FORECASTING INVESTMENT IN PORTUGAL USING QUALITATIVE AND QUANTITATIVE DATA*

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1. INTRODUCTION

Investment decisions are always conditioned by numerous factors. Some firms invest as a response to a favourable economic situation, possibly unexpected, while others invest due to expected higher demand over the medium or long run. This may co-exist with firms that do not invest at all simply because they have already achieved their desired capital stock. The objective of this article is to extend the work of Maria and Serra (2008), which assessed the usefulness of business surveys as a potential source of information behind investment developments in Portugal.[1] The information content of survey data has been widely explored in the literature. Larsen (2001), Barnes and Ellis (2005) or Claveria, Pons and Ramos (2007) are examples where the empirical associations between survey data and investment were subject to a special focus.

The analysis presented in this article starts by reviewing the methodology and main conclusions of Maria and Serra (2008). The usefulness of business surveys was analysed in Maria and Serra by promoting a fictional "fishing contest". This contest included bridge models as one of the "participants", *i.e.*, simple econometric formulations that establish a link, or a bridge, between two sets of data, which are typically disclosed with different timings.[2] Models based on principal components (derived from standard and non-standard methods), and models built within a partial least squares (PLS) framework were also included in the "fishing contest".[3] A striking outcome was, among all participants in the "fishing contest", the relative accuracy of bridge models. The accuracy of all models was measured by the Root Mean Squared Error (RMSE) of out-of-sample forecasts. The analysis included herein extends the empirical evidence of Maria and Serra by investigating the impact of additional explanatory variables on the initial specifications of these bridge models, namely industrial production (overall and components), cement sales and cement imports and data on vehicles. The out-of-sample performance of these extended models is then evaluated in order to analyse whether the relative RMSE are further reduced. In addition, the composition of the estimated models is also analysed, allowing the assessment of the complementary or substitution role of survey data against the additional explanatory variables.

This article is organized as follows. The next section presents the database. Section 3 reviews the methodology and main conclusions of Maria and Serra (2008). Additional empirical evidence is reported in Section 4 and Section 5 concludes.

* The analyses, opinions and findings represent the views of the authors; they are not necessarily those of the Banco de Portugal or the Eurosystem. The usual disclaimer applies.

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(1) Earlier versions of the *Working Paper* Maria and Serra (2008) were greatly improved by the discussions with Francisco Dias, having also benefited from the comments of Cláudia Duarte, Rita Duarte, Ricardo Mourinho Félix, Carlos Robalo Marques and Maximiano Pinheiro

(2) According to Baffigi *et al.* (2004), page 1, these models may "bridge the gap between the information content of timely updated indicators and the delayed (but more complete) national accounts".

(3) The multivariate PLS methodology is briefly reviewed in Maria and Serra (2008).

2. THE DATABASE

The database used herein has three main blocks. The first block of information contains survey data released by the European Commission (EC).[4] The second block contains several quantitative indicators that will be described below and, together with the first block, will be used as explanatory variables for the third block of information, which consists of Gross Fixed Capital Formation (GFCF) expenditures and several of its subcomponents. These data are estimates of Banco de Portugal based on national accounts data published by *Instituto Nacional de Estatística* (Statistics Portugal).[5]

The first block of information – the survey data – was divided into two different information sets: a "database of totals", which contains 42 variables with aggregates for the sectors as a whole (manufacturing industry, construction, retail trade and services); and a "database of sectors", which breaks down the industry and the construction surveys into several subsectors and contains 185 variables (see Table 1). Both databases are quarterly, balanced, and in those situations where the survey responses have a monthly frequency, it is assumed that all three months of the quarter are known. The monthly survey data is published on the last working day of the month to which it refers.

The survey data are in most cases published in the form of (seasonally adjusted) balances. Besides being in general unrevised, this data is disclosed in advance of national accounts. The sample period starts in 1997Q3, due to data availability issues, and has 42 observations (ending in 2007Q4).[6]

The second block of information is also quarterly, balanced and derived from indicators that have monthly frequency. Due to availability issues, the information set is restricted to sales of heavy commercial vehicles, Industrial Production Index (IPI), IPI - investment goods, IPI - transportation equipment, IPI - investment goods excluding transportation equipment, cement sales and imports of cement. All data was seasonally adjusted with the X12-ARIMA software. The indicators of the second block of information are disclosed with a delay that ranges from four to thirty days from the end of the month to which they refer.[7]

Finally, the third block of information contains the variables of interest. These are GFCF expenditures and several of its subcomponents, namely Public and Private GFCF, being the latter disaggregated into residential and productive GFCF. The disaggregation into construction and total excluding construction is also considered. In the case of Public GFCF, although the data depends on administrative decisions, it is being allowed that such decisions may have spill-over effects to the private sector of the economy and may eventually have an impact on the behaviour of some survey data. The analysis of the GFCF data will be carried out in quarter-on-quarter (qoq) and in year-on-year (yoy) changes. The two options can be found in the literature.[8]

The survey data were all assumed to be stationary in levels. This is in line with the empirical literature (see, for instance, European Commission (2000)), and in the vast majority of cases also in line with the conclusion stemming from at least one of the standard unit root tests usually considered in the literature (Augmented Dickey-Fuller, Philips-Perron and Kwiatkowski-Phillips-Schmidt-Shin) at a 10 per

(4) The data can be retrieved from the Eurostat website http://europa.eu.int/comm/eurostat.

(5) Total GFCF data is taken from the database of Banco de Portugal. See Banco de Portugal (2008) and the website www.bportugal.pt.

(6) 1997Q3 and 2007Q4 refer to the third quarter of 1997 and the fourth quarter of 2007, respectively.

(7) Between the full availability of a quarter of survey data and the publication of the corresponding first release of the national accounts (around 75 days), several different vintages of data belonging to the second block are available. All information of blocks one and two of a given quarter is available one month after the end of that quarter. An analysis based on the available data vintages is beyond the scope of this article.

(8) Rünstler and Sédillot (2003) use survey data to forecast quarterly changes of GDP. An analysis based on yearly rates of change can be found in Hansson, Jansson and Lof (2005) or Claveria *et al*. (2007). Artís and Suriñach (2003) and Barnes and Ellis (2005) have analyses in both quarterly and yearly terms.

Table 1

LIST OF SURVEY INDICATORS

Questions	Total and subsectors	Frequency	Starts in…
Industry			
Industry Confidence Indicator	Total Manufacturing	m	Jan 1987
Production trend observed in recent months	Consumer Goods	m	Jan 1987
Assessment of order-book levels	Durable Consumer Goods	m	Jan 1987
Assessment of export order-book levels	Non Durable Consumer Goods	m	Jan 1987
Assessment of stocks of finished products	Food, Beverages	m	Jan 1987
Production expectations for the months ahead	Investment Goods	m	Jan 1987
Employment expectations for the months ahead	Intermediate Goods	m	Jan 1987
Assessment of current production capacity		q	Jan 1987
Duration of production assured by current order-book levels		q	Jan 1987
New orders in recent months		q	Jan 1987
Export expectations for the months ahead		q	Jan 1987
Current level of capacity utilization		q	Jan 1987
Competitive position domestic market		q	Jul 1994
Competitive position inside EU		q	Jul 1994
Competitive position outside EU		q	Jul 1994
Factors limiting the production		q	Jan 1987
None		q	Jan 1987
Demand		q	Jan 1987
Labour		q	Jan 1987
Equipment		q	Jan 1987
Other		q	Jan 1987
Construction			
Construction Confidence Indicator	Total Construction	m	Jan 1989
Building activity development over the past 3 months	Building: total	m	Jan 1989
Main factors currently limiting your building activity	Building: residential	m	Jan 1989
None	Building: non-residential	m	Jan 1989
Insufficient demand	Public works (civil engineering)	m	Jan 1989
Weather conditions		m	Jan 1989
Shortage of labour force		m	Jan 1989
Shortage of material and/or equipment		m	Jan 1989
Other factors		m	Jan 1989
Evolution of your current overall order books		m	Jan 1989
Employment expectations over the next 3 months		m	Jan 1989
Operating time ensured by current backlog (in months)		q	Jan 1989
Retail Trade			
Retail Trade Confidence Indicator	Total Retail Trade	m	Jan 1989
Business activity (sales) development over the past 3 months		m	Jan 1989
Volume of stock currently hold		m	Jan 1989
Orders expectations over the next 3 months		m	Jan 1989
Business activity expectations over the next 3 months		m	Jan 1989
Employment expectations over the next 3 months		m	Jan 1989
Services			
Services Confidence Indicator	Total Services	m	Jun 1997
Business situation development over the past 3 months		m	Jun 1997
Evolution of the demand over the past 3 months		m	Jun 1997
Expectation of the demand over the next 3 months		m	Jun 1997
Evolution of the employment over the past 3 months		m	Jun 1997
Expectations of the employment over the next 3 months		m	Jun 1997

Source: European Commission.
Note: The the letter *m* or *q* indicates that the survey data is available with monthly or quarterly frequency, respectively.

cent significance level. According to similar considerations, the levels of the variables of the second and third block of information were taken to be non-stationary.[9]

(9) All results are available at request. It should be noted that in some cases, including in the second block, the results are not always conclusive and unambiguous. For instance, the non-stationarity null hypothesis of sales of heavy commercial vehicles is not rejected only at 5 per cent significance level. At a 10 per cent level that hypothesis is rejected.

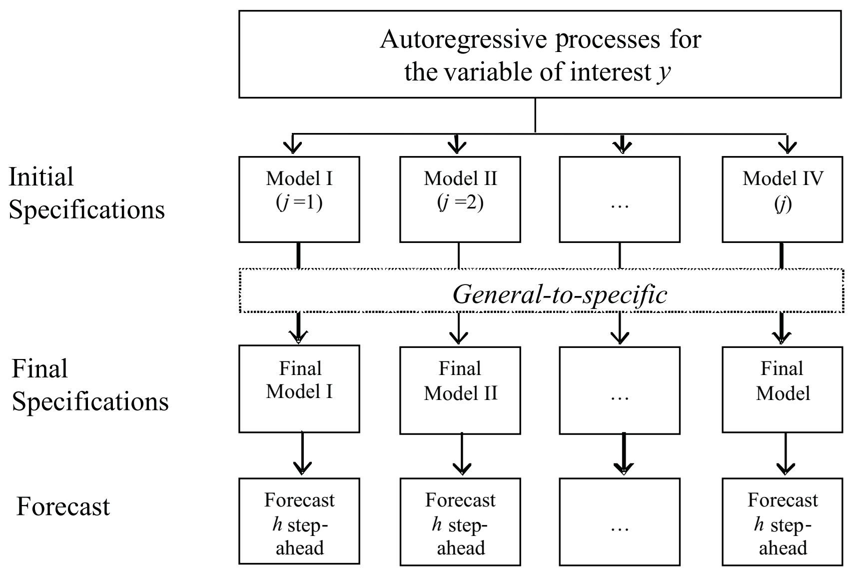
3. BUSINESS SURVEYS AND INVESTMENT

This section briefly reviews the methodology and main conclusions of Maria and Serra (2008), given that their main objective was to assess the usefulness of business surveys as a source of information behind contemporaneous or leading forces driving investment in Portugal. To achieve this goal, Maria and Serra implemented what was named a “fishing contest”. The participants in this contest included bridge models, which are simple econometric formulations that explore the existence of links between quarterly national accounts data and other information known in advance of national accounts, thereby establishing an empirical bridge between the two datasets. These models do not necessarily stem from economic theory, and therefore are not behavioural or structural in that sense. Other participants were models based on principal components (derived from standard and non-standard methods), and models built with the outcome of PLS regressions. The performance of these models was then evaluated against a benchmark autoregressive (AR) model. All models were tailored to produce *h*-step ahead direct forecasts, where $h = 1, 2, 3$ and 4.

The process of model building and model selection is summarized in Chart 1. The figure concentrates on AR models, but the process is identical to all participants of the “fishing contest”. The first step was always to construct several initial specifications for each variable of interest and for each period ahead. The second step was to eliminate all variables not significant at 10 per cent (one at a time starting from the least significant), following a general-to-specific approach. Lastly, all final specifications derived from all initial specifications were used to implement out-of-sample forecasts for the period 2006Q1-2007Q4, using an expanding window (*i.e.* the sample period increases, sequentially, one observation, for each new out-of-sample forecast).

Chart 1

FORECASTING PROCESS BASED ON AUTOREGRESSIVE MODELS



Source: Maria and Serra (2008).
Note: “*j*” is the initial number of regressors (up to a maximum of 4) in the AR models (besides a constant).

All “fishing contest” participants had the following general form:

$$y_{t-1+h} = \mu + \theta_1 y_{t-1} + \ldots + \theta_4 y_{t-4} + \psi_1 x_1^* + \ldots + \psi_k x_{k,t}^* + \eta_{t-1+h} \quad (1)$$

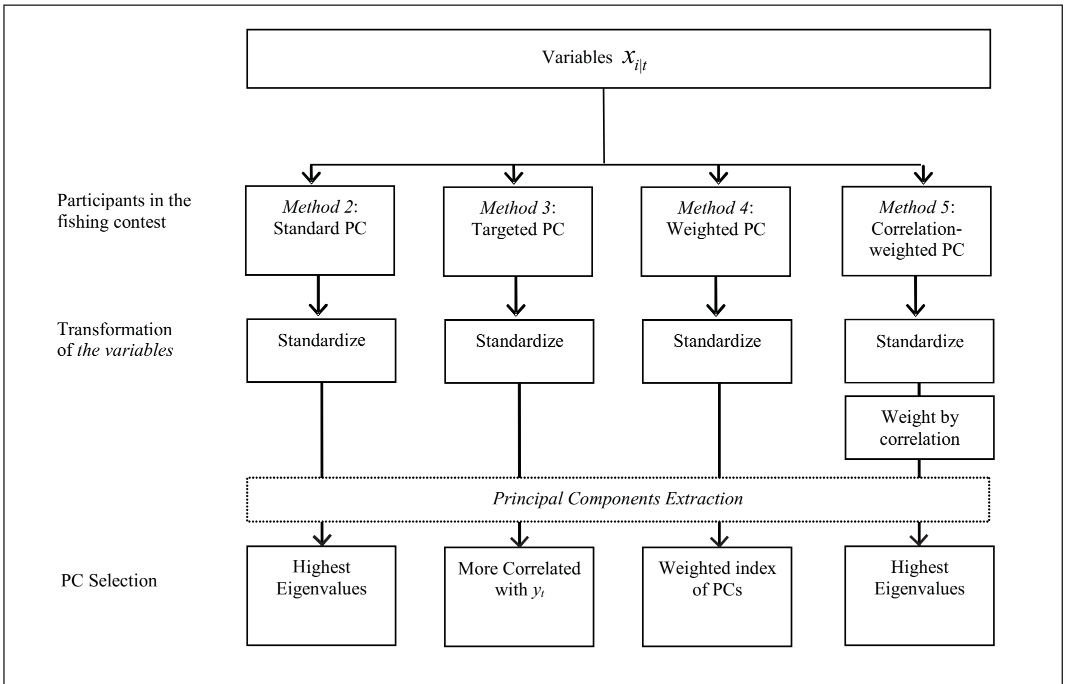
where $h = 1\ldots4$ and $k = 1\ldots5$

Variable y is the variable of interest and is defined in qoq or yoy rates of change. x^* represents the set of regressors. The procedure is implemented for each period ahead (h), thereby implying that the coefficients θ and ψ, as well as the constant μ are conditional on h. Equation (1) was estimated with or without the restriction $\theta_j = 0, \forall j$; with different x^*, defined according to the each participant; and using, alternatively, the “database of totals” and the “database of sectors”.

Previous work regarding the usefulness of surveys for short-term forecasting has extensively focused on bridge models and therefore this was naturally the first participant of the “fishing contest”.[10] In this case, x^* corresponds to a specific survey dataseries among the “database of totals” or the “database of sectors”. These series were listed in Table 1. More precisely, each variable was set to $x_{i|t}^*$, where the subscript $i|t$ indicates which lag i (from zero up to four) for which the survey indicator shows the highest correlation with the dependent variable y, conditional on information up to t. This implies that the lag order of each series in the first block of information was adjusted according to these correlations. The remaining participants also start by computing $x_{i|t}$, but instead of using them directly, reduce the dimensionality of this information set by exploring, in particular, their correlation structure. Methods based on the principal components (PC) methodology are natural participants in this context. These participants are summarized in Chart 2.

Chart 2

FORECASTING PROCESS FOR METHODS BASED ON PRINCIPAL COMPONENTS



Source: Maria and Serra (2008).
Note: $x_{i|t}$ stands for each of the variables listed on Table 1, already adjusted according to the correlation lag that produces the highest correlation with y.

(10) See, for instance, Rünstler and Sédillot (2003).

Method 2 (standard PC) corresponds to the standard principal components methodology. In this case, x^* refers to the components associated to the highest eigenvalues. Method 3 (targeted PC) differs from Method 2 in the selection of the principal components. Instead of choosing the components that are associated with the highest eigenvalues, it selects the ones that are more correlated with the variable of interest, and therefore potentially more appropriate, or "targeted", to forecast. This is in line with Bai and Ng (2007, 2008). These authors emphasise that when the goal is to forecast a specific series, and not just summarizing a particular database, there is no reason to think that the components that best explain a particular economic variable are also the same that explain another (completely different) variable. Method 4 (weighted PC) is derived from the work of Dias, Pinheiro and Rua (2008). These authors suggest the use of all principal components (which are also identical to those obtained with Method 2). After taking into account a particular weighting scheme of all components, x^* collapses in this case to one single regressor. These weights reflect two forces at work - alignment of the PC with the directions of the common movement of all variables present in the survey database and alignment of the PC with the variable of interest. Method 5 (Correlation-weighted PC) relies on the possibility that the principal components methodology can be applied to any second-moment matrix. While on Method 2, all $x_{i|t}$ were considered to "arrive on an equal footing" and are "equally important",[11] this method assumes that the survey indicators are not equally important. The weighting scheme suggested in Maria e Serra to differentiate their relative importance was constructed using the correlation coefficient of each $x_{i|t}$ with the variables of interest.[12]

Finally, the last participant in the "fishing contest" - Method 6 -, was obtained within a PLS framework. This participant includes features from the principal components methodology and from least squares. The variant of PLS used herein is such that the dependent variable is only one and x^* corresponds to one single regressor (as in Method 4). [13] More precisely, x^* is constructed with the goal of predicting a (standardized) dependent variable y, tailored to forecast h steps-ahead, from a database of (standardized) $x_{i|t}$ variables.

According with the empirical evidence of Maria and Serra (2008), models with survey data outperform, in general, simple AR models for the same horizon.[14] This indicates that survey data include relevant information for forecasting purposes that is not included in the dynamics of the dependent variables. In addition, the survey information included in the outperforming models is often obtained from the "database of sectors", which indicates that using a richer information environment produced some gains in terms of forecasting accuracy.

The outperforming models usually combine, in general, survey information and autoregressive terms, particularly when the dependent variable is expressed in yoy terms. Bridge models have a surprising relative performance, as they are in general the best method for all dependent variables and forecasting horizons. This is particularly evident using qoq data, but is also valid for some cases when considering yoy data. Even when bridge models do not produce the lowest RMSE, they often improve on the performance of the benchmark AR model. This suggests that particular survey data series do seem to possess non-negligible leading characteristics that should be explored further.

The forecasting accuracy of bridge models, measured by the ratio between their RMSE and the RMSE of the benchmark AR model, is depicted in Chart 3. As it can be seen, the large majority of outcomes is below 1, indicating a lower out-of-sample accuracy of the AR models in comparison with the bridge models.

(11) See Jackson (1991), Chatfield and Collins (1996) and Jollife (2002).

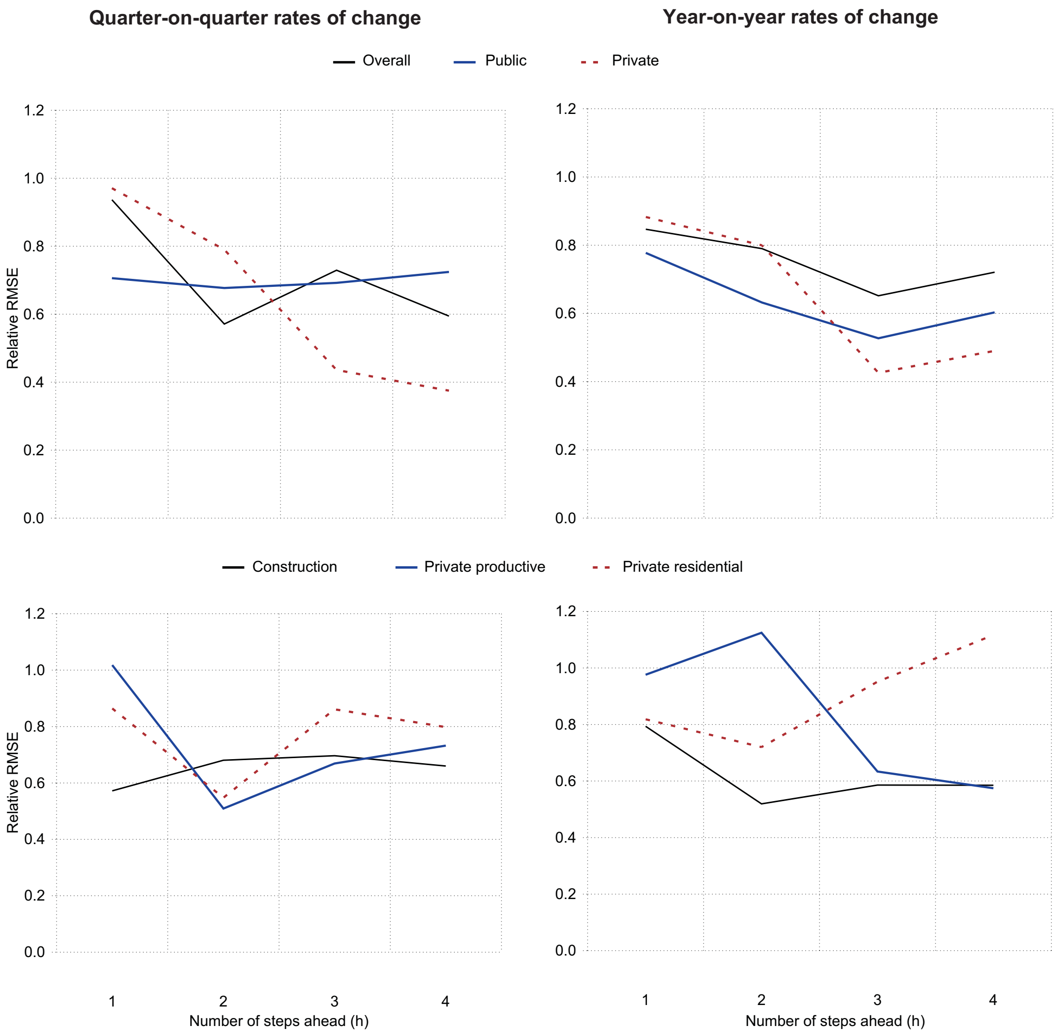
(12) Any set of weights is potentially usable. The definition of the best weighting scheme was beyond the scope of Maria and Serra (2008).

(13) The univariate variant of PLS used herein has been named in the literature as PLS1.

(14) For more detailed data on the results of Maria and Serra (2008), please see Tables 1 and 2 of the Appendix, regardind the qoq and yoy databases, respectively.

Chart 3

THE RELATIVE FORECASTING ACCURACY OF BRIDGE MODELS



Note: The relative RMSE is defined as the ratio between the RMSE of the bridge model and the RMSE of the benchmark AR model for the corresponding period-ahead forecast. A lower than 1 relative RMSE indicates a lower out-of-sample accuracy of the AR model over the period between 1996Q1 and 2007Q4, in comparison with the bridge model. A relative RMSE equal to zero would indicate an exact out-of-sample forecast of the bridge model. The actual numbers behind these graphs are reported in Tables 1 and 2 of the Appendix..

4. BRIDGE MODELS INCLUDING QUANTITATIVE INDICATORS

This section extends the empirical evidence of Maria and Serra by investigating the impact of additional explanatory variables on the initial specifications of bridge models. In contrast with the survey information, which is subjective by definition, these additional variables are of a quantitative nature. The main objectives of the present article are to evaluate if the information content of surveys is still useful when quantitative information is included in the equations, and whether forecast accuracy gains are achieved.

4.1. Database and methodology

The database in this section uses all three blocks presented in Section 2. Furthermore, the empirical evidence will be based on the breakdown of the first block in the "database of totals" and in the "database of sectors" and on the use of qoq and yoy changes of the variables of interest.

Given the relative performance of bridge models, the analysis focuses on the augmentation of equations with the structure defined in (1). To enhance the comparability with the previous results, all equations will be evaluated in terms of out-of-sample forecast accuracy for the period 2006Q1-2007Q4 using an expanding window; all RMSE will be compared with the same benchmark AR model; and the outset follows the structure presented in Chart 1. However, to avoid severe losses in degrees of freedom, a selection criterion has to be defined with the objective of clarifying how many quantitative and qualitative regressors should be used for forecasting purposes.[15] The procedure that was followed starts by introducing one single quantitative indicator at a time in equations (1), with $k = 1, 2, \ldots, 5$. The final specifications of these models are then evaluated by their relative out-of-sample accuracy. The best performing models will then be used to establish a maximum number of surveys and maximum number of quantitative indicators in the initial specifications. To assure a higher comparability with the previous results, the goal is to maintain a total number of regressors that does not exceed five, besides the autoregressive part.

4.2. Empirical results

The empirical evidence based on bridge models that include qualitative indicators and one quantitative indicator show that, in almost all situations, there is at least one survey variable that remains in the final specifications, implying that their information is useful for forecasting investment even when quantitative data is available. In addition, the usefulness of quantitative indicators seems very specific, given that not all lead to an improvement in the survey based bridge model, being often dropped from the final specification of the equations (about 60% of the cases), particularly for longer forecasting horizons. However, when these variables remain in the final specifications, the quantitative indicators lead in general to a reduction in the RMSE.

For models in qoq terms, the quantitative indicators that lead in more cases to a reduction in the RMSE *vis-à-vis* the bridge models composed only by survey data and autoregressive terms are cement sales and IPI - transportation material. For yoy data, besides the same IPI subcomponent, total IPI and imports of cement are also relevant. In general, a close inspection of both databases suggests that the number of survey regressors to be included in the initial specification of the equations in order to avoid a substantial loss of out-of-sample accuracy is around two.

In the case of qoq data, the best final models are in their majority obtained from the "database of sectors" (73% of the cases) and do not include autoregressive terms (56% of the times). On the other hand, the presence of the "database of sectors" is not so expressive for models in yoy terms (42% of the cases), and AR terms are in general included (97% of the cases).

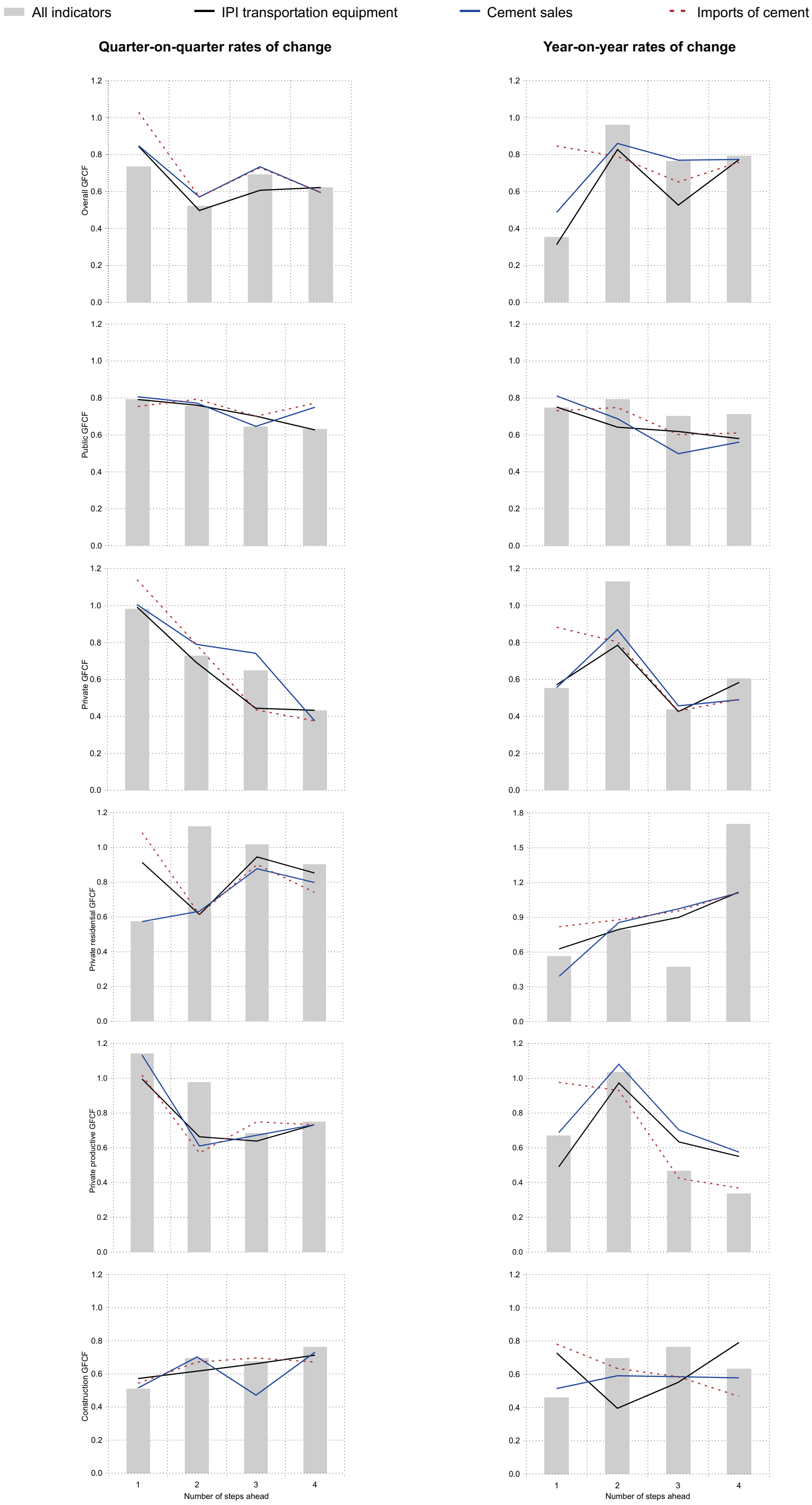
Chart 4 presents the results for those indicators which are more often found to improve on the survey based bridge models.[16] These indicators are IPI - transportation material, cement sales and imports of

(15) With 4 autoregressive terms, 5 survey variables and a total number of 7 quantitative indicators, plus a constant, this adds up to 17 regressors.

(16) The actual data behind Chart 4, results obtained from equations involving other quantitative indicators and information regarding the composition of the final estimated models are presented in Tables 3 and 4 of the Appendix, for qoq and yoy data, respectively.

Chart 4

THE FORECASTING ACCURACY OF BRIDGE MODELS INCLUDING QUANTITATIVE INDICATORS



Source: Authors' calculations.
Note: "Relative RMSE" is defined as the ratio between the RMSE of the bridge model and the AR model. A lower than 1 relative RMSE indicates a lower out-of-sample accuracy of the AR model over the period between 1996Q1 and 2007Q4, in comparison with the bridge model. The actual numbers behind these plots are reported in Tables 3 and 4 of the Appendix.

cement. As it can be seen, the large majority of outcomes for the relative RMSE is below 1. In these situations, Method 1 of Maria and Serra (2008) ceases to be the best performing model.

Based on these conclusions, the analysis proceeded with the estimation of bridge models of two survey indicators (the most correlated with the dependent variable) and three quantitative indicators (IPI - transportation material, sales of cement and imports of cement). In general, the results show that best performing models with dependent variables in qoq terms rely more on the “database of sectors” than in the “database of totals”, while the opposite occurs in the case of yoy terms. Regardless of the database, the final specifications of the models are relatively similar, given that AR terms, survey data and quantitative indicators are all present. For nearer term forecasts, these augmented models lead in some cases to reductions in the RMSE against the remaining bridge models. However, this gain is neither systematic across horizons nor valid for all dependent variables, which suggests that an adequate forecast should not neglect the predictive power of alternative specifications or alternative quantitative indicators.

Chart 4 also presents the empirical results showing that the RMSE of bridge models including two qualitative indicators and three quantitative indicators are not always the lower envelope of the corresponding RMSE of models which include only one of these quantitative indicators. For instance, the relative RMSE of the model for current-quarter qoq forecasts (h=1) of private productive GFCF is higher than 1. However, a model including AR terms, survey data and the IPI - transportation material indicator generates a relative RMSE of about 1. When this quantitative indicator is replaced by the overall IPI (which was not selected), the relative RMSE is reduced even further.

5. CONCLUSIONS

This article reviewed and extended the empirical evidence included in Maria and Serra (2008). The usefulness of business surveys was analysed in Maria and Serra by promoting a fictional “fishing contest”, where the participants were bridge models, models based on principal components (derived from standard and non-standard methods), and models built within a partial least squares (PLS) framework. In general, the empirical evidence indicated that there was always a participant producing a lower RMSE than the one associated with simple autoregressive models. In several specifications, the augmentation of each of the admitted participants with AR terms produced the lowest RMSE. This conclusion was in general valid for both the qoq and yoy databases, and as well as for two databases of surveys (“database of totals” and “database of sectors”). In addition, bridge models showed a striking performance in relative terms. Even when these models do not produce the lowest RMSE in absolute terms, they often improve on the performance of the autoregressive benchmark. In this context, the information provided by a few survey dataseries does seem to possess leading characteristics that are valuable for forecasting purposes.

The empirical evidence included in Maria and Serra was extended by investigating the impact of adding quantitative explanatory variables to the initial specifications of bridge models. The quarterly figures for these variables are also known in advance of national accounts, although the full set of quantitative indicators is only available with a delay of up to 30 days against the survey data, which are published on the last working day of each month. These properties make them natural competitors of survey variables. The quantitative data considered comprise sales of vehicles, industrial production (overall and components) and cement sales and cement imports.

The conclusions suggest that quantitative indicators work as complements of survey data, given that in the largest majority of cases, the latter remain in the final specification of equations when one or several quantitative indicators are added. Some indicators, namely IPI – transportation equipment, sales and imports of cement, considered both separately and jointly, lead to an improvement in RMSE in several cases when compared to the exclusively survey based bridge models. This adds to the overall view already present in Maria and Serra (2008) that a richer set of information seems to yield better results. However, this improvement is not systematic across forecasting horizons or across dependent variables, being more concentrated on shorter forecasting horizons, which implies that an adequate forecast should not neglect the predictive power of alternative specifications or alternative quantitative indicators.

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APPENDIX

This appendix presents four tables containing a comprehensive summary of all empirical evidence. Tables 1 and 2, derived using qoq and yoy rates of change, respectively, are a summary of the empirical evidence of Maria and Serra (2008). Tables 3 and 4 are a summary of the empirical results of this article, derived using qoq and yoy rates of change, respectively. All remaining results are available upon request.

In all tables, the first column identifies the models that are being evaluated. The initial rows report the absolute values of the lowest RMSE for the benchmark AR models (obtained following the structure presented in Chart 1). The remaining results are in relative terms against the benchmark model. Therefore, for h = 1, 2, 3 and 4 a relative RMSE higher/lower than 1 indicates a higher/lower RMSE than the corresponding AR model. If the figure is below 1, then the model is considered as depicting higher forecast accuracy than the benchmark AR process. This situation is highlighted in bold on all tables. The lowest relative RMSE among all non-benchmark models is highlighted with a shaded area. Furthermore:

- Column (1) indicates the number of survey regressors included in the initial specification of the equation corresponding to the lowest RMSE.

- Column (2) indicates the database from which the model was obtained: the letter "t" depicts the "database of totals" and the letter "s" the "database of sectors".

- The symbol (*) in column (3) indicates the presence of at least one AR term in the initial specification.

For Tables 3 and 4, in particular, the shading area in the upper part of the tables indicates the lowest relative RMSE within that part. These models include qualitative indicators and one quantitative indicator. For the lower part, shading depicts the situation where the corresponding model outperforms all models. These models include two qualitative indicators and three quantitative indicators. Tables 3 and 4 also include the following information:

- A star (*) in column (4) indicates the presence of at least one survey indicator in the final specification of the equation.

- A star (*) in column (5) indicates the presence of at least one quantitative indicator in the final specification of the equation.

Table 1

OUT-OF-SAMPLE RMSE FOR QUARTER-ON-QUARTER FORECASTS

		Overall				Public				Private			
		Specification				Specification				Specification			
		Initial				Initial				Initial			
		RMSE	k	Dat	AR	RMSE	k	Dat	AR	RMSE	k	Dat	AR
	h		(1)	(2)	(3)		(1)	(2)	(3)		(1)	(2)	(3)
Method 0 - AR Model	1	0.021	1			0.069	1			0.018	1		
	2	0.022	3			0.069	1			0.020	4		
	3	0.021	1			0.061	4			0.019	1		
	4	0.021	4			0.060	4			0.019	4		
	Mean	0.022	4			0.070	1			0.020	1		
Method 1 - Bridge Model													
	1	**0.94**	4	s		**0.71**	3	t		**0.97**	4	s	
	2	**0.57**	3	s	*	**0.68**	5	s		**0.79**	2	s	*
	3	**0.73**	5	s	*	**0.69**	3	s	*	**0.44**	1	t	*
	4	**0.59**	1	t	*	**0.72**	1	s	*	**0.38**	1	t	*
	Mean	**0.79**	2	s	*	**0.78**	5	s	*	**0.71**	1	t	*
Method 2 - Standard PC													
	1	**0.93**	2	s		**0.87**	5	t		0.97	2	s	
	2	**0.75**	4	s		**0.82**	5	t		0.82	4	s	
	3	**0.93**	2	s	*	**0.66**	4	t	*	0.93	2	s	
	4	**0.88**	2	s		**0.79**	3	t	*	0.86	2	t	*
	Mean	**0.90**	2	s		**0.80**	4	t	*	0.89	2	s	
Method 3 - Targeted PC													
	1	1.08	1	t		**0.71**	5	t	*	1.13	1	t	
	2	**0.77**	3	s		**0.86**	2	t		**0.62**	4	s	
	3	**0.89**	2	s		**0.68**	5	t	*	**0.93**	1	s	
	4	**0.84**	4	s		**0.78**	1	t	*	**0.84**	1	t	*
	Mean	**0.89**	2	s	*	**0.82**	4	t	*	**0.97**	1	s	
Method 4 - Weighted PC													
	1	1.07	1	s		**0.96**	1	t		1.13	1	s	
	2	1.04	1	s		**0.97**	1	t		1.04	1	s	
	3	1.01	1	s	*	**0.93**	1	s	*	1.13	1	t	
	4	**0.96**	1	t	*	0.85	1	s	*	**0.99**	1	t	*
	Mean	1.02	1	t	*	0.90	1	s	*	1.04	1	t	*
Method 5 - Correlation Oriented PC													
	1	**0.95**	2	s		**0.84**	5	t		**0.99**	2	s	
	2	**0.92**	2	s		**0.89**	3	t		**0.92**	2	s	
	3	**0.99**	2	s		**0.83**	4	t	*	1.12	2	s	
	4	**0.89**	2	s		**0.76**	3	t	*	**0.93**	5	t	*
	Mean	**0.93**	2	s		**0.84**	5	t		**0.95**	2	s	
Method 6 - PLS													
	1	**0.88**	2	s	*	1.03	1	s	*	**0.86**	2	s	
	2	**0.91**	4	t		**0.99**	1	t	*	**0.83**	2	s	
	3	**0.90**	4	t	*	1.22	1	t		**0.87**	5	t	
	4	**0.96**	4	s		1.26	1	t		**0.94**	2	s	
	Mean	**0.95**	4	t	*	1.05	1	t	*	**0.86**	2	s	

		Private Residential				Private Productive			
		Specification				Specification			
		Initial				Initial			
		RMSE	k	Dat	AR	RMSE	k	Dat	AR
	h		(1)	(2)	(3)		(1)	(2)	(3)
Method 0 - AR Model	1	0.034	2			0.018	1		
	2	0.034	1			0.023	2		
	3	0.034	2			0.019	1		
	4	0.034	1			0.019	1		
	Mean	0.034	1			0.020	1		
Method 1 - Bridge Model									
	1	**0.86**	5	s		1.02	1	s	*
	2	**0.55**	5	s		**0.51**	1	s	*
	3	**0.86**	4	t		**0.67**	5	s	*
	4	**0.80**	3	t	*	**0.73**	3	s	*
	Mean	**0.83**	5	s		**0.79**	1	s	*
Method 2 - Standard PC									
	1	1.03	2	s		0.98	2	s	
	2	1.05	4	s	*	**0.80**	2	s	
	3	**0.92**	3	s		**0.95**	5	t	
	4	**0.84**	5	s		**0.89**	2	s	
	Mean	1.00	3	s		**0.90**	2	s	
Method 3 - Targeted PC									
	1	**0.87**	4	s		1.03	2	s	
	2	1.00	2	s		**0.79**	1	s	
	3	1.00	1	s		**0.66**	3	t	*
	4	**0.77**	5	s		**0.87**	2	t	
	Mean	**0.99**	4	s		**0.93**	1	s	
Method 4 - Weighted PC									
	1	1.05	1	t		1.15	1	s	
	2	1.04	1	t		**0.92**	1	s	
	3	1.06	1	t		1.17	1	t	
	4	1.04	1	t		1.04	1	t	
	Mean	1.05	1	t		1.07	1	t	
Method 5 - Correlation Oriented PC									
	1	1.04	2	s		1.03	2	s	
	2	1.02	2	s		**0.84**	2	s	
	3	**0.97**	4	s		1.12	2	s	
	4	**0.86**	4	s		**0.91**	2	s	
	Mean	**0.98**	4	s		**0.96**	2	s	
Method 6 - PLS									
	1	**0.80**	5	t		**0.89**	2	s	
	2	0.81	5	t		**0.74**	2	t	*
	3	**0.85**	5	t		**0.90**	5	t	*
	4	0.84	4	t		**0.93**	4	s	
	Mean	**0.82**	5	t		**0.90**	2	s	

		Construction				Overall excl. construction			
		Specification				Specification			
		Initial				Initial			
		RMSE	k	Dat	AR	RMSE	k	Dat	AR
	h		(1)	(2)	(3)		(1)	(2)	(3)
Method 0 - AR Model	1	0.033	1			0.030	1		
	2	0.033	1			0.032	3		
	3	0.033	2			0.029	1		
	4	0.033	1			0.028	1		
	Mean	0.033	1			0.030	1		
Method 1 - Bridge Model									
	1	**0.57**	4	s	*	**0.79**	3	s	
	2	**0.68**	2	s	*	**0.69**	4	s	
	3	**0.70**	2	s	*	**0.88**	3	t	*
	4	**0.66**	5	s		**0.78**	1	s	*
	Mean	**0.73**	4	s	*	**0.81**	1	s	*
Method 2 - Standard PC									
	1	**0.92**	4	t		**0.81**	5	s	*
	2	**0.91**	5	s		**0.78**	4	t	
	3	**0.80**	4	s	*	**0.99**	2	t	
	4	**0.81**	2	s	*	1.01	1	s	*
	Mean	**0.90**	2	s	*	**0.91**	2	s	
Method 3 - Targeted PC									
	1	**0.98**	5	t		**0.81**	1	s	
	2	**0.86**	4	s		**0.81**	3	s	
	3	**0.89**	1	t	*	**0.94**	3	s	*
	4	**0.97**	5	s	*	**0.94**	5	s	*
	Mean	**0.97**	1	t	*	**0.90**	1	s	
Method 4 - Weighted PC									
	1	**0.98**	1	s		**0.92**	1	s	*
	2	**0.99**	1	t		**0.98**	1	s	
	3	**0.79**	1	s	*	**0.94**	1	s	
	4	**0.85**	1	s	*	**0.95**	1	s	
	Mean	**0.90**	1	s	*	**0.96**	1	s	
Method 5 - Correlation Oriented PC									
	1	**0.95**	4	s	*	**0.89**	2	s	
	2	**0.92**	5	s		**0.82**	4	t	
	3	**0.79**	1	s	*	**0.95**	1	s	
	4	**0.78**	2	s	*	0.96	1	s	
	Mean	**0.90**	1	s	*	0.93	2	s	
Method 6 - PLS									
	1	**0.89**	2	s	*	**0.74**	4	t	
	2	**0.87**	4	t		**0.76**	2	s	
	3	**0.97**	4	s		**0.87**	1	s	
	4	**0.95**	4	s		**0.88**	1	s	*
	Mean	**0.97**	4	t	*	**0.85**	2	s	

Source: Authors' calculations.

Table 2

OUT-OF-SAMPLE RMSE FOR YEAR-ON-YEAR FORECASTS

		Overall				Public				Private				Private Residential				Private Productive				Construction				Overall excl. construction			
		Specification				Specification				Specification				Specification				Specification				Specification				Specification			
		Initial				Initial				Initial				Initial				Initial				Initial				Initial			
		RMSE	k	Dat	AR	RMSE	k	Dat	AR	RMSE	k	Dat	AR	RMSE	k	Dat	AR	RMSE	k	Dat	AR	RMSE	k	Dat	AR	RMSE	k	Dat	AR
	h		(1)	(2)	(3)		(1)	(2)	(3)		(1)	(2)	(3)		(1)	(2)	(3)		(1)	(2)	(3)		(1)	(2)	(3)		(1)	(2)	(3)
Method 0 - AR Model	1	0.026	2			0.094	3			0.022	1			0.030	4			0.022	1			0.033	4			0.029	1		
	2	0.035	4			0.091	3			0.033	4			0.040	2			0.034	4			0.045	3			0.041	1		
	3	0.041	2			0.131	2			0.035	1			0.036	1			0.036	1			0.054	4			0.043	1		
	4	0.040	2			0.143	4			0.032	2			0.034	1			0.034	2			0.055	4			0.044	1		
	Mean	0.036	3			0.122	3			0.031	2			0.036	1			0.032	2			0.048	4			0.039	1		
Method 1 - Bridge Model																													
	1	**0.85**	1	t	*	**0.78**	5	s	*	**0.88**	2	t	*	**0.82**	2	t	*	**0.98**	1	t	*	**0.79**	5	t	*	1.04	1	t	*
	2	**0.79**	3	s	*	**0.63**	5	s	*	**0.80**	4	s		**0.72**	3	t		1.12	1	t	*	**0.52**	5	s	*	**0.89**	4	s	*
	3	**0.65**	2	t	*	**0.53**	4	s	*	**0.43**	2	t	*	**0.95**	3	t	*	**0.63**	1	s	*	**0.59**	3	t	*	**0.47**	5	t	*
	4	**0.72**	5	t		**0.60**	4	t	*	**0.49**	1	s	*	1.12	5	t	*	**0.57**	1	t	*	**0.59**	5	t	*	**0.62**	5	s	*
	Mean	**0.89**	5	s	*	**0.62**	4	s	*	**0.83**	4	s	*	1.06	3	t	*	**0.86**	1	t	*	**0.66**	5	t	*	**0.80**	3	s	*
Method 2 - Standard PC																													
	1	0.88	2	s	*	**0.92**	5	s	*	1.08	1	t	*	1.00	2	s	*	1.05	1	t	*	**0.78**	1	s	*	**0.90**	2	t	*
	2	**0.57**	2	s	*	**0.84**	1	s	*	**0.61**	2	s	*	**0.96**	5	s		**0.63**	2	s		**0.62**	1	s	*	**0.62**	2	s	
	3	**0.53**	2	s	*	**0.87**	1	s	*	**0.50**	2	s	*	**0.95**	2	t		**0.48**	2	s	*	**0.58**	1	s	*	**0.55**	2	s	*
	4	**0.65**	2	t	*	**0.65**	4	t	*	**0.66**	2	s	*	**0.97**	2	t		**0.74**	2	s	*	**0.51**	1	t	*	**0.72**	1	s	*
	Mean	**0.65**	2	s	*	**0.79**	4	t	*	**0.68**	2	s	*	**0.99**	3	s	*	**0.70**	2	s	*	**0.63**	1	s	*	**0.74**	2	s	*
Method 3 - Targeted PC																													
	1	**0.94**	1	t	*	**0.84**	2	s	*	1.08	1	t	*	1.07	1	t	*	1.05	1	t	*	**0.76**	2	s	*	0.92	2	s	*
	2	**0.59**	4	s	*	**0.83**	2	t	*	**0.61**	2	s	*	**0.93**	4	s	*	**0.81**	3	s	*	**0.62**	1	s	*	**0.52**	1	s	
	3	**0.70**	3	s	*	**0.86**	2	s	*	**0.45**	3	s	*	1.07	4	t		**0.48**	2	s	*	**0.58**	1	s	*	**0.49**	1	s	
	4	**0.78**	4	s	*	**0.66**	4	t	*	**0.59**	2	t	*	**0.82**	3	s	*	**0.65**	1	s		**0.49**	5	t	*	**0.82**	4	s	*
	Mean	**0.78**	3	s	*	**0.76**	2	t	*	**0.70**	3	s	*	1.04	3	s	*	**0.78**	1	s	*	**0.63**	1	s	*	**0.78**	1	s	*
Method 4 - Weighted PC																													
	1	**0.93**	1	s	*	**0.93**	1	s	*	1.08	1	t	*	1.06	1	t	*	1.05	1	t	*	**0.80**	1	s	*	1.05	1	t	*
	2	**0.94**	1	t	*	**0.85**	1	s	*	1.02	1	t	*	1.06	1	s		1.00	1	t	*	**0.62**	1	s	*	1.10	1	t	*
	3	1.01	1	s	*	**0.87**	1	s	*	1.22	1	s		1.30	1	t		1.05	1	t	*	**0.57**	1	s	*	1.07	1	s	*
	4	1.11	1	t		**0.78**	1	s	*	1.38	1	t	*	1.33	1	t		1.20	1	t	*	**0.49**	1	t	*	**0.99**	1	s	
	Mean	1.01	1	t	*	**0.80**	1	s	*	1.17	1	t	*	1.26	1	t		1.07	1	t	*	**0.62**	1	s	*	1.06	1	s	*
Method 5 - Correlation Oriented PC																													
	1	**0.92**	1	t	*	**0.90**	5	s	*	1.06	1	t	*	1.02	1	t	*	1.11	1	s	*	**0.83**	1	s	*	**0.93**	2	t	*
	2	**0.64**	2	s	*	**0.84**	1	s	*	**0.62**	2	s	*	**0.87**	2	s	*	**0.70**	2	s		**0.62**	1	s	*	**0.65**	2	s	
	3	**0.60**	2	s	*	**0.84**	1	s	*	**0.60**	2	s	*	1.07	2	t		**0.67**	2	s	*	**0.56**	1	s	*	**0.74**	2	t	*
	4	**0.70**	2	s	*	**0.70**	3	t	*	**0.72**	2	s	*	**0.97**	2	t		**0.67**	2	s	*	**0.50**	1	t	*	**0.66**	1	s	*
	Mean	**0.69**	2	s	*	**0.78**	1	s	*	**0.73**	2	s	*	1.03	3	s	*	**0.75**	2	s	*	**0.62**	1	s	*	**0.80**	2	t	*
Method 6 - PLS																													
	1	1.61	4	t		1.77	1	t		1.29	2	s	*	1.26	2	t	*	1.33	2	t	*	1.71	1	t		**0.98**	4	t	
	2	1.17	2	t	*	1.85	1	t		**0.78**	2	t	*	**0.89**	2	t		**0.78**	4	t	*	1.27	1	t		**0.75**	2	t	*
	3	**0.98**	2	s	*	1.27	1	t	*	**0.82**	2	s		1.07	2	t	*	**0.76**	2	t		1.12	1	s		**0.77**	2	s	
	4	1.09	2	s	*	1.21	1	t		**0.94**	2	s		1.11	2	s	*	**0.89**	2	s		1.14	1	s		**0.69**	1	s	*
	Mean	1.19	2	s	*	1.38	1	t		**0.95**	2	s		1.10	2	t	*	**0.94**	2	t		1.27	1	t		**0.85**	4	t	

Source: Authors' calculations.

Table 3 (to be continued)

OUT-OF-SAMPLE RMSE FOR GFCF QUARTER-ON-QUARTER FORECASTS

		Overall						Public						Private						Private Residential						Private Productive						Construction						Overall excl. construction					
			Specification						Specification						Specification						Specification						Specification						Specification						Specification				
			Initial	Final					Initial	Final					Initial	Final					Initial	Final					Initial	Final					Initial	Final					Initial	Final			
		RMSE	k	Dat	AR	Sur	Ind	RMSE	k	Dat	AR	Sur	Ind	RMSE	k	Dat	AR	Sur	Ind	RMSE	k	Dat	AR	Sur	Ind	RMSE	k	Dat	AR	Sur	Ind	RMSE	k	Dat	AR	Sur	Ind	RMSE	k	Dat	AR	Sur	Ind
	h		(1)	(2)	(3)	(4)	(5)		(1)	(2)	(3)	(4)	(5)		(1)	(2)	(3)	(4)	(5)		(1)	(2)	(3)	(4)	(5)		(1)	(2)	(3)	(4)	(5)		(1)	(2)	(3)	(4)	(5)		(1)	(2)	(3)	(4)	(5)
Method 0	1	0.021	1					0.069	1					0.018	1					0.034	2					0.018	1					0.033	1					0.030	1				
- AR Model	2	0.022	3					0.069	1					0.020	4					0.034	1					0.023	2					0.033	1					0.032	3				
	3	0.021	1					0.061	4					0.019	1					0.034	2					0.019	1					0.033	2					0.029	1				
	4	0.021	4					0.060	4					0.019	4					0.034	1					0.019	1					0.033	1					0.028	1				
	Mean	0.022	4					0.070	1					0.020	1					0.034	1					0.020	1					0.033	1					0.030	1				
Method 1	1	**1.03**	4	s		*		**0.79**	3	s		*		**1.14**	1	t	*	*		**0.91**	1	s	*	*		**1.02**	1	s	*	*		**0.57**	4	s	*	*		**0.80**	2	s		*	
- Just surveys	2	**0.57**	3	s		*		**0.82**	5	s		*		**0.79**	2	s		*		**0.61**	5	s		*		**0.51**	1	s		*		**0.68**	2	s		*		**0.72**	4	s		*	
	3	**0.73**	5	s		*		**0.69**	3	s	*	*		**0.44**	1	t		*		**0.88**	1	t		*		**0.67**	5	s		*		**0.70**	2	s		*		**0.88**	3	t		*	
	4	**0.59**	1	t	*	*		**0.72**	1	s	*	*		**0.38**	1	t	*	*		**0.80**	3	t		*		**0.73**	3	s	*	*		**0.71**	5	s		*		**0.78**	1	s	*	*	
	Mean	**0.79**	2	s				**0.78**	5	s				**0.71**	1	t				**0.87**	5	s				**0.79**	1	s				**0.73**	4	s				**0.81**	1	s			
Indicator 1	1	1.01	4	s		*		**0.77**	4	s		*		1.14	1	t	*	*		**0.91**	1	s	*	*		1.02	1	s	*	*		**0.57**	4	s	*	*		**0.77**	2	s		*	
- Sales of heavy	2	**0.56**	3	s		*		**0.73**	4	s		*		**0.66**	2	s		*	*	**0.52**	4	s	*	*	*	**0.51**	1	s		*		**0.66**	2	s		*		**0.75**	1	s		*	*
commercial	3	**0.73**	5	s		*		**0.72**	3	s	*	*		**0.44**	1	t		*		**0.68**	5	s	*	*	*	**0.67**	5	s		*		**0.65**	5	s	*	*		**0.90**	1	s		*	
vehicles	4	**0.65**	1	t	*	*	*	**0.80**	2	t	*	*		**0.41**	1	t	*	*	*	**0.80**	3	t		*		**0.66**	3	s	*	*	*	**0.71**	4	s		*		**0.77**	1	s	*	*	
	Mean	**0.80**	4	s				**0.78**	2	s				**0.72**	1	t				**0.80**	5	s				**0.79**	1	s				**0.69**	4	s				**0.80**	1	s			
Indicator 2	1	1.05	2	t		*	*	**0.78**	3	s		*		1.07	2	t	*	*	*	**0.91**	1	s	*	*		**0.95**	1	s	*	*	*	**0.62**	4	s	*	*		**0.80**	2	s		*	
- IPI	2	**0.57**	3	s		*		**0.82**	5	s		*		**0.79**	2	s		*		**0.61**	5	s		*		**0.53**	1	s		*		**0.71**	1	s	*	*	*	**0.69**	3	s		*	
	3	**0.73**	2	t		*		**0.72**	3	s	*	*		**0.44**	1	t		*		**0.88**	1	t		*		**0.67**	5	s		*		**0.70**	2	s		*		**0.87**	3	t		*	*
	4	**0.60**	1	t	*	*	*	**0.72**	1	s	*	*		**0.40**	1	t	*	*	*	**0.69**	2	t	*	*	*	**0.73**	3	s	*	*		**0.64**	5	s	*	*	*	**0.78**	1	s	*	*	
	Mean	**0.79**	2	s				**0.75**	5	s				**0.71**	1	t				**0.84**	5	s				**0.78**	1	s				**0.74**	4	s				**0.80**	1	s			
Indicator 3	1	1.01	2	t		*	*	**0.79**	3	s		*		1.10	2	t		*	*	**0.89**	1	s	*	*	*	1.08	1	s		*	*	**0.75**	4	s	*	*	*	**0.81**	2	s		*	
- IPI -	2	**0.56**	2	s		*		**0.78**	5	s		*		**0.81**	2	s		*		**0.61**	5	s		*		**0.51**	1	s		*		**0.68**	2	s		*		**0.72**	4	s		*	
Investment	3	**0.78**	5	s		*	*	**0.72**	1	s	*	*		**0.54**	1	t		*	*	**0.93**	5	s		*		**0.74**	5	s		*	*	**0.73**	5	s	*	*		**0.84**	3	t		*	
goods	4	**0.79**	2	t	*	*		**0.71**	1	s	*	*		**0.56**	1	t	*	*	*	**0.90**	1	s		*	*	**0.73**	3	s	*	*		**0.74**	4	s		*		**0.78**	1	s	*	*	
	Mean	**0.79**	2	s				**0.77**	1	s				**0.80**	1	t				**0.89**	5	s				**0.82**	1	s				**0.75**	4	s				**0.82**	1	s			
Indicator 4	1	**0.85**	2	t		*	*	**0.79**	3	s		*		**0.99**	2	t		*	*	**0.91**	1	s	*	*		1.00	1	s	*	*	*	**0.57**	4	s	*	*		**0.86**	2	s	*	*	*
- IPI	2	**0.50**	4	s	*	*	*	**0.76**	5	s		*		**0.69**	3	s		*	*	**0.61**	5	s		*		**0.66**	1	s	*	*	*	**0.62**	5	s	*	*		**0.71**	4	s		*	*
Transportation	3	**0.61**	5	s	*	*	*	**0.70**	3	s	*	*		**0.44**	1	t		*	*	**0.95**	5	s	*	*	*	**0.64**	5	s		*	*	**0.66**	2	s		*	*	**0.82**	3	t		*	*
equipment	4	**0.62**	1	t	*	*	*	**0.63**	1	s	*	*		**0.43**	1	t	*	*	*	**0.85**	2	t		*	*	**0.73**	3	s	*	*		**0.71**	5	s		*		**0.76**	1	s	*	*	
manufacture	Mean	**0.72**	2	s				**0.75**	1	s				**0.71**	1	t				**0.90**	5	s				**0.83**	1	s				**0.71**	5	s				**0.81**	1	s			

Table 3 (continued)

OUT-OF-SAMPLE RMSE FOR GFCF QUARTER-ON-QUARTER FORECASTS

		Overall						Public						Private					
		Specification						Specification						Specification					
		Initial		Final				Initial		Final				Initial		Final			
		RMSE	k	Dat	AR	Sur	Ind	RMSE	k	Dat	AR	Sur	Ind	RMSE	k	Dat	AR	Sur	Ind
	h		(1)	(2)	(3)	(4)	(5)		(1)	(2)	(3)	(4)	(5)		(1)	(2)	(3)	(4)	(5)
Indicator 5	1	1.14	1	t		*		**0.76**	3	s		*	*	1.20	2	t		*	*
- IPI Investment	2	**0.57**	3	s		*		**0.87**	5	s		*		**0.79**	2	s		*	
goods	3	**0.65**	2	s		*		**0.64**	5	t	*	*	*	**0.47**	1	t		*	
excluding	4	**0.59**	1	t	*	*		**0.72**	1	s	*	*		**0.46**	1	s	*	*	
transportation equipment	Mean	**0.83**	2	s				**0.79**	2	t				**0.83**	2	s			
Indicator 6	1	**0.85**	1	t	*	*	*	**0.81**	2	s	*	*	*	1.01	2	t	*	*	*
- Cement sales	2	**0.57**	3	s		*		**0.77**	4	s		*		**0.79**	2	s		*	
	3	**0.73**	3	s		*		**0.65**	2	s	*	*	*	**0.74**	1	t	*	*	*
	4	**0.59**	1	t	*	*		**0.75**	1	t	*		*	**0.38**	1	t	*	*	
	Mean	**0.75**	2	s				**0.75**	1	t				**0.75**	1	t			
Indicator 7	1	1.03	2	t		*		**0.75**	3	s		*	*	1.14	1	t	*	*	
- Imports of	2	**0.57**	3	s		*		**0.79**	1	t	*	*	*	**0.79**	2	s		*	
cement	3	**0.73**	5	s		*		**0.70**	3	s	*	*		**0.44**	1	t		*	
	4	**0.59**	1	t	*	*		**0.77**	1	s	*	*		**0.38**	1	t	*	*	
	Mean	**0.79**	2	s				**0.71**	3	s				**0.71**	1	t			
Chosen Indicators:	1	**0.74**	2	t	*	*	*	**0.79**	2	s	*		*	**0.98**	2	t	*	*	*
(1) IPI transp.	2	**0.52**	2	s		*	*	**0.76**	1	t	*	*	*	**0.73**	2	s		*	*
equipment, (2)	3	**0.69**	2	s	*	*	*	**0.65**	1	s	*	*	*	**0.65**	1	t	*	*	*
Cement sales	4	**0.62**	1	t	*	*	*	**0.63**	1	s	*		*	**0.43**	1	t	*	*	*
and (3) Cement imports	Mean	**0.69**	2	s				**0.68**	1	s				**0.75**	1	t			

		Private Residential						Private Productive					
		Specification						Specification					
		Initial		Final				Initial		Final			
		RMSE	k	Dat	AR	Sur	Ind	RMSE	k	Dat	AR	Sur	Ind
	h		(1)	(2)	(3)	(4)	(5)		(1)	(2)	(3)	(4)	(5)
Indicator 5	1	**0.91**	1	s	*	*		1.33	1	s		*	*
- IPI Investment	2	**0.61**	5	s		*	*	**0.49**	1	s		*	
goods	3	**0.87**	2	s		*		**0.64**	5	s		*	
excluding	4	**0.73**	2	t		*		**0.67**	2	s	*	*	
transportation equipment	Mean	**0.90**	5	s				**0.85**	1	s			
Indicator 6	1	**0.57**	1	s		*	*	1.13	2	s		*	*
- Cement sales	2	**0.63**	5	s		*		**0.61**	1	s		*	
	3	**0.88**	1	t		*		**0.67**	1	s		*	
	4	**0.80**	3	t		*		**0.73**	3	s	*	*	
	Mean	**0.79**	5	s				**0.82**	2	s			
Indicator 7	1	1.08	1	s	*	*		1.02	1	s	*	*	
- Imports of	2	**0.61**	5	s		*		**0.57**	1	s		*	
cement	3	**0.90**	5	s		*		**0.75**	3	s		*	
	4	**0.74**	1	t		*		**0.73**	3	s	*	*	
	Mean	**0.91**	5	s				**0.87**	1	s			
Chosen Indicators:	1	**0.57**	1	s		*	*	1.14	2	s		*	*
(1) IPI transp.	2	1.12	2	s	*	*	*	**0.98**	1	t	*		*
equipment, (2)	3	1.02	1	t		*	*	**0.68**	1	s	*	*	*
Cement sales	4	**0.90**	1	s		*	*	**0.75**	2	s	*	*	
and (3) Cement imports	Mean	**0.96**	1	t				**0.91**	2	s			

		Construction						Overall excl. construction					
		Specification						Specification					
		Initial		Final				Initial		Final			
		RMSE	k	Dat	AR	Sur	Ind	RMSE	k	Dat	AR	Sur	Ind
	h		(1)	(2)	(3)	(4)	(5)		(1)	(2)	(3)	(4)	(5)
Indicator 5	1	**0.86**	4	s	*	*	*	**0.95**	2	s		*	*
- IPI Investment	2	**0.67**	2	s		*		**0.76**	4	s		*	*
goods	3	**0.70**	2	s		*		**0.91**	1	s		*	
excluding	4	**0.75**	1	s	*	*		**0.79**	1	t	*	*	
transportation equipment	Mean	**0.83**	2	s				**0.88**	1	s			
Indicator 6	1	**0.52**	2	s	*	*	*	**0.97**	2	s		*	*
- Cement sales	2	**0.70**	5	s	*	*	*	**0.72**	4	s		*	
	3	**0.47**	5	s	*	*		**0.89**	4	s		*	
	4	**0.73**	1	s	*	*	*	**0.79**	1	t	*	*	*
	Mean	**0.64**	5	s				**0.88**	1	s			
Indicator 7	1	**0.54**	4	s	*	*		**0.82**	1	s		*	
- Imports of	2	**0.67**	5	s	*	*	*	**0.76**	4	s		*	
cement	3	**0.70**	2	s		*		**0.88**	3	t		*	
	4	**0.67**	5	s	*	*	*	**0.80**	1	s	*	*	
	Mean	**0.70**	5	s				**0.84**	1	s			
Chosen Indicators:	1	**0.51**	2	s		*	*	**0.87**	2	s	*	*	*
(1) IPI transp.	2	**0.70**	1	s	*	*	*	**0.81**	2	s		*	*
equipment, (2)	3	**0.68**	2	s		*	*	**0.81**	1	s		*	*
Cement sales	4	**0.76**	1	s	*	*	*	**0.81**	2	t	*	*	*
and (3) Cement imports	Mean	**0.70**	1	s				**0.85**	2	s			

Source: Authors' calculations.

Table 4 (to be continued)

OUT-OF-SAMPLE RMSE FOR GFCF YEAR-ON-YEAR FORECASTS

		Overall					
		Specification					
		Initial		Final			
		RMSE	k	Dat	AR	Sur	Ind
	h		(1)	(2)	(3)	(4)	(5)
Method 0	1	0.026	2				
- AR Model	2	0.035	4				
	3	0.041	2				
	4	0.040	2				
	Mean	0.036	3				
Method 1	1	0.85	1	t	*	*	
- Just surveys	2	0.79	3	s	*	*	
	3	0.65	2	t	*	*	
	4	0.77	4	t	*	*	
	Mean	0.89	5	s			
Indicator 1	1	0.85	1	t	*	*	
- Sales of heavy	2	0.76	3	s	*	*	
commercial	3	0.65	2	t	*	*	
vehicles	4	0.77	4	t	*	*	
	Mean	0.86	3	s			
Indicador 2	1	0.79	1	t	*	*	*
- IPI -	2	0.78	3	s	*	*	*
Investment	3	0.65	5	s	*	*	
goods	4	0.77	1	s	*	*	*
	Mean	0.82	5	s			
Indicator 3	1	0.67	5	t	*	*	*
- IPI -	2	0.94	5	s	*	*	*
Investment	3	0.54	2	t	*	*	*
goods	4	0.77	4	t	*	*	
	Mean	0.80	2	t			
Indicador 4	1	0.31	5	t	*	*	*
- IPI	2	0.83	5	t	*	*	*
Transportation	3	0.53	2	t	*	*	*
equipment	4	0.77	4	t	*	*	
manufacture	Mean	0.71	2	t			

		Public					
		Specification					
		Initial		Final			
		RMSE	k	Dat	AR	Sur	Ind
	h		(1)	(2)	(3)	(4)	(5)
Method 0	1	0.094	3				
- AR Model	2	0.091	3				
	3	0.131	2				
	4	0.143	4				
	Mean	0.122	3				
Method 1	1	0.78	5	s	*	*	
- Just surveys	2	0.63	5	s	*	*	
	3	0.53	4	s	*	*	
	4	0.60	4	t	*	*	
	Mean	0.62	4	s			
Indicator 1	1	0.78	5	s	*	*	
- Sales of heavy	2	0.79	5	s	*	*	
commercial	3	0.57	4	s	*	*	
vehicles	4	0.62	4	t	*	*	
	Mean	0.69	4	s			
Indicador 2	1	0.71	4	s	*	*	*
- IPI -	2	0.66	5	s	*	*	*
Investment	3	0.49	4	s	*	*	
goods	4	0.59	5	t	*	*	
	Mean	0.57	4	s			
Indicator 3	1	0.91	5	s	*	*	
- IPI -	2	0.73	4	s	*	*	
Investment	3	0.53	4	s	*	*	*
goods	4	0.63	4	t	*	*	
	Mean	0.66	4	s			
Indicador 4	1	0.75	3	s	*	*	
- IPI	2	0.64	5	s	*	*	
Transportation	3	0.62	4	s	*	*	
equipment	4	0.58	4	t	*	*	
manufacture	Mean	0.64	4	s			

		Private					
		Specification					
		Initial		Final			
		RMSE	k	Dat	AR	Sur	Ind
	h		(1)	(2)	(3)	(4)	(5)
Method 0	1	0.022	1				
- AR Model	2	0.033	4				
	3	0.035	1				
	4	0.032	2				
	Mean	0.031	2				
Method 1	1	0.88	2	t	*	*	
- Just surveys	2	0.87	4	s	*	*	
	3	0.43	2	t	*	*	
	4	0.49	1	s	*	*	
	Mean	0.83	4	s			
Indicator 1	1	1.01	2	t	*	*	
- Sales of heavy	2	0.80	4	t	*	*	
commercial	3	0.43	2	t	*	*	
vehicles	4	0.54	1	s	*	*	
	Mean	0.83	5	t			
Indicador 2	1	0.88	2	t	*	*	
- IPI -	2	0.87	4	s	*	*	*
Investment	3	0.43	2	t	*	*	
goods	4	0.44	1	s	*	*	*
	Mean	0.80	2	t			
Indicator 3	1	0.71	1	t	*	*	*
- IPI -	2	1.14	3	s	*	*	
Investment	3	0.43	2	t	*	*	
goods	4	0.49	1	s	*	*	
	Mean	0.79	2	t			
Indicador 4	1	0.57	1	t	*	*	*
- IPI	2	0.79	4	s	*	*	*
Transportation	3	0.43	2	t	*	*	
equipment	4	0.58	4	s	*	*	*
manufacture	Mean	0.75	4	s			

		Private Residential					
		Specification					
		Initial		Final			
		RMSE	k	Dat	AR	Sur	Ind
	h		(1)	(2)	(3)	(4)	(5)
Method 0	1	0.030	4				
- AR Model	2	0.040	2				
	3	0.036	1				
	4	0.034	1				
	Mean	0.036	1				
Method 1	1	0.82	2	t	*	*	
- Just surveys	2	0.88	1	t	*	*	
	3	0.95	3	t	*	*	
	4	1.12	5	t	*	*	
	Mean	1.06	3	t			
Indicator 1	1	1.24	2	t	*	*	*
- Sales of heavy	2	0.81	1	t	*	*	*
commercial	3	0.95	2	t	*	*	*
vehicles	4	1.04	5	t	*	*	*
	Mean	1.07	5	t			
Indicador 2	1	0.79	2	t	*	*	*
- IPI -	2	0.85	1	t	*	*	*
Investment	3	1.00	3	t	*	*	*
goods	4	1.11	5	t	*	*	*
	Mean	0.98	3	t			
Indicator 3	1	0.69	2	t	*	*	*
- IPI -	2	0.84	1	t	*	*	*
Investment	3	0.99	2	t	*	*	
goods	4	1.01	5	t	*	*	
	Mean	0.97	5	t			
Indicador 4	1	0.63	3	t	*	*	*
- IPI	2	0.80	5	t	*	*	*
Transportation	3	0.90	2	t	*	*	*
equipment	4	1.12	5	t	*	*	
manufacture	Mean	0.95	5	t			

		Private Productive					
		Specification					
		Initial		Final			
		RMSE	k	Dat	AR	Sur	Ind
	h		(1)	(2)	(3)	(4)	(5)
Method 0	1	0.022	1				
- AR Model	2	0.034	4				
	3	0.036	1				
	4	0.034	2				
	Mean	0.032	2				
Method 1	1	0.98	1	t	*	*	
- Just surveys	2	1.12	1	t	*	*	
	3	0.63	1	s	*	*	
	4	0.57	1	t	*	*	
	Mean	0.86	1	t			
Indicator 1	1	0.99	3	s	*	*	
- Sales of heavy	2	0.96	5	s	*	*	
commercial	3	0.54	1	s	*	*	*
vehicles	4	0.68	2	s	*	*	
	Mean	0.83	2	s			
Indicador 2	1	0.98	1	t	*	*	
- IPI -	2	1.05	1	t	*	*	*
Investment	3	0.63	1	s	*	*	
goods	4	0.52	2	t	*	*	*
	Mean	0.84	1	t			
Indicator 3	1	0.67	4	s	*	*	*
- IPI -	2	1.12	1	t	*	*	
Investment	3	0.63	1	s	*	*	
goods	4	0.57	1	t	*	*	
	Mean	0.84	4	s			
Indicador 4	1	0.49	4	s	*	*	*
- IPI	2	0.97	5	s	*	*	*
Transportation	3	0.63	1	s	*	*	
equipment	4	0.55	2	t	*	*	
manufacture	Mean	0.77	4	s			

		Construction					
		Specification					
		Initial		Final			
		RMSE	k	Dat	AR	Sur	Ind
	h		(1)	(2)	(3)	(4)	(5)
Method 0	1	0.033	4				
- AR Model	2	0.045	3				
	3	0.054	4				
	4	0.055	4				
	Mean	0.048	4				
Method 1	1	0.79	5	t	*	*	
- Just surveys	2	0.52	5	s	*	*	
	3	0.59	3	t	*	*	
	4	0.59	5	t	*	*	
	Mean	0.66	5	t			
Indicator 1	1	0.89	2	t	*	*	
- Sales of heavy	2	0.47	5	s	*	*	
commercial	3	0.52	3	t	*	*	*
vehicles	4	0.59	5	t	*	*	
	Mean	0.70	5	s			
Indicador 2	1	0.90	5	t	*	*	
- IPI -	2	0.50	5	s	*	*	
Investment	3	0.58	3	t	*	*	
goods	4	0.59	5	t	*	*	
	Mean	0.69	4	t			
Indicator 3	1	0.87	2	s	*	*	*
- IPI -	2	0.52	5	s	*	*	
Investment	3	0.63	5	s	*	*	
goods	4	0.71	5	t	*	*	
	Mean	0.72	4	t			
Indicador 4	1	0.73	2	s	*	*	*
- IPI	2	0.40	4	t	*	*	
Transportation	3	0.55	3	t	*	*	
equipment	4	0.79	4	t	*	*	
manufacture	Mean	0.63	4	t			

		Overall excl. construction					
		Specification					
		Initial		Final			
		RMSE	k	Dat	AR	Sur	Ind
	h		(1)	(2)	(3)	(4)	(5)
Method 0	1	0.029	1				
- AR Model	2	0.041	1				
	3	0.043	1				
	4	0.044	1				
	Mean	0.039	1				
Method 1	1	1.04	1	t	*	*	
- Just surveys	2	0.89	4	s	*	*	
	3	0.47	5	t	*	*	
	4	0.62	5	s	*	*	
	Mean	0.80	3	s			
Indicator 1	1	1.04	1	t	*	*	
- Sales of heavy	2	0.95	5	t	*	*	
commercial	3	0.53	5	t	*	*	
vehicles	4	0.65	2	s		*	
	Mean	0.81	2	s			
Indicador 2	1	1.04	1	t	*	*	
- IPI -	2	0.77	4	s	*	*	*
Investment	3	0.47	4	t	*	*	*
goods	4	0.64	2	s		*	
	Mean	0.77	5	s			
Indicator 3	1	1.10	1	t	*	*	
- IPI -	2	0.88	4	s	*	*	
Investment	3	0.47	5	t	*	*	
goods	4	0.64	2	s		*	
	Mean	0.79	3	s			
Indicador 4	1	0.98	1	t	*	*	*
- IPI	2	0.70	5	s	*	*	*
Transportation	3	0.37	5	t	*	*	*
equipment	4	0.64	2	s		*	
manufacture	Mean	0.77	5	s			

Table 4 (continued)

OUT-OF-SAMPLE RMSE FOR GFCF YEAR-ON-YEAR FORECASTS

		Overall						Public						Private					
			Specification						Specification						Specification				
			Initial	Final					Initial	Final					Initial	Final			
		RMSE	k	Dat	AR	Sur	Ind	RMSE	k	Dat	AR	Sur	Ind	RMSE	k	Dat	AR	Sur	Ind
	h		(1)	(2)	(3)	(4)	(5)		(1)	(2)	(3)	(4)	(5)		(1)	(2)	(3)	(4)	(5)
Indicator 5	1	**0.84**	1	s	*	*	*	**0.85**	3	s	*	*		1.00	3	s	*	*	*
- IPI Investment	2	**0.97**	5	s	*	*		**0.76**	3	s	*	*	*	**0.94**	3	s	*	*	*
goods	3	**0.63**	5	s	*	*	*	**0.58**	4	s	*	*		**0.43**	2	t	*	*	
excluding	4	**0.70**	5	t	*	*		**0.58**	4	s	*	*	*	**0.60**	1	s	*	*	*
transportation																			
equipment	Mean	**0.91**	2	t				**0.64**	4	s				**0.82**	4	s			
Indicator 6	1	**0.49**	1	t	*	*	*	**0.81**	3	s	*	*		**0.56**	1	t	*	*	*
- Cement sales	2	**0.86**	3	s	*	*		**0.69**	4	s	*	*		**0.87**	4	s	*	*	
	3	**0.77**	2	t	*	*	*	**0.50**	4	s	*	*		**0.46**	2	t	*	*	
	4	**0.77**	4	t	*	*		**0.56**	4	t	*	*		**0.49**	1	s	*	*	
	Mean	**0.83**	2	t				**0.63**	4	s				**0.76**	4	s			
Indicator 7	1	**0.85**	1	t	*	*		**0.73**	1	t	*	*	*	**0.88**	2	t	*	*	
- Imports of	2	**0.79**	3	s	*	*		**0.75**	5	s	*	*		**0.80**	5	s	*	*	
cement	3	**0.65**	2	t	*	*		**0.60**	5	t	*	*		**0.43**	2	t	*	*	
	4	**0.76**	5	t	*	*		**0.61**	3	t	*	*	*	**0.49**	1	s	*	*	
	Mean	**0.87**	2	t				**0.68**	4	s				**0.85**	4	s			
Chosen																			
Indicators:	1	**0.35**	1	s	*	*	*	**0.75**	1	t	*	*	*	**0.55**	1	t	*	*	*
(1) IPI transp.	2	**0.96**	1	t	*	*	*	**0.79**	2	s	*	*		1.13	2	s	*	*	*
equipment, (2)	3	**0.77**	2	t	*	*	*	**0.70**	2	s	*	*		**0.44**	2	t	*	*	
Cement sales	4	**0.79**	1	s	*	*		**0.71**	2	t	*	*	*	**0.61**	1	s	*	*	
and (3) Cement																			
Imports	Mean	**0.76**	2	t				**0.69**	2	s				**0.80**	2	t			

		Private Residential						Private Productive					
			Specification						Specification				
			Initial	Final					Initial	Final			
		RMSE	k	Dat	AR	Sur	Ind	RMSE	k	Dat	AR	Sur	Ind
	h		(1)	(2)	(3)	(4)	(5)		(1)	(2)	(3)	(4)	(5)
Indicator 5	1	**0.94**	4	s	*	*		1.02	1	t	*	*	*
- IPI Investment	2	**0.85**	1	t	*	*	*	1.12	1	t	*	*	
goods	3	**0.90**	3	t	*	*		**0.54**	2	s	*	*	*
excluding	4	1.12	5	t	*	*		**0.59**	1	t	*	*	
transportation													
equipment	Mean	1.06	5	t				**0.85**	1	t			
Indicator 6	1	**0.39**	2	s	*		*	**0.69**	1	t	*	*	*
- Cement sales	2	**0.86**	1	t	*	*	*	1.08	5	t	*	*	*
	3	**0.97**	2	t	*	*		**0.70**	1	s	*	*	
	4	1.11	5	s	*	*	*	**0.57**	1	t	*	*	
	Mean	1.01	5	t				**0.82**	1	t			
Indicator 7	1	**0.82**	2	t	*	*		**0.98**	1	t	*	*	
- Imports of	2	**0.88**	1	t	*	*		**0.93**	1	t	*	*	*
cement	3	**0.96**	1	t	*	*		**0.42**	2	t	*	*	*
	4	1.12	5	t	*	*		**0.37**	1	t	*	*	*
	Mean	1.09	5	t				**0.68**	1	t			
Chosen													
Indicators:	1	**0.57**	1	t	*	*	*	**0.67**	1	t	*	*	*
(1) IPI transp.	2	**0.80**	1	t	*	*	*	1.04	1	t	*	*	*
equipment, (2)	3	**0.48**	2	t	*	*	*	**0.47**	2	t	*	*	*
Cement sales	4	1.71	1	s	*	*	*	**0.34**	1	t	*	*	*
and (3) Cement													
Imports	Mean	1.03	2	t				**0.65**	1	t			

		Construction						Overall excl. construction					
			Specification						Specification				
			Initial	Final					Initial	Final			
		RMSE	k	Dat	AR	Sur	Ind	RMSE	k	Dat	AR	Sur	Ind
	h		(1)	(2)	(3)	(4)	(5)		(1)	(2)	(3)	(4)	(5)
Indicator 5	1	**0.88**	3	s	*	*	*	1.04	3	t	*	*	
- IPI Investment	2	**0.49**	5	s	*	*	*	**0.89**	4	s	*	*	
goods	3	**0.69**	4	t	*	*		**0.47**	5	t	*	*	
excluding	4	**0.78**	5	t	*	*	*	**0.48**	5	s	*	*	*
transportation													
equipment	Mean	**0.74**	5	s				**0.74**	5	s			
Indicator 6	1	**0.51**	4	t		*	*	1.02	1	t	*	*	*
- Cement sales	2	**0.59**	5	s	*	*		**0.88**	5	s	*	*	*
	3	**0.59**	3	t	*	*		**0.51**	2	s	*	*	*
	4	**0.58**	5	t	*	*	*	**0.58**	3	s	*	*	*
	Mean	**0.60**	5	t				**0.78**	3	s			
Indicator 7	1	**0.78**	5	t	*	*		**0.98**	1	t	*	*	*
- Imports of	2	**0.64**	5	s	*	*	*	**0.71**	5	s	*	*	*
cement	3	**0.59**	3	t	*	*		**0.42**	5	t	*	*	*
	4	**0.47**	5	t	*	*	*	**0.49**	1	s	*	*	*
	Mean	**0.64**	5	t				**0.68**	1	s			
Chosen													
Indicators:	1	**0.46**	1	s	*	*	*	**0.90**	1	t	*	*	*
(1) IPI transp.	2	**0.70**	1	s	*	*	*	1.11	1	t	*	*	*
equipment, (2)	3	**0.76**	2	t	*	*	*	**0.44**	2	s	*	*	*
Cement sales	4	**0.63**	1	t		*	*	**0.53**	1	s	*	*	*
and (3) Cement													
Imports	Mean	**0.73**	1	t				**0.75**	2	s			

Source: Authors' calculations.