Sentiments and Expectations in the German Economy

Stimmungen und Erwartungen in der Deutschen Wirtschaft

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What is PLS?

- Partial Least Squares (rarely “Projection to Latent Structures”)
- Introduced in the 1960s by Herman Wold (1908 – 1992)
- First Software: LVPLS by Jan-Bernd Lohmöller in the 1980s
- Linear Structural Equation Modeling with latent variables
- 2 Stage estimation: iterative Least Squares estimation for the LV scores, then OLS Regression between LVs
- Useful to model complex systems like an economy
- Renaissance in the last years, e.g. in Marketing
- Alternative to LISREL
Path modeling with PLS

Inner Model

Outer Model

LV1

LV2

LV3

X1
X2
X3

X4
X5

X6
X7
X8

OLS Coefficients
Correlation coefficients
t-ratios

weights, loadings
scores

R²

R²

R²
Path modeling with PLS

Hermann Wold (1973):

Outer model e.g.

\[ LV3 = \sum_{i=6}^{8} w_i X_i \]

Inner model e.g.

\[ LV3 = \beta_0 + \beta_1 LV1 + \beta_2 LV2 + u \]

Extensions: PLS for categorical Data (J. Betzin, Potsdam 1998)
Dynamic PLS for time series (H. G. Strohe, Potsdam 1995)
PLS Regression (e.g. Tenenhaus, Paris 1998)

...
# PLS vs. LISREL in a nutshell

<table>
<thead>
<tr>
<th></th>
<th>PLS</th>
<th>LISREL</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Estimation</strong></td>
<td>Partial Least Squares, Data and variance based, Consistency at large</td>
<td>Maximum-likelihood, Covariance based, Consistency</td>
</tr>
<tr>
<td><strong>Sample size</strong></td>
<td>Small possible (20+)</td>
<td>Large (200+)</td>
</tr>
<tr>
<td><strong>Assumptions</strong></td>
<td>“Soft modelling”, no assumptions about distribution of data</td>
<td>“Hard modelling”, multivariate normal distribution and independent observations</td>
</tr>
<tr>
<td><strong>Testing</strong></td>
<td>Resampling with limited number of tests</td>
<td>Wider number of tests</td>
</tr>
<tr>
<td><strong>Latent variables</strong></td>
<td>Reflective and formative, LV Scores estimated</td>
<td>Reflective, new: formative</td>
</tr>
<tr>
<td><strong>usage</strong></td>
<td>rare</td>
<td>common</td>
</tr>
</tbody>
</table>

Source: Chin, Newsted (1999), Fornell (1987)
Main questions of this paper

- How to measure sentiments [Stimmungen, Einschätzungen]?
- Any useful information?
- Model: systematic influence by major macroeconomic variables?
- Divergences from the model over time?
- Method: Partial Least Squares
Do sentiments and expectations matter?

„Stock market ignores weak sentiments“
(Handelsblatt, 12 /18 /2008)

„Depressed sentiments in the economy“
(Deutsche Welle, 02 /25 /2009)

„Sentiments in the economy worse than expected“
(Der Spiegel, 02 /24 /2009)
How to measure human sentiments?

- Based on monthly surveys from research institutes
- Question: "How do you evaluate the actual economic situation (sentiment)?"
  - good
  - bad
  - middle / don't know
- Transformed into Index number
- Typical latent variable
## Data sources for sentiments

<table>
<thead>
<tr>
<th>Institute</th>
<th>Ifo-Institute Munich</th>
<th>ZEW Mannheim</th>
<th>Eurostat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data name</td>
<td>1. Ifo-Economic Situation</td>
<td>2. ZEW-Economic Situation</td>
<td>3. Economic Sentiment Indicator</td>
</tr>
<tr>
<td>Period</td>
<td>since 01/1991 monthly</td>
<td>since 01/1992 monthly</td>
<td>since 01/1991 monthly</td>
</tr>
<tr>
<td>Sample (size)</td>
<td>Business Entrepreneurs (7,000)</td>
<td>Financial sector (400)</td>
<td>All sectors and consumers</td>
</tr>
</tbody>
</table>
Sentiments in the German economy

- Unification Boom
- Unification Depression
- New Economy Boom
- New Economy Crash
- Financial crisis
- Boom in 2007

Ifo-Economic Situation  ZEW-Economic Situation  Eurostat-ESI
How to measure the economy?

- Very complex System
- 10 latent variables with about 35 observed variables, based on economic theory and economic politics
- Time series data from Jan 1991 to Jan 2009
- 217 observations max
- Data from German Public Statistic Office and German Federal Bank
  - Overall reliable data sources
The PLS-Model for the sentiments

I. Product market
   - Investments
   - Demand
   - Incoming orders

II. Capital market
   - Share market
   - Bond market

III. Money market
   - Interest rates

IV. Labor market
   - Unemployment
   - Education
   - Labor costs
Results for product market Jan 92 – Sept 08

**Observed: weight**
- equipment inv. 1,84
- Building inv. 0,75
- Further inv. 0,65

**Private demand** 0,96
- State demand 0,98
- Exports 0,97

**Industry goods** 0,97
- Inv. goods 0,96
- Cons. goods 0,82
- Intermediate 0,97

**Investments**

**Demand**

**Incom ing orders**

**Sentiments**

Coefficient 0,51
Correlation 0,81

Coef. -0,29*
Corr. 0,37

R² = 0,68

Coef. 0,48*
Corr. 0,66

**Observed: weight**
- Ifo-ES 0,96
- ZEW-ES 0,97
- Eurostat 0,91

* 95% confidence level
Product market: actual vs. fitted values

- Poor model fit
- Better model fit ($R^2=0.8$)

Large residuals

sentiments vs. fitted values for sentiments
Results for capital market Jan 92 – Dec 08

Share market
- Coefficient 0,90
- Correlation 0,81
  - Observed: weight
  - DAX price 0,99
  - DAX perf. 0,99
  - CDAX price 0,99
  - CDAX perf. 0,99

Bond market
- Coef. -0,35*
- Corr. 0,37
  - Observed: weight
  - REX price 0,92
  - REX perf. 0,99

Sentiments
  - R²= 0,53
  - Coefficient 0,90
  - Correlation 0,81
  - Observed: weight
  - Ifo-ES 0,94
  - ZEW-ES 0,97
  - Eurostat 0,92

* 95% confidence level
Capital market: actual vs. fitted values

Very poor model fit

Better model fit ($R^2=0.7$)

Sentiments

fitted values Sentiments
Full macroeconomic model Jan 94 – Sep 08

Investments

Unemployment

Labor Costs

Demand

Incoming orders

Sentiments

R²= 0,85

Interest rates

Sentiments

R²= 0,8

Share market

Bond market

0,02

0,57

0,20

-0,34

0,59

-0,90*

0,24

0,98*

0,69

0,37

0,39

0,74

0,59

0,90*

0,24

0,98*

0,69

0,37

0,39

0,74

0,59

0,90*

0,24

0,98*

0,69

0,37

0,39

0,74

-0,24

0,44

* 95% confidence level
Conclusion

- Development of sentiments in the economy can be explained well from real economy data
- Product market and Capital market have best explanatory power
- Labor Market and Money Market are less important
- Model fit gets better in later years
- SEM and PLS are useful tools in economic science
Future prospects

- More and different observed and latent variables
- Further dynamisation of PLS time series models
- Different Models, e.g. prediction of economic growth with expectations
- Analysing periods of crisis, e.g. financial crisis

Thank you