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Construction of an Economic Sentiment Indicator for the Korean Economy

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Abstract

An Economic Sentiment Indicator(ESI) is a composite indicator of business survey indices(BSI) and consumer survey indices(CSI). The ESI designed to reflect economic agents' (this includes producers and consumers) overall perceptions of economic activity in a one-dimensional index. The European Commission has published an ESI since 1985. This paper demonstrates the construction of an ESI for the Korean economy. The BSI and CSI components (having a high correlation and a leading feature with respect to GDP) are selected to construct the ESI and they are aggregated using a weighted average and then scaled to have a long-term average of 100 and a standard deviation of 10. Thus values greater than 100 indicate an above-average economic sentiment and vice versa. The newly constructed Korean ESI that extends to January 2003 shows a good tracking performance of GDP and adequately reflects the overall perception of economic activity.

Keywords: Economic Sentiment Indicator(ESI), business survey index(BSI), consumer survey index(CSI), gross domestic product(GDP).

1. Introduction

Business and consumer surveys examine economic agents' opinions about past, current, and future economic activity. The main advantages of business and consumer survey data are timeliness and high frequency. The survey data have an informational lead because the data are available ahead of hard economic data like gross domestic product(GDP) and industrial production that are usually published with delays of 2 or 3 months. In addition, the survey data are generally available at monthly frequencies and hence are suitable for reflecting volatile economic developments. Therefore, the survey data are widely used to assess the current state of the economy and forecast short-term economic developments as a key complement to quantitative statistics.

Business surveys of corporations cover the perceptions of producers, while consumer surveys of households reflect the opinions of consumers. In Korea, business surveys are conducted by the Bank of Korea(BOK), the Federation of Korean Industries(FKI), and other economic organizations, from which business survey indices(BSI) are published. Consumer survey indices(CSI) are released by organizations such as the BOK, Statistics Korea(SK), and research institutes. The BSI and CSI

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data consist of the multiple component series that concern diverse facets of economic activity in different sectors of the economy.

The demand to incorporate most of the information contained in multiple indicators into a single indicator has led to the construction of a composite indicator. The single composite indicator is useful to reflect the economic agents' overall perceptions of economic activity. The European Commission(EC) has calculated an Economic Sentiment Indicator(ESI) since 1985 based on the Joint Harmonised Programme of Business and Consumer Surveys. The EC constructs the ESI using the weighted average of the 15 individual component series that belong to 5 sectors: industry (40%), services (30%), construction (20%), retail trade (5%), and consumers (5%). In particular, these component series are first standardized, aggregated using the above weights, and then scaled to have a mean of 100 and a standard deviation of 10. The weights of the EC are determined based on the "representativeness" of the corresponding sector in the total economy and "tracking performance" in relation to the reference variable, GDP growth. The EC has also published confidence indicators for each of the 5 sectors. The ESI is calculated at the EU and the euro-area level using country weights as well as at the individual EU member state level (see European Commission (1997, 2007) for a detailed description).

Another useful aggregation method is to use the dynamic factor model as described in Stock and Watson (2002). Bruno and Malgarini (2002) constructed a composite confidence indicator for the Italian economy by extracting a "common factor" by means of the dynamic factor model. Gayer and Genet (2006) used factor models to construct composite indicators and then compared them with the EC confidence indicators. Gelper and Croux (2007) compared the predictive power of the EC's ESI with that of the composite indicator constructed, based on statistical methods such as dynamic factor analysis and partial least squares. All of these methods are alike in that they construct a composite indicator by a linear combination of the component series; however, they show differences in the weighting scheme.

This paper instructs an ESI that adequately explains the Korean economy. To this end, this paper uses empirical studies to select informative components among all the BSI and CSI data and find the optimal weighting structure. This paper is organized as follows. Section 2 describes the process of constructing the ESI. Section 3 evaluates the performance of the ESI computed for the Korean economy and compares it with other economic indicators. Section 4 discusses the main findings and offers suggestions for further research.

2. Construction of an ESI

2.1. Data description

To construct the Korean ESI, the monthly BSI and CSI data from 2003 to 2009 published by the BOK are used exclusively. The monthly BSI data of the BOK are available from 2003. On the other hand, the monthly CSI data of the BOK are available only from July 2008 when the BOK changed the periodicity of the consumer survey from quarterly to monthly, when SK transferred the compilation of the CSI to the BOK. Accordingly, the monthly CSI data from January 2003 to June 2008 are estimated by temporal disaggregation, which is a process of deriving high frequency data from low frequency data. For the CSI components that exist in the BOK and SK surveys, the monthly data are estimated so that the disaggregated series from the quarterly data of the BOK follow the movements of the monthly data of SK considered as a reference indicator. For the CSI components without a reference indicator, the smoothing method is used to produce the monthly data. See Mazzi *et al.* (2005) for detailed explanations of temporal disaggregation. The used software is "ECOTRIM" released by Eurostat.

The BSI data consists of 30 component series in the manufacturing sector and 10 component series in the non-manufacturing sector. In each sector, half of the total component series provides the judgment for the current month, while another half represents the expectation for the next month. For the CSI data, 9 component series are considered, setting aside several component series that have recently been added. Subsequently there exist a total of 49 component series from the business and consumer survey data and let us call the component series variable for convenience. Then the type of these 49 variables is the index moving around 100 (ranging from 0 to 200). Each variable has 84 observations from January 2003 to December 2009.

GDP is used as a reference variable to represent the entire economy. In particular, the growth rate and cycle of the GDP are used to consider short-term and long-term characteristics of the economy. However, the monthly GDP data are unpublished and they they are estimated using the temporal disaggregation by the state space method. The GDP growth rate is then measured by the year-on-year percentage change of monthly GDP. The GDP cycle is extracted using the Hodrick-Prescott(HP) filter first described in Hodrick and Prescott (1997). In particular, the HP filter is applied twice to achieve a smoothed de-trended cycle, that is, it removes a long-term trend from the seasonally adjusted GDP and then smooths the de-trended GDP. The BOK-X-12-ARIMA procedure is used for seasonal adjustment. The cycles of the 49 variables are extracted in the same way as the GDP cycle (except for the detrending procedure because the 49 variables have no trend).

2.2. Selection of the informative components

The ESI should be constructed to track GDP well so that it can be used as a valuable complement to GDP. If the ESI and GDP move differently, it can cause confusion in assessing the current state of the economy. Therefore, the ESI must be highly correlated with GDP. The ESI will be useful for predicting future GDP developments if the ESI tracks GDP with a lead of a few months. Inherently the survey data related to the expectations of respondents have the potential to have a leading property. This is because producers and consumers tend to increase their production and consumption if they feel positive about the current and future economic situation. Therefore, the screening procedure is aimed at selecting informative components that are closely correlated with GDP as well as detect turning points for economic movements earlier than GDP. Cross-correlation analysis and turning point analysis are used here.

Let z_{1t} be the reference variable and z_{it} be the i^{th} variable to compare with. Then the cross-correlation between the reference variable and the i^{th} variable shifted m months is defined as

$$\rho_{1i}(m) = \frac{\mathrm{Cov}(z_{1t}, z_{it+m})}{\sqrt{\mathrm{Var}(z_{1t})\mathrm{Var}(z_{it})}}, \tag{2.1}$$

for $i = 1, \ldots, 49$. If $m = 0$, then it is a contemporaneous correlation between the reference variable and the i^{th} variable. The maximum cross-correlation can be obtained from different choices of positive or negative integer values of m. If the maximum is found for negative m, then it means that the i^{th} variable has the largest correlation with the reference variable when it is shifted m months ahead.

Here the sample cross-correlations between the GDP growth rate and each of the 49 variables are

Table 2.1. Tracking performance in the manufacturing sector

Variable	Judgment for Current Month					Expectation for the Next Month				
	Cross-correlation			Turning Points		Cross-correlation			Turning Points	
	r_0	$r_{\max}$	$t_{\max}$	Peak ('08.2)	Trough ('09.2)	r_0	$r_{\max}$	$t_{\max}$	Peak ('08.2)	Trough ('09.2)
Business conditions	**0.64**	**0.66**	**−1**	**−5**	**−1**	**0.64**	**0.67**	**−1**	**−3**	**−1**
Sales growth	0.64	0.64	1	1	0	**0.65**	**0.65**	**0**	**−1**	**0**
Exports growth	0.70	0.73	1	2	0	0.72	0.72	1	0	0
Domestic sales growth	0.62	0.62	0	1	0	0.63	0.63	0	0	0
Production growth	0.71	0.71	0	0	0	0.69	0.69	0	0	0
New orders growth	0.69	0.69	0	0	0	**0.68**	**0.68**	**0**	**0**	**−1**
Inventories	0.52	0.52	0	0	−1	0.55	0.55	0	2	−1
Operation ratio	**0.73**	**0.73**	**0**	**−2**	**0**	**0.71**	**0.71**	**0**	**−3**	**0**
Production capacity	0.68	0.70	1	−2	0	0.64	0.65	1	0	0
Facility investments	0.65	0.65	0	1	0	**0.69**	**0.69**	**0**	**0**	**−1**
Profitability	0.40	0.55	−4	−12	−3	0.45	0.57	−4	−12	−3
Raw material & parts price	0.24	0.29	3	3	2	0.25	0.26	2	2	2
Sales price	0.35	0.37	1	3	0	0.41	0.41	0	2	0
Financial situation	**0.56**	**0.66**	**−2**	**−7**	**−2**	**0.60**	**0.67**	**−2**	**−7**	**−2**
Human resources	0.64	0.64	0	0	0	0.61	0.61	0	0	−1

calculated. Denote the sample contemporaneous correlation by r_0, the maximum sample cross-correlation by $r_{\max}$, and the value of m with $r_{\max}$ by $t_{\max}$. A variable having a large $r_{\max}$ at the negative $t_{\max}$ is considered to have leading behavior.

The leading property is also examined in terms of the cyclical movement. The "BUSY" program based on the routine by Bry and Boschan (1971) is used to detect the turning points. It identifies the turning points of the reference variable and then denotes the leading or lagging months of each of the 49 variables by negative or positive values at the reference turning points. However, the turning points produced by "BUSY" are not obvious in some periods, due to a relatively short length of time series. So only the two latest turning points that are obviously identifiable even by the naked eye are considered. The recent peak and trough points of the GDP cycle occur in February 2008 and 2009 respectively. Variables with a negative sign at these time points are considered to have the leading property.

2.2.1. Preliminary screening The preliminary screening of the individual variables is carried out in each of three sectors: manufacturing, non-manufacturing, and consumer. The screening results are given in Table 2.1 for 30 variables in the manufacturing sector, in Table 2.2 for 10 variables in the non-manufacturing sector, and in Table 2.3 for 9 variables in the consumer sector. Overall, the variables in the manufacturing and non-manufacturing sectors show higher cross-correlations than the variables in the consumer sector. On the other hand, the leading period is longer for the variables in the consumer sector. This is because the consumer survey asks for expectations over the next six months while the business survey asks for expectations for the next month.

In each sector, the variables having high levels of cross-correlation and leading characteristics are pre-selected for further investigation. In particular, a variable that: (1) has a bigger value of $r_{\max}$ with the negative value of $t_{\max}$ than the mean of $r_{\max}$ and (2) records negative values in both peak and trough points of GDP. Under this criteria, the 9 variables in bold type such as business conditions, operation ratio, and financial situation are selected in the manufacturing sector.

Table 2.2. Tracking performance in the non-manufacturing sector

Variable	Judgment for Current Month					Expectation for the Next Month				
	Cross-correlation			Turning Points		Cross-correlation			Turning Points	
	r_0	$r_{\max}$	$t_{\max}$	Peak ('08.2)	Trough ('09.2)	r_0	$r_{\max}$	$t_{\max}$	Peak ('08.2)	Trough ('09.2)
Business conditions	**0.53**	**0.56**	**−2**	**−7**	**−1**	**0.55**	**0.59**	**−2**	**−5**	**−1**
Sales growth	0.36	0.39	1	−2	1	0.46	0.47	−1	−2	0
Profitability	**0.44**	**0.53**	**−2**	**−6**	**−2**	**0.48**	**0.57**	**−1**	**−9**	**−2**
Financial situation	**0.51**	**0.59**	**−1**	**−8**	**−2**	**0.53**	**0.62**	**−2**	**−9**	**−2**
Human resources	0.39	0.39	−1	−9	1	0.36	0.36	0	−9	−1

Table 2.3. Tracking performance in the consumer sector

Variable	Cross-correlation			Turning Points	
	r_0	$r_{\max}$	$t_{\max}$	Peak ('08.2)	Trough ('09.2)
Living standard of household	0.13	0.29	−4	−7	−6
Expectations of living standard of household	0.12	0.35	−4	−6	−7
Expected change in total household income	**0.36**	**0.44**	**−2**	**−5**	**−2**
Spending plans	**0.53**	**0.58**	**−1**	**−5**	**−1**
Domestic economic situation	**0.23**	**0.41**	**−4**	**−7**	**−4**
Expectations of domestic economic situation	0.11	0.30	−4	−6	−6
Expectations of employment situation	0.28	0.33	−1	−3	−3
Expected change in prices	0.41	0.41	1	2	0
Expected change in interest rates	0.35	0.35	0	−6	0

Table 2.4. ESI components

Sector	Variable	Cross-correlation			Turning Points	
		r_0	$r_{\max}$	$t_{\max}$	Peak ('08.2)	Trough ('09.2)
Manufacturing (BSI)	Expectation of sales growth Expectation of operation ratio Expectation of financial situation	0.6816	0.6898	−1	−5	−1
Non-manufacturing (BSI)	Expectation of business conditions Expectation of financial situation	0.5502	0.6164	−2	−5	−2
Consumer (CSI)	Expected change in total household income Spending plans	0.4590	0.5252	−1	−5	−1

In the non-manufacturing sector, 6 variables concerning business conditions, profitability, and financial situation are selected. For the consumer sector, 3 variables related to expected change in total household income, spending plans, and domestic economic situation are selected as candidate variables for further consideration.

2.2.2. Combination of candidate components In each sector, all possible combinations of the pre-selected variables are examined. There are $2^k - 1$ possible combinations when there exist k variables within a sector. In each combination, the variables are aggregated by a simple average of the standardized series and not the original series. This prior standardization is necessary to avoid the dominant effects of highly volatile variables on the composite indicator. The tracking performance of the aggregated series in relation to GDP is tested based on the cross-correlation and turning point analysis. The previous two criteria used in the preliminary screening are reapplied.

Table 2.5. Weights based on PCA

Sector	Variable	1st Principal Component		Weight
		coefficient	squared	
Manufacturing (BSI)	Expectation of sales growth	0.3803	0.1446	
	Expectation of operation rate	0.3847	0.1480	
	Expectation of financial situation	0.3767	0.1419	**0.75**
Non-manufacturing (BSI)	Expectation of business conditions	0.3962	0.1570	
	Expectation of financial situation	0.3909	0.1528	
Consumer (CSI)	Expected changes in total household income	0.3324	0.1105	**0.25**
	Spending plans	0.3812	0.1453	
	Eigen-value	5.7966	1	1
	Proportion of total variance	0.8281		

Among all combinations in each sector, a three-variable set (expectations of sales growth, operation ratio, and financial situation), a two-variable set (expectations of business conditions and financial situation), and another two-variable set (expected changes in total household income and spending plans) are selected as the best combination respectively. Therefore, 7 variables among a total of 49 variables are finally selected to construct the ESI. Note that all of the selected variables include anticipations of one month or up to six months.

2.3. Weights of the ESI components

To determine the weights of the selected variables, principal component analysis(PCA) is used. As given in Table 2.5, the first principal component explains about 83% of the total variance of the 7 variables. This means that the first principal component can replace the 7 variables without much loss of information. The coefficient $e_{1k}, k = 1, \ldots, 7$, of the first principal component measures the importance of the k^{th} variable to the first principal component, irrespective of the other variables. In particular, the relative sizes of importance are determined based on the squared coefficients $e_{1k}^2, k = 1, \ldots, 7$, which sum to 1. The sum of the squared coefficients within the manufacturing and non-manufacturing sectors is 0.75 and the sum of those in the consumer sector is 0.25. Accordingly, the weights of producers and consumers are determined by 0.75 and 0.25.

Within the BSI part, the weights of the manufacturing and non-manufacturing sectors are determined based on the contributions to GDP growth. The contribution of the non-manufacturing sector to GDP growth is computed to the exclusion of the the industries for which the business survey is not conducted (agriculture, financial intermediation, public administration and defence, compulsory social security, education, health and social work, and other service activities). The contributions to GDP growth from 2003 to 2009 are shown in Table 2.6. The average of the contributions over 2003 to 2009 is 1.3%p for the manufacturing sector and 0.9%p for the non-manufacturing sector, so the ratio of their relative magnitudes is almost 0.6 to 0.4. This ratio is stable for the other time periods such as 2003 to 2008 and 2003 to 2007. Thus the weights within the manufacturing and non-manufacturing sectors are determined as 0.6 and 0.4.

The weights of the manufacturing and non-manufacturing sectors are finally allocated to 0.45 and 0.30 since the BSI part has a total weight of 0.75. To sum up, the weights of the manufacturing, non-manufacturing, and consumer sectors are set by 0.45, 0.30, and 0.25. Note that the allocation of the weights is very close to the principal component analysis results in Table 2.5. Within each sector, the individual variables have equal weights.

Table 2.6. Contributions to GDP growth

Year	Contribution to GDP growth(%p)	
	Manufacturing	Non-manufacturing
2003	1.2	1.0
2004	2.3	1.1
2005	1.5	1.1
2006	2.0	1.5
2007	1.7	1.6
2008	0.7	0.5
2009	−0.4	−0.2
average from 2003 to 2007	1.7	1.3
average from 2003 to 2008	1.6	1.2
average from 2003 to 2009	1.3	0.9
Weight	**0.6**	**0.4**

Table 2.7. Weights allocated to the ESI components

Sector	Weight	Variable	Weight	Details
Manufacturing (BSI)	**0.45**	Expectation of sales growth	0.150	$=\frac{0.45}{3}$
		Expectation of operation ratio	0.150	
		Expectation of financial situation	0.150	
Non-manufacturing (BSI)	**0.30**	Expectation of business conditions	0.150	$=\frac{0.30}{2}$
		Expectation of financial situation	0.150	
Consumer (CSI)	**0.25**	Expected changes in total household income	0.125	$=\frac{0.25}{2}$
		Spending plans	0.125	

2.4. Calculation of the ESI

After determining the 7 informative variables (components series) and the corresponding weights, the exact calculation of the ESI is made as follows.

(1) Standardize the original component series

$$Y_{i,t} = \frac{X_{i,t} - \bar{X}_i}{S_i}, \tag{2.2}$$

where $X_{i,t}$ is the i^{th} component series observed at time t, $\bar{X}_i = 1/T \sum_{t=1}^{T} X_{i,t}$, and $S_i = \sqrt{1/(T-1)\sum_{t=1}^{T}(X_{i,t} - \bar{X}_i)^2}$ for $i = 1, \ldots, 7$.

(2) Aggregate the 7 standardized series using the weights in Table 2.7

$$Z_t = \sum_{i=1}^{7} w_i Y_{i,t}, \tag{2.3}$$

where w_i is a weight of the i^{th} component such that $\sum_{i=1}^{7} w_i = 1$.

(3) Scale Z_t to have a mean of 100 and a standard deviation of 10

$$\mathrm{ESI}_t = \left(\frac{Z_t - \bar{Z}}{S_Z}\right) \times 10 + 100, \tag{2.4}$$

where $\bar{Z} = 1/T \sum_{t=1}^{T} Z_t$ and $S_Z = \sqrt{1/(T-1)\sum_{t=1}^{T}(Z_t - \bar{Z})^2}$.

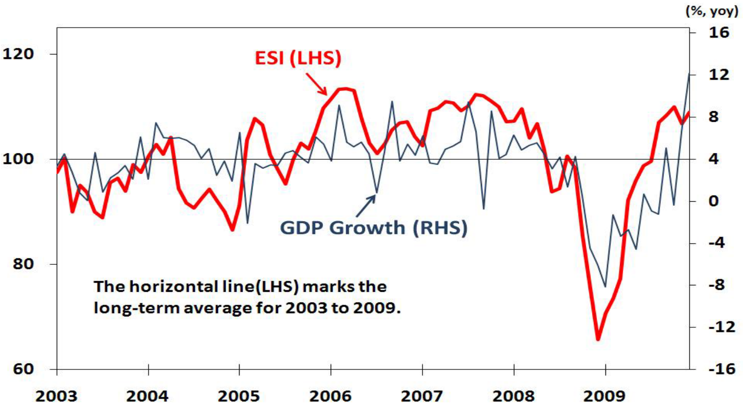

Figure 3.1. ESI and GDP growth

Table 3.1. Cross-correlation analysis of the ESI and GDP growth

	Leading(−) or Lagging(+) Months								
	−6	−5	−4	−3	−2	**−1**	0	1	2
Cross-correlation	0.35	0.46	0.50	0.56	0.63	**0.66**	0.62	0.53	0.43

The ESI value of 100 marks a long-term average over the time period from $t = 1, \ldots, T$. Values greater than 100 indicate an above-average position, while values below 100 indicate a below-average position. The fixed standard deviation of 10 implies that about 68% of the ESI values fall within a range between 90 and 110 assuming approximate normality. Unlike the ESI, a value of 100 in the BSI and CSI data means the equal proportion of negative and positive opinions. In addition, the BSI and CSI data have often fallen below 100 due to the cautiousness of respondents, even when the economy is booming. The ESI solves this problem by the rescaling step in (3). Moreover, the ESI is easy to interpret because the long-term average of 100 plays a yardstick role for making judgments.

Note that the standardization in steps (1) and (3) is carried out over the period from $t = 1, \ldots, T$. The end point T is extended every year to include up-to-date information, but does not change within a single year. For example, the ESI values from January to December in 2010 are calculated based on the standardization period from January 2003 to December 2009. However, the ESI values in 2011 are computed using a new standardization period extended to December 2010, and the ESI values before 2011 are all revised at once at the beginning of 2011. That is, the revision of the ESI data is undertaken every year. This revision may confuse users, but it is inevitable in order to reflect the recent economic situation adequately. The EC has also extended the time series beginning in 1990 and revised the ESI data every year.

3. An ESI for the Korean Economy

3.1. Tracking performance of the ESI

A Korean ESI from January 2003 to December 2009 is computed following the method presented in Section 2.4. Figure 3.1 displays the movements of the ESI and GDP growth. They seem to move closely together. Table 3.1 shows that the ESI has a maximum cross-correlation of 0.66 when it is one month ahead of GDP.

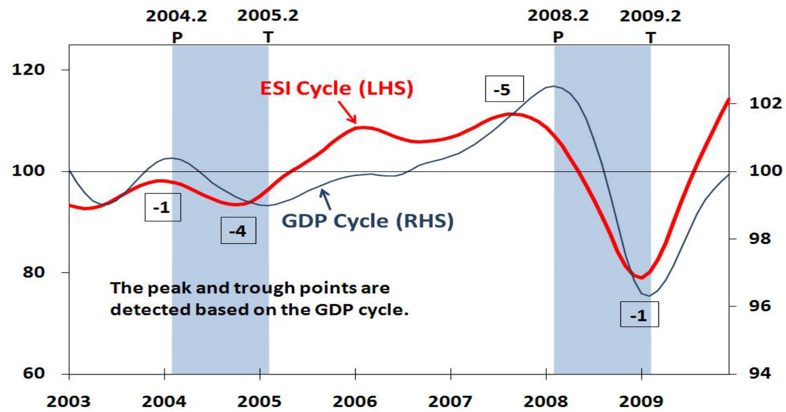

Figure 3.2. ESI cycle and GDP cycle

Table 3.2. Cross-correlation analysis of the cycles of the ESI and GDP

	Leading(−) or Lagging(+) Months								
	−6	−5	−4	**−3**	−2	−1	0	1	2
Cross-correlation	0.69	0.76	0.82	**0.85**	0.84	0.81	0.73	0.62	0.48

The cyclical development of the ESI and GDP is shown in Figure 3.2. Over the period of 7 years, the GDP cycle records 2 peaks in February 2004 and 2008, and 2 troughs in February 2005 and 2009. Compared to GDP, the cycle of the ESI detects turning points 1 month, 4 months, 5 months, and 1 month ahead at the 4 sequential reference points. The average of the leading months is 2.75. The leading characteristic of the cyclical movement is also found in the cross-correlation analysis of the cycles. The maximum cross-correlation is 0.85 when the ESI cycle is 3 months ahead of GDP as given in Table 3.2. Compared to the analysis of the ESI and GDP growth in Table 3.1, the analysis of the cycles records a better tracking performance in relation to GDP. Overall, the ESI tracks GDP well, being well correlated and co-moving with GDP with leads of a few months.

3.2. Comparison with other indicators

3.2.1. Comparison with benchmark BSIs As its benchmark BSI, the BOK takes the BSI concerning the judgment of business conditions in the manufacturing sector, and the FKI takes the BSI concerning overall business prospects. These indicators are compared with the ESI in Table 3.3. The FKI's benchmark BSI shows a longer and reliable leading property, but the maximum cross-correlation is much lower than that of the ESI. The BOK's benchmark BSI is similar to the ESI in terms of its cross-correlation and leading property. However, it reports values below 100 over the whole period as shown in Figure 3.3, so it does not represent the economic situation properly. Therefore, the ESI turns out to outperform the two benchmark indicators on the business side.

3.2.2. Comparison with a composite CSI The CCSI is a composite index of 6 major CSI components series in Table 2.3 (living standard of household, expectations of living standard of household, expected change in total household income, spending plans, domestic economic situation, and expectations of domestic economic situation). The monthly CCSI is only available from July 2008 by the BOK. Accordingly the comparison of the ESI with the CCSI is made on a basis of quarterly

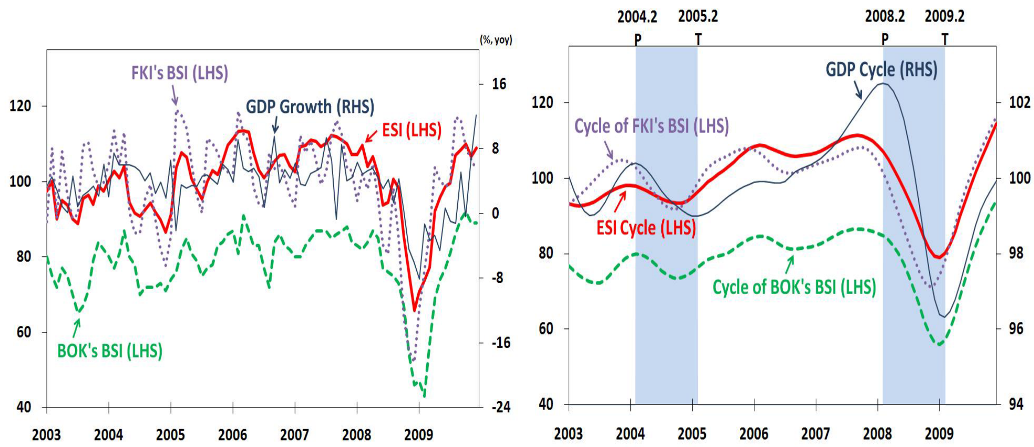

Figure 3.3. ESI and benchmark BSIs

Table 3.3. Comparison with benchmark BSIs

Monthly	Cross-correlation			Lead(−)/Lag(+) at Turning Point				
	r_0	$r_{\max}$	$t_{\max}$	Peak ('04.2)	Trough ('05.2)	Peak ('08.2)	Trough ('09.2)	Average
ESI	0.6200	0.6605	−1	−1	−4	−5	−1	−2.75
BOK's benchmark BSI	0.6412	0.6596	−1	0	−4	−5	−1	−2.50
FKI's benchmark BSI	0.4180	0.5763	−2	−3	−4	−4	−3	−3.50

data. The quarterly data are obtained by a simple average of the corresponding monthly data.

On a quarterly basis, the maximum cross-correlation between the ESI and GDP growth is raised from 0.6605 to 0.8007. Moreover, the ESI is better correlated with GDP than is the CCSI. But the leading property present in the monthly ESI is removed for the quarterly ESI because the length of leads do not exceed 3 months on average. On the other hand, the CCSI shows more reliable leading behavior.

In summary, the tracking performance of the ESI is comparable or superior to that of the existing indicators which consider only the BSI or the CSI. It is meaniningful that the ESI reflects effectively the overall perceptions of producers and consumers.

3.3. Comparison with coincident and leading composite economic indicators

Statistics Korea(SK) publishes composite economic indices by integrating major indices to reflect each part of an economy effectively. Here the component indices are obtained from quantitative statistics regarding production, consumption, employment, finance, trade, and investment. So the SK's composite indices differ from the ESI extracted from the business and consumer survey data.

The cycle of the ESI is compared with the cycle of the coincident composite index on the left side and with the 12 months smoothed change in the leading composite index(LCI) on the right side of Figure 3.5. During the period of 2003 to 2009, the ESI cycle leads the cycle of the coincident composite index and co-moves with the 12-month smoothed change in the LCI. Hence, the leading characteristic of the ESI seems to be evident in the past. However, it is interesting that the ESI has shown different movements from the SK's composite indices since 2010. In particular, the ESI

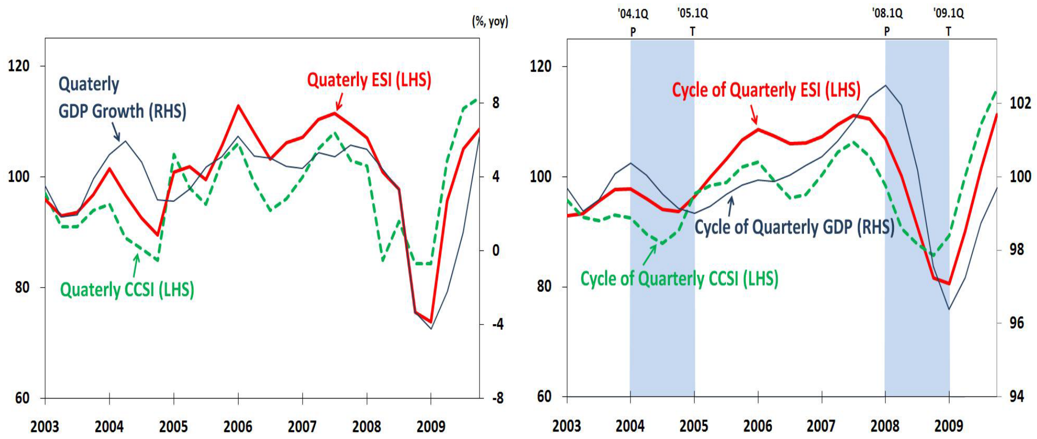

Figure 3.4. Quarterly ESI and CCSI

Table 3.4. Comparison with the CCSI

Quarterly	Cross-correlation			Lead(−)/Lag(+) at Turning Point				
	r_0	$r_{\max}$	$t_{\max}$	Peak ('04.1Q)	Trough ('05.1Q)	Peak ('08.1Q)	Trough ('09.1Q)	Average
ESI	0.8007	0.8007	0	0	−1	−2	0	−0.75
CCSI	0.3566	0.5185	−1	−1	−2	−2	−1	−1.50

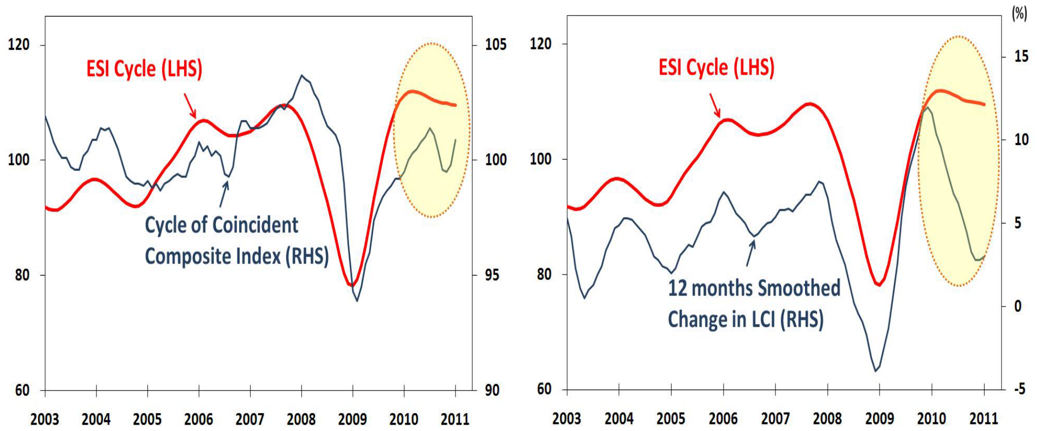

Figure 3.5. ESI and SK's coincident and leading composite indices

has only dropped slowly, holding at levels of above 100, while the SK's coincident and leading composite indices dropped sharply in July 2010 and in December 2009 respectively. The slowly downward trend of the ESI comes close to actual economic developments from 2010.

3.4. Comparison of construction methods

The composite indicator for the entire economy can be viewed as a common factor to explain the co-movement observed in different economic data. Then the ESI can be constructed by extracting

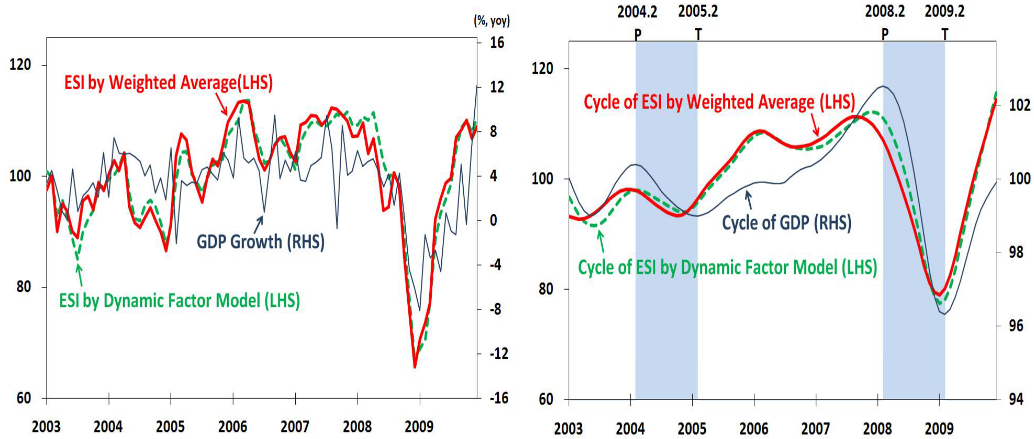

Figure 3.6. Comparison of ESI construction methods

Table 3.5. Comparison of ESI construction methods

Construction Method	Cross-correlation			Lead(−)/Lag(+) at Turning Point				
	r_0	$r_{\max}$	$t_{\max}$	Peak ('04.2)	Trough ('05.2)	Peak ('08.2)	Trough ('09.2)	Average
Weighted Average	0.6200	0.6605	−1	−1	−4	−5	−1	−2.75
Dynamic Factor Model	0.6616	0.6708	−1	0	−3	−2	−1	−1.50

the common factor using the dynamic factor model. Let $Y_{i,t}$ be the i^{th} variable observed at time t, for $i = 1, \ldots, I$ and $t = 1, \ldots, T$. Then the dynamic factor model is formulated as follows.

$$\begin{aligned} Y_{i,t} &= \sum_{j=1}^{J} \gamma_{i,j} F_{j,t} + u_{i,t}, \\ \phi_j(L) F_{j,t} &= \eta_{j,t}, \\ \theta(L) u_{i,t} &= \epsilon_{i,t}, \end{aligned} \tag{3.1}$$

where $\gamma_{i,j}$ is a loading of the i^{th} variable on the j^{th} common factor, $F_{j,t}$ is the j^{th} common factor, $u_{i,t}$ is an idiosyncratic component specific to the i^{th} variable at time t, L is a lag operator, and $\eta_{j,t}$ and $\epsilon_{i,t}$ are the innovations of the j^{th} common factor and the i^{th} idiosyncratic component which follow the white noise processes. In the model (3.1) the common factors and idiosyncratic components are assumed to follow the autoregressive processes, in consideration of the the auto-correlated nature of the time series data.

The proportion of the total variance explained by a single common factor is about 70%, when the dynamic factor model is applied to the 49 standardized variables. The ESI is obtained by synthesizing the common components of the 49 variables and then rescaling the synthesized index to have a mean of 100 and a standard deviation of 10.

The ESI constructed using the dynamic factor model is compared with the ESI obtained by the weighted average explained before. In Table 3.5, the ESI by the dynamic factor model has a slightly higher cross-correlation but a shorter leading month on average than the ESI by the weighted average. However, the overall levels and movements of the ESI based on these two methods are very similar, as shown in Figure 3.6. Thus the selected components and the weighting scheme in Table 2.7 used for the weighted average method seem to be comparable to the common factor extracted from all of the 49 variables.

The approach using the dynamic factor model is more sophisticated and is based on statistical theory and methodology. However, the ESI based on the dynamic factor model is revised every month as new sets of BSI and CSI data are added. Such frequent revision can reduce the reliability of statistics. So the heuristic approach using fixed weights for a given period and then updating the past time series once a year is more useful.

4. Conclusions

This paper describes empirical studies to construct an ESI for the Korean economy. The method that aggregates the standardized BSI and CSI component series by a weighted average and then rescales to have a mean of 100 and a standard deviation of 10, is the same as the approach of the EC. However, this paper focuses on selecting informative components and determining the weights so that the composite indicator is well correlated and has a reliable leading property with respect to GDP. Cross-correlation and turning point analysis are applied throughout the whole procedure of the empirical studies.

In conclusion, the ESI calculated for Korea tracks GDP and reflects the overall perception of economic activity better than the other indicators such as benchmark BSIs, a composite CSI indicator, and composite economic indices based upon quantitative statistics. In terms of the construction method, the rather ad hoc approach based on the empirical studies is comparable to the dynamic factor model. However, the adequacy of the ESI components and the weighting scheme proposed here needs to be evaluated for the regular update of recent information from the business and consumer surveys.

The ESI presented in this paper displays a good tracking performance based on the descriptive statistics. Furthermore, an econometric model is recommended to analyze the relationship between the ESI and GDP. An econometric model with a high explanatory power would be useful to make an accurate prediction for near term GDP. This would substantially increase the utility of the ESI in assessing the current state of the economy and forecasting short-term economic developments.

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