THE INSTITUTE FOR TRIPLE HELIX INNOVATION

# Innovation Indexes

## Methodology Statement

**The Innovation Indexes that are prepared by the Institute for Triple Helix Innovation are prepared using a nine-step process, which approximates the methodology that is used by the Conference Board to prepare Business Cycle Indicators.[1,2]**

1. **As part of its initial Megatrend Analysis project, the Institute collected retrospective annual data for a total of 46 innovation-related variables, across four primary categories (Technological, Economic, Demographic, and Ecological (sustainability)) for six Pacific Region locales (the states of California, Hawaii, Washington, and the nations of China, Japan, and Singapore).[3]**

2. **For the 21 series reflecting essentially complete data for each of the locales, the Institute calculated symmetric percent changes for each of the selected series ($x_i$) using the following equation:**

**Equation 1**

$$PC_{i,t} = 200 * \frac{(x_{i,t} - x_{i,t-1})}{(x_{i,t} + x_{i,t-1})}.$$

3. **The Institute prepared standardization factors for each selected series using the following procedures:**

   A. **Computed a standard deviation of symmetric percent changes (SDPC):**

**Equation 2**

$$SDPC_i = \sqrt{\frac{\sum_{i=1}^{n} (PC_i - \overline{PC})^2}{(n-1)}}$$

[1] For an overview of the Institute's innovation indexes, please visit the following Web page: http://www.triplehelixinstitute.org/projectInfo/megatrend.html

[2] The Conference Board's Methodology Statement is available in Conference Board (2000).

[3] Information about the Megatrend Analysis project is available at the following Web site: http://www.triplehelixinstitute.org/projectInfo/dataAnalysis.html. The list of 46 variables is derived primarily from the work of the European Commission to prepare annual measures of innovation for members of the European Community; see Sajeva et al. (2005).

**B. Computed the inverse of the standard deviations of symmetric percent changes (ISDPC) that are computed in part A.**

**Equation 3**

$$ISDPC_i = 1/SDPC_i$$

**C. Developed standardization factors (SF) by scaling the inverse standard deviations so that they sum to one (1) within each of the four categories.**

**Equation 4**

$$SF_i = ISDPC_i * \frac{1}{\sum_{i=1}^{n} ISDPC_i}$$

**4. Applied (multiplied) the standardization factors to the series' symmetric percentage changes to derive weighted percent changes (WPC) for each series.**

**Equation 5**

$$WPC_{i,t} = PC_{i,t} * SF_i$$

**5. Computed aggregate category values (ACV) for each of the four categories by summing the weighted percent changes within the categories.**

**Equation 6**

$$ACV_{i,t} = \sum_{i=1}^{n} WPC_{i,t}$$

**6. Initial index levels (IIL) were computed by summing the four aggregate category values.**

**Equation 7**

$$IIL_t = \sum_{i=1}^{4} ACV_{i,t}$$

**7. Calculated symmetric initial index levels percent changes (IPC) using the following equation:**

**Equation 8**

$$IPC_t = 200 * \frac{(IIL_t - IIL_{t-1})}{(IIL_t + IIL_{t-1})}$$

8. **The final composite index (CI) was calculated recursively by setting the initial (period 1) value of the composite index at 100 for the year 1995. Index values for all subsequent periods were computed by multiplying the initial index value (100) by the symmetric index percent change for all intervening periods. For example, the final composite index value for period 2 (1996) was calculated in the following manner:**

**Equation 9**

$$CI_{1996} = 100_{1995} * \frac{(200 + IPC_{1996})}{(200 - IPC_{1996})}.$$

**Similarly, the period 3 (1997) composite index value was computed in the following manner:**

**Equation 10**

$$CI_{1997} = 100_{1995} * \frac{(200 + IPC_{1996})}{(200 - IPC_{1996})} * \frac{(200 + IPC_{1997})}{(200 - IPC_{1997})}.$$

9. **The published composite index reflects a scaling or rebasing of the composite index to its base or reference period, which is currently the year 2000.**

## Contact Information

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***References***

**Conference Board (2000). *Business Cycle Indicators Handbook*. The Conference Board. New York, NY. Obtained from the Internet on June 26, 2007; http://www.conference-board.org/pdf_free/economics/bci/BCI-Handbook.pdf.**

**Organisation for Economic Co-Operation and Development. *Oslo Manual*. The Measurement of Scientific and Technological Activities: Proposed Guidelines for Collecting and Interpreting Technological Innovation Data. European Commission. Obtained from the Internet on June 26, 2007; http://www.oecd.org/dataoecd/35/61/2367580.pdf.**

**Sajeva, M. Gatelli, D., Tarantola, S., and Hollanders, H. (2005). *Methodology Report on European Innovation Scoreboard 2005*. European Commission. Obtained from the Internet on June 26, 2007; http://www.trendchart.org/scoreboards/scoreboard2005/pdf/EIS%202005%20Methodology%20Report.pdf.**

## Appendix A

## List of the series that are included in Innovation Indexes. [4]

### Technological

- **Total Research and Development (R&D) spending (CCTORDST)**
- **Private R&D spending (CCPRRDST)**
- **Public R&D spending (CCPURDST)**
- **Total registered patents (CCNPTT)**
- **Total registered patents per million population (CCNPTPMPT)**
- **Total registered trademarks (CCNTMT)**
- **Total registered trademarks per million population (CCTMPMPT)**
- **The number of research colleges and universities (CCNRDCUT)**
- **The number of engineering graduates (CCNENGT)**
- **The number of medical science graduates (CCNMSGT)**

### Economic

- **Gross domestic/state product (GDP/GSP) (CCGDPE)**
- **Per capita GDP/GSP (CCPCGDPE)**
- **Unemployment rate (CCURE)***
- **Exports (CCEXE)**
- **Median income (CCMIE)**

### Demographic

- **Population (CCPOPD)**
- **Female population (CCPFED)**
- **Male population (CCPMAD)**
- **Population > 65 years (CCPGT65D)**
- **Internet accessible households (CCHIAD)**

### Ecological (Sustainability)

- **Total number of hospitals (CCTOTHE)**

***--Percent changes in the unemployment rate enter the index as a subtraction.**

[4] The codes in parenthesis are the standard MegaTrend Analysis codes; for details visit the Data Dictionaries: http://www.triplehelixinstitute.org/projectInfo/megatrend.html