
The labour market cycle: which sectors and regions should we monitor?

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Ard den Reijer

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Outline of the presentation

- **Introduction:**
 - **flexible labour and staffing employment**
- **The data**
 - **Disaggregated data set of Randstad Nederland**
- **The model**
 - **Dynamic factor model to handle large data set**
- **Results**
 - **In-sample classification of regions and sectors as leading and lagging**
 - **Forecasting properties of different models**

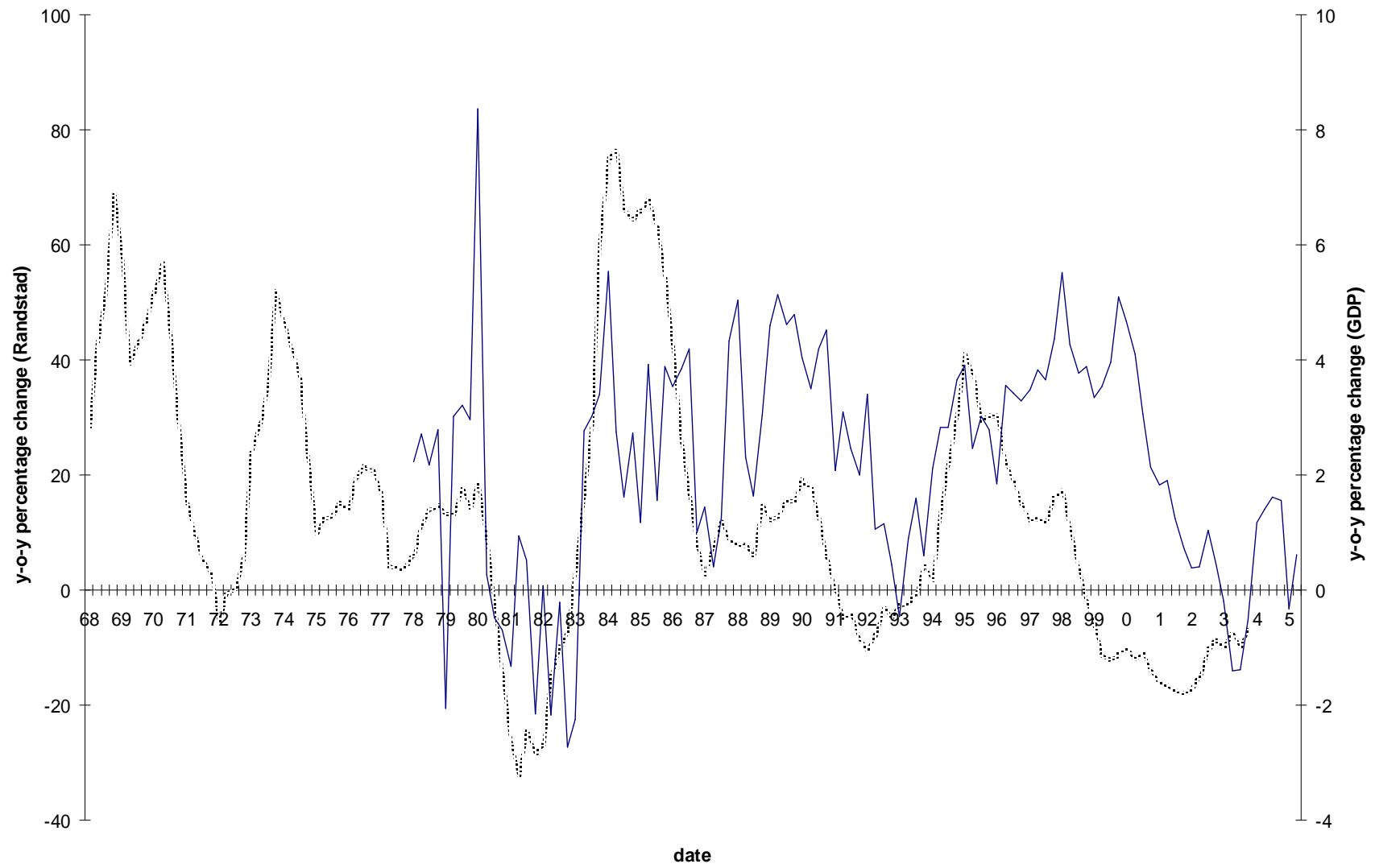
Flexible Labour: terminology

- **Self-employment: no official employer-employee relationship**
 - fast growth in the nineties
 - Concentrated in services sectors
- **Part-time work: permanent contract, <30 hrs/week**
 - Netherlands 1/3 compared to EU15 1/6
- **Temporary work: limited duration contract (both mediated and self-recruited)**
 - Screening device for a tenured position
 - Sectors with fluctuating production: seasonal and rush hour effects. agriculture, retail trade, hotels and restaurants.

Staffing employment (uitzendwerk)

- **Triangular relationship between**
 - **Staffing employee (agency worker): stepping stone to permanent job**
 - **User firm: offers employment and supervises the staffing employee, flexibility without incurring the usual hiring and firing costs.**
 - **Staffing services organization: private labour market agency that mediates between employee and employer.**
- **Staffing agencies create spot market for labour: Staffing employment is segment of labour market that is most sensitive to business cycle motions**
 - **Netherlands: 0% in 1960 to 5% in 2004 (% of labour force)**
 - **Market leader Randstad covers a stable market share of 40%**
 - **Data instantaneously available,**
- **Staffing employment as indicator of GDP growth, cf De Groot & Franses (2005), EICIE.**

Annual percentage change GDP and staffing employment in the Netherlands



..... Number of persons of staffing employment employed through Randstad Netherlands (source De Groot & Franses, 2005) — GDP

Randstad data set

- **observations on the amount of contracted staffing hours registered in 3 dimensions:**
 - **Time period: 4-weeks period covering 1998.1-2005.1**
 - **Region: 4-digit postal code**
 - **Sector: 4-digit sbi code (compare NACE/ISIC)**
- **Create balanced data set by aggregation:**
 - **15 regions, 58 sectors (2-digit sbi) of which some disappear (f.i. fishing, forestry, mining, personal services, extra-territorial bodies). Finally, N=307 time series remain.**
 - **Number of obs: 97.4%, number of staffing hours: 98%**

Factor model (1)

- **cope with many variables without running into scarce degrees of freedom often faced in regression based analysis (or $N > T$)**
- **summarize large data sets in few underlying forces (diffusion indices): common signals and (regional, sectoral or variable) specific shocks.**
- **Applied to business cycle analysis and macroeconomic forecasting (f.i. forecasts published by CEPR / Bdl, European Commission, Chicago FED)**

Factor model (2)

- **Factor model decomposition:**

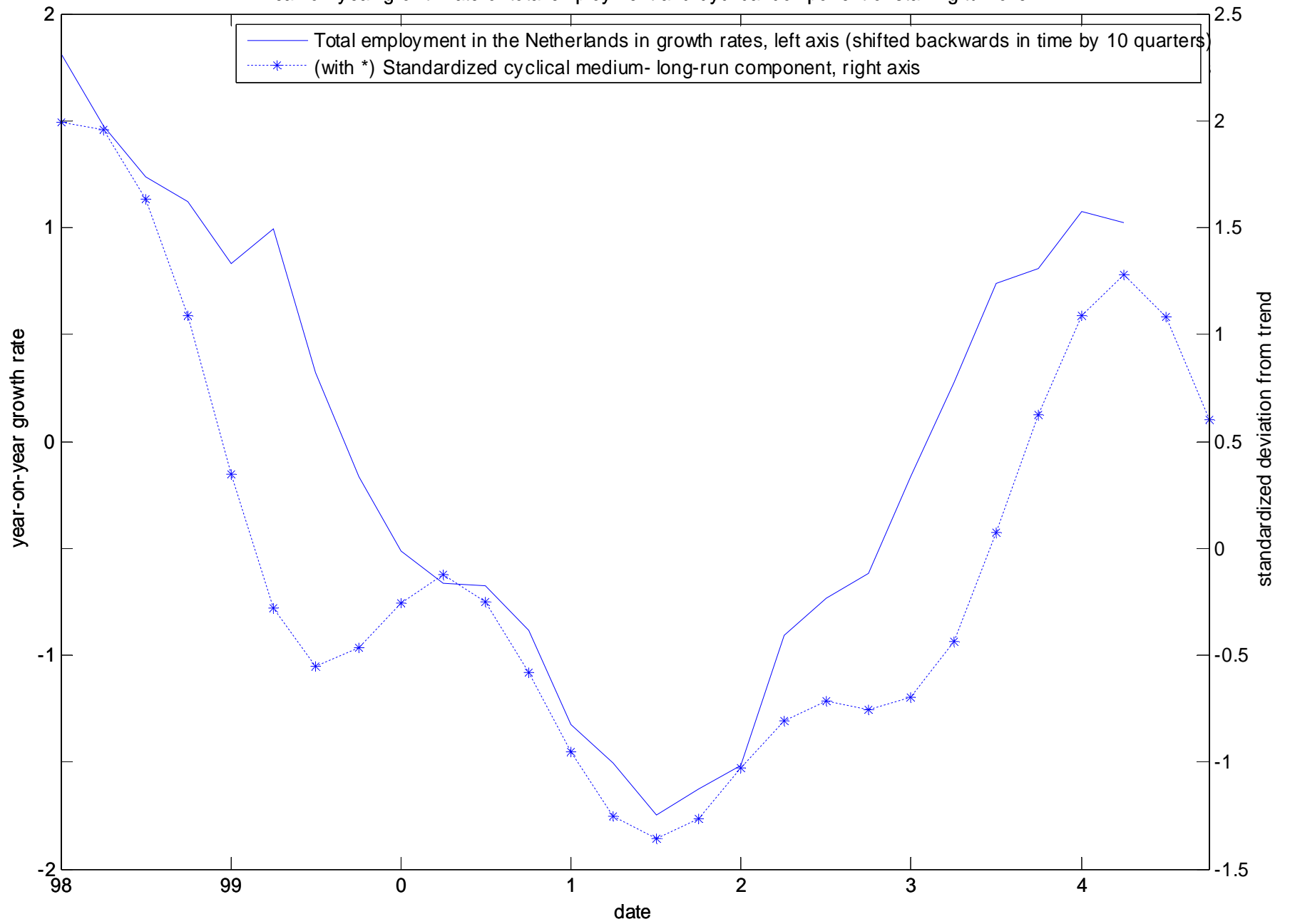
$$x_{it} = \chi_{it} + \xi_{it} = b_{i1}(L)f_{1t} + \dots + b_{iq}(L)f_{qt} + \xi_{it}$$

- **Static factor model: $b_{ij}(L)=b_{ij}$**
- **2-sided filtering allows decomposition into cyclical and non-cyclical**

$$x_{it} = \chi_{it}^c + \chi_{it}^{nc} + \xi_{it}$$

- **Classifying χ_{it}^c as leading/coincident/lagging**

Year-on-year growth rate of total employment and cyclical component of staffing turnover



A note on aggregation

- **Stationarity induced transformation of data into growth rates**
 $x_t = \text{dlog}(X_t)$, corrected for outliers and seasonal effects and standardized
- **Let $X_t = X_{1t} + X_{2t}$ then $x_t = x_{1t} * (X_{1,t-1}/X_{t-1}) + x_{2t} * (X_{2,t-1}/X_{t-1}) = a_{1t} * x_{1t} + a_{2t} * x_{2t}$, so time varying (pro-cyclical) weights.**
- **More generally:**

$$a_{it} = f\left(\frac{X_{i,t-1}}{X_{t-1}}, \frac{\sigma_{x_i}}{\sigma_x}, \text{seasonal + outlier correction}\right)$$

- **Projection of linear combination on common factors equals the linear combination of projected variables if weights are constant**

Empirical classification

- **Classifying variables according to criterium**

$$l_{ij}^* = \arg \max_l \left| \rho(y_t, y_{ij,t-l}) \right| \quad \text{for} \quad y = (x^4, \chi^c)$$

- **The correlation coefficients of the year-on-year growth rates x^4 reflect the cross-correlations between the cyclical common components χ^c and the idiosyncratic components.**
- **The aggregated results $(\bar{\rho}, \bar{l})$ reflect the average characteristics, while the aggregate results (ρ, l) reflect the characteristics of the most dominant underlying variable**

Preliminary results: sectors

Table 2: The empirical results of the staffing labour cycle at the sectoral level.

	$\overline{\text{var}}_{*j}(\hat{\phi})$	$\text{var}_{*j}(\hat{\phi})$	$\overline{\rho}_{*j}(\hat{\phi})$	$\overline{\rho}_{*j}(x^4)$	$\rho_{*j}(\hat{\phi})$	$\rho_{*j}(x^4)$	$\overline{l}_{*j}(\hat{\phi})$	$\overline{l}_{*j}(x^4)$	$l_{*j}(\hat{\phi})$	$l_{*j}(x^4)$
Agriculture, hunting and related service activities	0.31	0.74	-0.10	0.10	-0.93	0.80	-5.49	1.52	-26.00	16.00
Manufacture of food products and beverages	0.60	0.78	-0.12	-0.11	0.70	-0.05	3.55	-0.19	0.00	3.00
Manufacture of tobacco products	0.14	0.18	-0.63	-0.66	-0.84	-0.67	2.61	0.00	5.00	3.00
Manufacture of textiles	0.28	0.49	0.42	0.27	0.75	0.85	5.38	0.16	3.00	-2.00
Manufacture of wearing apparel	0.23	0.27	0.22	0.78	0.22	0.78	5.00	7.00	5.00	7.00
Tanning and dressing of leather	0.38	0.42	0.04	0.45	-0.93	0.45	0.00	0.00	14.00	0.00
Manufacture of wood and of products of wood and cork	0.50	0.79	0.11	0.24	0.32	0.81	-3.90	2.81	4.00	7.00
Manufacture of paper and paper products	0.38	0.75	-0.01	0.13	0.62	0.33	0.47	1.72	3.00	1.00
Publishing, printing and reproduction of recorded media	0.33	0.72	0.13	0.30	0.63	0.58	-0.47	-0.22	17.00	-1.00
Manufacture of coke, refined petroleum products and nuclear fuel	0.31	0.52	-0.46	0.42	-0.35	0.48	-8.56	10.56	-2.00	7.00
Manufacture of chemicals and chemical products	0.44	0.83	0.27	0.12	0.70	0.61	1.62	-0.46	2.00	-6.00
Manufacture of rubber and plastics products	0.42	0.78	0.22	0.42	0.69	0.64	-1.17	0.26	8.00	0.00
Manufacture of other non-metallic mineral products	0.48	0.86	0.55	0.48	0.97	0.86	0.41	0.44	4.00	0.00
Manufacture of basic metals	0.38	0.76	0.15	0.44	0.57	0.74	8.38	-0.83	6.00	2.00
Manufacture of fabricated metal products	0.52	0.88	0.11	0.37	0.69	0.66	-2.20	2.29	7.00	5.00
Manufacture of machinery and equipment n.e.c.	0.41	0.84	0.38	0.49	0.61	0.73	5.72	2.53	5.00	2.00
Manufacture of office, accounting and computing machinery	0.15	0.28	-0.02	-0.01	-0.42	-0.11	1.14	4.34	0.00	0.00
Manufacture of electrical machinery and apparatus n.e.c.	0.38	0.66	0.47	0.43	0.69	0.43	7.01	1.85	9.00	3.00
Manufacture of radio, television and communication equipment and apparatus	0.29	0.53	0.27	0.37	0.55	0.55	2.82	-0.15	9.00	2.00
Manufacture of medical, precision and optical instruments, watches and clocks	0.36	0.74	0.35	0.40	0.90	0.82	0.25	-3.10	1.00	-6.00
Manufacture of motor vehicles, trailers and semi-trailers	0.50	0.74	0.50	0.75	0.82	0.89	-0.59	-8.50	1.00	-4.00
Manufacture of other transport equipment	0.35	0.68	0.06	0.20	0.68	0.84	0.92	-5.69	6.00	1.00
Manufacture of furniture; manufacturing n.e.c.	0.34	0.62	-0.37	-0.12	0.63	-0.58	6.14	2.17	-19.00	7.00
Recycling	0.05	0.04	0.01	0.07	0.34	0.16	0.00	-1.24	0.00	2.00
Electricity, gas, steam and hot water supply	0.22	0.63	0.15	-0.10	-0.79	0.57	-7.07	1.79	14.00	-19.00
Collection, purification and distribution of water	0.16	0.21	-0.44	0.13	0.88	-0.76	-3.15	10.47	16.00	-17.00
Construction	0.65	0.90	0.42	0.48	0.48	0.71	-0.25	-2.82	1.00	-1.00
Sale, maintenance and repair of motor vehicles and motorcycles	0.16	0.35	0.16	0.41	0.53	0.79	3.19	5.69	9.00	13.00
Wholesale trade and commission trade	0.62	0.90	0.34	0.42	0.74	0.68	1.07	-1.61	5.00	0.00
Retail trade, except of motor vehicles and motorcycles	0.36	0.62	0.36	0.53	0.92	0.91	2.01	1.73	5.00	4.00
Hotels and restaurants	0.41	0.72	0.55	0.55	0.80	0.88	1.44	-2.18	2.00	2.00
Land transport; transport via pipelines	0.46	0.57	0.28	0.25	0.94	0.79	1.26	-2.35	-2.00	-12.00
Water transport	0.19	0.19	0.66	0.57	0.65	0.57	3.00	-11.00	3.00	-11.00
Air transport	0.17	0.13	-0.04	0.53	0.02	0.49	-2.05	3.38	1.00	1.00
Supporting and auxiliary transport activities	0.27	0.71	0.31	0.43	0.77	0.90	7.34	5.54	10.00	10.00
Post and telecommunications	0.41	0.21	0.63	0.41	0.84	0.54	7.18	1.90	16.00	-2.00
Financial intermediation, except insurance and pension funding	0.60	0.88	-0.06	0.07	-0.76	-0.23	-1.02	-2.05	10.00	6.00
Insurance and pension funding, except compulsory social security	0.26	0.39	0.36	0.33	0.67	0.61	-1.36	-1.05	-12.00	0.00
Activities auxiliary to financial intermediation	0.07	0.27	0.21	0.26	0.87	0.77	-3.30	-0.61	6.00	2.00
Real estate activities	0.24	0.75	0.18	0.25	0.63	0.68	3.16	-2.12	8.00	1.00
Renting of machinery and equipment without operator	0.20	0.57	0.23	0.35	0.42	0.68	0.82	0.58	3.00	1.00
Computer and related activities	0.23	0.33	0.56	0.60	0.91	0.93	-1.01	-1.08	1.00	-3.00
Research and development	0.26	0.64	0.08	0.24	-0.36	0.60	3.56	2.77	-4.00	1.00
Other business activities	0.41	0.65	0.31	0.22	0.75	0.70	-1.48	0.13	0.00	0.00
Public administration and defence; compulsory social security	0.55	0.76	0.20	0.31	0.87	0.71	-2.48	-2.49	-20.00	-6.00
Education	0.56	0.59	-0.11	0.20	0.94	0.58	5.67	1.83	-39.00	-1.00
Health and social work	0.60	0.89	0.42	-0.50	0.94	-0.91	-9.45	5.60	-23.00	10.00
Sewage and refuse disposal, sanitation and similar activities	0.37	0.75	0.23	0.22	0.83	0.25	1.77	-1.00	16.00	2.00
Activities of membership organizations n.e.c.	0.17	0.34	-0.04	0.05	0.09	0.36	0.46	-2.73	0.00	-3.00
Recreational, cultural and sporting activities	0.18	0.41	0.31	0.23	0.72	0.43	2.18	2.06	9.00	1.00
Other service activities	0.41	0.61	0.10	0.20	0.51	0.46	1.95	0.13	0.00	0.00

The variance (var) of the common component reports the fraction explained by the static factor model. The correlation ρ and the time shift l are calculated with respect to the aggregate cycle at the country level. The table reports the result for both the signal $\hat{\phi}$ and the growth rates x^4 for both the aggregate results and the aggregated results. The latter ones are denoted with a bar and aggregated using the weights $b_{i\alpha|T}$.

Preliminary results: sectors

- **More variation in explained variance, correlation and lead (-26<l<19)**
- **Leading Sectors:**
 - **Supporting and auxiliary transport activities (l=+16)**
 - **Sale, maintenance and repair of motor vehicles and motor cycles (l=+9)**
 - **Retail trade (except of motor vehicles and motor cycles) (l=+5)**
- **Lagging sectors:**
 - **Public administration and defense (l=-20)**
 - **Insurance and pension funding (l=-12)**

Forecasting

- Exploit leading variables to forecast country aggregate: $\mathcal{X}_{t+h|t}^m$
- Model specifications $m=\{\text{SF,DF,DFC,AR}(2),\mu\}$
- Forecasting the aggregate $\mathcal{X}_{t+h|t}^m$ vs aggregating the forecasts $\bar{\mathcal{X}}_{t+h|t}^{-m}$
- Recursive forecasting exercise starting in 2002.9, which produces 32 forecasts for each forecast horizon $h=1,\dots,13$
- Forecasting performance measured by mean squared error (MSE) and the variance ($=\text{MSE}-\text{ME}^2$) as a ratio of the benchmark AR(2)-model

Preliminary forecasting results

Table 3: Forecasting performance of different models using recursive windows

h	AR,u	μ,u	SF,u	SF,fm	DF,u	DF,fm	DFC,u	DFC,fm	$\overline{AR,u}$	$\overline{\mu,u}$	$\overline{SF,u}$	$\overline{SF,fm}$	$\overline{DF,u}$	$\overline{DF,fm}$	$\overline{DFC,u}$	$\overline{DFC,fm}$
	$x_{t+h t}$	$x_{t+h t}$	$x_{t+h t}$	$x_{t+h t}$	$x_{t+h t}$	$x_{t+h t}$	$x_{t+h t}$	$x_{t+h t}$	$x_{t+h t}$	$x_{t+h t}$	$x_{t+h t}$	$x_{t+h t}$	$x_{t+h t}$	$x_{t+h t}$	$x_{t+h t}$	$x_{t+h t}$
	mse	ratio	ratio	ratio	ratio	ratio	ratio	ratio	ratio	ratio	ratio	ratio	ratio	ratio	ratio	ratio
1	0.75	1.04	1.39	1.36	1.09	1.08	1.13	1.07	1.04	1.04	1.36	1.37	1.05	1.04	1.09	1.06
2	0.75	1.03	1.09	1.08	0.92	0.92	1.05	1.05	1.01	1.03	1.08	1.08	0.91	0.91	1.04	1.04
3	0.75	1.02	1.07	1.06	0.98	0.98	1.04	1.04	1.01	1.02	1.06	1.06	0.98	0.98	1.04	1.04
4	0.75	1.01	1.20	1.20	0.97	0.97	1.07	1.02	0.98	1.01	1.19	1.20	0.95	0.95	1.08	1.02
5	0.80	0.98	1.00	0.98	0.89	0.89	0.97	0.98	0.97	0.99	0.99	0.99	0.90	0.90	0.98	0.99
6	0.80	0.97	1.35	1.30	0.77	0.79	0.95	0.99	0.88	0.98	1.32	1.32	0.77	0.79	0.96	0.99
7	0.75	1.00	0.98	1.03	0.63	0.68	0.80	1.02	0.93	1.00	1.07	1.04	0.64	0.69	0.82	1.03
8	0.75	0.99	1.06	1.05	0.90	0.92	1.01	1.00	1.01	1.00	1.06	1.07	0.90	0.92	1.02	1.01
9	0.77	0.99	1.01	1.02	0.86	0.89	0.99	0.99	0.98	0.99	1.04	1.04	0.85	0.89	0.99	1.00
10	0.74	1.03	1.05	1.06	0.98	0.98	1.05	1.04	1.05	1.04	1.06	1.07	0.98	0.99	1.06	1.05
11	0.78	0.97	1.00	1.00	0.97	0.96	1.10	0.98	0.96	0.98	1.01	1.01	0.98	0.97	1.09	0.99
12	0.74	0.96	1.07	1.10	0.82	0.83	0.90	0.97	0.65	0.97	1.09	1.09	0.79	0.84	0.86	0.98
13	0.79	1.00	0.55	0.56	0.52	0.74	0.60	0.99	0.61	1.00	0.54	0.54	0.52	0.75	0.60	0.99
h	mse	ratio	ratio	ratio	ratio	ratio	ratio	ratio	ratio	ratio	ratio	ratio	ratio	ratio	ratio	ratio
1	0.75	1.04	1.39	1.36	1.09	1.08	1.13	1.06	1.04	1.04	1.36	1.37	1.05	1.04	1.09	1.06
2	0.75	1.03	1.09	1.08	0.92	0.92	1.05	1.04	1.01	1.03	1.08	1.08	0.91	0.90	1.04	1.04
3	0.75	1.02	1.07	1.06	0.98	0.98	1.04	1.04	1.01	1.02	1.06	1.06	0.98	0.97	1.04	1.04
4	0.75	1.01	1.21	1.20	0.97	0.97	1.07	1.02	0.98	1.01	1.19	1.20	0.95	0.95	1.08	1.02
5	0.79	0.99	1.00	0.98	0.89	0.89	0.98	0.99	0.96	0.99	0.99	0.99	0.91	0.90	0.98	0.99
6	0.78	0.97	1.37	1.32	0.79	0.80	0.97	0.99	0.85	0.97	1.33	1.32	0.78	0.79	0.97	0.99
7	0.73	1.01	1.00	1.04	0.63	0.69	0.82	1.03	0.91	1.01	1.08	1.05	0.64	0.69	0.83	1.03
8	0.73	1.01	1.08	1.06	0.92	0.93	1.01	1.02	0.99	1.01	1.06	1.07	0.92	0.93	1.02	1.02
9	0.76	1.00	1.02	1.03	0.87	0.90	1.00	1.00	0.97	1.00	1.04	1.04	0.86	0.90	1.00	1.00
10	0.73	1.04	1.06	1.07	0.99	0.99	1.07	1.04	1.04	1.04	1.07	1.07	0.99	0.99	1.07	1.04
11	0.76	0.99	1.01	1.01	0.98	0.97	1.11	0.99	0.95	0.99	1.02	1.02	0.98	0.97	1.10	0.99
12	0.73	0.97	1.08	1.11	0.81	0.84	0.88	0.98	0.64	0.97	1.10	1.10	0.78	0.83	0.84	0.98
13	0.79	1.00	0.54	0.55	0.51	0.74	0.56	0.99	0.60	1.00	0.54	0.54	0.51	0.75	0.56	0.99

$x_{ij,t+h|t}^{m,fe}$, represents the h -step ahead forecast with the different model specifications $m = \{SF, DF, DFC, AR, \mu\}$. The specifications employ respectively static factors, dynamic factors, cyclical dynamic factors, 2nd order autoregressive model and the first moment of the time series. Moreover, the forecast equation $fe = \{u, fm\}$ is unrestricted such that the time series variables are forecast directly, or, respectively, admits the factor model structure such that the common component is forecast. The first column reports for each forecast horizon h the forecast performance of the AR-model. The upper part of the column reports the Mean Squared Error (mse) and the lower part the Variance (var) of the forecast errors. The other columns report the forecasting performance of the respective models as a ratio to the performance of the benchmark AR-model. The forecasting exercise starts in 2002.9 and produces 32 forecasts for each horizon. All forecasts are evaluated since the aggregate data at the country level are available until 2006.4. The forecasts are generated using a recursive estimation window.

Preliminary forecasting results (2)

- AR(2) model slightly better than μ
- SF-model worse than AR(2)-model
- DF-model best model: common dynamics matter
- DFC-model slightly worse than AR(2): seasonalities matter
- In general the aggregated results are slightly better than the aggregate results