APPLICATIONS OF BENCHMARKING TECHNIQUES IN OFFICIAL STATISTICS

A MONTHLY INDICATOR OF THE BUSINESS CLIMATE IN THE FRENCH SERVICE INDUSTRY

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Abstract

Since September 2004, Insee has published the results of its business survey in the services sector on a monthly basis together with a synthetic indicator. This indicator is extracted from both monthly and quarterly balances of opinion derived from the survey. The methodological framework is provided by dynamic factor analysis. Indeed, it is flexible enough to deal with both multi frequency series and changes in frequencies. This model has a state-space representation and can be estimated by a Kalman filter. Alternative models have been explored and yield very similar indexes, which emphasizes the robustness of the Insee indicator.

This index can be obtained at a disaggregated level and provides an economic outlook of the services sector. Thus, it confirms the resurgence of activity in the services sector in France since mid-2003. More precisely, the activity appeared to be rather bumpy in 2004 and tends to decelerate in the beginning of 2005.

Keywords: business surveys, short-term analysis, dynamic factor analysis, unobserved components model, Kalman filter, multifrequency data.

Introduction

Traditionally, economic analysts have relied more on qualitative and quantitative data coming from the industrial sector than the services sector. This may be due to the relative abundance of statistical data dedicated to the first sector. This is however detrimental since the services sector accounts for a large part of total value added.

In order to improve upon the thoroughness and the quality of the data at hand, Insee has published the results of its services business survey on a monthly basis together with a synthetic indicator since September 2004. This indicator was built in order to get an easier interpretation of the survey's results and to provide a better economic outlook.

We chose the dynamic factor analysis to extract a synthetic indicator from the main balances of opinion of the services business survey. Indeed, this framework is large enough to deal with the multifrequency data of the survey. More precisely, each balance of opinion can be seen as the sum of two orthogonal components: a factor common to all the balances of opinion and a second component specific to each balance. Each term is modelized by an ARMA (Autoregressive Moving Average) process. The parameters are estimated through a Kalman filter. The synthetic indicator is then the expected value of the common factor conditionnally on past information.

As in the manufacturing sector, the services indicator can be interpreted as a measure of the business climate from the leaders' point of view. It represents an early signal of the activity in the services sector and complements its industrial counterpart. Moreover, the services indicator can be broken down into the three sub sectors of the services domain: business activities, personal service activities and real estate activities. All in all, these indicators provide a better insight of the underlying economic trend of the services sector.

The synthetic indicator confirms the resurgence of activity in the services sector in France since mid-2003. The activity appeared to be rather bumpy in 2004 and tends to decelerate in the beginning of 2005.

1. The Insee business survey plays a key role to measure the activity in the services sector

1.1. The services sector is crucial to the analysis and understanding of the global economic activity

Traditionally, analysts used to favour the results from the business survey in industry, "Activité dans l'industrie". Two main reasons for that:

- first, analysts are above all concerned about the contribution to the global growth of the economy; the industrial activity only represents 27% of the value added (VA) - which is less than the services sector's share in the VA - however, it contributes up to 36% to the variance of the value added (see figure 1);
- furthermore, historically, more data are available in the industrial sector and with a longer time span.

However, in France, as in the other developed economies, the services sector tends to play an increasing role:

- this sector represents 40% of the whole value added;
- it explains about 25% of the value added variance;
- from 1980 to 2004, the percentage of service activities in the employment of the competitive sector increased by 15 points, from 20% to 35%, in line with the outsourcing of some jobs in the industry and the recent growth of temporary work.

Thus, having an accurate insight of the services sector seems crucial to better understand the overall economic outlook. In this respect, the services business survey conducted by Insee plays a key role, as it yields the first available data.

Table 1 - Breakdown of the value added (in %)

	Breakdown of the value added…	
	… from 1978 to 1982	*… from 2000 to 2004*
Industry	28	27
Service industries	37	40
• Business activities	15	19
• Personal service activities	13	14
• Real estate activities	9	7
Other trading activities	35	33
Trading activities	*100*	*100*

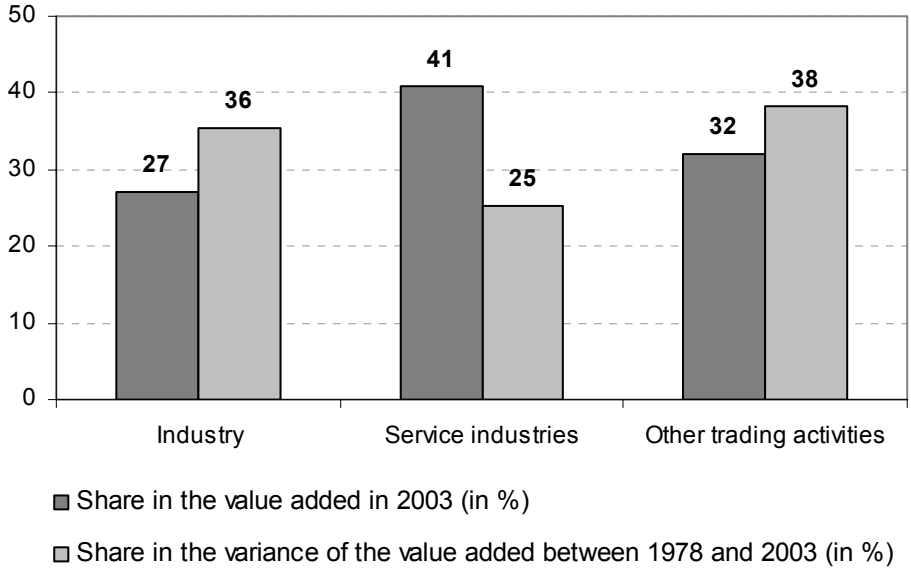
Source : Insee

Table 2 - Breakdown of the employment (in %)

	Breakdown of the employment…	
	… from 1978 to 1982	*… from 2000 to 2004*
Industry	41	27
Service industries	20	35
• Business activities	11	21
• Personal service activities	7	12
• Real estate activities	1	2
Other trading activities	40	39
Trading activities	*100*	*100*

Source : Insee

Figure 1 - Breakdown of the value added and its variance (in %)



1.2. The Insee business survey in the services sector

Insee has carried out a business survey in the services sector since January 1988. The field investigated covers: real estate activities, business activities and personal service activites. It leaves aside financial intermediation and transport.

Initially, the survey was quarterly. Since June 2000, most questions are asked every month in a light questionnaire. The survey results have been published on a monthly basis since September 2004.

Every month, the companies are questioned about their activity in the past three months and their expectations for the next three months. The managers also tell what they think about the global economic outlook of their sectors. Other questions are asked regarding the evolution of the total number of employees and the selling prices. Additional questions are asked to the company leaders once a quarter, concerning the recent and expected evolution of their operating results and the expected demand for their products.

It should be kept in mind that the questions are qualitative, generally with three possible answers: improvement, no change or deterioration. The breakdown between these three possible answers is displayed in the form of a balance of opinion, that is the difference between the percentage of firms posting an improvement and the percentage posting a deterioration. The month-by-month observation of these balances makes it possible to monitor the evolution of company managers' opinions on these questions.

As a general thing, business surveys offer some decisive advantages over hard data:

- first of all, they provide a signal that is obtained directly from the economic leaders regarding the short-term evolution of their activity;
- moreover, they are published very soon, by the end of the month of the data collection, in other words sooner than the main macroeconomic aggregates;
- lastly, the results are subject to only very minor corrections. Insee updates the raw results of a given survey when the next survey is published, by taking late responses into account. Seasonally-adjusted series are subject to slight changes as seasonal coefficients are estimated once a year.

However, the interpretation of the survey results is not straightforward for at least two reasons:

- the profile of a given balance of opinion can be quite volatile on a monthly basis;
- the profiles of all the balances of opinion can display opposite evolutions.

To get an easy interpretation, is it possible to sum up the common information between the main balances of opinion derived from a business survey?

2. Extraction of a monthly synthetic indicator for the services sector in a dynamic factor analysis framework

2.1. A monthly synthetic indicator gives a better understanding of the business climate in the services sector

This issue has been explored for the industrial survey in the mid 1990's. In order to simplify the interpretation of the business survey in the industrial sector, Insee has in recent years adopted a methodology, namely factor analysis, involving breaking down each balance of opinion into two orthogonal components. One of these is common to all the balances of opinion; the other is specific to the question being considered. The common tendency underlying the main questions of the survey, also known as the common factor, turns out to be a "summary" of the information contained in the survey and has been named the indicator of the business climate (BCI for Business Climate Indicator). This methodology is used by Insee to compile and publish every month a set of national indicators as well as an indicator for the euro zone relative to the industrial sector. This indicator gives a simple and understandable signal.

The six main balances of opinion of the services survey are taken into account to build a synthetic indicator. Even if the construction of a synthetic indicator for the services sector brings additional technical difficulties, the general framework of factor analysis is flexible enough to extract such an indicator. As its industrial counterpart, the latter is a measure of the business climate depicted by the company managers and gives a useful signal of the economic activity.

2.2. Methodology for the construction of a synthetic indicator in the services sector in France

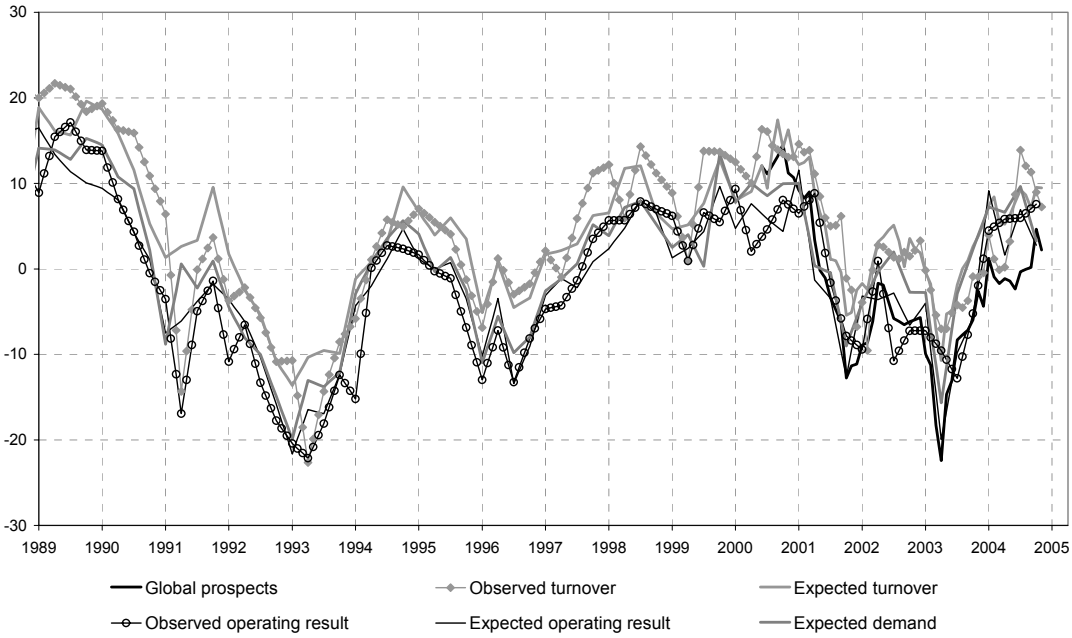
The balances of opinion used in the analysis

We would like to extract a common signal between the main balances of opinion of the services survey: past activity, expected activity, general expectations, expected demand, past operating result, expected operating result. The first three series are monthly since June 2000, while the three others have remained quarterly.

Table 3 - The series used in the extraction of a common factor

Series	*Description*	*Frequency*	*Available since*	*Notes*
OOR	Observed operating result	Quarterly	1988 Q1	
EOP	Expected operating result	Quarterly	1988 Q1	
ED	Expected demand	Quarterly	1988 Q1	
OT	Observed turnover	Quarterly / monthly	1988 Q1 / June 2000	Monthly since June 2000
ET	Expected turnover	Quarterly / monthly	1988 Q1 / June 2000	Monthly since June 2000
GP	Global prospects	Monthly	June 2000	Unavailable before June 2000

Figure 2 - The series used in the extraction of a common factor



The unobserved components model

Each balance of opinion is seen as the sum of two unobserved terms:

- a term proportional to the common factor ($\lambda_i F_t$);
- a component specific to the considered balance of opinion and called residual (u_{it}).

Notice that we are facing two types of difficulties: multiple frequencies (quarterly and monthly series) and breaks in frequencies (for example, the series on expected turnover became monthly in June 2000). So, the static factor analysis is not appropriate to handle this case. Following Doz and Lenglart, we consider this problem in a dynamic factor analysis framework and choose an ARMA(2,1) dynamic for the common factor and an AR(1) for the residuals.

Thus, we get the following monthly parametric model:

$$\begin{cases} y_{it} = \lambda_i F_t + u_{it} \\ F_t = \varphi_1 \, F_{t-1} + \varphi_2 \, F_{t-2} + \varepsilon_t - \theta \, \varepsilon_{t-1} \\ u_{it} = \rho_i \, u_{it-1} + \varepsilon_{it} \end{cases}$$

The common factor F_t being defined up to a multiplicative constant, we set: $\mathrm{V}(\varepsilon_t) = 1$.

(ε_t) and (ε_{it}) are the innovations of respectively (F_t) and (u_{it}); (ε_t) and (ε_{it}) are independent gaussian white noises, with respective variances 1 and σ_i^2.

y_i $(i = 1...6)$ represent the six balances of opinion. They are standardized.

The real parameters of this model are: $\lambda_i, \varphi_1, \varphi_2, \theta, \sigma_i, \rho_i$.

Recall that:

- this is a monthly model;
- all variables are not observed every month - for example, the quaterly series are observed every three months;
- before June 2000 (when the survey became monthly), only quarterly balances of opinion are observed;
- the balance of opinion on global prospects is available only since June 2000.

Latent state-space representation of the model

The unobserved components model admits the following linear state-space representation:

$$y_t = Z_t\,\alpha_t$$
$$\alpha_t = A\,\alpha_{t-1} + w_t$$
$$\alpha_1 \approx N(0,\Sigma) \quad (initial\ condition)$$

where:

- y_t is the column vector of balances of opinion for every month t; the dimension of this vector changes over time since the quarterly series are observed only every three months. Thus, before June 2000, the dimension of y_t is 0 or 5 and from June 2000, it is 3 or 6;
- Z_t is the measurement matrix; the number of lines of Z_t is equal to the number of observations at time t; it is thus time-dependent;
- $\alpha_t = (F_t, F_{t-1}, \varepsilon_t, u'_t)'$;
- $u_t = (u_{1t}, ..., u_{It})'$;
- $$A = \left(\begin{array}{ccc|ccc} \varphi_1 & \varphi_2 & -\theta & & & \\ 1 & 0 & 0 & & 0 & \\ 0 & 0 & 0 & & & \\ \hline & & & \rho_1 & & \\ & 0 & & & \ddots & \\ & & & & & \rho_I \end{array}\right) ;$$
- $$w_t = R\,\eta_t \quad ; \quad \eta_t = \begin{pmatrix} \varepsilon_t \\ \varepsilon_{it} \end{pmatrix} \quad ; \quad R = \left(\begin{array}{c|c} 1 & 0 \\ 0 & 0 \\ 1 & 0 \\ \hline 0 & Id(I) \end{array}\right) ;$$
- $$E(\eta_t) = 0 \quad ; \quad V(\eta_t) = B = \begin{pmatrix} 1 & & & \\ & \sigma_1^2 & & \\ & & \ddots & \\ & & & \sigma_I^2 \end{pmatrix} \quad ; \quad E(w_t) = 0 \quad ; \quad V(w_t) = R\,B\,R' \ ;$$
- I is the number of balances of opinion ($I = 6$) ;
- T is the number of months since January 1988 ($T = 206$ in February 2005).

Observed state-space representation of the model

The monthly latent state-space representation does not allow us to use Kalman filtering straightforwardly, since Z_t is null two months out of three from January 1988 to June 2000.

However, we can change the time frequency and get an irregular time series.

We obtain an observed model $y_{t'}$ with:

t' = 88-01, 88-04, 88-07, 88-10 … 00-01, 00-04, 00-06, 00-07 … 05-01, 05-02.

The new dates t' are the dates when we observe at least one variable. Call t_0 (t_0 = June 2000) the date from when we have monthly observations. The observed model has also a state-space representation:

$$y_{t'} = Z_{t'}\ \alpha_{t'}$$
$$\alpha_{t'} = A_{t'}\ \alpha_{t'-1} + w_{t'}$$

where:

- $y_{t'}$ is the column vector of balances of opinion for every date; its dimension is never equal to zero;
- $\alpha_{t'}$ and $Z_{t'}$ are unchanged;
- for $t' \leq t_0$, $A_{t'} = A^3$, $V(w_{t'}) = R\ B\ R' + A\ R\ B\ R'\ A' + A^2\ R\ B\ R'\ A'^2$ (see [1]);
  for $t' > t_0$, $A_{t'} = A$, $w_{t'} = w_t$;
  so, on the contrary of the first representation, $A_{t'}$ and $R_{t'}$ are time-dependent.

With this state-space representation, we can now apply a Kalman filter to compute the likelihood.

For the initialization of the filter, we simply set $\alpha_1 \approx N(0, Id)$ rather than the stationary solution. This choice is motivated by its computational advantage and the fact that the resulting estimator is asymptotically equivalent to the ML estimator.

Estimation of the parameters

The parameters are estimated by likelihood maximization using the BFGS (Broyden, Fletcher, Goldfarb, Shanno) algorithm.

The following parameters are estimated for the ARMA(2,1) dynamic of the common factor:

$$F_t = \underset{(0.05)}{1.90}\, F_{t-1} - \underset{(0.05)}{0.91}\, F_{t-2} + \varepsilon_t - \underset{(0.09)}{0.87}\, \varepsilon_{t-1}$$

[1] This comes from: $\alpha_t = A^3\ \alpha_{t-3} + w_t + A\ w_{t-1} + A^2\ w_{t-2}$

Table 4 - Parameter estimates

	λ_i		ρ_i		σ_i	
	estimate	**std**	**estimate**	**std**	**estimate**	**std**
OOR	0.21	0.02	0.00	0.01	0.33	0.03
EOR	0.22	0.02	0.38	0.34	0.25	0.04
ED	0.23	0.03	0.00	0.01	0.24	0.03
OT	0.21	0.02	0.64	0.08	0.30	0.03
ET	0.25	0.03	0.60	0.13	0.20	0.02
GP	0.28	0.03	0.87	0.09	0.17	0.04

Definition of the synthetic indicator

Once the parameters of the model are estimated, the services synthetic indicator (SSI) can be computed. This indicator is the expectation of the common factor F_t conditional on the information up to t: $SSI_t = \hat{F}_t = E(F_t | I_t)$.

Discussion of the statistical results

If we look at the estimated coefficients, they seem to reveal a unit root in the ARMA representation. This observation is directly linked to the persistence of the balances of opinion. This issue has already been pointed out by Doz and Lenglart (cf. Doz and Lenglart (1999)). In the present situation, it is even harder to conclude since fewer data are available; the usual tests (Augmented Dickey-Fuller, Phillips-Perron, Schmidt-Phillips, Elliott-Rothenberg-Stock) accept the null hypothesis of non-stationarity. That is why, in the sequel, we may consider the construction of a synthetic indicator rather as a descriptive approach.

2.3. Is the indicator of the business climate in the services sector robust?

Robustness is a highly desired characteristic when considering the opportunity of a new indicator. Indeed, we would rely more on our indicator if it shows some method-free properties. Moreover, for practical purposes, robustness also means the indicator will not be to much revised from one year to another. We assessed the robustness of the services common factor by:

- evaluating its response to a shock on global prospects, the series to which it is most correlated;
- comparing the indicator to three alternative common factors built under varying hypothesis.

In the short run, the services indicator appears to be very close to the balance of opinion on global prospects. However, it does not reproduce the pattern of this series since its response to a shock on the balance of opinion remains moderate.

The likeliness between the indicator and the balance of opinion on global prospects (see figure 3) suggests that the latter series is itself a good summary of the results of the services business survey.

It may be a concern that the indicator mirrors the evolution of global prospects. It is fortunately not the case as a shock applied on this series is only partially conveyed to the common factor (see figures 4 and 5). This experiment lends some confidence in the robustness of the indicator and its interest as a measure of the business climate.

Figure 3 - Global prospects and services synthetic indicator since June 2000

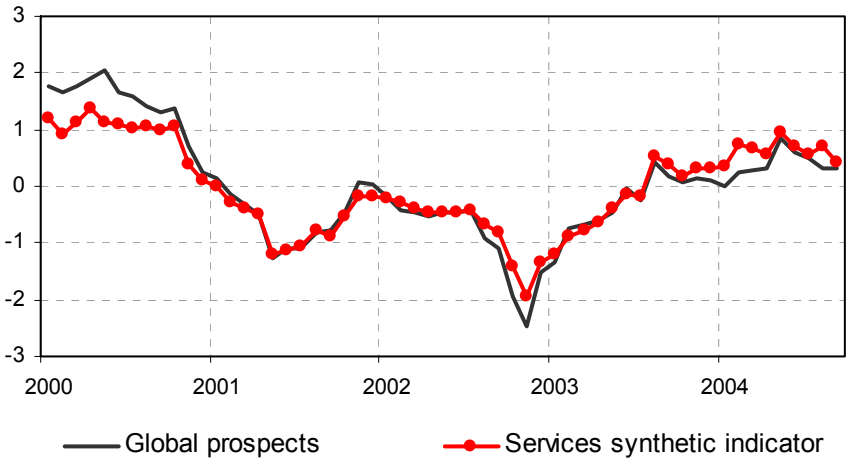
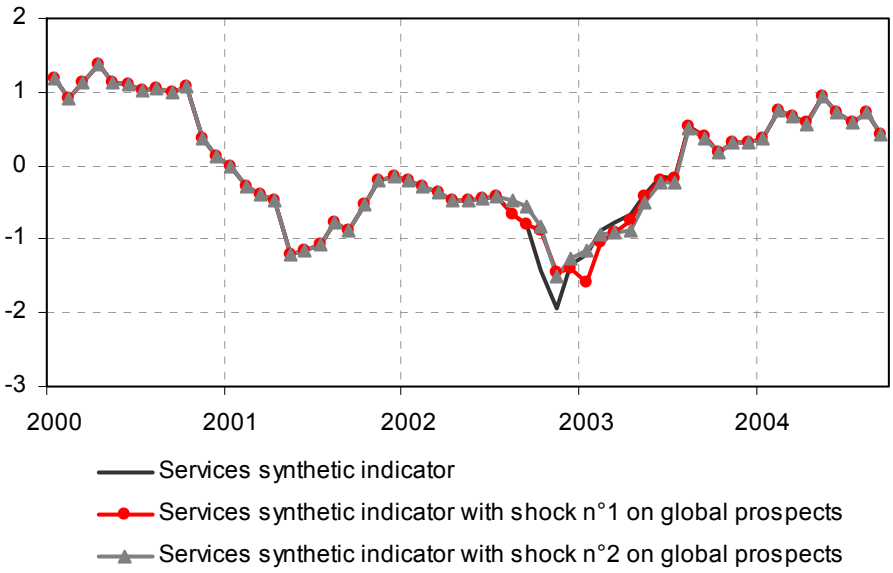


Figure 4 - Global prospects: original and stressed series

Figure 5 - The services indicator computed with a shock on global prospects



The indicator introduced in this paper appears to be quite close to alternative synthetic indicators relative to the services sector.

The services synthetic indicator (SSI) appears to be quite close to alternative indicators resulting from three different models (see figure 6). This is a further sign of its robustness.

- The alternative indicator n°1 (QS_SSI) is a quarterly indicator computed through a static analysis. It uses only 5 of the balances of opinion since the question on global prospects was introduced in 2000. This indicator is notably used in Bouton and Erkel-Rousse (2003) in addition to the industry synthetic indicator to forecast the French GDP. It is worthy to note the similarities of the two indicators although the quarterly static factor does not take global prospects into account. The main advantages of the dynamic factor over the static one are:
  - its timeliness as it is updated each month using the new information available;
  - its capacity to mix series of different frequencies.

- The alternative indicator n°2 (SSI_18) is based on the same unobserved components model (UCM) as SSI. But it uses the 18 subseries (6 series for each of the 3 subsectors: real estate activities, business activities, personal service activities) instead of the 6 balances of opinion relative to the services sector as a whole.

- The alternative indicator n°3 is also a dynamic factor derived from the 18 subseries. However it is based on a more elaborate UCM, in which each of the 18 opinion balances is the sum of a common part, a sector-based part and an idiosyncratic part. This model is thus made of an indicator common to all subseries and 3 additional sector-based indicators.

  In this model, each balance of opinion y_{it} is the sum of three terms:

  $y_{it} = \lambda_i F_t + \mu_i F_{j_i t} + u_{it}$, where $i = 1 \ldots 18$ and $j_i = 1 \ldots 3$ is the subsector to which y_i is related.

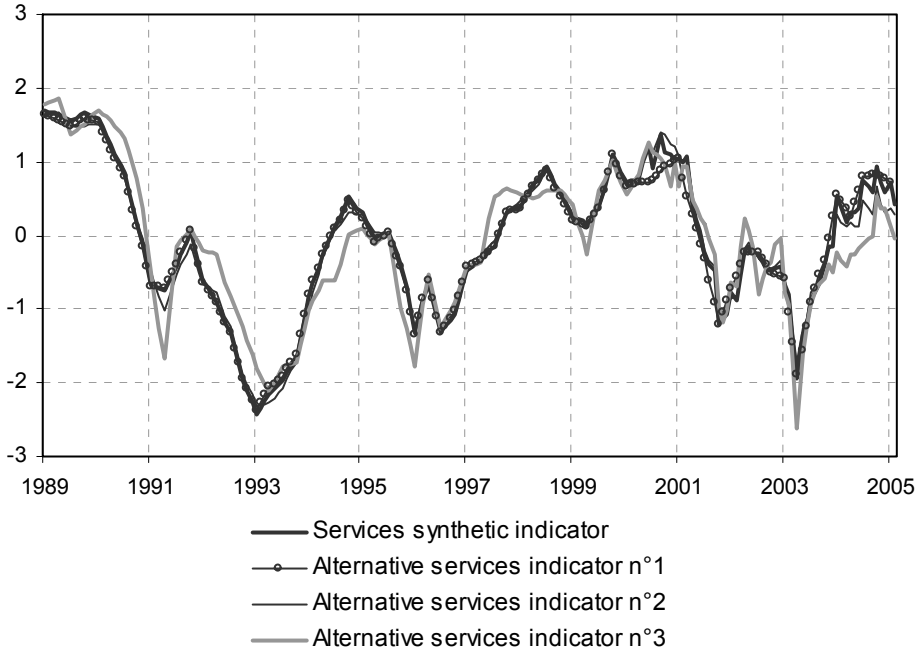
  Each sector-based indicator follows an AR(1) dynamic:

  $F_{jt} = \varphi_j F_{jt-1} + \varepsilon_{jt}$, where $j = 1 \ldots 3$.

Table 5 - Characteristics of the three estimated dynamic models

Indicator	Number of series	State dimension	Number of parameters
SSI	6	9	21
SSI_18	18	21	57
SSI_3_6	18	24	78

Figure 6 - A comparison of alternative synthetic indicators

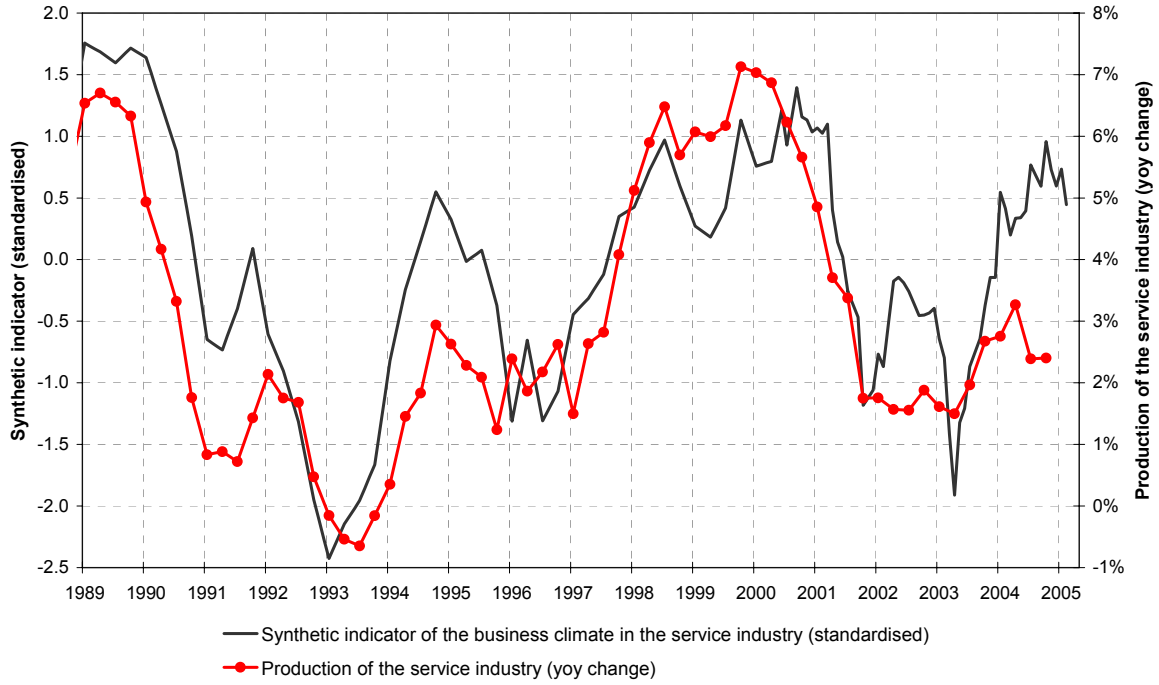


3. The role of the services indicator in short-term analysis

3.1. The services indicator gives an outline of the economic outlook in the services sector

The evolution of the economic outlook in the services sector in the last fifteen years can be read through this indicator, which is very correlated with the evolution of the services production (see figure 7) (the correlation coefficient between the indicator and the year-on-year change of the services production is equal to 81%).

Figure 7 - Synthetic indicator of the business climate and production in the services sector

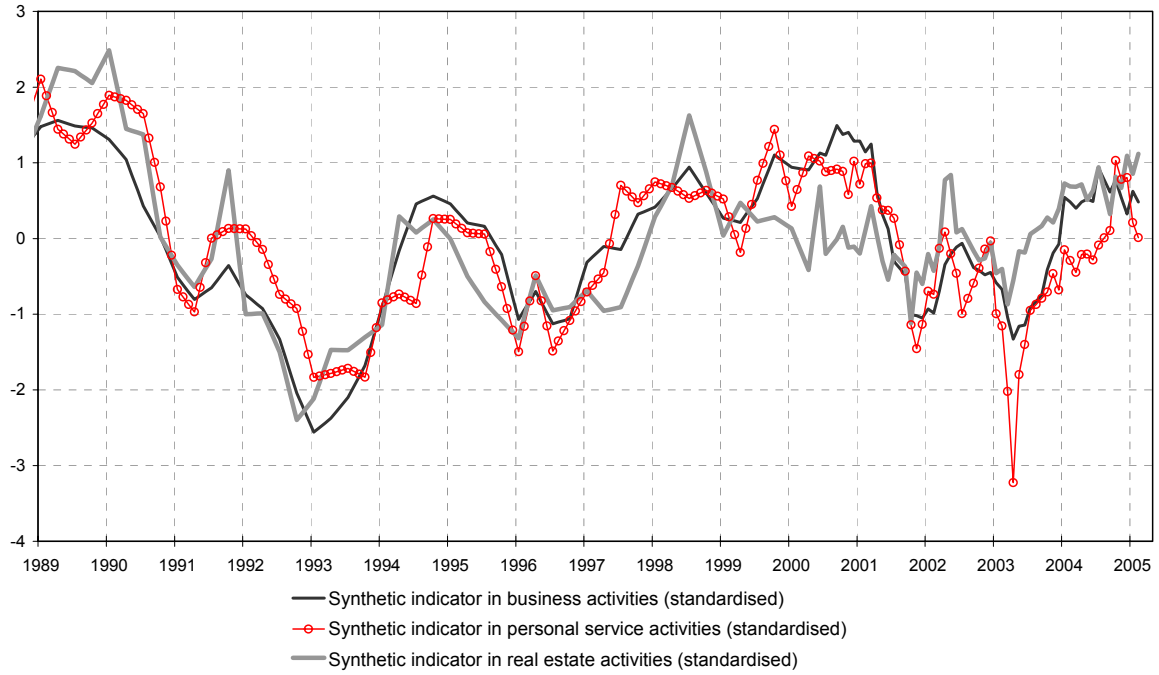


- From 1990 to 1993, the activity in the services slowed down after the strong growth of the late 80's. This slowdown, which is even stronger between 1992 and 1993, is well mirrored by the indicator.
- From 1996 to 2000, the services grow at a very dynamic rate, especially business activities and personal service activities. An explanation could lie in the boom of new technologies. This dynamic pattern took a break at the end of 1998. The financial crisis in several developing countries in particular in South East Asia brought about a temporary pause of the overall economy.
- From 2001 to 2003, the activity slowed down strongly. In 2002, the synthetic indicator showed a rebound, unlike the production: apparently, the early signals of a recovery brought the entrepreneurs to be more optimistic than necessary. Conversely, in Spring 2003, the indicator decreased a lot more than production: several financial events - among which the Enron affair and its repercussion on Andersen - and above all the Iraq War would have intensified the managers' pessimism.
- Since mid-2003, the indicator confirms the resurgence of activity in the services sector. In 2004, the activity appears to have been rather bumpy. It tends to decelerate in the beginning of 2005, after the survey results peaked in November 2004.

3.2. The reading of the indicators in the different sub sectors leads to a more accurate analysis

A similar synthetic indicator can be computed for the three sub sectors covered by the services survey: real estate activities, business activities and personal service activities (see figure 8). The comparison between the global indicator and the sector-based indicators gives a better understanding of the economic outlook.

Figure 8 - Sector-based synthetic indicators



- Business services account for half of the value added of the services sector. As a consequence, the synthetic indicator of this sub sector is very close to the global indicator. From 1994 to 1995, the business climate in this sub sector improved strongly thanks to the rebound in industrial investment. In 1997, the strong increase of the indicator can be partly explained by the expansion of temporary work due to the industrial recovery.
- After the recession of 1993, the straightening of activity in personal services seems less steady than in other sub sectors. In particular, in 1994-1995, the appreciation of the French Franc discouraged foreign tourists and put hotel and restaurant activities under stress. The wave of terrorist attacks in 1995 penalized tourism again. In 2001, the fall of the indicator in personal services is due to the conjunction of several events, among which the September 11th 2001 terrorist attack on America and the slow down of American economy. This sluggishness got even worse at the beginning of 2003 when the war against Iraq broke out: the indicator suddenly decreased. Since mid-2003, personal services activities have grown at a moderate pace, unlike the other sub sectors. Indeed, the increase of the indicator relative to personal services is more gradual than that of the global indicator.
- After a strong increase in the late 80's, real estate activities slowed down in the early 90's. From 1996 to 2001, the growth of this sub sector appears rather unstable as showed by the volatility of the sector-based indicator. After a stabilization in 2000 and a decrease in 2001, real estate activities have kept improving thanks to accommodating financial conditions and the "Besson" effect. At the same time, the synthetic indicator has been displaying a sharp increase.

3.3. The synthetic indicator is useful in order to forecast the quarterly growth of the services production

The services synthetic indicator (SSI) can be used to forecast the quarterly growth rate of the services production through a very simple calibration model. The following equation was estimated from 1989 Q1 to 2002 Q4:

$$\underset{(Student)}{GRQSP_t} = \underset{(3.29)}{0.37} + \underset{(4.14)}{0.52}\, GRQSP_{t-2} + \underset{(5.69)}{0.44}\, SSI_t - \underset{(-2.85)}{0.24}\, SSI_{t-2} + u_t$$

Where:

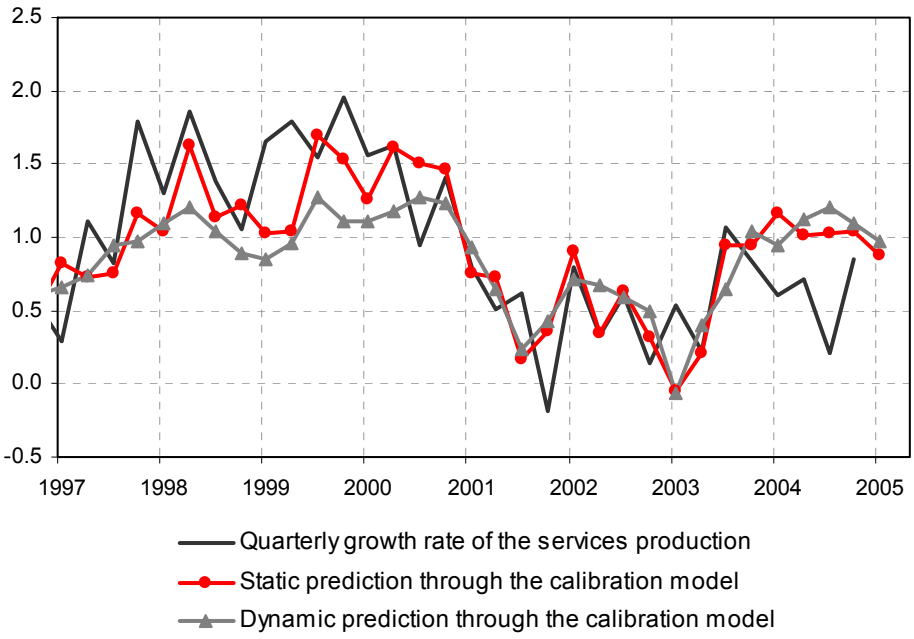
- *GRQSP* is the growth rate of the quarterly services production (in %);
- *SSI* is the services synthetic indicator (standardised).

R^2_{adj} = 0.67 RMSE = 0.37 STD_{GRQSP} = 0.65 DW-Stat = 1.92

Since the beginning of 2004, this equation tends to overestimate the growth rate of the services production (see figure 9). This means points out a disconnection between the managers' opinion and the economic indicators. On the contrary, during the period of high activity from 1997 to 2000, the estimated production was below that measured.

On the whole, the estimated growth rate of the services production appears to be smoother than the observed rate.

Figure 9 - Observed and predicted quarterly growth rate of the services production (in %)



We also tried a simple vectorial autoregressive (VAR) model with both the quarterly growth rate of the services production and SSI as endogenous variables. However, this model did not come out very well as the services production was mainly explained by its past values.

Conclusion

The framework introduced in this paper complements the Insee toolbox dedicated to short-term analysis. By taking advantage of the well-known Kalman filter, it brings new opportunities to the exploiting of business surveys.

The services synthetic indicator illustrates how this framework can be applied to very concrete questions. This indicator combines series of different frequencies and sheds a new light on the sector and subsectors under survey.

However, two shortcomings can be mentionned: the ARMA process may not fit correctly persistent data as the balances of opinion described in this paper; the parameters are estimated by maximum likelihood estimation, which forbids to extract a common signal from a large number of series.

Another question at stake is the recent disconnection between the managers' opinion and the economic indicators. This question could be further studied by exploring the opportunity of synthetic indicators combining both business surveys and quantitative data, i.e. branch production or industrial index.

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Appendices

Appendix A - Parameter estimates

Variable names

OOR	Observed operating result
EOR	Expected operating result
ED	Expected demand
OT	Observed turnover
ET	Expected turnover
GP	Global prospects

A.1. Parameter estimates for service industries

The following parameters are estimated for the ARMA(2,1) dynamics followed by the common factor:

$$F_t = \underset{(0.05)}{1.90}\, F_{t-1} - \underset{(0.05)}{0.91}\, F_{t-2} + \varepsilon_t - \underset{(0.09)}{0.87}\, \varepsilon_{t-1}$$

	λ_i		ρ_i		σ_i	
	estimate	**std**	**estimate**	**std**	**estimate**	**std**
OOR	0.21	0.02	0.00	0.01	0.33	0.03
EOR	0.22	0.02	0.38	0.34	0.25	0.04
ED	0.23	0.03	0.00	0.01	0.24	0.03
OT	0.21	0.02	0.64	0.08	0.30	0.03
ET	0.25	0.03	0.60	0.13	0.20	0.02
GP	0.28	0.03	0.87	0.09	0.17	0.04

A.2. Parameter estimates for real estate activities

The following parameters are estimated for the ARMA(2,1) dynamics followed by the common factor:

$$F_t = \underset{(0.22)}{0.19}\, F_{t-1} + \underset{(0.21)}{0.71}\, F_{t-2} + \varepsilon_t + \underset{(0.30)}{0.53}\, \varepsilon_{t-1}$$

	λ_i		ρ_i		σ_i	
	estimate	**std**	**estimate**	**std**	**estimate**	**std**
OOR	0.30	0.05	0.30	0.56	0.53	0.11
EOR	0.31	0.05	-0.68	0.10	0.40	0.06
ED	0.23	0.06	0.69	0.09	0.56	0.07
OT	0.26	0.05	0.47	0.11	0.62	0.06
ET	0.28	0.06	0.52	0.12	0.66	0.06
GP	0.56	0.28	0.89	0.21	0.42	0.28

Appendix A - Parameter estimates (followed)

A.3. Parameter estimates for business activities

The following parameters are estimated for the ARMA(2,1) dynamics followed by the common factor:

$$F_t = \underset{(0.06)}{1.86}\, F_{t-1} - \underset{(0.06)}{0.88}\, F_{t-2} + \varepsilon_t - \underset{(0.13)}{0.67}\, \varepsilon_{t-1}$$

	λ_i		ρ_i		σ_i	
	estimate	**std**	**estimate**	**std**	**estimate**	**std**
OOR	0.14	0.02	-0.08	0.06	0.31	0.03
EOR	0.15	0.02	-0.01	0.01	0.31	0.03
ED	0.15	0.02	-0.59	0.14	0.23	0.04
OT	0.14	0.02	0.67	0.07	0.25	0.02
ET	0.17	0.03	0.39	0.14	0.26	0.02
GP	0.19	0.03	0.80	0.11	0.19	0.03

A.4. Parameter estimates for personal service activities

The following parameters are estimated for the ARMA(2,1) dynamics followed by the common factor:

$$F_t = \underset{(1.26)}{1.18}\, F_{t-1} - \underset{(1.16)}{0.24}\, F_{t-2} + \varepsilon_t - \underset{(1.28)}{0.23}\, \varepsilon_{t-1}$$

	λ_i		ρ_i		σ_i	
	estimate	**std**	**estimate**	**std**	**estimate**	**std**
OOR	0.31	0.04	-0.01	na	0.53	0.05
EOR	0.34	0.04	0.76	0.09	0.22	0.04
ED	0.34	0.04	0.00	na	0.41	0.04
OT	0.32	0.04	0.51	0.12	0.46	0.04
ET	0.37	0.04	0.21	0.19	0.34	0.03
GP	0.46	0.06	0.89	0.10	0.18	0.08

Appendix B - Variance analysis

Variance explained by the common factor (in %)

	Service industries	Real estate activities	Business activities	Personal service activities
OOR	81	65	80	69
EOR	89	69	88	84
ED	94	39	90	81
OT	73	37	73	66
ET	95	44	93	87
GP	91	54	91	97

Appendix C - The multifrequence Kalman filter makes it possible to compute a synthetic indicator based on several Insee business surveys

Insee conducts business surveys in the main economic sectors: industry, building, public works, retail trade, wholesale trade, services. The balances of opinion derived from these surveys are of varying frequencies: monthly, bimonthly or quarterly. The framework used in this study (or multifrequence Kalman filter) is fit to compute an indicator based on the main results of these surveys (see figure 10).

Figure 10 - A synthetic indicator based on 29 opinion balances coming from 6 different business surveys (industry, building, public works, retail trade, wholesale trade, services)