The Direct versus Indirect Problem

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Eurostat

Outline

- The many faces of a complex problem
- The problem and its many variants
- Pros and Cons of Direct and Indirect
- What do you find in the literature?
- A first conclusion
- The controlled direct approach
- Applications

An First Important Reminder

- Nerlove (1964)

  "Indeed, seasonality does not occur in isolated economic series, but seasonal and other changes in one series are related to those in another. Hence, ideally one should formulate a complete econometric model in which the causes of seasonality are incorporated directly in the equations."

- The "bad" behavior of univariate SA methods during the Great Recession puts this remark back on the stage.

The Problem

- N sub-components, N weights and an aggregate

$$(X_{n,t}; \omega_{n,t}) \longrightarrow A_t = \bigotimes_{n=1}^{n=N} [\omega_{n,t} * X_{n,t}]$$

- And for the SA figures, what should we choose between:

$$A_t^{D,sca} \quad \text{or} \quad A_t^{I,sca} = \bigotimes_{n=1}^{n=N} \left[\omega_{n,t} * X_{n,t}^{sca}\right]$$

- Example: The European GDP
  - Sum of the 28 National GDPs with $\omega_{n,t} = 1$ for all n.
- More complex cases exist where the X_n are also aggregates (deflated series, unemployment rate)

An Second Important Reminder

- Lovell (1963) demonstrated that:

  ".... there exists no non-trivial technique for seasonal adjustment that preserves both sums and products, an adjustment procedure that preserves the definitional relationship between employment, unemployment, and the size of the labor force, cannot be expected to yield an adjusted unemployment rate equal to the ratio of adjusted unemployment to adjusted labor force."

- So ..... there is no perfect solution!!!!

The many faces of the problem

- EU aggregates: different countries, different SA policies, methods and software
  - Direct, Indirect, Mixed Indirect.
- The "accounting constraint"
  - Lovell's Theorem, Chain-Linking
- Never a pure indirect strategy
  - Direct up to a certain level of the classification (Pfefferman et al, 1984)

Indirect: Pros and Cons

- Recommended when components do not present the same seasonal behavior.
- Pros
  - "Less work"? No because you have to check the quality of the aggregates.
  - Respect "balancing constraints" (but chain-linking destroys these constraints)
- Cons
  - Components could (are) be more volatile, the SA could be more difficult
  - Statistical properties of the aggregate (residual seasonality)

Direct: Pros and Cons

- Recommended when components present the same seasonal behavior.
- Pros
  - Aggregates are often easier to adjust (less volatile, less outliers ...., CLT).
- Cons
  - Does not respect "aggregation constraints" (but discrepancies could be distributed).

Literature (1)

- Lovell (1963) shows that no perfect solution exists and advocates for multivariate regression analysis.
- Geweke (1978): under a MMSE criterion, within the class of linear methods, and assuming the joint distribution of the components is known, indirect is better.
- Ghysels (1997) and Ghysels and Osborn (2001) relax the assumption of knowledge of the full distribution and show that Geweke's result may well not hold (and SA is not a linear process).
- Gomez (2000): choice based on empirical revisions measured with 3 alternatives statistics.

Literature (2)

- Planas and Campolongo (2000) using TSW approach advocate direct if series are "similar" and indirect otherwise.
- Astolfi et al (2001), Hood and Findley (2001), Ladiray and Mazzi (2016): choose the solution that yields the SA series with the more desirable properties.
- Otranto and Triacca (2002) compare the 2 approaches in terms of dissimilarity of the 2 Reg-ARIMA models (using Piccolo's distance).
- Maravall (2006): *"The dilemma direct versus indirect adjustment seems to have a clear answer. At any level of aggregation, direct adjustment should be used"*.

Literature (3)

- Birrel et al (2011) compare the 2 approaches using univariate and multivariate basic structural models with no clear decision.
- Quenneville and Fortier (2012) reconcile the 2 approaches using benchmarking techniques.
- Buono and Infante (2013) use a 3-way Anova test to choose between the 2 strategies.
- Thorburn and Tongur (2014) use State Space Models to assess Direct and Indirect SA.
- McElroy (2015) extends multivariate SA using latent dynamic component models (and seasonal taxonomy).

Some “statistical” considerations

- Indirect approach
  - If the weight of the series is changing quite fast
  - If the series are not characterized by the same short-term pattern
- Direct approach
  - If the structure of the sub-series is quite constant
  - If the sub-series have a similar timing in their peaks and troughs

First conclusions

- Therefore, there is no definite answer.
- Direct is better (if performed on “similar” series)
  - The adjustment algorithm is directly applied to the raw aggregate and can be controlled.
- The respect of aggregation constraints advocates for indirect.
- The multivariate framework should be the right solution, but not ready for mass production and not yet recommended in the ESS guidelines for SA.
- A descriptive but pragmatic approach?

Evaluation criteria

- Mean and range of differences between series
- Inconsistencies in growth rates
- Quality of the seasonal adjustment
- Roughness of the components
- Idempotency
- Stability of the seasonal adjusted series
- Characteristics of the irregular component
- Example: GDP seasonal adjustment

TS: Direct, Indirect, Mixed (levels)

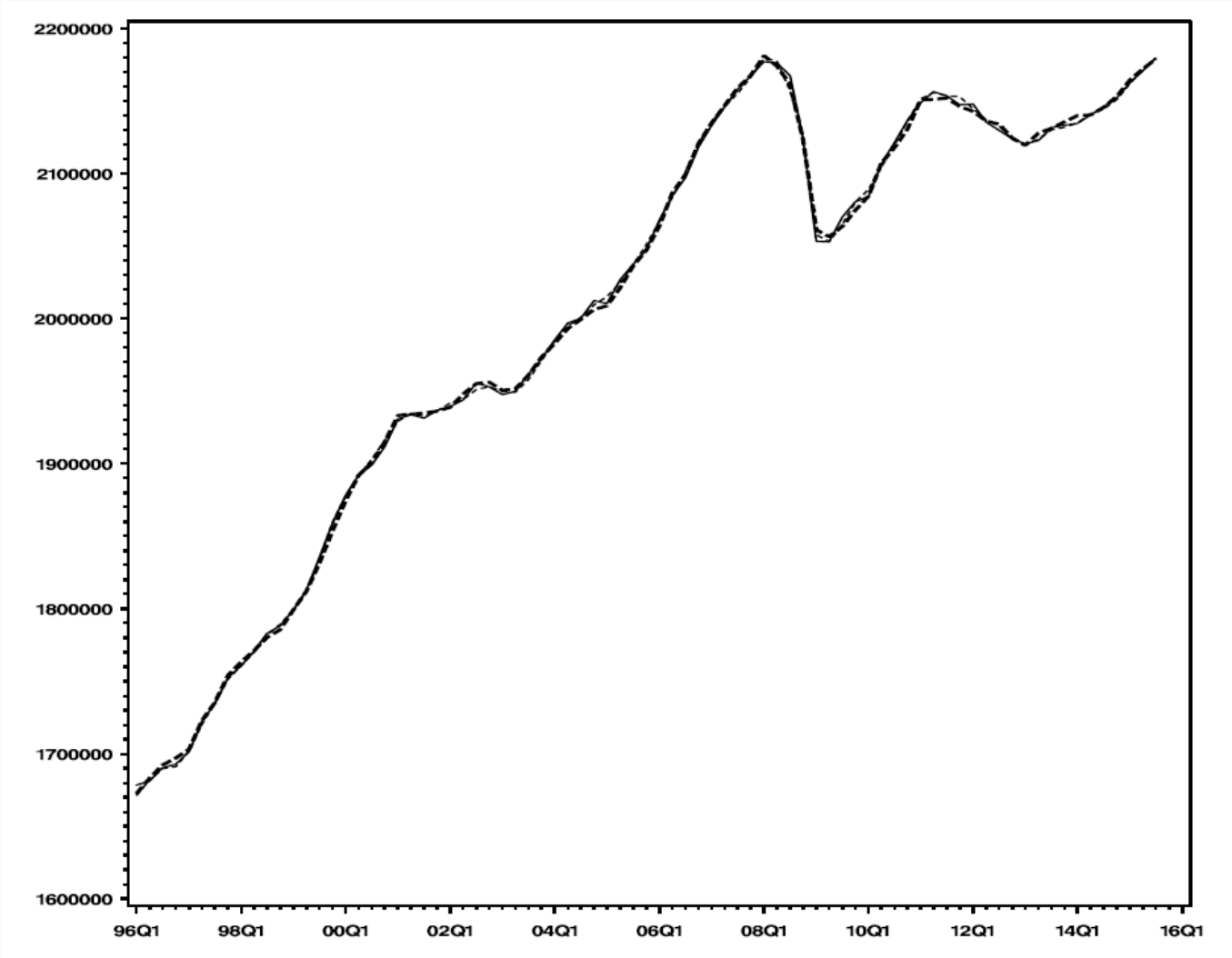

Figure 1: Mixed (thick dashed line) and Tramo-Seats Direct (thin dashed line) and Indirect (solid line) Adjustments; GDP geographical aggregation.

TS: Direct, Indirect, Mixed (growth rates)

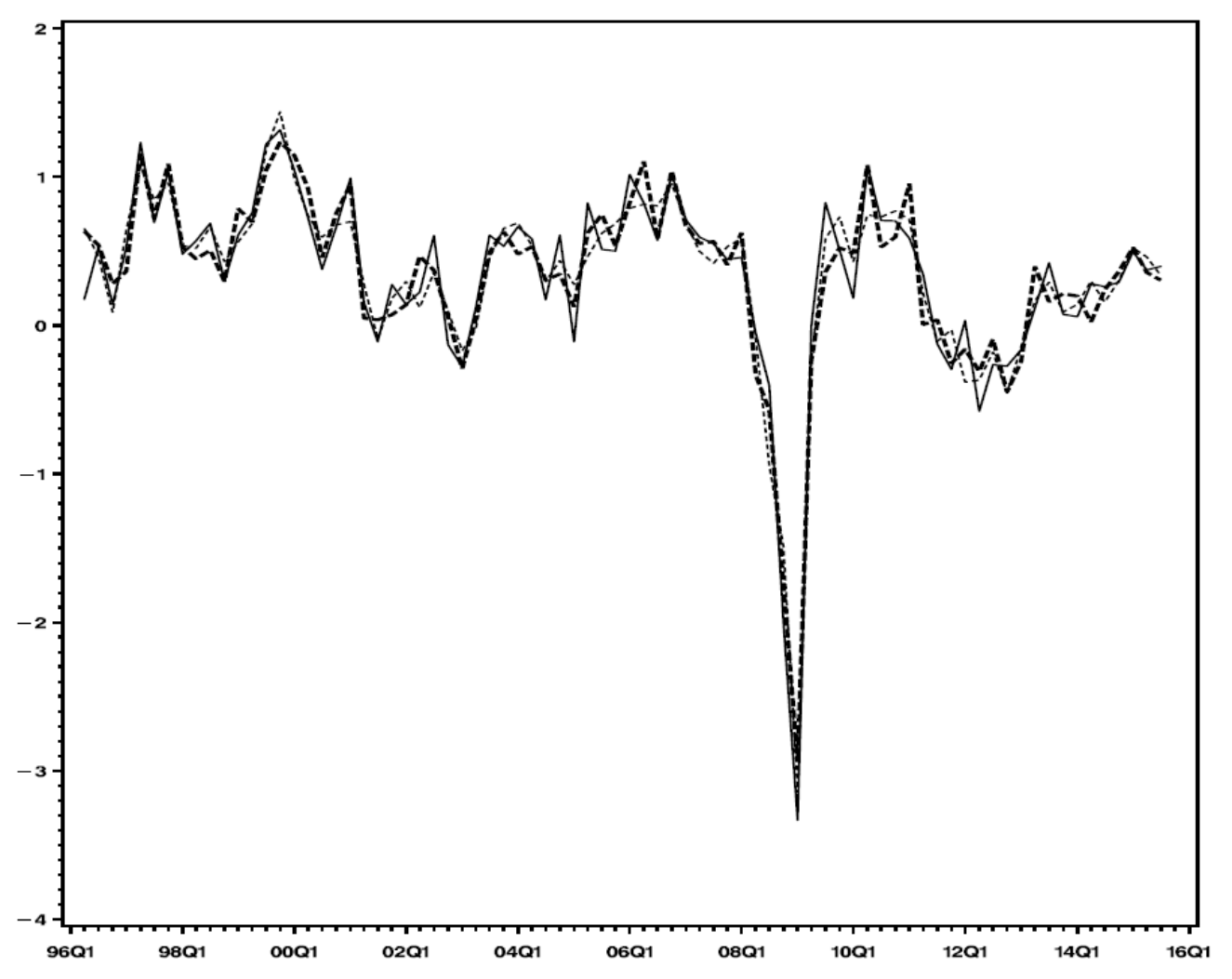

Figure 2: Growth Rates of Mixed (thick dashed line), Tramo-Seats Direct (thin dashed line) and Indirect (solid line) Adjustments; GDP geographical aggregation.

X12: Direct, Indirect, Mixed (growth rates)

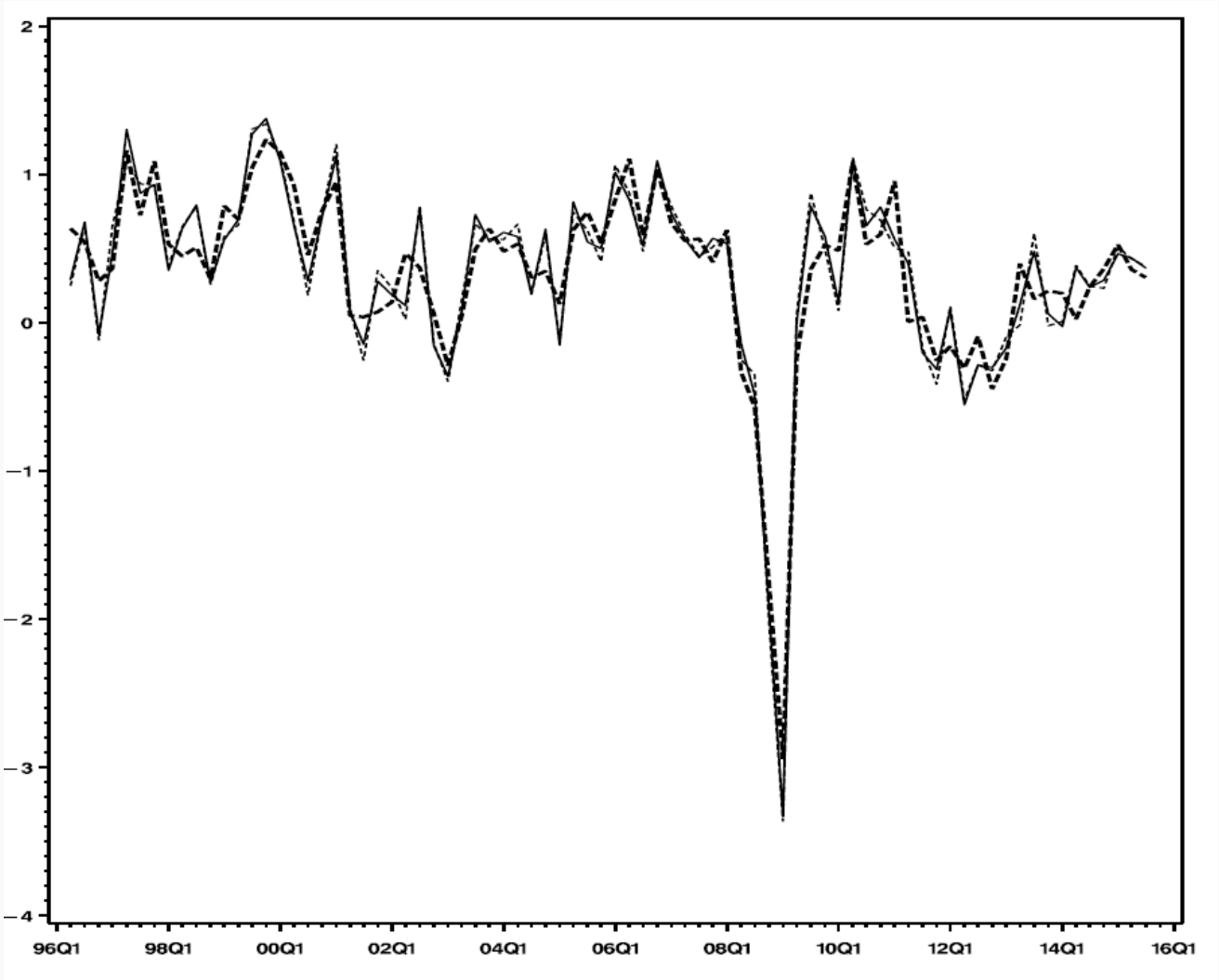

Figure 3: Growth Rates of Mixed (thick dashed line), X-12-Arima Direct (thin dashed line) and Indirect (solid line) Adjustments; GDP geographical aggregation.

Inconsistencies (1)

Direct versus Indirect					
Tramo-Seats			X-12-Arima		
Date	Direct	Indirect	Date	Direct	Indirect
02Q4	0.096	-0.132	09Q2	0.055	-0.003
03Q2	-0.023	0.123	13Q2	-0.018	0.118
05Q1	0.274	-0.111	13Q4	-0.021	0.059
12Q1	-0.382	0.031	14Q1	0.004	-0.028
Mixed vs Indirect					
Tramo-Seats			X-12-Arima		
Date	Mixed	Indirect	Date	Mixed	Indirect
01Q3	0.036	-0.111	96Q4	0.280	-0.085
02Q4	0.058	-0.132	01Q3	0.036	-0.148
05Q1	0.123	-0.111	02Q4	0.058	-0.159
11Q3	0.037	-0.128	05Q1	0.123	-0.154
12Q1	-0.161	0.031	11Q3	0.037	-0.205
			12Q1	-0.161	0.085
			14Q1	0.196	-0.028

Table 1: Inconsistencies in growth rates between the three approaches; GDP geographical aggregation.

Inconsistencies (2)

Direct or Indirect, Tramo-Seats										
Date	Direct	Indirect	Weights	BE	DE	ES	FI	FR	IT	NL
02Q4		-0.132	0.571	0.41	-0.59	0.86	0.79	-0.28	0.04	-0.37
03Q2	-0.023		0.571	0.05	0.40	0.76	1.38	-0.12	-0.32	-0.38
05Q1	0.274		0.429	0.25	-0.47	1.03	-0.52	0.28	-0.75	-0.13
08Q2	-0.083	-0.051	0.714	0.76	0.03	0.12	0.50	-0.27	-0.42	0.31
12Q1		0.031	0.429	0.21	0.57	-0.73	-0.34	0.26	-0.59	-0.12
Direct or Indirect, X-12-Arima										
Date	Direct	Indirect	Weights	BE	DE	ES	FI	FR	IT	NL
02Q4	-0.145	-0.159	0.571	0.35	-0.69	1.06	0.77	-0.36	0.08	-0.47
05Q1	-0.129	-0.154	0.571	0.23	-0.55	1.22	-0.23	0.31	-1.10	0.04
09Q2	0.055		0.286	-0.22	0.47	-0.50	-0.50	0.34	-0.48	-0.57
13Q2	-0.018		0.571	0.35	0.28	-0.35	0.61	0.35	-0.18	-0.12
13Q4	-0.021		0.571	0.42	0.05	0.19	-0.44	-0.05	-0.14	0.66
14Q1	0.004		0.429	0.33	0.48	0.34	-0.36	-0.52	-0.12	-1.09

Table 2: Inconsistencies in growth rates between Aggregate and Components; GDP geographical aggregation. If Weights is greater than 0.5 (less than 0.5), the main part of the national GDP increases (decreases).

Inconsistencies (3)

	Tramo-Seats	X-12-Arima
Direct and Indirect	94.87	94.87
Direct and Components	96.15	92.31
Indirect and Components	96.15	97.44
Mixed and Direct	96.15	88.46
Mixed and Indirect	93.59	91.03
Mixed and Components	93.59	

Table 3: Concordance Rates (in %); GDP geographical aggregation.

Quality of the Adjustment

Problems with the seasonal component and the irregular.

	Tramo-Seats		X-12-Arima		Mixed
Indicator	Direct	Indirect	Direct	Indirect	adjustment
M1	0.004	3.000	0.055	3.000	0.507
M2	0.001	3.000	0.326	3.000	0.124
M3	0.000	1.838	0.000	1.666	0.000
M4	0.733	2.514	0.838	2.514	0.733
M5	0.200	2.000	0.200	1.975	0.200
M7	0.447	2.742	2.853	2.359	3.000
M8	1.848	0.416	1.418	0.299	1.764
M9	0.150	0.142	0.139	0.162	0.789
M10	2.119	0.552	1.325	0.452	1.632
M11	0.493	0.552	0.694	0.452	0.674
Qstat	0.451	2.013	0.926	1.898	1.062
Mfailed	2	6	3	6	3

Table 4: Quality measures; GDP geographical aggregation.

Roughness measures

	Tramo-Seats		X-12-Arima		Mixed		
	Direct	Indirect	Direct	Indirect	approach	Seats	X-12
R1 (SA)	13951.087	14629.068	15043.192	14853.979	13978.243	D	I
R1 (SA), *	6339.939	6457.444	7136.898	6748.062	6857.561	D	I
R2 (SA)	1818.423	2168.231	2440.510	2340.712	2034.078	D	I
R2 (SA), *	854.905	1165.457	1639.328	1200.229	1418.054	D	I
R3 (SA)	648.513	1808.709	5816.095	2603.910	3718.361	D	I
R3 (SA), *	420.965	957.627	1819.880	1284.963	1706.645	D	I
Mar (TC,1)	13857.921	14250.905	17388.028	14868.373	15087.045	D	I
Mar (TC,1), *	6250.083	5850.033	6273.495	6105.345	5857.905	I	I
Mar (TC,2)	9821.836	11175.456	20853.710	13177.752	14939.680	D	I
Mar (TC,2), *	3016.534	2440.040	2731.729	2772.390	2840.508	I	D
Mar (S)	1435.020	258.488	972.938	159.957	19.378	I	I
Mar (S), *	1412.584	208.399	1075.098	152.380	17.272	I	I

Table 5: Roughness measures; GDP geographical aggregation. *: Last 3 years.

Absolute Revisions

Indicator	Tramo-Seats		X-12-Arima		Direct versus Indirect	
	Direct	Indirect	Direct	Indirect	T-S	X-12
Mean AR 1 qtr	0.045	0.016	0.016	0.019	I	D
Mean AR 2 qtrs	0.045	0.016	0.035	0.033	I	I
Mean AR 3 qtrs	0.050	0.033	0.041	0.038	I	I
Mean AR 4 qtrs	0.090	0.019	0.064	0.055	I	I
Mean AR 5 qtrs	0.071	0.013	0.076	0.056	I	I
Std AR 1 qtr	0.092	0.035	0.020	0.033	I	D
Std AR 2 qtrs	0.101	0.018	0.053	0.076	I	D
Std AR 3 qtrs	0.110	0.052	0.062	0.075	I	D
Std AR 4 qtrs	0.196	0.030	0.101	0.121	I	D
Std AR 5 qtrs	0.143	0.013	0.094	0.112	I	D
Sliding Spans						
A(%)	0.000	0.000	0.000	0.000	=	=
MM(%)	0.000	0.000	0.000	0.000	=	=

Table 6: Absolute Revisions (mean and standard deviation in %) and Sliding Spans analysis; GDP geographical aggregation.

Conclusions

- Mixed adjustment does not present a clear advantage and has real statistical drawbacks
- No clear advantage for the indirect method (convergence of cycles in the Euro zone ??)