU countries (21%), Asia (5%), Africa (5%), the Middle East (2%) and North America (1%).

3 Forecasting some construction industry variables

The economic importance of the Spanish construction industry means that a large number of studies analysing different times series are already available. Such studies usually target theoretical aspects, such as analysis of building company strategies (González, 2000), or the circumstances that influence the decision to buy a home (Follain and Jiménez, 1985). Other studies focus on forecasting some of the industry’s time series (Caridad and Ceular, 2001) with single-variable forecasts, often house prices, abounding in this type of study. Studies by Bee-Hua (1998) figure amongst those who have applied the Box-Jenkins methodology to forecast construction industry time series.
Given the dynamic, changing nature of this industry in Spain, forecasting the evolution of different variables is of enormous interest. Three time series were thus selected for this study:

- total tendering
- cement consumption
- total number of homes built.

These series were taken from the Tempus database, which is available at Spain’s National Institute of Statistics website (www.ine.es was the correct URL on 17th June 2003). All the series are made up of one hundred and thirty-two monthly observations from January 1992 to December 2002. Univariate forecasts were made for all of them using the Box-Jenkins methodology.

To gauge the quality of the forecasts produced using these models, the data for all the series were divided into two groups (Atienza, Ang and Tang, 1997). One of the sets was for one hundred and twenty observations between January 1992 and December 2001, which was used to provide a model to calculate forecasts for the following twelve months, January to December 2002. A second set was made up of twelve real observations for this same January to December 2002 period, so that forecasts could thereby be compared with the real data. Ex-post forecasting and comparison with this real data, meant that conclusions could thus be drawn as to how well the models worked.

4 A description of the Box-Jenkins methodology

The Box-Jenkins forecasting methodology (1970) consists of finding a mathematical model that represents the behaviour of a time series of data, so that forecasting would simply be a matter of including the time period to be forecast into this model. As previously mentioned, the models used in this study are ARIMA univariate models, where the behaviour of a time series is explained through past observations of the series and through past forecasting error (or discrepancies between real past values and their corresponding forecasts produced by that model). An ARIMA model has the following overall structure (Pulido and López, 1999):

$$\phi_p(B)(1 - B)^d x_t = k + \theta_q(B)\alpha_t$$

where $x_t$ represents observation during time period $t$ of the series being studied, $\phi_p(B)$ and $\theta_q(B)$ are two polynomials, with orders $p$ and $q$, in the delay operator $B$ ($B x_t = x_{t-1}$), $d$ is the order of the first order differences that have to be taken for the series to be stationary in mean, and $\alpha_t$ is a white noise series.

It should be noted that ARIMA models were introduced by Wold (1938) by combining autoregressive models, which Yule (1926) had previously introduced in 1926, and moving average models (MA), the brainchild of Slutsky (1937).

One of the advantages of the Box-Jenkins models is that a computer search to come up with the models is reasonably efficient, once experience has been acquired in the methodology. Furthermore, once the model has been found, forecasts and comparisons of the real data and forecasts for past observations are immediate, so the efficiency of the chosen model can be clearly appreciated. A further characteristic of these models is that
they provide better short-term than long-term forecasts, basically because of the structure of the ARIMA models, although such a statement is no more than a general statement, for each series has its individual, specific hallmarks and characteristics.

It should also be remarked that some software package is required to model a time series using the Box-Jenkins methodology; the complexity and large number of operations it requires mean that a computer technology is essential. The North-American SCA (Scientific Computing Associates) package – whom Box himself happens to be an advisor with – is one of the most internationally accepted packages in this respect, and is the one used in this study.

5 Description of the models

As has already been pointed out in the introduction, all the time series were taken from the Instituto Nacional de Estadística (National Statistics Institute) Tempus database and are a part of Spain’s national-level statistics for the construction industry. A hallmark shared by all the series is that they present annual seasonality; the order of this seasonality, as will be shown in the models, is twelve, given that the time series are composed of monthly observations.

Regarding stationarity, it should be remarked that over differencing (Makridakis and Hibon, 1997) is one of the risk factors of the methodology we are using. The danger of over differencing increases when working with time series where it is difficult to see whether they are stationary or not (Chatfield, 1997). For the series analysed, there was no need to take differences, due to the lack of a clear trend.

The Box-Jenkins models obtained for the series being studied are shown in Table 2, which also highlights how the BJ models for the three time series include annual seasonality (order 12).

<table>
<thead>
<tr>
<th>Series</th>
<th>BJ Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total tendering</td>
<td>( (1 - \phi_1 B^{12}) x = k + (1 - \theta_1 B) a_t )</td>
</tr>
<tr>
<td>Cement consumption</td>
<td>( (1 - \phi_1 B - \phi_2 B^2 - \phi_3 B^3)(1 - B^{12}) x = (1 - \theta_1 B) (1 - \theta_1 B^{12}) a_t )</td>
</tr>
<tr>
<td>Number of homes built</td>
<td>( (1 - \phi_1 B) (1 - B^{12}) x = k + (1 - \theta_1 B^{12}) a_t )</td>
</tr>
</tbody>
</table>

6 The results

This section describes the results obtained after forecasting with all the above-mentioned univariate models. Twelve forecasts, for the period from January to December 2002, were made for each times series and compared with the real data available for that same period. The Mean Absolute Percentage Error (MAPE), put forward by (Makridakis, 1993), a universally accepted statistic for measuring forecasting error, was used to gauge forecasting quality. Table 3 shows the MAPE values for the forecasts.

Figures 1 to 3 provide comparative illustrations of the real values for the series from period 121 to 132 (January to December 2002), alongside the forecasts that came out of the above-mentioned models.
Table 3  MAPE values for the forecasts

<table>
<thead>
<tr>
<th>Series</th>
<th>MAPE (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total tendering</td>
<td>30.8</td>
</tr>
<tr>
<td>Cement consumption</td>
<td>5.5</td>
</tr>
<tr>
<td>Number of homes built</td>
<td>6.6</td>
</tr>
</tbody>
</table>

Figure 1  BJ forecasts vs. real data: total tendering

Figure 2  BJ forecasts vs. real data: cement consumption

Figure 3  BJ forecasts vs. real data: number of homes built
Table 3 and Figures 1 to 3 highlight the generally good quality of the forecasts, with the exception of the total tendering series. In this particular case, the model used was unable to forecast the unexpected peak that occurred during period 127 (July 2002), as the remarkably high figure for tendering in July 2002 – 3,700 million euros – does not correspond to figures for previous months of July (indeed, the figure for July 2001 had been 2,517 million euros). Such an off-target forecast explains the high MAPE value for the series forecasts.

However, the other two series – in which all the maximum and minimum peaks of the real series are detected – do underline the quality of the forecasts, both in the graphs and in the MAPE value.

As far as error is concerned, the model’s ability to detect periods when there will be a change in the trend of the series is as important as the quality of the forecasts. Figures 1 to 3 again highlight how the forecasts detect practically every single swing in trends that occurs in the three series. This ability to produce good forecasts is likely to be of major interest to both companies trading in the sector and to local or national administrations when it comes to decision taking, as strategic decisions often need to be taken many months ahead of events.

7 Conclusions

This section presents an overview of the study and an explanation of the main conclusions to be drawn from the research on Spain’s construction industry. First, the present-day importance of the construction industry was briefly described in the context of its contribution to a number of economic variables and its status as part of Spain’s overall economic situation. Then, the relevance and importance of the forecasts obtained for the total tendering, total number of houses built and cement consumption series was analysed.

The construction industry was one of Spain’s most dynamic economic sectors in 2002. According to the 2003 SEOPAN report on Results in the Construction Industry, production figures stood at 116,000 million euros, that is 16.7% of GNP (set at 695,000 million euros). As part of the national economy as a whole, the construction industry represents 8.6% of GNP in terms of added value, 9.5% of Gross Added Value (GAV), and 59.1% of gross fixed capital formation. It also provides employment for 1,913,175 members of the work force, which is 11.8% of the total number of employed persons. Housing accounts for 31% of total production in the industry, a 2% increase on 2001 figures; non-residential building made up 18% of total production (up by 3% on the previous year’s figures); building renovation and maintenance contributed 25% of the total, with a 5% hike on the previous year’s totals, and public works made up the remaining 26% of the industry’s production (also up by 9%).

It is clear from such figures that the construction industry plays a key role as a driver of the Spanish economy, and having instruments available to forecast the evolution of critical variables in the industry is, therefore, of considerable interest. Such instruments require a solid methodology capable of generating good forecasts that are useful for decision taking by stakeholders involved in the industry.

This study has described the forecasts obtained by applying the Box-Jenkins methodology to three time series that are representative of the industry: total tendering, cement consumption and total number of homes constructed. The good quality of these
forecasts has been demonstrated by comparing them with the real data, with the exception of the June 2002 forecast for the total tendering series, which differs substantially from the real figure series, and which thereby raises the MAPE figure for this particular series forecasts. The study has also highlighted how the forecasts detect trend changes in the series that were analysed.

In short, these results point to the conclusion that the methodology that was applied provides good forecasts for the three key time series for Spain’s construction industry, and also detects changes in trends. Unquestionably, having such strategic information at one’s fingertips is important not only for the boards of construction companies when they come to decision taking but also for local and central administration when they come to establish their policies in the field.

8 Future research lines

In view of the ability of the methodology applied in this study to come up with good forecasts and to pinpoint trend changes in time series from the construction industry in Spain, it would be interesting to extend this study to other EU countries, so as to be able to compare forecasts for the evolution of selected time series for other European countries.

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